

GOVERNMENT OF KENYA**MWACHE MULTIPURPOSE DAM PROJECT****ENVIRONMENTAL AND SOCIAL IMPACT
ASSESSMENT (ESIA)**

June 2014

FINAL REPORT**Ministry of Environment, Water and Natural Resources****WATER SECURITY AND CLIMATE RESILIENCE IN COASTAL REGION**

Tito Kodiaga
Senior Environmental Safeguards Consultant
Kenya Water Security and Climate Resilience Project
fito@emconsultants.org
www.emconsultants.org

TABLE OF CONTENTS

| | |
|--|-------------|
| EXECUTIVE SUMMARY | 1-28 |
| CHAPTER 1: | 29 |
| INTRODUCTION | 29 |
| 1.1 BACKGROUND | |
| 1.2 THE PROJECT | 29 |
| 1.3 THE ESIA STUDY | 29 |
| 1.3.1 ESIA Terms of Reference | 30 |
| 1.3.2 ESIA Objectives and Scope of Work | 32 |
| 1.4 ESIA METHODOLOGY | 31 |
| 1.4.1 The Approach | 31 |
| 1.4.2 Scoping Process | 32 |
| 1.4.3 Documentary Review | 32 |
| 1.4.4 Field Assessment | 32 |
| 1.4.5 Detailed ESIA Study Activities | 33 |
| 1.4.6 Public Consultations | 33 |
| 1.4.7 Reporting | 34 |
| 1.5 STUDY EXPERTS | 34 |
| CHAPTER 2: PROJECT DESCRIPTION | 35 |
| 2.1 PROJECT LOCATION | 35 |
| 2.2 PROJECT HISTORY | 37 |
| 2.3 THE PROPONENT AND KEY STAKEHOLDERS | 37 |
| 2.4 PROJECT JUSTIFICATION | 37 |
| 2.5 PROJECT AREA | 43 |
| 2.5.1 Catchment Area Upstream of the Dam | 43 |
| 2.5.2 Dam Site and Buffer Areas | 44 |
| 2.5.3 Area to be Served and the Adjoining Land | 45 |
| 2.5.4 Downstream of the Dam | 45 |
| 2.6 DESIGN CONCEPTS | 23 |
| 2.6.1 Basic Consideration | 23 |
| 2.6.2 Dam Location and Components | 25 |
| 2.6.3 Water Use Options | 26 |
| 2.6.4 Water Supply | 26 |
| 2.6.5 Water Transmission Pipeline | 27 |
| 2.6.6 Irrigation | 29 |
| 2.6.7 Other Benefits | 30 |
| 2.7 PROJECT ACTIVITIES | 54 |
| 2.7.1 Planning and Feasibility Studies | 54 |
| 2.7.2 Design Work | 54 |
| 2.7.3 Construction Phase | 55 |
| 2.7.4 Commissioning | 56 |

| | | |
|---|--|-----------|
| 2.7.5 | Dam Operations | 56 |
| 2.8 | KEY LINKAGES | 56 |
| 2.9 | DECOMMISSIONING PHASE | 57 |
| 2.10 | PROJECT ESTIMATED COST AND IMPLEMENTATION SCHEDULE | 58 |
| 2.11 | ANALYSIS OF PROJECT ALTERNATIVE | 58 |
| CHAPTER 3: POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK | | 69 |
| 3.1 | AN OVERVIEW | 69 |
| 3.2 | POLICY PROVISIONS | 69 |
| 3.2.1 | Constitution of Kenya | 69 |
| 3.2.2 | The Kenya Vision 2030 | 70 |
| 3.2.3 | National Environment Action Plan (NEAP) | 71 |
| 3.2.4 | National Policy on Water Resources Management and Development | 71 |
| 3.2.5 | Sessional Paper No. 6 of 1999 on Environment and Sustainable Development | 72 |
| 3.2.6 | The Agricultural Policy | 72 |
| 3.2.7 | The Land Policy | 73 |
| 3.2.8 | CDA Strategic Plan | 73 |
| 3.3 | LEGAL FRAMEWORK | 74 |
| 3.3.1 | The Environment Management and Co-ordination Act, 1999 | 74 |
| 3.3.2 | EMCA Regulations | 75 |
| 3.3.3 | The Factories Act (Cap. 514) | 77 |
| 3.3.4 | The Water Act 2002 | 78 |
| 3.3.5 | Water Rules | 79 |
| 3.3.6 | The Public Health Act (Cap. 242) | 79 |
| 3.3.7 | The Forest Act | 80 |
| 3.3.8 | The Agriculture Act | 80 |
| 3.3.9 | Pest Products Control Act | 81 |
| 3.3.10 | Physical Planning Act (Cap. 286) | 81 |
| 3.3.11 | Local Government Act (Cap. 265) | 82 |
| 3.3.12 | The Land Planning Act (Cap. 303) | 82 |
| 3.3.13 | The Penal Code (Cap. 63) | 82 |
| 3.4 | INSTITUTIONAL STRUCTURE OF THE WATER SECTOR | 82 |
| 3.4.1 | Water Services Regulatory Board (WASREB) | 83 |
| 3.4.2 | Water Resources Management Authority (WRMA) | 83 |
| 3.4.3 | Water Services Trust Fund (WSTF) | 83 |
| 3.4.4 | Water Services Boards (WSBs) | 84 |
| 3.4.5 | Water Services Providers | 84 |
| 3.5 | NEMA COMPLIANCE | 84 |
| 3.6 | SECTORAL INTEGRATION | 84 |
| 3.6.1 | Project Institutional Management Structure | 85 |
| 3.6.2 | The Contractor | 86 |
| 3.6.3 | The Supervisor | 86 |
| 3.6.4 | The CDA Environmental Division | 86 |
| 3.6.5 | Project Management Responsibility Inter-Relationship | 86 |
| 3.7 | THE WORLD BANK ENVIRONMENTAL SAFEGUARS | 88 |
| 3.7.1 | OP/BP 4.01 (Environmental Assessment) | 88 |

| | | |
|---|---|------------|
| 3.7.2 | OP/BP 4.04 (Natural Habitats) | 90 |
| 3.7.3 | OP/BP 4.11 (Physical Cultural Resources) | 91 |
| 3.7.4 | OP/BP 4.12 (Involuntary Resettlement) | 91 |
| 3.7.5 | OP/BP 4.36 (Forests) | 92 |
| 3.7.6 | OP/BP 4.10 (Indigenous Peoples) | 92 |
| 3.7.7 | OP/BP 4.09 (Pests Control Management) | 93 |
| 3.8.8 | Activities Triggering World Bank Safeguards | 93 |
| CHAPTER 4: ENVIRONMENTAL BASELINE CONDITIONS | | 95 |
| 4.1 | GENERAL OVERVIEW | 95 |
| 4.2 | TOPOGRAPHY AND PHYSIOGRAPHY | 95 |
| 4.3 | DRAINAGE AND HYDROLOGY | 95 |
| 4.3.1 | Drainage | 95 |
| 4.3.2 | Hydrology | 95 |
| 4.4 | WATER RESOURCES | 97 |
| 4.4.1 | Overview | 97 |
| 4.4.2 | Surface Water Sources | 98 |
| 4.4.3 | Ground Water | 100 |
| 4.4.4 | Rainwater | 100 |
| 4.5 | BIODIVERSITY | 100 |
| 4.5.1 | Animal Species - Fauna | 100 |
| 4.5.2 | Aquatic and Marine Life | 103 |
| 4.5.3 | Vegetation and Flora | 110 |
| 4.6 | GEOLOGY AND SOILS | 112 |
| 4.6.1 | Geology Characteristics | 112 |
| 4.6.2 | Soils | 114 |
| 4.6.3 | Mineral Resources | 115 |
| 4.7 | CLIMATIC CONDITIONS | 115 |
| 4.7.1 | Rainfall | 115 |
| 4.7.2 | Temperatures | 116 |
| 4.7.3 | Precipitation and Evapo-transpiration | 117 |
| 4.7.4 | Humidity | 117 |
| 4.8 | STATUS OF THE CATCHMENT AND SILT TRANSPORTATION | 117 |
| CHAPTER 5: SOCIAL AND ECONOMIC SETTING | | 119 |
| 5.1 | BACKGROUND | 119 |
| 5.2 | ADMINISTRATIVE LOCATION | 119 |
| 5.2.1 | The Dam Site | 119 |
| 5.2.2 | Service Area | 120 |
| 5.3 | LAND OWNERSHIP AND SETTLEMENTS PATTERNS | 120 |
| 5.4 | POPULATION TRENDS | 120 |
| 5.5 | EDUCATION | 123 |
| 5.6 | WATER SUPPLY | 124 |
| 5.7 | HEALTH | 124 |
| 5.7.1 | Health facilities | 124 |
| 5.7.2 | Diseases | 124 |
| 5.7.3 | Sanitation and Hygiene | 125 |

| | | |
|---|--|------------|
| 5.8 | INSTITUTIONS AND DEVELOPMENT AGENCIES | 127 |
| 5.9 | ECONOMIC SETTING | 127 |
| 5.9.1 | Natural Resources | 127 |
| 5.9.2 | Poverty and Income Levels | 128 |
| 5.9.3 | Labour Force and Economic Occupation | 129 |
| 5.9.4 | Agricultural Production | 129 |
| 5.9.5 | Livestock and Fishing | 131 |
| 5.9.6 | Other Livelihoods | 132 |
| 5.10 | INFRASTRUCTURE AND COMMUNICATION | 133 |
| 5.11 | SOURCES OF ENERGY | 133 |
| 5.12 | CROSS CUTTING ISSUES | 134 |
| 5.12.1 | Gender | 134 |
| 5.12.2 | Cultural Issues | 134 |
| 5.12.3 | HIV/AIDS and Other Communicable Diseases | 135 |
| 5.12.4 | Disadvantaged People | 135 |
| CHAPTER 6: RESETTLEMENT ISSUES | | 136 |
| 6.1 | GENERAL | 136 |
| 6.2 | OBJECTIVES OF THE RESETTLEMENT ACTION PLAN | 137 |
| 6.3 | PROJECT LOCATION | 137 |
| 6.4 | THE LEGAL AND INSTITUTIONAL FRAMEWORK | 137 |
| 6.5 | SOCIAL AND ECONOMIC CONSIDERATION | 138 |
| 6.6 | INFRASTRUCTURE AND PUBLIC SERVICES | 139 |
| 6.7 | COMMUNITY PARTICIPATION AND CONSULTATION | 139 |
| 6.8 | PAPS CHARACTERISTICS | 140 |
| 6.8.1 | Partial Displacements | 141 |
| 6.8.2 | Displacements of Families | 142 |
| 6.8.3 | Displacements of House | 142 |
| 6.8.4 | Land Due to Project | 142 |
| 6.9 | COMPENSATION FACTORS | 144 |
| 6.9.1 | Land and Developments | 144 |
| 6.9.2 | Housing | 144 |
| 6.9.3 | Livelihoods | 145 |
| 6.10 | ENTITLEMENT MATRIX FOR PAPs | 145 |
| 6.11 | SUMMARY OF AFFECTED PROPERTIES AND PERSON DUE TO PROJECT | 147 |
| CHAPTER 7: CONSULTATIONS AND PUBLIC PARTICIPATION | | 148 |
| 7.1 | INITIAL INTERVIEWS | 148 |
| 7.2 | SOCIAL AND ECONOMIC SURVEYS | 148 |
| 7.3 | PUBLIC CONSULTATIVE FORUMS | 149 |
| 7.3.1 | Consultation Schedules | 149 |
| 7.3.2 | Participation | 149 |
| 7.4 | EMERGING ISSUES | 150 |
| 7.4.1 | Perceived Benefits | 150 |
| 7.4.2 | Fears and Concerns | 151 |
| 7.4.3 | Key Suggestions and Opinions | 152 |
| CHAPTER 8: ANTICIPATED IMPACTS AND MITIGATION MEASURES | | 157 |

