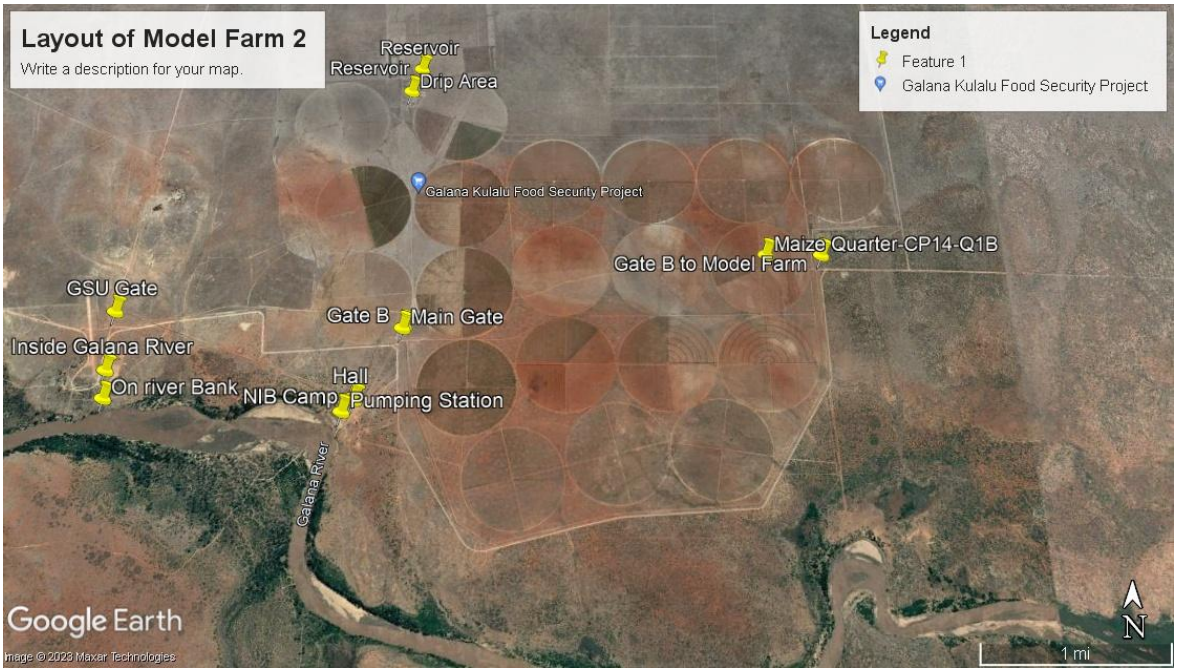
SELU LIMITED

GALANA-KULALU FOOD SECURITY PROJECT



ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Selu Village, Kisiki Sub-location, Chakama Location, Lengo Mbaya Division, Magharini Constituency, Kilifi County

OCTOBER 2025

DECLARATION

This Environmental Impact Assessment (EIA) Full Study Report (SR) for the GALANA KULALU FOOD SECURITY PROJECT (PROJECT NAFAKA) IN KILIFI AND TANA RIVER COUNTIES was compiled in accordance to the legal requirements to guide the practices, activities and conduct of EIA as stipulated in the Environmental Management and Coordination Act (EMCA), 1999 (now amended to EMCA, 2015) and through Legal Notice No. 31 of 2019 and in compliance to Environmental (Impact Assessment and Audit) Regulations, 2003 (amended to EIA Regulations, 2009) and other subsequent legislations relating to the environment.

I hereby certify that the particulars given in this EIA Comprehensive Project Report are correct to the best of my knowledge and a truthful representation of all findings as relating to the above proposed project.

Eng. Bernard Imbambi Kasabuli, lead expert, Reg. No. 0531

Signature: ..... Date:

GEOTELESPHERE CONSULTANTS LIMITED
Date: 29/5/2026
P.O. Box 1088-00517 NAIROBI

Contact Details:
4th Floor
KCB Building
Garage Road off Enterprise Road Industrial Area
P.O Box 1088-00517
Nairobi

PROJECT PROPONENT

Selu Galana Farm Limited, P.O. Box 20022-00200 Nairobi

Nicholas Muhambe Ambanya, Chief Executive Officer

Signature: ..... Date: 29/5/26

SELU GALANA FARM LIMITED
P. O. BOX 20022-00200
NAIROBI

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LIST OF ABBREVIATIONS AND SYMBOLS

P.O.	Post Office
Mob	Mobile
Reg.	Registration
No.	Number
NEMA	National Environmental Management Authority
ESIA	Environmental and Social Impact Assessment
Sh	Shilling
ADC	Agricultural Development Cooperation
EMCA	Environmental Management and Coordination Act
ADB	African Development Bank
RGS	River Gauging Station
KWS	Kenya Wildlife Service
S	South
E	East
N	North
KARI	Kenya Agricultural Research Institute
AD	After Death
WRA	Water Resources Authority
GPS	Geographical Positioning System
UTM	Co-ordinates on Earth
OK	Okay
Ksha	Kenya Shillings
NIA	National Irrigation Authority
PPP	Public Private Partnership
CPs	Central Pivot
Ms	Metres South
mE	Metres East
ASAL	Arid and Semi Arid Lands
KENHA	Kenya National Highway Authority
KURA	Kenya Urban Rural Authority
NGO	Non Governmental Organisation
Nos.	Numbers
D.O.	District Commissioner
D.O	District Officer
OIC	Officer In-charge

0 EXECUTIVE SUMMARY

0.1 General Project Background

The proposed Galana-Kulalu Food Security Project is being implemented in the 10,000-acre model farm, which was to mirror the larger Galana-Kulalu Food Security Project. It is partially developed and working. The Model Farm is located in Kilifi County within the land delineated as the Pilot Farm in the larger proposed Galana-Kulalu Food Security Project, which is located in the existing Galana-Kulalu Ranches.

Currently, the Galana Ranch in which the Model Farm is located is used for ranching purposes, and the model farm from which a variety of livestock, including cattle, sheep and goats, are being reared in the Galana Ranch.

The model farm is being used as a demonstration block for developing the entire 415,000 acres set aside for irrigation. Commercial production at the Galana Kulalu irrigation scheme will start next Year. The Government of Kenya is seeking Sh50 billion to construct the dam as the current flow of River Galana can only irrigate 20,000 acres. The source of water for the irrigation of the 10,000 acres is a reservoir that was constructed by the National Irrigation Authority.it is available and sufficient for the farm produce of maize, which is the main crop to be farmed.

Galana is a public-private partnership, and the government is expected to provide infrastructure services, while investors plant crops and set up processing factories for their produce. Galana-Kulalu Ranch is government-owned by ADC and leased to the National Irrigation Board.

0.2 Legal Framework

1) Legal Notice No. 31 of 30th April 2019 has amended the Second Schedule of EMCA 2015 and has categorised projects into three (3) Categories viz:-
   (a) Low Risk
   (b) Medium Risk and
   (c) High Risk Projects

   Large Agriculture exceeding one hundred hectares is classified as a High Risk Project (Refer 1© on page 199).

2) According to the Environmental Impact Assessment and Audit (Amendment) Regulations 2019, every proponent undertaking a project specified in the Second Schedule of the Act as being a high risk project, shall submit to the Authority a**n ESIA Report.**.

   The envisaged large agriculture Development of Phase 2 and 3 falls in this category.

0.3 Proponent

The project proponent, Selu Limited of P.O Box 38714-00100, Nairobi is in the process of leasing 20,000 acres which involves the Galana-Kulalu Model farm and an additional 10,000acres. The original 10,000acres model farm has been developed with irrigation facilities.

Selu limited is to develop the farm under Private-Public Partnership and has approached ADB for financingArising from above, Selu Limited is supposed to do all the required studies and acquire the ESIA licence.

Kilifi County has a bimodal rainfall pattern with average annual precipitation ranging from 300mm in the hinterland to 1,300mm in the coastal belt. The coastal belt receives an average annual rainfall of about 900mm to 1,300mm while the hinterland receives average annual rainfall of about 300 mm to 900 mm.

The short rain season is experienced in the months of October, November and December while the long rains are experienced in the months of March–April and May. The most important season to the hinterland is the short rains for pasture regeneration and water recharge while the long rain season is the most important season for the coastal area for crop production. Areas receiving highest average annual mean evaporation ranges from 1800mm along the coastal strip to 2200mm in the Nyika Plateau in the hinterland. The highest evaporation rates are experienced during the months of January to March in the county.

Rainfall of 762mm, which is often cited as the minimum necessary for the practice of permanent agriculture, can only be guaranteed, in 90 years out of 100, on a narrow Coastal belt from just south of Kilifi town to Shimoni. Most of the rain in Kilifi falls in heavy showers with peaks reaching up to 100mm per hour at times. Due to Kenya's position across the equator, the region is mostly dry and warm, experiencing only slight variations in temperature during the year.

As concerns Galana-Kulalu, the average annual rainfall is estimated at 562mm, which requires irrigation to practice farming.

0.4 Location

The first phase of the Galana-Kulalu Food Security Project is the 10,000-acre Model Farm, and the remaining 10,000acres under phase 2 is proposed to mirror the greater Galana-Kulalu Food Security Project when it is fully developed and working. The Galana-Kulalu Food Security Project is located in Kilifi and Tana River Counties within the land delineated as Galana-Kulalu Ranches in the larger proposed Galana-Kulalu Food Security Project, which is located in the existing

0.5 Water Resource

Most of the Kilifi County lacks adequate surface and underground water resources. The Sabaki River is the only perennial river, originating in the central highlands. The other rivers and streams are seasonal due to a variety of reasons, including low rainfall in the interior, small catchment areas, sandy soils which have high infiltration and low runoff rates, and high evapotranspiration rates.

0.5.1 Surface Water

The Sabaki River in the northern part of the County is perennial. During the wet season, the river's floods are a hazard to settlements and crops in the floodplain and bring large amounts of silt from upcountry. Siltation of the beaches around Malindi and the coral reef has been a notable problem

since the 1940s. The flow of water during the dry seasons is very low and the river is almost entirely maintained by Mzima Springs via the Tsavo River. The water of the Sabaki River is moderately coloured, soft, well mineralized and slightly alkaline with a seasonal PH range of 7.1 to 8.2. The River containing a fair amount of organic -matter and there is substantial amount of algal growth during the dry period.

The seasonal Goshi-Rare River is a continuation of the Voi River which originates from the Tiita Hills. The Rare River contains moderate amounts of organic matter and the water is generally hard and saline with a PH value of 7.2.

Other seasonal streams include Ndzovuni, Gandi, Wimbi and Mto Mkuu.

There are also numerous swamps and springs along the coastal plain and a few wet seasons ponds in the interior

0.5.1.1 Galana River

0.5.1.1.1 Probability of exceedance

The analysis at RGS 3HA012 showed that at 95% probability of exceedance the Galana River has low flow rate of approximately 7.6 m^3/s. While at 70% probability time period, the river discharge was about 13 m^3/s. The highest river discharge of about 110 m^3/s occurs in less than 5% probability time period. This indicates that the available water in the river during over 95% of the dry periods

The analysis at RGS 3HA013 showed that at 95% probability the Galana River has low flow rate of approximately 18.9 m^3/s. While at 70% the river discharge was about 33 m^3/s. During wet season the peak flow at RGS 3HA013 was approximately 107 m^3/s and it occurs in less than 5% probability time period. The average river discharges at the upstream of the project site in location **Ao** observed at RGS 3HA012 was 39 m^3/s. While at the downstream the average observed river discharges at RGS 3HA013 was 52.6 m^3/s. This indicates that at the downstream of RGS 3HA012 other tributaries join the Athi – Galana -Sabaki River raising the average river discharge to about 50 m^3/s.

0.5.1.1.2 Conclusion and Recommendation

The Galana-Kulalu project can be implemented given that during wet season (April, May, November and December) the river discharges in the Galana River are sufficient to be used for irrigation at the project site without interfering with the needs of the downstream water users.

However, during the low flow periods (January, February, March, June, July, August, September and October) its recommended that the project owner (Selu Limited) utilized the water from its storages without abstracting river water at the intake works. This is due to the need of the downstream water users and environmental flows. Alternatively, the company can explore groundwater resources to boost the water availability.

0.6 Proposed Project

0.6.1 Status

Phase 1, the model farm is fully developed and will be for maize farming, while Phase 2 3is currently a rangeland with no development. Phase 2 is adding 10,000 acres under pivot and is building on the success of Model Farm. It is located on the Eastern side of the model farm in Galana ranch, about 40km from the The company will also obtain water from Thwake dam upstream under PPP agreement. The dam is upstream and will be able to supplement the water requirements during the dry season.

The licence is being seeked for the current model farm of 10,000 acres.

0.6.2 Infrastructural Development

The main works to be done in the 10,000model farms are the Rehabilitation works through addressing current intake works shortcomings and existing infrastructure improvements.

0.6.3 Cost Estimate

About 425 million will be required for the rehabilitation of the irrigation scheme as indicated below:-

Item (KES)	Current	Additions	Total
Land & Buildings	5,354,360	115,217,670	120,572,030
Machine Handling Equipment	987,034		987,034
Plant & Machinery (A Equipment)	21,432,472	116,567,546	138,000,017
Vehicles	7,070,050		7,070,050
Tractors	15,930,082		15,930,082
Farm & Irrigation (Pivots)	37,987,254	52,507,052	90,494,306
Farm & Irrigation(Pump Station)	36,397,580		36,397,580
Farm & Irrigation (Piping)	1,389,600		1,389,600
Plant & Machinery Solar panels	690,000		690,000
Post Harvest Equipment	652,390		652,390
Computer Equipment	1,565,195	2,500,000	4,065,195
Furniture, Fixtures & Equipment	1,632,000	4,500,000	6,132,000
Total	**131,088,017**	**291,292,268**	**422,380,286**

0.7 Public Consultation

0.7.1 Stakeholder Consultation

Stakeholder consultation was in the form of interviews, Questionnaire, and surgical methods in and around the Galana-Kulalu Food Security Project.

0.7.1.1 Surgical Method

Three Surgical Consultations were held as follows:-

1. Galana Conservancy (Appendix 2)
2. KWS (Appendix 3)and
3. Residence of Bombi (Appendix 4)

Appendix 2 to 4 has the minutes.

0.7.1.1.1 Arising Issues

0.7.1.1.1.1 Galana Conservancy

Ben proposed that the wetland to be preserved along Galana River should be as large as economically possible.

He indicated that as far as he was concerned, there are four things required for wildlife viz:-

1. Availability of Grazing
2. Water
3. Safety and
4. Fencing

0.7.1.1.1.2 KWS

- The migratory path for wildlife is currently phasing a lot of encroachment

1. **Migratory Path**

- ✓ Should be left intact
- ✓ Migratory area is not established
- ✓ It is recommended that the farming block should be set away from the river preferably 100-500m and the proposed padox should be moved into interior away from Galana River.

2. **Human wildlife conflicts**

3. **Community needs to be sensitized and create awareness on the wild animal's importance**

4. **Water points on the designated areas should be increased to avoid movements of the wild animals through the migratory corridors and the game proof friendly fence to be set up**

5. **Ranches are transit routes for pastoralists from garsen to Taita ranch for somalis and orma and they have illegal weapons to defend themselves and their livestock from**

being attacked by the wild animals posing insecurity purposes and poaching with their crude weapons

6. KWS policy on ESIA, KWS has been reformed and given this role to wildlife and research institute which was being led by principal supt. Lala (Dr) who is KWS principal scientist
7. Next to Sala gate in mid-September to mid-October, there is no river moving and cannot be pumped

8. It is proposed that a game-proof fence, friendly to the wildlife, should be put where crops on Galana-Kulalu will be grown using 12 strands. This will be easy considering that power will have reached the project area of Galana.
9. The number of people in Galana will go up. This will increase wildlife-human conflict

10. **The Highest number of elephants is in May at** In May, the population of elephants is normally about 300
11. Sensitisation is proposed in the project area and environs
12. Giving wildlife water during drought, especially September to October, should be considered

13. A way of handling pastrolist should be put in place (i.e. security since they are armed.)

14. Issues of habitat degradation in Galana due to activities of Selu Limited, Mombasa Cement and the government

15. Will Galana river be enough? We have Kilifi county who depends on Sabaki (Galana)

16. The dispersal area of wildlife from Tsavo East National Park is that they go up to Kilifi

17. During wet periods, wildlife population grows drastically e.g. in June, their were a total of 120 species of wildlife and start grazing along the river.

0.7.1.1.1.3 Residence of Bombi

1. Kisiki Sub-location had a total of 14 villages namely:- Galana, Kulalu, Galana Conservancy, GSU Camp, Mombasa Cement, Selu, Bombi Market, Danisa village, Abura among others. Chakama has three sub-locations

2. **Dialect: -** There are three tribes in Kisiki Sub-location namely:- Watamu, Giriama and Oroma.

3. Neighborhood:- There is close collaboration between community and ADC (Agricultural Development Corporation)
4. the main beneficiaries of the proposed project would be the bombi and Danisa people who inhabited areas on the model farm boundary

5. Bombi Residence are experiencing wildlife conflicts due to the wild animals destroying their crops they have requested for the clients of the model farm in future for their farms to be fenced off to hinder wild animals from destroying their farm crops.

6. The community had a difficult time on different seasons of planting crops and they have sort to use expensive chemicals to spray their maize plantation due to the growth of maize diseases since inception of pilot model farm phase 1

7. The transport system is relatively poor as the gravel Roads linking the Model farm and the community become impassable due to the wild animals hovering around the area searching for water along Galana river and also the roads are impassable during the rainy seasons.

8. Selu limited to buy community maize in order to support them economically when it matures.
9. Oroma are pastoralist. In view of this, they normally graze in ADC farm
10. Galana conservancy sponsor students for education
11. Traditional herb also exist in the shrub land which is to be cleared
12. It was noted that both the new tenants in ADC land which currently consists of Simba Cement and Selu Limited are going to use Galana irrigation scheme. This might dry the river denying the environs to irrigate their land and water their flock. This will become pronounced with time by considering climate change phenomena.
13. The area is not accessible to clean portable water which the project should pursue as part of corporate social responsibility

14. The new tenants should consider building more schools and churches

15. farming in model farm was stopped abruptly, the community suffered since they had relied on the farm for employment
16. Model farm brought insecurity since women were impregated and their was rampant child abuse

17. If there is a disease on farm, Selu should come up with a strategy to manage it including in the community lands
18. Kids dropped out of school in preference to working in farm
19. On wages, he advised ADC tenants not to come up with there rates but seek opinion of leaders before coming up with their wages

20. They requested for the new tenants to live left overs to the community and surrounding community be looked at
21. Insecurity and human-wildlife conflict should be addressed moving forward.
22. Requested government to give them title deed where they are staying
23. Transport will be a challenge for community going to work for the new tenants.
24. They proposed the tenants should come up with transport and staff quarters as incentives of inducing the community to work for the new tenants.
25. They requested consultation should be done with right people and gave an example of Mombasa cement who were led to community land and not ADC. They indicated that any

conflict can be resolved between management and surrounding community and this should not worry the new tenants

26. They requested that in future, every body should be involved at every stage of the project.
27. Requested that the community be considered for solar fencing to deter wild animals.
28. It is proposed that the water sources in the area be diversified.
29. Requested for maintaining a buffer zone to allow elephants and other wildlife to move freely
30. Normally, wildlife move to conservancy then along Galana River
31. During green arrava, new diseases of maize emerged.
32. The normal chemicals used by community could not work and were advised to buy very expensive insecticides.
33. Requested for community to be assisted if this occurred.
34. The maize disease disappeared immediately when the project stalled and has not reappeared
35. The Israel's used aeroplanes for spraying
    - Rats increased tremendously and went upto villages
    - Maize in community farm started wilting
    - Investor could control occurrence of the disease while community could not.
    - Army worms became pronounced
36. Mombasa Cement has promised corporate social responsibility which should be duplicated by Selu Limited.

0.7.1.2 Questionnaires

0.7.1.2.1 People Consulted

A total of 73 people were consulted with 53 people filling the questionnaire and others filling the consultation form. Those consulted consisted of villagers, Departmental heads and workers of NIA and Selu Limited

Appendix 5 has the list of all people consulted.

0.7.1.2.2 Result

Majority of those consulted at 85% felt that phase 1-model farm had benefitted the local community and supported it being rolled into Phase 2

0.7.1.2.3 Arising Issues

The following issues arose:-

0.7.1.2.3.1 Positive Impacts

- ✓ Early payment & tourism
- ✓ Improvement in living standards
- ✓ Food security
- ✓ Income for families
- ✓ Improvement in infrastructure, job creation
- ✓ Accessibility due to development
- ✓ Reduction in crime & No drug abuse
- ✓ Youth employment & prevention of early marriages

- ✓ Boda boda business improved
- ✓ Small business growth
- ✓ Land utilization
- ✓ Economic growth

0.7.1.2.3.2 Negative Impacts

- ✓ Wild animals driven away &Reduction in forest covering
- ✓ Building more toilets
- ✓ Decrease in volume of water in rivers
- ✓ During drought galana river cannot be used
- ✓ Divorce among families of employed individuals
- ✓ Increase in S.T.I's;DevorceEarly marriages and pregnancies
- ✓ Accessibility & Development of infrastructure
- ✓ Expansion to be undertaken considering river galana

0.8 Potential Impacts

A standard checklist was adopted a

The results were grouped into Positive and Negative Impacts as detailed below:-

0.8.1 Negative Impacts

The following will have Negative effects:-

1. Hydrology

- Low Flow Regime
- Operation of the Dam
- Surface Water Quality
- Ground Water Quality

2. Soils

- ✓ Soil Properties
- ✓ Soil Fertility
- ✓ Soil Productivity

3.Pollution

- Noise
- Agrochemicals
- Organic Pollution
- Anaerobic effects
- Gas Emissions

4.Sediments

- ❖ Hinterland Effect
- ❖ River Morphology

- ❖ Channel Engine

5. **Ecology**
   - ➢ Project Land
   - ➢ Water Bodies
   - ➢ Surrounding Area
   - ➢ Valley and Slopes
   - ➢ Wetlands and Plains
   - ➢ Wildlife and
   - ➢ Vegetation

6.Socio=Economic

- ➢ Recreational sites
- ➢ Livestock raising
- ➢ Land Tenure

7.Health

- ▪ Water and Sanitation
- ▪ Disease Control
- ▪ Disease Hazards

8.Imbalances

- ➢ Animal Diseases

0.8.2 Positive Impacts

The following will have Positive effects:-

1. **Hydrology**
   - o Flood Regime
   - o Water Table Level
   - o Eutrophication
2. **Soils**
   - Salinization
   - Water Logging
   - Erosion
3. **Sediments**
   - ❖ Local Erosion
   - ❖ Sedimentation
   - ❖ Estuary Erosion
4. **Ecology**
   - Surrounding Area
   - Climate
5. **Socio=Economic**
   - ✓ Population Change

- ✓ Income
- ✓ Employment
- ✓ Arable Agriculture
- ✓ Sediments
- ✓ Tourism
- ✓ Infrastructure

6. Health

- Nutrition
- Disease Effect
- Disease Ecology

7. Imbalances

- Pests and Weeds
- Animal Diseases
- Aquatic Weeds
- Structural Damage
- Animal Imbalances

0.9 Environmental Management Plan

0.9.1 Introduction

This Environmental and Social Management Plan (ESMP) provides a logical framework within which the negative environmental and social impacts identified during the Environmental and Social Impact Assessment study can be mitigated and any beneficial environment effects can be enhanced. Monitoring and management practices are considered and cost estimates included. Responsibilities and time frames for the implementation of the various aspects of the Environmental and Social Management Plan have been identified. The Environmental and Social Management Plan should be implemented accordingly.

0.9.2 Mitigation of Negative Impacts

The mitigation measures for the anticipated negative impacts of the proposed project are presented in the Environmental and Social Management Plan (Tables 0-1, 0-2 and 0-3).

Table 0-1: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) DURING CONSTRUCTION

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2 AND 3		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
A. DURING CONSTRUCTION		
ITEM	**POTENTIAL IMPACT**	**MITIGSATION MEASURES**
A.1	**SOCIO-ECONOMIC**	

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2 AND 3		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
A.1.1	Workers accidents during construction process.	• All workers will be sensitized before construction begins, on how to control accidents related to construction. • A comprehensive contingency plan will be prepared before construction begins, on accident response. • A comprehensive contingency plan will be prepared before construction begins, on accident response • • A comprehensive contingency plan will be prepared before construction begins, on accident response. • • Accordingly, adherence to safety procedures will be enforced. • • All workers to wear protective gear during construction, including helmets • • Construction work should be limited to daytime only
A.1.2	Labour issues	• Project proponent should put in place a proper strategy to ensure fair recruitment of workers incorporating both locals and people from other areas incorporating both locals and people from other areas • • Sensitization to the local communities on the expected population influx should be done • seek opinion of leaders before coming up with their wages
A.1.3	Community Support	• Sensitize the community at each stage of Implementation through barazas • Have periodic Consultation with the environs communities throught the project lifespan
A.1.4	Breaking of families	• Inrease churches and mosque in camps and environs communities • Sensitization
A.1.5	Security	• Increase Number of GSU officers guarding GALANA ranch • Map and mark where headers will pass and access GALANA River and proceed with their migrations • Establish Order
A.2	**POLLUTION**	
A.2.1	.Air pollution by dust and VOCs generated during construction process	• Construction heavy earth moving vehicle drivers will be under strict instructions to minimize unnecessary trips, refill petrol fuel tanks in the afternoon and minimize idling of engines.

ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
		• Careful screening of construction site to contain and arrest construction-related dust. • Exposed stockpiles of e.g. dust and sand, will be enclosed, covered, and watered daily, or treated with non-toxic soil binders. • All workers will be required to wear protective gear • Ensure construction machinery and equipment are well maintained to reduce exhaust gas emission • Stop all excavation work if wind threshold velocity has been exceeded. • All personnel working on the project will be trained prior to starting construction on methods for minimizing air quality impacts during construction.
A.2.2	Noise and vibration by construction activities.	• Use of equipment designed with noise control elements will be adopted where necessary • • Trucks used at construction site shall be routed away from noise sensitive areas where feasible • • Idling time for pick-up trucks and other small equipment will be minimized to limited time. • • All workers operating in noisy areas or operating noisy equipment will be provided with earpieces to protect against extreme noise • • Comply with L.N. 25: Noise prevention and control rules, 2005
A.2.3	Generation of solid waste	• Wastes to be collected regularly to control air pollution and vermin/insects etc. • • Receptacles will be provided for waste storage prior to collection. • • Resource recovery will be encouraged once the project takes off so as to shrink waste stream and recover non-recyclables. • • Refuse collection vehicles will be covered to prevent scatter of wastes by wind.\ • • Wastes will be collected by a licensed operator to avoid illegal final dumping at unauthorized sites. • • All persons involved in refuse collection shall be in full protective attire.

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2 AND 3		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
A.2.4	Inadequate human waste disposal by workers during construction process	• As provided for by the Building Code, a temporary latrine will be provided on site to be used by construction workers
A.2.5	Pollution from Hazardous waste	• Handling of the materials using the material safety data provided by the manufacturers • • Appoint a safety officer to ensure that proper disposal guideline are observed • • Ensuring that maintenance and/or piece of work carried out on any piece of equipment or construction work is undertaken by qualified personnel • • In case of spillage emergency spillage control measures to be instituted • • Containerization of any wastes and disposal through a licensed waste handler.
A.3	**SOILS**	
A.3.1	Disturbance of soil structure	• Excavations on unintended areas should be avoided • Sensitization to the project workers on proper soil conservation and management measures
A.4	**SEDIMENTS**	
A.4.1	Sedimentation of Rivers/Lagas/Drainageways	• Undertake Construction where it is necessary • Store and Dump Excavations away from where it will find its direction in waterways • Divert River and Lagas before Construction • Employ competent professionals during construction • Employ nest Appropriate Technology during construction • Take Appropriate Soil Erosion control measures to reduce effect of erosion
A.5	**ECOLOGY**	
A.5.1	Loss of natural vegetation cover	• Ensure proper demarcation and delineation of the project area to be affected by construction works • • Introduction of vegetation (trees and grass) on within the green and recreational areas within the project and their maintenance. • • Design and implement an appropriate landscaping programme to help in re-vegetation of parts of the project area after construction.

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2 AND 3		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
A.5.2	Loss of food resources for wildlife	• Allow for a migration corridor of 100- 500 m in the Riverine • Clear where it is necessary • Speed up the construction of Galana Dam • Maintain an adequate storage of 3 months of water required for irrigation
A.5.3	Loss of biological resources for local communities	• establish a tree seedling project which will be used to rehabilitate the degraded areas in the ranches. The recommended tree species for planting include *Tamarindus indica*, acacia and commiphora *spp*. And *Erythrina abyssinica*.
A.5.4	human/wildlife conflicts,	• Live the natural vegetation wildlife migration corridors especially along the drainage lines with prolonged ground water storage and green vegetation

Table 0-2: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) DURING OPERATION AND MAINTENANCE

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2 AND 3		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
A. DURING OPERATION AND MAINTENANCE		
A.1	**SOCIO-ECONOMIC**	
A.1.1	Population influx	• Development of infrastructure: housing, electricity, domestic water supply, water treatment, roads, sanitation, bridges, schools, health facilities, etc to support the population increase • Population monitoring coordinated through the administration office
A.1.2	Conflicts	• Develop means to ensure equitable distribution among users and monitor to assure adherence between farmers and pastoralists • Develop proper measures to reduce conflicts

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2 AND 3		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
		• • Sensization of the project workers and local community on the expected culture change • Form Galana River Users Association to manage abstraction of Water in Galana River
A.1.3	Increased insecurity	• Provision of security measures within the project • Enforcing laws, rules and regulation pertaining security within the country
A.1.4	Increased poaching	• Enforce existing laws and by-laws concerning wildlife conservation and management
A.1.5	Increased accidents	• All workers will be sensitized and trained on occupational safety and health issues and on how to control accidents related to field operations. • • A comprehensive contingency plan will be prepared on accident response. • • Accordingly, adherence to safety procedures will be enforced • • Establishment of road bumps, zebra crossing areas and barriers • • Provision of speed bumps before and after human settlement, recreational, and national parks and game parks
A.1.6	Surging of crime	• Use law or alternate dispute resolutions
A.1.7	Iimpediment to movement of livestock and humans	• Provisions of passageways
A.1.8	Alteration or desctruction of wildlife habitat or impediment to movement of wildlife	• Siting of project to minimize loss or avoid encroachment on most sensitive or critical areas • Establishment of compensatory parks or reserved areas • Animal rescue and relocations • Provisions of corridors for movement
A.1.8	Dislocation of populations and communities	• Resettlement scheme ensuring at least eqyal orstandard of living • Siting of project to minimize effect\
	A.2	**HYDROLOGY**
A.2.1	Drying of Galana River during low flows	• Provide storage to carter for Water requirements for 6 months • Speed up construction of Galana Dam • Grow crops that require minimum water and can be irrigated at larger intervals • Pump water from Galana River during high flows when it has little impact on the river abstraction

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2 AND 3		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
A.2.2	Reduction of downstream flows affecting floodplain use, flood plain ecology, riverine and estuarine fisheries, users of water, dillution of pollutants	• Relocation or redesign of project • Regulation of takeoff to mitigate effects • Compensatory measures where possible
A.2.3	Encroachment on swamps and other ecologically sensitive areas	• Siting of projects to avoid or minimize encroachment on critical areas
A.2.4	Algal blooms and weed proliferation and weed proliferation	• Reduction of input to and release of nutrients (nitrogen and phosphorous) from cropped fields • Use of organic instead of chemical fertilizers where possible
	OPERATION OF DAM	
A.2.5	Drowning	• Fence the dam/pan with chain link of height 2m • Put a warning sign on impending danger
A2.6	Drying of the Dams	• Put enough dams to satisfy the demand • Fill the dams during high flows in Galana River
A2.7	Dam failure	• Undertake Regular dam safety monitoring and repairs • Employ adequate staff for operation and maintenance
A 2.8	Surface and ground water quality Water quality (sources of domestic water)	• Seek frequent professional inspections in line with Water Resource Regulation 2021
	Pollution	
A.3	**Agrochemicals**	
A.3.1	Deterioration of river water quality below irrigation project and contamination of local ground water (higher salinity, nutrients, agrochemicals) affecting community and downstream users	• As per the Second Schedule of Legal Notice No.120 2006 • As per the Second Schedule of Legal Notice #120 2006

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2 AND 3		
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ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
A.3.2	Air pollution	• Imposition of water quality criteria • • NEMA/ WHO environmental air emission standards should always prevail controlling suspended particles of matter, Sulphur Dioxide, Nitrogen Dioxide and other pollutants • • Tilled surface should not be left bare to minimise wind erosion and where possible embrace onservation agriculture. • • Use of pesticides and other chemicals should be done when the weather is relatively calm
A.3.3	Noise pollution resulting from operation of water pumping station	• Operate during daytime from 8.0am to 5.0pm • Locate the pumping station away from settlements • incorporate sound reduction facility around the pumping station
A.3.4	Organic pollution	• Limit sound production through migration from fossil to connection to electricity National Grid • • Bury wastes during tillage • Use the Wastes as manure or used for mulching purposes
A 3.5	Pollution from Hazardous Chemicals (Waste)	• Through the wastes in a land fill established in the project area • • • Appoint a safety officer to ensure that proper disposal guideline are observed • • Ensuring that maintenance and/or piece of work carried out on any piece of equipment or construction work is undertaken by qualified personnel. • • In case of spillage emergency spillage control measures to be instituted.
A 3.6	Improper solid waste management	• • Containerization of any wastes and disposal through a licensed waste • handler. • • Adhere to L.N. 121: Waste Management Regulations. • • Waste generation must be minimised as first priority • • Unavoidable wastes should be separated at source, recycled or re- used, combusted, and disposed in sanitary landfills • • Use of an integrated solid waste management system i.e. through several options including of source reduction recycling ,composting and reuse and incineration • • Ensure that wastes generated at the Farm are efficiently managed through recycling, reuse and proper disposal procedures.
A.4	**SOILS**	

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2 AND 3		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
A.4.1	**Soil erosion**	• Use erosion control techniques which disperse erosive energy and avoid concentrating it e.g providing good vegetative cover will disperse the energy of rain drops and contour drainage will slow down surface runoff • Proper maintenance of canal and the irrigation infrastructures. • Adopt conservation tillage systems and ripping to control hardpan and enhance infiltration and seepage
A 4,2	Alteration of soil structurestructure	• Sensitization to the project workers on proper soil conservation and management measures
A 4,3	Water-logging	• Use of proper irrigation management, closely matching irrigation demands and supply • Regulation of water application to avoid overwatering (Including controlled turn-out to allow cutting off water supply to irrigation fields • Use of sprinkler or drip irrigation
A 4.4	Increased soil salinization	• Careful management should be practiced to reduce the rate of salinity build up and minimize the effects on crops. • Avoid digging more than 0.60m or thereoff where gypsum is located • Use recommended fertilizers • Leaching of salts by flushing soils periodically
A 4.5	Soil fertility/Production	• Cultivation of crops with salinity tolerance • Undertake crop rotation • Use organic fertilizer to improve yield • Choose the cropping patterns as per recommendation of the experts.
A.5	**SEDIMENTS**	
A 5.1	Increased sedimentation	• Construction of sedimentation retention ponds (if necessary) • Filters should be added to all storm water inlets, and silt fences established where erosion is predicted. • Install sediment traps or screens to control runoff and sedimentatio • Design and management of canals to minimize sedimentation. • Provision of access to canals for removal of weeds and sediments • Take Catchment Management • Do not clear land that is not required • Do not interfere with wetlands

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2 AND 3		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
A 6	**Ecology**	
A 6.1	Biodiversity fragmentation and loss	• • Incorporation of horticultural tree crops, sugarcane, green areas and forestation within the recreational areas to ensure maintenance of biodiversity • Develop and implement a biodiversity awareness training programme for all staff. • Establish Biodiversity Management Committee to oversee the implementation of the biodiversity plan • Develop and implement a comprehensive biodiversity assessment programme
A 8.2	Restriction of wildlife movement & migration routes	• • Provision of wildlife migration routes especially at the proposed green areas • • Provision of wildlife crossing areas in the project roads especially at the provided migration routes
A 6.3	Loss of food resources for wildlife	• Include common native tree species as strips surrounding the farms to keep animals away from crops • Alternate cleared cropped land with uncleared natural vegetation. The natural vegetation will provide habitat and food for animals.
A 6.4	Water pollution-Siltation of breeding and feeding sites	• Establish receptacles, in form of artificial wetlands with plants such as Typha spp. Cyperus spp. and water sedges to trap the soil.
A 6.5	Water pollution-Chemical pollution from pesticides affects animals' biology and genetics affecting population survival	• Establish artificial wetlands with plant such as arrow roots which absorb harmful chemicals and reduce substances, store them in the leaves
A 6.6	Water pollution-Fertilizer and organic materials cause nutrient overload which causes death of fish and other aquatic animals	• Locate farms 3kms away from the river which will minimize the chances of the nutrient reaching the river.
6.7	Loss of species important as sources of medicine for the local	• Establish a tree nursery for common tree and shrubs. These will be used to rehabilitate the farm area as well as the community land

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
	communities and habitat and food for wildlife	
A6.8	Restricted migration and dry season dispersion for wildlife. This will increase human/wildlife conflict and affect wildlife population growth	• Establish migratory corridors especially along the drainage lines with prolonged ground water storage and green vegetatio
A6.9	Death of untargeted invertebrates in chemical pest control, thereby reducing biodiversity.	• Employ the Push and pull technology. This technology will use Napier grass (Pennisetum purpureum) to attract and traps pests such as stem-boring grass moths. The grass will be conveniently planted on field boundaries to trap the pest before they get into the farm.
A6.10	Air pollution by weed control chemicals	• Reduce chemicals use by including Desmodium spp. in the farm. These plants release allelopathic organic chemicals into the air and in the soil which inhibit the growth of weeds and repel pests
A6.11	Emission of greenhouse gases such as carbon dioxide from farm machinery. These gases cause climate change Note: Reduced emissions and carbon sequestration will earn the farm extra money from carbon credits.	• Uses of renewable energy such as solar energy and electricity in farm machinery. These energy resources do not emit carbon dioxide. • Include permanent trees and crop trees in the farm to enhance biomass and soil carbon accumulation and storage • Avoid waterlogging the soil to minimize emission of methane. Anaerobic decomposition of plant materials in waterlogged soils release methane into the air. • Minimum use of inorganic fertilizers and burning vegetation. Nitrogen based fertilisers and burning of vegetation emit nitrous oxide into the air.
A.7	**Health**	
A 7.1	Introduction or increase in incidences of water borne or water related diseases (Schistosomiasis)	• Prevention measures:- • Use of lined or pipes to discourage vectors • Avoidance of stagnant or slowly moving water • Use of straight or slightly curved canala • Filing or draining of borrow pits along roads and canals. • Disease prophylaxis • Disease treatment

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2 AND 3		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
A 7.2	Public Health and Safety	• HIV/AIDs, STDs and other diseases • Accidents; • Hazardous materials
A.8	Imbalances	
A.8.1	Human-Wildlife Conflicts	• Community needs to be sensitized and create awareness on the wild animal's importance • Water points on the designated areas should be increased to avoid movements of the wild animals through the migratory corridors and the game proof friendly fence to be set up • a game proof fence, friendly to the wildlife should be put where crops on Galana-Kulalu will be grown using 12 strands. This will be easy considering that power will have reached the project area of Galana. • Built labour camps and probide transport to those going home • Giving wildlife water during draught especially September to October should be considered
A.8.2	different seasons of planting crops	• Sensitization • Provide Agricultural extension Services
A.8.3	maize diseases	• Provide Agricultural extension Services • Support to community on chemicals for use
A.8.4	Price of Maize during Harvest time	• Government to stabilize price of maize vy buying maize from farmers
A.8.5	Clean Water for the Community	• Government should consider setting up of wholesome and palatable water supply
A.8.6	Immediate stoppage of Production	• Provide at least 30 days notice for termination of employees services
A.8.7	impregating women and rampant child abuse	• Follow the law
A.8.8	Occurrence of Disease	• Selu should come up with a strategy to manage it including in the community lands
A.8.9	Land Ownership	• Give Community title deeds on the land they own
A.8.10	Good Neighborhood	• Consider Coporate Social Responsibility
A.8.11	Diversifying Water Sources	• County and National Government should consider developing appropriate water supplies in the area
A.8.12	Increase in rodents	• Use appropriate methods of controlling on farm and environs community

Table 0-3: ***Environmental and Social Management Plan during Project Decommissioning***

Possible Impacts	***Proposed Mitigation Measures***	***Responsible Party***	**Cost Estimates (KSh.)**
1. Air pollution during Demolition process.	• The demolition exercise will be limited to day time only • All personnel working in the project will be trained prior to commencing the demolition exercise on methods for minimizing negative impacts on air quality. • Construction vehicle drivers will be under strict instructions to minimize unnecessary trips, refill petrol fuel tanks in the afternoon and minimize idling of engines. • All active demolition areas will be watered at least twice a day to reduce dust. • All trucks hauling demolition debris/wastes shall be covered. • Careful screening to contain and arrest demolition related dust will be adopted • Exposed demolition debris of e.g. dust and sand, will be enclosed, covered, and watered daily before transported to disposal site. • All workers on the site will be required to wear protective gear while on	• Project proponent • NEMA inspectors • Contractor	300,000
2. Noise pollution by disassembly activities	• Portable barriers will be installed to shield compressors • Use of equipment designed with noise control elements will be adopted where necessary. • Trucks used during demolition exercise on site shall be routed away from noise sensitive areas in the neighbourhood, where feasible. • Idling time for pickup trucks and other small equipment will be minimized to limited time.	• Project proponent • NEMA inspector • Contractor	100,000

Possible Impacts	• *Proposed Mitigation Measures*	• *Responsible Party*	**Cost Estimates (KSh.)**
	• All workers operating in noisy areas or operating noisy equipment will be provided with earpieces to protect against extreme noise. • The demolition exercise will be limited to day time only	•	
3. Traffic and Transport	• Carry out fuel deliveries during the day to avoid noise and disruption of sleep to the residents of the neighbouring center	• Project proponent	
4. Demolition debris and related wastes	• Private contractor will be engaged to collect demolition debris/wastes • All debris/wastes will be collected regularly to control air pollution and injury etc • A licensed operator to avoid illegal final dumping at unauthorized sites will collect demolition debris. • All persons involved in refuse collection shall be in full protective	• Project proponent • NEMA inspectors • Contractor	1,000,000
5. Workers accidents during demolition process.	• All workers will be sensitized before the exercise begins, on how to control accidents related to the demolition exercise • A comprehensive contingency plan will be prepared before demolition begins, on accident response. • Adherence to safety procedures will be enforced at all stages of the exercise • All workers, pursuant to labour laws, shall be accordingly insured against accidents. • All workers will be provided and instructed to wear protective attire during demolition, including helmets. • Demolition work will be limited to daytime only to avoid workers accidents due to poor visibility • Provision of mobile clinics	• Project proponent • Provincial Public Health Officer • Ministry of Labour • NEMA inspectors • Contractor	100,000

0.10 Conclusions And Recommendations

0.10.1 Conclusions

Irrigation development projects of large magnitude impose significant impacts to the physical and biological environment as well as social, cultural and economic setting of the area. The proposed Model Farm which is of this nature is also anticipated to impose such impacts. The negative impacts, however, are identifiable and can be mitigated through design and administrative measures. However, the overall positive impacts of the project far outweigh the negative projects through the mitigation measures outlined for the project.

0.10.2 Recommendations

i. Implementation

The Environmental and Social Impact Assessment was conducted in compliance with the relevant legislations and planning requirements of Kenya. It is therefore recommended that the proposed Model Farm project be implemented in compliance to the legislations and planning requirements at all times. In addition, the legislative framework provided in this report must be taken into consideration, during and after the implementation of the project, as will be appropriate.

ii. Environmental and Social Management Plan (ESMP)

A comprehensive Environmental and Social Management Plan (ESMP) has been presented in this report and it is recommended that the mitigation guideline provided be followed to the later and improvements made if need be. Specifically, key negative impacts that require careful management during the rehabilitation and construction of the Model Farm's infrastructure and operation phases be addressed.

iii. Environmental Monitoring

Environmental Monitoring Programme (EMP) provided for the key issues as a result of the proposed Model Farm's construction, operation and rehabilitation must also be followed to ensure that the construction and operation are in line with the ESIA license.

1 INTRODUCTION

1.1 General Project Background

The proposed Galana-Kulalu Food Security Project is to be implemented in three phases; a 10,000 acres Model Farm in the first phase which is to be developed into 100,000 acres Pilot Farm in the second phase, and later up-scaled to the larger 215,000 acres Galana-Kulalu Food Security Project in the third phase.

The first phase of the Galana-Kulalu Food Security Project was the 10,000 acres Model Farm which was to mirror the greater Galana-Kulalu Food Security Project. It is partially developed and working. The Model Farm is located in Kilifi County within the land delineated as the Pilot Farm in the larger proposed Galana-Kulalu Food Security Project which is located in the existing Galana-Kulalu Ranches.

Currently the Galana Ranch in which the Model Farm is located is used for ranching purposes and model farm from which a variety of livestock including cattle, sheep and goats are being reared in the Galana Ranch.

The model farm is being used as a demonstration block for developing the entire 415,000 acres set aside for irrigation.

Commercial production at the Galana Kulalu irrigation scheme will start next
Year.

The Government of Kenya is seeking Sh50 billion to construct the dam as the current flow of River Galana can only irrigate 20,000 acres.

The project is supposed to cover 514,000 acres but feasibility studies have indicated that the available water from the river has a capacity to irrigate 215,000 acres when it is dammed.

Galana, a Sh60 billion project, is a public private partnership and the government is expected to provide infrastructure services while the investors plant crops and set up manufacturing factories for processing their produce.

Galana-Kulalu Ranch is government owned by ADC and leased to National Irrigation Board.

1.2 Legal Framework

3) The Environmental Management and Co-ordination (Amendment) Act, 2015 dated 3rd June, 2015 under Second Schedule classifies Large Scale Agriculture as requiring submission of an Environmental Impact Assessment Study Report
4) Legal Notice No. 31 of 30th April 2019 has amended the Second Schedule of EMCA 2015 and has categorized projects into three (3) Categories viz:-
   (d) Low Risk
   (e) Medium Risk and
   (f) High Risk Projects

Large Agriculture exceeding one hundred hectares are classified as High Risk Projects (Refer 1© on page 199).

5) According to the Environmental Impact Assessment and Audit (Amendment) Regulations 2019, every proponent undertaking a project specified in the Second Schedule of the Act as being a high risk project, shall submit to the Authority a**n ESIA Report.**.

   The envisaged large agriculture Development of Phase 2 and 3 falls in this category.

1.3 Proponent

The project proponent, Selu Limited of P.O Box 38714-00100, Nairobi is in the process of leasing 20,000 acres which involves the Galana-Kulalu Model farm and an additional 10,000acres. The original 10,000acres model farm has been developed with irrigation facilities.

Selu limited is to develop the farm under Private-Public Partnership

Selu limited has approached ADB for financing

Original ESIA was done in year 2015 for 10,000acres model farm. Since the land area is two times the effect cannot be ascertained. Further, in the area bordering Galana, a risk of flooding is pronounced hence a flood risk map is required.

Arising from above, Selu Limited is supposed to do all the required studies and acquire license like:-

- Environmental License
- Reservoir Licenses
- Abstraction license
- Undertake stakeholders Consultation among others.

1.4 Location

The first phase of the Galana-Kulalu Food Security Project is the 10,000 acres Model Farm and the remaining 10,000acres under phase 2 is proposed to mirror the greater Galana-Kulalu Food Security Project when it is fully developed and working. The Galana-Kulalu Food Security project is located in Kilifi and Tana River Counties within the land delineated as Galana-Kulalu Ranches in the larger proposed Galana-Kulalu Food Security Project which is located in the existing Galana-Kulalu Ranch and model farm (Refer Figure 1-1)

The Model farm is located in Selu Village, Kisiki Sub-location, Chakama Location, Lengo Mbaya Division, Magharini Constituency, Kilifi County (Refer Figure 1-2 to 1-4)

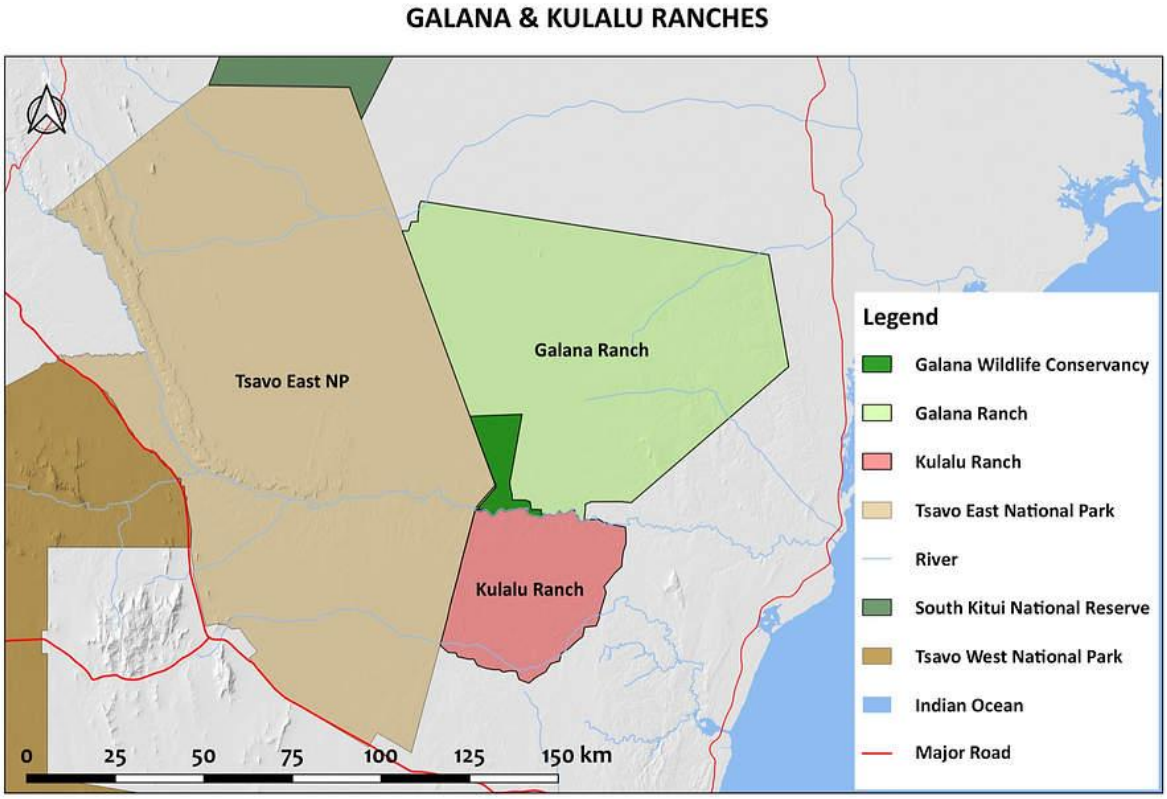


Figure 1-1: Location of Galana Ranch

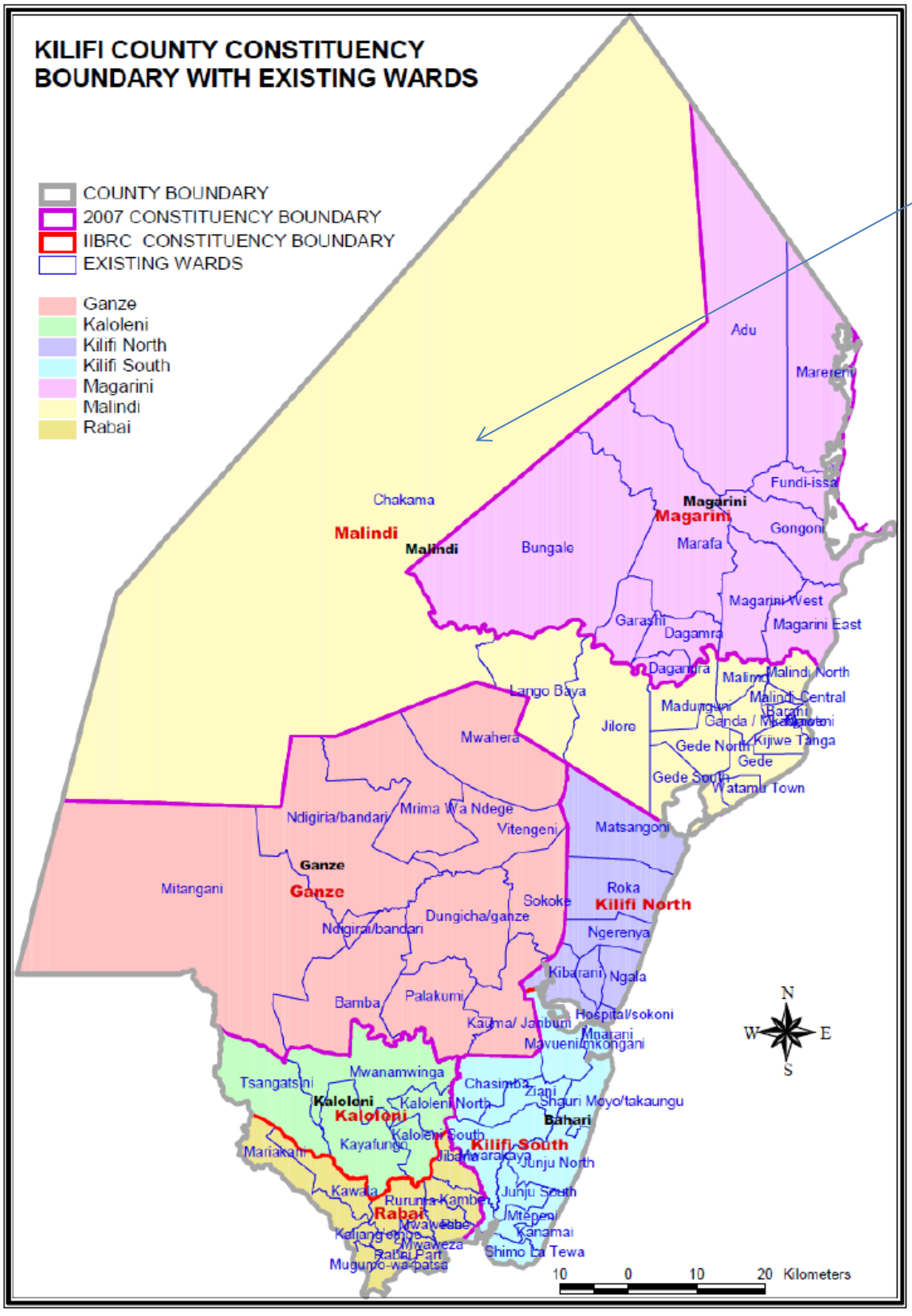


Figure 1-2: Location of Chakama in Kilifi County

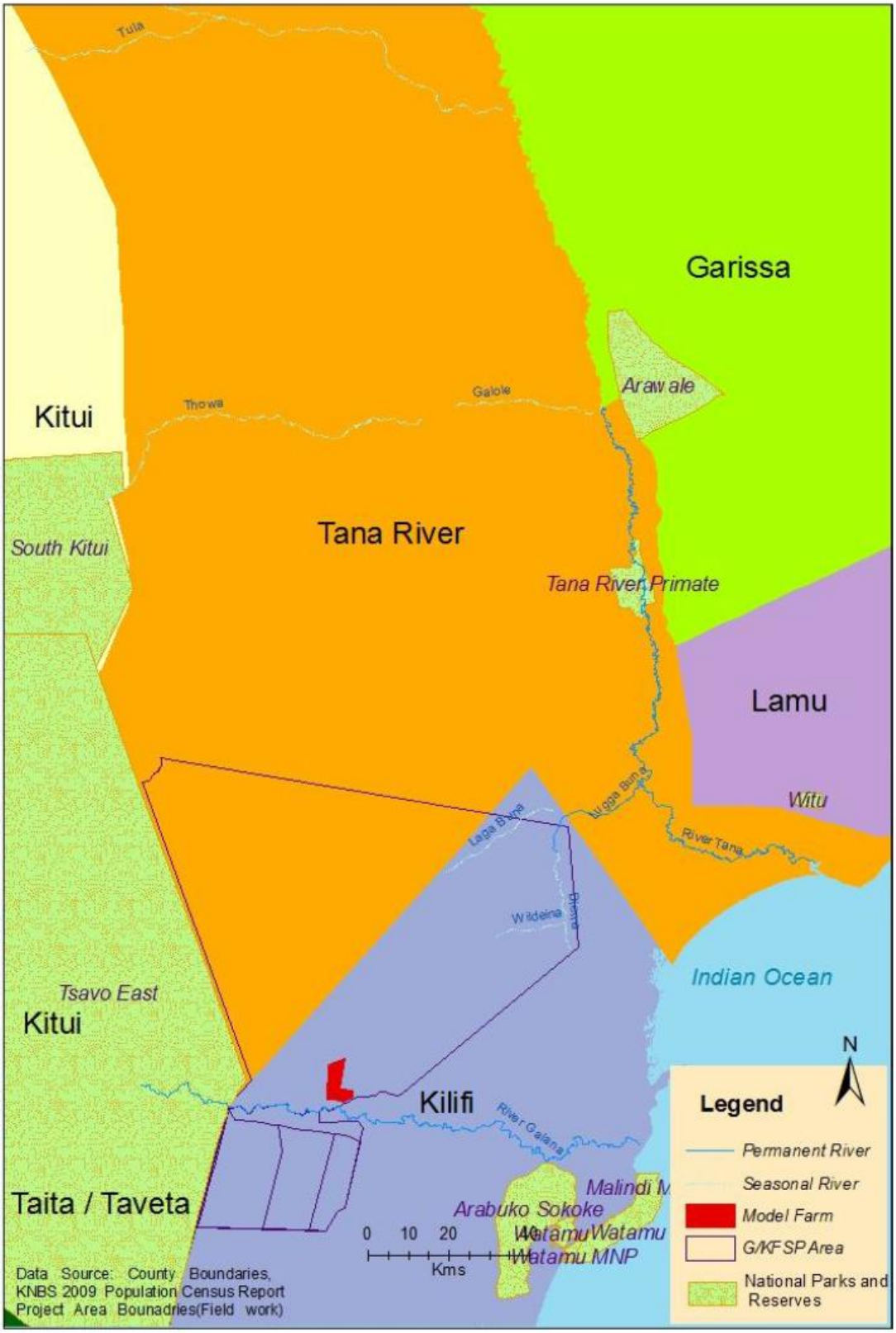


Figure 1-3: *Location of the Model Farm in Kilifi County*

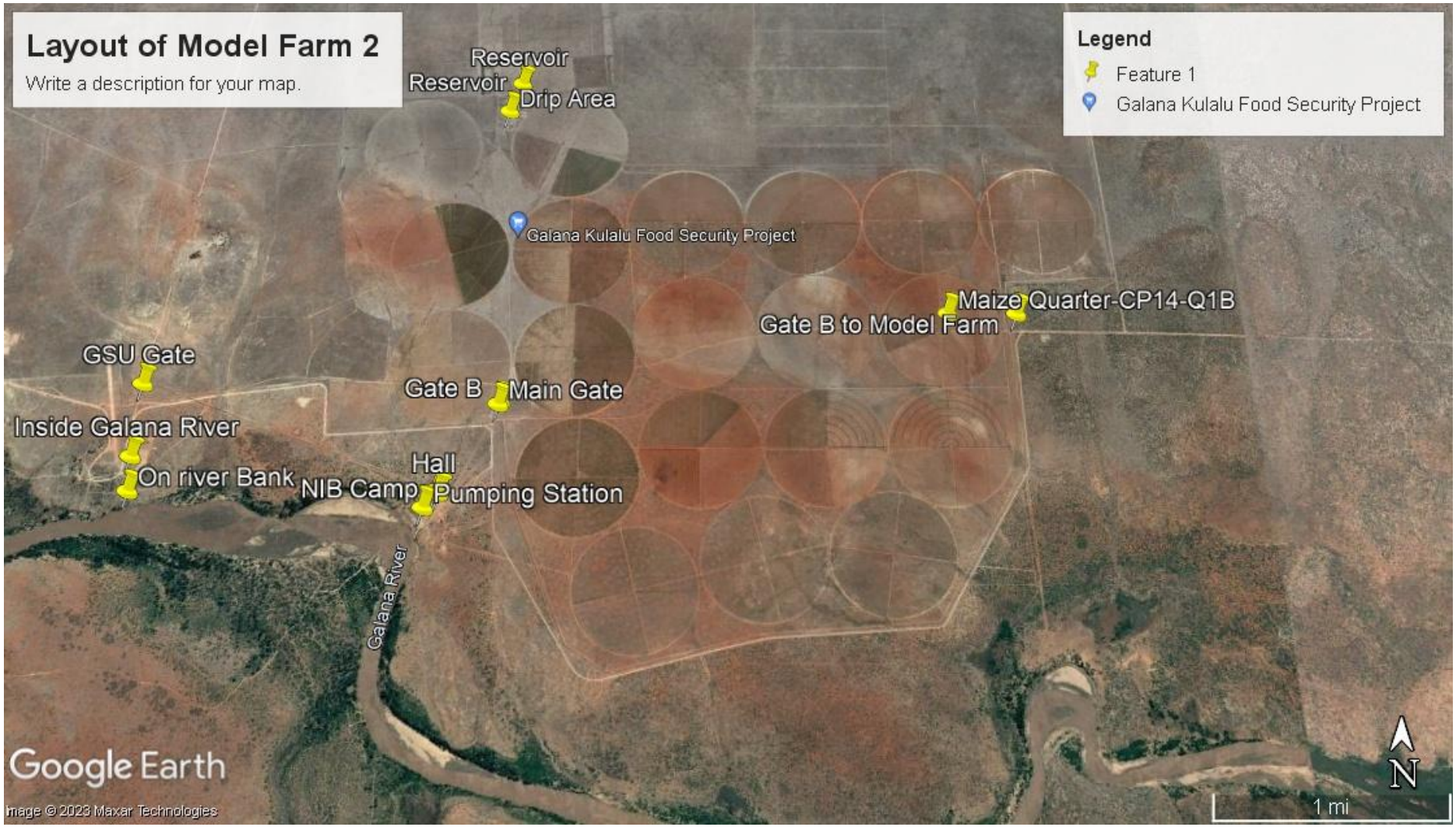


Figure 1-4: Layout of Model Farm on Google Image

1.5 Terms of Reference

The list below highlights the terms of reference for the study. The terms of reference define objectives and scope of the EIA as follows:

I. To determine the compatibility of the proposed development with the neighbouring land uses.
II. To identify and evaluate the significant environmental and social impacts of the proposed project
III. To assess and analyse the environmental and social costs and benefits associated with the proposed project
IV. To incorporate environmental and social management plans and monitoring mechanisms during implementation, operation and decommissioning phases of the project
V. To incorporate stakeholder consultations into the environmental and social management process.