| | | |
|--|---|------------|
| 8.1 | GENERAL OVERVIEW | 157 |
| 8.2 | ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES | 157 |
| | 8.2.1 Sedimentation | 160 |
| | 8.2.2 Water Quality | 161 |
| | 8.2.3 Water Loss | 163 |
| | 8.2.4 Air Quality | 164 |
| | 8.2.5 Species Diversity | 165 |
| | 8.2.6 Impacts on Hydrology | 167 |
| | 8.2.7 Effects to Mwache Creek and Tidal Waters | 168 |
| 8.3 | SOCIAL IMPACTS AND MITIGATION MEASURES | 169 |
| | 8.3.1 Positive Impacts | 169 |
| | 8.3.2 Potential Displacements of People | 170 |
| | 8.3.3 Potential Social Disruptions | 171 |
| | 8.3.4 Safety Issues | 171 |
| | 8.3.5 Potential Cultural Disruption | 174 |
| 8.4 | ECONOMIC IMPACTS AND MITIGATION MEASURES | 175 |
| | 8.4.1 Positive Impacts | 175 |
| | 8.4.2 Negative Impacts | 176 |
| 8.5 | DAM SAFETY | 177 |
| | 8.5.1 Overview | 177 |
| | 8.5.2 Immediate Upstream | 177 |
| | 8.5.3 Downstream Areas | 178 |
| | 8.5.4 Dam Components | 179 |
| | 8.5.5 Health Risks | 179 |
| | 8.5.6 Risk Preventive Measures | 179 |
| CHAPTER 9: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN | | 181 |
| 9.1 | MANAGEMENT PLAN PRINCIPLES | 181 |
| 9.2 | MANAGEMENT RESPONSIBILITIES | 181 |
| 9.3 | ENVIRONMENTAL MANAGEMENT GUIDELINES | 182 |
| 9.4 | ENVIRONMENTAL EDUCATION AND AWARENESS RAISING | 183 |
| 9.5 | HIV/AIDS ISSUES | 183 |
| 9.6 | THE MANAGEMENT PLAN | 183 |
| 9.7 | RESETTLEMENT ACTION PLAN | 205 |
| 9.8 | ENVIRONMENTAL AND SOCIAL MONITORING PLAN | 206 |
| 9.9 | INSTITUTIONAL CAPACITY AND CAPACITY BUILDING PLAN | 206 |
| 9.10 | IMPLEMENTATION OF EMP AND RAP | 208 |
| 9.11 | ENVIRONMENT AND SOCIAL MANAGEMENT COST | 208 |
| CHAPTER 10: CONCLUSIONS AND RECOMMENDATIONS | | 210 |
| 10.1 | CONCLUSIONS | 210 |
| 10.2 | RECOMMENDATION | 211 |

REFERENCES

ANNEXES

| | |
|------------|--|
| ANNEX I: | ESIA TERMS OF REFERENCE |
| ANNEX II | PROJECT LOCATION MAPS AND LAYOUT |
| ANNEX III | PROJECT DESCRIPTION, DESIGN CONCEPT AND SALIENT FEATURES |
| ANNEX IV | PUBLIC SENSITIZATION MINUTES AND PARTICIPATION |
| ANNEX VA | PUBLIC CONSULTATIONS MINUTES AND PARTICIPATION |
| ANNEX VB | LIST OF PUBLICATION REVIEWED |
| ANNEX VI | CATCHMENT AREA TREATMENT PLAN |
| ANNEX VII | AGRICULTURE CHEMICAL MANAGEMENT PLAN - ACMP |
| ANNEX VIII | HEALTH AND HYGIENE PLAN - HHP |
| ANNEX IX | ENVIRONMENTAL MONITORING PLAN |
| ANNEX X | WATER SUPPLY SYSTEM'S EMP AND ASSOCIATED COST |
| ANNEX XI | EMP AND RAP IMPLEMENTATION PLAN SUPPORT |
| ANNEX XII | ENVIRONMENTAL AND SOCIAL MANAGEMENT COST |

LIST OF TABLES

| | |
|-----------|---|
| TABLE 1: | PROJECT ADMINISTRATIVE LOCATION DETAILS |
| TABLE 2: | OP/BP 4.01 ENVIRONMENTAL ASSESSMENT |
| TABLE 3: | SAFEGUARDS TRIGGERING MATRIX |
| TABLE 4: | WATER QUALITY SAMPLES |
| TABLE 5: | MONTHLY AVERAGE TEMPERATURE DATA AT KINANGO |
| TABLE 6: | RELATIVE HUMIDITY DATA AT KINANGO |
| TABLE 7: | ADMINISTRATIVE LOCATIONS COVERED BY THE PROJECT |
| TABLE 8: | POPULATION TRENDS |
| TABLE 9: | MNYENZENI LOCATION POPULATION |
| TABLE 10: | MAZERAS LOCATION POPULATION |
| TABLE 11: | CHIGATO LOCATION POPULATION |
| TABLE 12: | MWAMDUDU POPULATION |
| TABLE 13: | POPULATION SUMMARY TABLE |
| TABLE 14: | HEALTH CENTERS IN THE DAM AREA |
| TABLE 15: | LIVESTOCK POPULATION IN PROJECT AREA |
| TABLE 16: | DISTRIBUTION OF PROJECT AFFECTED FAMILIES |
| TABLE 17: | AFFECTED NUMBER OF TREES DUE TO PROJECT |
| TABLE 18: | DISTRIBUTION OF PROJECT AFFECTED FAMILIES |
| TABLE 19: | DISTRIBUTION OF DISPLACED HOUSES UNDER DIFFERENT SETTLEMENTS |
| TABLE 20: | NUMBER OF LAND PARCELS AFFECTED DUE TO PROJECT |
| TABLE 21: | ENTITLEMENT MATRIX FOR PAPS FOR MWACHE DAM MULTIPURPOSE PROJECT |
| TABLE 22: | SUMMARY OF AFFECTED FAMILIES, ASSETS AND COMMUNITY PROPERTY |
| TABLE 23: | ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN MATRIX |
| TABLE 24: | RAP BUDGET |
| TABLE 25: | ENVIRONMENTAL AND SOCIAL MANAGEMENT COST |

LIST OF FIGURES

- FIGURE 1: SECTIONS OF MWACHE RIVER BASIN
FIGURE 2: SECTIONS OF THE DAM LOCATION
FIGURE 3: SECTIONS OF MWACHE RIVER DOWNSTREAM THE DAM SITE
FIGURE 4: SAMPLE FEATURES ON THE TRANSMISSION PIPELINE
ROUTE TO CHANGAMWE TANKS
FIGURE 5: SECTIONS OF THE IRRIGATION COMMAND AREAS
FIGURE 6: PROJECT ENVIRONMENT MANAGEMENT FRAMEWORK
FIGURE 7: PUBLIC WATER POINT FROM MZIMA PIPELINE TO MAZERAS
FIGURE 8: VEGETATION INFLUENCING FACTORS
FIGURE 9: SAMPLE GEOLOGICAL NATURE AND ECONOMIC VALUE
FIGURE 10: SAMPLE CATCHMENT DEGRADATION
FIGURE 11: EDUCATION TRENDS IN KINANGO DISTRICT
FIGURE 12: MODES OF SANITATION
FIGURE 13: HOUSING TYPES AS POVERTY INDICATORS
FIGURE 14: TYPICAL HOUSING AS POVERTY LEVEL INDICATOR
FIGURE 15: EMPLOYMENT CATEGORIES IN THE PROJECT AREA
FIGURE 16: SAMPLE AGRICULTURAL ACTIVITIES IN PROJECT AREA
FIGURE 17: SAMPLE LIVESTOCK AND FISHING FEATURES
FIGURE 18: FORMS OF ENERGY SOURCES
FIGURE 19: STAKEHOLDER CONSULTATION FORUMS
FIGURE 20: PAPS CONSULTATION FORUMS
FIGURE 21: SENSITIVE MANGROVE ECOSYSTEM IN MWACHE CREEK
FIGURE 22: SOCIAL FEATURES TO BE DISRUPTED
FIGURE 23: CULTURAL FEATURES TO BE DISRUPTED
FIGURE 24: POTENTIAL FEATURES AT RISKS DOWNSTREAM

ACRONYMS & ABBREVIATIONS

| | |
|----------|--|
| GoK | Government of Kenya |
| EIA | Environmental Impact Assessment |
| ufW | Unaccounted for Water |
| MORDA | Ministry of Regional Development Authorities |
| ASAL | Arid and Semi-Arid Land |
| MDGs | Millennium Development Goals |
| ESIA | Environmental and Social Impact Assessment |
| EMCA | Environmental Management Plan |
| EMP | Environmental Management Plan |
| EMoP | Environmental Monitoring Plan |
| PAPs | Project Affected Persons |
| RAP | Resettlement Action Plan |
| NEMA | National Environment Management Authority |
| CDA | Coast Development Authority |
| WRMA | Water Resources Management Authority |
| CWSB | Coast Water Services Board |
| WRUAs | Water Resources Users Associations |
| WUAs | Water Users Associations |
| DLASO | District Land Adjudication and Settlement Officer |
| CBOs | Community Based Organizations |
| AfDB | African Development Bank |
| PID | Preliminary Index Drawing |
| KWS | Kenya Wildlife Service |
| KFS | Kenya Forest Service |
| KMFRI | Kenya Marine and Fisheries Research Institute |
| UNICEF | United Nations International Children Emergency Fund |
| KPA | Kenya Ports Authority |
| LAP | Land Acquisition Plan |
| GGP | Gross Geographical Product |
| EA | Environmental Audit |
| NEAP | National Environment Action Plan |
| WASREB | Water Services Regulatory Board |
| WSTF | Water Services Trust Fund |
| NEC | National Executive Council |
| WSB | Water Services Board |
| KWAWASCO | Kwale Water and Sewerage Company |
| MOWASCO | Mombasa Water and Sewerage Company |
| DAO | District Agricultural Officer |
| IDA/WB | International Development Association (World Bank) |

EXECUTIVE SUMMARY

Introduction

Kenya's people and the economy are highly vulnerable to erratic climatic patterns and limited water availability due to their reliance on key sectors (agriculture, tourism, hydro-energy, etc.) that depend on rainfall and water availability. In the last two decades from 1992-2012, Kenya tops Africa in terms of people affected by droughts (~46m people) and stands fifth in terms of those affected by floods (~2.8m people) in the same period. Kenya has limited freshwater endowments and is classified as a chronically 'water scarce' country in absolute and relative terms. It faces the additional challenge of high inter-annual and intra-annual rainfall variability. Climate variability and hydro-climatic shocks (droughts and floods) impact disproportionately on the poor, and climate change is projected to exacerbate existing climate risks and water resource constraints. Kenya has yet to adequately manage its highly variable hydrology to improve climate resilience, as evidenced in decades-long underinvestment in water infrastructure.

The development and management of water resources in Kenya is based on the view that water is a social good and is a catalyst for economic development. The current access to clean water in the country is estimated at about 90% in urban areas and approximately 44% in the rural areas while the national average stands at about 57%. At the same time, provision for safe sanitation stands at a national average of 80% (95% in urban areas and 77% in rural areas). The Government of Kenya (GOK) has recognized the need for comprehensive institutional reform and increased investment in the water and sanitation sector in order to remove bottlenecks in its overall program to alleviate poverty and create employment and wealth.

The government has planned a large-scale water investment program to address these challenges and to close the massive water infrastructure gap that has been estimated at US\$ 5-7 billion. This is supported by strong institutional and legal structure that aligns the water sector to the Constitution of Kenya, 2010 (with a Water Resources Bill being prepared to fit with the new devolution principles). The government has requested that the World Bank support these ambitious plans for the water sector through a long-term, transformational program aimed at building water security and climate resilience for economic growth. The Kenya Water Security and Climate Resilience Program responds to this need, and is an integral element of the 2010-2013 Country Partnership Strategy. The first phase of this program was approved on June 18, 2013.

The Water Security and Climate Resilience in the Coastal Region herein referred to as "**the Project**" is centered around the Mwache Multipurpose Dam and related water supply and irrigation components. The Project was identified as a priority project in Vision 2030 and is included in the Water Supply Master Plan for Coast/Mombasa prepared for the Coast Water Services Board (CWSB) with funding

from the World Bank/French Development Agency (AFD) Water and Sanitation Service Improvement Project (WaSSIP). This “Project” includes the following components namely:

1. Dam Construction Component
2. Water related infrastructure Component (Supply and Sanitation in Kwale and Mombasa Counties)
3. Irrigation Component (Commencing with 100 ha Pilot)

The proposed Project was identified by the Government as a flagship project under the Kenya Vision 2030 mission and also as a necessary facility to provide water for domestic and sanitation purposes including irrigation for Kwale County and at the same time supplement water supply for Mombasa County. Feasibility studies covering the project area have established that water is a priority to all the residents in Kwale and Mombasa Counties in terms of livelihoods and social/economic requirements.

The Environmental and Social Impact Assessment (ESIA) Study

The goal of this ESIA study was to identify impacts resulting from the proposed project (specifically the dam including a check dam and pilot irrigation component) to the environment and social setting. The impacts were determined on the basis of the baseline conditions established during the fieldwork and information obtained from the documents reviewed as well as interviews of the stakeholders. For subjective predictions of the impacts, the site area was subjected to environmental scoping process. This was a process of evaluating the overall magnitude of the project and the significance of the anticipated impacts and possibilities of handling the same. Detailed evaluation of the project area was undertaken such as to focus on any significant environmental and social issues as established during the scoping process.

This scoping report was designed to provide a preliminary view of the environmental and social status. The report presents the overall project concepts, anticipated magnitude, key stakeholders and the implementation plan outline. It also involved establishment of the diversity on the physical environment, climatic conditions, demographic trends as well as the hydro-geological status in the area. Relevant policy and legal requirements were also listed. The study team strived to share experiences on water resources and social issues in that the part of the country where the project is located and in particular with regard to water demand and utilization. The report has provided the basic considerations that could be emphasized on during the detailed and consultation sessions.

Use of Environmental and Social Management Framework (ESMF) Kenya Water Security and Climate Resilient Project Phase 1 (KWSCR 1)

During the preparation of the ESIA for the Mwache Dam, a series of stakeholder consultations were held with the County government, local community, national

government among others. A key concern was the social benefits of the proposed dam to Kwale County in general and as a whole. The stakeholders expressed the need for developing activities that would benefit Kwale County in terms of Socio-economic aspects. These calls have therefore led to the development of another component (Kwale County Development Component) which aims to promote benefits sharing in Kwale County, where the Mwache Dam is located, through investments in water supply and sanitation in rural communities and small towns; community-based watershed management activities, and improvement of community livelihoods. By supporting these activities, Component 2 will bring near-term and medium-term benefits to Kwale County, in parallel to the planning and preparation for the large-scale infrastructure that would supply water to Kwale (from Mwache, and other sources) in the long-term. In addition, this component will finance a demonstration irrigation scheme to inform design of a large scale irrigation program in Kwale in the future.

This ESIA has not covered assessment of the envisaged water supply and sanitation infrastructure (urban and rural) in Kwale since the exact locations, designs and scope are not fully known at this stage and is subject of deliberations. In this regard, for this component (water supply and sanitation), the Environmental and Social Management Framework (ESMF) and Resettlement Policy Framework (RPF) prepared for the Kenya Water Security and Climate Resilience Project (KWSCR 1) will be used to ensure that safeguard issues are incorporated during the project design. Detailed ESIA's and Resettlement Action Plans (RAPs) will be conducted for the water supply and sanitation components (Mombasa and Kwale) once the locations, designs, scope etc. of the project are known and submitted for approval by the Bank prior to construction.

The Project Components

The "Project" targeting Kwale and Mombasa Counties include the following components namely;

I. Dam Component

Following acute shortage of water in most parts of the country (Kenya being a water scarcity country), it has become necessary that alternative mechanisms are developed to harness available sources to supplement the little available quantities of water. With intensive surface runoff during heavy rains, significant volumes of storm water are lost. Dam construction has been identified as an alternative to harness the storm water for storage and use during the dry conditions. Mwache Dam is among the flagship projects identified in the Kenya Vision 2030 geared towards closing the shortage gap in supplementing water to Mombasa, providing water to the local communities as well as other economic activities. The design of the dam has taken into consideration all the possible and but viable uses to ensure maximum benefits. The dam is expected to provide water to Kwale County for domestic and sanitation purposes including irrigation while complementing water supply to Mombasa County,

which faces a deficit.

II. Water Related Infrastructure Investments Component

Irrigation Infrastructure and agriculture productivity improvements pilot

The project entails an irrigation sub component (pilot) in an area of 100ha around the Mwache dam. The objective of the pilot is to test the introduction of high value crops, high efficiency irrigation technologies and institutional arrangements for replication on a broader scale. A high efficiency irrigation infrastructure will be deployed on a 100 Ha area close to the Mwache Dam project. Eventually, the results of the pilot will be used for final design of a larger 2,000 ha high value crops irrigation scheme to be implemented nearby Mwache dam and elsewhere in Kwale County.

The pilot Irrigation infrastructure will use water from a check dam, with the initial implementation of the RAP. Training of farmers will be done through participatory approaches, adaptive agricultural research introducing the new high value crops in the project areas. Main areas of intervention include:

- **Irrigation Infrastructure.** Includes the construction of a check dam and the development of 100 ha of irrigation. The pilot area would give priority to benefit the 167 households to be displaced by the dam, and selected farmers who could become lead farmers for training others, each on an average of 0.5 ha of irrigated land. Technologies including: dragline sprinklers, conventional hand-move sprinklers, hosepipe irrigation, bubbler irrigation, and drip irrigation will be tested with the proposed irrigated food and HVCs to be introduced, to demonstrate new practices and train farmers. The irrigation scheme will benefit up to 200 households who will produce food crops for self-consumption and horticultural crops for the local and export markets.
- **Implementation of the Resettlement Action Plan (RAP).** While construction of the check dam takes place, this activity would support the on-going process of cadastral mapping, as well as the land acquisition and resettlement processes required to resettle households to be displaced by the dams, including the proposed compensation and arrangements for grievance redress.
- **Formation of and capacity building for irrigation farmers' organizations.** Technical support for the formation of IWUA(s) and other farmers' organizations will help empower them to (a) operate and maintain the irrigation system and (b) contract with the market for improved access to agricultural inputs and to marketing of their products. Training would include 'training for transformation' (a form of civic education that prepares people for participation and includes topics such as 'how to conduct meetings', leadership and so on), as well as the basics of business and contracts. Implementation of this and the following subcomponents would commence with development of irrigation and with the support of the on-going Kenya Coastal Development Project (KCDP) operating in the region.

- **Marketing and Development of Market Linkages.** This subcomponent would provide for a study of the potential local and export markets to absorb horticultural and livestock produce from the project, to be completed prior to the MPIS Mid-Term Review. It would also provide for promotion of market linkages between irrigation farmers and agribusinesses, including exporters (such as VEGPRO) and local processors (such as the Mariakani Dairy plant being recovered by CDA), to support a sustainable and inclusive agricultural production and the development of value chains, including efficient on-farm production and pertinent post-harvest infrastructure and equipment for adding value to the farm produce through adequate handling, packing, processing and marketing.
- **Strengthening Public Extension Service.** In addition to the support provided through market linkages (e.g. through private sector partners such as VEGPRO), the Farmer Field School (FFS) approach will be adopted as a group-based, intensive and hands-on extension methodology. The FFS approach to learning ensures that the work is relevant to the needs of resource-poor farmers, enabling them to make their own decisions on best crop management practices that are within their means and environmental context. Some CDA, AD-CKG, KARI and other public extension service provider activities will be funded.
- **Establishment of a fund to provide seed capital for production.** This would function, as a revolving fund to be co-managed with farmers' organizations, will facilitate accessing inputs and services to 'kick-start' irrigated and livestock production.

III. Water Supply and Sanitation Infrastructure Component

The objective of this sub component is to enable Kwale County to increase access to safe water service in urban and rural areas and will include an urban and rural water supply sub components as described below.

Urban water supply– Kwale population in urban centers is estimated to be in the order of 137,863 by the year 2013; of which 10% are estimated to have access to potable water services. According to its County Integrated Development Plan (CIDP), the objective of Kwale County is to increase coverage to 30% in its main urban areas by the year 2017. Doing so will imply that the county needs financial resources to improve water infrastructure to service an additional 30,227 people in the period 2014-2017. The project will contribute with financial resources for the preparation and implementation of an urban water rehabilitation and improvement project that will cover the additional urban population at an additional average cost of US\$546 per connection serving households of 5 persons. The costs include preparation and implementation of urban water supply subcomponent. Criteria for the selection of Urban Centers (or borrows within urban centers) will be decided upon discussions with Kwale County Officers.

Rural water supply– Population in rural areas in Kwale County is estimated to be

585,155 by the year 2013, of which only 1% has access to safe water. Rural population is expected to reach 667,053 by the year 2017, and Kwale County intends to increase access to safe water for 10% of the rural population. Doing so, will mean that an additional 60,854 in Kwale County will need to be provided with infrastructure for accessing to safe water. The main means for accessing to safe water in rural areas are boreholes, which in average can serve about 300 people. At an average cost of about US\$14,700 per borehole, that means that Kwale County will need about US\$ 3 million to be able to achieve its target of increasing access to safe water for about 60,000 additional persons during the period 2014-2017. Criteria for the selection and rural areas will be discussed with Kwale County officers.