1.6 EIA Methodology

This EIA is based on the visit to the site, discussions with the proponents of the project, consulting the public, and reviewing the literature. While preparing the report for the project, care has been taken to identify the potential positive and negative impacts together with the mitigation measures in terms of:

1. Impact in terms of location
2. The impact from the design of the project and the time of construction
3. Impact at the time of operating the project

In assessing the project and preparing the report of the project, the following approaches have to be undertaken, and methodologies employed: -

I. The desktop studies have involved reviewing, and analysing literature for the acquisition of the secondary data.
II. Environmental screening, where the project is identified among the ones acquiring EIA under schedule two (2) of the EMCA,1999.
III. Environment scoping provides key environment issues being investigated concerning implementing the project which has been proposed.
IV. Physical inspection of the physical and the surrounding areas.
V. Consultation, and public participation
VI. Identifying potential impact while preparing
VII. Confirming and sharing the project findings with the proponents and reporting

1.7 Consultation and Public Participation (CPP)

This was done within the influence area. It promotes open governance where everybody is granted an equal opportunity to voice their voice about proposed projects: opinions given usually assist in planning the proposed project. This usually promotes awareness and provides an opportunity for better planning of the proposed project whereby opinions from various stakeholders being considered.

Kenya has developed EIA regulations, which must be adhered to by proponents of development projects. The regulations have spelled out of the environmental management and Coordination Act (EMCA, 1999 and revised in 2016) and EIA and Environmental Audit (EA) regulations of 2003 and reviewed in 2019. The documents guide environmental and social issues that must be considered during the EIA and preparation of the project report. The project was within the community and different stakeholders were consulted to determine the well-being of the project.

1.8 Report Layout

This report has been prepared under the following chapters:

Executive Summary: This chapter reviews the project and summaries key findings and Conclusions of the Environmental and Impact Assessment Study.

Chapter 1: Introduction. This chapter gives the background information relevant to the project and describes the objectives and requirements of the study.

Chapter 2: Description of the Environment : This chapter provides a description of the existing environment in order to provide an understanding of the bio-physical and social environmental setting.

Chapter 3: Policy, legal and institutional / administrative framework. This chapter outlines the Kenya's environmental policy, legal and institutional / administrative framework relevant to the proposed project.

Chapter 4: Description of Proposed Project. This chapter presents the proposed interventions to achieve the project's objectives.

Chapter 5: Analysis of Alternatives. Provides the existing Alternative to the Project

.

Chapter 6: Public consultation. This chapter outlines the actions undertaken to consult stakeholders. It also presents major findings and outcomes of public consultations.

Chapter 7: Potential impacts and mitigation measures. This chapter presents the analysis of beneficial and adverse impacts of the project on the biophysical and human (social, cultural and economic) environments. The analysis covers anticipated impacts during the construction and operation phases and also describes the enhancement and mitigation measures proposed to enhance benefits or prevent, minimize, mitigate or compensate for adverse impacts as well as the estimated cost of mitigation.

Chapter 8: **Environmental** management plan. This chapter presents the proposed Environmental Management Plan prepared for the project.

Chapter 9: Conclusions and Recommendation. The conclusion briefly presents the environmental and social acceptability of the project, taking into account the impacts and measures identified during the assessment process. It also makes recommendation to enable easy monitoring of the project.

Appendix Gives supporting information

2 EXISTING ENVIRONMENTAL CONDITIONS

2.1 Physical environment

2.1.1 Climate

The monsoonal air currents of the Indian Ocean, coupled with orographic effects of the coastal hills and convectional currents over the hot, dry hinterland immediately to the west, largely control the weather of the Kenyan Coast.

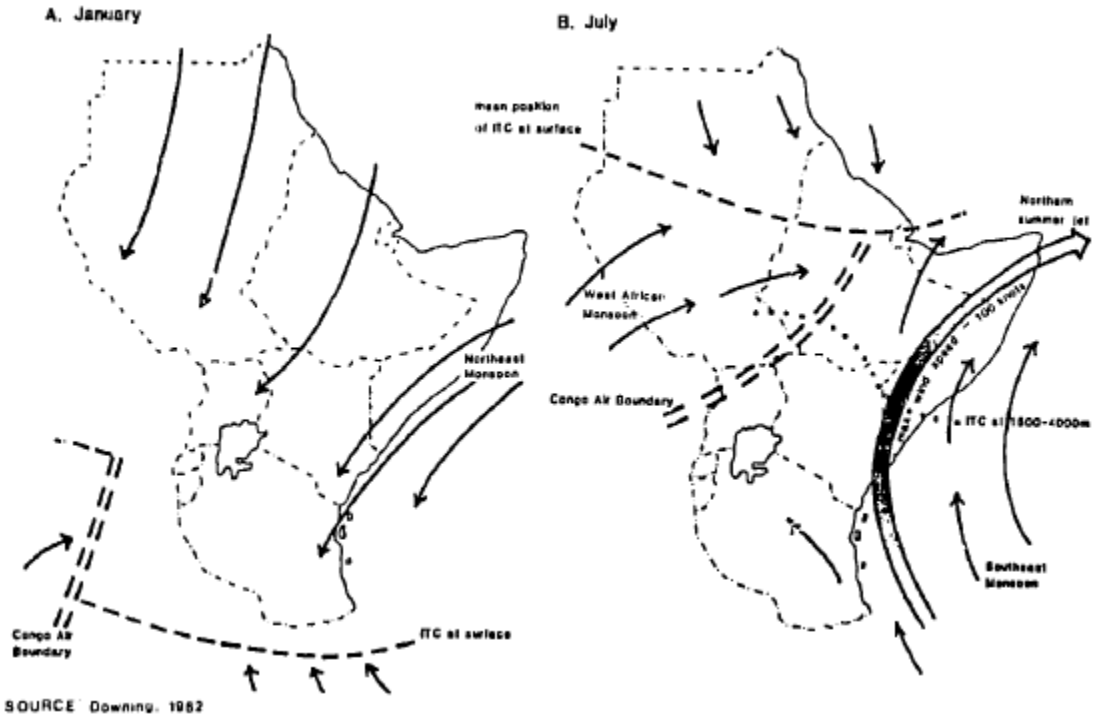


Figure 2-1: Regional Circulation patterns in January-July

The moist southeast moonsoon, relatively dry northeast monsoon, and the Equatorial trough or Intevtropical Convergence Zone (ITCZ), dictate the rainfall pattern of the region. In January the sun is over the Tropic of Capricorn and the ITCZ is centered in Zimbabwe. Thus wind blowing over the Kenya Coastduring November to March is dry and northeasterly (Figure 2-1). In July the sun is over the Tropic of Cancer and the ITCZ is centered in Sudan.
The wind blowing over the region during May to October is southerly or southeasterly (Figure 2-1). Most rainfall occurs in the months between the monsoons, when convection is enhanced.

The north/south shift of the ITCZ is responsible for abimodal rainfall pattern in Kilifi County, characterized by long rains during March-May and short rains in October-November. The year starts dry and remains so until March rain fall increases. A fairly rapid increase occurs through April and builds up to a maximum of rainfall in May. Then rainfall decrease steadily but significant amounts are still recorded in October arid November. During December a decreases is registered that leads to the rainfall minimum in January and" February.

The Project area is located in agro ecological zone VII and receives an average annual rainfall of 480mm. The average annual temperature of the project area is 25^0C. Due to low rainfall the zone has been classified as semi-arid hence it cannot support rain fed agriculture. To improve agricultural potential of the project area, alternative source of water are to be introduced through irrigation.

2.1.1.1 Rainfall

Kilifi County has a bimodal rainfall pattern with average annual precipitation ranging from 300mm in the hinterland to 1,300mm in the coastal belt. The coastal belt receives an average annual rainfall of about 900mm to 1,300mm while the hinterland receives average annual rainfall of about 300mm to 900mm.

The short rain season is experienced in the months of October, November and December while the long rains are experienced in the months of March–April and May. The most important season to the hinterland is the short rains for pasture regeneration and water recharge while the long rain season is the most important season for the coastal area for crop production. Areas receiving highest average annual mean evaporation ranges from 1800mm along the coastal strip to 2200mm in the Nyika plateau in the hinterland. The highest evaporation rates are experienced during the months of January to March in the county.

Table 2-1:Average Seasonal Rainfall in Kilifi County

STATION	JAN-MAR	APR-JUN	JUL-SEPT	OCT-DEC	ANNUAL
BAMBA	78	270	103	226	677
GANZE	87	340	140	265	832
MARIAKANI	125	156	156	273	896
KILIFI	71	342	190	187	955
KALOLENI	99	398	254	337	1088
MAZERAS	104	444	202	344	1094
MTWAPA	103	640	265	268	1267

SOURCE: Floor, et al. 1980

Rainfall of 762mm, which is often cited as the minimum necessary for the practice of permanent agriculture, can only be guaranteed, in 90 years out of 100, on a narrow Coastal belt from just south of Kilifi town to Shimoni. Most of the rain in Kilifi falls in heavy showers with peaks reaching up to 100mm per hour at times. Due to Kenya's position across the equator the region is mostly dry and warm, experiencing only slight variations in temperature during the year.

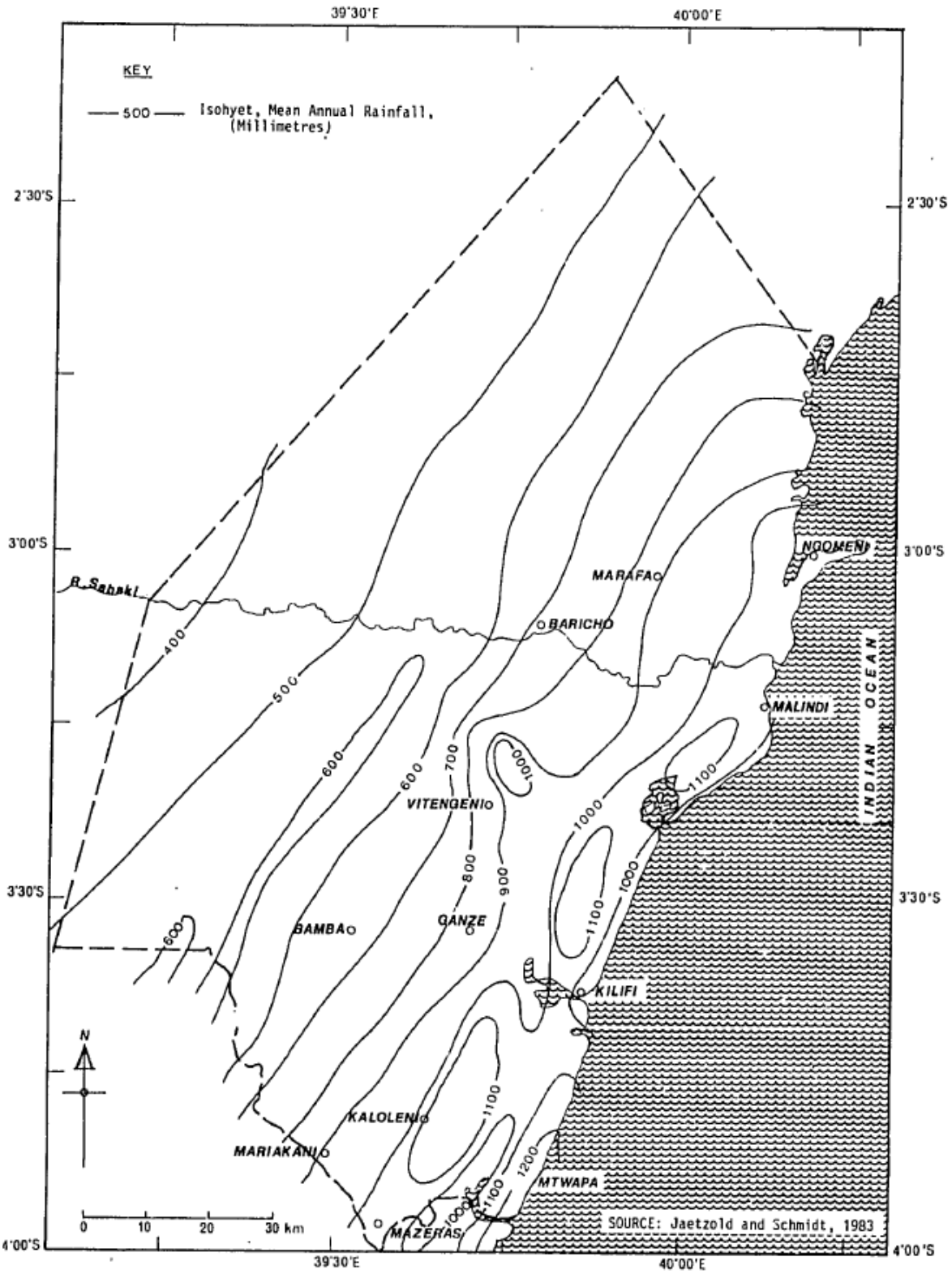


Figure 2-2: Average Seasonal Rainfall in Kilifi County

As concerns Galana-Kulalu, the average annual rainfall is estimated at 562mm as indicated in table 2-2.

Table 2-2: Annual Average rainfall from 1979 to 2009

YEAR	ANNUAL PRECIPITATION
1979	803.2
1980	315.6
1981	733.6
1982	695.6
1983	325.4
1984	528.4
1985	454.2
1986	554.7
1987	347.1
1988	609.5
1989	465.1
1990	662.6
1991	593.4
1992	602.5
1993	537.4
1994	766
1995	403
1996	476.9
1997	714.8
1998	1139.8
1999	439.8
2000	484.5
2001	505.7
2002	801.5
2003	210
2004	771.4
2005	282
2006	761.1
2007	422.9
2008	433.7
2009	588.1
Average	**562**

The average annual rainfall days is estimated at 58 with May to October and January to February being dry months. Representing an average of 8 months in a year (Refer table 2-1). This means that only irrigable farming can survive.

According to the ministry of water and irrigation practice manual, 2005 page A53, define a dry spell as when the average monthly rainfall is less than 50mm hence require storage.

As concerns climate change, no effect is to be observed as indicated in figure 2-1.

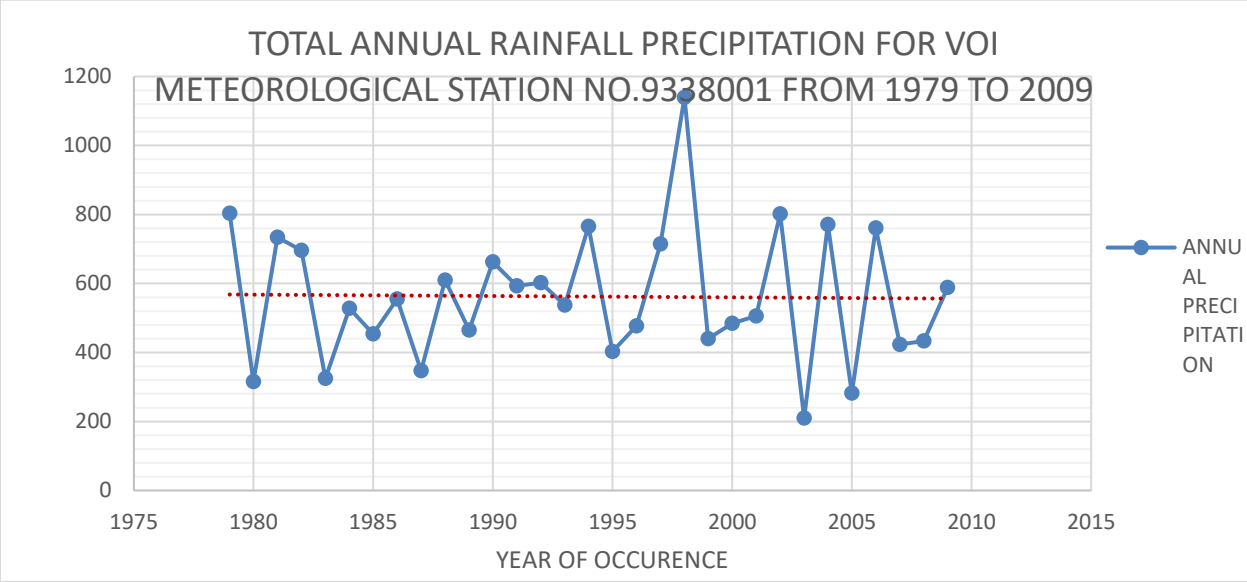


Figure 2-3: TOTAL ANNUAL RAINFALL PRECIPITATION FOR VOI METEOROLOGICAL STATION NO.9338001 FROM 1979 TO 2009

The long rains start from March with a peak in April while the short rains occur in November with a peak in December. Galana-Kulalu receives the largest rainfall during short rains at about 1.50 times the long rains as indicated in figure 2-2 and table 2-2.

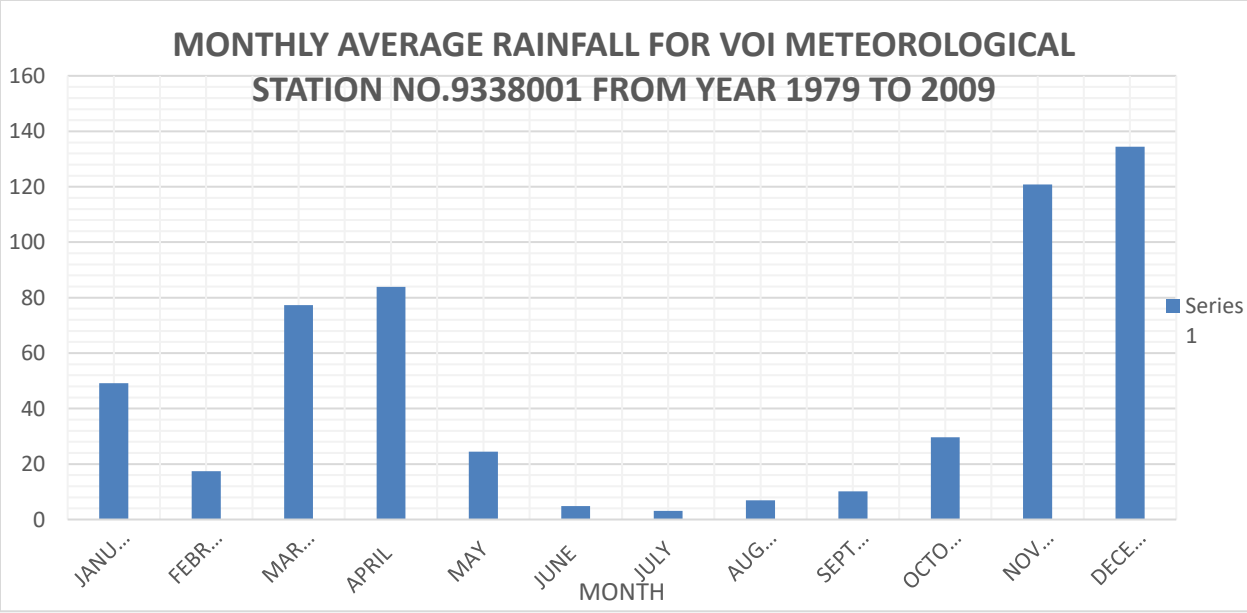


Figure 2-4: MONTHLY AVERAGE RAINFALL FOR VOI METEOROLOGICAL STATION NO.9338001 FROM YEAR 1979 TO 2009

Table 2-3: **MONTHLY RAINFALL DEPTH OF -9338001 VOI METEOROLOGICAL STATIONS**

MONTHLY RAINFALL DEPTH OF -9338001 VOI METEOROLOGICAL STATION													
YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	ANNUAL PRECIPITATION
1979	144.1	26.5	67.5	165.2	56.2	10.7	5.8	0.3	3.8	23.4	79.4	220.3	803.2
1980	50.4	15.8	54.1	49	4.4	0	1.5	32	8.9	2.6	0	96.9	315.6
1981	1.5	0.7	248.4	84.1	22.6	0	3	2.7	13.8	35.2	62.5	259.1	733.6
1982	4.5	0	68.6	82.9	25.9	5.3	10.1	12.9	60.8	106.4	254	64.2	695.6
1983	2.7	55.5	89.9	3.1	36.3	2.8	5.6	0.1	4.2	0	81.7	43.5	325.4
1984	0.3	0.6	24.5	60.2	1.6	10	4.6	0.2	4.1	72.5	120.6	229.2	528.4
1985	37.9	52.3	10.6	69.4	14.3	0	6.9	2.5	5.4	18	93.9	143	454.2
1986	7.6	0.1	24.2	30	97.3	0	0	8.4	0	20.4	148	218.7	554.7
1987	22.2	2.3	8.3	160.7	44.8	1.6	11.4	17.7	0	6.1	53.5	18.5	347.1
1988	110.4	3.5	95.4	65.7	4.8	6.4	0.1	9.9	29.5	27.3	63.1	193.4	609.5
1989	11.8	0	8.5	120.9	9	0	0	6.9	2.2	68.1	114.5	123.2	465.1
1990	0	0	204.3	209.5	1.3	0	0	0	19.8	0	57	170.7	662.6
1991	8.6	2.7	186.7	147.6	41.5	5.1	13.9	44.8	2.6	18.4	33	88.5	593.4
1992	2	0	44.8	103	31	8.9	0	0	1.2	20.6	192.8	198.2	602.5
1993	142.2	19.4	16.9	72.5	3.5	9.9	0.8	6.6	1	16.9	140.9	106.8	537.4
1994	8.1	21.5	203	10.9	24.8	1.2	5.7	0	10.6	14	264.1	202.1	766
1995	8.2	26.8	23.6	114.5	5.4	0	0.4	0	0	0	205.5	18.6	403
1996	6.2	29.3	106.3	62.3	37.8	0	0.6	0	0.4	2	176	56	476.9
1997	1.9	0	39.3	127.2	41.6	9.2	0	0	0.6	113.5	212	169.5	714.8
1998	355.8	196.8	120.2	129.3	26	1.2	3.8	0	10.2	4.2	238.4	53.9	1139.8
1999	16.3	7	48	109.4	8.6	14.3	0.5	6.7	3.9	0.4	112.8	111.9	439.8

MONTHLY RAINFALL DEPTH OF -9338001 VOI METEOROLOGICAL STATION													
YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	ANNUAL PRECIPITATION
2000	3	0	52.7	5.7	8.6	12.3	3.9	19	23.5	17.3	149.4	189.1	484.5
2001	68.2	4.1	91.3	32.3	11.7	7.9	0	0.5	0	5.7	112.6	171.4	505.7
2002	89.6	2.1	57	26.9	59.9	2.6	0.5	15	53.3	98.6	210.5	185.5	801.5
2003	2.3	6	66.9	21.7	28.7	1	0	6.3	3.2	0	23.8	50.1	210
2004	247.7	41.6	38.7	109.7	0	9.2	1.2	0	0	62.6	131.4	129.3	771.4
2005	18.2	2	64.8	59.3	34.6	0	1.1	4.9	8.2	14.7	48.8	25.4	282
2006	22.4	0	80.5	113.6	29.7	2	2.8	0.8	36.1	27.4	171.5	274.3	761.1
2007	53.6	8.6	48.1	12.7	42.7	9.7	8.2	10.4	1.5	35	55.2	137.2	422.9
2008	30.5	6.5	145	105.1	2.3	1.7	3.5	3.9	4.7	0.9	111.9	17.7	433.7
2009	44.5	9.2	59.7	137	0	17.3	0.6	0.6	0	88.8	27.9	202.5	588.1
Max(mm)	355.8	196.8	248.4	209.5	97.3	17.3	13.9	44.8	60.8	113.5	264.1	274.3	1139.8
Mean(mm)	49.1	17.4	77.3	83.9	24.4	4.8	3.1	6.9	10.1	29.7	120.9	134.5	562.2
Min(mm)	0	0	8.3	3.1	0	0	0	0	0	0	0	17.7	210
	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	
	49.12	17.45	77.35	83.92	24.42	4.85	3.11	6.87	10.11	29.71	120.86	134.47	

Table 2-4: Climate of Voi Meteorological Station

Station No :	**9338001**										
Station Name	**VOI MET STATION**										
Location Latitude 0 38 N	**Latitude 3 24 S**										
Location Latitude 0 38 N	**Longitude 38 34 E**										
Period of record	**1938-1980**										
Altitude	**560 m**										
		Temperature			**Relative humidity**						
						Daily minimum (%)					
Month	**Daily maximum (degree)**	**Daily minimum(degree)**	**Extreme high (degree)**	**Extreme low (degree)**	Daily maximum(%)		Daily sunshine(hrs)	Daily wind run(km)	Daily evaporation(mm)	Monthly mean rainfall(mm)	No of rain days(mm)
January	31.6	20.1	36.9	15.5	78	46	8.1	92.5	191	34	5
February	32.9	20.2	37.3	13	75	42	7.4	95.1	195	29	3
March	33.3	20.8	37.2	14.6	74	43	7.7	100	211	79	8
April	31.8	20.4	36.2	13.7	74	50	7	116.9	174	100	7
May	29.9	20	35	12.7	73	52	7	149.6	169	30	5
June	29	18.3	34.2	13	69	45	6.9	161.4	173	6	2
July	28.1	17.3	33	12.8	69	44	6.1	168.3	174	3	1
August	28	17.2	33.3	9.6	70	45	5.7	179.3	167	8	2
September	29.2	17.6	33.6	12.9	69	44	6.7	156.8	178	15	3
October	31.1	18.9	36.7	14.1	69	41	8.4	137.5	206	26	4

Station No :	**9338001**										
Station Name	**VOI MET STATION**										
Location Latitude 0 38 N	**Latitude 3 24 S**										
Location Latitude 0 38 N	**Longitude 38 34 E**										
Period of record	**1938-1980**										
Altitude	**560 m**										
		Temperature			**Relative humidity**						
						Daily minimum (%)					
Month	**Daily maximum (degree)**	**Daily minimum(degree)**	**Extreme high (degree)**	**Extreme low (degree)**	Daily maximum(%)		Daily sunshine(hrs)	Daily wind run(km)	Daily evaporation(mm)	Monthly mean rainfall(mm)	No of rain days(mm)
November	31.4	20.1	35.4	15	74	47	7.7	103.2	181	106	10
December	30.6	**20.4**	34.7	16	79	51	7.8	87	170	119	8
TOTAL	**366.9**	**231.3**	**423.5**	**162.9**	**873**	**550**	**86.5**	**1547.6**	**2189**	**555**	**58**
Maximum(mm)	**33.3**	**20.8**	**37.3**	**16**	**79**	**52**	**8.4**	**179.3**	**211**	**119**	**10**
Minimum(mm)	**28**	**17.2**	**33**	**9.6**	**69**	**41**	**5.7**	**87**	**167**	**3**	**1**
Average	**30.58**	**19.28**	**35.29**	**13.58**	**72.75**	**45.83**	**7.21**	**128.97**	**182.42**	**46.25**	**4.83**

2.1.1.2 Temperature

Minimum and maximum average temperatures range from *26* -30 C in the coastal belt to **30** -34 C near Bamba.

The annual temperatures range between 21^0C and 30^0C in the coastal belt and between 30^0C and 34^0C in the hinterland.

The coldest month is August at 17.2^0c while the hottest month is February as detailed in table 2-4.

2.1.1.3 Evaporation

The total annual evaporation is 2189mm with an average of 182.42mm.

The highest evaporation occurs in March at 211mm with the least of 167mm in May.

(Refer table 2-4).

2.1.1.4 Sunshine

Day length is rather constant and the average hours of sunshine is about 7-8 hours per day.

The Project area receives an average sunshine of 7.21hous per day with a least of 5.7hous which occurs in August with a maximum of 8.4hours which occurs in October as indicated in table 2-4.

2.1.1.5 Daily Wind Run

The Mean wind run in the County is about 160 kilometres per day. The monsoon winds blow from the south and east during May to October and from the north and east from November to March. Light, mostly local winds are associated with the inter-monsoonal periods, November and April.

The highest wind run occurs in August with the least in December as indicated in table 2-4.

2.1.1.6 Humidity

The average relative humidity in the district is 65% at 15,00 hours along the coastal belt, but decreases as one moves westward into the hinterland. Mean annual dew-point at the Coast is 23.

2.1.2 Ecological Conditions

The Kilifi County is divided into five Agro-Ecological Zones (AEZ) defining areas with similar production related characteristics such as annual mean temperatures, vegetation and humidity. These zones include the following:-

Coconut-Cassava Zone: This zone covers the coastal uplands and the low-level coastal plains and has the highest potential for crop production in the county. The major farming activities in this area includes fruit tree cropping (mango, citrus, cashew nut and coconut), vegetable farming (chilli, brinjals, okra) and food cropping (maize, bananas, cowpeas, upland rice, green grams). Dairy farming also does well in this zone. The zone receives an average annual precipitation of 1,300mm per annum and a mean annual temperature of 24^0C.

Cashewnut-Coconut zone: this zone stretches northwards along the coastal plain up to Arabuko Sokoke forest. The zone receives an average precipitation of 900mm and mean annual temperature

of 24^0C. It has agricultural potential with the same crop types as the coconut-cassava zone but with slightly less production.

Livestock-Millet Zone: The zone is of lower agricultural potential with annual precipitation ranging from 700mm to 900mm. The area is suitable for dry land farming supporting drought tolerant crops and ranching activities.

Lowland Ranching: This zone varies in altitude from 90m to 300m with annual mean temperature of 27^0 Celsius and annual precipitation of 350mm to 700mm. The major activities within this zone are ranching and wildlife. The project area lies in Low land Ranching as indicated in figure 2-6.

Coconut Cashew Nut – Cassava Zone: this zone is mainly found in Kilifi South and North constituencies and is the smallest of all the zones. It lies in the altitude between 30m to 310m above mean sea level with mean temperature of 27^0 Celsius and annual precipitation of 900mm per annum. The area has a similar potential for the crops found in the coconut-cassava and cashewnut-cassava zones.

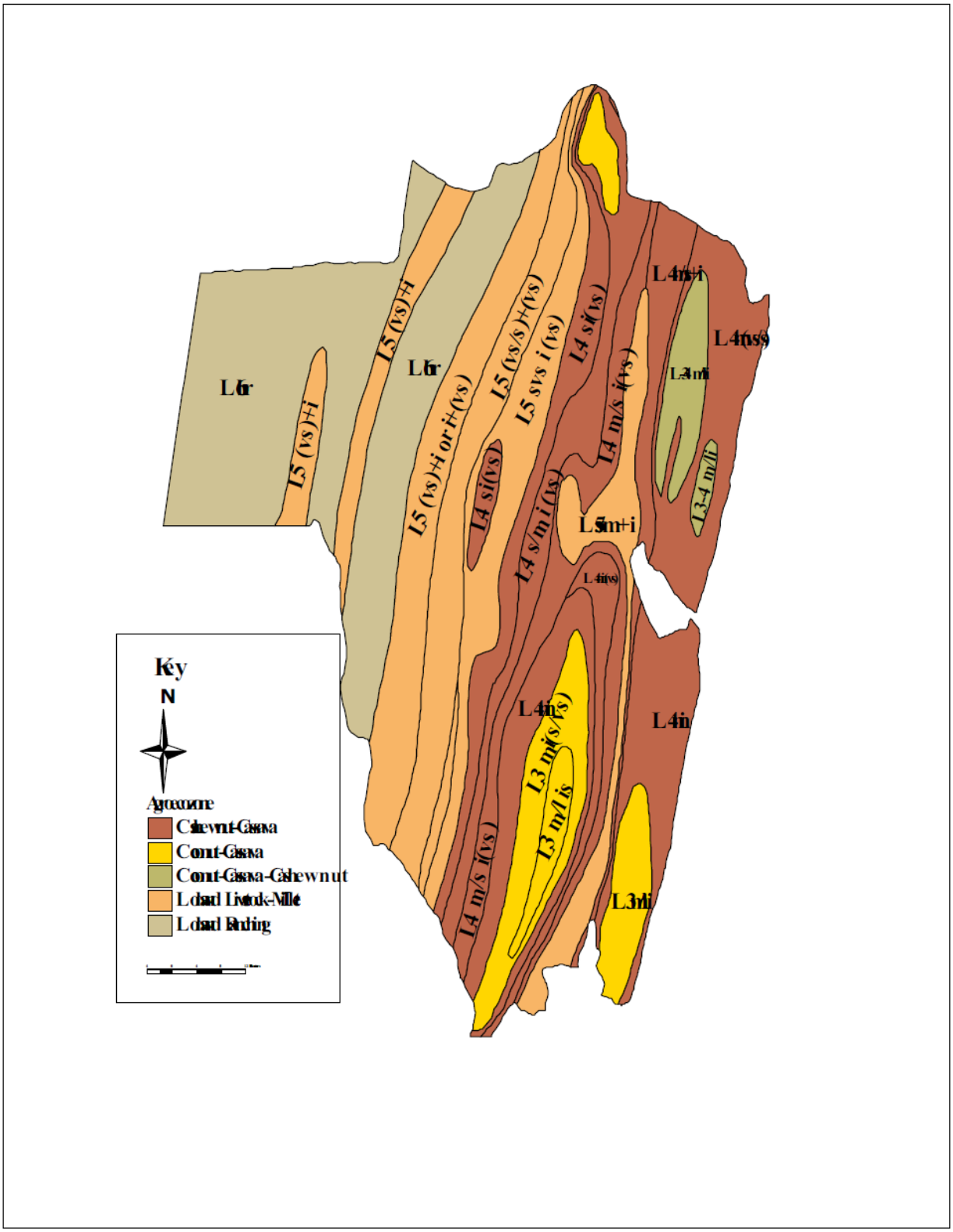


Figure 2-5: Agro-Ecological Zones of Kilifi County

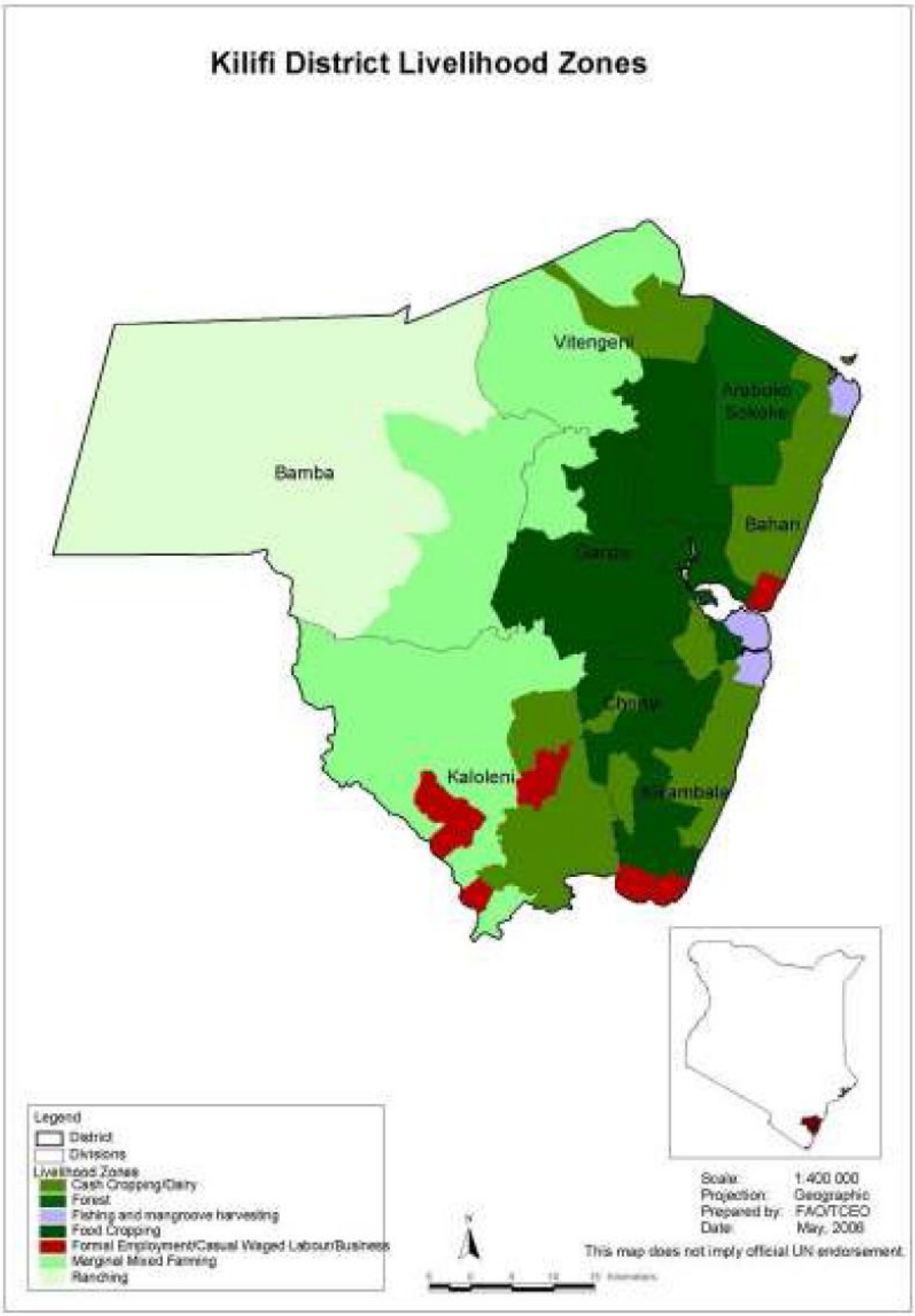


Figure 2-6: Kilifi County Livelihood Zones

2.1.3 Topography

The land rises gradually from sea level to 900m on the South-Western side of the County. It can be divided into six physiographic regions

The first one is the narrow belt, which forms the coastal plain and varies in width from 3km to 20km. This region is generally below 30m in altitude except from Malindi northwards where the land rises to 60m in someplaces. The coastline consists of beaches, mangrove forests,sand dunes north of the Sabaki River, arid creeks of which the main ones are 1-itwapa, Kilifi, Mida and Ngomeni. The creeksinclude marine swamps covered by mangrove forests The coastal plain lies below 30m above sea level with a few prominent peaks on the western boundary such as the Mwembetungu hills. Across this plain are several creeks with excellent marine swamps that are richly endowed with mangrove forests and present great potential for marine culture. This zone is composed of marine sediments, including coral, limestone, marble, clay stones and alluvial deposits that support agriculture.

The second topographical feature is the foot plateau that lies to the east of the coastal plain. The western extension of the coastal plain lies between 60m and 135m in altitude. It is characterized by a flat suface except where Mwembe Chungu, Ngoni and Mtuni Hills betweenMtwapa and Kilifi rise to over 120m. The Sabaki and Koromirivers have incised into the plateau, almost obliterating it.

Otherwise the region is dissected by several small valleys. It is characterized by a slightly undulating terrain that falls between 60m and 150m altitude and slopes towards the sea. A number of dry river courses transverse the surface with underlying Jurassic sediments consisting of shells, sandstones and clays. This zone is covered by grassland and stunted shrubs.

The third feature is the coastal range, which falls beyond the foot plateau between 150m to 450m altitude and has distinct low-range sandstone hills. These hills include Simba, Kiwava, Daka, Wacha, Gaabo, Jibana, Mazeras and Mwangea.

The fourth is the Nyika Plateau, which rises from 100m to 340m above sea level covering about two-thirds of the county area on its western side. The Nyika plateau is a large lowland west of the coastal range. Altitude is between 150 and 300m except where the rivershave reduced the altitude to below 150m level. This plateau is characterized by a low population density, thin vegetative cover, shallow depressions and gently undulating terrain. It constitutes the arid and semi-arid areas of the county, which are suitable for ranching.

The Tana River Basin and Lowlands This is in the northern part of the County, generally below 300m. It is made up of alluvium and old sediments includingsand gravel, silt, clay, marsh and composed of narrow elongated plateaus and lowlands

The Plateau At an altitude between 300m and 900m, the plateau is formed of ancient rocks, mainly metamorphic of the basement complex.

Flood plains are prominent along the Sabaki river, and in certain areas along the Ndzovuni and Rare (Goshi) Rivers. Bottomland (a depression without visible drainage out lets) occur in the north, drained by the Mukale and Wildeinia Rivers.

The project area is located in the coastal lowlands. The topography of the area is largely flat. The slope of the site ranges from 0 to 4.4 percent. The largest area has slope values in the range of 0.0% to 0.2 %, 0.5% to 1.0% and 01% to 2% which covers 40.39%, 43.32% and 12.57 % respectively of the total land. The nature of topography makes the project area suitable for mechanized farming since the equipments used move about without terrain challenges. The low slopes make construction of water conveyance system less challenging.

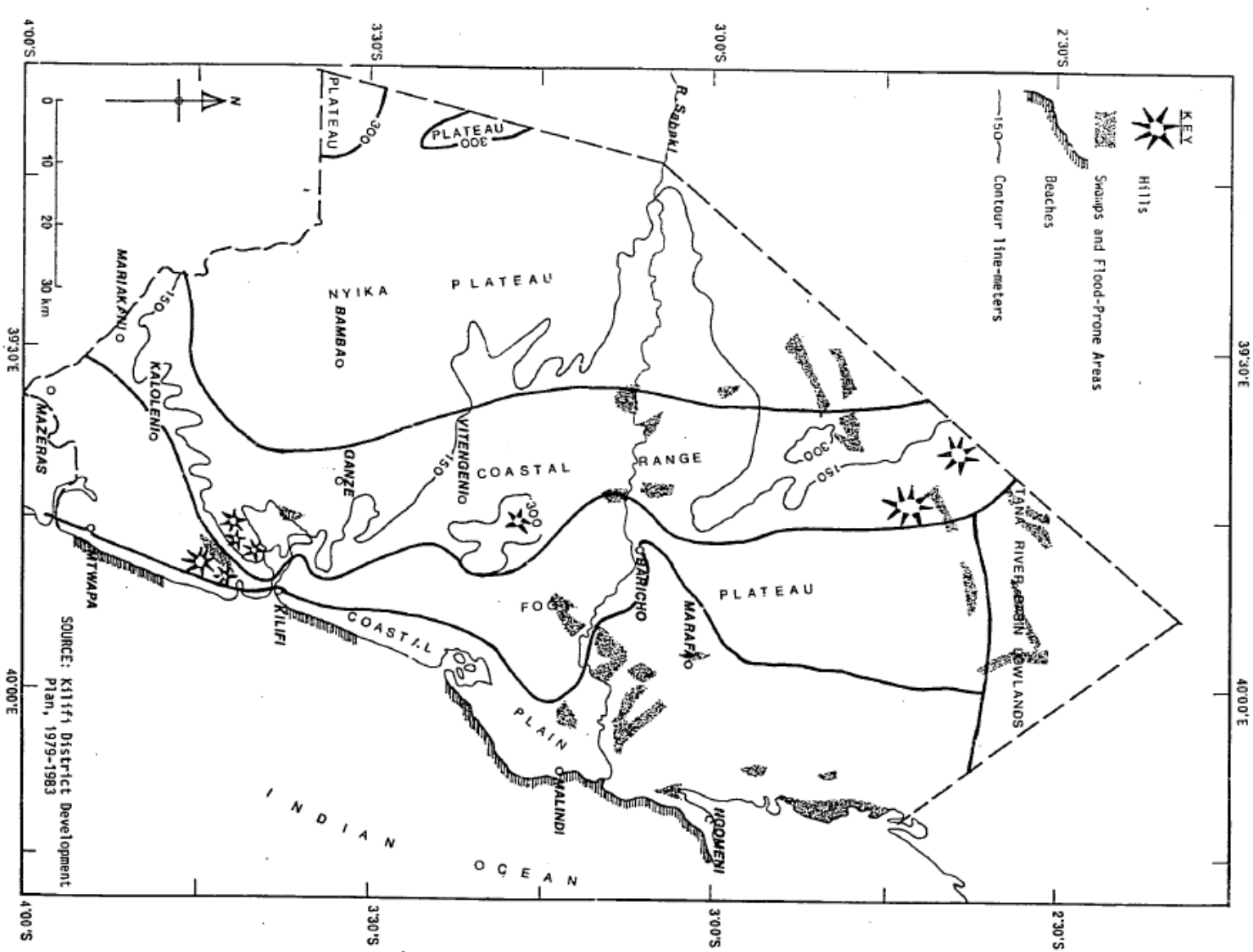


Figure 2-7: Relief and Landform in Kilifi County

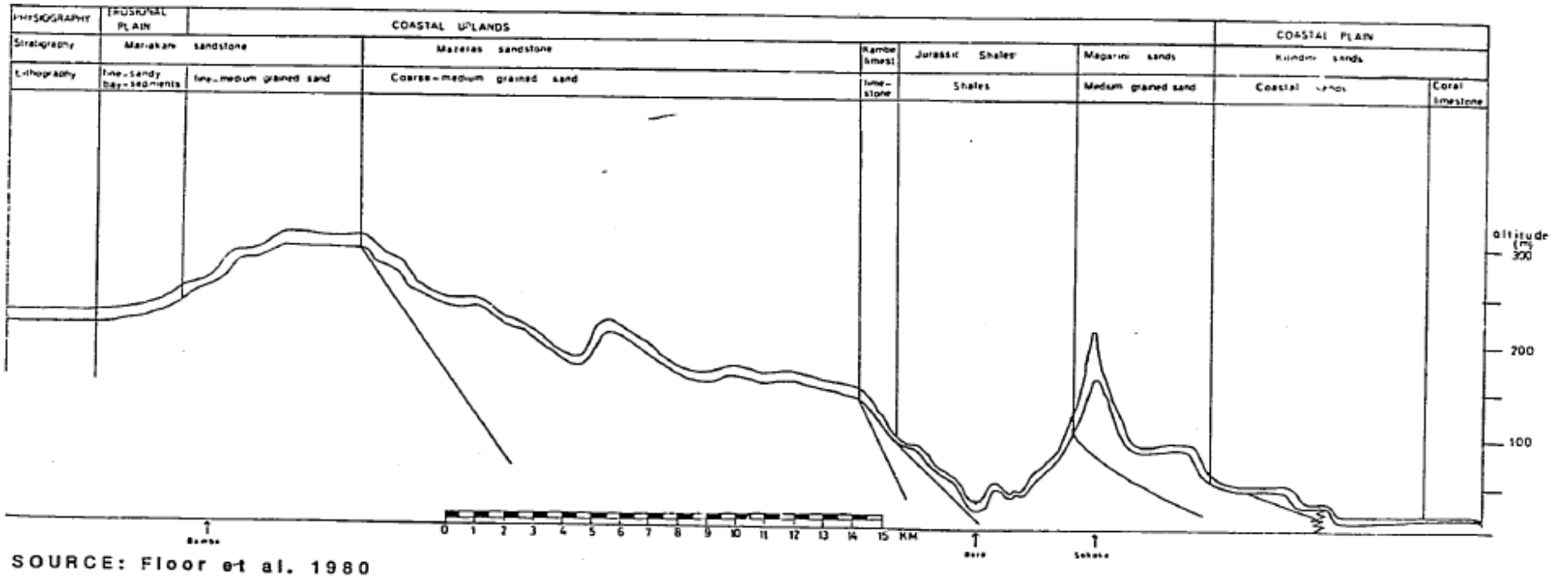


Figure 2-8: Schematic Cross Section of Kilifi County

2.1.4 Soils

The soils in the county differ widely in depth, texture,physical and chemical properties, mainly because of the under lying geology. The soils are poor in fertility, except where indigenous vegetation remains and a layer of fertile loam soil have developed.

The soils can be grouped into three major units.(letters refer to figure 2-9): Coastal Plain, Coastal Uplands and Erosional Plain.

(a) Coastal Plain (D,P,T,2) These soils here have developed on coral limestone and coastal sands (Kilindini Sands). The former are generallywell drained and of loamy sand to sandy clay texture. The latter are also well-drained and are sandy to sandy loamy.Sand dunes and mangrove swamps are also found along the coast.

(b) Coastal Uplands (F,H,L,U,W)
The soils here can be subdivided into five different categories:

(i) Soils developed on Magarini sands are excessively drained to well-drained, very deep soils with a sandy clay loamy subsoil.
(ii) Soils developed on Jurassic shales are very heavy clay soils. U
iii) Soils developed on Kambe limestone are well drained, generally very deep, red, silty clayey to clayey soils.
(iv) Soils developed on Mazeras sandstone are variable, On the steeper slopes in the southern part and to a greater extent in the northern part the soils are shallow to very deep and generally coarse sandysoils. North of Kaloleni the soils can be gradedfrom loamy sand topsoil to sandy clay subsoil.
(v) Soils developed on Mariakani sandstone are well drained deep, dark brown to yellowish brown, firm, very fine sandy clay loam. In addition there are a few areas characterized as badlands, or related to topography.

(c) Erosional Plain (A,B,P)
The soils here are developed on Pleistocene bay sediments 0Marafa beds) and are sandy to clayey soils, Also included are riverine floodplain soils.

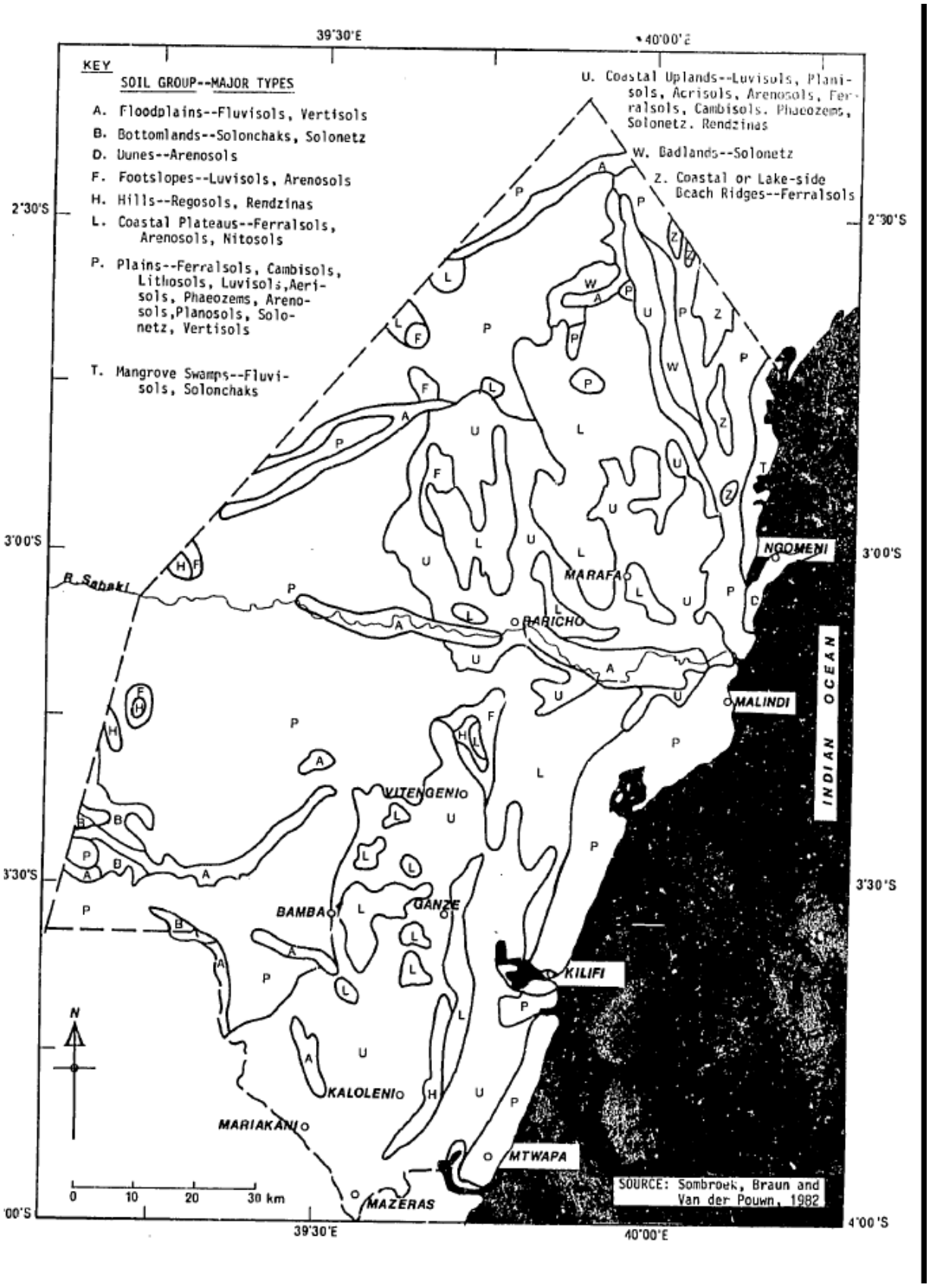


Figure 2-9: Soils in Kilifi County

The soil type over most of the area of the Model Farm is defined by the Kenya Agricultural Research Institute (KARI) Soils Report[1] as: PsmOb1 which is moderately well drained, deep to very deep, brown to very dark grey, friable to extreme firm, slightly to strongly calcareous, moderately saline, moderately sodic, cracking clay with very thin topsoil of sandy clay. The soils are suitable for the proposed crops of the Model Farm. However, some soils are classified as light to medium soils (sandy clay) which will require frequent water application that can be done by the proposed irrigation methods/technologies.

2.1.5 Drainage Patterns and Sources of Water in Kilifi

The drainage pattern in Kilifi County is formed by seasonal rivers and streams such as Goshi, Mzovuni, Wimbi and Mtamkuu. The Sabaki River the only perennial river, originating in the central highlands. Other sources of water in the region consists of hand dug water pans, dams, traditional river wells, boreholes and piped water from Baricho water works.

2.1.6 Geology

Geologically, Kilifi County is part of a system of sedimentary and basement rocks with a generally NE to SEstrike parallel to the coastline. The geology of the County can be described according to the ages of the rocks (Figure 2-10).

2.1.6.1 Summary

The rocks of the district are mainly of sedimentary origin except in the western side of the county where the basement complex is mainly metamorphic gneisis and schists. The sedimentary system consists of the Duruma sandstone series –grits sandstone and shale; which is further classified into: Lower Duruma Series (carbonaceous materials and Taru grits) and Middle.

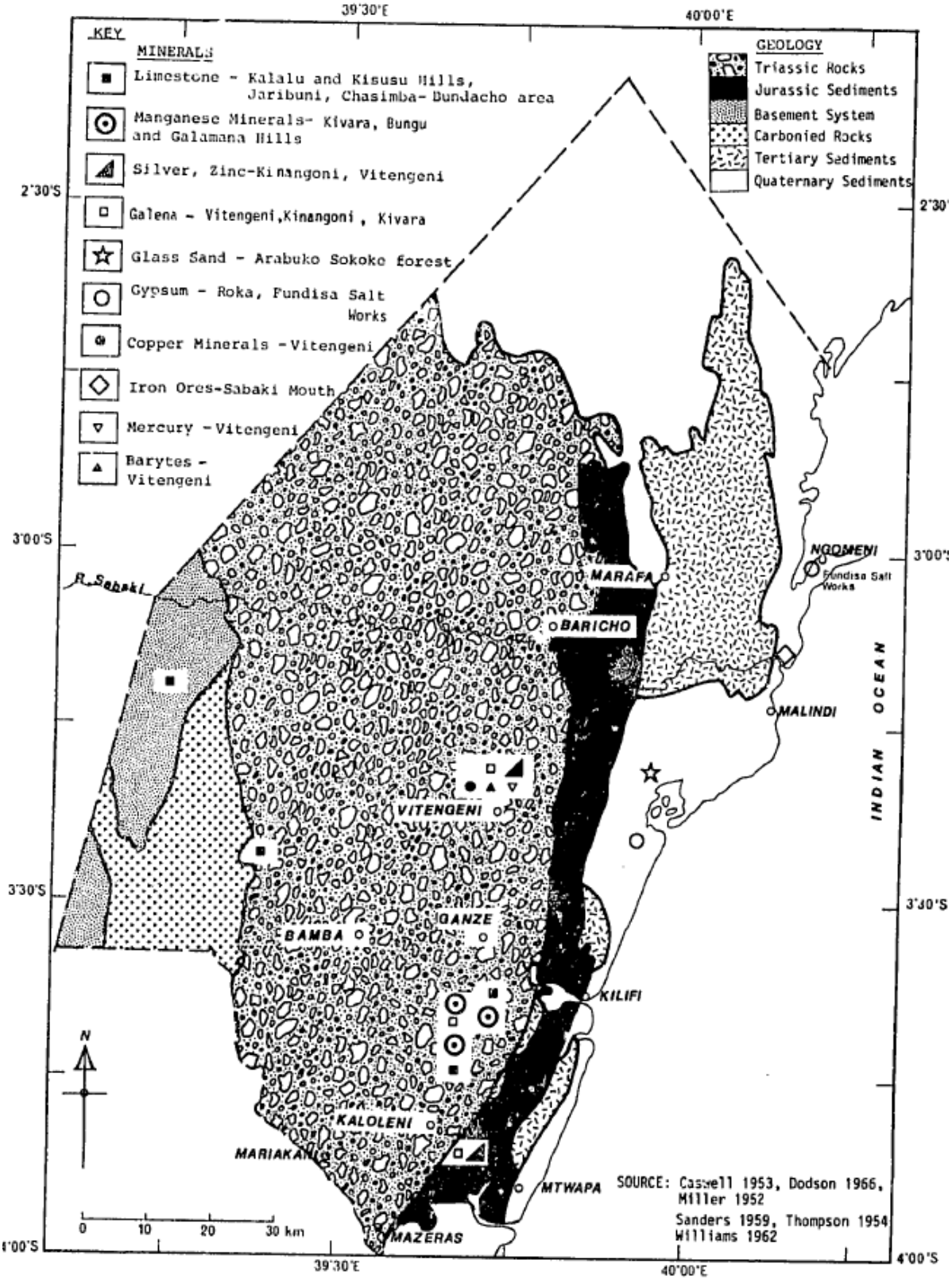


Figure 2-10: Geology and Minerals of Kilifi County

2.1.6.2 Detailed Geology

Basement System Rocks

These are represented in the western side of the county and are mainly grits, sandstones, shales and limestones that have been metamorphosed. The most abundant are gneisses and schists.

Sedimentary Rocks

These are composed of the Duruma Sandstones which are Triassic in age, except for the Taru grits which are in age Carboniferous.

The Duruma Sandstones can be subdivided:

(a) Mazeras Sandstone -coarse-grained sandstone with yellow to purple bands, deposited under continental lacustrine and deltaic conditions. They overly the Mariakani sandstones often with faulted contacts and contain,silicified wood. Outcrops are rare and indistinct -the exact boundary between the Mazeras and Mariakani sandstones is not very clear.

(b) Mariakani sandstone -fine-grained deltaic and lacustrine sandy deposits. They can be traced from Kaloleni westward to Gotani and further northward towards Bamba.

Jurassic Rocks

These include two types of rocks:

(a) Kambe Limestone -This is capped in several placesby reddish, clayey sands representing remnants of a former cover of magarini sands in the north the limestone forms a well-marked escarpment overlooking shales, with altitudes of about 180m and some deeply incised ballyes (Njora 120m, Ndzovurii 130m).

(b) Jurassic Shales -The shales attain maximum altitudes of approximately 120m and are very susceptible to erosion. Several watersheds at 75m have a flat-topped topography, due to magarini sands. These magarini sands once covered larger area, but as a result of erosion which es, only remnants can be seen. The Rare River is incised and has a broad flat valleys bottom showing small levees and backswamps.

Carboniferous Rocks

Consist of Taru grits, a monotonous series of sandstoneand shales, located in the southwestern area of the County.

Tertiary Sediments (Cainozoic Era)

These are ur marine-deltaic origin and consist mainly of marls, limestone, clays, sands, gravel, pebble beds, sandstones and conglomerates.

Quarternary Sediments

These are of Pleistocene (recent) era and occupy the areas immediately bordering the coastline. They consist of coral reefs, coral breccias, sandstones and sands of alluvial and marine nature.

Economic Minerals Minerals exist in the county, and some are currently being exploited.
Barytes are found in Vitengeni, gypsum west of Malindi at Roka, limestone east of Nariakani, and crude salt
near Ngomeni. Lead, zinc and silver exist near Kinangoni, manganese near Bamba, titanium near Malindi, mercury near Vitengeni, zircon north of Kilifi Township, and monazitebetween Kilifi and Mombasa.

2.1.7 Water Resource

Most of the Kilifi County lacks adequate surface and underground water resources (Figure 2-11). The Sabaki River is the only perennial river, originating in the central highlands. The other rivers and streams are seasonal due to a variety of reasons, including low rainfall in the interior, small catchment areas, sandy soils which have high infiltration and low runoff rates, and high evapotranspiration rates.

2.1.7.1 Surface Water

The Sabaki River in the northern part of the County is perennial. During the wet season, the river's floods are a hazard to settlements and crops in the flood plain and bring large amounts of silt from up country. Siltation of the beaches around Malindi and the coral reef has been a notable problem since the 1940s. The flow of water during the dry seasons is very low and the river is almost entirely maintained by Mzima Springs via the Tsavo River. The water of the Sabaki River is moderately coloured, soft, well mineralized and slightly alkaline with a seasonal PH range of 7.F to 8.2. The River containing a fair amount of organic -matter and there is substantial amount of algal growth during the dry period.