Sanitation Infrastructure in Urban Areas– Communal sanitation facilities in critical spots of main urban centers will be financed, based on discussions with county officers in charge of sanitation affairs and urban development planning.

Project Justification

Kwale and Mombasa Counties is provided water from four sources including Baricho Water Works in Malindi District providing 47,000 m³ /day), Mzima Springs (providing 35,000m³/day, Marere River (bringing in 6,900³ per day) and Tiwi boreholes (producing 3,900³ per day). The sources provide only 35% of the total water demand of the city. The total demand for Mombasa City is estimated about 206,000m³ per day but only 92,800m³ per day is available). There is also significant unaccounted for water (ufW) arising from poor integrity of the distribution network, illegal connections and poor tracking of accessibility. There is, therefore, a strong need to supplement the available water to meet the demand. The community at the project area relies on the limited connections from the Mzima Springs pipeline to a few communal water points that is hardly enough to meet their requirements. It is hoped that the proposed project will be able to supply water to residents of Kwale County and further supplement the water supply into Mombasa County.

Project Beneficiaries

There are two broad groups of beneficiaries that would benefit from this project. Firstly, there are a number of beneficiaries that would be supplied water, including urban and rural households (estimated at 1.2 million¹). Key beneficiaries also include those services (e.g., hotels/tourist resorts, residential estate sites, schools, etc.), and industries (e.g., Moi International Airport, Kipevu Power Station, Kenya Oil Refineries Complex, Railway Stations, Harbor, etc.) where water is a key input. The urban (particularly those residing in the suburbs) and rural poor, who currently have limited or no access to safe water sources and rely on low quality but high priced sources are expected to benefit the most. Women and children, who are often responsible for fetching water and spend significant amount of their productive and leisure time are also expected to obtain significant benefits. These beneficiaries

¹ Based on estimates of the number of people whose water demands would be met with water from Mwache Dam, once all infrastructure per Phases I, II and III of the Water Master Plan for Mombasa and Coast is in place.

would be located in Mombasa and Kwale Counties, but also in other counties in the region benefiting from the water from Mwache dam. In order for this benefit to be realized, key infrastructure to treat, pump, transmit, store and distribute the bulk water, would need to be developed and/or rehabilitated, as proposed under the Water Supply Master Plan study for the Coast / Mombasa. In addition, the realization of the benefits entails investments in water infrastructure in targeted small towns and rural communities of Kwale County.

Secondly, there will be a number of beneficiaries in Kwale County as a result of enhanced livelihood activities. To ensure equity, the target beneficiaries of these activities will prioritize women and the unemployed or underemployed young.

Proposed “Project” Site

The project will in terms of site will be located in Mombasa and Kwale Counties with the specific location of the dam and pilot irrigation area in Kwale County already known and described below. The locations for related water supply and sanitation infrastructures in Kwale and Mombasa Counties are however not yet fully known but are likely to be known with the completion of the Kwale Water Master Plan which will be prepared and the completion of feasibility studies for water infrastructure targeting Mombasa County which are nearing finalization in terms of designs.

The ESIA considered specific design alternatives including alternative **water supply options, potential dam sites, alternative dam types (mixed RCC and rock fill is referred from a technical perspective)**, irrigation types, as well as **No Project Option**; as well as alternative **dam site options**, which were considered at two levels. Mwache Dam as the most viable option for water supply to Mombasa and Kwale Counties was based on financial and environmental considerations.

Proposed Dam Site

The dam is in Kinango District (Kwale County) and is habited by a community who are basically farmers. The river basin spanning to as far as the Taita hills to the west covers an estimated catchment of 2,250km² with a total length of 110km and elevation of between 300 m. a.s.l. down to 20 m. a.s.l. at the dam. There is no notable information on the river characteristics in terms of hydrology, ecological and water quality conditions of the river basin. The river comprises of various streams including Ngoni originating from Pemba and Taita hills joining with Mto wa Nguro rising from Mabesheni hills to the south, a short distance upstream of the dam area. Mnyenzi River rises from a series of hills among them Chigato, Mukanyeni, Kikuyu and Mabesheni hills to join Mwache River at Miyani area a short distance upstream of the proposed dam wall. The actual catchment area from the tributaries could not be established during this study. Mwangombe River is also a major basin originating from hills on the northeastern covering Tsavo areas and joining the Mwache basin on Ngoni section. The water from the dam will be utilized for two primary purposes: namely supply water to Kwale and Mombasa Counties for domestic, commercial and industrial use including irrigation (specifically for Kwale County).

Potential Impacts (Adverse and Beneficial)

The overall impacts arising from the project are positive and negative from an environmental, social and economic perspective. Once constructed, the project will supply water to Mombasa and Kwale Counties. This will have major positive impacts on economic growth, tourism development, people's livelihoods, incomes and food security.

Social Impacts (Positive Impacts)

The positive impacts anticipated from the project include;

- (i) The standard of living of the beneficiary residents will improve such as to include income generation and productivity, housing, health and hygiene, etc.,
- (ii) The distances traveled and time spent in search of water will be reduced hence the beneficiaries (especially women and children) using the energy and time on economically and socially viable activities for the families,
- (iii) Areas suitably situated to receive water for irrigation will not only help the local communities in sustaining food production but also all the residents of the neighboring districts in food supply. It is proposed that farmers will be supported on Small Holder Irrigation Programme system to provide food sufficiency at family levels,
- (iv) The dam will also moderate the micro-climatic conditions of the immediate surrounding areas through increased humidity and/or cooling effects to the comfort of the residents,
- (v) Overall increase of the total population and density as people are attracted by the high potential in economic production. This will provide ready markets for goods and services and reduced rural-urban migration as people are employed in the upcoming opportunities in the area.
- (vi) Raising the population growth and density resulting from natural growth and immigration that further enhances the availability of cheap labour and provision of ready markets for goods and services thereby spurring economic growth of the area
- (vii) Upgrading of certain roads, necessary for the construction and maintenance of the dam, will also contribute to a better transport and travel networks in the area. This will have positive social and economic impacts in the area.

Positive Impacts-Economic

- (i) In addition to water supply, the dam has numerous economic benefits to the local residents such as to include fishing, tourism,
- (ii) Potential appreciation of property values including significant increase the price of land and associated development.

- (iii) The project will be a major boost to realizing the vision 2030 and achievement of the MDGs through eradication of extreme poverty and hunger by enhancing income sources and food security,
- (iv) Farm management is likely to improve, as possibilities for capacity building are likely to accompany increased potentiality of the land. This will result to increased crop yield and food security,
- (v) Enhanced crop yield and food security resulting from change in farming practices with more reliance on irrigation, as opposed to reliance on rainfall, and increased use of inputs including certified seeds and fertilizer.
- (vi) By providing direct and indirect local employment, the project will ease the direct resource dependency pressures in the district's sectors especially agriculture thereby easing soil erosion.
- (vii) Provision of water has the potential to enhance development and growth of local markets as more economic and social interests arise. More important is the opportunity to improve sanitation and hygiene in these markets as opposed to the currently potential threat of diseases in almost all the markets.
- (viii) Reduced poverty levels, increased incomes and improved livelihoods resulting from dam construction and maintenance employment and consumption from the local markets, emergence of other associated economic opportunities and activities including tourism, fishing, trade, production of high value crops and transport among others. Further, these will increase the Gross Domestic Product (GDP) of the area as well as the tax base for the government.

Adverse Impacts

Cumulative Impacts

Water abstraction from the Mwache River will marginally reduce the net water volume available in the River (because of consumptive use for domestic and agricultural purposes). The proposed location of the dam is downstream and in effect, no down stream water users are going to be impacted negatively. However, when combined with other existing and planned water abstractions from the Mwache River, it will contribute to significant impacts on overall water availability in the sub-basin in dry years.

Abstraction of water from the Mwache River combined with other irrigation schemes within the same River will cumulatively impact on the hydrology of the River especially downstream therefore, Environmental Flows must be observed to ensure that the integrity of the river is maintained. An Environmental Flow Analysis (EFA) has been determined for this project as per the Water Resources Management Authority (WRMA) requirements.

In terms of water use by the communities along Mwache River, abstraction of water for domestic and irrigation combined with other on-going abstraction projects may

cause adverse impacts and conflicts by communities who depend on the water for domestic purposes. Especially the populations living downstream whose livelihoods may be affected by dam-induced alterations of river flows especially during the dry season.

Sedimentation

Construction

Construction activities will involve massive earth moving within the river flood plains and sections of the adjoining riverbanks and lands. This loosening of the soil creates a situation where any heavy rains will freely wash down the silt into the downstream areas including Mwache Creek. The silt so washed down may contain high levels of organic matter and deposition of this may lead to anoxic conditions in the lower water levels with potential risks to the associated aquatic life.

Operations

Typically, dams and reservoirs intercept close to 90% of sediments from the catchments. Sediments loads, that are dependent on the catchment characteristics (geology, soil nature, topography and vegetation cover), is likely to be the major challenge to Mwache dam considering the high potential of Mwache River to generate sand. A visual estimate at the confluence with Mnyenzi River just upstream of the dam wall shows a significant sand deposit during rainy sessions with about 80% originating from Mwache River. The slope of the river is estimated at less than 1% and the flow is physically sluggish, a situation that indicates a higher retention and storage capacity and ability compared to the transportation speed (no measurements were carried out in this regard). In addition to overloading the dam and gradual reduction of its storage capacity, the effects could be felt upstream due to the flow back along the river basin and its tributaries.

Mitigation Measures

- Construction activities should take place during the dry conditions. Topsoil removed will need to be transported away from the site to a location not accessible to storm water.
- Provide a soil trap downstream the dam site to intercept excessive silt during the construction. This may be in form of a pan,
- Provide sand check dams upstream of the dam and more specifically along Mwache river basin to intercept excessive silt from the catchment and effectively increase the capacity of the dam in the long term. The dam could be located at east every 5 – 10km from each other depending on the topography, accessibility and availability of space,
- The check dams should also be provided downstream of every major tributary to not only provide additional sand dams for water storage to serve the immediate communities upstream of the dam, but also as silt traps.
- The sand dams could also serve as approved sand harvesting points to be managed through organized community groups that will also enhance conservation of the river flood plains and acceptability by the local communities,

- The communities at the dam site will be assisted into groups for an economic disposal of the accumulated sand ahead of the dam construction. Access to the site, is however a limiting factor in this regard,
- While holding sand back for the safety of the dam, modalities should be established to ensure that economic interests of downstream dependents of the sand are also addressed.

Water Quality

Water stored in a dam or reservoir is subject to undergo certain physical, chemical and biological transformations overtime caused by varying conditions. These phenomena are induced by climatic conditions (heat exchanges, extent of aeration, etc.), chemical exchanges from geological formations, aquatic chemical reactions and material degradations among others as well as biological reactions associated with the organic materials decaying in the water (biomass and humic matter decomposition). Massive potential for sand generation in the catchment, high vegetation cover that also leads to potential humic content of the soils, variations in weather conditions and exposure to atmospheric conditions are among other conditions with potential effect to water quality. Mwache dam location will be faced with all such scenarios.