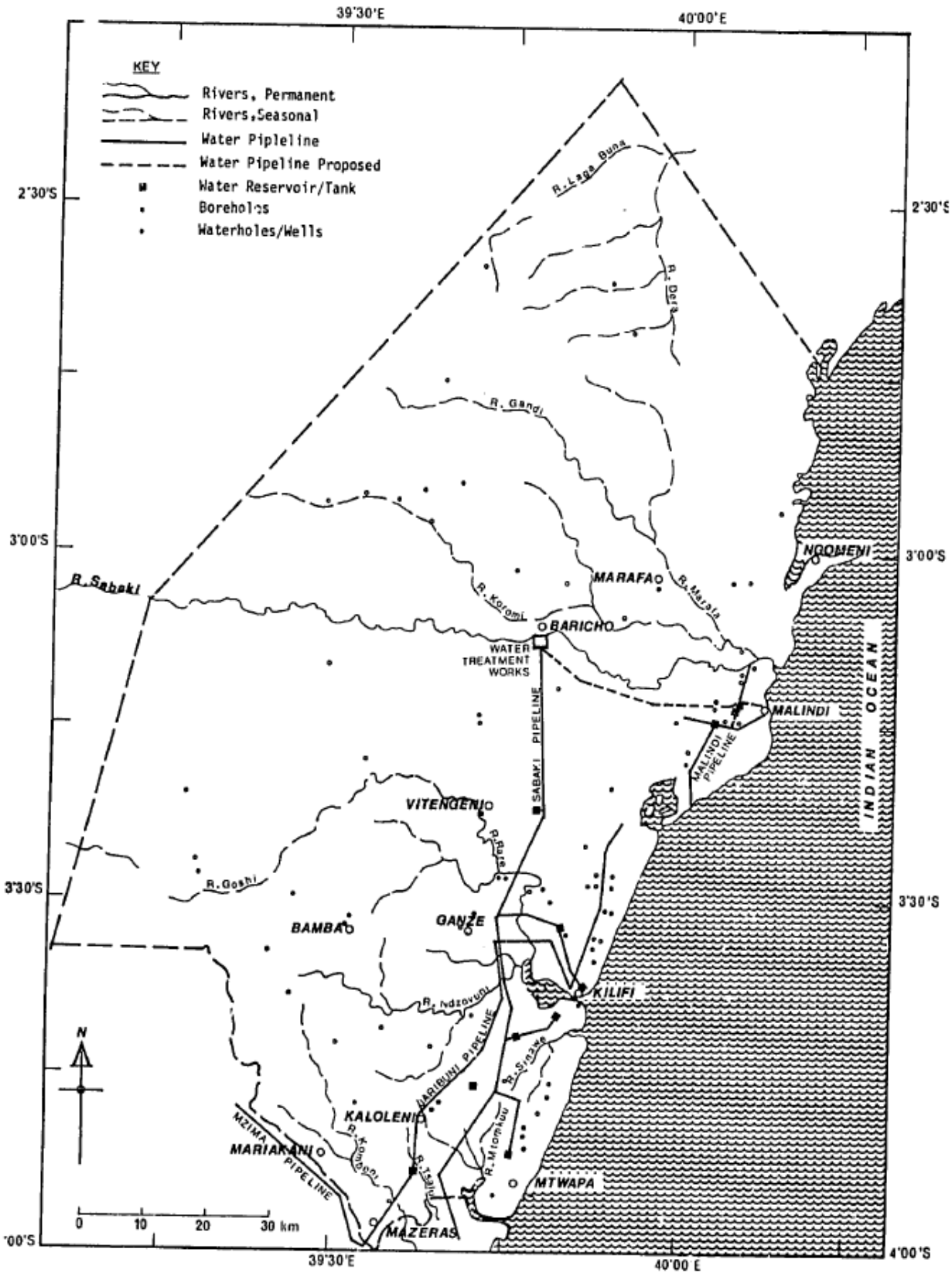

39°30'E
40°00'E
KEY
Rivers, Permanent
Rivers, Seasonal
Water Pipeline
Water Pipeline Proposed
Water Reservoir/Tank
Boreholes
Waterholes/Wells
2°30'S
3°00'S
3°30'S
4°00'S
R. Lagga Buna
R. Dera
R. Gandi
R. Sabaki
R. Kgromi
MARAFA
R. Marafa
NGOMENI
BARICHO
WATER TREATMENT WORKS
SABAKI PIPELINE
MALINDI
MALINDI PIPELINE
INDIAN OCEAN
VITENGENI
R. Rare
R. Goshi
BAMBA
GANZE
KILIFI
R. Mdzovuni
MARIBUNI PIPELINE
R. Sirazwe
KALOLENI
R. Komboni
MZIMA MARIAKANI PIPELINE
R. Tsalu
R. Miomuu
MTWAPA
MAZERAS
N
0 10 20 30 km

Figure 2-11: Water Resources of Kilifi County

The seasonal Goshi-Rare River is a continuation of the Voi River which originates from the Tiita Hills. The Rare River contains moderate amounts of organic matter and the water is generally hard and saline with a PH value of 7.2.

Other seasonal streams include Ndzovuni, Gandi, Wimbi and Mto Mkuu.

There are also numerous swamps and springs along the coastal plain and a few wet seasons ponds in the interior.

2.1.7.1.1 Galana River

2.1.7.1.1.1 Hydrology and catchment area

The Athi–Galana–Sabaki (A-G-S) catchment, the second-largest river network in Kenya, drains a total catchment area of 46 600 km^2. The headwaters of the A-G-S catchment are situated in central and south-east Kenya, in the vicinity of Nairobi city (Figure 1-7). The Athi River basin is drainage basin number three (3) of the Kenya's drainage basins and is about 540 km long. The river drains a catchment area of about 70,000 km^2 (66,837 km^2) representing 12% of Kenya's total land area. It is the second largest basin in Kenya after the Tana River drainage basin. Furthermore, the river traverses agro-ecological zones of diverse climatic characteristics and land use activities. The river draws most of its headwaters from the Kenya Highlands (Kikuyu and Ondiri springs) flowing through the dry and semi-arid lands of Kenya and discharging its waters into the Indian Ocean, north of Malindi town (Marwick et al., 2018).

In addition, the Kenya highlands are endowed with vast water resources but land use activity changes in these areas have led to water quality degradation in addition to affecting the flow characteristics of the rivers in the basin. Within the basin, there are two major urban and industrial centres from Kenya. Nairobi city, which lies at the upper catchment areas, and Mombasa, which is located on the southern outlet of the basin. Most of the upper-Athi river tributaries and the three main streams investigated (Ngong, Nairobi and Mathare) drain the Kikuyu escarpment through the city (now Nairobi County) and joining before the Kilimambogo hill (Donyo Sabuk) to form the main Athi-Sabaki River as shown in Figure 2-12. The mean annual run-off is about 1294×10^3 with annual rainfall of 550 mm translating to 19 m^3/s mean annual runoff for the whole basin.

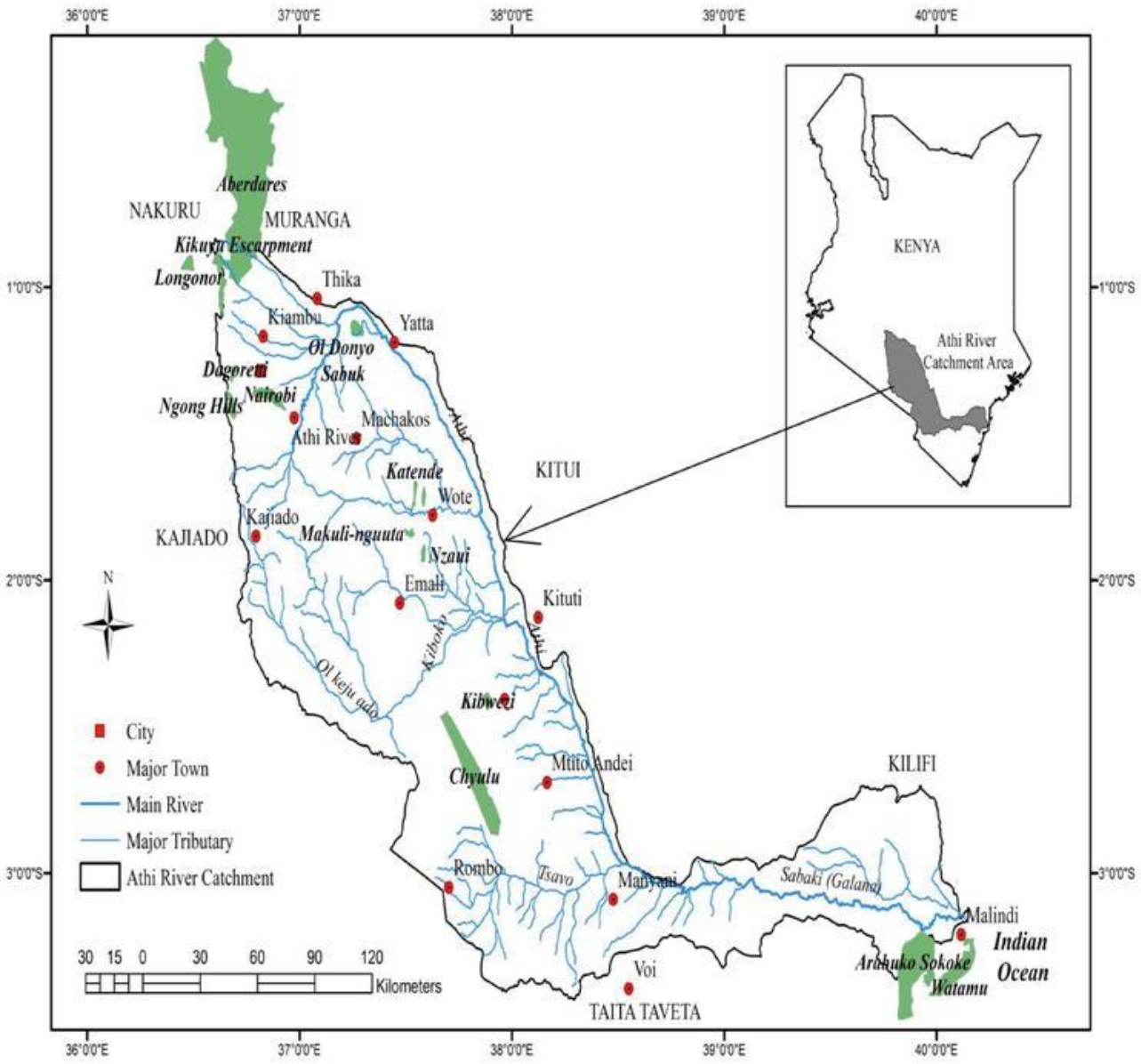


Figure 2-12: Athi-Galana-Sabaki-River Drainage Basin

2.1.7.1.1.2 Topography and population

The catchment basin varies in topography ranging from 2,600 m asl in the Aberdare Range to the sea level in coastal area. The basin covers three zones in altitude, with the upper zone at 2600–1500 m asl, middle zone at 1,500–500 m asl, and coastal zone at 500–0 m asl.

The population size based on the Kenya National Bureau of Statistics report Census 2019, population was estimated about 12 million people or 25.4% of the total population of Kenya with a population density of 167 persons/km^2.

2.1.7.1.1.3 Discharges

The discharges observed at the River Gauging Station (RGS) 3HA08 upstream of the project site inside Tsavo East National Park showed that Galana River receives high flows in the month of

April. In Figure 2-13 the peak discharge observed in the river channel in the month of April especially in 1979 and 1978 was approximately 3800 m^3/s and 3100 m^3/s respectively. The low flows were observed in the month of May, June and July with discharge ranging between 6 m^3/s and 15 m^3/s. The discharge observed at RGS 3HA12 presented in Figure 2-3 indicated that river discharges respond to the rainfall events. The average monthly available discharges observed in RGS 3HA12 portrays two peak months and low flow periods. The reduction in rainfall affects significant the river discharges. This also indicates that surface runoffs contribute a higher percentage of discharges compared to base flows from ground water discharge. The RGS 3HA13 located downstream of the project site.

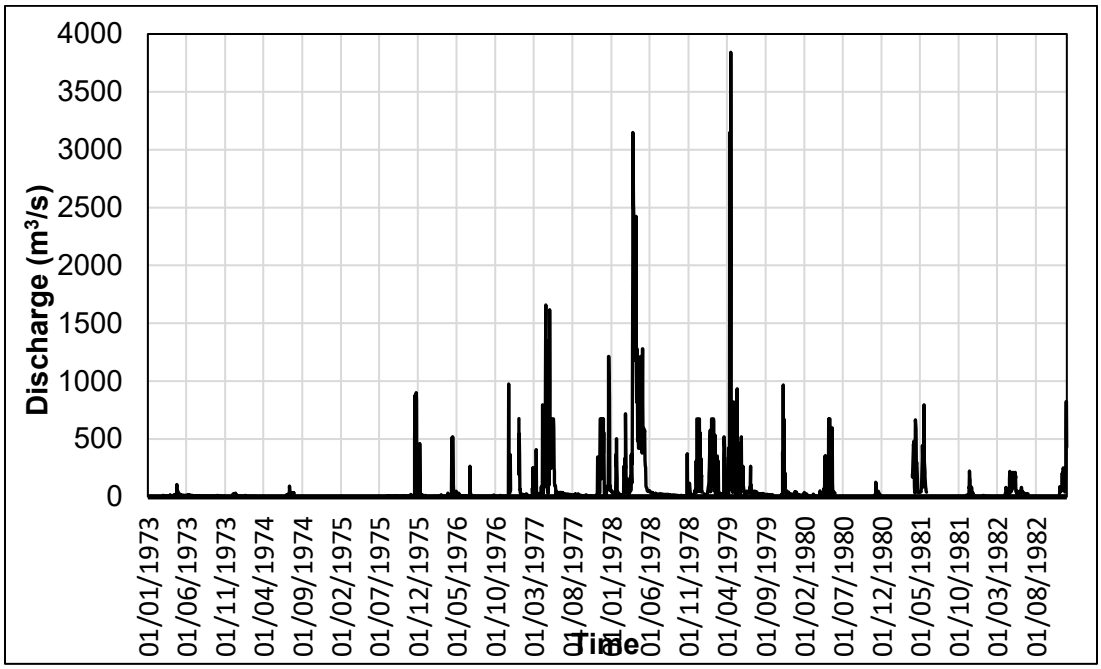


Figure 2-13: Time series for observed discharge at RGS 3HA08 in Galana River

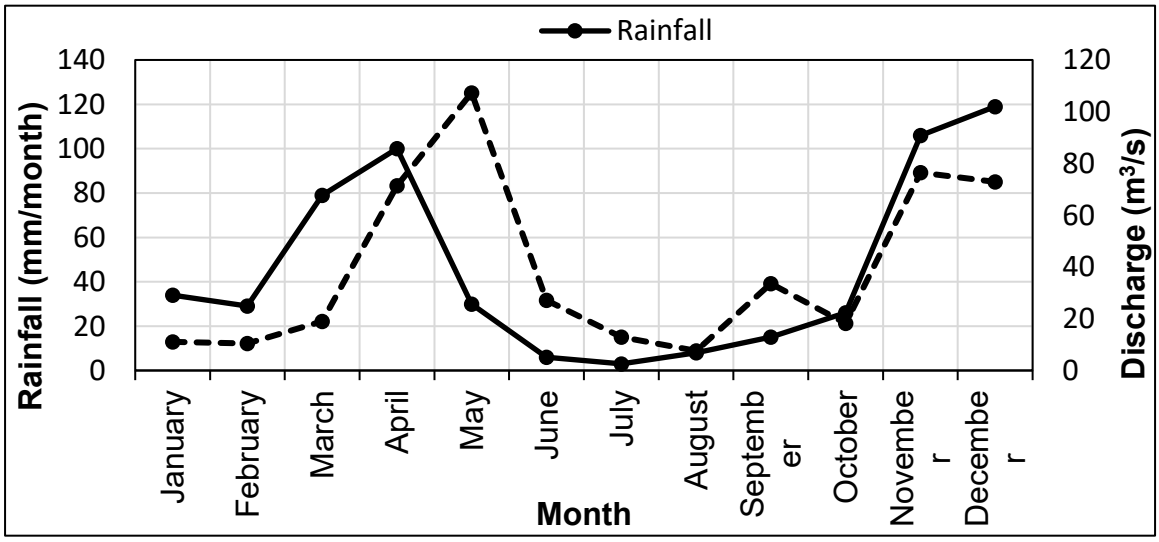


Figure 2-14: Monthly rainfall and average discharges observed at RGS 3HA12

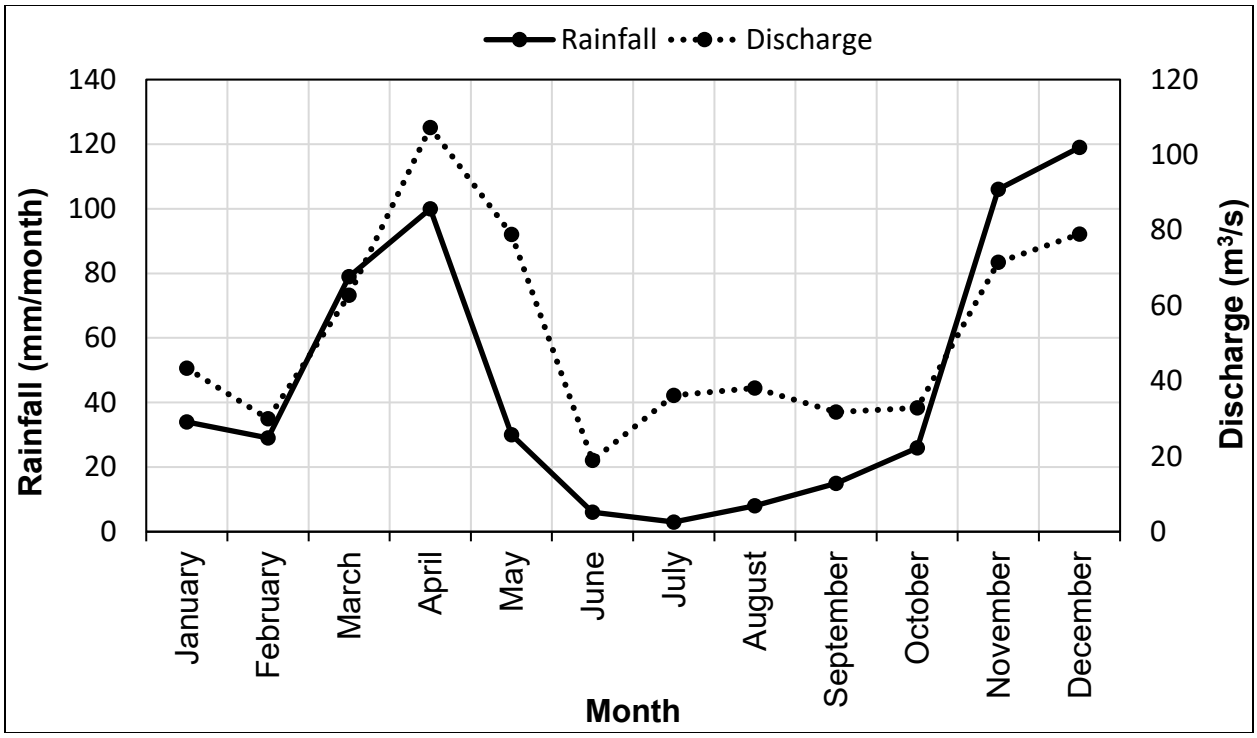


Figure 2-15: Monthly rainfall and average discharges observed at RGS 3HA13

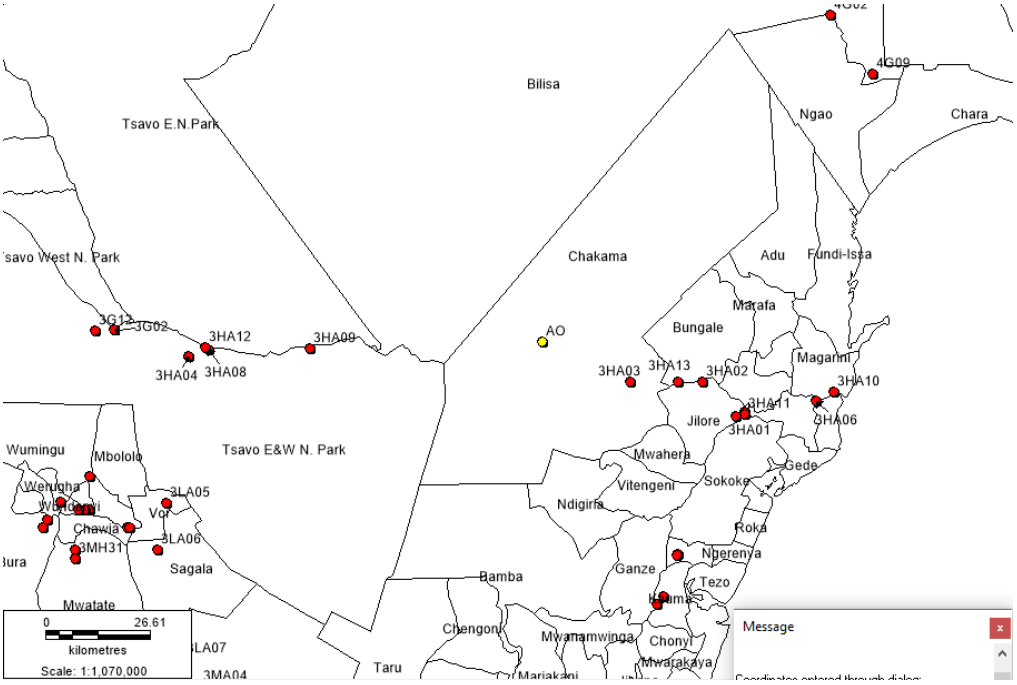


Figure 2-16: Map of coastal part of Kenya showing the project zone

2.1.7.1.1.4 Probability of exceedance

The analysis at RGS 3HA012 showed that at 95% probability of exceedance the Galana River has low flow rate of approximately 7.6 m^3/s. While at 70% probability time period, the river discharge was about 13 m^3/s. The highest river discharge of about 110 m^3/s occurs in less than 5% probability time period. This indicates that the available water in the river during over 95% of the dry periods

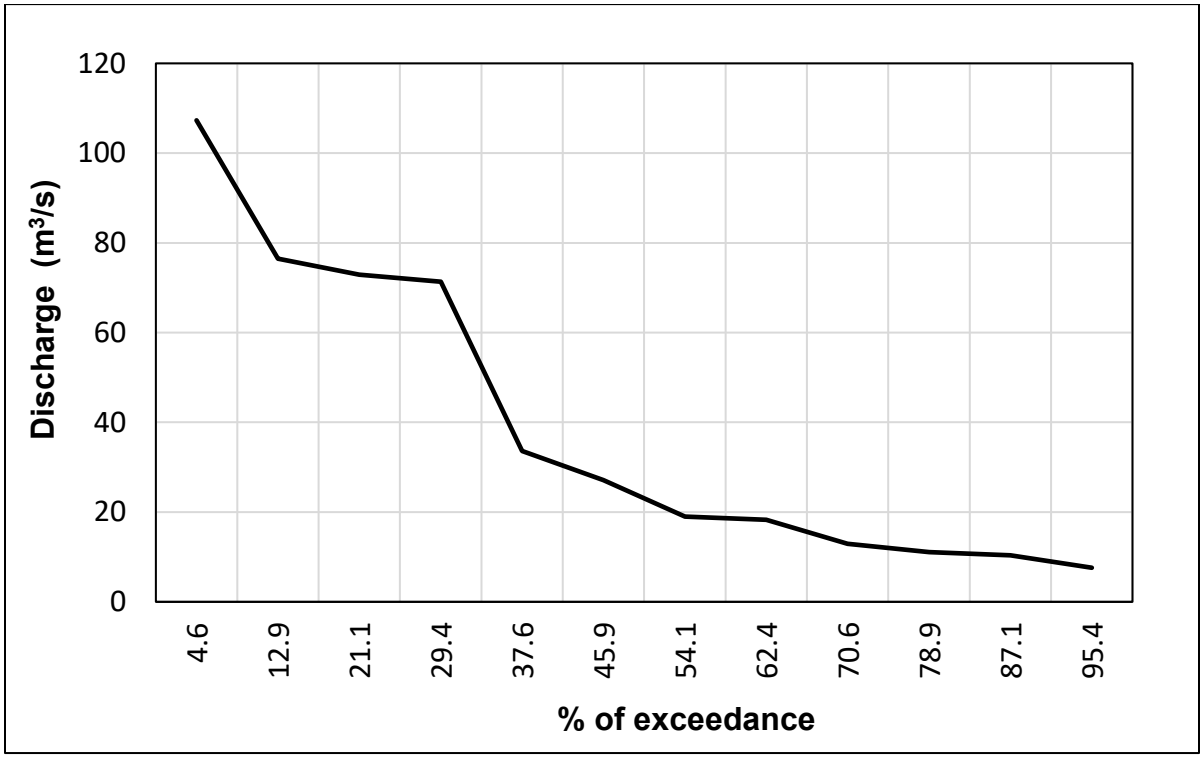


Figure 2-17: Flow Probability distribution at Athi-Galana-Sabaki RGS 3HA012

The analysis at RGS 3HA013 showed that at 95% probability the Galana River has low flow rate of approximately 18.9 m^3/s. While at 70% the river discharge was about 33 m^3/s. During wet season the peak flow at RGS 3HA013 was approximately 107 m^3/s and it occurs in less than 5% probability time period (Figure 2-18). The average river discharges at the upstream of the project site in location **Ao** shown in Figure 2-17 observed at RGS 3HA012 was 39 m^3/s. While at the downstream the average observed river discharges at RGS 3HA013 was 52.6 m^3/s. This indicates that at the downstream of RGS 3HA012 other tributaries join the Athi – Galana -Sabaki River raising the average river discharge to about 50 m^3/s.

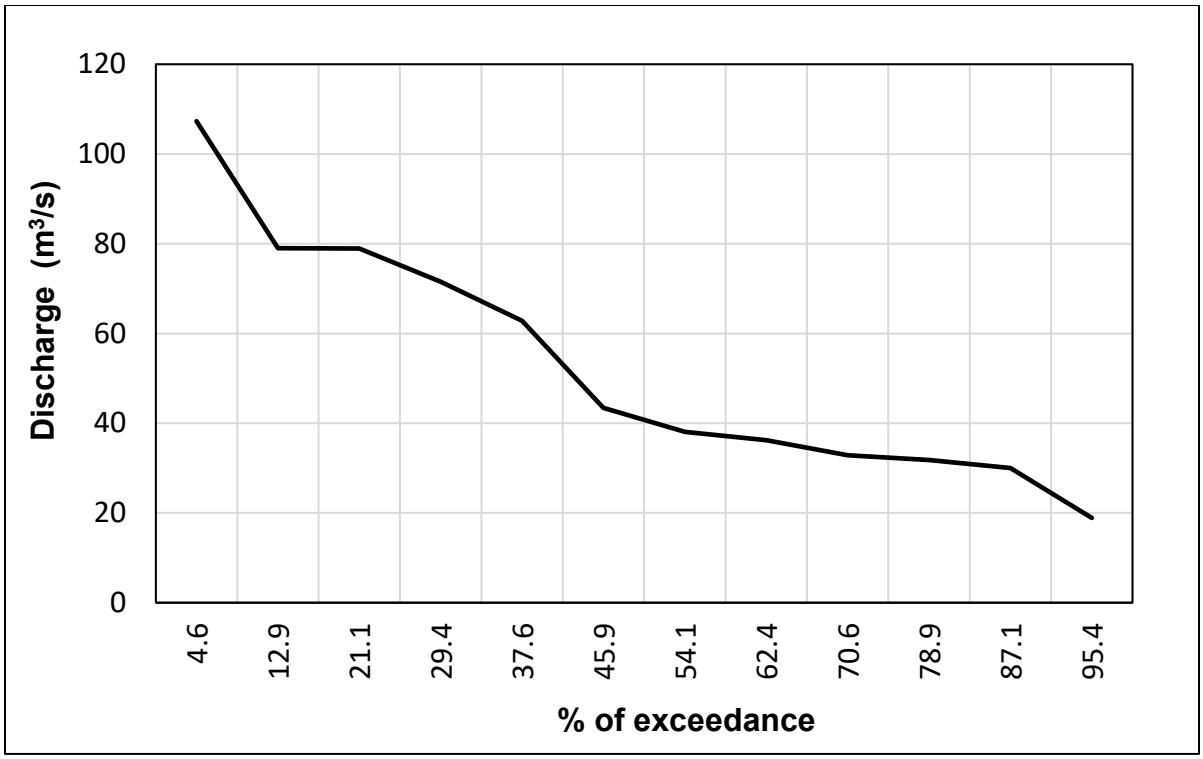


Figure 2-18: Flow Probability distribution at Athi-Galana-Sabaki RGS 3HA013

2.1.7.1.1.5 Water demands and balance

The project will be conducted in semi-arid part of the coastal region and water will be needed for irrigation. The amount of water required to irrigate the hundred thousand Hectare farm depends on the consumption of the crop type and duration of dry days. The estimated irrigation hours are 10 hours per day with design water abstraction of 40 m^3/s. This indicates that in a day the total amount of water required for irrigation will be 1,440,000 m^3/day. At the downstream of the project site water users' abstract water for irrigation along Sabaki River. Hence there is need to allow adequate flows downstream.

The results in section 2.4 Figure 2-17 indicated that less than 40% of the time the Galana River has discharges exceeding 40 m^3/s. This shows that there is need to have onsite storages for water to allow continuous irrigation of the crops during low flow seasons. The average discharge at the project is approximately 39 m^3/s while at the downstream is 52 m^3/s. Environmental flow rate should be at least 30% of the mean river flow. In Galana River the environmental flow should be about 15 m^3/s. The water balance for the Galana River at the project site was done using Equation 3. The outflow is the water balance for environmental flows and downstream water users. In Figure 2-19 it showed that 4 months in a year the water withdrawal can be done directly from the river to the irrigation site for use. While in 8 months there is inadequate flows in the river for daily use in the farm. This therefore indicates a deficit of water to meet irrigation demand at the project site for 243 days in a year. This results in total deficit of approximately 350 MCM per year. Therefore, there is need to install on-farm water storages which will be able to meet the deficit.

$$Observed\ flow\ at\ the\ project\ site - abstracted\ water = Outflow \quad (3)$$

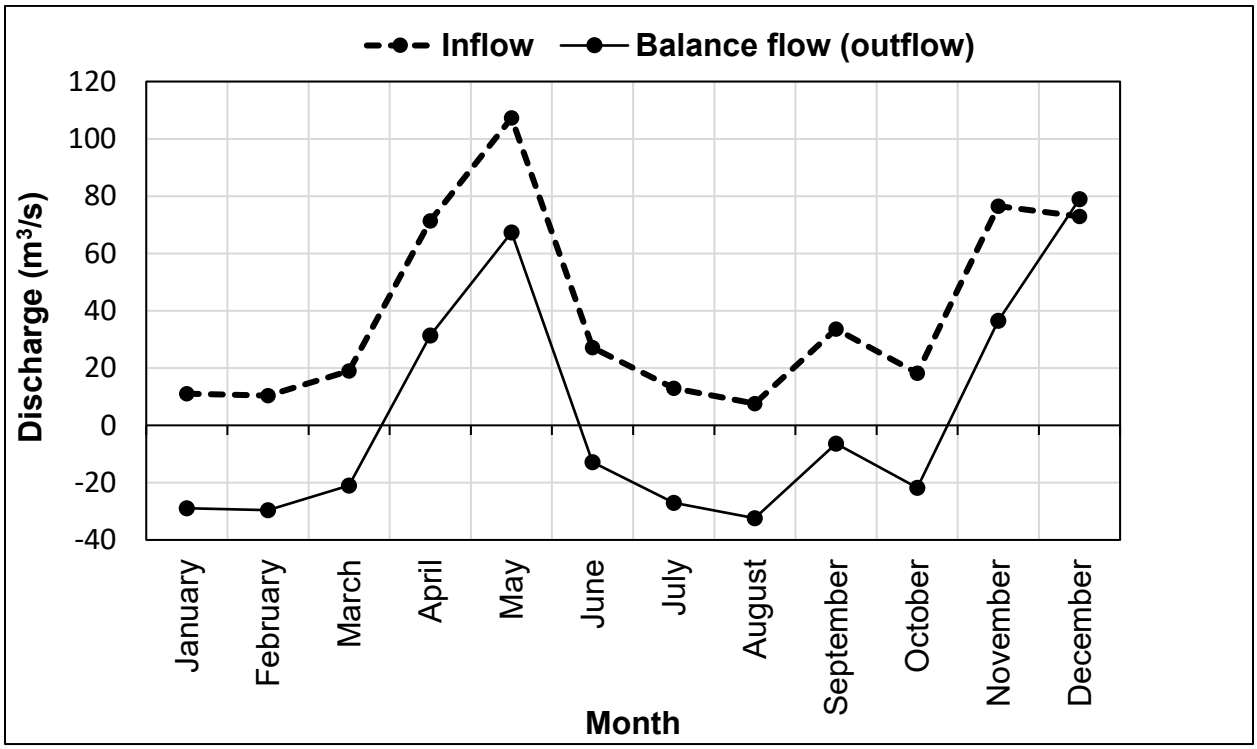


Figure 2-19: Monthly time series for the inflow and outflow from the project site after proposed abstraction point

2.1.7.1.1.6 Conclusion and Recommendation

The Galana-Kulalu project can be implemented given that during wet season (April, May, November and December) the river discharges in the Galana River are sufficient to be used for irrigation at the project site without interfering with the needs of the downstream water users. However, during the low flow periods (January, February, March, June, July, August, September and October) its recommended that the project owner (Selu Limited) utilized the water from its storages without abstracting river water at the intake works. This is due to the need of the downstream water users and environmental flows. Alternatively, the company can explore groundwater resources to boost the water availability.

2.1.7.2 Underground Water

There are numerous wells along the coastal plain since the water table is shallow. High-Vield boreholes along the coast have been successfully drilled. The average test yield of 9xisitng wells providing water of acceptable quality is 12m /hr. In the higher, dry hinterland the water table is usually deep. Although there are a few boreholes that have proved successful the yield from most boreholes is low, and many are dry. It is common for the underground water to be of unacceptable quality it is usually hard, highly mineralised and saline, and the quality deteriorates during the dry

periods. The low quality and scarcity of underground water has made water supply difficult, especially in the dry hinterland.

2.1.8 Availability & Accessibility of Physical Infrastructure

The state of physical infrastructure plays a major role in the attraction of investments which are in turn vital for employment creation.

2.1.8.1 Transportation Network

The Project area can be accessed through Voi or via Malindi. The road connecting the site from either Voi or Malindi is only gravelled and becomes impassable during rainy season. The drift linking the site to other areas is only passing. The main modes of access to the project area are broad and air. The level of road standards requires the use of four-wheel drive vehicles. The access roads in the Project area are generally graded and the running surfaces are in fairly good condition. Moreover, more grading works are on-going in the project area and more access roads being put up. Motorbikes have also been embraced as modes of transport in the area and are widely being used of late. According to the study, locals travelling far distances to Malindi and other towns take long to travel as the available buses plying Bombi-Malindi route make few trips in a week.

The connection between Kulalu and Galana is through a concrete raft across the river but this is only possible during the dry spell. During rains the river swells rapidly and the raft is submerged. This leaves the locals to devise own methods of crossing the river such as using electric cables. The available modes of crossing the river in the river are inadequate unreliable. Planning of the proposed Model Farm project must provide for construction of a number of permanent bridges at strategic points along Sabaki River. This would ease movement of people and especially school children across the river.

2.1.8.2 ICT Infrastructure

Access to information is a big challenge for residents in the project area. Modes of accessing information such as newspapers, internet and television are hardly available. There are two mobile phone network providers in the project area (Safaricom and Airtel). However, the networks in the area are poor. As per the study, majority, 87 per cent, of residents in the area own cell phones. There were a number of challenges identified in using alternative sources of information. These included high prices, inadequate sources of energy, poor communication networks for available providers, failure of radio waves and financial challenges.

2.1.8.3 Health and Education Infrastructure

More than half (55%) of households are more than ten (10) kilometers away from hospitals with in-patient facilities. While a little over a quarter are within a kilometer away from such a facility, about three quarter are still within about four kilometers or farther from higher level medical infrastructure and care. Also, one in every four household has no information about their access to hospitals with in-patient facilities Figure 2-11 has a summary of the physical access to selected social infrastructure.

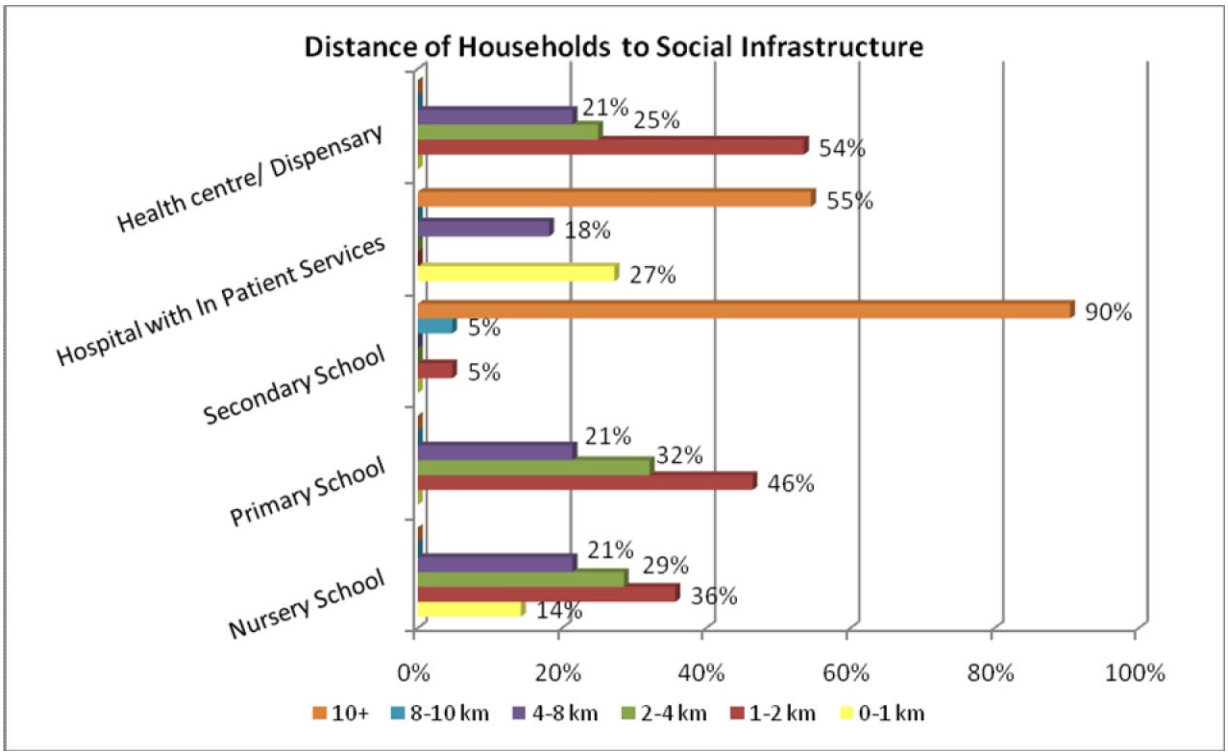


Figure 2-20: *Access to Social Infrastructure*

2.1.8.4 Water and Sanitation

Almost 90% of all households source their domestic water requirements from rivers or streams whereas the rest use rain water. The average household travel a kilometer or less to get water from these rivers and streams (Figure 2-12).

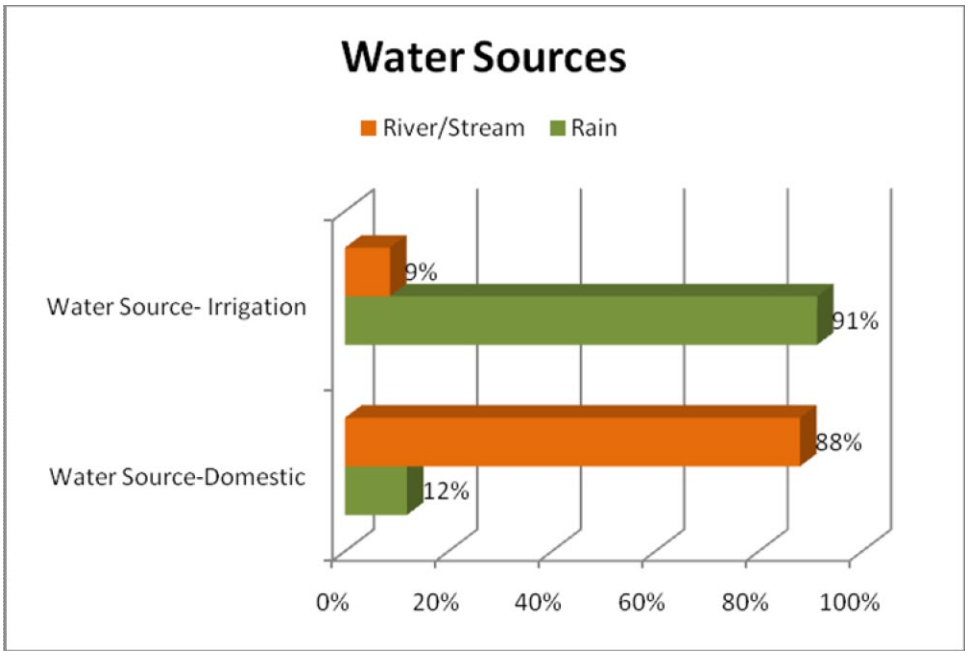


Figure 2-21: *Water Sources*

Rain water and rivers and streams are also the main sources of water for crops and livestock. As with water for domestic use, nine out of every ten households use the rivers and streams as sources of water for crops. Households have to travel about 0.7 kilometers to get water for their crops.

2.1.8.5 Water and Sewerage Network

There is no water and sewerage networks within the project area. Water pipes will be key trunk infrastructures in order to deliver the required amounts for irrigation and are therefore designed within the Model Farm.

2.1.8.6 Solid and Liquid Waste Management

Burying, burning, composting and community garbage collection are the main methods of solid waste disposal in the area. Still, two (2) in every five (5) households burn their solid waste while one in every five either bury or burn (Figure 2-13).

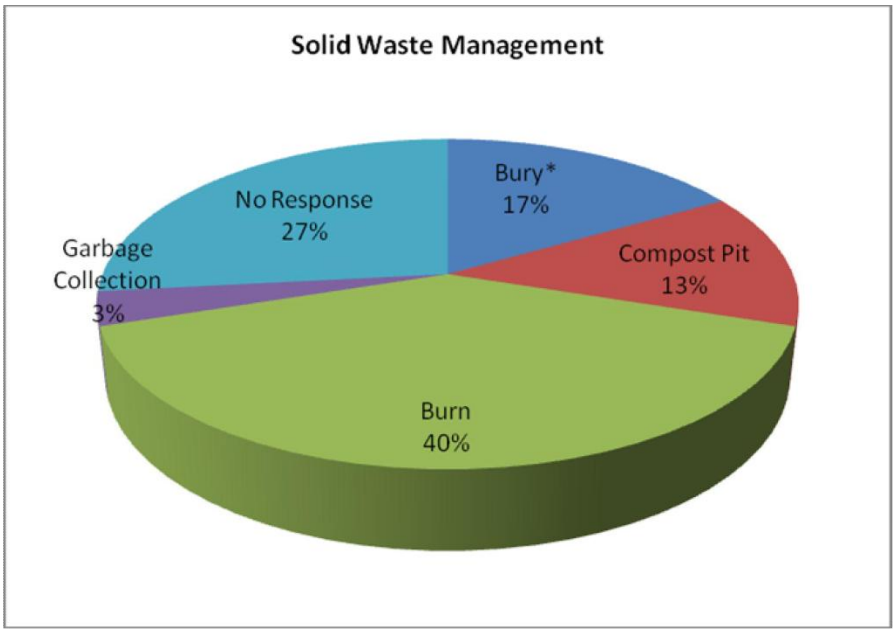


Figure 2-22: *Solid Waste Management*

However, in this case, it is possible that the community interprets solid waste in the context of human fecal matter. In this case, all households use the burying method.

2.1.8.7 Housing Characteristics

The nature of housing and the materials used for them are proxy indicators of affluence and living condition. In the project area, almost all of dwellings (96%) of houses have mud walls and 4% are brick walls. Meanwhile, more than three quarters of houses have grass roofs and a quarter (23%) is roofed with corrugated iron sheets (see Figure 2-14 and Figure 2-15).

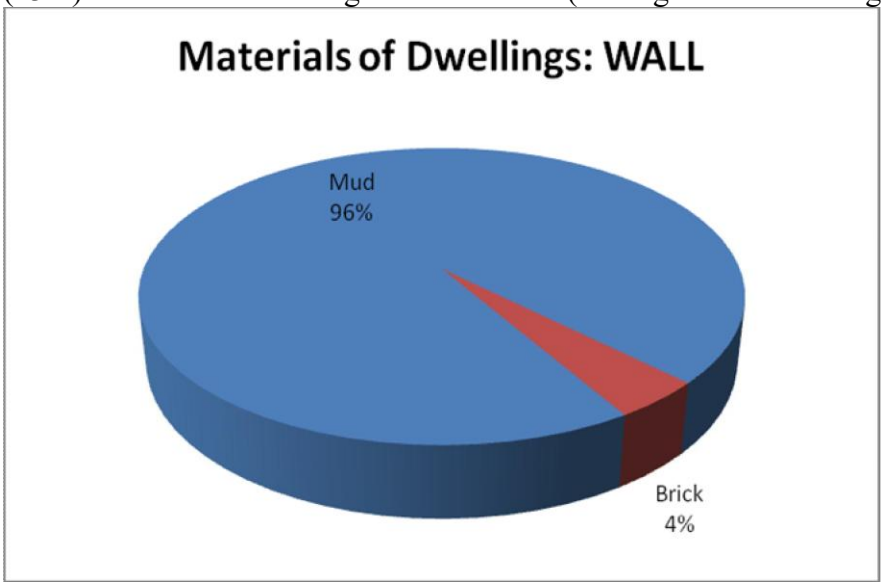


Figure 2-23: *Building Material Walls*

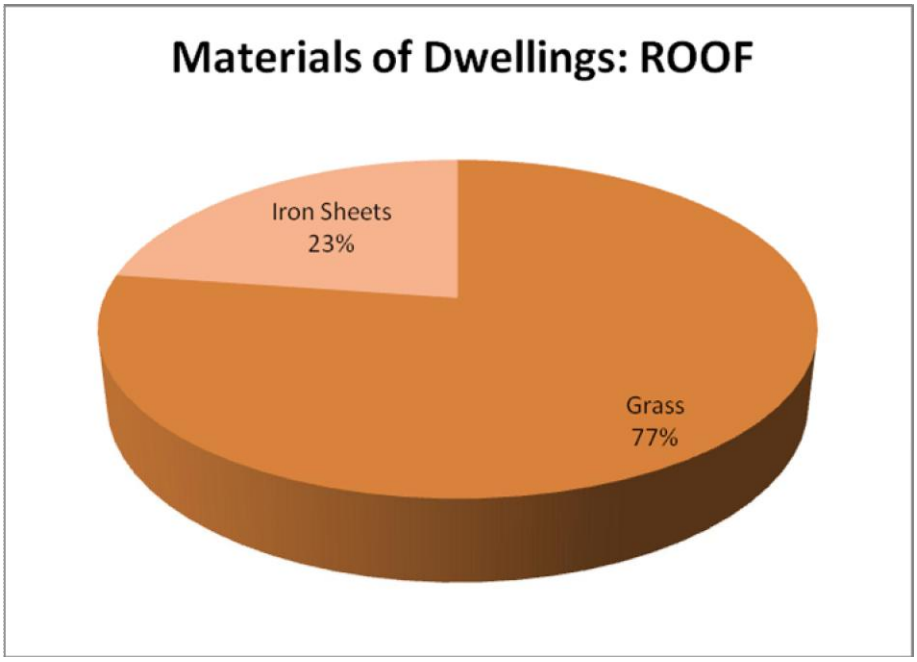


Figure 2-24: *Building Material Roof*

2.1.9 Economic Analysis

Subsistence farming, which is characteristic of the surrounding areas, is the prevalent mode of economic activity in the area. Currently, 96% of residents are farmers with main activities being pastoralism and peasant agriculture. Four percent (4%) of residents are tour guides, a situation expected to be changed once the project is initiated. Figure 2-16 shows that only 30 of the respondents live within the ranch.

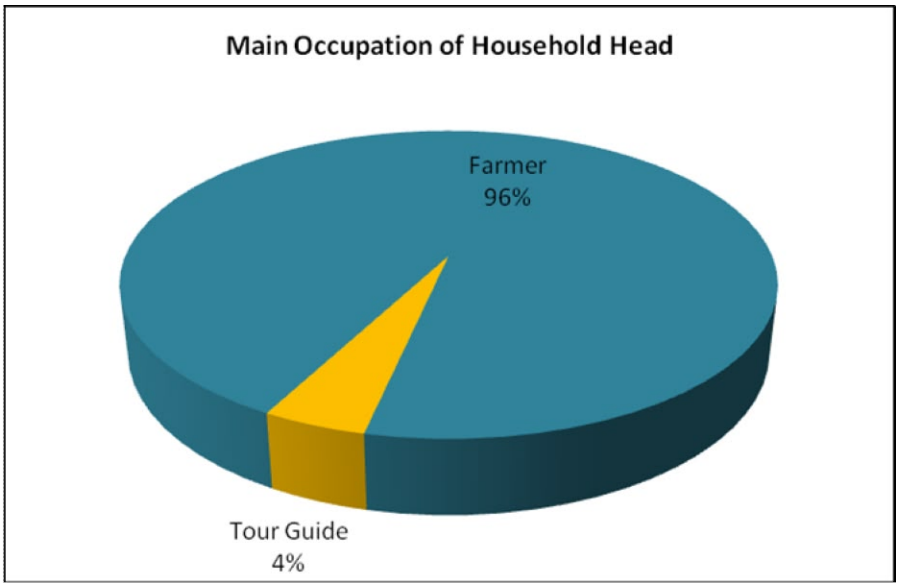


Figure 2-25: *Occupation*

2.1.10 Land use

2.1.10.1 LAND TENURE

Land in Kilifi is under several ten-re systems: previously registered land, trust land being adjudicated, state land for settlement, group ranches and government reserves (Table 2-5 and Figure 2-26).

Table 2-5: Land Tenure in Kilifi County

	km^2
Government land	5,043
Freehold land	233
Trust land	498
Registered land	511
Unregistered land	6,238
Area of water	109
TOTAL	12,632

SOURCE: Central Bureau of Statistics, 1981

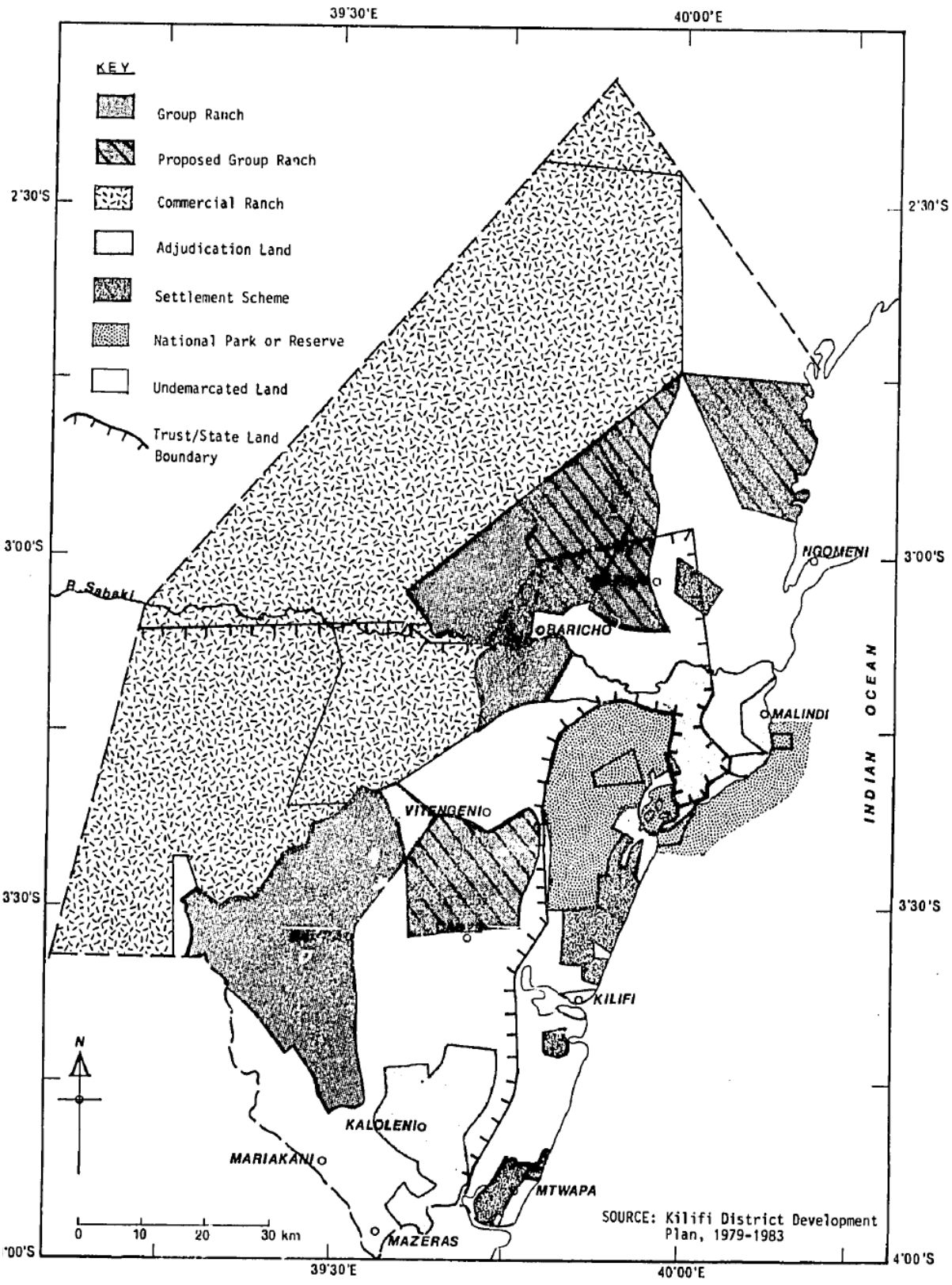


Figure 2-26: Land Tenure in Kilifi County

2.1.10.1.1 Registered Land

The registered land is mainly in the Coastal Belt which was occupied by Arabs and ruled by Sultan of Zanzibar before Kenya's independence.

Large parcels were registered by Arabs an6 Indians, although few of the owners now remain in Kenya.

The British and Kenyans have honored these title deeds andthe local people, mostly Giriama who have settled on this land are regarded as squatters. Although they have rights of usufruct, title deeds which prove ownership have not been systematically surveyed. Except for the few who now have registered title deeds from trust lands, most will be considered squatters until the land can be adjudicated under the Registration and Adjudication Act.

Some squatters have bought land from Arab and Indian owners and received title deeds but due to this early Registration Law, there are no schemes for land reforms. The policy over the long-term is to allocate plots to the residents although absentee land owners are a constraint.

2.1.10.1.2 Trust Land

Trust land is mostly in the high agricultural potential zone, and has a high population density. Earlier people used to farm this land under customary tenure but the Government's aim is to adjudicate and register all the Trust land and givetenure to individuals under the Land Adjudication Act.

2.1.10.1.3 State Land (Settlement Land)

The Government has established settlement schemes in Sokoke, Tezo/Roka, Vipingo, Mtwapa and Magarini etc. To the North-West there are group ranches and the Galare Game Reserve.

The group ranches are adjudicated and registered under one title deed and are communally utilized. In the settlement schemes people are issued with temporaryoccupation licences (certificates) which cannot be used to secure loans for farm development. Other state lands include the forest reserve, parks and Galana Game Ranch.

2.1.10.1.4 Unregistered Land

Traditional land tenure in Kilifi includes inheritance of the unadjudicated crop land by families in succession. There is little crop land free for occupation to which these principlesdo not apply. Newcomers borrow or rent land under a wide rangeof rent arrangements. Tree crops are subjected to leasing arrangements quite distinct from that of the land.

2.2 Biological environment

2.2.1 Background

Galana and Kulalu Ranches form the eastern frontier of the Tsavo Conservation Area, spanning some 2 million acres. While a map demarcates them as distinct landscapes, they share an unfenced border with Tsavo East. To any roaming elephant, lion, leopard, or giraffe, the ranches are indistinguishable from the national park they neighbour.

Not so long ago, in the grand scheme of Earth's history, our planet belonged to nature. There were no borders or boundaries, just vast open space that stretched from ocean to ocean.

Those days have long passed. Now, national parks, reserves, and protected areas are the last remaining sanctuaries for wildlife. No longer is untouched land the default, but the exception.

Here in Africa, Kenya is known for its commitment to conservation. The country is home to 27 national parks, 34 national reserves — yet collectively, these make up just 8 per cent of Kenya's land. However, there are also increased initiatives to secure wilderness outside national parks and reserves. In an effort to further protect important landscapes, conservancies have been formed, along with other creative conservation projects. These dedicated spaces for wildlife are vitally important — and, in an age of relentless development, their existence must never be taken for granted.

I often say that Kenya's national parks and reserves are the beating heart of its natural world. But what is a heart without its arteries? No wilderness should be an island; elephants and other animals don't understand the distinction between land that has been designated for them and land that is no longer their own. They are driven by something far more ancient and innate, following migratory paths that have been etched through the generations.

Thus, the importance of buffer zones, wildlife corridors, and dispersal areas. They increase protected land and link habitats across the country, expanding rangelands and ensuring that migratory species, such as elephants, can travel between cradles of life. They also remove pressure from park borders, creating soft transition buffer zones that give wildlife a larger cushion from human settlements.

In today's increasingly developed world, most buffer zones are small-yet-vital pockets of land. But on the eastern frontier of the Tsavo Conservation Area sits a behemoth. Galana and Kulalu Ranches stretch along almost the entire eastern boundary of Tsavo East, collectively covering 2 million acres that extend towards the coast. They are stacked on top of each other and bisected by the Galana River, with Galana Ranch to the north and Kulalu Ranch to the south. It is important to note that they share an unfenced border with Tsavo East, meaning wildlife can roam freely between the park and the ranches. Like their neighbour, the ranches provide vital habitat for all manner of species, including elephants, lions, cheetahs, giraffes, wild dogs, leopards, and plains game.

Both Galana and Kulalu Ranches are managed by the Agricultural Development Corporation, a parastatal that oversees sustainable agriculture development in Kenya. Galana and Kulalu were always intended to be mixed land use, with selective ranching activities that are complementary to conservation efforts. However, it is a vast landscape, and ADC lacked the resources to focus on the conservation aspect. Over the past 40 years, the landscape had become increasingly hostile, overrun by illegal activities such as poaching, charcoal burning, and livestock incursions. The eastern frontier of the Tsavo Conservation Area — Kenya's largest protected wilderness — was in peril.

Our efforts in Galana began in May 2021, when we were asked to assume management of Galana Wildlife Conservancy by its board of directors. Spanning 60,000 acres, the dedicated wildlife conservancy sits within Galana Ranch and was struggling with the same challenges that plagued the wider landscape. Galana Wildlife Conservancy is an important area. Fully protected for conservation, it is essentially a continuation of Tsavo East. Insecurities in Galana affect not only the conservancy, but also the national park. Galana Wildlife Conservancy is also a favoured tourist destination, with game roaming seamlessly between the two.

Everyone quickly realised, however, that to truly secure Tsavo's eastern frontier, we needed to work across Galana/Kulalu as a whole. As we continued to build upon our conservation work in Galana Wildlife Conservancy, we also agreed upon a second arrangement with ADC, in which the Sheldrick Wildlife Trust manages the conservation mandate of Galana and Kulalu Ranches.

From KARI Ranch to the Kibwezi Forest, we are no strangers to prodigious undertakings — but even by our standards, Galana/Kulalu was daunting. Over the past decade, illegal activities had taken hold across the landscape. Bushmeat poaching had reached rampant levels; poachers saw it as open season across the ranches, killing scores of creatures for the commercial bushmeat trade. This, coupled with illegal cattle incursions from the north and widespread charcoal burning, degraded the land and created a hostile environment for wildlife.

Our goal is to turn Galana/Kulalu into a flourishing wildlife habitat once more. Our first move was to establish a field base at Lali, which would serve as our hub in the landscape. Bushland dominates the ranches, stretching endlessly into the horizon. The Lali Hills, which sit at the heart of Galana Wildlife Conservancy, offer one of the few elevated vantage points. With 360-degree visibility, the camp is in prime position to spot disturbances in the land unfolding around it. We also graded Lali airstrip and based a plane there to support field operations.

Given the pervasive threat of bushmeat poaching, we placed great emphasis on targeted patrols. We began by rotating our existing Anti-Poaching Teams into Galana/Kulalu. As the year progressed, we established four Anti-Poaching Teams that are permanently based in the ranches. They are supported by the 18 SWT/KWS Anti-Poaching Teams who are already working within the Tsavo Conservation Area. Fully equipped, their collective manpower has proven to be a formidable presence. Each recruit goes through intensive training and then hits the ground running.

Arresting poachers requires a constant change of tactics, as they continue to adapt their nefarious strategies. The teams have logged countless hours on the ground, understanding perpetrators' favoured routes and routines. For targeted operations, the Canine Unit is brought in to track down perpetrators. Extensive aerial patrols bring a new dimension to our anti-poaching efforts, ensuring no corner remains unsurveilled. The dedicated Galana/Kulalu plane flies over 50 hours each month.

Already, we have witnessed a decline in poaching on Galana/Kulalu. The teams have spearheaded many significant arrests — each one a sobering reminder of the devastating effect that poaching has on wildlife populations. Over the course of a two-day ambush in February, four people were arrested, and eight motorbikes (the favoured vehicle of poachers) were confiscated. The scale of their bushmeat haul was staggering: 142 dik-dik, three gerenuks, three bustards, two kudus, two

hares, and one warthog were retrieved. To harvest such a bounty, they employed the lamping technique. On moonless nights, animals are blinded by bright lights and frightened by bicycle bells. As they stand, stock still and startled, the poachers make their move. When one considers that this level of poaching once went unchecked, one begins to understand how poaching can decimate even the most significant wildlife populations and disrupt the entire food chain.

Faced with a prolonged dry season that evolved into a brutal drought, we have focused significant resources on water projects across Galana/Kulalu. We installed a borehole at Lali, which supplies both the teams in situ and local wildlife, and upgraded dams and watering points. To support animals through the current drought, a watering team harnesses water from the Galana River to keep the banks green and viable. We also provide supplemental lucerne and range cubes to more than 45 hippos who would otherwise be at risk of starvation.

Just as wildlife feel the effects of the drought, so do rural communities bordering conservation areas. Building on our successful school feeding program in the Tsavo Conservation Area, we secured funding to expand the program to Galana/Kulalu, providing daily lunches to 900 students from four local schools.

Like the rest of the Tsavo Conservation Area, Galana/Kulalu is a challenging landscape even in the best of times. The drought has taken it to a new level. Field emergencies have become an everyday occurrence, from orphan rescues to veterinary treatments. These are difficult, heart-wrenching operations — but they are often full of hope.

I immediately think of a recent mission to rescue a large elephant from the drying mud of Harawa Dam. Day turned into night, and still our team, working alongside KWS and ADC rangers, struggled to excavate the elephant. It wasn't until 10 PM that they finally succeeded. Just as the team pulled the bull to solid ground, a wild herd arrived at the water's edge. The rangers swiftly retreated so the herd could drink in peace. Instead, the elephants gathered around the recumbent bull and helped him to his feet. Together, they disappeared into the darkness. It was an incredibly humbling reminder of all that is great about our wild world.

2.2.2 Galana Conservancy

This 60,000-acre wildlife haven for some of the world's most renowned and rarest African wildlife species is situated on the eastern boundary of Tsavo East National Park and on the northern banks

of the Galana River.

Photos 2-1: Galana Conservancy, 2hrs from Watamu

The Galana Conservancy is one of Kenya's real wildlife treasures, offering a truly personal experience of the African bush.

The principal objectives of the GWC include: Conservation of the natural environment in partnership with local communities. A robust community development policy.Agricultural and pastoral development in harmony with wildlife conservation. Conservation of water catchments and natural waterways. Conservation and expansion of the natural flora with a view to benefiting the present and future generations of the Kenyan nation.The development of international partnerships to advance education and the academic opportunities of the surrounding communities.

The rough arid terrain of the Conservancy is one where only the strongest survive, and yet this area was a hugely successful working Game Ranch run by the Galana Game Management Scheme in the last quarter of the nineteen hundreds and has been feted as a prototype for modern ranching where game and cattle are run together.