Construction

- (i) The vegetation (biomass accumulation) in the dam area could render high humic (organic concentration) conditions in the dam water and Mwache Creek downstream if not removed during construction period. It also has a potential to increase the nutrients and other minerals associated with plant decaying matter.
- (ii) There are graveyards around the dam area (locations based on family villages) that would not be inundated in the dam water due to the actual and perceived implications on water quality. This situation should be addressed during construction phase,
- (iii) Like the graveyards, pit latrines in the settlement areas will not be inundated due to their long-term potential contamination of water, but will be decommissioned and the earth scooped for safe disposal to pre-agreed sites. The exact locations for all pit latrines, therefore, will be established to enable smooth relocation,

Operations

- (i) Residual faecal and organic matter from pit latrine, open-air toilets and waste holding sites from the displaced and residual homesteads and social locations. This would particularly impact on the health of the water consumers and their animals within the dam area as well as the ultimate piped destinations in the long-term,
- (ii) Nutrients (nitrogen, phosphorous potassium) among other trace elements in the soil are expected from the geological discharges, organic decompositions of plants matter and surface runoff discharges from farms, settlement areas and markets around the dam. This could create potential for eutrophication of the dam water,
- (iii) Turbidity and suspended settleable matter of water from the inflows, surface runoff discharges and organic reactions among other sources is also a potential challenge to water quality. This situation may lead to limited light penetration that has got direct linkage to biological quality of the water,
- (iv) Limited water mixing, aeration and light penetration reduces available oxygen resulting into anoxic conditions at the lower layers of water in deep reservoirs. Anaerobic conditions in the lower layers of the water generate carbon dioxide, methane, and hydrogen sulphide and create low pH scenarios, particularly if the organic content is high. Due to the lowered pH, the geologically held iron and manganese and other heavy metals are likely to be released into the water effectively changing the water quality,
- (v) Implications on water quality would be felt by the water consumers in the immediate location of the dam as well as social and ecological dependants of Mwache River downstream in terms of habitat pollution, people's health and cost of water treatment at various stages.

Mitigation Measures

- Institute a broad water quality monitoring system such as to focus on the catchment sources, incoming flows, entire dam water quality variations, treated water and water downstream of the dam location. Maintain appropriate records on water quality as required by the law upon commissioning of the dam, including the implications of the dam to the water quality downstream (mainly tidal waters in Mwache River mouth) need to be monitored,
- All vegetation materials (live and dead) at the dam site shall be cleared and removed before the area is excavated and inundated. This will ensure controlled release of organic matter into the dam water. Proliferation of aquatic macro-flora could be encouraged along the periphery of the dam to ensure natural aeration and purification of the water,
- Pit latrines in the acquired land will not be inundated due to their long-term potential contamination of water, but will be decommissioned and the earth scooped for safe disposal to pre-agreed sites. The exact locations for all pit latrines therefore will be established to enable smooth relocation. Identify specific point sources of water pollution during construction (cattle pens, market centers,

- agro-chemical use points, etc.) for isolation and safe management,
- All identifiable graves falling within areas to be inundated will require be decommissioning and relocating to prevent contamination of water. The exercise will, however, be undertaken in full observance of traditional rites as well as the wishes of the affected families.

Water Loss

The general rate of surface water loss from the dam area could increase through exposure to weak geological points and increased surface area. The surface to sub-surface geology of the project area is characterized with discontinuous fractures and fissures at the contact between the basement system rocks and the sedimentary geological type. The fractures and fissures could provide a potential for infiltration of water into the sub-surface and possibly creating springs on the lower areas. This possibility should be established further during construction for remedial preventative measures.

Other modes of water loss would include;

- (i) Evaporation associated with high temperatures experienced most of the year in the project districts. Effectively this raises the average humidity in the surrounding areas (currently reported at over 15%),
- (ii) Transpiration through aquatic plants and vegetation on the surrounding area that are also necessary for environmental and water quality conservation.
- (iii) Wastage of water through the distribution network and at consumer points resulting from perception of abundance, poor appreciation of value of water and low knowledge in wise use water.

The implications of the evaporation would be more pronounced on increased surface area of water exposure. While this could not be quantified at this point, it is expected to be relatively significant. Other water loss pathways effectively imply;

- (i) Unaccounted for water losses from the dam structures such as seepage through possible fissures in the base rock and hence unachieved desired dam expectations,
- (ii) The scenario could also cause possible weaknesses to housing foundations downstream of the dam location, though there are no significant settlement downstream and the few present are likely to be relocated,
- (iii) Micro-climate moderation (lower temperatures and higher humidity) through increased atmospheric moisture arising from evaporation and transpiration. This would be enhanced by the breeze arising from the sea blowing westwards,
- (iv) Potential losses of water at consumer points through wanton wastage, leakages in the distribution pipelines and over use in the farms in the case of irrigation.

Mitigation Measures

- Geological profiles throughout the area proposed for inundation should be continuously monitored and areas of weaknesses noted for incorporation of appropriate strengthening measures (this constituted an important part of the feasibility and design stages of the project),
- Sub-surface water infiltration trends on affected areas should be monitored over a period of time with respect to effects on houses and other structures downstream. However, it is noted that there might be no residuals on the lower zones of the dam,
- Indigenous trees and shrubs with low water dissipation capacity should be encouraged around the dam buffer zone to minimize loss of water through evapotranspiration processes,
- Ensure enhanced monitoring maintenance of the transmission and distribution pipelines upon commissioning to ensure minimal loss of water through leakages,
- Introduce economic and financial initiatives towards water saving and responsible utilization at all consumer points. Water Service Providers have a significant role in this regard.

Air Quality

Main implications to air quality will be expected from the construction activities due to intensive earth moving and handling of materials as well as emission from construction equipment. No significant emissions are anticipated from the completed dam.

Loss of Species Diversity

Construction

Construction of the dam implies removal of existing vegetation while clearing the areas to be inundated and/or possibility of submerging of others potentially losing certain species. It is likely that certain plant species will get extinct especially those in sensitive zones (close to river edges and riverbed of the rivers, especially Mwache stream) while others are likely to get introduced. There is also potential disruption of habitats downstream of the dam area as a result of construction activities (discharge of excessive particulate matter, cement residuals and other construction materials) as well as interrupted flood flow downstream into the Mangrove ecosystem and habitats of Mwache Creek.

Operations

Upon inundation of the dam area, the following impacts are anticipated;

- (i) Riparian aquatic vegetation could develop on the new water/land transition zones with new species introduced and flourishing of the existing species (e.g. grasses, reeds, *Cyprus* spp., etc.). Completely new ecosystem will possibly be established around the inundated areas including planktons, periphytons and aquatic macrophytes established and changing the characteristics of the current aquatic life,
- (ii) Inundated land may also have a linkage to the overall water quality of Mwache River that will range from improved aeration, pollutant accumulation

- (nutrients and heavy metals) and reduced settleable matter from extended settling. Decaying aquatic organic matter from submerged residual plant matter and humic residuals in the soil may also affect water quality negatively by imparting undesirable odor, color and turbidity),
- (iii) Indigenous fishery species, aquatic animals such as to include frogs, birds and other micro-organisms are potentially going to thrive while larger species including crocodiles and hippos could migrate from other areas to the project area and perhaps in specific locations of the dam,
 - (iv) Presence of water might also attract other species of wildlife from as far as Shimba hills and the coastal strip, especially grazers with potential transformation of the ecological characteristics. This situation could create a new human-wildlife conflict that need to be addressed through a collaborative interventions,
 - (v) Vectors are part of the biodiversity, but with negative implications to the residents. These include mosquitoes (associated with stagnant water), snails (carriers of bilharzias) and microorganisms carrying other disease causing germs (typhoid, cholera, dysentery, skin infections, eye infections, etc.).

Mitigation Measures

- Develop a database of animal and plant species found in the dam area as a basis for conservation and monitoring of newly introduced species in the future. The inventory and monitoring register should be maintained by CDA Water Service Board in collaboration with the environmental office and other interested parties,
- An ecologist would need to be engaged to oversee monitoring and management of ecological changes around the dam ecosystem and downstream during construction as well as upon commissioning,
- The role of the Kenya Wildlife Services (KWS), Kenya Marine and Fisheries Research Institute (KMFRI) and the Kenya Forest Service (KFS) would be crucial in monitoring the new habitats in the river basin and the Mwache Forest characteristics around the dam area,
- Establish community interests and values in the evolving ecological setting and enhance economic benefits and cultural values from the same. Fishing, irrigation, livestock keeping are notable economic benefits while conservation of the Kaya cultural activities will be in agreement with the UNICEF initiatives already in place.

Impacts on Hydrology

Construction

Construction activities are not anticipated to manifest any impacts to the local hydrology. However, draining of the river and its tributaries may have limited implications to the local flow regimes that will, only last during the construction period.

Operations

Depending on the dam design, the flow regime of Mwache River could change for considerable distance downstream. Currently, the flow in the river occurs only during the rainfall periods with peak flows during high rainfall intensity periods and no flows observed during the dry conditions that affect both the main stream and the associated tributaries that are also dry. With the construction of the dam, the flows downstream will most likely be regulated to a relative constant flow rate over longer durations of time as opposed to the current conditions when no flows are observed for long periods of time. The hydrological implications to downstream environmental setting will be;

- (i) Reduced average high water levels downstream the basin and hence minimal deposition of silt on the flood plain where ecological and limited food production takes place. Constant but reduced distribution of silt deposition (land fertility for downstream habitats) will be confined to a narrower flood plain since flood flows will be reduced and not enough to spread over the current flood plain. Potential reduced recharge of silt into Mwache Creek may also effectively reduce the productivity of Mwache Creek through reduced nutrients, affected breeding zones and food for aquatic animal species present,
- (ii) On the other hand, current aquatic ecosystems are likely to be compromised on the higher flood plain zones of the river basin thus slightly changing the basin characteristics (this change in trend has not been quantified at this stage),
- (iii) One advantage is the reduced channel erosion during high peak flows, reduced water quality (turbidity and suspended matter) and delta protection further downstream at the river mouth.
- (iv) Upstream, the main Mwache stream and the lower tributaries will be permanently flooded all year around. This change in hydrological pattern will reduce scouring of the streambeds as well as controlled bank erosion. It will, however, create new habitats with new aquatic vegetation and possible animal species. The extent of land flooded during the rains rising up to the 95m elevation will increase with implications on naturally dry land converted wet areas. This will also effectively raise the extent of sub-surface water levels in the adjoining areas.

Mitigation Measures

- Ensure compliance with the water resources regulations at all times. At least 30% of the base flow should always flow in the stream to sustain ecological and social requirements downstream. The flow would be necessary for sustenance of Mwache Creek ecosystem,
- With effects on the level of flood levels upstream, it may be necessary to review the riparian land ownership to provide the mandatory buffer area for conservation and the extent of associated sub-aquatic ecosystem such as to

include plant and animal species on the buffer zone,

- River gauging stations around the dam and upstream including the key tributaries may require to be reactivated (or installed where none exists) to monitor effects of the dam to the river basin over time as well as enable taking stock of water balances at any given time against the rainfall in the catchments.