This scheme spanned the same total landscape comprising 3,000 square miles of unspoilt and largely empty scrub land. This not only provided a safe environment for the wildlife to roam free, but also provided limitless vegetation for the Boran cattle kept at the ranch. The infrastructure that was built around the ranch was dynamic, adaptable and purposeful. 2000km roads were constructed, constantly graded and maintained through the rainy season. Several dams were built to catch the intermittent and very short life giving rainfall in the region to the benefit of both the cattle and the wildlife. Over a dozen airstrips were constructed, along with management and ranger outposts, to protect the animals and cattle in the Ranch.

The residents that do not need to drink daily and so canstay further away from the river throughout Dik, Oryx and Giraffe during the dry season. These include animals such as the majestic Lesser Kudu, Peters Gazelle, Gerenuk, Dik-.

The Migrants who need daily water include Buffalo, Eland, Zebra and the Elephant feast on the bloom of grasses and shrubs that follows the short but torrential rainy season and who come to the mighty Sabaki river to quench their thirst.

2.2.3 Tsavo East National Park

Tsavo East National Park is a national park in Kenya with an area of 13,747 km(5,308 sq mi). It was established in April 1948 and covers a semi-arid area..

Tsavo National Park was officially gazetted as a wildlife refuge by Kenya's colonial government in 1949. It was by no means the best wildlife region in Kenya, but rather the only sizeable piece of country that was largely uninhabited by humans. It was too arid for agriculture, infested by tripanosomiasis-carrying tsetse fly which precluded livestock practices –a hot and inhospitable arid bush scrubland simply know in the early days as the Taru desert.

It was, however, home to a sizeable elephant and rhino population, some 45,000elephants in the 16,000 square-mile Tsavo ecosystem (twice the size of the park itself which was 8,000 square miles). It was home to some 8,000 black rhinos as well.

Human population pressures beyond the boundaries of the park deprived elephants of much of their original habitat, so additional elephant pressure was onthe park proper, impacting the wooded scrubland which was gradually being transformed to open grassland, that was beneficial to grazing species but not tolarge browsers such as elephants and rhino. The changes in the habitat adversely affected the elephants who underwent a natural die off in the early 1970's whereby nature targeted the females and their young creating generation gaps that put the population into further long term decline. (The artificial culling of entire elephant family units as practiced in southern Africa had the opposite effect – relieving pressure on the land but leaving remaining units intact so the breeding rate went up with the result that artificial culling of elephants was accepted as management practice).

Illegal poaching for ivory also exacted a heavy toll and today on some 11,000elephants remain within the Tsavo greater ecosystem which once accommodated45,000. (Indeed elephants as a species are facing ultimate extinction -- more being killed throughout Africa on a daily basis then are being born). Rhinos now only exist in highly protected fenced sanctuaries and the price of their horns is five times that of gold per ounce. The horns are erroneously believed to have magical healing properties in the Far East despite being comprised of the same substances a fingernail. As long as the demand for ivory persists in the Far East (China and Vietnam being the main culprits), elephants will continue to be annihilated for their ivory teeth and rhinos for their keratin horns.

Figure 2-27: Location of Tsavo East National Park

Tsavo East National Park is a national park in Kenya with an area of 13,747 km2 (5,308 sq mi). It was established in April 1948 and covers a semi-arid area previously known as the Taru Desert. Together with the Tsavo West National Park, it forms an area of about22,000 square kilometers. The Tsavo River flows west to east through the national park, which is located in the Taita-Taveta County of the former Coast Province.

2.2.3.1 Geography

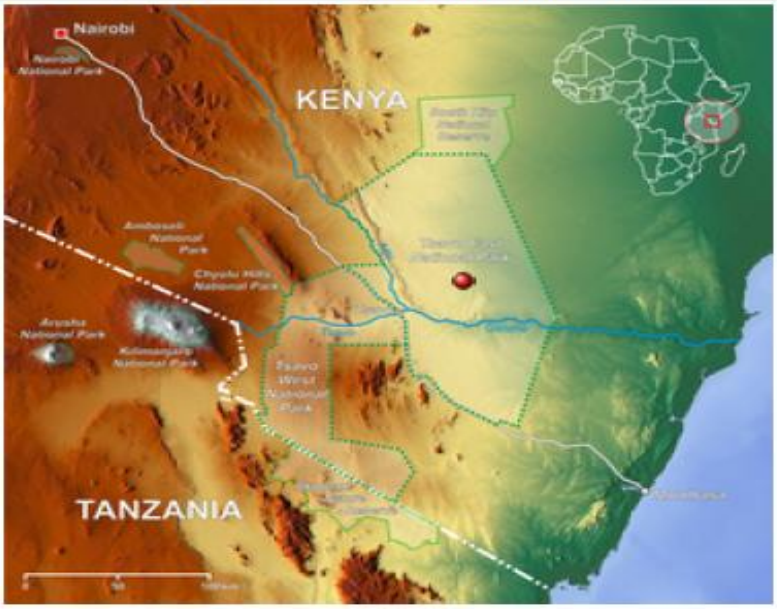
Tsavo East National Park is generally flat, with dry plains across which the Galana River flows. Other featuresinclude the Yatta Plateau and Lugard Falls.[1] Inside Tsavo East National Park, the Athi and Tsavo rivers converge to form the Athi-Galana-Sabaki River. Most ofthe park consists of semi-arid grasslands and savanna.

The Yatta Plateau, the world's longest lava flow, runsalong the western boundary of the park above the Athi-Galana-Sabaki River. Its 290 km (180 mi) length wasformed by lava from Ol Donyo Sabuk Mountain.[3] TheMudanda Rock is a 1.6 km (0.99 mi) inselberg ofstratified rock that acts as a water catchment that suppliesa natural dam below. It offers an excellent vantage pointfor the hundreds of elephants and other wildlife thatcome to drink during the dry season. Lugard Falls, named afterFrederick Lugard, is a series of white water rapids on the Athi-Galana-Sabaki River. Aruba Dam was built in 1952 across the Voi River. The reservoir created by the dam attracts many animals and water birds.

Tsavo West National Park is more mountainous and wetter, withswamps, Lake Jipe and the Mzima Springs. It is known for birdlife and for its large mammals. It is also home to a black rhino sanctuary.

Tsavo East National Park

IUCN category II (national park)



Location of Tsavo National Parks

Location	Kenya
Coordinates	2°46′43″S 38°46′18″E
Area	13,747 km^2 (5,308 sq mi)
Established	1948
Governing body	Kenya Wildlife Service

Figure 2-28: Geographical location of Tsavo East National Park

2.2.3.2 Archaeology and history

Although a few Early Stone Age and Middle Stone Age archaeological sites are recorded from ground surface finds in Tsavo, there is much evidence for thriving Late Stone Age economy from 6,000 to1, 300 years ago. Research has shown that Late Stone Age archaeological sites are found close to the Galana River in high numbers. The inhabitants of these sites hunted wild animals, fished and kept domesticated animals. Because of the sparse availability of water away from the Galana River, human settlement in Tsavo focused on the riparian areas and in rock shelters as one moves west.

Swahili people traded with the inhabitants of Tsavo for ivory, catskins, and probably slaves as early as700 AD (and probably earlier). There is no evidence for direct Swahili "colonisation" of Tsavo. Instead, trade was probably accomplished by moving goods to and from the Swahili Coast

via extended kin-networks. Trade goods such as cowry shells and beads have been recovered from archaeological sites dating to the early Swahili period.

19th-century British and German explorers document people we now refer to as Orma and Watha during their travels through the "nyika" ("bush" or "hinterland") and generally viewed them as hostile toward their interests. Beginning in the late 19th/early 20th century, the British began a concerted effort to colonise the interior of Kenya and built a railway through Tsavo in 1898. Two Tsavo Man-Eaters terrorized the construction crews led by John Henry Patterson who eventually shot the pair not before they had killed one hundred and thirty five Indians and local workers. The railway was eventually completed through to Kisumu on Lake Victoria.

Tsavo remained the homeland for Orma pastoralists and Watha hunter-gatherers until 1948, when it was gazetted a national park. At that time, the Orma with their livestock were driven off and theaboriginal population of the Watha people was forcefully relocated to Voi and Mtito Andei as well as other locations within the nearby Taita Hills. Following Kenyan independence in 1963, hunting was banned in the park and management of Tsavo was turned over to the authority that eventually became the Kenya Wildlife Service.

2.2.3.3 Wildlife

Tsavo East National Park is considered one of the world's biodiversity strongholds, providing undeveloped homes to vast numbers of animals.

2.2.3.4 Mammals

Famous are the Tsavo lions, a population whose adult males often lack manes entirely. As of 2006, there were about 675 lions in the Amboseli-Tsavo ecosystem.

Some of the many mammals found in the park include:

- ✓ Aardwolf
- ✓ Yellow baboon
- ✓ African buffalo
- ✓ Senegal bushbaby
- ✓ Bushbuck
- ✓ Caracal
- ✓ African wildcat
- ✓ Southeast African cheetah
- ✓ African civet
- ✓ Kirk's dik-dik
- ✓ African wild dog
- ✓ African dormouse
- ✓ Blue duiker
- ✓ Bush duiker
- ✓ Harvey's red duiker
- ✓ Common eland
- ✓ African bush elephant
- ✓ Bat-eared fox
- ✓ Northern greater galago

- ✓ Grant's gazelle
- ✓ Rusty-spotted genet
- ✓ Common genet
- ✓ Gerenuk
- ✓ Giraffe
- ✓ African savanna hare
- ✓ Springhare
- ✓ Coke's hartebeest
- ✓ Hunter's hartebeest
- ✓ East African hedgehog
- ✓ Spotted hyena
- ✓ Striped hyena
- ✓ Yellow-spotted rock hyrax
- ✓ Southern tree hyrax
- ✓ Impala
- ✓ Black-backed jackal
- ✓ Side-striped jackal
- ✓ Klipspringer
- ✓ Lesser kudu
- ✓ African leopard
- ✓ Lion
- ✓ Banded mongoose
- ✓ Dwarf mongoose
- ✓ Egyptian mongoose
- ✓ Marsh mongoose
- ✓ Slender mongoose
- ✓ White-tailed mongoose
- ✓ Vervet monkey
- ✓ Sykes' monkey
- ✓ Fringe-eared oryx
- ✓ Clawless otter
- ✓ Ground pangolin
- ✓ Crested porcupine
- ✓ Cane rat
- ✓ Giant rat
- ✓ Naked mole rat
- ✓ Honey badger
- ✓ Bohor reedbuck
- ✓ Black rhinoceros
- ✓ Serval
- ✓ Elephant shrew
- ✓ Bush squirrel
- ✓ Red bush squirrel
- ✓ Striped ground squirrel
- ✓ Unstriped ground squirrel
- ✓ Suni
- ✓ Common warthog
- ✓ waterbuck

- ✓ Plains zebra
- ✓ Grevy's zebra

2.2.3.5 Birds

Over 500 bird species have been recorded in the area, including ostriches, kestrels, buzzards,starlings, weaver birds, kingfishers, hornbills, secretary birds and herons.

2.2.3.6 Threats

Between 2001 and 2006, more than 100 lions, elephants and other wildlife have been killed in the Amboseli-Tsavo ecosystem. Most of them have been speared by young men. The poachers usually donot face serious consequences. In contrast, the game scouts who arrested offenders have been punished by the community

2.2.4 Galana-Kulalu Ranches

2.2.4.1 Biodiversity of Project Area

The Galana and Kulalu ranches are found within arid and semi-arid Counties of Kilifi and Tana River. The ranches were established in 1968 with an objective of integrating wildlife conservation and livestock rearing for tourism and beef production. The two Ranches occur along the eastern boundary of the Tsavo East National Park.

The Galana River, the only source of water in this arid country, intersects the two ranches. The Galana Ranch which is located on the northern side of the river, has wildlife conservation in the Galana Wildlife Conservancy and the farming in the Galana-Kulalu Food Security irrigation project as the main land uses. In addition, the ranches are important for the conservation of the wildlife in the Tsavo East National Park because they form and important dry season dispersal areas and migratory routes for wildlife.

2.2.4.2 Plant Community of the Project Area

The ranches have diverse plant communities including xerophytes and halophytes which are, adapted to low water availability and very saline soils respectively. Additionally, the hydrophytes do well in waterlogged soils conditions while mesophytes prefer the medium water and saline conditions. The dominant vegetation types include the narrow Galana riverine forest, bushland and the shrub land.

2.2.4.3 The Galana riverine Forest

The Galana riverine forest is a narrow strip of trees and ground herbs restricted to the immediate area of river bank. Its common plant species includes *Tamarindus indica*, *Ficus sycomorus, Dobera glabra, Populus ilicifolius, Albizia anthelmintica*, *Newtonia hildebrandtii*, *Terminalia kilimandscharica*, *Hyphaene compressa*, *Acacia elatior* and *Kigelia Africana.*

2.2.4.4 Ecological and Economic value of Forest trees species

Tamarindus indica (Tamarind) is a fruiting tree which can grow up to 30 metres high. It has a dense, spreading crown, fragrant flowers and feathery evergreen foliage. The seedpod of the tamarind is widely used for food and medicine for different ailments. Ecologically, the tree is an

important habitat for animals, a shade provider, and a soil stabiliser. The population of this tree is large and has no known threats. It is classified as 'Least Concern' in the IUCN Red List of Threatened Species.

Photos 2-2: Tamarindus indica on the shores of Galana river

Photos 2-3: Dobera glabra

Dobera glabra is an evergreen tree that grows to a height of between 8-10 m. The fruits of the drought-resistant tree is valued are ingested and dispersed by frugivores such as the hornbills. The fruits and seeds are also used as food resources for humans whereas the leaves are browsed by livestock and wildlife. Moreover, the tree is good sources of firewood and its soft wood is used for carving such as for pestles, mortars, spoons, storage containers and other domestic items. It is also used for making bed-frames and stools. Ecologically the tree is important for shade, shelter, carbon sequestration and soil erosion control., greyish-brown to dark grey bark is fissured in rectangular patches; bark on younger

Hyphaene compressa (East African Doum palm) is a medium to large, evergreen palm tree growing to a height of 20m. Unlike almost all other palms, this species is able to form branches, each branch being crowned with large, fan-shaped leaves. Dry areas along river courses and at the coast, often forming pure stands on deep sand or alluvial soils, at elevations from sea level to 1,400 metres. The tree is found in hot and dry climates and is therefore fire resistant and drought resistant. The fruits are eaten by elephants, baboons, small mammals and monkeys. The high energy packed fruits are also an important source of food for humans.

Photos 2-4: Doum Palm on the shores of river Galana

Photos 2-5: *Acacia elatior*

Acacia elatior is a tall, evergreen tree commonly growing along rivers and drainage lines in arid and semi-arid regions. It can grow to a height of between 7-40 m and often has rounded crown. Its plays an important ecological role by stabilizing river banks, soil erosion control, habitat and shade for animal species in the arid areas. Economically, the tree is important as the pods and young shoot are browsed by livestock and wildlife. This tree is also used to make drinking vessels and its bark is used to make medicine for diarrhoea, gonorrhoea and coughs. The dry tree makes good timber for livestock enclosures.

2.2.4.5 Bushland

Bushland is land covered with evergreen or deciduous armed or unarmed small trees or bushes growing densely together. The bushes have no clearly defined stems and may be between 2-5 metres tall. The common plant species in the bushlands includes *Salvadora persica, Azima tetracantha*, *Capparis sepiaria*, *Pluchea dioscoridis, Combretum ukambensis, Cordia goetzei, Gardenia jovis-tonantis, Lawsonia inermis, Vernonia hildebrandtii, Lecaniodiscus fraxinifolius and Meyna tetraphylla, Ziziphus mucronata, Suaeda monoica. Adansonia digitata, Delonix elata, Balanites aegyptiaca Melia volkensii, Euphorbia robecchii and Lonchocarpus-Terminalia.*

2.2.4.6 Ecological and Economic value of Bushland species

Balanites aegyptiaca (desert date) is a spiny shrub or tree up to 10 m in height. It is an arid and semi-arid tree, growing in river valleys, river banks and rocky slopes. The fruits, leaves and flowers are used as food for human consumption and fodder for livestock. The wood from the tree produces firewood and charcoal, especially for indoor use because it produces very little smoke. It produces hard, durable, easy-to-work timber used to make stools, yokes, pestles, wooden spoons, and

combs. Moreover, gum from the stem and fibre from the bark are used to make glue and ropes respectively. The kernels produce edible oil used for cooking while fruits are used to brew an alcoholic drink. Roots are used to treat malaria oedema and stomach pains, heartburn, chest pains. Balanites aegyptiaca is not facing any form of threat and it is classified as Least Concern.

Photos 2-6: Balanites aegyptiaca

Photos 2-7: Salvadora persica

Salvadora persica is an arid and semi-arid evergreen bush with a height of between 6-7 m. The plentifully branched bush occurs together with thorny bushes in desert floodplains, river and stream bank vegetation and wet grassy savannahs. It is commonly found in areas with high groundwater such as riverbanks, perimeters of waterholes, seasonally wetlands and along drainage lines in arid zones. The drought resistant tree is highly salt tolerant. The fruits, leaves, and seeds are used as food resources as well as sources of salt. The leaves and young shoots are browsed by all livestock and wildlife stock and they serve as sources of food, water and minerals. Moreover, the tree is a good source of bee food for honey making. Additionally, the tree produces termite resistant wood for making coffins, gum for making varnish, oil for making detergents and chemicals for making mouthwash and medicine. Commonly used as shelter and windbreakers in human habited areas. *Salvadora persica* is not facing any form of threat and it is classified as Least Concern.

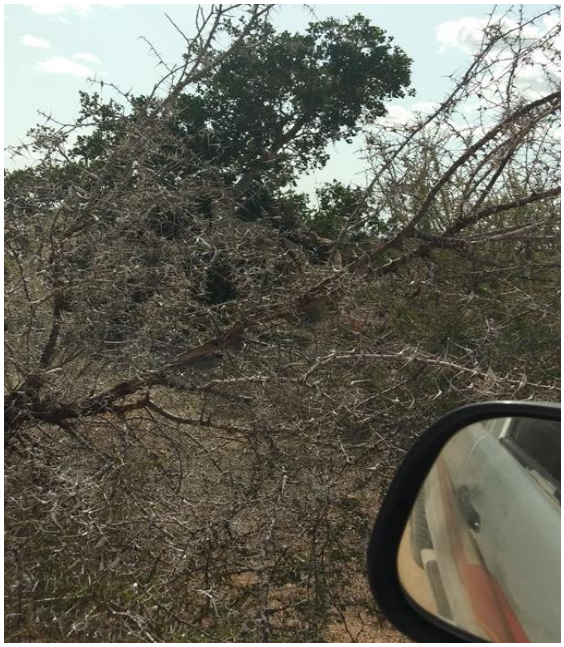
Delonox elator is a drought resistant deciduous tree between 2.5-15 m tall. It has a spreading rounded crown and drooping branches. It is common in dry Acacia-Commiphora bushland and shrubland usually on rocky shallow soils. It is valued as sources of browsing material for goats, sheep, cattle and camels. It is also valued as treatment for scorpion bite and poles for fencing. The ecosystem services include soil erosion control, wildlife shelter, soil fertility improvement and carbon sequestration. *Delonox elator* is not facing any form of threat and it is classified as Least Concern.

Acacia polycantha (falcon's claw acacia) is a deciduous short tree growing to a height of between 3.5-10 m. The is common in wooded grasslands, bushland along riverine ecosystems with high ground water table or soil with impended drainage such as the black cotton soils. Fuel: The wood is a good source of firewood and charcoal. It produces a smell the repels animals such as snakes and crocodiles. An infusion of the leaves is used treat snake bites and calm the mind. *Acacia polycantha* is not facing any form of threat and it is classified as Least Concern.

Photos 2-8 Delonox elator

Acacia Senegal (Gum Arabic) is a branched deciduous bush or tree which can grow to a height of 15 m. The drought resistant shrub grows in association with a variety of vegetation types such as semi-desert grasslands and wooded grassland. The seeds and gum from the shrub are important food resources while the roots are used to manage leprosy, gonorrhea and dysentery. Moreover, the wood from the shrub is used to make farm implements, carts and handles for tools. Ecologically the shrub provides ecosystem services such as soil erosion control, bee food, carbon storage and habitat for wildlife. *Acacia Senegal* is not facing any form of threat and it is classified as Least Concern.

Acacia Zanzibarica is a shrub or short tree which can reach a height of between 3-7m. is common in bushed grasslands or shrubland often in areas with high water table mostly near river banks or on black cotton soils. The tree is a source of ecosystem services such as soil erosion control, carbon sequestration and water conservation. *Acacia Zanzibarica* is not facing any form of threat and it is classified as Least Concern.



Photos 2-9: **Acacia Senegal**

Photos 2-10: **Acacia Zanzibarica**

Boscia coriacea is an evergreen shrub or small tree growing to a height of between 1 and 6 m. It is common in dry bushland along drainage lines and near water areas such as wells and springs. Its strong wood is used for building and fencing. Its fruits are edible and eaten after cooking. It provides ecosystem services such as carbon sequestration, water and soil conservation as well as habitat for wildlife. *Boscia coriacea* is not facing any form of threat and it is classified as Least Concern.

Photos 2-11: **Boscia coriacea**

Photos 2-12: **Acacia Polyacantha**

Photos 2-13: Commiphora campestris

Photos 2-14: Acacia horrida

Commiphora campestris is a spiny tree with irregular wavy trunks growing to a height of 9m. The drought resistant shrub is widely branched, with spines throughout the branches and occurs in the Acacia-Commiphora bushland. The tree is a source of ecosystem services such as soil erosion control, carbon sequestration and water conservation. *Commiphora campestris* is not facing any form of threat and it is classified as Least Concern.

2.2.4.7 Animal communities in the Galana Ranch

2.2.4.7.1 Bird community

Birds use plants as habitats, source of food and as hiding sites from enemies and undesirable environmental events. They have mutualistic relationships with some plants where the act as pollinators and seed dispersers. In the Galana ranch the avian species diversity is high represented by about 500 species of birds. The Isabelline Shrike (*Lanius isabellinus*), South African Swallow (*Petrochelidon spilodera*), Short-toed Snake-Eagle (Circaetus gallicus) and Bat-like Spinetail (Neafrapus boehmi) are rare resident in the region

Photos 2-15: hellys Starlin

Photos 2-16: Red billed hornbill

The seed eating (granivorous) birds are small with short, conical bills adapted to searching the ground for seeds and insects. They have an important ecological role where they help dispersal which reduces death due to competition for space, water and nutrients. The seed eating birds such the are destructive agricultural pests which cause great economic losses. The seed eating birds includes Red-billed Buffalo-Weaver (*Bubalornis niger*) White-headed Buffalo-Weaver (*Dinemellia dinemelli*), White-browed Sparrow-Weaver (*Plocepasser mahali*), Gray-headed Social-Weaver (*Pseudonigrita arnaudi*), Red-headed Weaver (*Anaplectes rubriceps*) Cardinal Quelea (*Quelea cardinalis*) Red-billed Quelea (*Quelea quelea*) Chestnut Weaver (*Ploceus rubiginosus*), Parrot-billed Sparrow (*Passer gongonensis*), Eastern Paradise-Whydah (*Vidua paradisaea*), Gray-headed Silverbill (*Spermestes griseicapilla*), Bronze Mannikin (*Spermestes cucullate*)

Photos 2-17: Golden breasted starling

Photos 2-18: White Headed buffalo weaver

Insect eating birds are medium sized with short narrow bills for scoping insects from trees, ground or air. They are generally considered as the biological pest control because they feed on insects that destroy crops. About 80% of all bird families such as granivorous, herbivorous, frugivorous

and nectarivorous include some insects in their diet during the different stages of development. The insect eating birds includes Spotted Flycatcher (*Muscicapa striata*), African Gray Flycatcher (*Bradornis microrhynchus*), Rufous-tailed Scrub-Robin (*Cercotrichas galactotes*), Red-backed Scrub-Robin (*Cercotrichas leucophrys*), Plain Martin (*Riparia paludicola*), Spotted Morning-Thrush (*Cichladusa guttata*), Northern Wheatear (*Oenanthe Oenanthe*), Plain Martin (*Riparia paludicola*), Bank Swallow (*Riparia riparia*), Little Bee-eater (*Merops pusillus*), White-throated Bee-eater (*Merops albicollis*), European Roller (*Coracias garrulus*), Lilac-breasted Roller (*Coracias caudatus*) Rufous-crowned Roller (*Coracias naevius*), Red-and-yellow Barbet (*Trachyphonus erythrocephalus*).

Sunbird are active birds that generally feed on nectar which they such using their tubular tongue and the narrow long curved bill. They fly from one flower corolla to another and hence move pollen grains. They provide the very important pollination ecosystem service to agricultural and wild plants. The sunbird species in the ranch incudes Eastern Violet-backed Sunbird (*Anthreptes orientalis*), Collared Sunbird (*Hedydipna collaris*) Amethyst Sunbird (*Chalcomitra amethystine*) Scarlet-chested Sunbird (*Chalcomitra senegalensis*) Hunter's Sunbird (*Chalcomitra hunter*), Beautiful Sunbird (*Cinnyris pulchellus*), Black-bellied Sunbird (*Cinnyris nectarinioides*), Tsavo Sunbird (*Cinnyris tsavoensis*), Violet-breasted Sunbird (*Cinnyris chalcomelas*) Variable Sunbird (*Cinnyris venustus*)

Other birds in the ranch includes the fish-eating birds such as Striped Kingfisher (*Halcyon chelicuti*) Pygmy Kingfisher (*Ispidina picta*), Gray-headed Kingfisher (*Halcyon leucocephala*) Giant Kingfisher (*Megaceryle maxima*), Pied Kingfisher (*Ceryle rudis*).

Birds of prey have strong hooked bills, good eyesight and strong talons to enable them to capture other animals for food. Their important ecological role is controlling the population of other birds such as the seedeaters. They include the Secretary bird (*Sagittarius serpentarius*), Bateleur (*Terathopius ecaudatus*) Short-toed Snake-Eagle (*Circaetus gallicus*) Black-chested Snake-Eagle (Circaetus pectoralis) Brown Snake-Eagle (*Circaetus cinereus*) Martial Eagle (*Polemaetus bellicosus*) Tawny Eagle (*Aquila rapax*) Steppe Eagle (*Aquila nipalensis*) Verreaux's Eagle (*Aquila verreauxi*) Eastern Chanting-Goshawk (*Melierax poliopterus*).

Vultures are birds without killing abilities and therefore scavenge on dead animals. Their adaptations to scavenging includes featherless head, strong hooked bills and acid filled stomach. They include Egyptian Vulture (*Neophron percnopterus*) White-headed Vulture (*Trigonoceps occipitalis*), Lappet-faced Vulture (*Torgos tracheliotos*), Hooded Vulture (*Necrosyrtes monachus)*, White-backed Vulture (*Gyps africanus),* Rüppell's Griffon Vulture (*Gyps rueppelli*).

Fruit eating birds (frugivores) subsist on wild fruits and berries. The birds found in the ranch include the Speckled Mousebird (*Colius striatus*), White-headed Mousebird (*Colius leucocephalus*), Blue-naped ousebird (*Urocolius macrourus*), Narina Trogon (*Apaloderma narina*) Red-bellied Parrot (*Poicephalus rufiventris*).

2.2.4.7.2 Mammals Community

Large ungulates influence vegetation cover and composition as they seek for food and shelter Naturally the herbivorous mammals keep the vegetation vibrant by eliminating competition between individual species. The large charismatic ungulates of touristic value includes the endangered African elephant (*Loxodonta africana*), Near threatened (NT) Lesser Kudu

(*Tragelaphus imberbis*), Gerenuk (*Litocranius walleri*), African Buffalo (*Syncerus caffer*) and Least concern (LC) Common Waterbucks (*Kobus ellipsiprymnu*), Grants gazelle (*Nanger granti*) Impala (*Aepyceros melampus)*, Thompsons gazelle (*Eudorcas thomsoni*), Blue wildebeest (*Connochaetes taurinus*), Cokes Hartebeest (*Alcelaphus buselaphus*), Suni (*Neotragus moschatus*), the vulnerable Hippopotamus (*Hippopotamus, amphibius*) Rock Hyrax *Procavia capensis*,). Other mammals includes primates such as Olive Baboon (*Papio Anubis*), and Vervet Monkey (*Chlorocebus pygerythrus*).

The Galana-Kulalu ecosystem is also home to the critically endangered hirola (*Beatragus hunteri,* Sclater, 1889) and the gravy's (*Equus grevyi*) translocated into the Tsavo East National Park/Galana ranch ecosystem in 1963 and 1977 respectively.

Other captivating mammals includes the vulnerable Lion (*Panthera leo)* and Leopard (*Panthera pardus*). The endangered (EN) African wild dog (*Lycaon pictus*), the Least Concern Spotted hyena (*Crocuta Crocuta*), Silver-backed Jackal (*Canis mesomela*), and the Bush-tailed Mongoose (*Bdeogale crassicauda*).and the Near threatened Striped hyena (*Hyaena hyaen*) occur in the region. The region is also a home to the Nile Crocodile (*Crocodylus niloticus*), Nile monitor (*Varanus niloticus*), Leopard tortoise (*Stigmochelys pardalis*).

2.2.4.8 The importance of the Galana Ranch in Biodiversity Conservation

Galana Ranch ecosystem mirror the Tsavo east National Park ecosystem and therefore the have similar plants and animal species richness and diversity. Both ecosystems are dependent on each other as the large mammals use the Galana and Kulalu Ranches and dispersal areas during the dry seasons. The wildlife also uses the two ranches and migratory routes as they disperse further into the areas beyond the ranches. Significant changes to the Two ranches would impact on the ecological integrity of the Tsavo East National Park.

2.2.5 Neighboring Settlement activities

The settlements inside and neighboring the project area is predominantly rural partly nucleated with up to ten households. The communities living around express a dichotomy of livelihood strategies along agrarian and pastoralist practices. For the Giriama and Watha indigenous peoples, they are hunters and gatherers who are slowly settling down to carry out minimum agriculture. The political class has demanded an out-grower arrangement with the project so that they can access enterprises within the project area for value addition.

The pastoralist Orma community have been grazing within the ranch against the policy of the ADC. Individuals own up to 3,000 heads of cattle. This has brought about a hostile relationship between the community and the ADC. They argue that whenever they are caught grazing within the farm they are fined and in the process their fattest and most pricey animals have to be forfeited. They claim indigenous and use rights which they say will be further alienated if the ranch is developed into a large scale irrigation project. Besides their conflicts with the ADC over grazing rights and penalties, they argue that they main need is to access the river and they have used the ranch as the only corridor. Use of other routes brings them into conflict with the communities who practice agriculture o the riverine over livestock destruction of crops. They argue that with alienation of the ranch, and its potential in accessibility they will be deprived of the only avenue to avoid conflicts with the agrarian communities as they seek access to Galana River for watering their livestock. The political class claims that a 2.5 mile (5km) buffer zone between the Tsavo

National Park and the ranches was designated or them as a corridor to access the river and must be maintained.

In general, as a condition for acceptance of the project, adjacent communities have demanded mitigation measures to disruption of their livelihoods and a reservation of 70% of jobs generated within the project area

3 POLICY, LEGAL AND INSTITUTIONAL / ADMINISTRATIVE FRAMEWORK

This Chapter reviews the pertinent institutional, policy and legal framework governing environmental and socio-economic issues that must be taken into consideration during the Project implementation.

3.1 Overview

The Constitution of Kenya is the supreme law of the republic and binds all persons and all state organs at all levels of government. The Constitution of Kenya, 2010 provides broad frame work regulating all existence and development aspects of interest to the people of Kenya, and along which all national and sectorial legislative documents are drawn.

In relation to the environment, article 42 of chapter four, the Bill of Rights, confers to every person the right to a clean and health environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative measures, particularly those contemplated in article 69, and to have obligations relating to the environment fulfilled under Article 70.

Kenya is a signatory to various international agreements, conventions and treaties that have environmental implications/provisions and as such cannot be contravened during project development phases. In the past, the government had established a number of National policies and Legal Statutes to enhance environmental conservation and sustainable development. Some of the policy and legal provisions are briefly presented in the following sub- sections.

Before enactment of EMCA in 1999; Environmental conservation aspects and pollution control were scattered in the various sectoral pieces of legislation thus making coordination very difficult. However, since it is not possible to capture everything, it is recommended that the proponent acquire copies of the Acts, Regulations and Policy documents for completeness.

3.2 Environmental Management Principles and Guidelines

The project proponent is expected under law and set practice to consider and exercise the principles and guidelines of environmental management as follows:

3.2.1 Sustainability

In the course of implementing the proposed project, the project proponent is expected to use resources sustainably and source materials from suppliers that have been identified as practicing sustainable resources use, thereby maintaining the potential of the natural resources to meet the needs and aspirations of present and future generations.

3.2.2 Intergenerational Equity

Operations and activities undertaken at all the stages of the proposed project ought to be designed to comply with the principle of intergeneration equity in resources use of both natural and man-

made resources. Additionally, various resource users in the current generation should not have their resource use ability compromised by the proposed project

3.2.3 Prevention

The project proponent should undertake all the preventive and viable measures to protect the environment in the first place, throughout all the phases of the project (Construction, Operation and Decommissioning) rather than allow damage to take place then take remedial action. Prevention is far less costly than mitigating environmental damage.

3.2.4 Precaution

The project proponent should undertake all the necessary precaution in the making of environmental decisions where there is scientific uncertainty and such uncertainty should not be used as a reason for not taking cost effective measures to prevent environmental harm.

3.2.5 Polluter Pays Principle

Polluters of natural resources are required to bear the full environmental and social costs of their activities. Therefore, should the project proponent cause damage to private properties or public utilities such as roads or public goods such as water bodies, measures to compensate the affected should be instituted immediately.

3.2.6 Public Participation

The project proponent will ensure environmental democracy and involvement of the public, especially local communities in environmental and developmental decisions that it seeks to make, which affect their lives. The public participation process shall be open and transparent, provide valuable information on key impacts, potential mitigation measures and possible alternatives as well as enlightens the community on the opportunities and benefits that could arise from a project.

3.2.7 Cultural & Social Principal

Due consideration shall be made of the local environment management systems in the course of implementing the project and due care shall thus be exercised while introducing technologies that may conflict with the existing environmental management systems.

3.3 Multilateral Environmental Agreements (MEAs)

Kenya as a member of the international family of nations is a signatory to various MEAs whose aim is to ensure global environmental sustainability at national level. Under the old constitution of Kenya, the ratification of treaties was purely within the purview of the executive arm of government, which could determine whether to present a treaty to parliament for operationalization through Kenyan legislation.

In terms of article 2(6) of the Constitution of Kenya, 2010 as read together with section 12(1) of the 2012 Treaty Making and Ratification Act (No. 45 of 2012), Kenya remains a dualist jurisdiction whereby for treaties to take legal effect, they must be approved both by Cabinet, and by Parliament.

The MEAs which Kenya has ratified and whose obligations are relevant for the construction of Galana-Kulalo Irrigation Project Phase 2 and independent environmental monitoring of the said project are as below:-

3.3.1 Convention on biological diversity (CBD Secretariat, 1992)

The CBD is also known as the "Omnibus Convention" or the "Convention for all life on the Earth" and is regarded as the over-arching biodiversity convention which deals with many critical issues including access and benefit sharing. Kenya signed the CBD on 11th June 1992 and ratified it on 26th July 1994.

The CBD is one of the outcomes of the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. The CBD establishes a global legally binding framework for the conservation of biodiversity, the sustainable use of it components and the fair and equitable sharing of benefits arising out of utilization of genetic resources. The provisions of this convention should be taken into account in the conservation of various species of plants, animals and the variety of ecosystems in the project area.

3.3.2 Ramsar Convention (UN, 1971)

The objective of this Convention is to protect important habitats of water birds by controlling the encroachment and loss of wetlands and ensuring their wise use. Kenya signed the Ramsar Convention on 5th October 1990 and ratified it on 5th June 1991

3.3.3 World Heritage Convention (UN, 1972)

The objective of the convention is to establish an effective system of collective protection of the cultural, historical and natural heritage of outstanding universal value. Kenya signed the World Heritage Convention on 5th June 1991

The World Heritage Convention, whose full title is "The Convention Concerning the Protection of the World Cultural and Natural Heritage," was adopted by UNESCO in 1972. The Convention today has 131 countries that are party to it. Through this instrument nations of the world have agreed to inventory, recognize and protect unique and irreplaceable properties of universal value. For the first time, the convention provides a permanent framework-legal, administrative and financial-for international cooperation in safeguarding mankind's cultural and natural heritage, and introduces the specific notion of "World Heritage" whose importance transcends all political and geographic boundaries.

The Convention is the bedrock document of World Heritage Sites.

The World Heritage List

On signing the Convention, each county pledges to conserve the cultural and natural sites within its borders that are recognized by the Convention as being of exceptional and universal value. In

return, the international community helps to protect these treasures. To define these significant sites the Convention has established the World Heritage List. The cultural and natural properties proposed to the list must meet specific criteria defined by the World Heritage Committee, The first eight sites were inscribed on the list in 1978, Currently there are 358 sites listed in 82 countries: 260 cultural sites, 84 natural sites and 14 mixed cultural and natural sites.

National and International Protection

Member countries recognize their own responsibility to safeguard World Heritage properties in their countries. They agree to do all they can with their own resources and with International assistance.

3.3.4 Convention on Migratory Species – Bonn Convention (UN, 1979)

The MEA was established in order to protect wild animals that migrate across national and trans-national boundaries, including migratory land and SESA animals. The aim of the Convention is to ensure that the traditional migration of wildlife through different regions of the world is sustained through international collaboration. Kenya entered into the agreement of adopting the Convention on Migratory Species on 1st May 1999.

The convention is relevant due to presence of migratory wild animals, bird species and other aquatic organisms within the project area.

3.3.5 United Nations Framework Convention on Climate Change, UNFCCC (UN, 1992)

An international agreement on climate change concluded under the UNFCCC governing global actions to address climate change, and creating obligations for developing countries through Nationally Determined Contributions (NDC) that specify national commitments to reduced GHG emissions through mitigation and adaptation actions supported by climate finance.

3.3.6 United Nations Convention to Combat Desertification, UNCCD (UN, 1994)

The Convention specifically addresses the arid, semi-arid and dry sub-humid areas, known as the dry lands, where some of the most vulnerable ecosystems and peoples can be found. It aims at forging a global partnership to reverse and prevent desertification/land degradation and to mitigate the effects of drought in affected areas in order to support poverty reduction and environmental sustainability Kenya ratified the convention in June, 1997

3.3.7 East African Community (EAC) Protocol on Environment and Natural Resources, 1999, Amendment 2006 (EAC, 1999)

The role of the protocol, although not yet in force, is to govern the partner states in their cooperation in the management of environment and natural resources over areas within their jurisdiction including transboundary environment and natural resources. It is a protocol of general application which applies to all activities, matters and areas of management of the environment and natural resources of the Partner States.

The protocol was signed by the Partner States of the East African Community on 29th November

2003. It has relevant provisions for environmental and social management for the project; Article 5: Paragraph 4 provides that Partners States should promote sustainable utilization of water resources while taking into consideration factors such as ecology, geographic, climatic, hydrologic factors among others; the social and economic needs of each Partner States; the population dependent on the water resources; existing and potential uses of the water resources.

Article 6: Paragraph 1 identifies the protection and conservation of the basin and its ecosystem with emphasis on improving water quality and quantity; preventing the introduction of invasive species; conservation of biological diversity and forest resources; protection and conservation of wetlands and fisheries resources conservation. Part 2 of the article provides for the harmonization of laws and policies for stakeholder participation in protection, conservation and rehabilitation. Sustainable agriculture and land use practices to achieve food security and rational agricultural production is provided for in Article 9. Article 12 of the Protocol urges Partner States to develop national laws and regulations requiring project proponents to undertake EIA and review of EIA reports to be done by all the Partner States if the potential impacts are likely to be trans-boundary and the same to apply for Environmental Audits in Article 13. Partner states should ensure control of pollution from non-point sources through legal, economic and social measures. This is provided for in Article 20 which further states that pollution control measures should promote sustainable forestry practices, appropriate agricultural land use methods, sanitation and hygiene within the basin. Public participation is provided for in Article 22 which should be enhanced to influence government decisions on project formulation and implementation.

Article 23 of the Protocol provides that Partner States should promote Community involvement and mainstreaming gender concerns at all levels of socio-economic development especially in decision making, policy formulation and implementation of projects and programmes.

3.3.8 The Rio Declaration

Agenda 21 – a program of action for sustainable development worldwide, the Rio Declaration on Environment and Development was adopted by more than 178 governments at the United Nations Conference on Environment and Development, known as the Earth Summit, held in Rio de Janeiro, Brazil from 3rd to 14th June 1992. On sustainable and responsible development, Principle 3 states that "the right to development must be fulfilled so as to equitably meet development and environmental needs of present and future generations." Principle No. 10 of the declaration underscore that environmental issues are best handled with participation of all concerned citizens at all the relevant levels.

In the Model Farm and Phase 2, stakeholder participation has been in-built so far in the pre-feasibility stage. The views of communities and their concerns have been captured through focus group discussions and interviews. Furthermore, mechanism exists through which they can raise issues and seek redress in situations where they feel their rights have been infringed upon.

3.3.9 World Commission on Environment and Development (WCED)

The Bruntland Commission as it is commonly known focused on the environmental aspects of development, in particular, the emphasis on sustainable development that produces no lasting damage to biosphere, and to particular ecosystems. In addition, environmental sustainability is the economic and social sustainability. Economic sustainable development is development for which progress towards environmental and social sustainability occurs within available financial resources. While social sustainable development maintains the cohesion of a society and its ability to help its members work together to achieve common goals, while at the same time meeting individual needs for health and well-being, adequate nutrition, and shelter, cultural expression and political involvement. In the Model Farm, efforts have so far been made to abide by the principles of WCED by trying to solve the development problem of achieving food security while at the same time protecting the environment by undertaking a study that captures both principles.

3.3.10 Kyoto Protocol (1997 and 2004)

The protocol generally promotes the use of renewable energy through the requirement in Article 2 of the protocol that: "Each party included in Annex 1 ... Shall:
(i) Research on, promote, develop and increase use of new and renewable forms of energy, of carbon sequestration technologies and of advanced and innovative environmentally sound technologies".
(ii) Demonstrate the "progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse gas emitting sectors that run counter to the objective of the protocol and apply market instruments". Article 10 (c) requires that all parties "cooperate in the promotion of effective modalities for the development, application and diffusion of, and take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of or access to environmentally sound technologies, know-how, practices and processes pertinent to climate change, in particular to developing countries, including the formulation of policies and programmes for the effective transfer of environmentally sound technologies that are publicly owned or in the public domain and the creation of an enabling environment for the private sector to promote and enhance the transfer of and access to environmentally sound technologies"

However the Kyoto protocol is not legally binding and there has been a major debate on the renewal of the protocol.

3.4 International Finance Cooperation (IFC) Performance Standards

The section summarizes the IFC Performance Standards (PS) 1-8. Note that the IFC PS was revised in January 2012. Some PS aspects are enhanced and there are some new areas of focus.
The main changes are in respect of issues around gender; resource efficiency; climate change and adaptation; project disclosure; supply chain management; waste management; labour conditions.

3.4.1 Assessment and Management of Environmental and Social Risks and Impacts

This Standard is similar to the NEMA Environment Regulations 2003. In addition to identifying risks and impacts of proposed projects, it also aims at ensuring that affected communities are appropriately engaged on issues that could potentially affect them.

3.4.1.1 Assessment and Management of Environmental and Social Risks and Impacts

This Standard is similar to the NEMA Environment Regulations 2003. In addition to identifying risks and impacts of proposed projects, it also aims at ensuring that affected communities are appropriately engaged on issues that could potentially affect them.

The Standard requires that the area of influence encompasses, as appropriate:

(i) The primary project site(s) and related facilities that the project proponent (including its contractors) develops or controls , such as power transmission corridors, pipelines, canals, tunnels, relocation and access roads, borrow, disposal areas and construction camps;
(ii) Associated facilities that are not funded as part of the project (funding may be provided separately by the project proponent or by third parties including the government), and whose viability and existence depend exclusively on the project and whose goods or services are essential for the successful operation of the project;
(iii) Areas potentially impacted by cumulative impacts from further planned development of the project, any existing project or condition, and other project-related developments that are realistically defined at the time the Social and Environmental Assessment is undertaken; and
(iv) Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location. The area of influence does not include potential impacts that would occur without the project or independently of the project.

The standard has a number of components including management systems, training, and community engagement, consultation and grievance mechanisms, actions plans and organizational capacity.

3.4.1.2 Labour and Working Conditions

Performance Standard 2 recognizes that the pursuit of economic growth through employment creation and income generation should be balanced with protection for basic rights of workers. Good practice for labour and working conditions requires compliance with International Labour Organization (ILO) and UN conventions and prevention of child labour, i.e. persons under the age of 18 years.

3.4.1.3 Resource Efficiency and Pollution Prevention

This revised PS requires assessment and effective use of resources as well as prevention and control of pollution in line with good international practice.

3.4.1.4 Biodiversity Conservation and Sustainable Management of Living Natural Resources

In order to avoid or minimize adverse impacts to biodiversity in the project's area of influence, the significance of project impacts on all levels of biodiversity is an integral part of the Social and Environmental Assessment process. The assessment should consider critical habitats with high biodiversity value and also legally protected areas. PS 6 presumes against development for certain critical habitats.

3.4.1.5 Indigenous People

The Indigenous Peoples are recognized as social groups with identities that are distinct from dominant groups in national societies, are often among the most marginalized and vulnerable

segments of the population. Their economic, social and legal status often limits their capacity to defend their interests in, and rights to, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. They are particularly vulnerable if their lands and resources are transformed, encroached upon by outsiders, or significantly degraded. Their languages, cultures, religions, spiritual beliefs, and institutions may also be under threat. These characteristics expose Indigenous Peoples to different types of risks and severity of impacts, including loss of identity, culture, and natural resource-based livelihoods, as well as exposure to impoverishment and disease. Government sector projects may create opportunities for Indigenous Peoples to participate in, and benefit from project-related activities that may help them fulfill their aspiration for economic and social development. In addition, this Performance Standard recognizes that Indigenous Peoples may play a role in sustainable development by promoting and managing activities and enterprises as partners in development.

3.4.1.6 Cultural Heritage

This Performance Standard recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, the Contractor will protect and support irreplaceable cultural heritage by undertaking internationally recognized practices for the protection, field-based study, and documentation of cultural heritage.

3.4.2 Convention on Biological Diversity (1992)

Principle No. 10 of the declaration states that environmental issues are best handled with participation of all concerned citizens at all relevant levels. At the national level, each individual shall have appropriate access to information that is concerning environment that is held by public authorities. States shall encourage and facilitate public participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy shall be provided.

3.4.3 United Nations Convention to combat Desertification (1994)

An agreement to combat desertification and mitigate the effects of drought through national action programs that incorporate long term strategies supported by international cooperation and partnership arrangements. The contractors will also combat land degradation through mechanisms which will involve planting trees to enhance vegetation cover.

3.4.4 Bamako Convention (1991)

A treaty of African nations prohibiting the import of any hazardous (including radioactive) waste. The materials used in the construction of irrigation scheme are not hazardous.

3.4.5 World Tourism Organization (UN WTO)

The World Tourism Organization (UNWTO) is the United Nations agency responsible for the promotion of responsible, sustainable and universally accessible tourism. As the leading international organization in the field of tourism, UNWTO promotes tourism as a driver of economic growth, inclusive development and environmental sustainability and offers leadership and support to the sector in advancing knowledge and tourism policies worldwide.

UNWTO encourages the implementation of the Global Code of Ethics for Tourism, to maximize tourism's socio-economic contribution while minimizing its possible negative impacts, and is committed to promoting tourism as an instrument in achieving the United Nations Millennium Development Goals (MDGs)**,** geared towards reducing poverty and fostering sustainable development. UNWTO works in six main areas - competitiveness, sustainability, poverty reduction, capacity building, partnerships and mainstreaming - to achieve responsible, sustainable and universally accessible tourism.

UNWTO generates market knowledge, promotes competitive and sustainable tourism policies and instruments, fosters tourism education and training, and works to make tourism an effective tool for development through technical assistance projects in over 100 countries around the world. UNWTO's membership includes 156 countries, 6 Associate Members and over 400 Affiliate Members representing the private sector, educational institutions, tourism associations and local tourism authorities.

3.5 International guidance and standards

3.5.1 Equator Principles

The Equator Principles refer to a financial industry benchmark for determining, assessing and managing social and environmental risk in project financing. As per the Equator Principles, negative impacts on project affecting the ecosystems and communities should be avoided whenever possible, and if the impacts are unavoidable, they need to be reduced, mitigated and/or compensated for appropriately. In accordance to Equator Principles, potential social and environmental issues to be addressed in documentation include the following:

· Assessment of the baseline social and environmental conditions;
· Consideration of the feasible environmentally and socially preferable alternatives;

Requirement under the host country laws and regulations, applicable international treaties and agreements;

- Protection of human rights and community health, safety and security;
- Protection of cultural property and heritage;
- Protection and conservation of biodiversity, including endangered species and sensitive ecosystems in modified, natural and critical habitats, and identification of legally protected areas;
- Sustainable management and use of renewable natural resources (including sustainable resource management through appropriate independent certification systems);
- Use and management of dangerous substances;
- Major hazards assessment and management;
- Labour issues and occupational health and safety;
- Socio-economic impacts;

✓ Fire prevention and life safety;

- Land acquisition and involuntary resettlement;

- Impacts on affected communities, and disadvantaged or vulnerable groups;
- Impacts on indigenous peoples, and their unique cultural systems and values;
- Cumulative impacts of existing projects, the proposed project, and anticipated future projects;
- Consultation and participation of affected parties in the design, review and implementation of the project;
- Efficient production, delivery and use of energy; and
- Pollution and prevention and waste minimization, pollution controls (liquid effluents and

✓ air emissions) and solid and chemical waste management.

For this project, adherence to IFC standards is required to be Equator Principles (EP) compliant and is a sufficient condition.

3.5.2 ISO 14000 Standards

ISO 14000 is a series of voluntary international standards on environmental management. It provides a framework for the development of an environmental management system, environmental auditing, environmental labeling, environmental performance evaluation and life cycle assessment. The standards provide a framework for a strategic approach to an organization's environmental policies, plans and actions. An Environmental Management System (EMS) based on the ISO 14000 standards is a management tool enabling an organization of any size or type to control the impact of its activities, products or services on the environment.

It defines a structured approach for;
a) Setting environmental objectives and targets;
b) Achieving these goals; and
c) Demonstrating that they have been achieved.
Because ISO 14000 does not set levels of environmental performance, the standards can be implemented by a wide variety of organizations, whatever their current level of environmental maturity. However, a commitment to compliance with applicable environmental legislation and regulations is required, along with a commitment to continuous improvement.

3.6 African Development Bank Updated Integrated Safeguards System dated April 12, 2023

3.6.1 Overview1 of the African Development Bank Group's Integrated Safeguards System

1. In 2013, the African Development Bank adopted an Integrated Safeguards System (also referred to as the "2013 ISS") which established the Bank Group's commitment to sustainable development, consolidating and building upon the Environment (2004) and Involuntary Resettlement (2003) safeguard2 policies, as well as cross-cutting policies and strategies on Gender (Gender Strategy 2021- 2025–Investing in Africa's Women to Accelerate Inclusive Growth), the Civil Society Engagement Framework (2012). The current ISS update has been further informed by the AfDB Climate Change and Green Growth Strategic Framework: Projecting Africa's Voice (2021) and Bank's sector policies such as Forestry (1993), Agriculture and Rural Development (1999), Water (2021), the Strategy for Quality Health

Infrastructure in Africa 2021-2030 (2021), and the Bank Group Policy on Program-Based Operations (2012).

2. The key aims underlying the ISS are to:

• Better align the safeguards with the Bank's new policies and strategies.
• Adopt Good International Industry Practice.
• Adapt the safeguards to an evolving range of lending and investment products.
• Work towards greater harmonization of safeguards with those of other multilateral finance institutions.
• Tailor safeguards approaches to the nature and needs of different Borrowers with varying capacities.
• Improve internal processes and resource allocation.

3. The Integrated Safeguards System (ISS) comprises:

• The ***African Development Bank Group's Vision for Sustainable Development***, which sets out the Bank Group's approach and aspirations regarding environmental and social sustainability.
• The ***African Development Bank Group's Environmental and Social Policy*** that sets out the Bank's commitments and the relevant principles and requirements that the Bank must follow regarding projects, activities and initiatives that it supports.
• ***Ten Environmental and Social Operational Safeguards (OS)***, together with supporting Annexes, which set out the mandatory requirements that apply to the projects, activities and initiatives of Borrowers.
• ***Environmental and Social Guidance Notes (ISS Guidance notes)*** are tools which provide technical guidance for the Bank and its Borrowers on specific methodological approaches, Good International Industry Practice (GIIP) and standards relevant to meeting the requirements of the Operational Safeguards. Bank's ISS Guidance Notes are supplemented where necessary by the World Bank Group Environmental, Health and Safety (EHS) Guidelines that were adopted by the MFI Working Group on Environment. The guidance notes provide advisory information

4. The ***Ten Environmental and Social (E&S) Operational Safeguards*** establish the standards that Borrowers will meet, as appropriate, in projects, activities and initiatives supported through Bank financing throughout the life cycle of operations, as follows:-

- ***E&S Operational Safeguard 1 (OS1)***: Assessment and Management of Environmental and Social Risks and Impacts.
- o***E&S Operational Safeguard 2 (OS2)***: Labour and Working Conditions.
- ***E&S Operational Safeguard 3 (OS3)***: Resource Efficiency and Pollution Prevention and Management.
- ***E&S Operational Safeguard 4 (OS4)***: Community Health, Safety and Security
- ***E&S Operational Safeguard 5 (OS5)***: Land Acquisition, Restrictions on Access to Land and Land Use, and Involuntary Resettlement.
- ***E&S Operational Safeguard 6 (OS6)***: Habitat and Biodiversity Conservation and Sustainable

- Management of Living Natural Resources.
- ***E&S Operational Safeguard 7 (OS7)***: Vulnerable Groups.
- ***E&S Operational Safeguard 8 (OS8)***: Cultural Heritage.
- ***E&S Operational Safeguard 9 (OS9)***: Financial Intermediaries.
- ***E&S Operational Safeguard 10 (OS10)***: Stakeholder Engagement and Information Disclosure

5. E&S Operational Safeguard 1 (**OS1**) applies to all projects, activities and other initiatives for which Bank financing is sought. OS1 establishes the importance of: (a) the Borrower's existing environmental and social framework in addressing the risks and impacts of the project; (b) an integrated environmental and social assessment to identify the risks and impacts of a project, activity or other initiative; (c) effective stakeholder engagement through disclosure of relevant information, consultation and effective feedback; and (d) management of environmental and social risks and impacts, including climate risk and adaptation, by the Borrower throughout the life-cycle of operations. The Bank requires that all environmental, social risks and impacts, including climate vulnerability and adaptation, of the operations be addressed as part of the environmental and social assessment conducted in accordance with OS1.

6. **OSs 2 to 10** complements **OS1** and set out the obligations of the Borrower in identifying and addressing environmental and social risks and impacts that may require particular attention. These Operational Safeguards establish objectives and requirements to maximize positive impacts and to avoid, minimize, reduce and mitigate risks and adverse impacts, and where significant residual impacts remain, to compensate for or offset such impacts. Operational Safeguard 5 covers involuntary resettlement (previously covered by OS2 under the 2013 ISS, which had replaced and superseded the Involuntary Resettlement Policy of 2003).

3.7 Policy Frameworks

3.7.1 Kenya Vision 2030

The Kenya Vision 2030 is the new county's development blueprint covering the period 2008 to 2030. It aims at making Kenya a newly leading industrializing middle income country providing high quality life for all its citizens by the year 2030. The vision has been developed through an all- inclusive stakeholder consultative process, involving Kenyans from all parts of the country. The vision is based on three 'pillars' – Economic, Social and Political.

The environmental sector falls under the social pillar. The vision came after the successful implementation of the Economic Recovery Strategy for Wealth Creation which saw the country's economy back on the path to rapid growth since 2002 when the GDP was at 0.6% rising to 1% in 2006.

The long-term success of achieving Vision 2030 targets will largely be dependent on ensuring that environmental management is addressed in medium term plans as an enabler for sustained pro-development rather than as an inhibitor to development. It is therefore critical that all constructions within the country take care of the environment and ensure environmental

sustainability in order to help achieve this very important Millenium Development Goal amongst others.

3.7.2 National Environmental Action Plan (NEAP)

According to NEAP 1994, the government recognized the negative impacts on ecosystems emanating from development programmes that disregarded environmental sustainability. Established in 1990, the plan's effort was to integrate environmental considerations into the Country's Economic and Social Development. The integration process was to be achieved through a multi-sectoral approach to develop a comprehensive framework to ensure that environmental management and the conservation of natural resources are an integral part of societal decision-making. Under the NEAP process EIA was introduced.

3.7.3 National Policy on Water Resources Management & Development

It enhances a systematic development of water facilities in all sectors for the promotion of the country's socio-economic progress and recognizes the by-products of these processes as wastewater. It calls for development of appropriate sanitation systems to protect people's health and water resources from pollution.

3.7.4 Policy Guidelines on Environment and Development

Among the key objectives of the policy paper on Environment and Development (Sessional Paper No. 6 of 1999) are to ensure that from the onset, all development policies, programmes and projects take environmental considerations into account and to ensure that an EIA report is prepared for any industrial venture or any other development before implementation among others.

3.7.5 National Environmental Policy (2013)

The National Environmental Policy aims at integrating environmental aspects into national development plans and the broad objectives of policy include:

- ✓ Optimal use of natural land and water resources in improving the quality of human environment;
- ✓ Sustainable use of natural resources to meet the needs of the present generations while preserving their ability to meet the needs of future generations;
- ✓ Integration of environmental conservation and economic activities into the process of sustainable development;
- ✓ Meet national goals and international obligations by conserving bio-diversity, arresting desertification, mitigating effects of disasters, protecting the ozone layer and maintaining an ecological balance on earth

Various Acts and Regulations addressing environmental management seek to make provisions that enable the achievement of the National Environmental Policy objectives. ***The project proponent will thus endeavour to observe the provisions of the various statutes***

that are aimed at maintaining a clean and healthy environment.

3.7.6 National Water Policy (2000)

The objective of the National Water Policy is to lay the foundation for the rational and efficient framework for meeting the water needs for national economic development, poverty alleviation, environmental protection and social well-being of the people through sustainable water resources development and management. The policy describes the guidelines that promote comprehensive water resources management and development with the private sector and community participation as the prime movers in the process to guarantee sustainability.

The policy underscores the threat of water resources due to degradation of water catchment areas affecting siltation; run-off, water balance and groundwater recharge characteristics. This has led to the diminishing or drying up of the water resources. The paper calls for preservation, conservation and development of national water resources for the benefit of all Kenyans. The policy stresses the need for developing options for mitigating negative impacts as well as enhancing positive ones through a careful analysis of the environment. This is aimed at improving the environment on which the water development sustenance depends.

The policy further states that the government will support initiatives aimed at development of appropriate water and sanitation facilities in the rural areas as a means of attracting viable economic activities and improving health. The proposed project is guided by this policy as it is in the rural area and aims at improving economic activities and thus ensures sustainable water resources use and environmental protection to protect the investment.

3.7.7 National Water Resources Management Strategy (NWRMS)-2012- 2017

The formulation of the NWRMS 2012-2017 was guided by the emergence of new developments in the water resources sub-sector through policy development brought about by the Constitution of Kenya 2010, the vision 2030, the Water Bill 2014, the ational Rain Water Harvesting and Storage policy, the guidelines on the use of trans boundary water resources and the National Water Master Plan (NWMP) 2030.

The strategy was founded on major thematic areas in water resources management. These included data acquisition and management, water resource planning and allocation, adequate quantity and quality water resources, catchment protection and management, human resource development and management and financial resources mobilization and accountability.

Based on these thematic areas, strategic objectives were formulated and are identified as follows; Strengthening monitoring networks to enhance data collection and improve information management system;

- Improving the use of water resources management tools for effective water resources planning and allocation;
- Strengthening stakeholder collaboration to enhance water storage and adaptation to climate change impacts;
- Strengthening enforcement mechanism and collaboration for effective catchment

protection and conservation;

- Building staff capacity and improve work environment;
- Enhancing resource mobilization and effective use of finances;

The strategy recognizes the negative impact on water resources due to environmental changes and the continued demand for water services.

The Ministry of Water Sanitation and Irrigation has emphasized on storage development through which the National Water Harvesting and Storage Policy which provides a framework for water harvesting including mandatory requirement to provide buildings with rainwater harvesting systems, has been developed.

The NWMP 2030 aims at progressively increasing availability of water resources through accurate assessment, optimal management and development of existing potentials. This entails enhancing water storage through designing additional large/medium and small- scale storage facilities as envisaged in Vision 2030. It also entails promoting rainwater harvesting and storage systems, re-establishing green water storage area such as wetlands and forests, water saving technologies, ground aquifer re-charging, recycling treated effluent water, and restoring and rehabilitating identified storage systems constructed since the colonial period.

3.8 Institutional framework

3.8.1 Introduction

The Constitution of Kenya is the supreme law of the Republic and binds all persons and all state organs at all levels of government. It provides broad frame work regulating all existence and development aspects of interest to the people of Kenya, and along which all national and sectoral legislative documents are drawn.

In relation to the environment, article 42 of chapter four and the Bill of Rights confers to every person the right to a clean and health environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative measures, particularly those contemplated in article 69, and to have obligations relating to the environment fulfilled under Article 70.

Environmental impact assessment is a tool for environmental conservation and has been identified as a key component in new project implementation. According to section 58 of the Environmental Management and Coordination Act (EMCA Cap 387), second schedule and Environmental (Impact Assessment and Audit) Regulation, 2003, both new and old projects must undergo Environmental Impact Assessment and Audits. The report of the same must be submitted to NEMA for review/approval and issuance of the relevant certificates/licenses. This was necessary as many forms of developmental activities cause damage to the environment and hence the greatest challenge today is to maintain sustainable development without interfering with the environment.

3.8.2 Environmental Problems in Kenya

There are many environmental problems and challenges in Kenya today. Among the cardinal environmental problems include: loss of biodiversity, land degradation, water management and environmental pollution. This has been aggravated by lack of awareness and inadequate information amongst the public on the consequences of their interaction with the environment. In addition, there is limited local communities' involvement in participatory planning and management of environmental and natural resources.

Recognizing the importance of natural resources and the environment in general, the Kenyan Government has put in place wide range of policy, institutional and legislative framework to address the major causes of environmental degradation and negative impacts on ecosystem emanating from industrial and economic development programmes.

Two major institutions are in place for purpose of administration of the Environmental, namely, National Environmental Council (**NEC**) and National Environmental Management Authority (**NEMA**).

3.8.3 National Environmental Council (NEC)

This is a body that is made up of members charged with the duty of natural resource management and conservation with members drawn from all the relevant ministries as well as a broad range of other stakeholders. The functions of the council are to formulate national policies, goals, and objectives and determination of policies and priorities for the environmental protection. The council also promotes co-operation among all the players engaged in environmental protection programmes.

3.8.4 National Environmental Management Authority (NEMA)

NEMA is the organization responsible for the administration of the environmental act. Among the functions of NEMA include;

- Co-ordination of various environmental management activities
- Initiation of legislative proposals and submission of such proposals to Attorney General
- Research, investigate and carry out surveys in the fields of environment
- Enhance environmental education and awareness on the need of sound environmental management
- Advice the government on regional and international agreements to which the country should be a party and issue an annual report on the state of environment
- ✓ Charged with the responsibility of the execution of EIA and EA

3.8.5 Kenya Wildlife Service (KWS)

Kenya Wildlife Service (KWS) is a State Corporation established by the Wildlife (Conservation and Management) Act, CAP 376 and The Wildlife (Conservation and Management) (Amendment) Act no. 16 of 1989. They provide for the establishment of national parks and national reserves and define how they are to be managed. The Environmental Management and Coordination Act (EMCA) of 1999 provides for the legal and administrative co-ordination of the diverse sectoral initiatives, including management and conservation of wildlife so as to improve the national capacity for the management of biodiversity and the environment in general.

The operations of the KWS are also impacted and guided by other overarching policy and legal frameworks (e.g. those relating to Forests, Fisheries, Mining, Lands, Water, Industry, Rural Development, Agriculture, Local Government, National Security, National Museums and the research programs under KEFRI, KEMFRI and KARI) which necessitate structured and functioning relationships with other GOK departments/agencies and the international and local communities.

The overall mandate of KWS is to conserve and manage wildlife in Kenya with the following:

I. Sole jurisdiction over National parks supervisory role in the management of National Reserves, Local and Private Sanctuaries
II. License, control and supervise all wildlife conservation and management activities outside the protected areas
III. Conservation Education and Training
IV. Wildlife Research

3.8.6 Kenya Tourism Board

Kenya Tourist Board (KTB) was established in 1997 through the legal notice no.14 under the state Corporations Act (Cap 446) of the laws of Kenya.

The mandate of the Board is to:

i. Promote and market Kenya as a tourist destination locally and internationally;
ii. Establish public Relations services to address issues of concern to the tourism industry, and facilitate the resolution of conflicts within the industry;
iii. Monitor the quality and standards of facilities available to tourists and advice both the private sector and relevant Government agencies on how to improve the facilities;
iv. Work in partnership with national, regional and international organizations as well as local authorities in the country to improve the tourism environment;
v. To initiate education and awareness programs on tourism locally as well as abroad;
vi. Develop and maintain professional personnel to deal with issues that adversely affect Kenya`s image in the tourism industry;

3.8.7 Kenya Tourist Development Authority (KTDA)

KTDA is established as a state corporation under the Kenya Tourist Development Authority Act (CAP 382) of the laws of Kenya. KTDA is charged with the duty of securing the investigation,

formulation and carrying out of projects for developing the tourism industry in Kenya.

According to the KTDA ACT, the Corporation shall have power, either alone or in association with other authorities or persons, or as managing agent or otherwise on behalf of other authorities or persons to:

(a) investigate and formulate projects for the promotion or expansion of new or existing enterprises to which this section applies, and to carry out such projects;
(b) carry on undertakings which appear to the Corporation to be needed for or in connexion with the promotion or expansion of new or existing enterprises to which this section applies;
(c) carry on any activities incidental to such a project or to such an undertaking which appear to the Corporation to be requisite, advantageous or convenient for or in connexion with that project or undertaking;

(d) assist other authorities or persons, either financially or in any other way, to perform any functions which the Corporation is empowered to perform by virtue of any of the foregoing paragraphs;
(e) establish or expand, or promote the establishment or expansion of, other bodies to carry on (either under the control or partial control of the Corporation or independently) any such functions as are mentioned in paragraph (d).

3.8.8 Kenya Tourism Federation

Kenya Tourism Federation (KTF), was formed as an umbrella body bringing together the private sector bodies including; associations of Tour Operators, Hotelkeepers and Caterers, Travel Agents, Air Operators, Mombasa & Coast Tourism and Ecotourism Kenya. The key aims of KTF are to: -

Provide a single voice for the tourism industry;
ii. Enhance ethics and standards in the tourism industry;
iii. Strengthen private sector representation on the various organizations/boards that impact on tourism;
iv. Provide a forum through which the industry can give input to the marketing activities of the Kenya Tourism Board;
v. Lobby and constructively engage Government on issues critical to the industry.

3.8.9 National Irrigation Authority(NIA)

The National Irrigation Authority was established in 1966 through an Act of Parliament (Cap 347) to take over the activities of ALDEV. As per the Irrigation Act, NIA's mandate is;

a. Promoting and improving national irrigation schemes in the country
b. Conducting research and investigation into the establishment of national schemes
c. Designing, constructing, supervising and administering irrigation schemes
d. Coordinating and planning settlement on national irrigation schemes
e. Determining the number of settlers to be accommodated in national irrigation schemes

f. Promoting marketing of crops and produce in national irrigation schemes in liaison with
g. organizations responsible for marketing of agricultural produce and
h. Formulating and executing policy regarding national irrigation schemes in conjunction with the Water Resource Authority

· For many years, NIB operated under the above mandate till 2002 when the board restructured itself following changes in government policy to focus its activities in;
· Coordination of construction and rehabilitation of major irrigation and drainage Infrastructure · Operation and maintenance of major irrigation and drainage infrastructure
i. · Administering land in the public schemes and providing technical advice to farmers

National Irrigation Board (NIB) is implementing a number of developments projects which are spread out in the 47 counties and are at various stages of implementation: feasibility studies, detailed designs preparation, tendering for construction and construction. The existing 10,000 acres Model Farm within the Galana-Kulalu Food Security Project is part of these development projects and therefore NIB will be the implementer in accordance with its mandate.

3.8.10 Agricultural Development Corporation (ADC)

Agricultural Development Corporation is a Government Parastatal, which was established in 1965 through an Act of Parliament Cap 346, to facilitate the land transfer programme from European settlers to locals following the country's independence. It was also to be a stabilizing factor to assist in maintaining the good quality livestock and continuity of the breeding programs in the affected farms.

With the successful completion of the land transfer programme, revision of objectives of the Corporation was done resulting in the Act of Parliament Cap 444 of 1986.As per this Act, the functions of the Corporation were redefined to include promotion and execution of agricultural schemes and reconstruction in Kenya by initiating, assisting or expansion of agricultural undertaking ands and enterprises. The land on which the proposed Model Farm is located has is currently ADC Galana-Kulalu Ranches and has been leased by NIB from ADC. On the basis of its mandate, ADC will implement the project in conjunction with NIB.

3.9 Environmental Legal Framework

In 1999, the Government of Kenya provided a bill for the establishment of an appropriate legal and institutional framework for the management and protection of the environment. The same was enacted into law as the Environmental Management and Co-ordination Act (**EMCA**), 1999 and received the presidential assent on 6th January 2000.

Other key national laws governing the management of environmental resources in the country are as outlined.

3.9.1 Environmental Management and Co-ordination Act (EMCA Cap 387)

Part II of Environment Management and Co-ordination Act, 1999 states that every person in Kenya is entitled to clean and healthy environment and has duty to safeguard the same. To ensure this is achieved EIA/EAs are prepared to very existing and new projects as already stated above. The second schedule of the Act proposes that urban development activities are among the facilities to undergo EIA.

Although there are other sectorial laws on environment, this is the supreme Act and it is the Act that established NEMA.

3.9.2 Environment (Impact Assessment & Audit) (amended) Regulations, 2019

The regulations were gazetted in June 2003 but amended vide legal notice no 31 by the cabinet secretary in charge of Environment in April empowered under section 147 of EMCA. These regulations provide the framework for carrying out EIAs and EAs in Kenya by NEMA licensed Lead Experts or Firm of Experts. ***The proponent has initiated the writing of this Environmental Impact Assessment project report***

3.9.3 Environmental Management and Co-ordination (Water Quality) Regulations, 2006

These Regulations applies to drinking water, water used for industrial purposes, water used for agricultural purposes, water used for recreational purposes, water used for fisheries and wildlife, and water used for any other purposes

The regulation is very clear on the discharge of effluent to the environment. It states that "Every person who generates and discharges effluent into the environment under a licence issued under the act shall carry out effluent discharge quality and quantity monitoring in accordance with methods and procedures of sampling and analysis prescribed by the Authority, and shall submit quarterly records of such monitoring to the Authority or its designated representative."

Article 19 of the regulation is very explicit on the use of wastewater for Irrigation. It states, "No person shall be permitted to use wastewater for irrigation purposes unless such water complies with the quality guidelines set out under the Eighth Schedule to these Regulations".

3.9.4 Environmental Management and Co-ordination, (Waste Management) Regulations, 2006

This regulation defines the responsibilities of waste generators and the duties and requirements for transportation and disposal of wastes. It states that "no person shall dispose of any waste on a public highway, street, road, recreation area or in any public place except in a designated receptacle and a waste generator shall collect, segregate and dispose such waste in the manner provided for under these regulations". It provides for mitigation of pollution and provides for hazardous and toxic wastes.

Responsibilities of a waste generator

No person shall dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle.

Any person whose activities generate waste shall collect, segregate and dispose or cause to be disposed of such waste in the manner provided for under these Regulations.

Without prejudice to the foregoing, any person whose activities generate waste has an obligation to ensure that such waste is transferred to a person who is licensed to transport and dispose of.

Cleaner Production Principles

Any person who owns or controls a facility or premises which generates waste shall minimize the waste generated by adopting the following cleaner production principles:

1.Improvement of production process through:

2. Conserving raw materials and energy

3. Eliminating the use of toxic raw materials within such time as may be prescribed by the Authority

4. Reducing toxic emissions and wastes monitoring the product cycle from beginning to end by: - Identifying and eliminating potential negative impacts of the product.

- Enabling the recovery and re-use of the product where possible.
- Reclamation and recycling.
- incorporating environmental concerns in the design, process and disposal of a product.

3.9.5 Environmental Management and Coordination Act (Noise and Excessive Vibration Pollution) (Control) Regulations 2009

The Act is conferred by section 147 of EMCA 1999. Part II section (5) states that "no person shall make, continue or cause to be made or continued any noise in excess of the noise levels set in the First Schedule, unless it's necessary to the preservation of life, health, safety or property". Section (6) (1and 2) ensures that no person shall cause noise from any source which exceeds any sound level as set out in the regulations and measurements shall be taken by the relevant lead agency.

Sub section (5) states that "any person who makes noise more than the prescribed levels commits an offence". Section 7 (a-d) exempts noise emitted during alerting, performance or noise in connection with the protection of the health and safety of residents or their property during emergency conditions and or warning devices necessary for the protection of public safety.

3.9.6 Public Health Act (Cap. 242)

Part IX, section 115, of the Act states that no person/institution shall cause nuisance or condition liable to be injurious or dangerous to human health. Section 116 requires that Local Authorities take all lawful, necessary and reasonably practicable measures to maintain their jurisdiction and sanitary clean to prevent occurrence of nuisance or condition liable to be injurious or dangerous to human health.

Such nuisance or conditions are defined under section 118 as waste pipes, sewers, drainers or refuse pits in such state, situated or constructed as in the opinion of the medical officer of health to be offensive or injurious to health. Any noxious matter or waste water flowing or discharged from any premises into the public area in general or into the gutter or side channel or watercourse, irrigation channel, or bed not approved for discharge is also deemed as nuisance. Other nuisances are accumulation of materials or refuse which in the opinion of the medical officer of health is likely to harbour rats or other vermin.

On responsibility of the Local Authorities Part XI, section 129, of the Act states in part "It shall be the duty of every local authority to take all lawful, necessary and reasonably practicable measures for preventing any pollution dangerous to health of any supply of water which the public within its district has a right to use and does use for drinking or domestic purposes….".

Section 130 provides for making and imposing regulations by the local authorities and others the duty of enforcing rules in respect of prohibiting use of water supply or erection of structures draining filth or noxious matter into water supply as mentioned in section 129. This provision is supplemented by section 126A that requires local authorities to develop by-laws for controlling and regulating among others private sewers, communication between drains and sewers and between sewers as well as regulating sanitary conveniences in connection to buildings, drainage, cesspools, etc. for reception or disposal of foul matter.

Part XII, Section 136, states that all collections of water, sewage, rubbish, refuse and other fluids which permits or facilitates the breeding or multiplication of pests shall be deemed nuisances and are liable to be dealt with in the matter provided by this Act.

3.9.7 The Chiefs' Authority Act CAP 128

The Act in Section 10 States that any chief may from time to time issue orders to be obeyed by the persons residing or being within the local limits of his jurisdiction for any of the following purposes;

- p r e v e n t i n g the pollution of the water in any stream, watercourse or water-hole and preventing the obstruction of any stream or watercourse
- r e g u l a t i n g the cutting of timber and prohibiting the wasteful destruction of trees
- p r e v e n t i n g the spread of diseases, whether of human being or animals
- P r o h i b i t i n g any act or thing that may cause damage to any public road or to any

work constructed or maintained for the benefit of the community.

3.9.8 Water Act, 2016

This is an act of parliament whose purpose is to provide for the regulation, management and development of water resources and sewerage services and other connected purposes in line with the Constitution.

Article 63 of the acts states that every person in Kenya has a right to clean and safe water in adequate quantities and to reasonable standards of sanitation as stipulated in article 43 of the constitution.

The act also establishes a Water Services Regulatory Board (WSRB) whose principle objective is to protect interests and rights of consumers in the provision of water services.

Section 108 of the act states that; It shall be the duty of a licensee receiving trade effluent into its sewerage system to ensure that it has in place measures for the receipt and handling of the effluent without causing; pollution of the environment, Harm to human health, damage to the sewerage system or Contravention of applicable laws or standards set by the Regulatory Board.

Further, a person shall not discharge any trade effluent from any trade premises into the sewers of a licensee without the consent of the licensee.

An application for consent shall be made to the licensee and shall state among other things; the nature or composition of the trade effluent, the maximum quantity of the effluent which it proposes to discharge on any one day, the highest rate at which it is proposed to discharge the effluent and any other information required by the licensee.

The licensee's consent may be given subject to conditions, including conditions requiring pre-treatment and payments to the licensee of charges for the discharge.

Any person who is dissatisfied with the decision of the licensee on an application under this section may within thirty days of the decision, appeal to the Regulatory Board.

A person who contravenes the provisions of this section commits an offence. In this section of the act, "trade effluent" means any liquid, whether with or without suspended particles, produced as a by-product in the course of any trade or industry.

3.9.8.1 The Water Resources Authority (WRA)

The Water Act, 2016 established the Water Resources Authority (WRA) whose functions, among others are to:

- Formulate and enforce standards, procedures and Regulations for the

management and use of water resources and flood mitigation;

- Regulate the management and use of water resources as well as enforce the regulations;
- Issue water permits for water abstraction, water use and recharge, enforce the conditions of those permits;
- determine and set permit and water use fees and collect water permit fees and water use charges;
- provide information and advice for formulation of policy on national water resource management, water storage and flood control strategies.

Application for authorization to construct works for purposes of impounding water (storage) is submitted to WRA. WRA then reviews the application and issue a permit to construct works.

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3.9.8.2 Water Regulation, 2021

Water Regulation 2021 has replaced Water Rules, 2007.

It has 3 Regulations namely:-

1) Water Services Regulation, 2021
2) Water Harvesting and Storage Regulation,2021 and
3) Water Resources Regulation, 2021

3.9.8.3 Water Services Regulation, 2021

This Regulation deals with Water Services.

Part 1 deals with Preliminary which basically define terms which have been used in the Regulation and what they imply.

Par II provides County Government Framework for Water Services

Part III defines Operation and Financing of water services providers. It requires a county government to establish a service provider in form of a liability company to offer water and sanitation services.

Part IV deals with effluent and wastewater disposal

Part VIII deals with clustering of Water Services on basis of Commercial Viability

Part IX Deals with Bulk Water Supply

Part V requires Water Service Providers to pay requisite fees and levees to Regulatory Boad and Water Resources Authority

Part XI deals with Administration of certain water supply and infrastructure services. It requires anybody who want to drill a borehole or supply water from a different source to get the consent of the Water Service Provider in the area of question

Part XII deals with approvals concerning all works affection the water infrastructure

Part XIII requires a WSP to establish an Inspectorate for monitoring and evaluation.

Part IV requires Regulation Board andWorks Development Agencies to undertake Reporting and Record Keeping

Part XVI requires WSP and Regulatory Boards to adopt mechanism of engagement in their operations

Part XVIII defines General Offences

Schedules -Water Services Regulation has 2 schedules

1-Lays modalities of conducting business while 2 deals with way of handling compaints.

3.9.8.4 The Water Harvesting and Storage Regulations, 2021

It is divided into 10 parts as follows:-

Part I-Preliminaries

Part II Classification of Storage Dams and Other Waterworks

Part III Development of Water Works

Part IV Release of water from storage dams from storage dams and other water works.

Part V Maintenance and Management of Water Works

Part IV Strategic Water Emergency Interventions

Part VII Climate changes and flood mitigation

Part VIII Water Harvesting

Part IX-Licensing of Qualified Professionals and Contractors in respect to water works

Part C General Offences

Five Schedules as follows:-

1. Classification of Dams
2. Risk Categorization of dams and Other Water Works
3. Content and Format of Technical Reports
4. Premiums for use of water from storage facilities and
5. Complaints

3.9.8.5 The Water Resources Regulation, 2021

Is divided into 15 parts as follows:-

Part 1 Preliminary

Part II Description of Water Use Activities

Part III Application for a permit or other Authority for water use

Part IV Surface Water

Part V Ground Water

Part VI Water Quality Monitoring and waste disposal

Part VII Works

Part VII Conditions of Authorization, permits and Approved water uses

Part IX Water use charges

Part X Water Resource Users Association

Part XI Basin Water Resource Committees

Part XII Protected Areas and around Water Conservation areas

Part XIII The Reserve

Part XIV Registration of water sector professionals

Part XV Licensing of Contractors

Part XVI Miscellaneous-Contains WRA Standard Forms

3.9.9 Forest Act

The Forest Act No7 of 2005 consolidates all forests under the act, and prescribes heavy penalties for damage to forests and trees. Charcoal burning in a forests or farmlands without a license or permit is an offence. Section 52(1) deals with felling, cutting, burning, injuring or removing of any forest produce only cover state, local authority or provisional forest. It sets heavy penalties

for damaging trees. This will assist farmers in maximizing benefits from growing trees. Section 40(1) of the act sets to ensure that the forest areas under her management are maintained for biodiversity, cultural or recreational use. In addition it protects the concession area from destruction and encroachment by other persons.

Section 41(1) says that all indigenous forests and woodlands shall be managed on a sustainable basis for purposes of, Conservation of water, soil and biodiversity, River line and shoreline protection. Recreation and tourism, Sustainable production of wood and non-wood products, Carbon sequestration and other environmental services Education and research purpose and habitat for wildlife in terrestrial forests and fisheries in mangrove forests. The Act puts emphasis on the need to strengthen community-based institutions by creation of Community Forest Associations, which gives the public a greater participatory role to the community in the forest conservation.

3.9.10 Climate Change Act, 2016

This Act requires that no entity or a person who willingly, unwillingly, knowing or not knowing shall undertake any project which is likely to bring about adverse changes in the environment and likely to affect the climate negatively.

3.9.11 Land Registration Act, 2012

This act requires registration of private land to proof ownership inform of title deed.

The act came to effect in year 2012.

4 DESCRIPTION OF PROPOSED PROJECT

4.1 Project Area

Galana Kulalu Food Security project is located in the coastal region within Kilifi and Tana River Counties, situated about 105km North West from Malindi town off the Malindi-Voi Road. The area borders Tsavo East National Park to the East and it is accessible through the Malindi Tsavo Road. The project involves development of physical infrastructure for viable and economic utilization of the natural resources available within or accessible to the area making up the Galana Kulalu Ranches including but not limited to water storage, conveyance and distribution, irrigation, livestock production, aquaculture road network, land development, eco-tourism among others. It consists of various enterprises including maize, sugarcane, horticulture and orchards, dairy and beef ranching, fisheries, tourism and recreation, processing industries and human settlement.

Figure 4-1:CP at work at Galana-Kulalu Irrigation Scheme

The first phase of the Galana-Kulalu Food Security Project is the 10,000 acres Model Farm and the remaining 10,000acres under phase 2 is proposed to mirror the greater Galana-Kulalu Food Security Project when it is fully developed and working. The Galana-Kulalu Food Security project is located in Kilifi and Tana River Counties within the land delineated as Galana-Kulalu Ranches in the larger proposed Galana-Kulalu Food Security Project, which is located in the existing Galana-Kulalu Ranch and model farm. Galana-Kulalu Ranch is government-owned by ADC and leased to the National Irrigation Board.

4.1.1 Model Farm

The Galana Kulalu Food Security Project in its entirety is a transformative project geared towards driving the food security agenda of the Nation. During inception, it was envisaged that the project will increase the production of maize by more than 12million bags as well as support

growth of other crop enterprises such as sugarcane, horticulture, cotton and orchards, dairy and beef ranching. These would intern support the growth of the agriculture value chain industries and support sectors such as service, tourism, recreation among others.

The Project is set up in vast Galana Kulalu ranch located in the coastal region within Kilifi and Tana River Counties. The GPS location of the farm is Latitude -3.04774^0, Longitude 39.35763^0. It is bordering Tsavo East National Part to the East.

Galana Model Farm is centered around irrigated agriculture as the mean annual rainfall in the area is as low as 500 mm. The rainfall is unreliable and poorly distributed thought the year. Thus the project entails development of irrigation infrastructure to enhance economic utilization of the land through agricultural production. The infrastructure scoped includes provision of water storage, water conveyance and distribution, irrigation, aquaculture, road network, and ancillary structures. Due to its magnitude, a phased implementation of the project was adopted with 10,000acre model farm as phase 1, followed by 215,000 acre pilot farm as phase II. The implementation of the project commenced in 2014 with the commissioning of a pre-investment and prefeasibility study followed by commencement of construction works for the 10,000 acre model farm.

4.1.1.1 Location

The Model farm is located in Selu Village, Kisiki Sub-location, Chakama Location, Lengo Mbaya Division, Magharini Constituency, Kilifi County .

It is located at the bottom of Galana Ranch where it boarders Galana River at the following coordinates

Table 4-1: Location of Dam No. 14

	Degrees	**UTM**
Region		37
Longitude	E039.39297^0	543666
Latitude	S3.05566^0	966244
Altitude	147m	144

Refer Figure 4-2 has its location while 4-3 has the overall project layout.

From figure 4-1, the model farm has a distorted rectangular shape.

According to the analysis undertaken on the marked google image, the land has the following characteristics:-

Length	8996.25	m
Width	5814.95	M
Area	52312744	m2
	13078.19	Acres
	5231.274	Ha

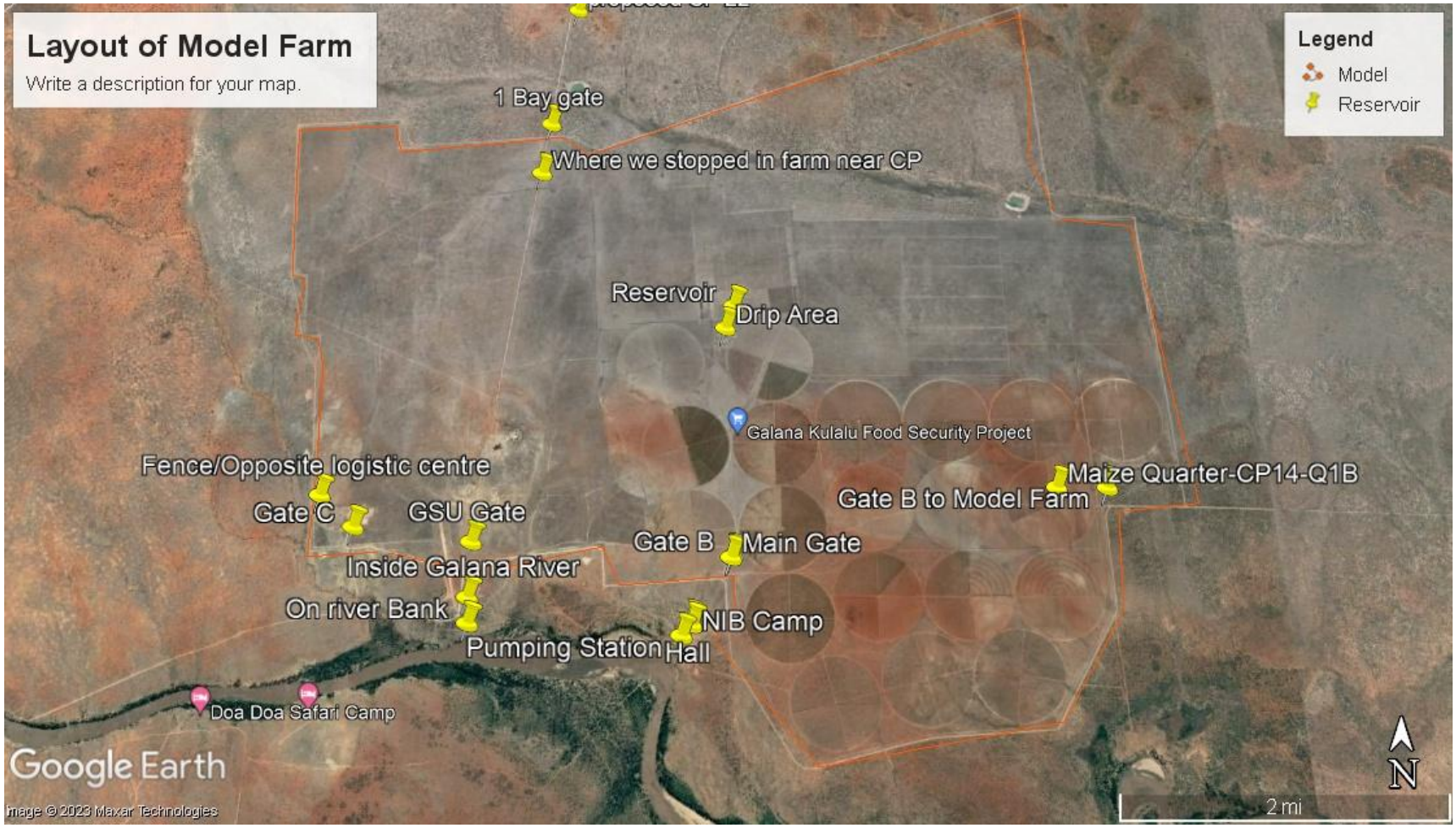

Figure 4-2: Location of Model Farm

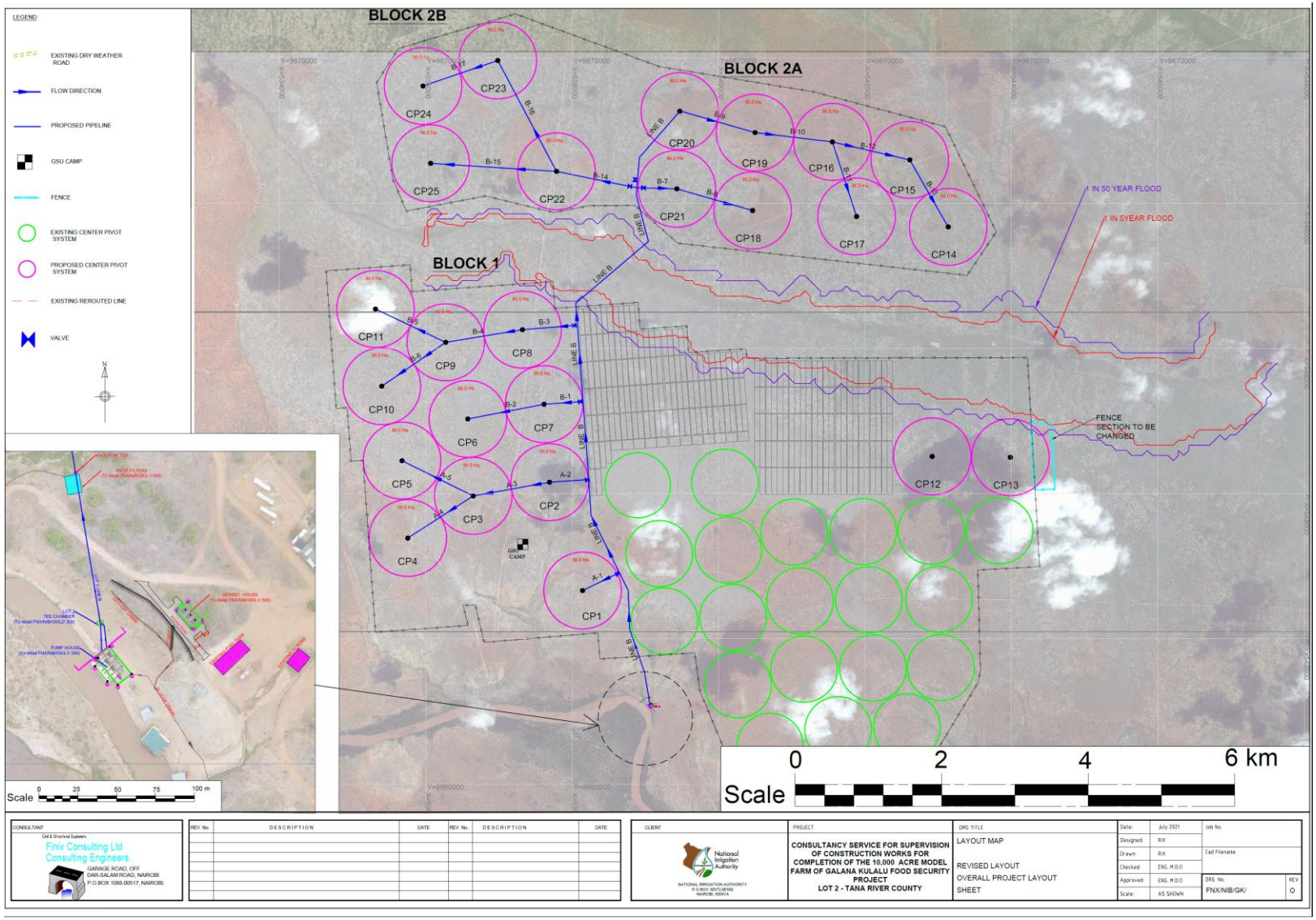

Figure 4-3: Overall Project layout of Model Farm

The main source of water for the existing uses in the ranches is the Galana River which is at the south of the Model Farm and separates Galana Ranch from Kulalu Ranch.

There are two intakes on the Galana River to supply water to the Model Farm through an elaborate pipe system. The coordinates for the water intakes are:

Intake A - 3° 4'8.54"S, 39°19'51.38"E
Intake B - 3° 4'12.23"S, 39°21'9.66"E

The same river provides water to the neighboring communities. Sedentary farmers have settled along this river where they practice small scale rain fed farming. The pastoralists who move from North to South in search of water and pasture also use the river, where their livestock get water.

4.1.1.2 Description Galana Kulalu 10,000 Acre Model Farm

4.1.1.2.1 Objective

The objective of developing the 10,000 acre farm was to model modern irrigation application systems, simulate production systems for the identified value chains to inform the development of the larger pilot farm.

4.1.1.2.2 Irrigation system installed.

The model farm features center pivot and drip irrigation systems backed by an elaborate pumping system and water conveyance and distribution systems. The farm also features modern farm equipment such as planters, combined harvesters and sprayers. Due to lack of connection to the national power grid, the pumps and center pivots are fueled using diesel. The details of the assets installed on the farm are as below:-

(a) Pump station

The pump station at the intake features vertical multi-stage pumps and centrifugal pumps some coupled to engines and others coupled to motors that are driven by diesel generators.

Photos 4-1: Elaborate Intake

1) Pumps and generators

Pump Type	Number of pumps	Design Duty	Prime mover	Mounting	Status
Vertical turbine pump	10	600 M^3/hr each	3 Diesel Engine 492 Hp – Gearbox coupling 5 Diesel Engine 400 Hp – Gearbox coupling 2 Diesel Engine 600 Hp – Generator driven	Fixed on slab	2 serviceable (gearbox) 2 serviceable (generator) 6 require major repairs (gearbox))
Centrifugal Pumps	2	540 M^3/hr	Diesel Engine 400 Hp	On wheels	2 serviceable

(2) Fuel station

There are 4 tanks located at the intake of capacity 30,000 litres for one and the rest three are of 10,000 litres. There is another fuel substation at the drip area of 20,000 litres.

(3) Filtration Unit

Filter Type	Number of filters	Design Duty	Prime mover	Mounting	Status

AMIAD Disc filters 400 micron (intake)	6	4800 m^3/h	Generator 16 KVA	Fixed	2 serviceable 4 requires repair
Apollo Disc Filters Battery 130 micron (drip area)	1	1500 m^3/h	Generator 230 KVA	Fixed	Serviceable

4.1.1.2.3 Water conveyance and distribution system

The center pivot irrigation system consists of pipe sizes 710mm HDPE, 630mm HDPE, 450mm uPVC, 400mm uPVC, 350mm uPVC, 315mm uPVC, 225mm uPVC with total length estimated at 40km.

The drip system consists of pipes sizes 710mm HDPE, 630mm HDPE, 500mm uPVC, 450mm uPVC, 400mm uPVC, 350mm uPVC, 315mm uPVC, 225mm uPVC, 280mm uPVC, 160mm uPVC, 110mm uPVC, 90mm uPVC with total length estimated at 100km. The pipe network is fitted with water control accessories that include butterfly valves, air valves, pressure regulating valves, water meters and pressure gauges.

4.1.1.2.4 Irrigation system

Modern irrigation systems have been adopted for the project that include center pivot assemblies and drip irrigation system.

(a) Center Pivots

The irrigation systems consist of 20 centre pivots of 165 acres each equipped with generators of 22 KVA or 16 KVA. There is another set of 25 centre pivots under installation covering an area of 200 acres each equipped with a generator. Details of each pivot are as below: -

CENTRE PIVOTS					**GENERATORS**			
CP NO	**CP NO**	**TYPE**	**SERIAL.NO**	**STATURS**	**TYPE**	**SERIAL.NO**	**CAPACITY**	**STATUS**
1	19	ZIMMATIC	2402154	OK	CUMMINS	L08059457	22KVA	OK
2	20	ZIMMATIC	2402155	OK	CUMMINS	L081058521	22KVA	OK
3	21	ZIMMATIC	2402152	OK	CUMMINS	B161135043	22KVA	OK
4	18	ZIMMATIC	0112140	OK	CUMMINS	G93562	22KVA	OK
5	17	ZIMMATIC	01121402	OK	PERKINS	181433	16KVA	OK
6	16	ZIMMATIC	01121404	OK	PERKINS	192650	15KVA	OK
7	15	ZIMMATIC	13111401	OK	PERKINS	180294	15KVA	OK
8	11	ZIMMATIC	1711401	OK	PERKINS	192651	15KVA	OK
9	07	ZIMMATIC	11111402	OK	PERKINS	180292	15KVA	OK

10	01	ZIMMATIC	23081601	OK	PERKINS	180289	15KVA	OK
11	04	ZIMMATIC	2402153	OK	PERKINS	181434	15KVA	OK
12	23	ZIMMATIC	2402156	OK	PERKINS	181431	15KVA	OK
13	22	ZIMMATIC	2402151	OK	PERKINS	181435	15KVA	OK
14	08	VALLEY	N/A	OK	PERKINS	192649	15KVA	OK
15	09	VALLEY	N/A	OK	PERKINS	180293	15KVA	OK
16	10	VALLEY	N/A	OK	PERKINS	180290	15KVA	OK
17	12	VALLEY	N/A	OK	PERKINS	192648	15KVA	OK
18	13	VALLEY	N/A	OK	PERKINS	180291	15KVA	OK
19	14	VALLEY	N/A	OK	PERKINS	192652	15KVA	OK
20	24	VALLEY	N/A	OK	PERKINS	181430	15KVA	OK
Fertigation pumps					**Fertigation tanks**			

No.	**Type**	**Serial No.**	**Make**	**Status**	**No.**	**Make**	**Capacity**	**Status**
1	Hydraulic	1501032	AMIAD40.10	OK	1	POLY TANK	2,000	OK
2	Hydraulic	1404062	AMIAD40.10	OK	2	TOP TANK	1,000	OK
3	Hydraulic	1404063	AMIAD40.10	OK	3	TOP TANK	1,000	OK
4	Hydraulic	1502037	AMIAD40.10	OK	4	TOP TANK	1,000	OK
5	Hydraulic	1502036	AMIAD40.10	OK	5	TOP TANK	1,000	OK
6	Hydraulic	1501033	AMIAD40.10	OK	6	TOP TANK	1,000	OK
7	Hydraulic	1404061	AMIAD40.10	OK	7	TOP TANK	1,000	OK
8	Hydraulic	1404065	AMIAD40.10	OK	8	TOP TANK	1,000	OK
9	Hydraulic	1404064	AMIAD40.10	OK	9	TOP TANK	1,000	OK
10	Electric	3530-110080	MATRIX/A5-5T/1.3M	OK				
11	Electric	3530-110081	MATRIX/A5-5T/1.3M	OK				
12	Electric	3530-110082	MATRIX/A5-5T/1.3M	OK				
13	Electric	3530-110083	MATRIX/A5-5T/1.3M	OK				
14	Electric	3530-110084	MATRIX/A5-5T/1.3M	OK				

15	Electric	3530-110085	MATRIX/A5-5T/1.3M	OK				

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Photos 4-2: maize crop under center pivot irrigation by Selu Ltd

(b) Drip System

The drip irrigation system has blocks A, B, C. This is supported by a 45,000 cubic meter reservoir with a booster pumping station consisting of 6 centrifugal pumps and a filtration unit. The drip area is divided into blocks which have control heads with PRVs, Pressure gauges, 130mm micron filters. The drip tapes are 16 mm with pressure compensating emitters spaced at 0.5m maximum discharge 1.6 litres per hour.

Pump Type	**Number of pumps**	**Design Duty**	**Prime mover**	**Mounting**	**Status**
Centrifugal Pumps (drip)	6	230 M^3/hr	Generator 200 KVA	Fixed on slab	5 serviceable 1 requires major repair

Photos 4-3:maize crop under drip irrigation

4.1.1.2.5 Ancillary facilities

4.1.1.2.5.1 Fence

The farm is secured by an electric fence alongside a moat to mitigate against trespass and keep out wildlife. There are 16 solar houses and electric wire fence of 33 km which were inspected and for some houses it was recommended that further remedy be done to ensure conformity with the rated voltage.

The fence consists of the following

- 16 No. Solar houses
- 16 No. 18j Energizer
- 16 No. 20A charge controller
- 16 No. 140Watts Solar Panel
- 16 No. 100Ah Solar Battery

Table 4-2: Fence status

House No	Item Description	Make/Brand	Serial Number	Performance (kV)	Status
1	18j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	150270308	7.1	OK
2	12j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	154581184	5.4	OK
3	18j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	150270291	4.9	OK
4	18j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	134080604	6.9	OK
5	18j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	150370695	7.2	OK
6	18j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	143178615	7.2	OK
7	18j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	151573435	7.2	OK
8	18j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	151774036	8.7	OK
9	18j Energizer, 20A charge controller,	Stafix – True test	1520270293	6.6	OK

House No	Item Description	Make/Brand	Serial Number	Performance (kV)	Status
	140Watts Solar Panel and 100Ah Solar Battery				
10	18j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	143278813	6.2	OK
11	18j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	143278720	9.2	OK
12	18j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	150270283	6.8	OK
13	18j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	143278708	7.1	OK
14	18j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	150270540	6.5	OK
15	18j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	150270257	8.4	OK
16	18j Energizer, 20A charge controller, 140Watts Solar Panel and 100Ah Solar Battery	Stafix – True test	1511271827	4.9	OK

4.1.1.2.5.2 Farm roads

There are a number of farm roads which require maintenance from time to time. The total distance is about 100 km.

4.1.1.2.5.3 Logistic center

The logistic centre consists of the garage, tractor parking, 2 odzu grain drying units with drying rate of 18 tons every 4 hours each, 2 grain storage units of 800 tons each.

4.1.1.2.5.4 Tented camp

There are two tented camps and one iron sheet camp for staff.

i Senior staff tented camp: 10 units with makuti roof with washroom and piped water supply

ii Junior staff tented camp: 15 units without makuti and piped water supply

iii Operator iron sheet camp: 10 units with trailed water supply

4.1.1.2.6 Farm equipment

No	Equipment/Vehicle		Remarks
1	**Tractor** Reg/No: KTCB 480U	Case 180 Capacity: Engine No: 1438213 Machine Hours: 752.1 ➢ Serial No: ZGBH07051	➢ No manual books available. ➢ Only one ignition key available. ➢ Condition Seviceable
2	**Tractor** Reg/No: KTCB 071N	Case IH 260 Magnum Capacity: Type: RDCRDB7B Product ID: ZBRD06267 ➢ Machine Hours: 3913.3	➢ No manuals available ➢ Dual-wheels available but not fitted ➢ Condition Seviceable
3	**Tractor** Reg/No: KTCB 061R	Case 340 Capacity: Type: 2015 Product ID: ZFRF03904 ➢ Machine Hours: 3442.6	➢ No manuals available ➢ Suspended Axle Fault warning light on ➢ Dual-wheels available but not fitted ➢ Condition Serviceable
4	**Tractor** Reg/No: KHMA 521K	John Deere 6165J Capacity: Engine No: J06068B705616 Chasis No: IBM6165JCFB002678 ➢ Machine Hours: 2300	➢ No manuals available ➢ Left rear tyre has two cracks ➢ Condition Serviceable

No	Equipment/Vehicle		Remarks

5	**Tractor** Reg/No: KTCB 043N	New Holland Ts 6.040 Capacity: Make: NH6040 Type: 3-188-17 Engine No: 318126850 Serial No: L0151757 ➢ Hours reading: 1045.4 hrs	➢ No manuals available ➢ Left lift pump oil leakage ➢ Leakage on rear-left hydro-cylinder. ➢ Bent left lower link lift arm. ➢ Condition Requires repairs
6	**Tractor** Reg/No: KTCB 823P	New Holland TD 5.110 Engine No: 704028279 Machine Hours: 1937.2	➢ No manuals available ➢ Condition Seviceable
7	**Tractor** Reg/No: KTCB 524N	New Holland 6.140 Capacity: Engine NO: 2831308 Serial No: 00109320 ➢ Machine Hours: 3809.4	➢ No manual books ➢ Gear system faulty. ➢ Left rear wheel on a metallic stand and has no pressure. ➢ Condition Requires repairs
8	**Back Hoe** Reg/No: KHMA 824F	Make: JCB Capacity: Model: 3DX-Super Engine No: H00079248 Serial No: 1606851 Chasis No: HAR3DXSUJ01606851 ➢ Manufacture Year 2014	➢ No manual books ➢ One rear indicator damaged ➢ Three ignition keys available ➢ Two buckets available ➢ Condition Seviceable
9	**Combine Harvester** Reg/No: KTCB 601P	Case IH 6130 Axial Flow Capacity: Serial No: YDG011312 Manufacture Year: 2014 ➢ Machine Hours: 1267.65	➢ No manual books ➢ Eight row harvester fitted with Header ➢ Condition Seviceable

10	**Combine Harvester** Reg/No: KTCB 178R	Case IH 6140 Axial Flow Capacity: Model: 6140 AFS Product ID: YGG014288 Manufacture Year: 2016	➢ No manual books ➢ Eight row harvester with Header fitted ➢ Condition Seviceable

No	Equipment/Vehicle		Remarks
		➢ Machine Hours: 833.62	
11	**Forklift** Reg/No: KHMA 724H	Make: Manitou Loading Capacity: 3 tones Model: M-x 30-2 Serial Number 797388 Hours: 250.7 hrs ➢ Manufacture Year: 2015	➢ No manual books ➢ Condition Seviceable
12	**Forklift** Reg/No: KHMA 484G	Hyester 2.0 Model: 4TNE92-NMHA Capacity: Engine No: 44071 Hours: 1964 hrs ➢ Manufacture Year: 2014	➢ No manual books ➢ Condition Seviceable
13	**Trailer** Reg/No: ZF 2082	Self-tipping Grain Trailer Capacity: Make: Feil Capacity: Self-tipping Double-axle ➢ Serial No: 1777/15	➢ No manual books ➢ Condition Seviceable
14	**Trailer** Reg/No: ZF 0631	Make: CMC Capacity: ➢ Serial Number/Year: 0782/2015	➢ No manual books ➢ Condition Seviceable

15	**Trailer** Reg/No: ZF 1348	Flat-bed Trailer Capacity: Make: Feil ➢	➢ No manual books ➢ Condition Seviceable
16	**Cultivator** Field-Cultivator –	➢ Afula (No 1) ➢ Span	➢ No manual books ➢ No tag-plate for details ➢ 2 No. Pneumatic Trailing wheels faulty ➢ Condition requires replacement of tyres
17	**Cultivator** Field Cultivator –	Afula (No 2) Span Type: 1115	➢ No manual books ➢ Condition Seviceable

No	Equipment/Vehicle		Remarks
		➢ Year/Serial No: 16/16118	
18	**Cultivator** Field Cultivator –	Afula (3) Span Type: 1115 ➢ Year/Serial Number: 16/16117	➢ No manual books ➢ 2 No. Pneumatic Trailing wheels faulty ➢ Condition requires replacement of tyres
19	**Cultivator** Row Cultivator –	Afula (5) Span Type: 1161 ➢ Year/Serial No: 17/17016	➢ No manual books ➢ 2 No. Pneumatic Trailing wheels faulty ➢ Condition requires replacement of tyres
20	**Disc Harrow** (Afula) Heavy Disc harrow	Type: 1403 Span Year/Serial No: 17/17015 ➢	➢ No manual books ➢ With 14 plain discs and 14 serrated discs. ➢ Condition Seviceable
21	**Disc Harrow** (Afula) Heavy Disc harrow	➢	➢ No manual books ➢ With 24 plain discs. ➢ No tag-plate for details. ➢ Condition Seviceable
22	**Disc Harrow** Light disc –	Nardi Span Series: 44FC1230/GP Manufacture Year: 2012 ➢ Serial No: 563764	➢ No manual books ➢ With 22 serrated discs and 22 plain discs ➢ Condition Seviceable

23	**Fertilizer Elevator**	(Afula) Span Type: 1282 Year/Serial: 15/15311 ➢	➢ No manual books ➢ Condition Seviceable
24	**Cultivator** Conservation Tillage Cultivator (CTC)	Type: RFCSTxx Span Model: CTC Manufacture Year: 2015 Serial Number: RFCSTxx010053 ➢ Mass: 6,750 kg	➢ No manual books ➢ Rear coulter detached but available ➢ Condition Seviceable

No	Equipment/Vehicle		Remarks
25	**Sub-soiler**	Type: 4830 Span Serial: 4830-730F-B0251 Date of Manufacture: 02/17 ➢ Seven Bottom	➢ No manual books ➢ Condition Serviceable
26	**Multi-cut**	Make: Spearhead (Multicut 620) Model: 620R Serial No: 50610570 ➢ Year of Manufacture: 2016	➢ No manual books ➢ Condition Serviceable
27	**Sub-soiler**	Shuvalim ➢ Eight Bottom	➢ No manual books ➢ No tag-plate for details
28	**Shredder**	Model: RM 320 Make: KUHN ➢ Serial No: 142034	➢ No manual books ➢ Condition Serviceable
29	**Fertilizer Distributor/spreader**	Make: KUHN Type: Axis 30.1 Serail No: 09-41820 ➢ Capacity: 3000 kg	➢ No manual books ➢ Need dust-boot for the propeller shaft. ➢ Condition Serviceable
30	**Fertilizer Distributor/spreader**	Model: MDS 19.1 Serial No: 75092 ➢ Capacity: 1800 kg	➢ No manual books ➢ Condition Serviceable
31	**Boom Sprayer**	Make: Hardi Model: Ranger 2500 Serial No: 00150009000258 ➢ Capacity: 2500L	➢ No manual books ➢ Condition Serviceable
32	**Boom Sprayer**	➢ Make: Degania	➢ No manual books ➢ No tag-plate for details ➢ Dust-boot damaged ➢ Condition Seviceable
33	**Sprayer**	Make: KUHN Model: Optis 800L Serial No: E802B ➢ Year of Manufacture: 2014	➢ No manual books ➢ Condition Seviceable

No	Equipment/Vehicle		Remarks
34	**Monosem Fertilizer Drill (1)**	➢ Eight rows	➢ No manual books ➢ No tag plate for details ➢ Condition Seviceable
35	**Monosem Fertilizer Drill (2)**	➢ Eight rows	➢ No manual books ➢ No tag plate for details ➢ Condition Seviceable
36	**Monosem Planter (1)**	➢ Eight Rows	➢ No manual books ➢ No tag plate for details ➢ Condition Seviceable
37	**Monosem Planter (2)**	➢ Eight rows	➢ No manual books ➢ No tag plate for details ➢ Condition Seviceable
38	**Row Planter**	Make: Nardi Series: FK570/8 ➢ Serial No: 566653	➢ No manual books ➢ Deflated wheels ➢ Condition Seviceable

4.1.1.3 Project Costs

The Galana Kulalu Food Security project was funded using proceeds from credit agreement between Kenya and Bank Leumi of Israel and GoK development grants. The land development, acquisition of assets for installation and operation as well as construction of ancillary facilities is estimated to cost Kshs 5.95 billion (Kshs 2.55 billion GOK & Kshs 3.4 billion Bank Leumi loan) and an additional Kshs 600 million for the ongoing works to complete the 15% balance of works by June 2021. This will bring the total cost of the assets installed to Kshs 6.55 billion upon completion.

4.1.1.4 Project Access and Communication

The project is linked to Malindi via Baricho Road which is 140 km long and is an earth road from Galana to Baricho. Baricho to Malindi is currently being paved. Alternative route to from Galana to Malindi is a paved road of 110 km. This crosses river Galana near the intake but only s drift is available here and therefore it is impassable during high flows. KERRA is already planning to erect the bridge. At Baricho there is another bridge and an alternative road under construction to connect Baricho to Malindi. The project is linked to Voi by two earth roads passing through Tsavo East National Park. One route is 100 km but passes across Galana River through the drift at the project site. The other route is 150 km crossing Galana

River via a 30 ton steel girder bridge. The earth roads are a challenge during the rains. There are two airstrips which are operational in Galana that can land light aircraft of capacity 14 seats. The airstrip is made of well-maintained gravel. The airstrips are also being used for landing planes used for aerial spraying of crop.

The phone network service is fair with Safaricom being the only provider of the service. The internet speed in the area is satisfactory.

4.1.1.5 Agricultural Production of the Model Farm

The project purpose of the project was to will increase the production of maize as a food security crop as well as support growth of other crop enterprises such as sugarcane, horticulture, cotton and orchards, dairy and beef ranching. This section details the benefits to be derived from implementing the project and its contribution to the Government's general goals and policy

4.1.1.5.1 Farm size and technical solution

The total targeted area was 10,000 acres out of which 5,100 acres comprising of 20 centre pivots covering 3300 acres, pipes for drip irrigation covering 1800 acres that were installed Green Arava of Israel. The other part will comprise 5000 acres made up of 25 center pivots each irrigating 200 acres. Notably, the irrigation infrastructure installed presents the modern irrigation technologies adopted by commercial farmers since it guarantees high irrigation efficiency, precise application of water, support production of diverse crops and opportunity for automation.

4.1.1.6 Project Output Specifications and Performance Standards

4.1.1.6.1 Crops and value chains

Concerning production, under the contractor the farm yielded 109,259 bags of 90kg bags of maize valued at KES 278 million. The Authority took over cropping on the completed sections of the project starting with the 3300 acres. After taking over, in season 1, 2500 acres have already been prepared for planting and 2384 acres planted 2050 acres of maize, 42 acres cotton, 125 acres Green grammes, 125 acres Fodder and 42 acres soya. In Season II targeting 3300 acres, land preparation is at 1500 acres, 1000 acres planted with maize. Details of the already tested value chains is as detailed below: -

Maize

The major crop grown is maize. Aflasafe is being used on the farm to reduce the aflatoxin level to acceptable standards. With the product Galana Maize has met both the Kenyan and European standards.

Photos 4-4: **Stocks of maize harvested at Galana**

Table 4-3: **Maize production cost summary**

Production Inputs and Operations to Harvesting	**Kshs per Acre**
Inputs up to Harvesting	25,651.50
Land preparations	3,937.74
Irrigation	17,000.00
Harvesting	3,365.21
Post-Harvesting	3381.04
Supervision	1,346.53
Maintenance cost	1190.27
Grand Total to cost on production	**55,872.29**
Gross return upto harvesting 32 bags of 90kg @3000	86,400.00
Net return	30,527.71

Cotton

Table 4-4: ESTIMATED PRODUCTION COST OF COTTON PER ACRE

ESTIMATED PRODUCTION COST OF COTTON PER ACRE				
ACTIVITY	UNIT	N0. of units	UNIT COST	**COSTS (KSHS)**
Land preparation	acre	1	3400	3400
O&M	acre	1	3400	3400
Planting	acre	4	400	1600
Spraying Labour(9 times)	Man-days	9	300	2700
First Weeding	Man-days	10	300	3000
Second Weeding	Man-days	8	300	2400
Third Weeding	Man-days	6	300	1800

Harvesting	Man-days	30	400	12000
Grading and packing	Man-days	18	300	5400
Top dressing	Man-days	1	300	300
Polytrin	lts	2	1000	2000
Nurelle D	lts	0.5	1000	500
Thunder	lts	0.5	1000	500
D.A.P/NPK	Bags	1.33	3800	5054
Urea	Bags	1.33	3300	4389
Packing bags	pcs	30	50	1500
Diesel	lts	115	100	11500
Total Costs				**61443**
AVERAGE YIELD(KGS)			2000	
PRICE PER KG(Kshs)			55	
TOTAL INCOME				**110000**
NET PROFIT per acre				48557
BREAK EVEN PRICE				30.7215

4.1.1.6.2 Demonstration farm

A demonstration plot of 10 acres has been established and planted with various crops. The crops planted include Banana, Mango, Cashew nuts, Citrus, Coconut, Passion fruits, Water melon, Kales, Tomatoes, cotton, Sugar cane and cassava. The demonstration farm has proved that not only maize can be produced in Galana but other crops as well. Tomatoes, Water melons, Passion fruits, citrus, cashew nuts, pineapple, cassava and coconut have been singled out as the candidate alternative crops to maize.

Photos 4-5: Pineapples under drip system at the demonstration farm

4.1.1.6.3 Farm production activities

The farm is highly mechanized but there are also farm hands being hired to support crop production. The machinery on the farm are sufficient to carry out farming throughout the year by putting area under crop as 2000 acres in succession to be harvested every month for 10 months. Two, (2) months were omitted due to the peak rainy months of the year.

The heavy machinery for land preparation have high performance of about 8 acres per hour. Chemical application is done using tractor drawn boom sprayers however, the centre pivots are also being used for the same attached to fertigation pumps. Harvesting is being carried out by two combine harvesters working at an average rate of 40 acres per day

To minimise the cost of crop production, conservation agriculture technology is being employed to improve the soil structure. This has resulted into increase in soil organic matter, water infiltration and retention hence the saving on the cost of irrigation per unit area.

4.1.1.6.4 Power Requirement

It is estimated that the Model Farm requires installation of electricity from the National electricity supply grid or a solar farm to be located near the farm to supply 5MW. The current use of diesel to power Engines is costly and affects the gross margins. For instance, one pump irrigating 500 acres consumes 60 litres per hr of 22 hours. Each centre pivot in operation consumes 40 litres per day as used in generators supporting operation of centre pivots.

4.1.1.6.5 Staff Complement.

The key staff operating the farm is the Manager, Agronomists, Irrigation Engineers, Accountants, Plant Operators and drivers. The labourers (farm workers) are on temporary terms and are sourced from the neighboring villages.

4.1.1.7 Challenges and Further Opportunities for Investment

4.1.1.7.1 Performance of the irrigation system

The project location has high temperatures and occasional winds that affect the application efficiency of the system. This is easily overcome with good experience and competent team to operate the system. The private partner may undertake improvements based on their experience to enhance the efficiency of the system.

4.1.1.7.2 **Intake**

The flood events in the recent years affected the morphology of the river at the current intake site. This has resulted in silt deposition when the river is in spate after flood events. As part of operation, the silt is removed to ensure smooth running of the pump station. This is also a possible area of improvement for the private partner.

4.1.1.7.3 Soils

Galana farm soils have a saline and sodic layers in the medium depth of the profile. Hence deep ploughing has to be avoided through No till or minimum tillage support by periodic ripping. The soil health has greatly improved from use of farm yard manure and conservation tillage where the crop biomass is reintegrated into the soil to increase the organic material content.

4.1.1.7.4 Pests and diseases

The main pests include fall army worms and rodents while maize rust is main disease observed during maize production. Cotton production was mainly affected by jassid and cotton bollworms however adoption of the BT cotton variety complemented by a single spray contained the pests.

4.1.1.7.5 Land Ownership

The project is set up on land owned by Agricultural Development Corporation, a state agency under the Ministry of Agriculture. As the onset of the project, ADC entered into a 3-year lease from 2015 with NIA. However, the Attorney General in has given an advisory opinion on payment of the lease noting that this is a government initiative to close the food gap and thus need to minimize on the cost of operating the farm.

4.1.1.7.6 Human-Wildlife Conflict

The project boarders a wildlife conservancy to the western part of the farm. Periodically, the wild animals crosses over to some parts of the farm in search of water and pasture. Electric fencing and a moat around the firm has minimised the encroachment and conflict.

4.1.1.7.7 Energy

The pumping station operates on disiel fuel. There is no electicity connectivity in the area. However, efforts are in place to ensure connectivity of the farm to the national grid for improved efficiencies.

4.1.1.7.8 Accessibility

Poor roads and lack of a bridge to the project makes it challenging to access and transport materials to the project. However, alternative routes and bridges have been identified to enable communication to the project. In the long run, the GOK has commenced the process of constructing a road and major bridge to the project.

4.1.1.8 Handing Over Production on Model Farm to the Private Sector

The installation of irrigation infrastructure and other ancillary facilities has set up the 10,000 acre model farm ready for production. To ensure full utilization of the model farm to meet the production objective, it is proposed that the project is handed over to the private sector under a suitable PPP model.

4.1.2 Phase 2

4.1.2.1 General

This land currently is a rangeland with no development.

Phase 2 is adding 10,000 acres under pivot and building on the success of Model Farm.

It is located on the Eastern side of the model farm in Galana ranch, about 40km from the head office of the model farm.

About 10,000acres will be under maize production while 10,000acres will be under castle oil to be used for Bio-fuel.

4.1.2.2 Location of Phase 2

Phase 2 is located just on top of the model farm, about 15km North of the NIA offices in Kilifi County.

The land is rectangular in shape and can be located by the following coordinates (Refer figure 4-4 and table 4-5)

Table 4-5: Coordinates defining Phase 2

Description		**GPS No.2**		
	Region (M)	**Longitude (UTM) East**	**Latitude (UTM) South**	**Altitude (ft)**
Point A	37N	534964.53	9666458	591
Point B	37N	543028.92	9668270.89	563
Point C	37N	542442.84	967159.27	603
Point D	37N	534444.1	9671195.57	626

Below are the characteristics of Phase 2:-

Table 4-6: Characteristics of Phase 2

Width	8122.63	m
Length	4924.513	m
Area	10000	Acres

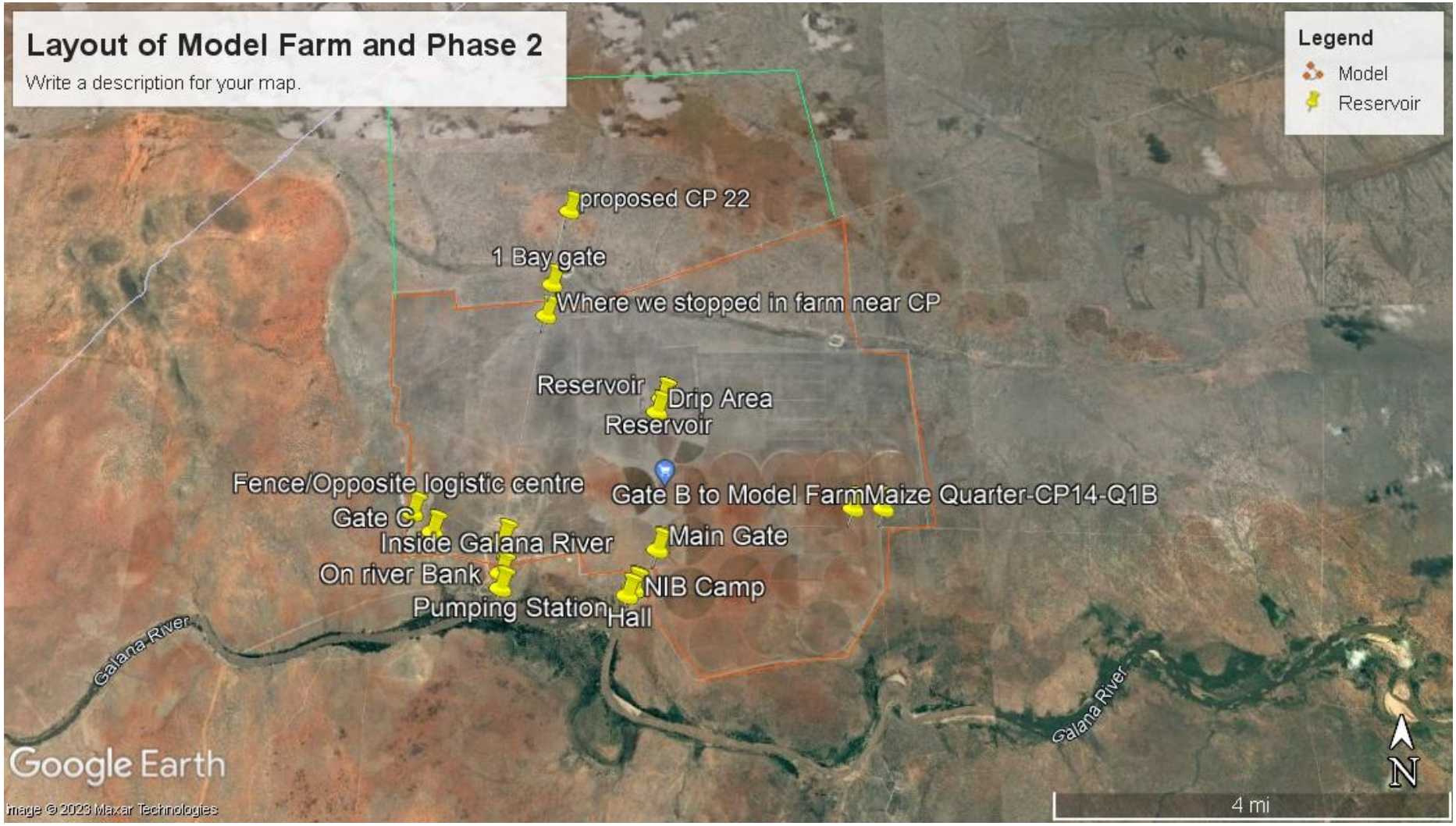


Figure 4-4: Location of Phase 2 (In green)

4.1.2.3 Infrastructural Development

To ease on financial burden and ensures that the infrastructural development does not affect the irrigation of phase 1 (Model) and 2 is proposed to phase the works into 2 (Two) phases as follows:-

1. **Phase 1:-** Rehabilitation works through addressing current intake works shortcoming and existing infrastructure improvements

2. **Phase 2:-** Relocation and improvement of current intake works, building new facilities and augmentation of infrastructural works and providing farm storage to cover at least 90 days as required by Water Resources Authority and when there is no adequate water in the Galana River to cover the anticipated abstraction.