Effects to Mwache Creek and Tidal Waters

Reduction in silt discharge and alterations in flow regimes of freshwater into Mwache Creek could cause changes in nutrient cycling in the creek ecosystem effectively disrupting the marine life trends and the associated productivity including the mangrove development, breeding habitats and buffering capacity of Port Reitz and Likoni channel in the long term. On the other hand, the tidal water fluctuations may interrupt the intake of the dam water and other operation if appropriate structural measures are not taken. Quantified detailed investigations, however, were not undertaken during this study.

Mitigation Measures

- Integrate simulated flood release programmes in the dam operations to sustain the nutrient requirements and freshwater feed into the creek ecosystem. The simulation should be part of the detailed investigation of the creek system
- Involve and collaborate at the highest levels with possible technical mechanisms for sustained conservation of Mwache Creek and safety of the surrounding infrastructure. Among the players would include KMFRI, WRMA, KPA, KAA, KFS, CWSB, MAWASCO, Kwale Water and Sanitation Company, Mombasa and Kwale Counties etc.
- Ensure that the minimum release provisioned for the project equivalent to 0.1 cumec (3.2 million cubic meter) is followed during dam operation.

Social Impacts and Mitigation Measures

Displacements of People

- (i) Potential displacements and re-settlement of people to alternative locations. While some may be marginally displaced to different locations on the same land, those whose land wholly falls within the dam area will have to be shifted to other parts of the district or country. This will have far reaching repercussions including:
 - Those to be displaced feared that their community as well as kinship and social associations would be fragmented in the host area leading to disturbance and possible disintegration. Further, they would like to be resettled near their kin and previous support system and that the socio-economic infrastructure in the host area may not be adequate

for their needs.

- There are possibilities of disenfranchising and interfering with livelihoods especially for the weak members of the society especially widows, the disabled persons and the poor who are not able to sustain court cases in-order to retain their land and other rights
- (ii) It could not be predicted at this stage how the hosts to the displaced persons would receive the displaced persons, especially considering that migration goes into exerting pressure onto the natural resources such as water, land and energy among others. This issues has been adequately addressed through a comprehensive resettlement action plan (RAP),
- (iii) Potential dissatisfaction to the project affected persons (PAPs) on the mode of compensation and quality of alternative settlements may be a challenge to the project. This could arise from inadequate preparation and sensitization of the PAPs,
- (iv) The transmission pipelines and distribution tank locations could also have implications to the immediate landowners and residents. Considering that majority of the people lives below poverty lines, it would mean that prior relocation without support would not be possible unless support is made available,

Mitigation Measures

- Involvement of the residents through consultations and participation will be necessary to ensure acceptability and ownership of the project by all stakeholders, irrespective of the implications to the individuals,
- Initiate a public education and awareness forums on the catchment management and protection of the dam, especially the immediate neighboring landowners. Involving school children in this regard would also see long-term sustainability.
- Preparation and inclusion of the affected persons into existing social associations of their choice in the “new” settlement alternatives through education, awareness creation and facilitation. There may be need to pay for disturbance costs to those affected
- An all inclusive participatory Land Acquisition and Resettlement Action Plan (LAP & RAP) should be systematically conducted to establish who owns (interested parties and shareholders) what so as to determine the rightful owners who should benefit and the share each should receive.
- Provide counseling services and spiritual support to those affected by the inundation and reburial activities. Further those wishing to pay respects to their departed on agreed periodic basis either annual or five-year periods should be facilitated.

Potential Social Disruptions

The dam construction and operations thereafter will have permanent impacts on the social features across the area of coverage. Among the effects will include the following;

- (i) Social facilities including playgrounds, passages from one end to the other and social resting or recreation points (e.g. under-tree meeting points for village elders). Such locations are under threat of displacement of lost all together,
- (ii) Bridges and crossing points on affected rivers and streams (Mazeras – Kinango road bridge on Mwache and Mnyenzi rivers) will be relocated or redesigned to prevent conflicts with the inundation of the dam coverage area,
- (iii) Settlement areas with residential houses, stores, toilets and cattle pens as well as small-scale trading points (kiosks) will be relocated or partially affected. This will not have disrupt the co-existence of the villagers but also the attachments to their homes,
- (iv) Social and economic linkages to the resources associated with the riverine zones (domestic water sources, watering of livestock, sand harvesting, building stones collection) will also be affected.
- (v) Graves are potentially emotive issues, which may lead to rejection of the project by those to be displaced as it is traumatic for many households in the community and carries with it the added burden of potentially upsetting the ancestors. In this area, some graves constitutes part of the cultural Kaya lineage,
- (vi) Angry ancestors are often regarded as responsible for misfortunes such as illness, drought, cattle dying, crop failure, loss of employment, etc. The disturbance of graves is, therefore, regarded as a serious matter and belief dictates that when graves are disturbed a sacrifice should be made to the ancestors to appease the spirits.
- (vii) The nature of the sacrifice usually depends on the role that the ancestor is seen to play in the lives of living descendants. The disturbance of a grave of great significance might call for sacrifice of a goat; provision of traditional beer and hiring of a customary expert to “transfer” the grave among others. The monetary and time costs to periodically visit new burial sites will be prohibitive especially for those preferring reburial on cemeteries.

Mitigation Measures

- (i) Restore to the extent possible any public infrastructure or amenities that is disrupted to enable continuity of the residual PAPs. Among these include;
 - Relocate and/or raise the Mazeras – Kinango Bridge to a safe crossing upstream but still being easily accessible by the residents. Similar interventions should be undertaken for all other streams

- affected,
- Provide a public crossing over the embankment of the dam to facilitate movements of residents who would otherwise move far upstream to reach the bridge,
- Consult with the leadership and other authorities in selecting suitable locations for the new crossings
- (ii) Provide appropriate alternative watering points for the communities and their animals for any facility disrupted,
- (iii) The project construction and operations thereafter should bring the communities on board for awareness and consultations on the most suitable alternatives for the disrupted services and amenities,

Safety Issues

- (i) Human-wildlife conflicts cases will potentially increase from the increase in populations of aquatic animals notably crocodiles and hippopotamus that may pose threat to the safety of the residual residents,
- (ii) There will be a link to the health and safety of the residents from possible enhanced vector breeding (mosquitoes, snails, etc.), attraction of wildlife to the area and water contamination,
- (iii) With a huge mass of water, there are potential risks of drowning for the residents, especially children, the aged as well as livestock. This is a safety risks that need to be addressed. The risk would even be higher when the residents attempts to reach the water and watering their livestock,
- (iv) In order to ensure safety, there is need to fence the dam and educate the communities on co-existence with wildlife. This also includes adopting economic activities that co-exist with wildlife such as eco-tourism affecting children, the aged as well as animals.
- (v) Take off flight path for Moi International Airport is over the dam site. Potential attraction of birds into the fresh water dam zone is a risk to the safety of the aircrafts, particularly the highflying species. This aspect may be investigated further based on the characteristics of the birds as well as the height of the airplanes at that points,
- (vi) There is a large population crossing from both sides of Mwache Creek, at the Marere pipeline crossing and at the Bonje crossing point downstream the bridge. Fluctuation in downstream flows in Mwache dam may affect safety at the two locations

Mitigation Measures

- In order to ensure safety, there is need to fence the dam and educate the communities on co-existence with wildlife. This also includes adopting economic activities that co-exist with wildlife such as eco-tourism
- It will be necessary fence-up the dam and its buffer zone to isolate it from the

public for their safety

- Provide safe access points to the water for the local residents and their livestock to enhance their safety from drowning and potential attacks by wild animals
- Initiate continuous consultations with the Kenya Airports Authority and by extension the airline operators who fly over the dam area to discuss potential safety risks and agree on preventive measures,
- Inform members of public (crossings and anglers) downstream of the dam location on any un-usual releases or discharges from the dam's spillway for appropriate safety precautions.

Potential Cultural Disruption

The communities living in the project areas are very strict to their cultures. The attachment to their departed ones evidence to the reverence with the graves yards, the Kaya sites and associated "Beacons" around the sites and certain traditional sites including traditional medicine men premises are among the cultural sites that are likely to be affected. Among these include graveyards within areas to be inundated; Kaya Mswakara that even if it will not be reached could be indirectly affected. Other impacts include;

- (i) Graves are potentially emotive issues, which may lead to rejection of the project by those to be displaced as it is traumatic for many households in the community and carries with it the added burden of potentially upsetting the ancestors. In this area, some graves constitutes part of the cultural Kaya lineage,
- (ii) Angry ancestors are often regarded as responsible for misfortunes such as illness, drought, cattle dying, crop failure, loss of employment, etc. The disturbance of graves is therefore regarded as a serious matter and belief dictates that when graves are disturbed a sacrifice should be made to the ancestors to appease the spirit.
- (iii) The nature of the sacrifice usually depends on the role that the ancestor is seen to play in the lives of living descendants. The disturbance of a grave of great significance might call for sacrifice of a goat; provision of traditional beer and hiring of a customary expert to "transfer" the grave among others. The monetary and time costs to periodically visit new burial sites will be prohibitive especially for those preferring reburial on cemeteries

Mitigation Measures

- Involve the communities in identifying and advising on acceptable handling procedures of the traditional and cultural sites to avoid conflicts,
- Identify the cultural sites and support the communities to conservation for posterity (UNICEF has already intervened in the conservation of the Kaya site in

Mwache Forests,

Liaise with the relevant departments (Culture and Social Services) to identify and control genuine cultural facilities and sites.

Economic Impacts and Mitigation Measures

- (i) Some access roads will be inundated breaking means of internal communication from one community to another. However, alternative routes will be established as part of the project.
- (ii) Significantly increase the price of land, which may deny those displaced the ability to purchase it.

Those with farms next to the river will be denied access to it and therefore substantially lose high value and productive farmland on the river.

Mitigation Measures

- A programme should be established to enable affected communities benefit from the economic potential of the resources in the area before displacements. This would include controlled burning of charcoal and making briquettes, cutting wood for construction, harvesting building materials (sand and stones) and any other movable natural resources,
- Appropriate compensations and/or provision of alternative settlements and livelihoods for the affected communities shall be accomplished before commencement of the project.
- Undertake detailed risk assessment of the dam to downstream ecosystems, social and economic setting.
- Organization of the community into a strong unit to control local resources as well as social and economic benefits resulting from construction of the dam including sand harvesting and marketing of products such as fish, crops and livestock
- Put in place supportive and cushioning mechanisms and programmes for those affected such as training, enhancing access to alternative resources and livelihood means

Dam Safety

While full risk assessment study has not been undertaken this report provides general pointers for detailed evaluation and quantification of potential damages from various components of the project. It will, however, be necessary to undertake a comprehensive risk assessment of the project covering all aspects of human life, social setting and economic trends linked with the dam. Damages to environmental features, human life and properties could arise from the following scenarios;

- (i) The dam breaking,
- (ii) The spillways giving in,

- (iii) Collapsing of the raised storage tanks,
- (iv) Overflows onto upstream roads and bridges,
- (v) Accidental drowning of residents and their livestock.

Risk impacts associated with these scenarios varies depending on location, public awareness and preparedness, habitats and land use affected and duration of occurrence.