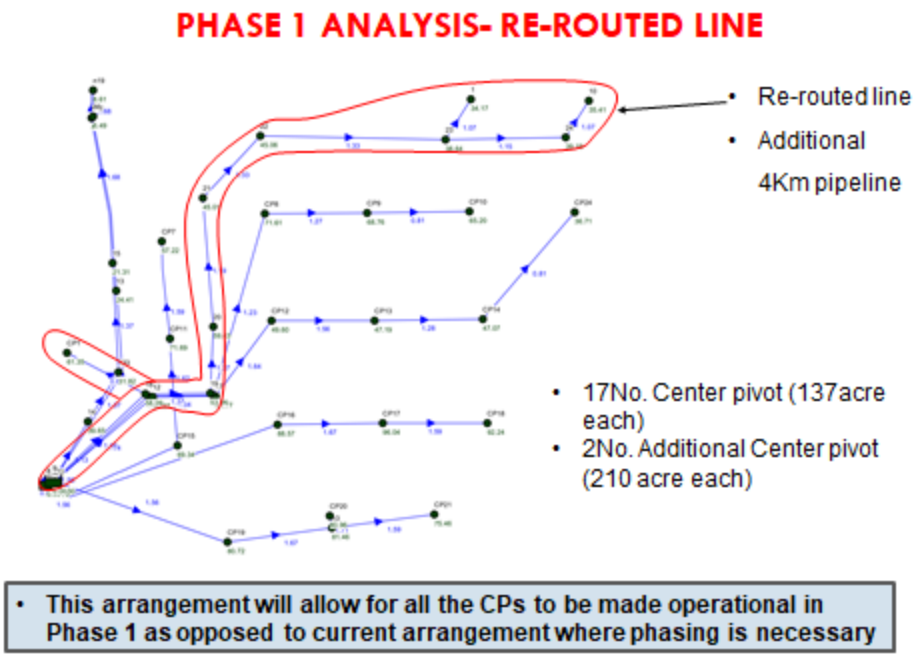
4.1.2.3.1 **Phase 1:-** Rehabilitation works through addressing current intake works shortcoming and existing infrastructure improvements

4.1.2.3.1.1 Proposed Rehabilitations

1. The Intake improvement works will include construction of the detention basin and lining a section of the canal to remove sediments which are currently wearing the impellers and reducing their lifespan. A section of the canal will also be lined to reduce water losses.

2. To operate 20No. CPs simultaneously, 4No. Additional pumps are required. The current pump house and pipework can support.

3. Some of the current pipeline will be rerouted so that allow 22CP can operate simultaneously



4. The supply, installation and operation is dependent on the rehabilitation of CPs and drip area.

4.1.2.3.1.2 Cost Implications

A total of Kshs 237,177,461 is required to undertake the rehabilitation works required (Refer table 4-9)

Table 4-7: Preliminary Costs and Time Schedule of Phase 1: Rehabilitation Works

PIPEWORK AND PUMPS : PRELIMINARY COSTS AND TIME SCHEDULE

			IMPLEMENTATION PLAN (MONTHS)					
ITEM	DESCRIPTION	PRELIMINARY COST	2	4	6	8	12	14
1	PIPEWORK	71,299,533.0						
2	RESERVOIRS	69,713,785.0						
3	CANAL							
4	PUMPS UPGRADE & PIPE FITTINGS	24,000,000.0						
		237,177,461						

3

Through pursuing two (2) possible options as indicated in table 4-10 and 4-11.

Table 4-8: Phase 1 Option 1 Summary of Cost Estimates

PHASE 1 OPTION 1

ITEM		MONTHS		
	ACTIVITIES/DURATION	0-3	3-6	6-9
1	INTAKE WORKS (excavation and lining of RESERVOIRS&CANAL)	69,713,785		
2	INTAKE PUMPS (PURCHASE&INSTALLATION)		24,000,000	
6	PROJECTED COST	69,713,785	24,000,000	
3	ACTIVATION OF CENTER PIVOTS FARM AREA	15CPS (2400ACRES)	5 CPS (3200ACRES)	
4	ACTIVATION OF DRIP FARM AREA	NONE	1,800	
5	FARM UNDER CULTIVATION (ACRES)	2,400	5,000	
	PROJECT SOLARISATION			210,000,000

1. The Intake works will include construction of the detention basin and lining a section of the canal
2. To operate 20No. CPs simultaneously, 4No. additional pumps are required. The current pump house and pipework can support.
3. The supply, installation and operation is dependent on the rehabilitation of CPs and drip area.

Table 4-9:Phase 1 Option 2 Summary of Estimated Cost

PHASE 1 OPTION 2

ITEM		MONTHS		
	ACTIVITIES/DURATION	0-3	3-6	6-9
1	INTAKE WORKS (RESERVOIRS&CANAL)	69,713,785		
2	INTAKE PUMPS (PURCHASE&INSTALLATION)		24,000,000	
3	PARALLEL LINE TO CP12(2) &CP13(2)		71,299,533.66	
3	CENTER PIVOTS FARM AREA	15CPS (2400)	22CPS (3620)	
4	DRIP FARM AREA	NONE	1,800	
5	FARM UNDER CULTIVATION (ACRES)	2,400	5,420	
6	**PROJECTED COST**	69,713,785	95,299,533.66	
	PROJECT SOLARISATION			231,000,000

1. To operate 22No. CPs simultaneously, 5No. additional pumps will be required. The current pump house and pipework can support.
2. The supply, installation and operation is dependent on the rehabilitation of CPs and drip area.

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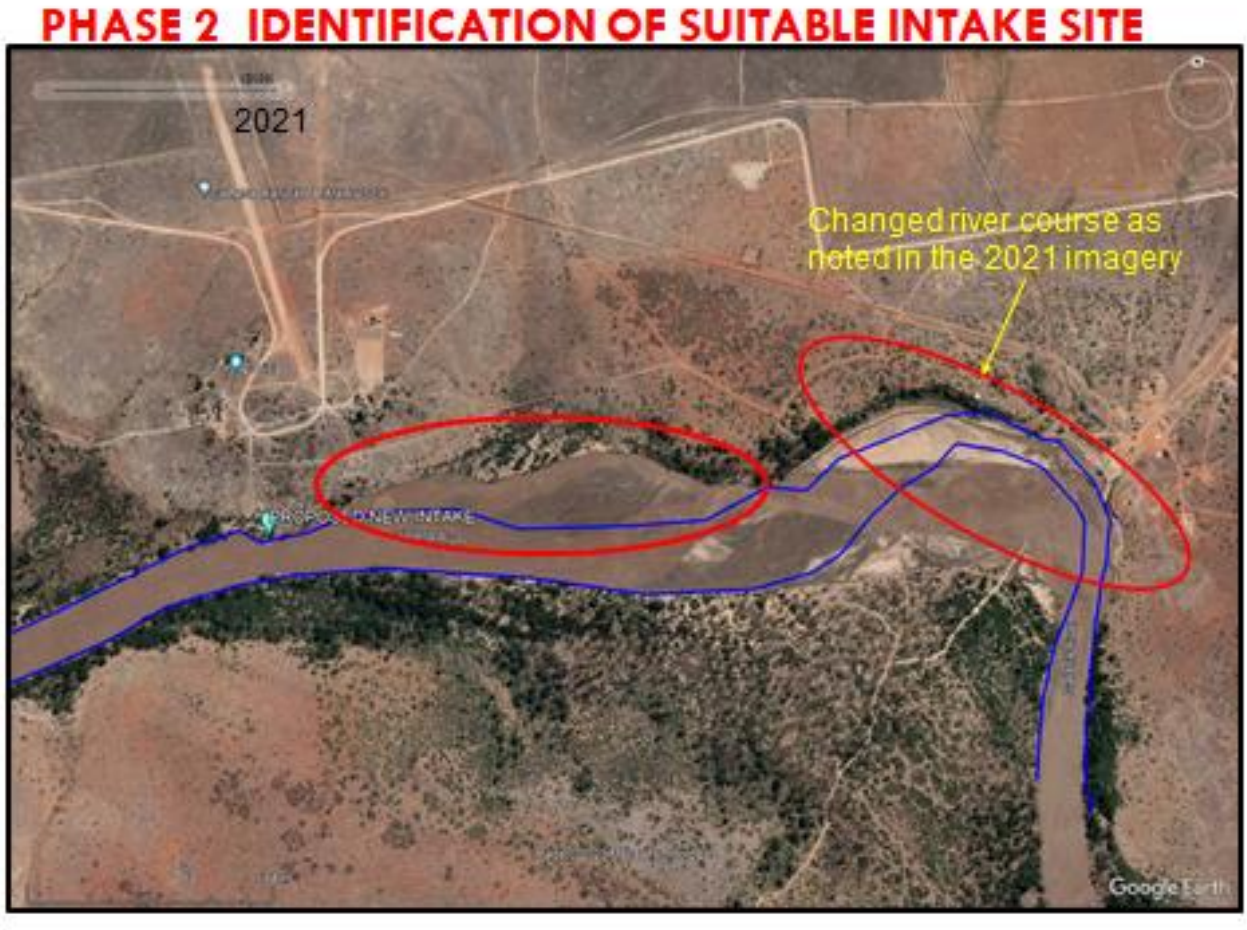
4.1.2.3.2 **Phase 2:-** Relocation and improvement of current intake works, building new facilities and augmentation of infrastructural works and providing farm storage to cover at least 90 days as required by Water Resources Authority and when there is no adequate water in the Galana River to cover the anticipated abstraction

4.1.2.3.2.1 Proposed Augmentations

4.1.2.3.2.1.1 Identification of Suitable Intake

The current intake site according to 2021 google imagery has changed as indicated below:-

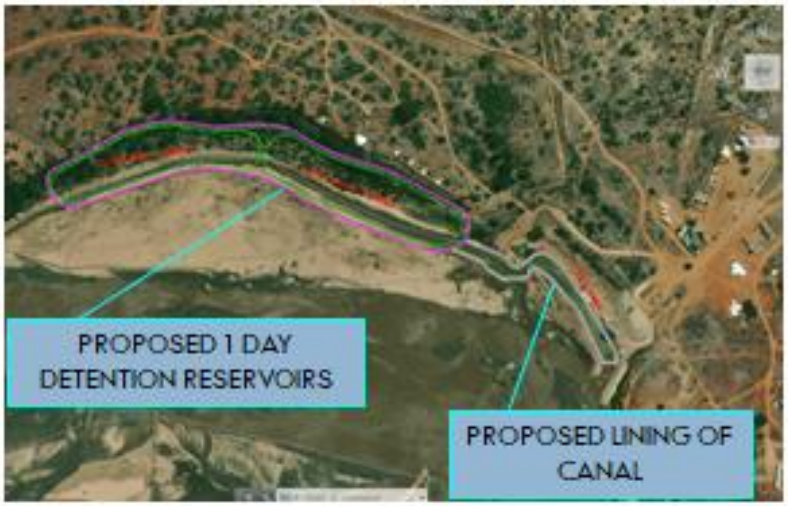


In view of the above, there is need to locate it at a permanent site.

4.1.2.3.2.1.2 Proposed Silt Reduction at the Intake

The current intake has no pre-treatment facility. There is need to reduce sediments through construction of plain sedimentation near the intake including the cost implication.

PROPOSED SILT REDUCTION AT THE INTAKE



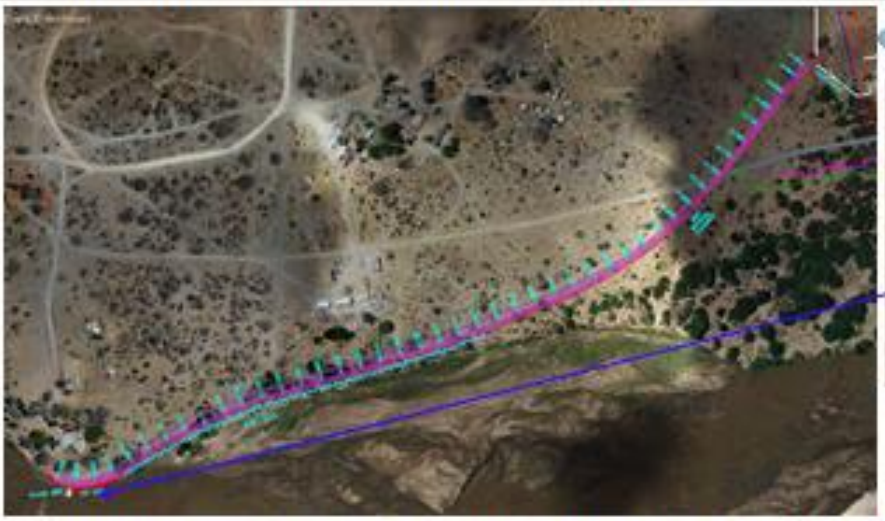
ITEM	DESCRIPTION	PRELIMINARY COST
1	RESERVOIRS EXCAVATIONS	41,391,000
2	LINING OF CANAL & 1NO. RESERVOIR	10,347,750
3	RIP-RAP AND GEOTEXTILE FOR SLOPE PROTECTION	4,281,565
		56,326,915

8 **It is noted that the above measures are not conclusive and additionally the structure is susceptible to periodic flooding. It is worth to note that a huge investment has been put into the intake facilities**

4.1.2.3.2.1.3 Proposed Weir and Canal to Abstract Water from the River

RAW WATER ABSTRACTION WORKS (PH 2) - 1

PROPOSED WEIR AND CANAL TO ABSTRACT WATER FROM THE RIVER



Proposed gate type

1. The intake weir is capable of abstracting volumes sufficient to meet Phase 1 and 2 needs (139,000 + 158,000 M3/DAY).
2. The canal is protected from flooding risks and piers that will support the canal from dispersive soils
3. Vortex means of silt flushing are proposed

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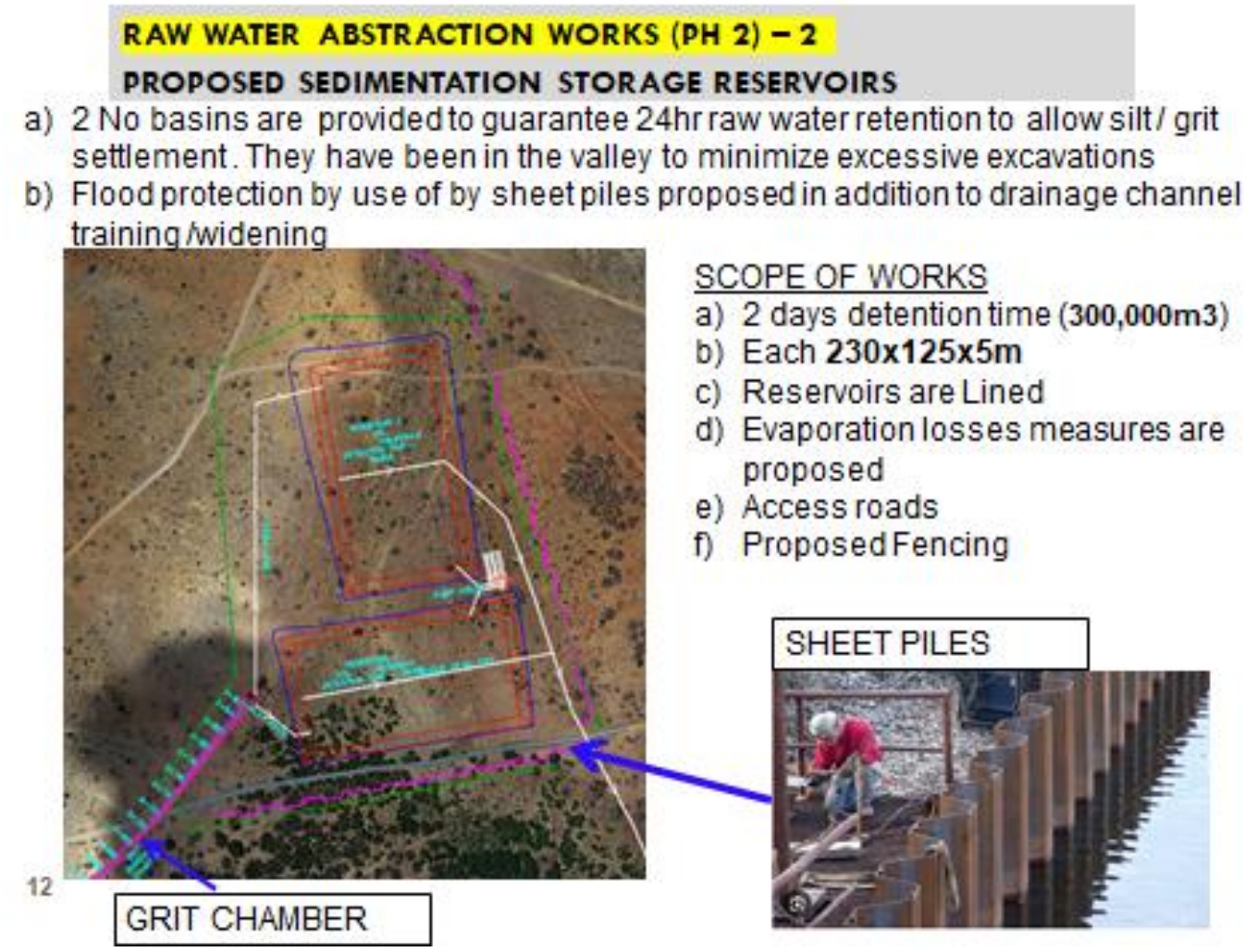
According to **Amiran&Agri green Feasibility Report,** the Q80 vary between 4.4m3/s and 3.5m3/s . Thus 3.5m3/s was adopted in designing the weir and the canal

4.1.2.3.2.1.4 Proposed Sedimentation Storage Reservoirs

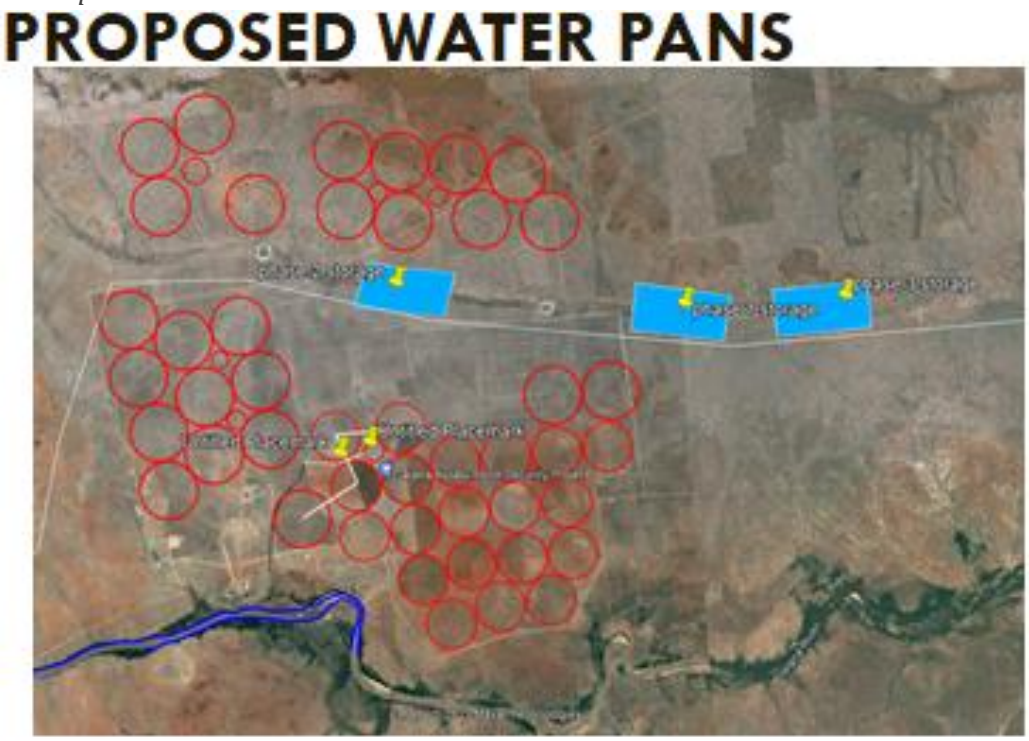


4.1.2.3.2.2 Storage

4.1.2.3.2.2.1 Analysis

1. Irrigation water was estimated at 13,005 m3/ha.
2. The mean river flow from Athi/Galana is 91.8m3/s
3. The mean environmental flow is 4.4 m3/s and the approved abstractions along the river is 20m3/s
4. The Q80 flows vary between 3.5m3/s to 4.4m3/s
5. The current abstraction is 3.4375 m3/s

4.1.2.3.2.2.2 Proposed Water Pans



- Each Pan has the capacity of 5,400,000m3 (8.1million inclusive of evaporation)
- This is a 30 day storage
- 3No. Options are proposed to fill the water pans;
  - To be filled by the proposed dam to be done by the national government
  - To construct a weir at an upstream location to fill the pans by gravity
  - To install pumps to fill the reservoirs

A storage of 3 pans are proposed to be constructed on the laga located in Phase 2 and currently feeding 2 pans as indicated in figure 4-8.

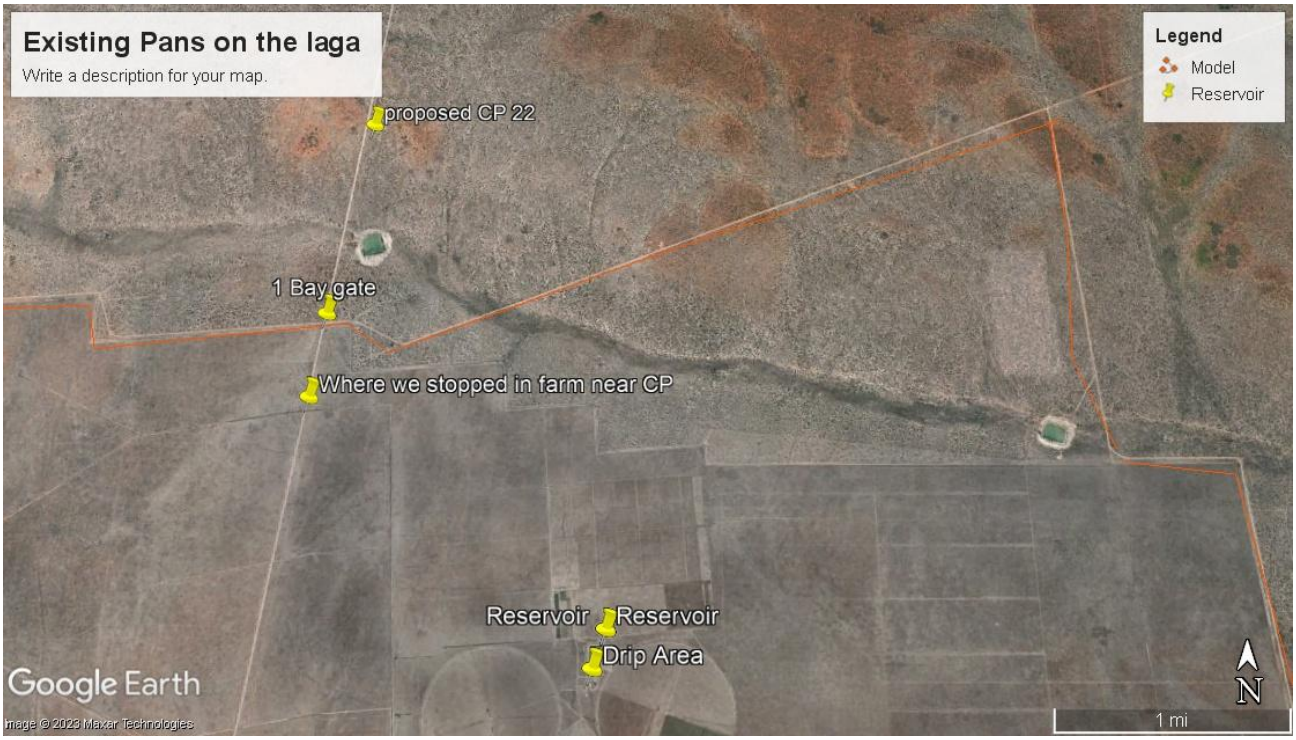


Figure 4-5: Existing Pans on the laga

This laga is located in phase 2 in Kilifi County and crosses model farm around the middle top and proceeds to model farm. It has a length of about 23km and a catchment of 194.6km2 which is adequate to fill one pan in a year of capacity 8.1million m3 hence requires water from Galana River to fill the remaining two pans (Refer figure 4-7 for catchment and table 4-12 for catchment yield)

Table 4-10: Anticipated Catchment of the Laga

CATCHMENT YIELD
The annual runoff for the catchment (the catchment yield in an average year),
Y, in m^3, is given by:
Y = Rr x A x 1 000
Where A is catchment area in km^2
Rr is Annual Rainfall in mm times Runoff Coefficient mostly assumed to be 10%

Source:_FAO Irrigation and Drainage Paper 64-Manual on Small Earth Dam, a guide to siting, design and construction dated Rome, 2010						
A	Rr	Y				
km^2	%	m^3/year				
194.6	50	9,730,232				
Note						
The Catchment yield is 9,730,232m^3/year						

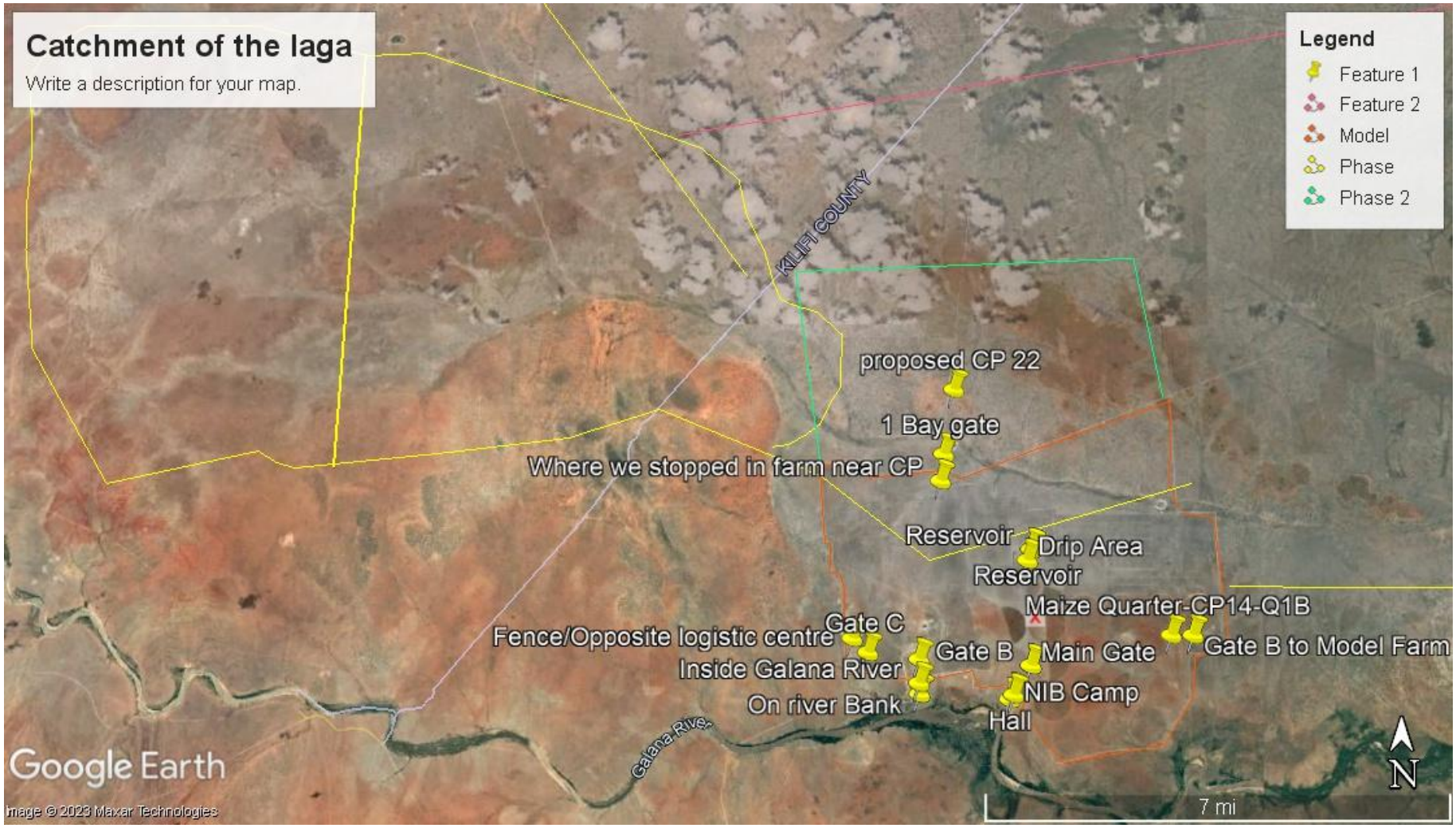


Figure 4-6: Catchment of the Laga

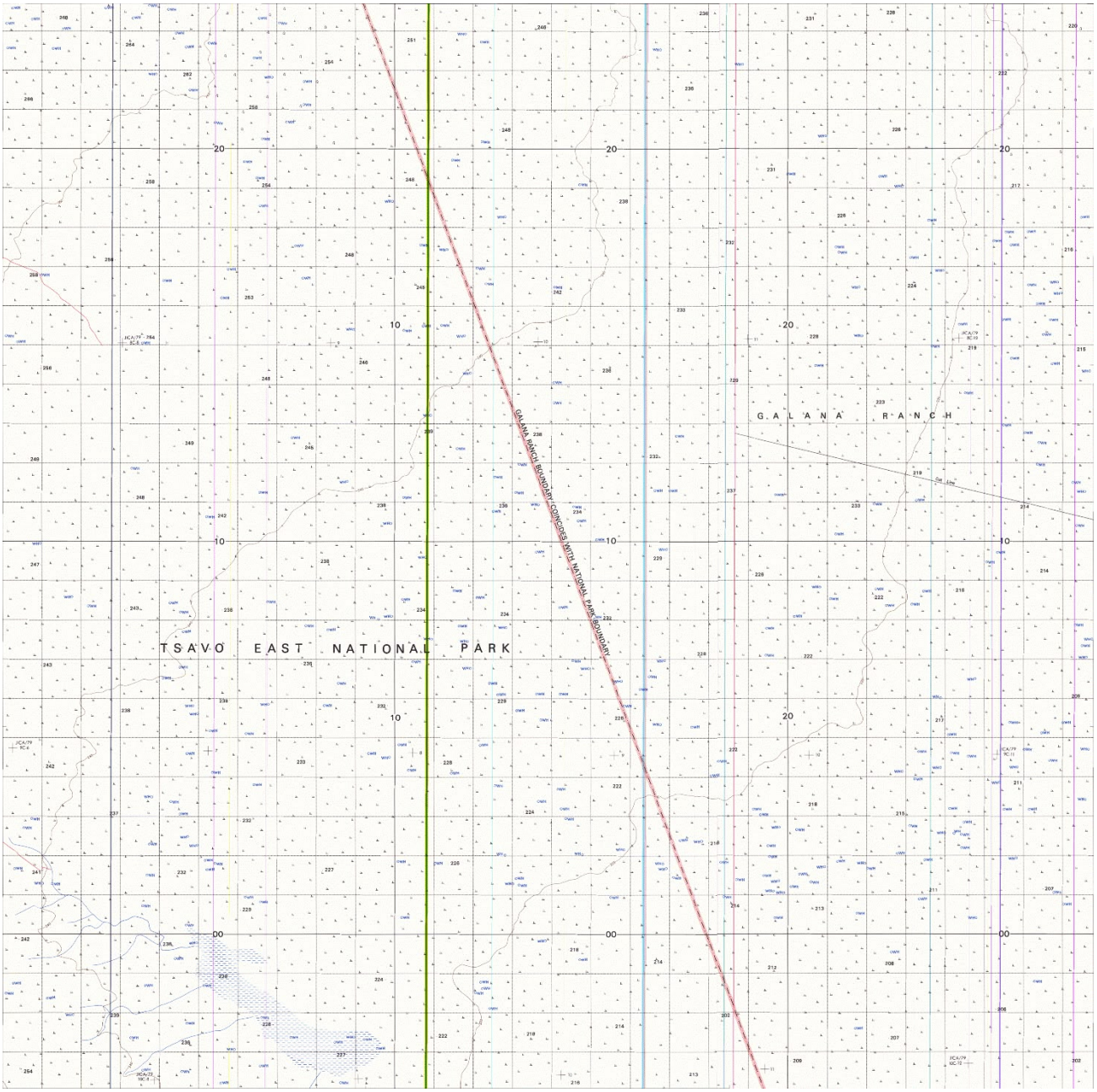
The laga enters Galana Ranch at:-

Region	37N
Longitude	532583.79mE
Latitude	9670256.00MS
Altitude	604ft

Lives Galana Ranch:

Region	37N
Longitude	543265.18mE
Latitude	9665865.32MS
Altitude	506ft

This area is generally flat and it is prone to flooding as indicated in map 4.1.



Map 4-1:Map showing the Galana Ranch (Refer SK 185/1 Emusya East

4.1.2.3.2.3 Cost Estimates

Kshs 237,177,461 is required to improve the intake works as indicated below:-

NEW INTAKE PRELIMINARY COSTS AND TIME SCHEDULE

			IMPLEMENTATION PLAN (MONTHS)					
ITEM	DESCRIPTION	PRELIMINARY COST	2	4	6	8	12	14
1	INTAKE WEIR	22,900,120						
2	GRIT CHAMBER	2,528,000						
3	RESERVOIRS	90,609,857						
4	SHEET PILING WORKS/FLOOD & EROSION PROTECTION	16,832,800						
5	CANAL	32,860,683						
7	SUPPORT COLUMNS	15,000,000						
8	FENCING	4,446,000						
9	PUMP HOUSE/PIPE FITTINGS	52,000,000						
10		**237,177,461**						

4.1.2.3.3 Pipeline Works

Four Scenarios have been considered as below:-

SCENARIOS DESIGN CONSIDERATIONS IN PHASE 2

PHASE 2 ONLY					
A	B	C	D	E	F
Scenario investigation		Description	Considers new intake location	Considers additional parallel lines	Additional reservoir in field
1		Complete construction of the original design	NO	NO	NO
2		As in (1) above with new parallel line	NO	YES	NO
3		As in 1 above in new intake location and new parallel line	YES	YES	NO
4	4.1	As in (1) above but with new intake location, new parallel line and infill reservoirs	YES	YES	YES
	4.2	As in 4.1 but with a 3rd parallel line	YES	YES	YES
	4.3	As in (1) above but with new intake location, new parallel line and infill reservoirs	YES	YES	YES

NEW INTAKE PRELIMINARY COSTS AND TIME SCHEDULE-1

			IMPLEMENTATION PLAN (MONTHS)					
ITEM	DESCRIPTION	COST (kshs)	2	4	6	8	12	14-16
1	**SCENARIO 1** COMPLETE ORIGINAL WORKS	410,866,083						
2	**SCENARIO 2:** RELOCATION/CONSTRUCTION OF PARALLEL LINE	1,451,491,929						
3	**SCENARIO 3:** RELOCATION/CONSTRUCTION OF PARALLEL LINE + NEW INTAKE	1,498,007,549+ **237,177,461**						
4	**SCENARIO 4.1 :** RELOCATION/CONSTRUCTION OF PARALLEL LINE +6 RESERVIORS + NEW INTAKE	**1,551,288,817+ 237,177,461+ 270,000,000**						

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NEW INTAKE PRELIMINARY COSTS AND TIME SCHEDULE-2

			IMPLEMENTATION PLAN (MONTHS)					
ITEM	DESCRIPTION	COST (kshs)	2	4	6	8	12	14-16
4	**SCENARIO 4.2 :** RELOCATION/CONSTRUCTION OF 2No PARALLEL LINE +6 RESERVIORS + NEW INTAKE	**2,140,310,053+ 237,177,461+ 270,000,000**						
4	**SCENARIO 4.3 :** RELOCATION/CONSTRUCTION OF PARALLEL LINE +4No RESERVIORS + NEW INTAKE	**1,639,670,770.66+ 237,177,461+ 270,000,000**						

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SCENARIO 1 - (AS IS)

1. This Scenario Considers Completing the Implementation of Designs as Envisaged by NIA under their existing contract.

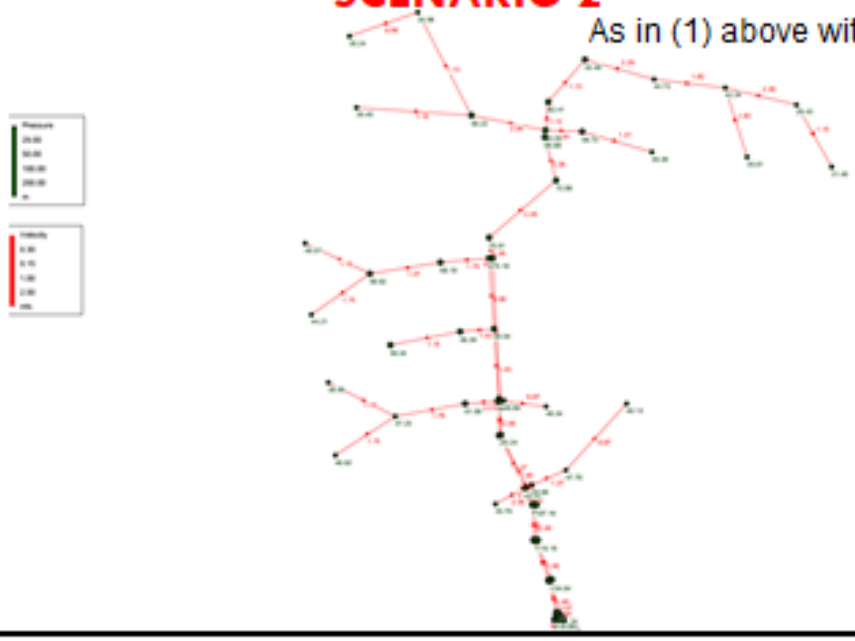
Limitations

1. Not all 25 CPs CAN BE OPERATED SIMULATENOUSLY
2. Intake is shared with Phase 1 (water abstraction capacity will eb affected if intake in not enlarged)

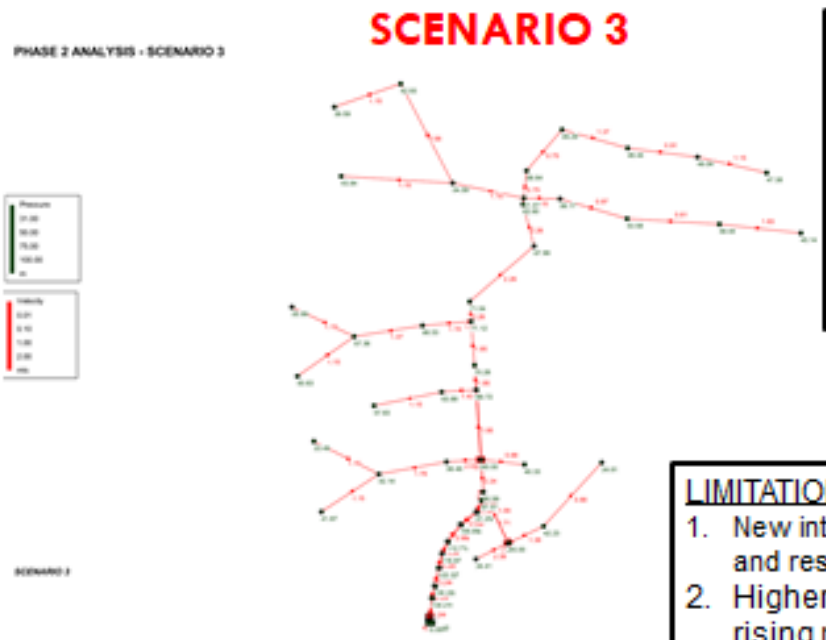
PHASE 2 ANALYSIS- SCENARIO 2

SCENARIO 2

As in (1) above with new parallel line



- Proposed to serve some Phase 1 CPs in line with Phase 1 optimization measures
- parallel main line (DN800) now provided to enable the irrigation of all (23+3) 26No CPs simultaneously
- LIMITATION : Intake is shared with Phase 1 (water abstraction capacity will eb affected if intake in not enlarged)



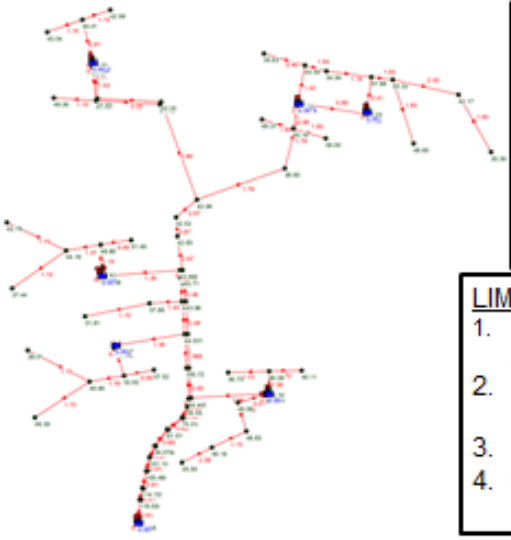
1) Parallel main line (DN800) now provided to enable the irrigation of all (23+3) 26No CPs simultaneously
1) NEW intake facilities now provided

LIMITATIONs :

1. New intake and pumping station and reservoir must be constructed
2. Higher velocities in a section of rising mains

A	B	C	D	E	F
Scenario Investigation		Description	Considers new intake location	Considers additional parallel lines	Additional reservoir in field
1		Complete original design as is	NO	NO	NO
2		As in (1) above with new parallel line	NO	YES	NO
3		As in (2) above in new intake location	YES	YES	NO
4	4.1	As in (3) above with infill reservoirs	YES	YES	YES
	4.2	As in (3) above with infill reservoirs and extra parallel line	YES	YES	YES
	4.3	As in (3) above with infill reservoirs	YES	YES	YES

SCENARIO 4.1 AND 4.2



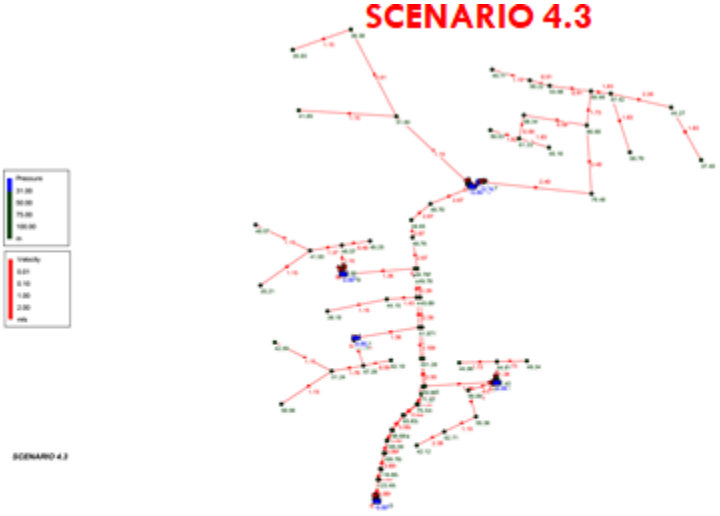
1) Parallel main line (DN800) now provided to enable the irrigation of all (23+3) 26No CPs simultaneously
1) NEW intake facilities now provided
2) Infield reservoirs and pumping facilities included

LIMITATIONs :

1. New intake and pumping station and reservoir must be constructed
2. Higher velocities in a section of rising mains
3. 3rd parallel line
4. Construction of additional infield reservoirs and pimping stations

Scenario Investigation		Description	D Considers new intake location	E Considers additional parallel lines	F Additional reservoir in field
1		Complete original design as is	NO	NO	NO
2		As in (1) above with new parallel line	NO	YES	NO
3		As in (2) above in new intake location	YES	YES	NO
4	4.1	As in (3) above with infil reservoirs	YES	YES	YES
	4.2	As in (3) above with infil reservoirs and extra parallel line	YES	YES	YES
	4.3	As in (3) above with infil reservoirs	YES	YES	YES

SCENARIO 4.3



PHASE 2 ONLY					
A	B	C	D	E	F
Scenario Investigation		Description	Considers new intake location	Considers additional parallel lines	Additional reservoir in field
1		Complete original design as is	NO	NO	NO
2		As in (1) above with new parallel line	NO	YES	NO
3		As in (2) above in new intake location	YES	YES	NO
4	4.1	As in (3) above with infil reservoirs	YES	YES	YES
	4.2	As in (3) above with infil reservoirs and extra parallel line	YES	YES	YES
	4.3	As in (3) above with infil reservoirs	YES	YES	YES

4.1.2.4 Summary

SUMMARY OF SCENARIOS INVESTIGATED

PHASE 2 ONLY															
A	B	C	D	E	F	G	H	I	J	K	L	O	O	M	N
Scenario investigation		Description	Considers new intake location	Considers additional parallel lines	Additional reservoir in field	Maximum No of CPs irrigable simultaneously	Gross irrigable area (Ha)	Size of additional parallel main pipe requires	Length (km)	No pump at main station station	Infield reservoir (No.)	No pump at each reservoir station	Total No pump at reservoir station	Reservoir capacity (each) (m3/day)	Total capacity reservoir (m3/day)
1		Complete original design as is	NO	NO	NO	7(9)	595 (765)	0	0	3(6)	0	0	0	0	0
2		As in (1) above with new parallel line	NO	YES	NO	23No +3No from phase 1	2123	DN 800	10	8	0	0	0	0	0
3		As in (2) above in new intake location	YES	YES	NO		2123	DN 800	10	8	0	0	0	0	0
4	4.1	As in (3) above with infil reservoirs	YES	YES	YES		2123	DN 800	10	9	2	3	6	30,000	180,000
											4	4	16		
	4.2	As in (3) above with infil reservoirs and extra parallel line	YES	YES	YES		2123	DN 800	15	9	2	3	6	30,000	180,000
											4	4	16		
	4.3	As in (3) above with infil reservoirs	YES	YES	YES		2123	DN 800	11	9	1	6	6	30,000	90,000
											2	3	6		
											1	4	4	90,000	90,000

SUMMARY OF SCENARIOS INVESTIGATED- POWER CONSUMPTION

PHASE 2 ONLY														
A	B	C	D	E	F	G		H	I	J	K	L	M	N
Scenario investigation		Description	Maximum No of CPs irrigable simultaneously	Size of additional parallel main pipe requires	Length (km)	No pump at main station station	main pumps total Kw/month	Infield reservoir (No.)	Reservoir capacity (each) (m3/day)	Total capacity reservoir (m3/day)	No pump at each reservoir station	Total No pump at reservoir station	infil pumps total Kw/month	Total pump Kw/month
1		Complete original design as is	7(9)	0	0	3(6)	1,168,440.00	0	0	0	0	0		1,168,440.00
2		As in (1) above with new parallel line	23No +3No from phase 1	DN 800	10	8	2,359,812.00	0	0	0	0	0		2,359,812.00
3		As in (2) above in new intake location		DN 800	10	8		0	0	0	0	0		2,359,812.00
4	4.1	As in (3) above with infil reservoirs		DN 800	10	9	2,654,788.50	2	30,000	180,000	3	6	887,045.25	3,541,833.75
								4			4	16		
	4.2	As in (3) above with infil reservoirs and extra parallel line		DN 800	15	9		2	30,000	180,000	3	6	887,045.25	3,541,833.75
								4			4	16		
	4.3	As in (3) above with infil reservoirs		DN 800	11	9		1	30,000	90,000	6	6	933,462.08	3,588,250.58
								2			3	6		
								1	90,000	90,000	4	4		

INDICATIVE INSTALLATION COST FOR PRINCIPLE WORKS

installation costs								
Scenario		Description	initial cost	extra pipeline	main pumps	reservoirs	infield pumps	TOTAL
1		Complete original design as is	665,702,575	-	36,466,049	-	-	702,168,624
2		As in (1) above with new parallel line	665,702,575	851,904,000	48,621,398	-	-	1,566,227,973
3		As in (2) above in new intake location	665,702,575	851,904,000	48,621,398	-	-	1,566,227,973
4	4.1	As in (3) above with infill reservoirs	665,702,575	851,904,000	54,699,073	270,000,000	26,150,132	1,868,455,781
	4.2	As in (3) above with infill reservoirs and extra parallel line	665,702,575	1,277,856,000	54,699,073	270,000,000	26,150,132	2,294,407,781
	4.3	As in (3) above with infill reservoirs	665,702,575	937,094,400	54,699,073	270,000,000	28,359,222	1,955,855,270

PRELIMINARY COSTING – PUMP OPERATIONAL COST

operational costs					
Scenario		Description	main pumps	infill pumps	PUMPING COST (KSH/M3)
1		Complete original design as is	23,368,800	-	13.64
2		As in (1) above with new parallel line	47,196,240	-	9.81
3		As in (2) above in new intake location	47,196,240	-	9.81
4	4.1	As in (3) above with infil reservoirs	53,095,770	17,740,905	12.23
	4.2	As in (3) above with infil reservoirs and extra parallel line	53,095,770	17,740,905	12.23
	4.3	As in (3) above with infil reservoirs	53,095,770	18,669,242	12.23

The CURrent ESIA seeks to get licence for the CAPEX provided below based on the farmimg of only Phase 1 that is the !0000 acres model farm that had been farmed inirtially and requires rehabilitation works to be able to produce farm products efficiently and raise capital for further expansion.

Item (KES)	Current	Additions	Total
Land & Buildings	5,354,360	115,217,670	120,572,030
Machine Handling Equipment	987,034		987,034
Plant & Machinery (A Equipment)	21,432,472	116,567,546	138,000,017
Vehicles	7,070,050		7,070,050
Tractors	15,930,082		15,930,082
Farm & Irrigation (Pivots)	37,987,254	52,507,052	90,494,306
Farm & Irrigation(Pump Station)	36,397,580		36,397,580
Farm & Irrigation (Piping)	1,389,600		1,389,600
Plant & Machinery Solar panels	690,000		690,000
Post Harvest Equipment	652,390		652,390

Computer Equipment	1,565,195	2,500,000	4,065,195
Furniture, Fixtures & Equipment	1,632,000	4,500,000	6,132,000
Total	**131,088,017**	**291,292,268**	**422,380,286**

4.2 Farming

Due to limitation of water, about 10,000acres will be under maize production while 90,000acres will be under castle oil to be used for Bio-fuel.

The Castle oil in 10,000acres will use the same amount of water as 10,000 acres under Maize.

4.2.1 Castor Oil

4.2.1.1 Introduction

Castor oil (Ricinus communis) plant is native to Africa and India. Castor plant is also known as castor bean and belongs to the spurge family (Euphorbiaceae) grown commercially for the industrial uses and pharmaceutical uses of its oil and for use in landscaping. It is a large flowering shrub with seeds that are poisonous to both humans and animals. Castor is grown for its seeds. The oil extracted from castor seeds are used for many purposes like used as a lubricant in high-speed engines and aero planes, in the manufacture of soaps, transparent paper, printing-inks, varnishes, linoleum and plasticizers. Castor seeds contain between 45 to 60% of oil that is rich in triglycerides mainly ricinolein. Commercial growing of castor beans is very much successful due to its demand in local and international markets.

4.2.1.2 Castor Varieties

The varieties of castor differ in the branching habits of the plant, colour of the branches and stem, duration, nature of the capsules, the size of the seed and oil content.

Photos 4-6

4.2.1.3 Agro ecological Conditions

4.2.1.3.1 Temperature

Castor beans grow in temperate and tropical regions and requires moderately high temperature 20 to 27ºC with low humidity throughout the growing season. It grows best in areas where there are clear warm sunny days. Prolonged cloudy weather with high temperature at the time of flowering results to poor seed setting also known as sex reversion.

4.2.1.3.2 Soil

The best soils to grow castor oil are fertile soils that drain quickly. Though the beans require an adequate supply of soil moisture they are harmed by high humidity which causes development of capsule and foliage diseases. Castor plants need neutral to slightly acidic soil (Ph6.0-7.3). Electrical conductivity (EC) >4dS/m and exchangeable sodium percentage 9ESP)>20% is not suitable for castor cultivation. Moderately fertile soils are preferable than excessive fertile because excessive fertility favors vegetative growth in the expense of seed yield.

4.2.1.3.3 Soil salinity

Soil salinity refers to an excessive amount of dissolved inorganic salts or total soluble salts in soil to allow adequate plant growth. Most crops do not thrive in saline affected soils. Castor bean can survive in drought and saline environments due to its deep extensive root system and fast growth pattern. However, some studies have classified castor beans as moderately saline sensitive crop. Jeschke and Wolf reported that >40mM NACL reduced growth, suppressed branching and reduced leaf size in castor bean. Research has shown that salt stress reduced the total root length and increased the average root diameter in castor bean. The greater salt tolerance of the Freo castor bean genotype than Zibo could be attributed to its higher average root diameter, selective uptake of K^+ Potassium and exclusion of Na^+ in young leaves under salt stress.

4.2.1.3.4 Wind Conditions

The place where you plant castor beans should not be prone to strong wind which can make the plants snap and damage the leaves.

4.2.1.3.5 Water and Irrigation

Castor beans are normally planted just before the rainy season. However, it can be cultivated throughout the year in areas where irrigation facility is available. Irrigated crops need 2 to 3 and half acre feet of water during the growing season to produce good yields. The crop spacing should be about 90- 120cm between rows and 40-60cm between plants in the row.

4.2.1.3.6 Land Preparation

For better yields land preparation is an important step since it makes soil favorable for cultivation, controls weeds and preserves soil moisture. Castor needs moist and well pulverized loose top soil for better seed germination and early growth. It needs about three to four deep plowings followed by two to three harrowing to break the clods and leveling the field. Ridging is recommended in dry areas where total rainfall is low.

4.2.1.3.7 Seed rate, spacing and sowing

A seed rate of about 10-12kg is recommended but it varied upon cultivars and sowing method. The seed rate will be 8-10kg/ha for hand dibbling and for intercropping it depends on sowing proportion component crops. The spacing of castor varies with cultivars early and medium duration cultivars are sown at a closer spacing of 90cm by 45cm and long duration cultivars are sown at a wider spacing of 90cm by60cm under rainfed condition.90cm by 60 cm spacing is favorable under irrigated condition. However, under late sown situation a narrow spacing 60cm by 60 cm is practiced to realize higher yields. Deep sowing(8-10cm) is recommended in light soils under rainfed conditions and shallow(6-8cm) is preferable under irrigated condition and heavy soils.

4.2.1.3.8 Weed Management

Weed management is one of the important practices in cultivation of any crop. Weeds compete for fertilizer, manure light and water and if not managed they suppress growth of the main crop. The critical period of crop weed competition is 50-60days after sowing. After proper land preparation

he crop needs two weeding's and hoeing's either manually or mechanically at 25 and 50 days after sowing. Chemical control like use of herbicides is also effective in controlling weeds. The pre-emergence herbicides selective to castor are alachor, trifluralin, pendimethalin and clomazone (Maciel et al 2007) are efficient against monocotyledon species but they have lower efficiency against broad leaf plants.

4.2.1.3.9 Manures and Fertilizers

The application of manure and fertilizer in appropriate time and dose ensures better crop growth and yield. More fertilizers are required for hybrids and irrigated crop than other varieties and rainfed crops. Before final land preparation15-20t/ha well decomposed farm yard manure should be applied in both irrigated and rainfed condition for supplying nutrients as well as for moisture conservation. Under rainfed condition the recommended dose of both N and P_2O_5 fertilizers is 40kg/ha. At the time of sowing all P fertilizer with 50% N fertilizer should be applied and remaining and the remaining N fertilizer should be top dressed after first weeding. Under irrigated condition both P_2O_5 and K_2O are required at a dose pf 40kg/ha and N fertilizers should be applied at three splits at sowing, first hoeing and pre-flowering stages. As a source of P fertilizer single superphosphate is more preferable because Ca and S fertilizers are also applied.

4.2.1.3.10 Cropping and intercropping

Castor plant can be intercropped with other plants. It can be used as a shade plant for other plants like turmeric and can also be a trap crop for pests. Castor can be intercropped with groundnut, black gram, green gram, sorghum, pearl, millet, cowpea. Pigeon pea and cotton. Crop rotation can be done while planting castor plant as a sole crop in rotation with wheat and linseed. Intercropping pigeon pea with castor extenuate the occurrence of *Spodoptera litura*.

4.2.1.3.11 Pest and Diseases control

Pest and diseases affect plant growth and the yields of the crop in the long run. If not managed in good time they can result to total crop failure. Capsule borer (Dichocrosis punctiferalis) and semi looper (Achaea Janata) can be controlled by dusting BHC 10% in early stages or spraying 0.1% carbaryl on the crop. To protect the crop from seedling blight, water logged and low-lying areas should be avoided. Castor seed should be treated with thiram or agrosan Gn at 3g/kg seed to prevent the occurrence of root rot and Alternaria blight. In the latter stage of Alternaria blight of castor foliar application of carbamates or copper-based fungicide may be effective. Treatment with carbendazim in combination with Trichoderma at 10g/kg seed and soil application of Trichoderma has been found very effective in preventing castor wilt. Seed treatment with Trichoderma viride and neem cake application really reduces the occurrence of Alternaria blight.

4.2.1.3.12 Harvesting and threshing

The annual type of castor requires about 4-9 months to mature depending on the variety. The perennial type may continue bearing for 10-15 years. Varieties with shattering type capsules are harvested when the capsule turn from greenish to yellow while the improved varieties with non-

shattering capsule should be harvested when they are fully dry. In most cases the central spike on the main rachis matures first than the spike on side branches which matures abut later needing about two to three harvests of the crop. Harvesting of immature capsules should be avoided as it has negative impacts on oil content. After harvesting the capsule should be sun dried for 4-5 days and finally threshing and winnowing are done to clean the harvest.

Photos 4-7: Castor plants ready for harvesting

Photos 4-8: Castor seeds

4.2.1.4 Yield

The yield of castor may vary from 1 to 3 tons of seed/ha depending on agroclimatic conditions, crop management practices and the hybrid or variety used. The percentage of oil is 37 % and seed cake 63%.

4.2.1.5 Castor seed oil composition

Castor oil is economically important seed oil in the world. Castor seed comprises about 40-55% oil and kernel contains 64-71% oil which is the highest among all cultivated oil crops. Castor oil is a unique vegetable oil due to high ricinocleic acid content (84.2%-94%) which is a monosaturated and 18-carbon fatty acid. Ricinocleic acid is exceptional from other fatty acids because it has a hydroxy functional group on the 12^{th} carbon that makes it more polar than other fats. The chemical reactive capacity of the alcohol group also approbates chemical derivatization that is almost impossible with other seed oils. Castor oil is a valuable chemical in feedstock due to its ricinocleic acid content and underling a high price than other seed oils. Besides ricinocleic acid content some other fatty acids are present in castor oil.

OIL CROP	Average seed oil percentage	Oleic acid	Linoleic acid	Linolenic	Ricinoleic acid
Castor	40-55%	2-6%	1-5%	0.5-1%	85-95%
Jatropha	35-40%	21.8%44.7%	31.49-47.8%	0.2%	_
Pongamia pinnata	30-40%	44.5-71.3%	10.8-24.75%	2.9-6.3%	_
Canola	42%	57.59-61.41%	15.3%22.3%	10.8-13%	_
Linseed	38%	20.6-23.6%	19-22%	41.9-53.1%	_
Sunflower	48%	27-36%	52-67%	_	_
Soybean	18%	27.3-29.7%	43-56%	4.6-11.4%	
Palm	52%	20.3-24.7%	0.7-1.8%	_	_

4.2.1.6 Other impacts of Castor oil Production

- Creation of employment to the community around
- Generation of revenue from the sales made
- Production of oil for various uses
- Improved social amenities in the area

4.2.1.7 Safari Report

On Friday, 30th June 2023, when the team was traveling from Malindi to Galana around Chalama Small holder's irrigation project after Shakahola, the ecologist noticed castle oil being grown by the community along Galana-Malindi tarmac road and requested the driver to stop and view the castle oil in the farms.

The Ecologist noted that the plant takes 3-6 months. There is no side effect on the soil.

He explained that people are moving away from fossil fuel. The plant is being used to make biodiesel. He explained that the plant is not evasive. He explained that there is also Jettroto which is evasive. He explained that there was a firm which had proposed to plant jettroto in Tana River delta is an important area for birds. The plant kills all other plants.

Castle oil is locally called Mibono (Giriama), Maragoli's call it "Rivono" while Kikuyu's call it "Mwarelo"

Photos 4-9: Plantation of Castle Oil

Photos 4-10: Castle Oil

Photos 4-11: Castle Oil with the fruit for the oil when mature

Photos 4-12: Castle with the oil fruit

4.2.2 Maize Production

4.2.2.1 Introduction

Maize is the staple food in Kenya providing food to millions of people. Total and area under maize production is about 1.5 million hectares with an annual average production of about 3 million metric tons giving a national yield of 2 metric tons per hectare. Normally yields range from 4 t0 8t/ha in the high potential highlands of Kenya representing only 50% or less of the genetic potentials of the hybrids. Highland maize varieties are grown on a total maize area ranging from 600,000-800,000 hectares.

Maize is one of the most important staple food in Kenya. However, its production has not kept pace with the growth in population. Pest and diseases, drought, low infertility is among the challenges facing maize production.

4.2.2.2 Maize Varieties cultivated in Kenya

Kenya is a diverse country with various ecological zones hence different varieties are planted in the different regions. Hybrid maize is one of the cultivars planted In Kenya some of the popular hybrid maize varieties grown in Kenya are H624,H614 and H512.Open pollinated varieties are those that have not undergone genetic modification and rely on natural pollination by wind, insects and other natural factors. This are adapted to a wide range of environmental conditions examples

are katumani, MH18 and PH4.High altitude maize varieties are adapted to cooler temperatures and higher altitudes. Some examples include Longe 5, H614, and H621. Quality protein maize varieties are a special type of maize with higher protein content and better-quality amino acids than regular maize. They are grown to address malnutrition and improve the nutritional status of vulnerable groups. Some popular quality protein maize in Kenya includes, Mwaiwathu, Makueni and KDV4.

Farmers in Kenya choose the maize variety to grow based on their specific needs such as soil type, climate, market demand and farming practices. The government nad agricultural research institutions provide guidance on the appropriate maize varieties to grow in different regions to achieve maximum yields and profits.

Photos 4-13: Maize plantation

4.2.2.3 AGROECOLOGICAL CONDITIONS

4.2.2.4 Climate Requirements

Maize is a warm season crop that needs minimum temperature of 10-15ºC for germination and growth. The ideal climate for maize farming is found in areas with an altitude ranging from 900-2500 meters above sea level. These areas have a mean annual rainfall of 600to 100mm which is well distributed throughout the growing season. However, maize can also be grown in drier areas with the help of irrigation.

4.2.2.5 Soil Requirements

Maize can grow well in a wide range of soils, but it performs best in well-drained fertile soils with a Ph range of 5.5 to 7.5. If the soil pH is too low or too high it can affect maize growth and yields. Lime or sulfur can be added to adjust the soil Ph to the optimal range for maize cultivation. The soil should have good organic matter content which improves soil fertility and water retention capacity. In areas with high rainfall soils should be well-drained to avoid water logging which can lead to poor crop growth and yield.

Soil testing is recommended to determine the nutrient status of the soil and guide on fertilizer application. If the soil lacks essential nutrients such as nitrogen, phosphorus and potassium, fertilizers should be applied to enhance soil fertility.

4.2.2.6 Soil salinity

Maize plants are sensitive to soil salinity. Salinity has damaging effects through physiological, biochemical nad morphological mechanisms resulting in poor stand establishment and stunted plant growth. Various agronomic approaches and breeding programs have focused on imparting salinity tolerance in crops. Among agronomic approaches the use of allelopathic water extracts is gaining popularity because it is easily accessible, environmentally safe, and sustainable. The exogenous application of natural plant growth regulators such as aqueous extracts of sorghum and moringa enhances growth and development, photosynthesis and the plant defense system combating various abiotic stresses. Vermicompost organic fertilizer that possesses broader microbial activity and plant growth hormones and hence can be used to ameliorate the effect of salt stress in the soil plant system. Exploring the combined effect of the exogenous application of sorghum water extract and soil applied vermicompost for enhancing the growth and biomass production of maize grown under saline can help in mitigation of soil salinity stress in maize seedlings.

4.2.2.7 Land Preparation

Land preparation is necessary before planting maize. The land needs to be cleared of any bushes, trees or grass which can be done either manually using machetes, hoes or slashes or mechanically using tractors and ploughs to clear the land.

After land clearing the soil needs to be tilled to prepare a suitable seedbed for the maize. Tilling involves loosening the soil and breaking up any clumps of soil to create smooth and even surface. In areas of high rainfall or poor drained soils, a ridge and furrow system can be used to improve soil drainage and reduce waterlogging. This involves planting the maize on the ridges and leaving furrows in between to allow excess water to drain away.

4.2.2.8 Planting

Maize is usually planted during the rainy season. The ideal time for planting is at the beginning of the rainy season to ensure that there is enough moisture in the soil. Depending on rain availability

in some regions farmers plant two or three times in a year. Proper spacing is necessary for optimum yields. The recommended spacing of maize in Kenya is 75cm between rows and 30cm between plants. However, the spacing can be adjusted depending on the variety, soil fertility and rainfall.

Maize should be planted at a depth of 5-10cm. Planting too shallow can lead to poor germination while planting too deep can lead to delayed emergence and poor growth.

The advised seed rate for maize in Kenya is 20-25kg per acre. However, this can vary depending on the variety, spacing and soil fertility. There are different maize planting methods which include drilling, broadcasting and dibbling. Drilling is making furrows in the soil using a tractor or hand hoe placing the seed in the furrow and covering it with soil. Dibbling involves making small holes in the soil using a stick or dibble placing the seed in the hole ad covering it with soil. Broadcasting is spreading the seed on the soil surface and covering it with soil using a hoe or rake.

4.2.2.9 Pre-Planting Treatment

Most farmers treat their maize seeds before planting to control pests and diseases increase germination rates and improve plant growth. Treatment methods include soaking the seeds in water, applying fungicides, insecticides and using biofertilizers.

4.2.2.10 Manures and Fertilizers

Maize farming in Kenya requires careful management of fertilizers to ensure optimum yields. Basal fertilizers, foliar fertilizers and manures are necessary. Basal fertilizers are applied at the time of planting while foliar fertilizers are applied after the crop has emerged. During planting a teaspoonful of Diammonium Phosphate (DAP) fertilizer should be placed into each planting hole mixed thoroughly with soil and then the seeds are placed. Alternatively well-calibrated planters with fertilizers hoppers can be used for mechanical planting. The fertilizer rate is 50kg per acre. DAP contains phosphorus which is essential for root growth. It is important to mix the fertilizer thoroughly with the soil to avoid burning the seeds.

Foliar fertilizers are applied to the leaves of the maize plants after they have emerged.

Top dressing with Calcium Ammonium Nitrate (CAN) fertilizer should be done after 2-3 weeks after planting or when the crop is 45cm high. About one teaspoonful of CAN fertilizer at the base of each plant in a ring or along the row about 15cm away from the plant to avoid scorching. In high rainfall areas, top dressing is done in two splits with the first split done 6 weeks after sowing and the second done 10-15 days later or just before tasseling. In low rainfall areas fertilizer is applied once at a rate of 50-100kg per acre. CAN fixes nitrogen in the soil which is essential for the green colour that is essential in photosynthesis.

Well composted manures are necessary in maize production because the improve the organic matter content and improves soil texture that improves soil fertility hence increasing yields.

4.2.2.11 Weed management

Weed management is an important agronomy aspect in maize production. The first crucial period for weed controls from sowing to six weeks of growth. When planting the seed-bed should be weed free. Maize germinates after five to seven days and after germination the seedlings are vulnerable to weed competition. Weeds compete with maize for nutrients, water and space. Weed management mainly focuses on annual weeds than perennial weeds. Annuals complete their life cycle from seed to seed in less than one year or in one growing season. They produce lots of seeds and are not always easy to control for example pigweed, common blackjack and gallant soldier.

Perennials are divided int two groups, creepers and simple perennials. Simple perennials spread only by seed. If the shoot is injured or cut off it may generate a new plant vegetatively but reproduction is normally done by seeds. Creeping perennials reproduce by seed and vegetative plant parts. These include above-ground stems(stolon's), below ground stems(rhizomes), tubers, aerial bulblets and bulbs for example yellow nutsedge.

Cultural methods of weed management include increasing plant populations which decreases weed densities and growth. Crop rotation of maize with a broadleaved crop like soyabeans since more grass herbicides are registered on soyabean than maize and this will allow better control of the grass.

Mechanical methods of weed management include tillage which controls the weeds by burying them separating shoots and exhausting the carbohydrates reserves of perennial weeds. Mulching also excludes light and prevents shoot growth weed seedlings emerging are killed through starvation from lack of photosynthesis. In no tillage farming systems weed control with cultivation is not possible

Chemicals can also be used in weed management. However, close attention should be taken on the type of weeds, weather patterns, cropping systems and soil types. The type of weed present matters since some herbicides are selective to particular crop type. Only registered herbicides should be used. Herbicides are broadly divided into two groups soil acting herbicides which are taken up by germinating seeds and foliar applied herbicides taken up by leaves and stems. It is important to use the chemicals when the crop is at its most resistant time and the weeds are at their maximum susceptibility.

The time of application makes herbicides to be grouped into four categories burndown, pre-plant, pre-emergence and post emergence. Burndown herbicides control emerged weeds before or just after planting but prior to crop emergence. Pre-plant herbicides are applied to the soil any time before the crop planting and persist in the soil. The main objective is to prevent early weed growth. Pre-emergence herbicides are applied shortly after the crop planting but before the weeds emerge. Unfortunately, rain is needed for washing them into the soil and triggering their activity. Post emergence herbicides are applied after the crop has emerged and are therefore not strongly

influenced by the soil environment as they act on the above-ground plants. Integrated weed management should be embraced since chemical control has disadvantages such as negative impact on food and environmental safety and herbicide resistance.

4.2.2.12 Cropping and Intercropping

Maize can be intercropped with legumes like beans, cowpeas, pigeon peas, groundnuts and soybeans. It can also be intercropped with potatoes, cassava and pumpkin. Intercropping maize with beans and other legumes regulates pest's leafhopper, leaf beetles, stalk borer and fall armyworm and increases the land utility. Intercropping Canavalia with maize improves soil productivity. However, it must be noted that intercropping maize with other crops limits the opportunities for mechanization beyond seed bed preparation and drilling.

4.2.2.13 Pests and Diseases control

Maize being a vital staple food most economies depend on it for food and economic security. There are a number of pests and diseases that attack maize and limit yields. The pests that attack maize include maize stalk borers (Busseola fusca), the spotted borer (Chilo partellus, the African pink borer (Sesamia calamistis), cutworms, maize thrips, maize weevils and the fall army worm. Insecticides can be used to manage the pests, organic treatment like use of neem oil, onion brew can also be used to manage the pests and other biocontrol agents. Integrated pest management is recommended for better environment safety.

Head smut is a disease caused by a fungus that infect tassels, ears, and occasionally leaves. It can spread via wind and can survive for years in the soil. The grains of plants infected with head smut maintain their size but become dark and deformed. As a result, maize quality and yield decreases. Maize lethal necrosis disease (MLND) can be devastating for farmers, causing low yields to total crop failure. A combination of two viruses causes MLND the Maize Chlorotic Mottle Virus (MCMoV) and any of the cereal viruses in the Potyviridae group like the Sugarcane Mosaic Virus (SCMV), Wheat Streak Mosaic Virus (MDMV), or Maize Dwarf Mosaic Virus (MDMV). The double infection of the viruses gives rise to what is known as MLND also referred to as Corn Lethal Necrosis (CLN). Vectors spread the diseases transmitting it from plant to plant and field to field. The most common vectors are maize thrips, rootworms and leaf beetles. The disease causes a variety of symptoms in maize depending on the genotype, age of infection and environmental conditions. Symptoms include dying leaves, leading to premature plant death, failure to tassel and sterility in male plants, malformed or no ears and rotting cobs.

4.2.2.13.1 How to prevent the spread of the head smut disease

- Use of clean and disease-free maize seeds because the disease like head smut can be seed-borne.
- Use resistant/tolerant varieties.
- The fungus infects plants during seedling stage. Use cultural practices that promote rapid seedling germination and emergence.

- Frequent irrigation for three weeks after planting reduces the incidence of the disease.
- Balanced soil fertility the diseases are more severe under nitrogen deficiency.
- If the field has a history of maize smut, you can avoid plant since the spores survive in the soil for a long time or you plough deep to at least 50 cm to bury any surviving spores.
- Avoid feeding livestock with infected materials because it can be transmitted through manure.
- Directly controlling of the disease involves promptly removing, destroying by burning don't bury smutted tassels, ears and infected plants before the fungus spreads to reduce the build up of the disease in the soil.

4.2.2.13.2 Prevention and management of Maize Lethal Necrosis disease.

- Maintain soil fertility
- Timely planting
- Use of disease-free seed for seed production
- Cleaning farm equipment
- Eliminating alternate hosts
- Monitoring and spraying for vector species
- Scouting for virus symptoms and rouging symptomatic plants burn or bury
- Diagnostic on suspect plants
- Post-harvest selection and seed testing for viruses causing MLND
- Seed treatment with systemic insecticides
- Crop rotations with non-cereals and employing a closed growing season of maize

Head smut *Sphacelotheca reiliana* Image CABI

Photos 4-14: Maize Lethal Necrosis CABI

4.2.2.14 Harvesting and Threshing

Maize can be harvested manually this is by use of hands and storage in the traditional structures. Most often the crop is left standing in the field after the maize cob has matured so that they can lose moisture and store more safely after harvest. During this period the plant I smore likely to suffer infestation by moulds and insects and be attacked by birds and rodents. To reduce such risks an old practice of hand-bending the ears in the standing crop without removing them from the stalks. It helps mainly to prevent rainwater from entering the cobs and also limits bird attacks but because of high labour requirements the practice is gradually falling into disuse. Manual harvesting of maize does not require any tools it simply involves removing the cob from the standing stalk. Maize husking can also be done by people manually. Traditional maize shelling is carried out as manual operation maize kernels are separated from the cob by pressing on the grains with the thumbs. According to operators' ability the work rate is about 10kg per hour. Outputs up to 20 kg per hour can be achieved with hand-held tools wooden or slotted metal cylinders. To increase output small disk shellers can be used. These are hand-driven or powered machines which commonly require 2 operators to obtain 150kg to 300kg per hour. Another threshing method sometimes involves putting cobs in bags and beating them with sticks outputs achieved prove attractive but bags deteriorate rapidly.

Mechanized harvesting involves use of maize harvesters to harvest maize. A specific feature in maize harvesters is the header which leaves the stalks standing as it removes the ears. The rates of work can vary from 2 hours per hectare with a 3-row self-propelled harvester to 5 hours per hectare with a tractor-drawn or mounted single row unit. Generally speaking, harvest losses range from 3% to 5%, but they may be up to 10%-15% under adverse conditions. Depending on the situations

a single row harvester can be employed effectively on up to 20 hectares or more but the use of a multirow machine demands several tens of hectares to be economically effective.

Initially designed for harvesting maize as a grain the corn sheller was initially a cornhusker in which the husking mechanism was replaced by a threshing one usually the axial type. Corn shellers are self-propelled machines of the 3 to 6 row types with capacities of one to 2 hours. The surface areas harvested during a 180-hour campaign range between 100 ha with a 3row unit and 200ha with a 6 row one. Another alternative consists of equipping a conventional combine with a number of headers corresponding to the machine horsepower. However, although widely used such a method requires many adjustments to the threshing and cleaning mechanisms.

Nowadays many small maize shellers equipped with a rotating cylinder of the peg or bar type are available on the market. Their output ranges between 500 and 200kg per hour and they may be driven from a tractor power take off or have their own engine power requirements vary between 5 and 15 hp according to the equipment involved. For instance, the French Bourgoin "Bamba" model seems well suited to rural areas in developing countries because of its simple design, easy handling and versatility which can be used for maize, millet and sorghum.

4.2.2.15 Yields

The level of soil fertility, agroecological conditions and variety chosen impacts the yield achieved from the maize production. A soil that is rich in nutrients and very healthy can produce more than 20 bags of maize per acre. Poor soils can adverse climate conditions can produce as low as one bag.

4.2.2.16 Benefits of Maize Production

Maize is one of the staple food crops in Kenya hence its production leads to increased food security. Maize contains about 72% starch, 10% protein, and 4% fat supplying a substantial amount of energy for humans and animals.

Maize can be used in various industries for the production of food and industrial products, including starch, sweeteners, oil, beverages, glue and industrial alcohol.

4.2.2.17 Maize By-products

4.2.2.17.1 Animal Feed

Maize gluten meal is a by product of the manufacture of maize starch by the wet milling process. Corn gluten meal is a protein-rich feed used as a source of protein energy and pigments for livestock species including fish.

Maize fibre cellulosic fraction of maize grain rich in carbohydrates, easily digestible. Product as a result of manufacture of corn starch. Used in cattle breeding and oil cake manufacturing industry.

Oil cake after expelling oil from dry maize germs the residue is corn oil cake which has substantial amount of fat and protein which is used as a major ingredient in the cattle feed industry.

4.2.2.17.2 Food industry

High maltose maize syrup is a food additive used as a sweetener and preservative. Used in producing ice creams, confectionary and baked goods.

Maize oil is extracted from the germ of maize used for cooking.

Liquid glucose also known as maize syrup or glucose syrup is manufactured by subjecting starch to high temperature in the presence of acid. Used in manufacturing food products like jam, jellies, chewing gums, canned fruits.

Special maize starch is the starch derived from the maize. The starch is obtained from the endosperm of the kernel. Commonly used in thickening sauces or soups and in making maize syrup and other sugars.

Dextrose monohydrate is a white crystalline powdered sugar obtained from the complete hydrolysis of maize starch. It is used as a sweetener, a fermentation substrate a wetting agent or in confectionary, bakery, snacks, beverages and dairy products.

4.2.2.17.3 Textile and Paper Industries

Sayatex is an oxidized starch derived from maze. The fil produced from sayatex adherent continuous and clear. It is used for surface sizing of paper and yarn.

Native maize starch is a cereal starch which has low ash and protein content. It is used in textile finishing operation to change stiffness, feel or handle of fabrics to modify the appearance by filling the interstices of the weave and to add weight. Also used in paper industry.

Fabrilose modified thin boiling starch used in textile sizing.

Dextrins are normally prepared by roasting starch in the presence of acid which materially changes the character and properties of starch. They are used in foundries, distemper and textiles.

Sayafield ester field starch plays an important role in the manufacture of gypsum wallboard, protecting the gypsum crystals that form the bond between the gypsum core and the paper. Used in the paper industry and textile sizing industry.

Dextrose anhydrous is used in intravenous injections vital for preventing dehydration.

Starch specially manufactured for the pharmaceutical formulation as a binder and filler for tablets and capsules.

Maize steep liquor is a by product of the wet milling of maize. It contains much of maize's soluble protein, carbohydrates and minerals. It has a vital function in production of penicillin and other antibiotics.

Sorbitol is a sugar alcohol which the human body metabolizes slowly. Used for the production of cough syrups, toothpastes and other oral hygiene products, cosmetics, paints, cigarettes and baked food items.

4.2.2.18 Other impacts of maize production

- Increased food security since it's a staple food
- Income generation after selling hence economic boost
- Improved social amenities
- Creation of employment opportunities for those farming

4.3 Products, By-Products and Wastes

Numerous products, by-products and wastes are expected from the project during the Construction and rehabilitation phase and operational phases. These are presented as;

4.3.1 Construction and Rehabilitation Phase

4.3.1.1 Products

The product from the construction and rehabilitation works are the infrastructure developments and this are seen as products of the project, this are:

· Intake works
· Riverbank protection works
· Irrigation system structures
· Greenhouses works
· Human settlement and associated physical and social infrastructure
· Water supply systems
· Access roads

4.3.1.2 By-products

By definition a by-product is a substance that is incidentally manufactured, processed or otherwise used at the facility at any concentration and released in-situ to the environment, released to surface waters or transferred off site for disposal.

During the project construction phase it is foreseen that the by-products may include any excess construction materials brought to the site by the contractor and can be reused later.

4.3.1.2.1 Waste

During the construction and rehabilitation phase, numerous waste products are expected to be generated. These include:

4.3.1.2.1.1 Domestic Wastes

The construction workers are expected to be supplied with various forms of foodstuffs packed in plastic or other types of containers. These are expected to occur within the site area and in the immediate vicinity. The management of such waste will need to be incorporated by the Contractor in the Construction HSE Management Plan.

· Other forms of waste include sanitary waste and therefore the provision of sanitary facilities will need to be considered both for the site construction workers and the visiting population.
· Kiosks selling various items will also emerge.

4.3.1.2.1.2 Site clearing Waste

The project will generate waste from the site construction activities including:
· Demolition wastes;
· Excavated soils and vegetation;
· Construction equipment maintenance wastes;
· Dusts and fumes;
· Packaging materials, etc.

4.3.1.2.1.3 Dust

The construction activities that will occur particularly during the site excavation process will generate a considerable amount of dust and other particulates that will be released into the atmosphere.

4.3.1.2.1.4 Smoke Emissions

The site machinery, equipment and trucks brought in by the Contractor are expected to generate smoke emissions when in operation during the construction activities. The concentration of these emissions will depend on their maintenance levels and servicing by the Contractor.

4.3.2 Operational Phase

4.3.2.1 Products

The main products from the project are crops produce and animal products.

4.3.2.2 By-products

During the operational phase of the project there will be minimal amounts of by-products generated except the manure and crop residues like plant stalks and stovers after crop harvesting. This could be utilized for organic fertilization, biogas production, mulching and as livestock feed.

4.3.2.3 Waste

Along the canal the main waste likely to be produced will be silt, the potential build-up of stagnant water and the proliferation of exotic plants. Crops organic waste will be produced but should be recycled to improve soil humus. Of importance will be packaging material used for crop carriage especially plastic bags.

Other wastes to be generated are those from human settlements and recreational areas within the project. This is expected to be channelled to an onsite sewage disposal system.

5 ANALYSIS OF ALTERNATIVES

5.1 Do Nothing Alternative

Kenya's population is currently (2013) estimated to be around 40 million and is expected to rise to 45.7million by 2015 and 64 million by 20302. This population will present a greater food security challenge than experienced today. Currently, the country faces challenges in feeding that population if the country is to continue relying on rain-fed agriculture. When rains fail, people in different parts of the country have difficulties feeding themselves and have to rely on famine relief.

Maize is the main source of carbohydrate food component and a key indicator of food security. Due to crop failure in the predominantly short rains dependent southeastern lowlands in addition to pre- and post-harvest losses of up to 20-30% in Kenya's grain basket (Rift Valley), food insecurity for farmers and urban households is high. Furthermore, increase in prices of food stuffs and other commodities exacerbate the food security challenge. According to Kenya Maize Development Programme (KMDP, 2012) the per capita maize consumption stands at 98 kilograms (aprox.100 kilograms) which is equivalent to 35% energy requirement. This is however ifferentiated with incomes whereby the lowest income quartile uses 28% of its income on maize.

Productivity of small holder farms has rarely been optimal. Whereas optimum maize production per acre should be around 32bags/acre many small scale farmers rarely produce more than 5-8 bags per acre. This is part of the challenge that places the National maize production is 40 million bags against a national consumption requirement of 42 million bags [3]. This deficit has hitherto been met through importation of maize which stood at 314,000tonnes in 2001 and 243,000 tonnes in 2009 or 16.8million bags. The deficit is never a definite known. According to FAO, the number of food insecure people requiring direct food aid has dropped from 2.1 million in 2012 to 1.1 million in 2013. The National maize stocks as at 30th April 2013 stood at 21,574,305 bags, with farmers holding about 14,886,683 bags, traders 3,666,176 bags, millers 721,446 bags and National Cereals and Produce Board (NCPB) holding 2,300,000 bags. Beans stocks totaled 2,443,685 bags, Wheat 602,521 bags and Rice 687,665 bags. The position of the Government is that National stocks will continue being replenished by imports, cross-border inflows especially from Uganda and Tanzania where harvests is expected to peak in May to July. This state of affairs predisposes the country to risk as food security ought to be a national security issue. The proposed project is planned to reduce national imports and cross-border inflows.

This alternative requires that no intervention should be carried out in the project area, the land should remain at status quo. If the project is not implemented food security will remain a crisis in Kenya. Other benefits associated with the project will not be realized. At the same time, the negative impacts emanating from the project would not also materialize.

5.2 The Proposed Phase 2 Farm Project

The proposed Phase 2 Project is expected to develop a total of 20,000 acres within the

Proposed Galana-Kulalu Food Security Project and 10% of the land will be under maize crop. It will act as a mirror of the larger Galana-Kulalu Food Security Project (GKFSP). It will be a research farm as far as PPP is concerned.

Phase 2 Farm is to be located in the Galana-Kulalu ranches which for several years have remained unproductive apart from the model farm. The area is currently used for used for ranching purposes of a variety of livestock including cattle, sheep and goats. This has not been lucrative especially during the dry spells. The area is also infested with tsetse flies which is a threat to the livestock within the ranches. The proposed Phase 2 is expected to convert part of the Galana-Kulalu into an agricultural land under irrigated agriculture.

The main source of water for the existing uses in the ranches is the Galana River which is at the south of the Model Farm and separates Galana Ranch from Kulalu Ranch. Hydrological analysis of the Galana River indicates that there is enough water to irrigate 20,000acress. Water quality analysis also shows that the water is suitable for irrigation. However, for domestic and industrial uses, the water requires purification and a treatment plant is designed to cater for that.

The soils within the selected Model Farm's and Phase 2 are also suitable for irrigation. In areas where salinity and infiltration is a challenge, the proposed irrigation technologies will counter. These soils are also suitable for various crops such as maize, vegetables and most other high value crops. Crops planned for the Model Farm are maize and vegetables.

The Model Farm and Phase 2 are located in an ASAL area where evapotranspiration is quite high. Therefore, efficient irrigation methods are proposed to counter this. These include drip and centre pivot irrigation. It is also expected that these irrigation methods will lead to lesser water use as compared to other irrigation methods such as furrow. Drip irrigation will be done on open fields and in greenhouses whereas centre pivot will be done on open fields.

The Model Farm and Phase 2 are likely to impact the project area and its surroundings either directly or indirectly. Some of the project impacts highlighted is improved food security, job creation, increased revenue, increased income, increased accidents, change of population dynamics, Improved physical and social infrastructure, reduced food prices, lifestyle change, flood moderation, micro-climate change, curtailing of wildlife movement, pollution (air, noise, water and soil), conflicts, water-logging, salinity and cultural exchange among others.

5.3 Comparison of alternatives

Under the Do Nothing alternative, no change or development would be expected therefore, there would neither be benefits from the project nor the insignificant effects. On the contrary, the proposed Phase 2 is expected to impact the area through improved food security, job creation, increased revenue, increased income, improved physical and social infrastructure, reduced food prices, flood moderation and micro-climate change among others. The proposed Model Farm is therefore the most feasible alternative for Kenya.

6 PUBLIC CONSULTATION

Public consultation and disclosure of information about Galana-Kulalu Phase 2 Irrigation Scheme Project took place through Questionnaires and surgical consultation with key stakeholders. The public consultation exercise was conducted during the month of June 2023 in the project area. The exercise identified all the stakeholders of the project within the area including the communities around the area, administration, government ministries and agencies and private sector among other stakeholders.

6.1 Stakeholder Mapping

At the start of the process, stakeholders were grouped based on the following categories:-

- Relevant Kilifi and Tana River County governmental offices including County Agricultural Office, Public Health Office, County Gender and Social Development Office, District County Children's Office, MoH, MoW&I, MoE, OOP, MoA among others
- Government Agencies including NEMA, NIB, WRMA,
- Various Cooperative/Association
- Local community or the project beneficiaries (farmers)

6.2 Stakeholder Identification

The first step in the process of public participation process was stakeholder identification, determining the project stakeholders, their key groupings. Stakeholder identification was to determine all organizations and individuals who may be directly or indirectly (positively or negatively) affected by the Galana-Kulalu Phase 2 Irrigation Project.

To identify the stakeholders of this project, a list of relevant ministries and departments of the government was compiled based on the government structures. The list of persons and institutions contacted and consulted is appended in table 6-1.

Table 6-1: GALANA-KULALU FOOD SECURITY PROJECT -PHASE 2 STAKEHOLDERS CONSULTATION MATRIX

CONSULTATION PLAN FOR GALANA-KULALU FOOD SECURITY PROJECT -PHASE 2 IN KILIFI AND TANA RIVER COUNTY					
	who is to be consulted	**when each consultation is expected to be done**	**Number of Experts Expected to be Involved**	**Methodology to be Adopted**	Number of Stakeholders expected to be Consulted
1	Project Area(Galana-Kulalu)	27-28TH June 2023	At Least 10 people	Field Visit ,Questionnaire and Surgical	Tour Project Area, profiling the expected project area, Administer Questionnaire and also ask critical Question Relevant to Stakeholder. About 10 stakeholder to be consulted including Sub-County Water, Where the Project Action will take place and PAP
2	Magharini -Agricultural Officer	29thJune 2023	2Nos.	Questionnaire and Surgical	Sub-County Agricultural Officer
3	Public Works	29thJune 2023	2Nos.	Questionnaire and Surgical	
4	Public Health	29thJune 2023	2Nos.	Questionnaire and Surgical	Magharini Sub-County MOH
5	MOH	29thJune 2023	2Nos.	Questionnaire and Surgical	Magharini Sub-County MOH
6	KERHA and KENHA	29thJune 2023	2Nos.	Questionnaire and Surgical	
7	Social Services Officer	29thJune 2023	2Nos.	Questionnaire and Surgical	

CONSULTATION PLAN FOR GALANA-KULALU FOOD SECURITY PROJECT -PHASE 2 IN KILIFI AND TANA RIVER COUNTY					
	who is to be consulted	**when each consultation is expected to be done**	**Number of Experts Expected to be Involved**	**Methodology to be Adopted**	Number of Stakeholders expected to be Consulted
8	Cultural Officer	29thJune 2023	2Nos.	Questionnaire and Surgical	
9	Sub-County Children Officer	29thJune 2023	2Nos.	Questionnaire and Surgical	
10	Disaster Management Team	29thJune 2023	2Nos.	Questionnaire and Surgical	
11	SubCounty Forest Officer	30thJune 2023	2Nos.	Questionnaire and Surgical	
12	KWS	31st June 2023	2Nos.	Questionnaire and Surgical	
13	Provincial Administration	29thJune 2023	6	Surgical and Questionnaire	County Commissioner, Respective D.c, D.O, Chiefs or subchiefs,BaraZa
14	Sub-County Land Officials	29thJune 2023	3Nos.	Surgical and Questionnaire	Land Registrar, Sub-County Surveyor
15	NGO	3rd July 2023	3Nos.	Surgical and Questionnaire	Existing NGO,s in Kilifi and Tana River Counties
16	NEMA	3rd July 2023	3Nos.	Surgical and Questionnaire	County Environmental Officer
17	WRA	3rd July 2023	2	Surgical and Questionnaire	Regional Manager

CONSULTATION PLAN FOR GALANA-KULALU FOOD SECURITY PROJECT -PHASE 2 IN KILIFI AND TANA RIVER COUNTY					
	who is to be consulted	**when each consultation is expected to be done**	**Number of Experts Expected to be Involved**	**Methodology to be Adopted**	Number of Stakeholders expected to be Consulted
18	Continuous	29thJune 2023	3Nos.	Surgical and Questionnaire	At least 100people per baraza
19	Water Resource Users Association of Galana River	29thJune 2023	3Nos.	Surgical and Questionnaire	At least 2 officials

6.3 Stakeholder Consultation

Stakeholder consultation was in form of interviews, Questionnaire, and Surgical Method in and around Galana-Kulalu Food Security Project.

6.3.1 Surgical Method

Three Surgical Consultations were held as follows:-

1. Galana Conservancy (Appendix 2)
2. KWS (Appendix 3)and
3. Residence of Bombi (Appendix 4)

Appendix 2 to 4 has the minutes.

6.3.1.1 Arising Issues

6.3.1.1.1 Galana Conservancy

Ben proposed that the wetland to be preserved along Galana River should be as large as economically possible.

He indicated that as far as he was concerned, there are four things required for wildlife viz:-

18. Availability of Grazing
19. Water
20. Safety and
21. Fencing

6.3.1.1.2 KWS

- The migratory path for wildlife is currently phasing a lot of encroachment

1. **Migratory Path**

- ✓ Should be left intact
- ✓ Migratory area is not established
- ✓ It is recommended that the farming block should be set away from the river preferably 100-500m and the proposed padox should be moved into interior away from Galana River.

2. **Human wildlife conflicts**

3. **Community needs to be sensitized and create awareness on the wild animal's importance**

4. **Water points on the designated areas should be increased to avoid movements of the wild animals through the migratory corridors and the game proof friendly fence to be set up**

22. **Ranches are transit routes for pastoralists from garsen to Taita ranch for somalis and orma and they have illegal weapons to defend themselves and their livestock from being attacked by the wild animals posing insecurity purposes and poaching with their crude weapons**
23. KWS policy on ESIA, KWS has been reformed and given this role to wildlife and research institute which was being led by principal supt. Lala (Dr) who is KWS principal scientist
24. Next to Sala gate in mid-September to mid-October there is no river moving and cannot be pumped

25. It is proposed that a game proof fence, friendly to the wildlife should be put where crops on Galana-Kulalu will be grown using 12 strands. This will be easy considering that power will have reached the project area of Galana.
26. Number of people in Galana will go up. This will increase wildlife-human conflict

27. **The Highest number of elephants is in May at** In may, the population of elephants is normally about 300
28. Sensitization is proposed in the project area and environs
29. Giving wildlife water during draught especially September to October should be considered

30. Away of handling pastrolist should be put in place (i.e. security since they are armed.)

31. Issues of habitat degradation in Galana due to activities of Selu Limited, Mombasa Cement and the government

32. Will Galana river be enough? We have Kilifi county who depends on Sabaki (Galana)

33. The dispersal area of wildlife from Tsavo East National Park is that they go up to Kilifi

34. During wet periods, wildlife population grows drastically e.g. in June, their were a total of 120 species of wildlife and start grazing along the river.

6.3.1.1.3 Residence of Bombi

1. Kisiki Sub-location had a total of 14 villages namely:- Galana, Kulalu, Galana Conservancy, GSU Camp, Mombasa Cement, Selu, Bombi Market, Danisa village, Abura among others. Chakama has three sub-locations

2. **Dialect: -** There are three tribes in Kisiki Sub-location namely:- Watamu, Giriama and Oroma.

3. Neighborhood:- There is close collaboration between community and ADC (Agricultural Development Corporation)
4. the main beneficiaries of the proposed project would be the bombi and Danisa people who inhabited areas on the model farm boundary

5. Bombi Residence are experiencing wildlife conflicts due to the wild animals destroying their crops they have requested for the clients of the model farm in future for their farms to be fenced off to hinder wild animals from destroying their farm crops.

6. The community had a difficult time on different seasons of planting crops and they have sort to use expensive chemicals to spray their maize plantation due to the growth of maize diseases since inception of pilot model farm phase 1

7. The transport system is relatively poor as the gravel Roads linking the Model farm and the community become impassable due to the wild animals hovering around the area searching for water along Galana river and also the roads are impassable during the rainy seasons.

8. Selu limited to buy community maize in order to support them economically when it matures.
9. Oroma are pastoralist. In view of this, they normally graze in ADC farm
10. Galana conservancy sponsor students for education
11. Traditional herb also exist in the shrub land which is to be cleared
12. It was noted that both the new tenants in ADC land which currently consists of Simba Cement and Selu Limited are going to use Galana irrigation scheme. This might dry the river denying the environs to irrigate their land and water their flock. This will become pronounced with time by considering climate change phenomena.
13. The area is not accessible to clean portable water which the project should pursue as part of corporate social responsibility

14. The new tenants should consider building more schools and churches

15. farming in model farm was stopped abruptly, the community suffered since they had relied on the farm for employment
16. Model farm brought insecurity since women were impregated and their was rampant child abuse

17. If there is a disease on farm, Selu should come up with a strategy to manage it including in the community lands
18. Kids dropped out of school in preference to working in farm
19. On wages, he advised ADC tenants not to come up with there rates but seek opinion of leaders before coming up with their wages

20. They requested for the new tenants to live left overs to the community and surrounding community be looked at
21. Insecurity and human-wildlife conflict should be addressed moving forward.
22. Requested government to give them title deed where they are staying
23. Transport will be a challenge for community going to work for the new tenants.
24. They proposed the tenants should come up with transport and staff quarters as incentives of inducing the community to work for the new tenants.
25. They requested consultation should be done with right people and gave an example of Mombasa cement who were led to community land and not ADC. They indicated

that any conflict can be resolved between management and surrounding community and this should not worry the new tenants

26. They requested that in future, every body should be involved at every stage of the project.
27. Requested that the community be considered for solar fencing to deter wild animals.
28. It is proposed that the water sources in the area be diversified.
29. Requested for maintaining a buffer zone to allow elephants and other wildlife to move freely
30. Normally, wildlife move to conservancy then along Galana River
31. During green arrava, new diseases of maize emerged.
32. The normal chemicals used by community could not work and were advised to buy very expensive insecticides.
33. Requested for community to be assisted if this occurred.
34. The maize disease disappeared immediately when the project stalled and has not reappeared
35. The Israel's used aeroplanes for spraying
    - Rats increased tremendously and went upto villages
    - Maize in community farm started wilting
    - Investor could control occurrence of the disease while community could not.
    - Army worms became pronounced
36. Mombasa Cement has promised corporate social responsibility which should be duplicated by Selu Limited.

6.3.2 Questionnaires

6.3.2.1 People Consulted

A total of 73 people were consulted with 53 people filling the questionnaire and others filling the consultation form. Those consulted consisted of villagers, Departmental heads and workers of NIA and Selu.

Appendix 5 has the list of all people consulted.

6.3.2.2 Result

Majority of those consulted at 85% felt that phase 1-model farm had benefitted the local community and supported it being rolled into Phase 2 and 3.

6.3.2.3 Arising Issues

The following issues arose:-

6.3.2.3.1 Positive Impacts

- ✓ Early payment & tourism
- ✓ Improvement in living standards

- ✓ Food security
- ✓ Income for families
- ✓ Improvement in infrastructure, job creation
- ✓ Accessibility due to development
- ✓ Reduction in crime & No drug abuse
- ✓ Youth employment & prevention of early marriages
- ✓ Boda boda business improved
- ✓ Small business growth
- ✓ Land utilization
- ✓ Economic growth

6.3.2.3.2 Negative Impacts

- ✓ Wild animals driven away &Reduction in forest covering
- ✓ Building more toilets
- ✓ Decrease in volume of water in rivers
- ✓ During drought galana river cannot be used
- ✓ Divorce among families of employed individuals
- ✓ Increase in S.T.I's;DevorceEarly marriages and pregnancies
- ✓ Accessibility & Development of infrastructure
- ✓ Expansion to be undertaken considering river galana

7 POTENTIAL IMPACTS AND MITIGATION MEASURES

The project is expected to have environmental impacts on certain aspects of biophysical and socio-economic environment of the project area both during the construction and operation stages. The impacts of the project were assessed and are generally grouped into those *affecting soil, water resources, air quality, flora and fauna, community and their economic activities, vegetation and forests, land acquisition and resettlement, aesthetics and landscape, noise and human health.* Appropriate mitigation measures are also discussed. These impacts were considered for the various phases of the project as:

· During construction and rehabilitation of Model Farm infrastructure and augmentation to Phase 2
· During operation of the Model Farm and Phase 2
· Decommissioning of the facilities such as construction camps, equipment and materials used for the construction and maintenance of the Farm when in operation.

7.1 Scooping

A standard checklist was adopted as indicated in table 7-1.

Table 7-1: **Scooping of Galana Kulalu Food Security Project Phase 2 /Galana Rach, Kilifi and Tana River Counties**

Project Name/Location	**Galana Kulalu Food Security Project Phase 2 /Galana Rach, Kilifi and Tana River Counties**					
				Date	**4th September 2023**	
Enumerator's Name	**Eng. Benard Imbambi Kasabuli**					
Assessment: 1st/2nd	**1st**					
For each potential Environmental effect place cross (x)	**Positive Impacts**			**Negative Impacts**		
	None	**Minor**	**Major**	**None**	**Minor**	**Major**
1. Hydrology						
Low Flow Regime						**X**
Flood Regime			**X**			
Operation of Dam						**X**
Water Table Level			**X**			
Surface water quality						**X**
Ground Water Quality						**X**
Eutrophication			**X**			

Project Name/Location	**Galana Kulalu Food Security Project Phase 2 /Galana Rach, Kilifi and Tana River Counties**					
				Date	**4th September 2023**	
Enumerator's Name	**Eng. Benard Imbambi Kasabuli**					
Assessment: 1st/2nd	**1st**					
For each potential Environmental effect place cross (x)	**Positive Impacts**			**Negative Impacts**		
	None	**Minor**	**Major**	**None**	**Minor**	**Major**
2. Pollution						
Noise						**X**
Agrochemicals						**X**
Organic pollution						**X**
Anaerobic effects						**X**
Gas emissions						**X**
3. Soils						
Salinization			**X**			
Soil properties						**X**
Waterlogging			**X**			
Erosion			**X**			
Soil fertility						**X**
Soil productivity						**X**
4. Sediments						
Local erosion			**X**			
Hinterland effect						**X**
River morphology						**X**
Channel engine						**X**
Sedimentation			**X**			
Estuary Erosion			**X**			
5. Ecology						

Project Name/Location	**Galana Kulalu Food Security Project Phase 2 /Galana Rach, Kilifi and Tana River Counties**					
				Date	**4th September 2023**	
Enumerator's Name	**Eng. Benard Imbambi Kasabuli**					
Assessment: 1st/2nd	**1st**					
For each potential Environmental effect place cross (x)	**Positive Impacts**			**Negative Impacts**		
	None	**Minor**	**Major**	**None**	**Minor**	**Major**
Project lands						**X**
Water bodies						**X**
Surrounding area			**X**			
Valleys and slopes						**X**
Wetlands and plains						**X**
wildlife						**X**
Vegetation						**X**
Climate			**X**			
6. Socio-Economjc						
Population change			**X**			
Income			**X**			
Employment			**X**			
Arable Agriculture			**X**			
Settlements			**X**			
Recreational sites						**X**
Historical and archaeologist sites				**X**		
Livestock raising						**X**
Tourism			**X**			
Infrastructure			**X**			
Fishing	**X**					
Land tenure						**X**
7.Health						

Project Name/Location	**Galana Kulalu Food Security Project Phase 2 /Galana Rach, Kilifi and Tana River Counties**					
				Date	**4th September 2023**	
Enumerator's Name	**Eng. Benard Imbambi Kasabuli**					
Assessment: 1st/2nd	**1st**					
For each potential Environmental effect place cross (x)	**Positive Impacts**			**Negative Impacts**		
	None	**Minor**	**Major**	**None**	**Minor**	**Major**
Water and Sanitation						X
Nutrition			X			
Relocation Effect	X					
Disease Effect			X			
Disease Ecology			X			
Disease control						X
Disease Hazards						X
8.Imbalances						
Pests and weeds			X			
Animal diseases						X
Aquatic weeds			X			
Structural damage			X			
Animal imbalances			X			

The results were grouped into Positive and Negative Impacts as detailed below:-

7.1.1 Negative Impacts

The following will have Negative effects:-

1. Hydrology

- Low Flow Regime
- Operation of the Dam
- Surface Water Quality
- Ground Water Quality

2. Pollution

- Noise
- Agrochemicals
- Organic Pollution
- Anaerobic effects
- Gas Emissions

3.Pollution

- Noise
- Agrochemicals
- Organic Pollution
- Anaerobic effects
- Gas Emissions

3. Soils

- ✓ Soil Properties
- ✓ Soil Fertility
- ✓ Soil Productivity

4. Sediments

- ❖ Hinterland Effect
- ❖ River Morphology
- ❖ Channel Engine

5.Ecology

- ➢ Project Land
- ➢ Water Bodies
- ➢ Surrounding Area
- ➢ Valley and Slopes
- ➢ Wetlands and Plains
- ➢ Wildlife and
- ➢ Vegetation

6. Socio=Economic

- ➢ Recreational sites
- ➢ Livestock raising
- ➢ Land Tenure

7.Health

- Water and Sanitation
- Disease Control
- Disease Hazards

8.Imbalances

- Animal Diseases

7.1.1.1 Hydrology

7.1.1.1.1 Low Flow Regime

Galana Kulalu Food Security project intends to utilize 20,000 acres in downstream of the Athi Galana Sabaki River Basin to produce maize and castle oil. In order to realize high production rate, the proponent has to increase water availability in the farm through irrigation given that at the downstream of the river basin rainfall is limited. The required amount of water for irrigation per day is approximately 288,000 CM/day. The available stream flow for use will be during rainy season so that flood water can be abstracted. But during dry periods the stream flows are below the water demand by the project. This is therefore recommended that the proponent provide on-farm storages which will store water for use during dry periods. The estimated deficit will be 350 MCM if the crops will be in the farm 365 days in a year. This analysis recommends that abstraction of the water from the river only be done during wet periods and when river discharges are above $60m^3/s$.

7.1.1.1.2 Operation of the Dam

The large amount of water required for irrigation will put a lot of strains on the intake and storage dams/pans to be constructed. Planning for storage, planting and harvesting will have to be done carefully to avoid lack of water when the crops seriously need it leading to wilting.

About 3 pans of total capacity about 24million m^3 are planned which should be constructed to limit strain on Galana River.

7.1.1.1.3 Surface Water Quality

The fertilization and chemicals being used in the farms will find their way into Galana River hence polluting it.

7.1.1.1.4 Ground Water Quality

According to a trial pit dug in one of the areas indicates:-

1. The soil strata are very shallow at about 0.60m consisting of sandy or black cotton soil.
2. Gypsum lies just about 0.60m from surface as indicated in table 7-2.

Table 7-2: Soil Log of TP01

	Degrees	UTM	
Longitude	E039.34091	537886	
Latitude	S03.00219	9668157	
Altitude	183	183	
Black Clay Soil			
			0.60m
Calcium (Gypsum)			

Photos 7-1:gypsum about 0.60m from surface

This implies leakage of irrigation water beyond 0.60m will pollute the ground water with gypsum.

7.1.1.2 Pollution

7.1.1.2.1 Noise

Due to limited urban development and heavy industry, existing background environmental noise is relatively low. Whilst construction equipment and increased traffic may cause some noise, nearby schools, clinic, community houses and other public facilities will not be significantly impacted because the level of noise generated will be short-term and not severe, particularly as most of the works will be carried out by laborers using labour-based techniques, with equipment such as trucks being mobilized only when required during specific phases in the construction.

All construction and operation activities have the potential to cause noise nuisance. The use of machinery or introduction of noise generating facilities could have an adverse effect on the environment and residents if not appropriately managed. Potential noise sources during construction may include:

- heavy construction machinery;
- power tools and compressors;
- Delivery vehicles.

Noise from vehicles is a concern in the areas around the project area as traffic from construction vehicles will increase. In addition, power tools and plant equipment will increase noise levels.

Contractors involved in construction activities should be familiar with methods of controlling noisy machines and alternative construction procedures or good international industry practice may be used if the legislation has not been enacted. The detailed, typical equipment sound power levels, provides advice on project supervision and gives guidance on noise reduction.

Mitigation measures should include:

- Restrictions on working hours on weekdays, weekends or public holidays set and complied with, no night-time working allowed;
- Allowable noise level must not be violated (which is Leq55dB(A))
- Issue protective equipment to onsite employees and those operating heavy machine and power tools
- Install silencers and mufflers as appropriate to site plant and equipment
- Optimum travel speed during offsite travel set and complied with;
- Travel speed in residential areas reduced to reduce vibration
- Temporary noise barriers (whether appropriate) installed;
- Vegetation preserved (that can act as a natural noise barrier);
- Prohibit leaving vehicles with the engine idling;
- Complaints registers and record of response measures provided available;
- Staff trained/briefed in and aware of construction best practice.

7.1.1.2.2 Water Pollution

Water draining from irrigated fields is likely to contain residues of pesticides and fertilizers, which may not only affect aquatic life, but also reduce the value of the water downstream as a source of drinking water. Also portable water from groundwater may be affected by contamination with nitrates as a result of excessive use of fertilizers.

7.1.1.3 Soil

7.1.1.3.1 Soil Properties

The soil is shallow. Digging should be done carefully to avoid hitting the saline gypsum layer.

7.1.1.3.2 Soil Fertility

Sandy soil fertility is poor and hence any growth will have to be supported by fertilizer in substantial amount.

7.1.1.3.3 Soil Productivity

Transported by water infiltrating in the soil, pesticide residues may accumulate and affect soil organisms, including micro-organism which play a prominent part in soil fertility.

7.1.1.4 Sediments

A storage of 3 pans are proposed to be constructed on the laga located in Phase 2 and currently feeding 2 pans

This laga is located in phase 2 in Kilifi County and crosses model farm around the middle top and proceeds to model farm. It has a length of about 23km and a catchment of 194.6km2 which is adequate to fill one pan in a year of capacity 8.1million m3 hence requires water from Galana River to fill the remaining two pans

Further, there is a rock weir of about 2m high and thickness of about 2m which blocks Galana River and directs the water to the intake site.

The physical and biological effects of Galana River and laga development arise from the obstacle the weir and the 3 pans to be developed causes to the natural flow of water, the climate changes caused by the reservoirs interacting with the overlying atmosphere, the effects of the structures on the water in and near the reservoirs, and earth movement and ground tremors caused by the stored water.

The following effects have been identified:-

- Hinterland Effect
- River Morphology
- Channel Engine

7.1.1.4.1 Effect of River/Laga impoundment

The changes following the creation of an impoundment stem from the physical changes induced by the reservoir, owing both to its presence and its operation..

The construction of an impoundment generally involves raising the water level upstream, and this changes the morphology of the reaches approaching the reservoir as well as their erosion and sedimentation process. It also involves lowering the water level downstream and blocking the passage of floating debris.

7.1.1.4.1.1 Shoreline Erosion

Erosion of the new shoreline and unstable slopes are sometimes observed phrnomena on the fine-grained banks of reservoir flooding. The creation of a large body of water also increases the influence of the wind and wave action on the new banks.

Certain steps may be taken to limit the erosion of reservoir banks, control of shore use, shore zoning, soil conservation measures in certain sensitive shoreline sectors, use of vegetation resistant to the prevailing filling and draw-down regime and appropriate management of levels and flow are some of the mitigation measures recommended.

7.1.1.4.1.2 Sedimentation

A large storage reservoir allows suspended matter to settle out from river water and acys as a trap for sediments transported during rainy periods or heavy storms. Intensivied activities in the reservoir catchment, land clearing and deforestation may provide additional inflow of sediments, which is deposited in the reservoir..

Fine sediments may form a mud lake just infront of the reservoir capable of blocking the bottom outlets as it hardens. Ultimely, th accumulation of sediments reduces the reservoir's storage capacity.

Several different approaches can be taken to mitigate reservoir sedimentation. These include watershed management as a preventive means, soil and water conservation in the catchment, debris dams, sediment by passing, sediment flushing, sediment sluicing, utilization of reservoir density currents and sediment dredging.

7.1.1.4.1.3 Downstream of Impoundments

Reducing or completely blocking the passage of the solid matter conveyrd by the river creates varying degrees of disturbances to the natural conditions downstream of impoundments.

Because of sediments retention upstream, increased erosion will often be observed, as well as degradation of the channels of the river/laga and its tributaries for several kilometres below the reservoirs, as natural erosion will longer offset by added sediment. Reducing the suspended load will deprive arable land of the silt brought down by the river/laga floods.

Downstream channel erosion will be mitigated by river training works in order to keep the banks stable. The erosion process could be controlled by reconstructing the slope of the channel or by changing the discharge from the reservoirs.

7.1.1.5 Ecology

7.1.1.5.1 Project Land

The Project land which is currently under farming is 10,000acres as Model Farm. This is going to be scaled upto 20,000 aces by adding and clearing an extra 10,000 acres under Phase 2.

This is a large chunk of land to be cleared and put under irrigation in Kilifi County.

7.1.1.5.2 Water Bodies

The source of water is Galana River while the laga transversing just upstream of the laga is to receive three Mega Pans to catch runoff from the lagas and also receive more storage water from Galana River.

Considering the large flows required to sustain the irrigation, it will have a very big impact on the flows of Galana River and flood flows on the laga by considering the draught months of September to October. Galana River does not have enough flows to sustain the flows majority of the times.

The client has an option of completely stopping irrigation during yhis critical moths or store enough water to carry him along provides he harvests enough flood water before construction of Galana Mega Dam is done.

7.1.1.5.3 Surrounding Area

The surrounding areas are those borders the Galana-Kulalu Food Security Project like Bombi etc.

The farmers depending on flows of Galana river on irrigation might not have such an oppurnity or will have less or no water for watering their livestock.

7.1.1.5.4 Valley and Slopes

This are going to suffer the increase in erosion as Galana River and the laga regenerates.

7.1.1.5.5 Wetlands and Plains

Wetlands and plains have thick vegetation and define Galana River as indicated in figure 7-1.

Wetlands are responsible for regeneration of the river and become grazing grounds for wildlife during draught. Wetlands and plains define the migratory route of wildlife from Tsavo East to Watamu.

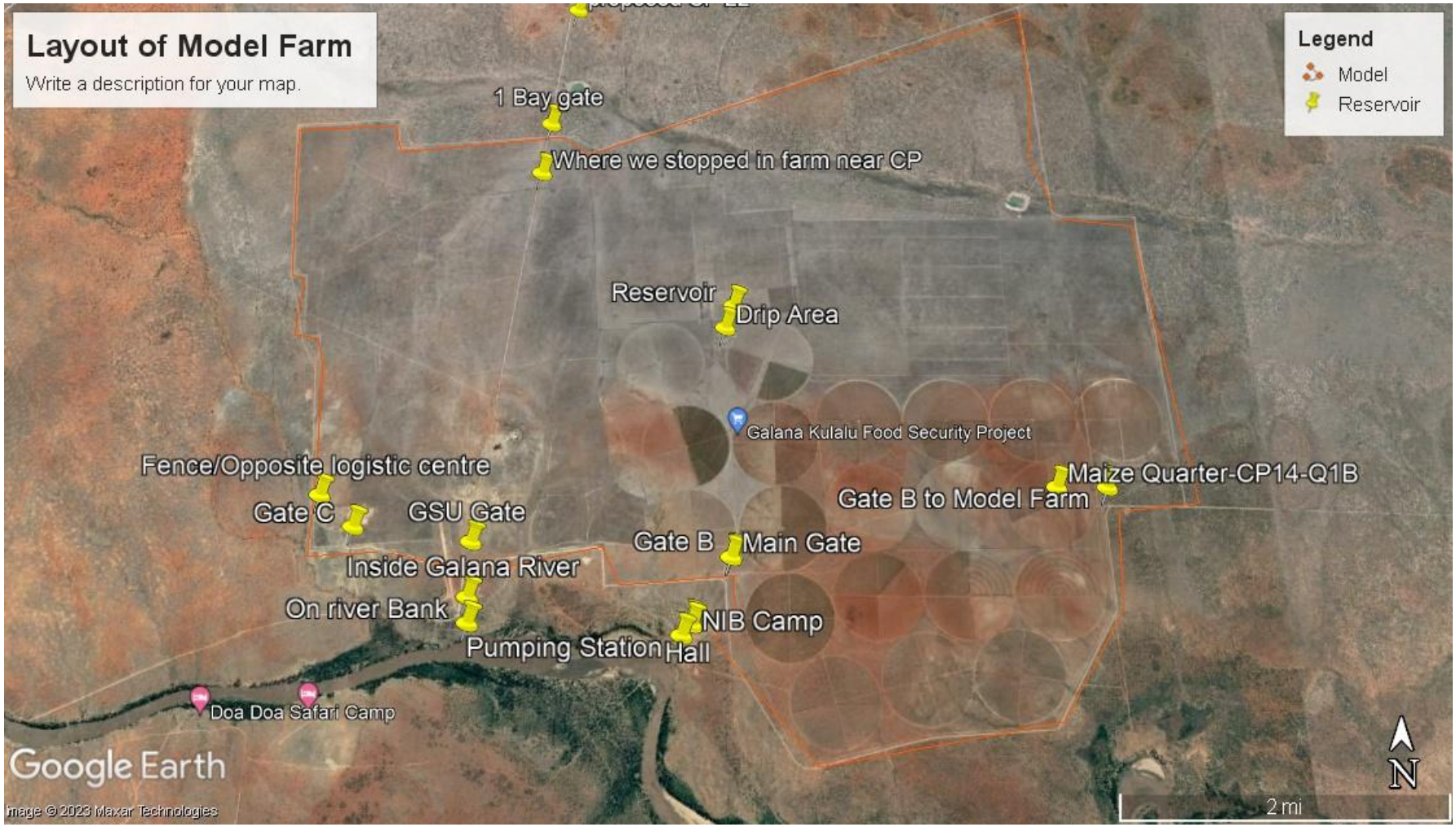


Figure 7-1:Thicck Vegetation defining the boundaries of Galana River

7.1.1.5.6 Wildlife

In today's increasingly developed world, most buffer zones are small-yet-vital pockets of land. But on the eastern frontier of the Tsavo Conservation Area sits a behemoth. Galana and Kulalu Ranches stretch along almost the entire eastern boundary of Tsavo East, collectively covering 2 million acres that extend towards the coast. They are stacked on top of each other and bisected by the Galana River, with Galana Ranch to the north and Kulalu Ranch to the south. It is important to note that they share an unfenced border with Tsavo East, meaning wildlife can roam freely between the park and the ranches. Like their neighbour, the ranches provide vital habitat for all manner of species, including elephants, lions, cheetahs, giraffes, wild dogs, leopards, and plains game.

Both Galana and Kulalu Ranches are managed by the Agricultural Development Corporation, a parastatal that oversees sustainable agriculture development in Kenya. Galana and Kulalu were always intended to be mixed land use, with selective ranching activities that are complementary to conservation efforts. However, it is a vast landscape, and ADC lacked the resources to focus on the conservation aspect. Over the past 40 years, the landscape had become increasingly hostile, overrun by illegal activities such as poaching, charcoal burning, and livestock incursions.

7.1.1.5.7 Vegetation

The ranches have diverse plant communities including xerophytes and halophytes which are, adapted to low water availability and very saline soils respectively. Additionally, the hydrophytes do well in waterlogged soils conditions while mesophytes prefer the medium water and saline conditions. The dominant vegetation types include the narrow Galana riverine forest, bushland and the shrub land.

7.1.1.6 Socio=Economic

The notion of economic impacts refers to the effects, on the local and regional economies , of project construction and subsequent operating activities. Such economic effects s also cause significant impact.

7.1.1.6.1 Recreational sites

No recreational site exist downstream of the project.

7.1.1.6.2 Livestock raising

ADC practice limited rearing of goats and cattle in the ranches.

Oroma are pastoralist. In view of this, they normally graze in ADC farm

7.1.1.7 Health

7.1.1.7.1 Water

Almost 90% of all households source their domestic water requirements from rivers or streams whereas the rest use rain water. The average household travel a kilometer or less to get water from these rivers and streams

Rain water and rivers and streams are also the main sources of water for crops and livestock. As with water for domestic use, nine out of every ten households use the rivers and streams as sources of water for crops. Households have to travel about 0.7 kilometers to get water for their crops

7.1.1.7.2 Sanitation

The mode of Sanitation in the project area is pit latrines.

7.1.1.7.3 Water Borne Diseases

The following diseases are expected to increase:- Malaria, filariasis, schistosomiasis and vieal encephalitis due to the irrigation and construction of 3 megapans.

7.1.2 Positive Impacts

The following will have Positive effects:-

1. **Hydrology**
   - Flood Regime
   - Water Table Level
   - Eutrophication
2. **Soils**
   - Salinization
   - Water Logging
   - Erosion
3. **Sediments**
   - Local Erosion
   - Sedimentation
   - Estuary Erosion
4. **Ecology**
   - Surrounding Area
   - Climate
5. **Socio=Economic**
   - ✓ Population Change
   - ✓ Income
   - ✓ Employment
   - ✓ Arable Agriculture
   - ✓ Sediments
   - ✓ Tourism
   - ✓ Infrastructure

6. **Health**
   - Nutrition
   - Disease Effect
   - Disease Ecology
7. **Imbalances**
   - Pests and Weeds
   - Animal Diseases
   - Aquatic Weeds
   - Structural Damage
   - Animal Imbalances

7.1.2.1 Hydrology

7.1.2.1.1 Flood Regime

Due to opening up of more land living the ground bare, this will increase the flood regime in the vicinity of the project.

7.1.2.1.2 Water Table Level

Due to increase in water, this will cause rise in water table level in the vicinity of the project.

7.1.2.1.3 Eutrophication

Use of fertilizer and pestsides which will find their way into the nearest water bodies leading to excess nutrients.

7.1.2.2 Soils

7.1.2.2.1 Salinization

Salinization is caused by the double action of evaporation and capillary movements in the soil. It can be a consequence of either too much or too little irrigation. Soluble salts in the soil surface will accumulate to such an extent that their concentrations become toxic to plants.Salinization occurs to some extent in all irrigated areas, but is most commonly associated with arid or semi-arid areas.

7.1.2.2.2 Water Logging

Water Logging, a common phenomenon in irrigated areas, occurs when groundwater saturates the plant root zone. Small pores between soil particles, normally filled with air, become saturated thus preventing the exchange of oxygen between the plants roots and the soil. Water logging can be the result of poor drainage of irrigated lands, but in some places it is a natural phenomenon.

7.1.2.2.3 Erosion

Irrigation Schemes often require land clearing and leveling in the preparation stage. Removal of trees and shrubs, which act as wing-breaks and soil stabilizers, can accelerate soil erosion.

7.1.2.3 Ecology

7.1.2.3.1 Climate

While the climatic features which influence large water bodies are quite well known, such as the effect of wind, precipitation and air temperature, the influence of a water body on the climate is hard to determine and is the subject of some controversy. The climate changes caused by the reservoir are so minimal that it is hard to distinguish the specific impact associated with the presence of the new water body from the region's complex weather system and its normal fluctuations.

Generally speaking the main climatic changes that can be induced by a major body of water such as an impoundment are the effect on temperature, wind regime, evaporation and humidity, precipitation and occurrence of fog.

The larger the water body, the greater its heat capacity is. The water body has the effect of reducing variations in local temperatures. Reservoirs can also affect atmospheric stability.

The creation of a large reservoir creates a large flat surface and offers less resistance to the flow of moving air with increased wind velocity.

It is generally accepted that, in the same climatic regime, the amount of water evaporated annually by a water body is proportional to its area and is inversely proportional to its depth. It also appears that the seasonal variations are higher for shallower lakes, whereas deeper lakes have later minimum and maximum evaporation dates. One problem to be considered with respect to the influence of new impoundment on evaporation and humidity is the difference between the evaporation regime of an open-water body and that of a vegetation cover. The problem is further complicated by the interaction of soil moisture, humidity, atmospheric pressure and wing.

It has demonstrated experimentally that large reservoirs produce a new microclimate. The influence of the new water body on local precipitation is however the subject of much controversy. Increased precipitation has been observed in the areas surrounding large reservoirs in the tropical regions. These observations are based on short-term records and it would be rather risky to draw the conclusion that the increased precipitation is due to the reservoir formations.

Fog generally occurs more frequently after a reservoir is built. In warm climates a large shallow impoundment area can increase fog generally on the coolest days.

In conclusion, the climatic effects of reservoirs are likely to be quite local. Predictions should be made for all new reservoirs of significant size. Available data and the power of mathematical models are continually increasing, making the accuracy of predictions more reliable.

7.1.2.4 Socio=Economic

The notion of economic impacts refers to the effects, on the local and regional economies, of project construction and subsequent operating activities. Such economic effects also cause significant social impacts.

- ✓ Population Change
- ✓ Income

7.1.2.4.1 Impacts during Implementation

7.1.2.4.1.1 Employment

About 2000 jobs will be created during construction which will be of temporary in nature. A limited number of the people employed during the construction, preferably local residents , will be retained as operation staff. Very often, may lack the necessary rducation and skills, but this might be overcome by on-the job training and additional courses during the implementation phase. A Close cooperation between the construction entity and the local authorities would facilitate smooth transition from construction to operation phase and redeployment of local work force.

The creation of new employment in the area will create prevent post project migration to the cities of newly trained labour. Generally skills learned during construction give flexibility and potential for redployment and betterment of the local workforce.