Immediate Upstream

- (i) There are a number of farmers along the banks of Mwache River immediately downstream the embankment wall with vegetables being the main crops. The farmers and their crops are at risk of damage in the event of a dam break,
- (ii) The local communities graze and water their animals on residuals of water left after the floods. The dam instability also poses a risk to the grazers and their livestock,
- (iii) Section of Mwache Forest, that also harbors Kaya Mswakara, spans from downstream the dam site. Together with the associated ecosystem, the section of the forest is at risk from the dam instability,
- (iv) The lower zones of Mwache River before confluence with the seawater provide a breeding environment for certain aquatic animal species including fish. In the event of a dam break, the breeding habitats could get destabilized,

Downstream Areas

- (i) Further downstream is the sea ecosystem comprising of mangrove forest and habitats of numerous aquatic animal species among them fish, crabs, lobsters, etc. within Mwache creek. The habitats and the animal species may get disrupted in the event of dam breaking,
- (ii) There is a pipeline transmitting water from Marere springs to Mazeras tanks for the supply of water into Mombasa city and its surroundings. This pipeline that is anchored on steel structures could get broken or damaged in the event of the dam break,
- (iii) Without a bridge on the section of Mwache River at the downstream the dam site, the residents use small boats to cross from one side of the river to the other of Mwache Creek at a small fee. This crossing point and to some extent the residents stand a risk of their lives in the event of dam break,
- (iv) The public commercial jetty at the mouth of the river at Mwache Creek and the boats that serves the public are also at risk of damage
- (v) Moi International Airport grounds lies directly ahead of the Mwache River entrance into the Mwache Creek and right onto the proposed Mwache Dam embankment wall. It would potentially suffer serious damage in the event of dam break when at full capacity.

- (vi) Kilindini Harbor at Port Reitz that is link of Mwache Creek with the ocean could be affected in the event of accidental dam break, particularly the stability of the docking ships and vessels.

Management Issues

This project is geared towards enhancing social and economic benefits to the people living in Kwale and Mombasa Counties. The project will however also observe environmental conservation requirements in accordance to the established laws and regulations. To realize this goal, acceptability by a majority of the beneficiaries and minimal effects to the physical environment will require to be integrated in the project through constant consultations, evaluations and review of the design aspects throughout the projects implementation and operation. It is recommended that guiding principles specific to this project and the regulations governing water resources management will be developed in an Environmental and Social Management Plan that will allow integration of environmental management considerations in the construction, maintenance of the facilities constructed under the project components and the public amenities.

In order to implement the management plan, it is recommended that an suitable experts will be appointed to oversee the environment and management aspects including the dam conservation, soil erosion control, re-vegetation whenever appropriate, water conservation and equity in distribution, enhanced sanitation and hygiene measures throughout the project area. The expert staff would also be expected to co-ordinate and monitor environmental management during construction and conduct post-construction monitoring audits

Upon completion and commissioning of the dam, it will be necessary to establish appropriate operational guidelines on environmental conservation and social linkages, which will be prepared and adopted to enable the management of identified critical environmental and social issues and institute appropriate actions towards minimizing associated conflicts. Basically, the guidelines will cover, among other areas things, environmental management program, standard operation procedures, compliance monitoring schedule and environmental audit schedules as required by law. Social harmony in the area where of the dam and its associated components are located will be achieved through the collaborations with the stakeholders or community management committees introduced at various water consumption points.

Conclusions

The following overall conclusions have been arrived at with regard to the proposed multipurpose dam and its components as follows:

- (i) The construction of the dam has not been fully embraced by authorities and residents of Kwale County and based on extensive consultations held, even though there is appreciation of the value of the project, the residents of Kwale would like assurance

that the water will benefit them. There is a general fear that the water will only supply Mombasa County and provide no benefit to Kwale County and this is fuelling apprehension. In this realization, the project has been re-designed to include water supply and sanitation component for urban and rural Kwale County.

- (ii) The small Duruma community has high cultural values that may come into conflict with the dam during construction and thereafter. Among the notable features, include graveyards, at least one Kaya Site and at least one traditional consultation site. These cultural considerations will be fully addressed and integrated into the dam project implementation and operations,
- (iii) Communities in Kwale and Mombasa have indicated their desire to have water for domestic, commercial irrigation and industrial needs. This need will be addressed through this project. There are several potential social and economic opportunities in the project to communities in both counties.
- (v) The dam will cause displacement of approximately 800 households and also affect a notable number of residual residents who would have to live with the new environment. The exact number and status has only been estimated in this report leaving details to be dealt with in the full Resettlement Action Plan (RAP) while provision of CSR will deal with the residual communities,
- (vii) Mwache dam sits immediately upstream of Mwache Creek, a marine ecosystem featuring mangrove forest cover, which is highly productive and an economic lifeline for a section of the local community. This will need to be conserved,
- viii) EMSP are designed costing Kshs 236 million to offset the negative impacts and enhance the positive impacts of the project on the social and environmental condition of the project area.

Recommendations

From the foregoing, the following recommendations have been established

- (i) Adopt dam characteristics that will enhance enrichment of biodiversity through proliferation of appropriate vegetation and create appropriate habitats for fish as social value adding features. Facilitate the establishment of vegetated zones as compensation of the lost biomass. This will be further enhanced due to the inclusion of a sizeable buffer around the dam comprising suitable tree species,
- (ii) Initiatives on the conservation and protection of the immediate catchment as formulated under the project should be implemented effectively
- (iii) To enhance social integration, the local communities and all the stakeholders involved will be sensitized on the benefits and risks of the project so that they are all on board in advance for effective participation and sustainability. A social component, therefore, needs to be built into the overall project implementation.

Entrench ownership of the project upon the residents through participation during construction and thereafter when they can report negative activities within the project area. In this endeavor, local sensitization committees should be developed from the communities to act as liaison between the project implementation group and the stakeholders.

- (iv) Compensation and resettlement of the project affected persons (PAPs) will be finalized before commencement of the project to ensure minimal social conflict over the project in future. Land matters are rather sensitive and thorny issues. Acquisition and related compensation aspects should be approached with caution through a well-defined inclusive process involving identification of the true target beneficiaries, awareness creation and political will. Consultations will be undertaken especially with all affected landowners, and household members on the, valuation processes, negotiations and, awards. Within the compensation component, there is also need to develop livelihood restoration programmes will be developed and those moved from their land will be to settled near the rest of their clansmen, subject to availability of land. The PAPs would be provided an opportunity to buy alternative land of their choice
- (v) There is need to undertake capacity building for the local communities that will be undertaken so as to enable them to competitively exploit opportunities that arise from construction of the project (employment, supplies, etc.) as well as utilization of their resources. The Government through the Authorities in-charge of water resources should come on board to support the local communities' access water through established procedures.
- (vi) Inhabitants living around impounding water should be protected from health concern through effective implementation of designed health and hygiene plan under the project.
- (vii) Likely additional load of agriculture chemical due to irrigated farming in the command area will be reduced through implementing various activities (IPM, IPNM, Bio-fertilizer promotion, etc.) designed under Agriculture Chemical Use Reduction Plan.
- (viii) For ESMP implementation a budget of Kshs 236 million is allocated that need to be implemented effectively in order to minimize the negative impacts and enhance the positive impacts of the project on environmental and social condition of the project area.

CHAPTER 1: INTRODUCTION

1.1 Background

The current access to clean water in Kenya is estimated at about 90% in urban areas and approximately 44% in the rural areas while the national average stands at about 57%. At the same time, provision for safe sanitation stands at a national average of 80% (95% urban and 77% rural). This makes Kenya a “chronically water scarce” country and results from the limited endowment of water of only 647m³ per capita and this is projected to fall down to 245m³ per capita by the year 2025, well below the internationally recommended minimum of 1,000m³/capita/year. Kenya’s Water resources are also highly vulnerable to climate variability often resulting into floods and drought with inadequate storage capacity, which limits the ability to buffer against the water shortage shocks.

A special focus is required on the economically critical Coastal region (the areas that were part of the Coast Province prior to devolution in 2013), and particularly on Kenya’s second-largest city, Mombasa. The current level of water infrastructure development is not in tune with the envisaged economic potential of the Coastal region. There is an obvious water infrastructure deficit, dissipating the impacts of other on-going and planned flagship projects unless action is taken now.

Among the worst hit by water shortage is the greater Mombasa and Kwale Counties that receives annual average rainfall of between 500mm – 600mm per year, increasing in the higher altitude zones. Divisions in Kwale County get an annual average rainfall of 500mm per year that is also unevenly distributed over time with long periods of dry weather. As a result, sources of water are unreliable, far apart and of poor quality. Residents of Kwale County are forced to walk long distances (5 – 10km) in search of water, hence wasting significant economic time and energy in addition to poor hygiene. Seasonal rocky rivers that flow with water only during the rains and originate from the highlands are supplemented with shallow wells (usually with unclean water) and stagnant water ponding in the dry riverbeds after rains.

The National Policy on Water Resources Management and Development focuses on streamlining provision of water for domestic use, agriculture, livestock development and industrial utilization with a view to realizing the goals (among them Goal No. 7) of the Millennium Development Goals (MDGs) as well as the Kenya Vision 2030. Mwache Dam has been identified under the Kenya Vision 2030 as one of the flagship projects. Following feasibility and social baselines studies covering both Counties, it was established that water is a priority to all the area residents in terms of livelihoods and social requirements.

Harnessing of the fluctuating flows in Mwache River and the seasonal waters from its tributaries would complement water supply for Mombasa County, and provide water for domestic and commercial use in Kwale County included in the short term limited

irrigated farming and local livestock requirements.

1.2 “The Project”

Mwache Multipurpose Dam Project herein referred to as “*the Project*” includes a dam located in Kwale County along Mwache River as described below. “The project” further includes other components namely, water supply and sanitation infrastructures to serve Mombasa and Kwale County and finally an irrigation component to provide water for irrigated farming in Kwale County. The objectives of the Project include the improvement of the living standards of Kwale and Mombasa County residents through Poverty Alleviation and Sustainable Development. A large-scale multi-purpose water reservoir will be created to cater for public, domestic, commercial and industrial water supply for both Counties and a pilot **100-ha Pilot Irrigation (Kwale)** component in order to effectively contribute towards regional and national socio-economic development.

The Dam Component

The dam is expected to cover an area including section of the lower zones of the Mwache River flood plain, with a catchment spanning about 2,250km² spanning from the dam site to the Taita hills and comprising of Mwangombe, Majiya Chumvi, Nyongoni, Dambola and Mnyenzi sub-catchments. It will fall within among other locations Kasemeni, Mwatate, Mwavumbo, Gandini and Mtaa.

Mwache River, in the Coast Province, runs through Kwale County via Kasemeni Division, about 22km from Mombasa City. Deep valleys characterize the last 6km of the river with steep slopes making it the perfect site for a dam. The proposed Mwache dam is slated for implementation at this section of the river during a period of four year.

Pilot Irrigation Component

The pilot irrigation component to be financed under KWSCR-1 would test the approaches proposed for the irrigation component and also initiate the broader rural development and livelihoods program as well as watershed management actions. Other specific objectives include recreational sports development and tourism, fisheries and ecosystem conservations.