7.1.2.4.1.2 Arable Agriculture

This land currently is a rangeland with no development.

Phase 2 is adding 10,000 acres under pivot while 3 is adding a final 80,000acres.

Phase 2 and 3 is building on the success of Model Farm.

It is located on the Eastern side of the model farm in Galana ranch, about 40km from the head office of the model farm.

About 10,000acres will be under maize production while 90,000acres will be under castle oil to be used for Bio-fuel.

7.1.2.4.1.3 Sediments

The Reservoirs and retention basins to be created on the laga and Galana River will harvest sediments reducing their lifespan for the reservoir and sediments harvested from retention basins will require landfill for disposal.

7.1.2.4.1.4 Tourism

Provided the project area was already attractive or becomes so by the creation of the project, the development of tourism and recreation facilities in the project area nay become a source of additional income for the local inhabitants as well as an asset for a wider region

7.1.2.4.1.5 Infrastructure

The additional farming will require more workforce leading to construction of more labour camps and construction of more buildings in places like Bombi Market to house the workforce. This will require more water infrastructure and sanitation facilities for the betterment of the project area.

Increased Accidents

The project area is inhabited with wild animals. Implementation and operation of the Farm will result in more and improved transport networks. The anticipated rail and road networks will pose accident risks to both humans and wildlife. To mitigate this, road and air safety measures will be taken such as extra training for road users and installation of road safety infrastructure like road bumps, zebra crossings and speed limit posters at strategic locations along the roads. All workers will be sensitized and trained on occupational safety and health issues and on how to control accidents related to field operations. In cases of unavoidable accidents, there will be emergency response provided within the proposed health centre.

7.1.2.5 Health

7.1.2.5.1 Nutrition

The more maize to be planted will reduce the price of maize and will generally improve the health of local population and in Kenya .

7.1.2.5.2 Disease

The community also has had a difficult time on different seasons of planting crops and they had sort to use expensive chemicals to spray their maize plantation due to the growth of maize diseases since inception of pilot model farm phase 1. Most of the residence in the project area support the project since they belief it will not have adverse effects to their health since the Galana river water being used at the model farm is treated and used for irrigation purposes while small percentage don't support the project since they believe the government can have to displaced them in future for more expansion of the farm. Growing different varieties of crops is an important factor to the development and the capacity of people to participate in development activities.

Since agriculture is a devolved function, Kilifi and Tana River should consider providing agricultural extension services and deploy more resources in compacting diseases and rodent menace during harvesting and storage period of maize to the community bordering the project area to control occurrence of diseases.

7.1.2.6 Imbalances

7.1.2.6.1 Pests and Weeds

The project area has the natural vegetation which is currently supporting rangeland activities. With farming, new pests and diseases will emerge and some might pause a challenge to the survival of the farming and the natural vegetation's.

7.1.2.6.2 Animal Diseases

Animal diseases will decrease since the area is going to be cultivated.

7.1.2.6.3 Aquatic Weeds

Aquatic weeds will emerge due to more usage of water and some becoming standstill. This can be mitigated during improvement of drainage

7.1.2.6.4 Structural Damage

Due to the land being bare, erosion will increase especially immediately after tilling.

7.1.2.6.5 Animal Imbalances

The area basically is an extension of wildlife. With cultivation, more herbivorous will not venture outside the park leading to impalances.

7.1.2.6.6 Human-Wildlife Conflicts

During the operation stage, crops on the farms could be affected adversely by encroachment of Wildlife. This would lead to perpetual conflict on the beast control approach that would solve the same challenge. Restriction of wildlife movement within the project area will also result in more human-wildlife conflict in the surrounding areas or even in the irrigated land. In addition, increased human settlement within the project area may lead to increased human attacks by wildlife and vice-versa. This will be mitigated by fencing off the project area leaving some corridors for the wildlife to move to river and Tsavo National Park.

7.1.2.6.7 Increased Communicable Diseases

If not well managed, an irrigation project may result to water-borne diseases such as malaria, bilharzia, diarrhoea among others. On the other hand, increased population growth with the associated social change may lead to communicable diseases such as HIV/AIDs. The proposed mitigation measure for these effects is to ensure stagnant waters and possible mosquitoes breeding areas are controlled and that HIV/AIDS campaigns and safeguard against prostitution are done to create awareness to the population within the area. Awareness creation on the expected social changes amongst the population will also be done.

7.1.2.6.8 Increased Poaching

Increased population coupled with improved road and rail networks will ease access to the neighboring Tsavo National Park and Arabuko-Sokoke Forest, which may lead to increased poaching activities. This may be mitigated by enforcing laws governing wildlife conservation and management

8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 Introduction

This Environmental and Social Management Plan (ESMP) provides a logical framework within which the negative environmental and social impacts identified during the Environmental and Social Impact Assessment study can be mitigated and any beneficial environment effects can be enhanced. Monitoring and management practices are considered and cost estimates included. Responsibilities and time frames for the implementation of the various aspects of the Environmental and Social Management Plan have been identified. The Environmental and Social Management Plan should be implemented accordingly.

8.2 Mitigation of Negative Impacts

The mitigation measures for the anticipated negative impacts of the proposed project are presented in the Environmental and Social Management Plan (Tables 8-1, 8-2 and 8-3).

Table 8-1: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) DURING CONSTRUCTION

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
	A. DURING CONSTRUCTION	
A.1	**Socio-Economic**	
A.1.1	Workers accidents during construction process.	• All workers will be sensitized before construction begins, on how to control accidents related to construction.
		□ A comprehensive contingency plan will be prepared before construction begins, on accident response.
		□ Accordingly, adherence to safety procedures will be enforced.
		□ All workers to wear protective gear during construction, including helmets

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
		Construction work should be limited to daytime only
A.1.2	Labour issues	Project proponent should put in place a proper strategy to ensure fair recruitment of workers incorporating both locals and people from other areas incorporating both locals and people from other areas
		Sensitization to the local communities on the expected population influx should be done
		seek opinion of leaders before coming up with their wages
A.1.3	Community Support	Sensitize the community at each stage of Implementation through barazas
		Have periodic Consultation with the environs communities throught the project lifespan
A.1.4	Breaking of families	Inrease churches and mosque in camps and environs communities
		Sensitization
A.1.5	Security	Increase Number of GSU officers guarding GALANA ranch
		Map and mark where headers will pass and access GALANA River and proceed with their migrations
		Establish Order
A.2	**Pollution**	
A.2.1	.Air pollution by dust and VOCs generated during construction process	All personnel working on the project will be trained prior to starting construction on methods for minimizing air quality impacts during construction.
		Construction heavy earth moving vehicle drivers will be under strict instructions to minimize unnecessary trips, refill petrol fuel tanks in the afternoon and minimize idling of engines.

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
		Careful screening of construction site to contain and arrest construction-related dust.
		Exposed stockpiles of e.g. dust and sand, will be enclosed, covered, and watered daily, or treated with non-toxic soil binders.
		All workers will be required to wear protective gear
		Ensure construction machinery and equipment are well maintained to reduce exhaust gas emission
		Stop all excavation work if wind threshold velocity has been exceeded.
A.2.2	Noise and vibration by construction activities.	Use of equipment designed with noise control elements will be adopted where necessary
		Trucks used at construction site shall be routed away from noise sensitive areas where feasible
		Idling time for pick-up trucks and other small equipment will be minimized to limited time.
		All workers operating in noisy areas or operating noisy equipment will be provided with earpieces to protect against extreme noise
		Comply with L.N. 25: Noise prevention and control rules, 2005
A.2.3	Generation of solid waste	Wastes to be collected regularly to control air pollution and vermin/insects etc.
		Receptacles will be provided for waste storage prior to collection.
		Resource recovery will be encouraged once the project takes off so as to shrink waste stream and recover non-recyclables.
		Refuse collection vehicles will be covered to prevent scatter of wastes by wind.

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
		Wastes will be collected by a licensed operator to avoid illegal final dumping at unauthorized sites.
		All persons involved in refuse collection shall be in full protective attire.
A.2.4	Inadequate human waste disposal by workers during construction process	As provided for by the Building Code, a temporary latrine will be provided on site to be used by construction workers
A.2.5	Pollution from Hazardous waste	Handling of the materials using the material safety data provided by the manufacturers
		Appoint a safety officer to ensure that proper disposal guideline are observed
		Ensuring that maintenance and/or piece of work carried out on any piece of equipment or construction work is undertaken by qualified personnel
		In case of spillage emergency spillage control measures to be instituted
		Containerization of any wastes and disposal through a licensed waste handler.
A.3	**Soils**	
A.3.1	Disturbance of soil structure	Sensitization to the project workers on proper soil conservation and management measures
		Excavations on unintended areas should be avoided
A.4	**Sediments**	
A.4.1	Sedimentation of Rivers/Lagas/Drainageways	Undertake Construction where it is necessary
		Store and Dump Excavations away from where it will find its direction in waterways
		Divert River and Lagas before Construction

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
		Employ competent professionals during construction
		Employ nest Appropriate Technology during construction
		Take Appropriate Soil Erosion control measures to reduce effect of erosion
A.5	**Ecology**	
A.5.1	Loss of natural vegetation cover	• Ensure proper demarcation and delineation of the project area to be affected by construction works
		• Introduction of vegetation (trees and grass) on within the green and recreational areas within the project and their maintenance.
		• Design and implement an appropriate landscaping programme to help in re-vegetation of parts of the project area after construction.
A.5.2	**Loss of food resources for wildlife**	Allow for migration coridor of 100-500m in the Riverine
		Clear where it is necessary
		Speed up the construction of Galana Dam
		Maintain an adequate storage of 3 months of water required for irrigation
A.5.3	**Loss of biological resources for local communities**	establish a tree seedling project which will be used to rehabilitate the degraded areas in the ranches. The recommended tree species for planting include *Tamarindus indica*, acacia and commiphora *spp*. And *Erythrina abyssinica*.
A.5.4	human/wildlife conflicts,	Live the natural vegetation wildlife migration corridors especially along the drainage lines with prolonged ground water storage and green vegetation

Table 8-2: **ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) DURING OPERATION AND MAINTENANCE**

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
	A. DURING OPERATION AND MAINTENANCE	
A.1	**Socio-Economic**	
A.1.1	Population influx	• Population monitoring coordinated through the administration office
		• Development of infrastructure: housing, electricity, domestic water supply, water treatment, roads, sanitation, bridges, schools, health facilities, etc to support the population increase
A.1.2	Conflicts	Develop means to ensure equitable distribution among users and monitor to assure adherence between farmers and pastoralists
		• Develop proper measures to reduce conflicts
		• Sensization of the project workers and local community on the expected culture change
		Form Galana River Users Association to manage abstraction of Water in Galana River
A.1.3	Increased insecurity	• Provision of security measures within the project
		• Enforcing laws, rules and regulation pertaining security within the country
A.1.4	Increased poaching	• Enforce existing laws and by-laws concerning wildlife conservation and management
A.1.5	Increased accidents	• All workers will be sensitized and trained on occupational safety and health issues and on how to control accidents related to field operations.
		• A comprehensive contingency plan will be prepared on accident response.
		• Accordingly, adherence to safety procedures will be enforced
		• Establishment of road bumps, zebra crossing areas and barriers
		• Provision of speed bumps before and after human settlement, recreational, and national parks and game parks
A.1.6	Surging of crime	Use law or alternate dispute resolutions

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
A.1.7	Iimpediment to movement of livestock and humans	Provisions of passageways
A.1.8	Alteration or desctruction of wildlife habitat or impediment to movement of wildlife	Siting of project to minimize loss or avoid encroachment on most sensitive or critical areas
		Establishment of compensatory parks or reserved areas
		Animal rescue and relocations
		Provisions of corridors for movement
A.1.8	Dislocation of populations and communities	Siting of project to minimize effect
		Resettlement scheme ensuring at least eqyal orstandard of living
	A.2	**Hydrology**
A.2.1	Drying of Galana River during low flows	Provide storage to carter for Water requirements for 6 months
		Speed up construction of Galana Dam
		Grow crops that require minimum water and can be irrigated at larger intervals
		Pump water from Galana River during high flows when it has little impact on the river abstraction
A.2.2	Reduction of downstream flows affecting flood plain use, flood plain ecology, riverine and estuarine fisheries, users of water, dillution of pollutants	Relocation or redesign of project
		Regulation of takeoff to mitigate effects
		Compensatory measures where possible
A.2.3	Encroachment on swamps and other ecologically sensitive areas	Siting of projects to avoid or minimize encroachment on critical areas

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
	Algal blooms and weed proliferation and weed proliferation	
A.2.4		
		• Reduction of input to and release of nutrients (nitrogen and phosphorous) from cropped fields
	Operation of Dam	• Use of organic instead of chemical fertilizers where possible.
	Drowning	
A.2.5		
	Drying of the Dams	Fence the dam/pan with chainlink of height 2m
A.2.6		Put a warning sign on impending danger
	Dam failure	Put enough dams to satisfy the demand
		Fill the dams during high flows in Galana River
A.2.7		Undertake monitoring and repairs
	. Surface and ground water quality	Seek frequent professional inspections in line with Water Resource Regulation 2021
	Water quality (sources of domestic water)	Employ adequate staff for operation and maintenance
A.2.9		• As per the Second Schedule of Legal Notice No.120 2006
		• As per the Second Schedule of Legal Notice #120 2006
	Pollution	
A.3	**Agrochemicals**	
	Deterioration of river water quality below irrigation project and contamination of local ground water (higher salinity, nutrients, agrochemicals) affecting community and downstream users	
A.3.1		

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
A.3.2	Air pollution	Imposition of water quality criteria
		• NEMA/ WHO environmental air emission standards should always prevail controlling suspended particles of matter, Sulphur Dioxide, Nitrogen Dioxide and other pollutants
		• Tilled surface should not be left bare to minimise wind erosion and where possible embrace onservation agriculture.
		• Use of pesticides and other chemicals should be done when the weather is relatively calm
A.3.3	Noise pollution resulting from operation of water pumping station	Operate during daytime from 8.0am to 5.0pm
		Locate the pumping station away from settlements
		incorporate sound reduction facility around the pumping station
	Organic pollution	Limit sound production through migration from fossil to connection to electricity National Grid
A.3.4		
		Bury wastes during tillage
		Use the Wastes as manure or used for mulching purposes
	Pollution from Hazardous Chemicals (Waste)	Through the wastes in a land fill established in the project area
A.3.5		
		• Appoint a safety officer to ensure that proper disposal guideline are observed
		• Ensuring that maintenance and/or piece of work carried out on any piece of equipment or construction work is undertaken by qualified personnel.
		• In case of spillage emergency spillage control measures to be instituted.

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
	Improper solid waste management	• Containerization of any wastes and disposal through a licensed waste handler.
A.3.6		• Adhere to L.N. 121: Waste Management Regulations.
		• Waste generation must be minimised as first priority
		• Unavoidable wastes should be separated at source, recycled or re-used, combusted, and disposed in sanitary landfills
		• Use of an integrated solid waste management system i.e. through several options including of source reduction recycling ,composting and reuse and incineration
	Soils	• Ensure that wastes generated at the Farm are efficiently managed through recycling, reuse and proper disposal procedures.
A.4		
	Soil erosion	
A.4.1		• Use erosion control techniques which disperse erosive energy and avoid concentrating it e.g providing good vegetative cover will disperse the energy of rain drops and contour drainage will slow down surface runoff
		• Proper maintenance of canal and the irrigation infrastructures.
		Adopt conservation tillage systems and ripping to control hardpan and enhance infiltration and seepage
A.4.2	Alteration of soil structurestructure	• Sensitization to the project workers on proper soil conservation and management measures
A.4.3	Water-logging	• Use of proper irrigation management, closely matching irrigation demands and supply
		Regulation of water application to avoid overwatering (Including controlled turn-out to allow cutting off water supply to irrigation fields
		Use of sprinkler or drip irrigation
A.4.4	Increased soil salinization	• Careful management should be practiced to reduce the rate of salinity build up and minimize the effects on crops.
		Avoid digging more than 0.60m or thereoff where gypsum is located
		Use recommended fertilizers
		Leaching of salts by flushing soils periodically

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
		Cultivation of crops with salinity tolerance
A.4,5	Soil fertility/Production	Undertake crop rotation
		Use organic fertilizer to improve yield
		Choose the cropping patterns as per recommendation of the experts.
A.5	**Sediments**	
A.5.1	Increased sedimentation	• Construction of sedimentation retention ponds (if necessary)
		• Filters should be added to all storm water inlets, and silt fences established where erosion is predicted.
		• Install sediment traps or screens to control runoff and sedimentatio
		• Design and management of canals to minimize sedimentation.
		• Provision of access to canals for removal of weeds and sediments
		Take Catchment Management
		Do not clear land that is not required
		Do not interfere with wetlands
A.6	**Ecology**	
A.6.1	Biodiversity fragmentation and loss.	• Incorporation of horticultural tree crops, sugarcane, green areas and forestation within the recreational areas to ensure maintenance of biodiversity
		Develop and implement a biodiversity awareness training programme for all staff.
		Establish Biodiversity Management Committee to oversee the implementation of the biodiversity plan
		Develop and implement a comprehensive biodiversity assessment programme
A.6.2		• Provision of wildlife migration routes especially at the proposed green areas

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
	Restriction of wildlife movement & migration routes	• Provision of wildlife crossing areas in the project roads especially at the provided migration routes
A.6.3	Loss of food resources for wildlife	Include common native tree species as strips surrounding the farms to keep animals away from crops
		Alternate cleared cropped land with uncleared natural vegetation. The natural vegetation will provide habitat and food for animals.
A6.4	Water pollution-Siltation of breeding and feeding sites	Establish receptacles, in form of artificial wetlands with plants such as Typha spp. Cyperus spp. and water sedges to trap the soil.
A6.5	Water pollution-Chemical pollution from pesticides affects animals' biology and genetics affecting population survival	Establish artificial wetlands with plant such as arrow roots which absorb harmful chemicals and reduce substances, store them in the leaves
A6.6	Water pollution-Fertilizer and organic materials cause nutrient overload which causes death of fish and other aquatic animals	Locate farms 3kms away from the river which will minimize the chances of the nutrient reaching the river.
A6.7	Loss of species important as sources of medicine for the local communities and	Establish a tree nursery for common tree and shrubs. These will be used to rehabilitate the farm area as well as the community land

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
	habitat and food for wildlife	
A6.8	Restricted migration and dry season dispersion for wildlife. This will increase human/wildlife conflict and affect wildlife population growth	Establish migratory corridors especially along the drainage lines with prolonged ground water storage and green vegetatio
A6.9	Death of untargeted invertebrates in chemical pest control, thereby reducing biodiversity.	Employ the Push and pull technology. This technology will use Napier grass (Pennisetum purpureum) to attract and traps pests such as stem-boring grass moths. The grass will be conveniently planted on field boundaries to trap the pest before they get into the farm.
A6.10	Air pollution by weed control chemicals	Reduce chemicals use by including *Desmodium spp.* in the farm. These plants release allelopathic organic chemicals into the air and in the soil which inhibit the growth of weeds and repel pests
A6.11	Emission of greenhouse gases such as carbon dioxide from farm machinery. These gases cause climate change	Uses of renewable energy such as solar energy and electricity in farm machinery. These energy resources do not emit carbon dioxide.
	Note: Reduced emissions and carbon sequestration will earn the farm	Use energy efficient diesel farm machinery to minimize emission of carbon dioxide. Use energy efficient diesel farm machinery to minimize emission of carbon dioxide.

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
	extra money from carbon credits.	
		Ensure frequent and timely servicing of farm machinery to minimize emission of carbon dioxide,
A6.12	Emission of nitrous oxide, carbon dioxide and methane from the soil. These gases cause climate change.	Employ minimum soil disturbance (minimum tillage) to keep the carbon dioxide in the soil in from of humus
	Note: Reduced emissions and carbon sequestration will earn the farm extra money from carbon credits	Include permanent trees and crop trees in the farm to enhance biomass and soil carbon accumulation and storage
		Avoid waterlogging the soil to minimize emission of methane. Anaerobic decomposition of plant materials in waterlogged soils release methane into the air.
		Minimum use of inorganic fertilizers and burning vegetation. Nitrogen based fertilisers and burning of vegetation emit nitrous oxide into the air.
A.7	**Health**	
A.7.1	Introduction or increase in incidences of water borne or water	Prevention measures:-
		Use of lined or pipes to discourage vectors
		Avoidance of stagnant or slowly moving water
		Use of straight or slightly curved canala

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
	related diseases (Schistosomiasis)	Filing or draining of borrow pits along roads and canals.
		Disease prophylaxis
		Disease treatment
A7.2	Public Health and Safety	• HIV/AIDs, STDs and other diseases
		• Accidents;
		• Hazardous materials
A.8	**Imbalances**	
A.8.1	Human-Wildlife Conflicts	Community needs to be sensitized and create awareness on the wild animal's importance
		Water points on the designated areas should be increased to avoid movements of the wild animals through the migratory corridors and the game proof friendly fence to be set up
		a game proof fence, friendly to the wildlife should be put where crops on Galana-Kulalu will be grown using 12 strands. This will be easy considering that power will have reached the project area of Galana.
		Built labour camps and probide transport to those going home
		Giving wildlife water during draught especially September to October should be considered
A.8.2	different seasons of planting crops	Sensitization
		Provide Agricultural extension Services
A.8.3	maize diseases	Provide Agricultural extension Services
		Support to community on chemicals for use
A.8.4	Price of Maize during Harvest time	Government to stabilize price of maize vy buying maize from farmers
A.8.5	Clean Water for the Community	Government should consider setting up of wholesome and palatable water supply
A.8.6	Immediate stoppage of Production	Provide at least 30 days notice for termination of employees services
A.8.7	impregating women and	Follow the law

GALANA-KULALU FOOD SECURITY PROJECT PHASES 2		
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY		
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)		
ITEM	POTENTIAL NEGATIVE IMPACT	MITIGATION MEASURES
	rampant child abuse	
A.8.8	Occurrence of Disease	Selu should come up with a strategy to manage it including in the community lands
A.8.9	Land Ownership	Give Community title deeds on the land they own
A.8.10	Good Neighborhood	Consider Coporate Social Responsibility
A.8.11	Diversifying Water Sources	County and National Government should consider developing appropriate water supplies in the area
A.8.12	Increase in rodents	Use appropriate methods of controlling on farm and environs community

Table 8-3: *Environmental and Social Management Plan during Project Decommissioning*

Possible Impacts	***Proposed Mitigation Measures***	***Responsible Party***	**Cost Estimates (KSh.)**
1. Air pollution during Demolition process.	• The demolition exercise will be limited to day time only • All personnel working in the project will be trained prior to commencing the demolition exercise on methods for minimizing negative impacts on air quality. • Construction vehicle drivers will be under strict instructions to minimize unnecessary trips, refill petrol fuel tanks in the afternoon and minimize idling of engines. • All active demolition areas will be watered at least twice a day to reduce dust. • All trucks hauling demolition debris/wastes shall be covered. • Careful screening to contain and arrest demolition related dust will be adopted • Exposed demolition debris of e.g. dust and sand, will be enclosed, covered, and watered daily before transported to disposal site. All workers on the site will be required to wear protective gear while on duty	• Project proponent • NEMA inspectors • Contractor	300,000
2. Noise pollution by disassembly activities	• Portable barriers will be installed to shield compressors • Use of equipment designed with noise control elements will be adopted where necessary. • Trucks used during demolition exercise on site shall be routed away from noise sensitive areas in the neighbourhood, where feasible. • Idling time for pickup trucks and other small equipment will be minimized to limited time. • Use of very noisy equipment will be limited to daytime only.	• Project proponent • NEMA inspector • Contractor	100,000

Possible Impacts	*Proposed Mitigation Measures*	*Responsible Party*	**Cost Estimates (KSh.)**
	• All workers operating in noisy areas or operating noisy equipment will be provided with earpieces to protect against extreme noise. • The demolition exercise will be limited to day time only		
3. Traffic and Transport	• Carry out fuel deliveries during the day to avoid noise and disruption of sleep to the residents of the neighbouring center	• Project proponent	
4. Demolition debris and related wastes	• Private contractor will be engaged to collect demolition debris/wastes • All debris/wastes will be collected regularly to control air pollution and injury etc • A licensed operator to avoid illegal final dumping at unauthorized sites will collect demolition debris. • All persons involved in refuse collection shall be in full protective attire.	• Project proponent • NEMA inspectors • Contractor	1,000,000
5. Workers accidents during demolition process.	• All workers will be sensitized before the exercise begins, on how to control accidents related to the demolition exercise • A comprehensive contingency plan will be prepared before demolition begins, on accident response. • Adherence to safety procedures will be enforced at all stages of the exercise • All workers, pursuant to labour laws, shall be accordingly insured against accidents. • All workers will be provided and instructed to wear protective attire during demolition, including helmets. • Demolition work will be limited to daytime only to avoid workers accidents due to poor visibility • Provision of mobile clinics	• Project proponent • Provincial Public Health Officer • Ministry of Labour • NEMA inspectors • Contractor	100,000

8.3 Environmental and Social Monitoring Programme

8.3.1 Introduction

It is important that the Project Proponent sets up regular monitoring programmes to assess the ambient levels in principle parameters of the environment and social aspects as stipulated under sub-section 40-41 of EMCA, 1999.

Environmental and Social Monitoring will serve the following functions:-

- To ensure that the environmental and social mitigation measures proposed in the ESIA report are effectively implemented by the various agencies in compliance to environmental provisions and standard specifications
- To evaluate the effectiveness of environmental and social remedial measures as well as various evaluation techniques and procedures
- To facilitate development of responses to new and developing issues of concern.

The environmental and social monitoring program will operate through the project construction and operation phases as presented in Tables 8-4 and 8-5.

Table 8-4: Environmental Monitoring during Construction

Item	*Parameter*	*Frequency*	*Location*
1. Public Health and Safety	• Frequency of incidents/accidents and fatalities • Number of vector breeding sites created by poor drainage. • Availability of condoms, contraceptive supply, impregnated bed nets, mosquito repellents. • Health and safety awareness among staff	Weekly	Project area and environs
2. Soil Erosion and siltation	• Soil erosion rates, stability of bank and canal embankments, etc.	Monthly	River banks, farm and canals
3. Solid and liquid wastes	• Scattered litter and interruption of surface water flows • Unpleasant smell • Complain/ lack of complain of pollution of water sources.	Weekly	Project area and environs
4. Surface and ground water quality	• As per the Second Schedule of Legal Notice No. 120 2006	Monthly	River :same locations that were sampled during baseline studies
5. Noise	• Noise limits.	Monthly	At major construction sites
6. Air pollution	• Particulates, especially dust as a result of earthworks and construction machinery	Monthly	In the project area and environs where major works will take place
7. Vegetation and habitats	• Vegetation structure, biodiversity, fuel wood,	Quarterly	Project area and environs
8. Crime	• Registered crimes/disputes; • Crimes/disputes involving women; • Crimes/disputes involving vulnerable groups	Monthly	In the project area and environs
9. Demographic and population changes	• Total population, in- and out-migration, structure of the population and vital statistics; informal settlements	Annual	In the project area and environs
10. Infrastructure	• Housing, health facilities, water, transport and communications	Annual	Project area and nearby settlement

Item	*Parameter*	*Frequency*	*Location*
11. Water	• Water usage by different operation areas	Monthly	Project area

Table 8-5: Environmental Monitoring during Operation

Item	*Parameter*	*Frequency*	*Location*
1. Surface and ground water quality	• As per the Second Schedule of Legal Notice No. 120 2006	Monthly	River :same locations that were sampled during baseline studies
2. Water quality (sources of domestic water)	• As per the Second Schedule of Legal Notice # 120 2006	Monthly	Water source: same locations that were sampled during baseline studies
3. Hydrology	• Discharge of Sabaki River	Monthly	River Sabaki (Downstream the irrigation scheme)
4. Water from irrigation farms and Discharge from the Irrigation scheme	• As per the Eighth Schedule of Legal Notice # 120 2006	Monthly	River Sabaki (Downstream the irrigation scheme)
5. Water related diseases	• Identification of water related diseases, adequacy of local vector control and curative measure.	Three times a year	Labour camps and farmers homes.
6. Soil erosion and siltation	• Types and rate of erosion on farmland and banks of rivers and canals	Seasonally	Project area
7. Solid waste generation	• Types and sources of solid wastes	Monthly	Project area
8. Air quality	• NO_2, SO_2, O_3, CO_2, CO,VOC, Benzene, and Hydrocarbons	Monthly	Project area
9. Noise	• Noise limits for different working environments	Monthly	Project area
10. Wildlife	• Types and condition of habitats (nesting places, breeding grounds, feeding places etc); endemic biota	Annual	Project area and environs

Item	*Parameter*	*Frequency*	*Location*
11. Aquatic ecology	• Phytoplanktons, zooplanktons, benthic life, fish composition and diversity; food chain and food webs;	Annual	River Sabaki (Downstream the proposed project area)
12. Infrastructure	• Housing, health facilities, water, transport and communications	Annual	Urban centers in the project area
13. Accidents and hazards	• Number, causes and actions taken	Quarterly	Project area
14. Public Health and Safety	• HIV/AIDs, STDs and other diseases • Accidents; • Hazardous materials	Quarterly	Project area and environs
15. Demographic and population changes	• Total population, in- and out-migration, structure of the population and vital statistics; informal settlements	Annual	In the project area and environs
16. Crime	• Registered crimes/disputes; crimes/disputes involving women; crimes/disputes involving vulnerable groups.	Monthly	In the project area and environs
Item	Παραμετερ	Frequency	Location
11. Aquatic ecology	• Πηψτοπλανκτονσ, ζοοπλανκτονσ, βεντηιχ λ ιφε, φισηη χομποσιτιον ανδ διωερσιτψ; φοοδ χ ηαιν ανδ φοοδ ωεβσ;	Annual	River Sabaki (Downstream the proposed project area)
12. Infrastructure	• Ηουσινγ, ηεαλτη φαχιλιτιεσ, ωατερ, τρανσπ ορτ ανδ χομμυνιχατιονσ	Annual	Urban centers in the project area
13. Accidents and hazards	• Νυμβερ, χαυσεσ ανδ αχτιονσ τακεν	Quarterly	Project area
14. Public Health and Safety	• ΗΙς/ΑΙΔσ, ΣΤΔσ ανδ οτηερ δισεασεσ • Αχχιδεντσ; • Ηαζαρδουσ ματεριαλσ	Quarterly	Project area and environs
15. Demographic and population changes	• Τοταλ ποπυλατιον, ιν– ανδ ουτ–μιγρα τιον, στρυχτυρε οφ τηε ποπυλατιον ανδ ϖιτ αλ στατιστιχσ; ινφορμαλ σεττλεμεντσ	Annual	In the project area and environs

16. Crime	• Ρεγιστερεδ χριμεσ/δισπυτεσ; χριμεσ/δισ πυτεσ ινϖολϖινγ ωομεν; χριμεσ/δισπυτεσ ινϖολϖινγ	Monthly	In the project area and environs

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

Irrigation development projects of large magnitude impose significant impacts to the physical and biological environment as well as social, cultural and economic setting of the area. The proposed Model Farm which is of this nature is also anticipated to impose such impacts. The negative impacts, however, are identifiable and can be mitigated through design and administrative measures. However, the overall positive impacts of the project far outweigh the negative projects through the mitigation measures outlined for the project.

9.2 Recommendations

i. Implementation

The Environmental and Social Impact Assessment was conducted in compliance with the relevant legislations and planning requirements of Kenya. It is therefore recommended that the proposed Model Farm project be implemented in compliance to the legislations and planning requirements at all times. In addition, the legislative framework provided in this report must be taken into consideration, during and after the implementation of the project, as will be appropriate.

ii. Environmental and Social Management Plan (ESMP)

A comprehensive Environmental and Social Management Plan (ESMP) has been presented in this report and it is recommended that the mitigation guideline provided be followed to the later and improvements made if need be. Specifically, key negative impacts that require careful management during the rehabilitation and construction of the Model Farm's infrastructure and operation phases be addressed.

iii. Environmental Monitoring

Environmental Monitoring Programme (EMP) provided for the key issues as a result of the proposed Model Farm's construction, operation and rehabilitation must also be followed to ensure that the construction and operation are in line with the ESIA license.

10 APPENDIX

10.1 Appendix 1:- List of Reference

1. Groundwater Quality Analyses along Kenyan Coastal Region, Case Study of Kilifi, Kenya by Mary Makokha dated 12th February, 2019

2. Kilifi County Integrated Development Plan 2023-2027 Draft

3. Environmental and Social Impact Assessment (ESIA) Report for the Model Farm in Galana-Kulalu by Dr. Mary Wambui Kimani dated 10th August, 2015

4. Kilifi District Environmental Assessment Report by National Environment and Human Settlements Secretariat dated December, 1984

5. Galana Kulalu Food Security Project :- Proposed handing over production on the 10,000 acre model farm to the private sector through a suitable PPP Model by National Irrigation Authority dated May, 2021

6. Environmental Assessment Sourcebook:- Volume II-sectoral guidelines;- World Bank Technical Paper Number 140 dated 1991

7. Guideline for Environmental Assessment of Dam Projects by M. Trojanow, Kenyan German Water Team, GTZ dated Nairobi, June, 1993

8. Kenyan Constitution 2010, Several Policies and Laws of Kenyan

10.2 APPENDIX 2:- MINUTES OF SURGICAL CONSULTATION MEETING HELD ON FRIDAY 30th JUNE,2023 AT GALANA CONSERVANCY GATE BETWEEN GALANA CONSERVANCY AND ESIA TEAM FROM 12.30AM TO 1.30PM

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED GALANA-KULALU PHASES 2 AND 3 IN THE LARGER PROPOSED GALANA-KULALU FOOD SECURITY PROJECT LOCATED IN THE EXISTING GALANA- RANCH AND GALANA-KULALU MODEL FARM WITHIN KILIFI AND TANA RIVER COUNTIES

MINUTES OF SURGICAL CONSULTATION MEETING HELD ON FRIDAY 30th JUNE,2023 AT GALANA CONSERVANCY GATE BETWEEN GALANA CONSERVANCY AND ESIA TEAM FROM 12.30AM TO 1.30PM

IN ATTENDENCE

Item	Name	Designation	Institution	Comment
1	Mr. Ben Gordon	TCL	Galana Conservancy	E-mail bengordoninev41@gmail.com
2	2 Rangers			
3	Eng. Benard I. Kasabuli	Lead Expert	Consultant	Taking Minutes
4	Ms Teresia Njeri	Ecologist	Consultant	
5	Mr. Lamek Ogeto	Surveyor	Consultant	
6	Clifford Ngeno	Technical Assistant	Consultant	
7	Newton Kirimi	Environmentalist	National Irrigation Authority	

AGENDA

Introduction
Galana Conservancy Remarks
Remarks by Lead Expert
Brief Description of the Project
Questions and Concerns from the Attendees
Resolutions
Any Other Business
Adjournment

1	**Minute 1**	**Introduction** The meeting started with self-introductions starting with Galana Conservancy with the Consultant starting with the lead expert.
2	**Minute 2**	**Galana Conservancy Remarks** Ben Gordon stated that he is the TCL and acts as OIC when Ben is off. He said that they started the conservancy about 2 years ago on 60,000 acres which has now increased to 200,000 acres.

		He indicated that the Conservancy borders Tsavo East National Park and on the lower is the Galana Ranch. He indicated that there are all the big five wildlife apart from the rhino. He requested the consultant to go a head and see how he could assist.
3	**Minute 3**	**Remarks by the Lead Expert** The Lead Expert introduced the EIA team allowing each to give a brief of their respective roles in the assignment. Thereafter he gave a background of the proposed project with the following key highlights. a) That the main objective of the project was to foster peace among the inhabitants of the area and its close environs, like Galana Conservancy. b) That the model farm phase 1 of 10,000acres, the proposed phase II of 10,000 acres and another phase III of 80,000acres being scoped totaling 100,000acres in future will be undertaken by Selu limited. c) That the Laws of Kenya require that an Environmental Impact Assessment be carried out on such proposals. He explained that the meeting was a suitable forum to get the Conservancy opinion on the proposed project; its likely position or negative impacts and suggestions on mitigation measures for any negative ones. He also noted that the meeting would also give an indication on whether the Conservancy was for or against the project. He highlighted the findings on wildlife on the consultation they had held with the community. He explained that from layman point of view, preserving wetlands along Galana river and expand will form the grazing grounds of herbivorous wildlife during dry spell. He wondered on the suitable size and width of the wetland.
4	**Minute 4**	**Brief Description of the Project** The Lead Expert gave a brief description of the project mentioning, among others: i) That the scope of the project was to construct a phase II of Galana –kulalu of 10,000 acres of maize, castor oil and different varieties of crops. ii) That a pre-feasibility study of the project was undertaken which identified the catchment area, water demand, and the existing river galana along the proposed site as the sources of water. iii) That the water from the proposed project would be available for use for irrigating the model farm and small scale community farms will be sufficient.
5	**Minute 5**	**Questions and Concerns from the Attendees** Ben proposed that the wetland to be preserved along Galana River should be as as large as economically possible. He indicated that as far as he was concerned, there are four things required for wildlife viz:- 1. Availability of Grazing 2. Water 3. Safety and 4. Fencing He indicated that there is no fence between the conservancy and the park. He indicated that the conservancy has 4-5 dams which get filled when you have good rains. He requested that

		preserving a buffer zone for safety of wildlife. He indicated that a wetland cover is not a solution since at night the wildlife will go to peoples land and day they go to the wetland.
6	**Minute 6**	**<u>Resolutions</u>** a) Mr. Ben gave the team his contacts and said that he is available for further consultation if the Consultant feels so
7	**Minute 7**	**Any Other Business** • The Lead Expert assured the Conservancy that his contributions would be useful in preparation of the Environmental Management Plan, one of the contents of an EIA report.
8	**Minute 8**	**<u>ADJOURNMENT</u>** There being no other business the Chairman adjourned the meeting at 1.30pm

10.3 APPENDIX 3:- MINUTES OF SURGICAL CONSULTATION MEETING HELD ON 30th JUNE, 2023 AT TSAVO EAST NATIONAL PARK, VOI AT ASSISTANT DIRECTOR'S OFFICE, TAITA TAVETA COUNTY FROM 4.05PM TO 4.45PM

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED GALANA-KULALU PHASES 2 AND 3 IN THE LARGER PROPOSED GALANA-KULALU FOOD SECURITY PROJECT LOCATED IN THE EXISTING GALANA-RANCH AND GALANA-KULALU MODEL FARM WITHIN KILIFI AND TANA RIVER COUNTIES

MINUTES OF SURGICAL CONSULTATION MEETING HELD ON 30th JUNE,2023 AT TSAVO EAST NATIONAL PARK, VOI AT ASSISTANT DIRECTOR'S OFFICE ,TAITA TAVETA COUNTY FROM 4.05PM TO 4.45PM

IN ATTENDENCE

Item	Name	Designation	Institution	Comment
1	Mr. Njue	Assistant Director in charge of Tsavo East National Park	KWS	Chairing
2	Eng. Benard I. Kasabuli	Lead Expert	Consultant	Taking Minutes
3	Ms Teresia Njeri	Ecologist	Consultant	
4	Mr. Lamek Ogeto	Surveyor	Consultant	
5	Clifford Ngeno	Technical Assistant	Consultant	Taking Minutes

AGENDA

Introduction
Chairman's Remarks
Remarks by Lead Expert
Brief Description of the Project
Questions and Concerns
Resolutions
Any Other Business
Adjournment

1	**Minute 1**	**Introduction** The meeting started with self-introductions starting with chairman followed with the Consultant starting with the lead expert..
2	**Minute 2**	**Chairman's Remarks** He stated that the government has been supporting a number of mitigation programmes and has plans to construct three mega dams inside the park. He also stated that due to human wildlife conflicts the community needs to be sensitized and create awareness on the wild animal's importance. He also noted that the water points on the designated areas should be increased to avoid movements of the wild animals through the migratory

		corridors and the game proof friendly fence to be set up. He stated that the ranches are transit routes for pastoralists from garsen to Taita ranch for somalis and orma and they have illegal weapons to defend themselves and their livestock from being attacked by the wild animals posing insecurity purposes and poaching with their crude weapons. Most of the residence in the project area support the project since they belief it will not have adverse effects to them since the KWS team have put in place measures to curb human wildlife conflicts. Growing different varieties of crops is an important factor to the development and the capacity of people to participate in development activities. Concerning KWS policy on ESIA, KWS has been reformed and given this role to wildlife and research institute which was being led by principal supt. Lala (Dr) who is KWS principal scientist and was not around until Monday, 3rdjuly 2023. However, putting this constrains in perspective, he said he was willing to proceed with the discussion. In conclusion he invited the Lead expert to give his remarks:
3	**Minute 3**	**<u>Remarks by the Lead Expert</u>** The Lead Expert introduced the EIA team allowing each to give a brief of their respective roles in the assignment. Thereafter he gave a background of the proposed project with the following key highlights. a) That the main objective of the project was to foster peace among the inhabitants of the area and its close environs, especially the communities of Bombi and danisa benefiting directly from the model farm. b) That the model farm phase 1 of 10,000acres, the proposed phase II of 10,000 acres and another phase III of 80,000acres being scoped totaling 100,000acres in future . c) That the Laws of Kenya require that an Environmental Impact Assessment be carried out on such proposals. He explained that the meeting was a suitable forum to get the opinion of KWS on the proposed project; its likely position or negative impacts and suggestions on mitigation measures for any negative ones. He also noted that the meeting would also give an indication on whether the KWS was for or against the project and d) Issues of Human-wildlife conflict was emerging as the critical part of the project e) Selu Limited is in the process of being awarded a lease for 100,000acres on Gala Ranch which includes the Model farm. Simba cement has alo been leased 22,500 acres to grow palm oil.

		f) He had already had a meeting with Galana Conservancy and their views have been noted.
4	**Minute 4**	**<u>Brief Description of the Project</u>** The Lead Expert gave a brief description of the project mentioning, among others: i) That the scope of the project was to construct a phase II of Galana –kulalu of 10,000 acres of maize, castor oil and different varieties of crops. ii) That a pre-feasibility study of the project was undertaken which identified the catchment area, water demand, and the existing river galana along the proposed site as the sources of water. iii) That the water from the proposed project would be available for use for irrigating the model farm and small scale community farms will be sufficient.
5	**Minute 5**	**Questions and Concerns from the Attendees** The Assistant Director of KWS who is incharge of Tsavo East Park had the following to say:-. 1. In Galana-Kulalu, the most wildlife which visit this area are elephants and other small animals. Others are Hippos. 2. Next to Sala gate in mid-September to mid-October there is no river moving and cannot be pumped. 3. Galana-Kulalu dam is proposed to be constructed towards Mtito-Andei where Tsavo river and Galana meet. The water will gravitate to Galana through a canal from Mtito Andei. 4. It is proposed that a game proof fence, friendly to the wildlife should be put where crops on Galana-Kulalu will be grown using 12 strands. This will be easy considering that power will have reached the project area of Galana. 5. In may, the population of elephants is normally about 300. 6. Number of people in Galana will go up. This will increase wildlife-human conflict. 7. Number of people in Galana will go up. This will increase wildlife-human conflict. 8. Sensitization is proposed in the project area and environs. 9. Giving wildlife water should be considered 10. Galana-Kulalu is a transit route of pastrolist coming all the way upto Taita ranch. They are not good since they are destructive 11. There is a GSU camp in Galana. 12. When it is dry, a Somali will enter where it is green 13. Away of handling pastrolist should be put in place (i.e. security since they are armed.) 14. Issues of habitat degradation in Galana due to activities of Selu Limited, Mombasa Cement and the government

		15. Will Galana river be enough? We have Kilifi county who depends on Sabaki (Galana) 16. During September and October before the onset of short rains, Galana area is normally dry 17. During wet periods, wildlife population grows drastically e.g. in June, their were a total of 120 species of wildlife and start grazing along the river. 18. Conservancy is an extension of the park and being managed by Shedrick wildlife conservancy. 19. The dispersal area of wildlife from Tsavo East National Park is that they go up to Kilifi. **Migratory Path** ✓ Should be left intact ✓ Migratory area is not established ✓ It is recommended that the farming block should be set away from the river preferably 100-500m and the proposed padox should be moved into interior away from Galana River. ✓ The migratory path for wildlife is currently phasing a lot of encroachment
6	**Minute 6**	**<u>Resolutions</u>** From the foregoing it was resolved unanimously that: a) This Report should not be made to gather dust on shelves but should be implemented to the later.
7	**Minute 7**	**Any Other Business** • The Lead Expert assured the participants that their contributions would be useful in preparation of the Environmental Management Plan, one of the contents of an EIA report. • The Assistant Director thanked the EIA team for availing themselves for the consultation
8	**Minute 8**	**<u>ADJOURNMENT</u>** There being no other business the Chairman adjourned the meeting at 4.45pm

10.4 APPENDIX 4:- MINUTES OF SURGICAL CONSULTATION MEETING HELD ON 29th JUNE,2023 AT KISIKI SUB-LOCATION SUB-CHIEFS OFFICE BOMBI MARKET ,KILIFI COUNTY FROM 10.30AM TO 1.15PM MINUTES OF SURGICAL CONSULTATION MEETING HELD ON 29th JUNE,2023 AT KISIKI SUB-LOCATION SUB-CHIEFS OFFICE BOMBI MARKET ,KILIFI COUNTY FROM 10.30AM TO 1.15PM

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED GALANA-KULALU PHASES 2 AND 3 IN THE LARGER PROPOSED GALANA-KULALU FOOD SECURITY PROJECT LOCATED IN THE EXISTING GALANA-RANCH AND GALANA-KULALU MODEL FARM WITHIN KILIFI AND TANA RIVER COUNTIES

MINUTES OF SURGICAL CONSULTATION MEETING HELD ON 29th JUNE,2023 AT KISIKI SUB-LOCATION SUB-CHIEFS OFFICE BOMBI MARKET ,KILIFI COUNTY FROM 10.30AM TO 1.15PM

IN ATTENDENCE

Item	Name	Designation	Institution	Comment
1	Mr. Stephen Mramba	Kisiki Sub-Location, Sub-Chief	Provincial Administration	Chairing
2	Mr. Jackson Kadenge Karisa	Village elder, Bombi	Community	
3	Mr. Joseph Mulunyu	Community Leader	Community	
4	Eng. Benard I. Kasabuli	Lead Expert	Consultant	Taking Minutes
5	Ms Teresia Njeri	Ecologist	Consultant	
6	Mr. Lamek Ogeto	Surveyor	Consultant	
7	Clifford Ngeno	Technical Assistant	Consultant	
8	Newton Kirimi	Environmentalist	National Irrigation Authority	

AGENDA

Introduction
Chairman's Remarks
Remark by National Irrigation Authority
Remarks by Lead Expert
Brief Description of the Project
Questions and Concerns from the Attendees
Resolutions
Any Other Business
Adjournment

1	**Minute 1**	**<u>Introduction</u>** The meeting started with self-introductions starting with chairman and the rest of the community members followed with the Consultant starting with the lead expert..
2	**Minute 2**	**Chairman's Remarks** The chairman started the meeting by giving an overview of Kisiki Sub-location where the project is located. He stated that he was the sub-chief of Kisiki Sub-location,Chakama location, Lango Mbaya Division, Magharini Constituency, Kilifi County. Kisiki Sub-location had a total of 14 villages namely:- Galana, Kulalu, Galana Conservancy, GSU Camp, Mombasa Cement, Selu, Bombi Market, Danisa village, Abura among others. Chakama has three sub-locations. **Road Network**:- The road network consists of Bombi, Kisiki, Hawewenje, and Shakahola Bridge.. Yhere is a bridge on Galana ADC being constructed. **Dialect: -** There are three tribes in Kisiki Sub-location namely:- Watamu, Giriama and Oroma. Neighborhood:- There is close collaboration between community and ADC (Agricultural Development Corporation) In conclusion he invited the Lead expert to give his remarks:
3	**Minute 3**	**Remark by National Irrigation Authority** Mr. Newton said he was working for National Irrigation Authority in Galana. He said he was accompanying Selu limited who has leased land from ADC including the model farm. He told the meeting the Selu Limited had hired a consultant to undertake ESIA to try to understand the project area and if possible if there are negative impacts, see how to mitigate them. He requested the lead expert to introduce the subject matter.
4	**Minute 4**	**<u>Remarks by the Lead Expert</u>** The Lead Expert introduced the EIA team allowing each to give a brief of their respective roles in the assignment. Thereafter he gave a background of the proposed project with the following key highlights. a) That the main objective of the project was to foster peace among the inhabitants of the area and its close environs, especially the communities of Bombi and danisa benefiting directly from the model farm. b) That the model farm phase 1 of 10,000acres, the proposed phase II of 10,000 acres and another phase III of 80,000acres being scoped totaling 100,000acres in future will be undertaken by Selu limited.

		c) That the Laws of Kenya require that an Environmental Impact Assessment be carried out on such proposals. With the area sub-chief participating through methods such as such meetings being part of its procedures. He explained that the meeting was a suitable forum to get the area stakeholders opinion on the proposed project; its likely position or negative impacts and suggestions on mitigation measures for any negative ones. He also noted that the meeting would also give an indication on whether the area community was for or against the project.
5	**Minute 5**	**Brief Description of the Project** The Lead Expert gave a brief description of the project mentioning, among others: i) That the scope of the project was to construct a phase II of Galana –kulalu of 10,000 acres of maize, castor oil and different varieties of crops. ii) That a pre-feasibility study of the project was undertaken which identified the catchment area, water demand, and the existing river galana along the proposed site as the sources of water. iii) That the water from the proposed project would be available for use for irrigating the model farm and small scale community farms will be sufficient.
6	**Minute 6**	**Questions and Concerns from the Attendees** The Sub-chief took the team on the overview of the project. He stated that in addition to the bombi community who resided at the border of the project area side are the main beneficiaries of the proposed project would be the bombi and Danisa people who inhabited areas on the model farm boundary. Thereafter, he explained that since they are experiencing wildlife conflicts due to the wild animals destroying their crops they have requested for the clients of the model farm in future for their farms to be fenced off to hinder wild animals from destroying their farm crops. The community also has had a difficult time on different seasons of planting crops and they have sort to use expensive chemicals to spray their maize plantation due to the growth of maize diseases since inception of pilot model farm phase 1. Most of the residence in the project area support the project since they belief it will not have adverse effects to their health since the Galana river water being used at the model farm is treated and used for irrigation purposes while small percentage don't support the project since they believe the government can have to displaced them in future for more expansion of the farm. Growing different varieties of crops is an important factor to the development and the capacity of people to participate in development activities. The transport system is relatively poor as the gravel Roads linking the Model farm and the community become impassable due to the wild animals hovering around the area searching for water along Galana river and also the roads are impassable during the rainy seasons. The expansion of the phase 2 model farm will create employment opportunities both directly and indirectly during construction phase.

		Most people will be employed as skilled and semi-skilled workers. This will open up new positions for both men and women. . Finally, he added that Selu limited to buy community maize in order to support them economically when it matures. - Oroma are pastoralist. In view of this, they normally graze in ADC farm - Galana conservancy sponsor students for education - Traditional herb also exist in the shrub land which is to be cleared. - It was noted that both the new tenants in ADC land which currently consists of Simba Cement and Selu Limited are going to use Galana irrigation scheme. This might dry the river denying the environs to irrigate their land and water their flock. This will become pronounced with time by considering climate change phenomena. - Community irrigate about ¼ acre be each household - It is envisaged the new tenants will lead to benefit of the community like job, access road. - The area is not accessible to clean portable water which the project should pursue as part of corporate social responsibility. - Further, they should consider building more schools and churches - The meeting was told that when the farming in model farm was stopped abruptly, the community suffered since they had relied on the farm for employment - Model farm brought insecurity since women were impregated and their was rampant child abuse - If there is a disease on farm, Selu should come up with a strategy to manage it including in the community lands - Kids dropped out of school in preference to working in farm - The sub-chief said he also secured a job on the farm as a human resource personnel. - On wages, he advised ADC tenants not to come up with there rates but seek opinion of leaders before coming up with thir wages. - The community observed that:- -Skilled labourers are a few within the community. -They border Tsavo East National Park where wild animals roam freely - Initially, Galana Ranch fenced exactly where the project was active. - The 10,000 acres was ever green. - Elephant, lion become a threat to the community. - They requested for the new tenants to live left overs to the community and surrounding community be looked at. - Insecurity and human-wildlife conflict should be addressed moving forward. - Requested government to give them title deed where they are staying - Transport will be a challenge for community going to work for the new tenants.

		▪ They proposed the tenants should come up with transport and staff quarters as incentives of inducing the community to work for the new tenants. ▪ They requested consultation should be done with right people and gave an example of Mombasa cement who were led to community land and not ADC. They indicated that any conflict can be resolved between management and surrounding community and this should not worry the new tenants ▪ They requested that in future, every body should be involved at every stage of the project. ▪ Requested that the community be considered for solar fencing to deter wild animals. ▪ It is proposed that the water sources in the area be diversified. ▪ Requested for maintaining a buffer zone to allow elephants and other wildlife to move freely ▪ Normally, wildlife move to conservancy then along Galana River ▪ During green arrava, new diseases of maize emerged. ▪ The normal chemicals used by community could not work and were advised to buy very expensive insecticides. ▪ Requested for community to be assisted if this occurred. ▪ The maize disease disappeared immediately when the project stalled and has not reappeared ▪ The Israel's used aeroplanes for spraying ▪ Rats increased tremendously and went upto villages ▪ Maize in community farm started wilting ▪ Investor could control occurrence of the disease while community could not. ▪ Army worms became pronounced ▪ Mombasa Cement has promised corporate social responsibility which should be duplicated by Selu Limited.
7	**Minute 7**	**<u>Resolutions</u>** From the foregoing the Sub-chief resolved unanimously that: a) The responses given by the EIA team to their questions and concerns were satisfactory. b) The community was happy with the proposed project and fully supports it. The participants unanimously agreed that the project would come with other benefits such as creation of employment opportunities, provide adequate water, increase access to water, boost livestock population numbers, and foster peaceful coexistence with their neighbours.

		c) That the community fully supports the project and longs for commencement of construction works of Phase II.
8	**Minute 8**	**Any Other Business** • The Lead Expert assured the participants that their contributions would be useful in preparation of the Environmental Management Plan, one of the contents of an EIA report. • The Sub-chief kiziki location thanked the EIA team for availing themselves for the meeting
9	**Minute 9**	**ADJOURNMENT** There being no other business the Chairman adjourned the meeting at 1.15pm

10.5 APPENDIX 5:- LIST OF PEOPLE CONSULTED

S/N	Name	ID NO.
1	Ann M. Kimanzi	25101019
2	James K. Kisasu	8801750
3	Nyacho Said Abdalla	11891809
4	Joseph Muhindi	29887355
5	Johnson Mwandawiro	23270143
6	Ronald Ndira	26022205
7	Aldid Mhidin Yussuf	39268860
8	Rachael K. Kahindi	29462048
9	James Ngaza Gandi	9113889
10	Lole Gulad Kosar	21149254
11	John Otieno Oyoga	31428590
12	Abel Wambua	31128416
13	Samuel Ngala Sirya	41163256
14	Mohammed Ore Adhan	33175444
15	Isaac Charo Ngala	40821335
16	Mwanzu Matheka	7917204
17	Yusuf Kedia	8296951
18	George Odera Omaido	3895823
19	Simon Katana Karabu	34195179
20	Robert Kirotich	26295181
21	Nicholas Ambanya	1338080
22	Haman Mbugua	
23	Newton Kirimi	30691595
24	Joseph Irungu	33331889

S/N	Name	ID NO.
25	Bernard Kariuki	25948309
26	Edward Mghanyi	32500233
27	Adhan Yasin Yusuf	40173771
28	Thomas Bwahi Commando	35102870
29	Ahmed Tawane Boshi	35676694
30	Sadia Harova Suleiman	29702308
31	Siad Adhan	10311127
32	Omar Abdi	27801049
33	Adam Karisa	34198964
34	Esther B. Changawa	25601511
35	Lilian Idza Mwalungo	29230448
36	Victor Charo Shedrack	29910584
37	Lydia Wario Barisa	30736439
38	Bidii Kazungu Karisa	23445587
39	Elina Jumwa Kazungu	30998237
40	Happy Karembo Sammy	14689551
41	Faith Saro Charo	29509985
42	Mary Kazungu Nzai	3163134
43	Everlyne Gona	37561563
44	Safari Ziro Kenga	36584608
45	Festus Mwaringa Mae	27289331
46	Hussein Safari Charo	29955966
47	Thomas Katana	28530194
48	Jefferson Guyo Badiva	27346208
49	Stephen S. Mramba	28832131
50	Michael Ngonyo Chome	35554585
51	Pantency Katana Mangi	37310510
52	Benson Barua Galgato	34317177
53	Emmanuel Chea	26120050

Engineer Benard Imbambi Kasabuli
LEAD EXPERT NO. 0531

ENVIRONMENTAL IMPACT ASSESSMENT
FOR THE PROPOSED GALANA-KULALU PART OF PHASE 2(16,000HA OF PROPOSED 100,000ACRES) IRRIGATION PROJECT IN THE LARGER PROPOSED GALANA-KULALU FOOD SECURITY PROJECT LOCATED IN THE EXISTING GALANA-KULALU RANCHES WITHIN KILIFI COUNTY

LIST OF PEOPLE WHO WERE INTERVIEWED

NAME	VILLAGE	ID NUMBER	MOBILE	E-MAIL	SIGNATURE
Ronald Wdiwa	ADC Galana	26072201	0702641149		
JOHNSON MWANDAWIRO	ADC GILANA	27270143	0790258758		
Joseph Muthindi	ADC GALANA	29887355	0716318216	Jmachila@gmail.com	
NYACHO SAID ABDALLA	ADC GALANA	11891809	0715426943		
MM M. KUMANA	ADC GALANA	25101019	07243085[illegible]		
JAMES K. KISASU	ADC GALANA	8801750	0724204602	Jamesp@gmail.com	

Engineer Benard Imbambi Kasabuli
LEAD EXPERT NO. 0531

ENVIRONMENTAL IMPACT ASSESSMENT
FOR THE PROPOSED GALANA-KULALU PART OF PHASE 2(16,000HA OF PROPOSED 100,000ACRES) IRRIGATION PROJECT IN THE LARGER PROPOSED GALANA-KULALU FOOD SECURITY PROJECT LOCATED IN THE EXISTING GALANA-KULALU RANCHES WITHIN KILIFI COUNTY

LIST OF PEOPLE WHO WERE INTERVIEWED

NAME	VILLAGE	ID NUMBER	MOBILE	E-MAIL	SIGNATURE
Aidid Mhidin yussuf	Galana	39268860	0112394382	Aididmhd@gmail.com	
[illegible]	GALANA	21149854	0706533765		
[illegible]	GALANA	9113889	0724941036	[illegible]	
RACHEAL K, KAHINDI	GALANA	29462048	0715685092		

Engineer Benard Imbambi Kasabuli
LEAD EXPERT NO. 0531

ENVIRONMENTAL IMPACT ASSESSMENT
FOR THE PROPOSED GALANA-KULALU PART OF PHASE 2(16,000HA OF PROPOSED 100,000ACRES) IRRIGATION PROJECT IN THE LARGER PROPOSED GALANA-KULALU FOOD SECURITY PROJECT LOCATED IN THE EXISTING GALANA-KULALU RANCHES WITHIN KILIFI COUNTY

LIST OF PEOPLE WHO WERE INTERVIEWED

NAME	VILLAGE	ID NUMBER	MOBILE	E-MAIL	SIGNATURE
JOHN OTIENO OYOLA	DANISA	31428590	0717163052		
ABEL WAMBUA	DANISA	31128416	0717287703		
SAMUEL SIMA	DANISA	41163256	07975258		
MOHAMMED ADIAN	DANISA	33175444	0700875000		
ISAAC NGALA	DANISA	40821335	0114358517		
AHMED BOSHI	DANISA	35676694	0702327729		
MWANZU MATHEKA	ADC DANISA	7417204	0796900810		
YUSUF KEDIA	DANISA	8296591	0711235209		

10.6 APPENDIX 6:- IMPORTANT GPS POINTS PICKED

	Galana-Kulalu Food Security Project									
			GPS No.1				GPS No.2			
Item		Description	Longitude (Degrees)	Latitude (Degrees)	Altitude (M)	Region (M)	Longitude (UTM) East	Latitude (UTM) South	Altitude (M)	Remarks
		Drift where we stepped	E038.85011^0	S3.06458^0	270	37N	483346	9641267	273	
		NIB Camp	E039.35366^0	S3.06838^0	148	37N	539297	966838	144	
		Gate B to Model Farm	E039.39297^0	S3.05566^0	147	37N	543666	966244	144	
		Maize Quarter-CP14-Q1B	E039.38820^0	S3.05564^0	149	37N	543135	966225	147	
		Gate B	E039.35748^0	S3.06223^0	158	37N	539700	966151	157	
		Drip Area	E039.35682^0	S3.03941^0	171	37N	539651	9664045	157	
		Reservoir	E039.35764^0	S3.03704^0	175	37N	539741	9664307	175	Being used for drip irrigation
		Fence/Opposite logistic centre	E039.31854^0	S3.05639^0	154	37N	535394	9662166	153	stores produce
		Gate C	E039.32196^0	S3.059461^0	160	37N	535777	9661834	156	
		Hall	E039.35374^0	S3.06859^0	131	37N	539306	9660820	128	Infrond of Mbugua's Office
		Pumping Station	E039.35282^0	S3.06957^0	136	37N	539206	9660713	133	
		GSU Gate	E039.33310^0	S3.06090^0	155	37N	537013	9661669	154	
		Where we stopped in farm near CP	E039.33792^0	S3.02213^0	181	37N	537546	9665963	181	Under Construction by IRRICO

	Galana-Kulalu Food Security Project									
			GPS No.1				GPS No.2			
Item		Description	Longitude (Degrees)	Latitude (Degrees)	Altitude (M)	Region (M)	Longitude (UTM) East	Latitude (UTM) South	Altitude (M)	Remarks
		1 Bay gate	E039.33863^0	S3.01632^0	179	37N	537633	9666609	176	
		proposed CP 22	E039.34091^0	S3.00219^0	183	37N	537886	9668157	183	No CP backwards. Stephen Murama
		Main Gate	E039.35736^0	S3.06237^0	158	37N	5389714	9661507	154	CP 13,14
		Bao Lala Market Centre	E039.78631^0	S3.10502^0	113	37N	587097	9648029	121	
		Sub-Chief's Office, Bombi Market	E039.48171^0	S3.07657^0	118	37N	553526	9659933	119	
		Inside Galana River	E039.33308^0	S3.06607^0	154	37N	537014	9661098	164	
		On river Bank	E039.33321^0	S3.06844^0	139	37N	537035	9660835	136	
		Said Talim Office-KWS, Voi Town	E038.59747^0	S3.35521^0	609	37N	455641	9629120	541	