Water Supply and Sanitation Component-Kwale

This activity will support increased access to water supply and sanitation in small towns and rural communities in Kwale County. Water supply at the coast and particularly in the urban areas is based mostly on a bulk water supply system. Currently, the Coast Water Services Board is responsible for efficient and economic provision of water and sanitation services in the six counties in the coastal region, including Kwale County. CWSB has contracted water services providers for provision of water and sanitation services. Under the devolved system, provision of water and sanitation services is a county government function, and this continues to be provided by existing water companies. Kwale Water and Sewerage Company

(KAWASCO) is thus responsible for provision of water and sanitation services in Kwale County.

Investments to be supported under this component will be selected and prepared in line with the KWSCRIP Investment Framework. Application of the Investment Framework, which will continually be improved through application and refinements under KWSCRIP-1, will help ensure that transparent selection criteria are used for selection of sub-projects, and that selected sub-projects are prepared according to agreed quality assurance standards, including on technical, economic, financial, environmental, social and institutional aspects.

Kwale County is largely rural. The County has 5 towns/urban centers which are mainly located along the coast. Urban population constitutes only about 18% of the total county population of about 650,000. According to the Water Supply Master Plan for the coastal region, the current urban water demand in Kwale is about 25,000 m³/d, of which less than 50% is currently supplied. This demand is projected to reach 58,000m³/d in 2035. Water supply to Kwale, Kinango and Ukunda towns comes from two bulk water systems—Marere springs and Tiwi aquifer—which are located in Kwale County, and whose supply is shared between Kwale and Mombasa counties. Both Marere and Tiwi systems have recently undergone massive rehabilitation under WaSSIP (IDA and AFD financing). WaSSIP also supported rehabilitation and expansion of the water network in Kwale and Ukunda. As the supply to Mombasa increases with development of new water sources including the Mwache Dam, more water will be released from Marere and Tiwi systems to supply Kwale and Kinango towns. In the long term, Ukunda and Lunga Lunga towns will likely be supplied entirely from Mwache Dam and Msambweni from Msambweni aquifer once these sources are developed.

This sub-component will finance water network rehabilitation and expansion particularly in Kwale, Kinango and Ukunda towns in addition to the work done under WaSSIP. This will ensure maximum utilization of current supply to these towns, as well as prepare them for receiving additional water supply after completion of the Mwache Dam. This sub-component will also support rehabilitation of existing and construction of new boreholes to supply Msambweni and Lunga Lunga towns as an immediate intervention. Preparation of designs and tender documents for these works and for the infrastructure required to supply Kwale urban areas from Mwache Dam will be financed under KWSCRIP-1.

Due to the dispersed nature of Kwale County population, sustainable supply to small towns and rural areas through conventional water systems is not feasible in most cases. The option to supply the rural population located along the bulk water system in Kwale, Kinango and Msambweni through water kiosks along the main pipeline will be explored further². For instance, the new Marere pipeline has provided off-takes to

² Estimated that 30% of total population in the 3 towns could be supplied via kiosks

accommodate supply to these rural areas. This sub-component could support extension of the pipelines from the off-takes to the communities. Other viable, low-cost near-term options for water supply include point water sources (boreholes, protected dug wells, protected springs); rainwater collection; and small dams across seasonal streams. While the areas of Kwale County close to the coast, in Msambweni, have a fair supply of shallow ground water, the remainder of the county (i.e. from Kinango to Lunga Lunga) is poorly endowed with water resources. In these areas, protected springs and earth dams appear to be viable options, and will be explored further. Several institutions have supported development of these rural schemes in Kwale County. The first step will be to map and identify the performance of these point sources (KWSCR-1). Investments to be made under this sub-component will be identified through a participatory and demand-driven approach and will include rehabilitation and construction of boreholes, protected dug wells and springs and small dams.

This sub-component will also support increased access to improved sanitation facilities in both urban and rural areas. A recent Water and Sanitation Program (WSP) study estimates that only 18.4% of the county has access to improved sanitation. Just over half of the population practices open defecation, with estimated losses of at least KES 677 million (USD 8 million) each year due to poor sanitation. This includes losses due to access time, premature deaths, health care costs and productivity. A sanitation/sewerage masterplan for Kwale County is planned under KWSCR-1 to better inform the exact activities to be implemented. This sub-component will support activities including construction of a sludge management facility for KAWASCO, and public sanitation facilities in urban areas and public institutions (schools and health centres). The challenges include no clear advocacy plan to gain political support for sanitation, insufficient number of government staff in place to implement, and lack of quality assurance controls for sanitation products and services.

KAWASCO will receive technical support under KWSCR-1 for improvement of its operational performance. This will include technical support for reduction of non-revenue water, and development of financial, management and customer strategies. Technical advice on sustainable development and management of rural water and sanitation schemes will also be provided.

1.3 The ESIA Study

1.3.1 ESIA Terms of Reference

ESIA study was carried out as per the Guideline of World Bank and NEMA, Kenya i) to establish the environmental and social baseline, ii) to assess the project impact on environment and social conditions and iii) formulate the environmental management plan and social action plan to reduce the negative impact and enhance the positive impact of the project.

1.3.2 ESIA Objectives and Scope of Work

ESIA is prepared in accordance with WB Safeguards Policies and Procedures, which consist of

- OP/BP 4.01 – Environmental Assessment
- OP/BP 4.04 – Natural Habitats
- OP/BP 4.36 – Forests
- OP/BP 4.09 – Pest Management
- OP/BP 4.10- Indigenous Peoples Policy
- OP/BP 4.11 – Physical and Cultural Resources
- OP/BP 4.12 - Involuntary Resettlement
- OP/BP 4.37 – Safety of Dams
- OP/BP 7.50 - Projects on International Waterways

In addition, ESIA study has been conducted in compliance with the Environmental Impact Assessment Regulation as outlined under the Gazette Notice No. 56 of 13th June 2003 established under the Environmental Management and Coordination Act (EMCA), 1999 of Kenya.

1.4 ESIA Methodology

In accordance to the ESIA guidelines, the study included the following:

- (i) A clear description of the proposed project including its objectives, design concepts, proposed water uses and anticipated environmental and social impacts,
- (ii) Description of the baseline conditions in the project area to cover the physical location, environmental setting, social and economic issues,
- (iii) A description of the legal, policy and institutional framework within which the proposed dam project will be implemented,
- (iv) Description of the project alternatives and selection criteria,
- (v) Details of the anticipated impacts to the environment, social and economic aspects of the area covered by the project.
- (vi) Appropriate mitigation and/or corrective measures,
- (vii) Development of an environmental and social management plan (ESMP) presenting the project activities, potential impacts, mitigation actions, targets and responsibilities, associated costs and monitoring indicators,

1.4.1 The Approach

The ultimate goal of this approach was to identify impacts resulting from the proposed project to be determined on the basis of the baseline conditions established during the field work and information obtained from the documents reviewed. For subjective predictions of the impacts, the site area was subjected to environmental scoping process. This was a process of evaluating the significance of

the project impacts and possibilities of handling the same that lead to this report.

Detailed evaluation of the project area is being undertaken to focus on any significant environmental issues. The communities living within the proposed dam coverage area were interviewed during consultation and participation process during the detailed study process. Among the tools that was used include questionnaires, self-writing forms, photographs, etc. Overall, the study was undertaken through the following stages:

1.4.2 Scoping Process

The project is classified as Category A, because of the scope of the expected impacts from construction and operation, the impacts of land acquisition, the resettlement of more than 200 persons and the expected impacts on the natural environment. The Environmental Impact Assessment Regulation as outlined under the Gazette Notice No. 56 of 13th June 2003 established under the Environmental Management and Coordination Act (EMCA), 1999 was followed for the scoping process of NEMA in defining the defining the TOR for the detailed ESIA.

1.4.3 Use of ESMF and RPF

The exact locations, designs and scope of the water related infrastructure for Kwale County are not yet know and in this respect, the Environmental and Social Mngement Framework (ESMF) and Resettlement Policy Framework (RPF), document prepared to ensure safeguard measures for projects under KWSCR 1 will be used for guidance to ensure environmetal and social safeguards during the design of the components. Once the locations, designs and scope are concluded as part of the feasibility studies, separate ESIA's and RAPs will be prepared for these sub projects and submitted for approval by the Bank prior to commencement of construction activities.

1.4.4 Documentary Review

Various relevant documents were reviewed for a clear understanding of the terms of reference, environmental status of the project area and the target river systems, data on demographic trends (for the project area, the beneficiary areas and the adjoining districts), land use practices in the affected areas (either as catchments, dam location or the beneficiary areas), development strategies and plans (local and national) as well as the policy, legal and institutional documents. Some of the documents reviewed include:

- (i) Detailed Design Report and associated documents developed for the project;
- (ii) Feasibility Study Report;
- (iii) Relevant Legal, Policy and Regulatory documents;
- (iv) Relevant World Bank Safeguard Policies and Procedures;
- (v) EMCA 1999

1.4.5 Field Assessment

Field assessment was designed to address the physical and biological environment of the project impact area (i.e., 10 km radius of dam site as given in **Map 1**) as well as the project affected persons (PAPs). Determination of the affected environmental and social features would not only be felt within the dam area but in the defined project impact area. The fieldwork was, therefore, focused on establishing the anticipated positive and negative impacts in terms of physical and biological environment (hydrology, climatic patterns and water resources related aspects), social and economic trends, (population trends, settlement trends, economic patterns, cultural setting and linkages, land ownership issues, etc.). Specific objectives of the field assessment included:

- (i) Obtaining any available information and data from the local public offices including environment, water, lands and agriculture. Public consultations were also organized with the stakeholders.
- (ii) Evaluating the environmental setting around the proposed site. General observations were focused on the topography, land use trends, surface water sources, public amenities, land cover, climate, settlements, forests, soils, etc. Evaluate social, economic and cultural settings in the entire project areas,
- (iii) Undertake comprehensive consultative public participation exercises such as to reach a large section of the project affected persons as well as other stakeholders.

1.4.6 Detailed ESIA Study Activities

This assignment involved a series of activities carried out in liaison with the Client, relevant government departments, local authorities, community groups and other organizations in the area with a view to sharing their experiences and information with respect to environmental resources and social aspects. Effective evaluation of the social baseline status achieved through interviews (consultative meetings and discussions) and physical inspection of the entire project area. The baseline conditions provided the starting point for the impacts predictions and benchmark for the mitigation measures.

Details of the activities are listed under the terms of reference, and the outputs for each activity are outlined in the sub-sections below;

- (i) Review of the proposed dam project details to understanding of the dam project magnitude and the overall implementation plan by the client.
- (ii) Establishment of the current baseline conditions to provide a documented foundation for the impact predictions and a benchmark for the development of mitigation measures
- (iii) Update of the legislative and regulatory requirements as a basis for drawing a compliance monitoring protocol for the construction and commissioning phases.
- (iv) Environmental and social impacts assessments for the identification of

significant impacts to the environment and the nearby communities. Types and levels of impacts as well as criteria for developing suitable mitigation measures and an environmental management plan.

- (v) Environmental management plan on mitigation measures, responsibilities, timeframes, environmental costs and a comprehensive environmental management plan.

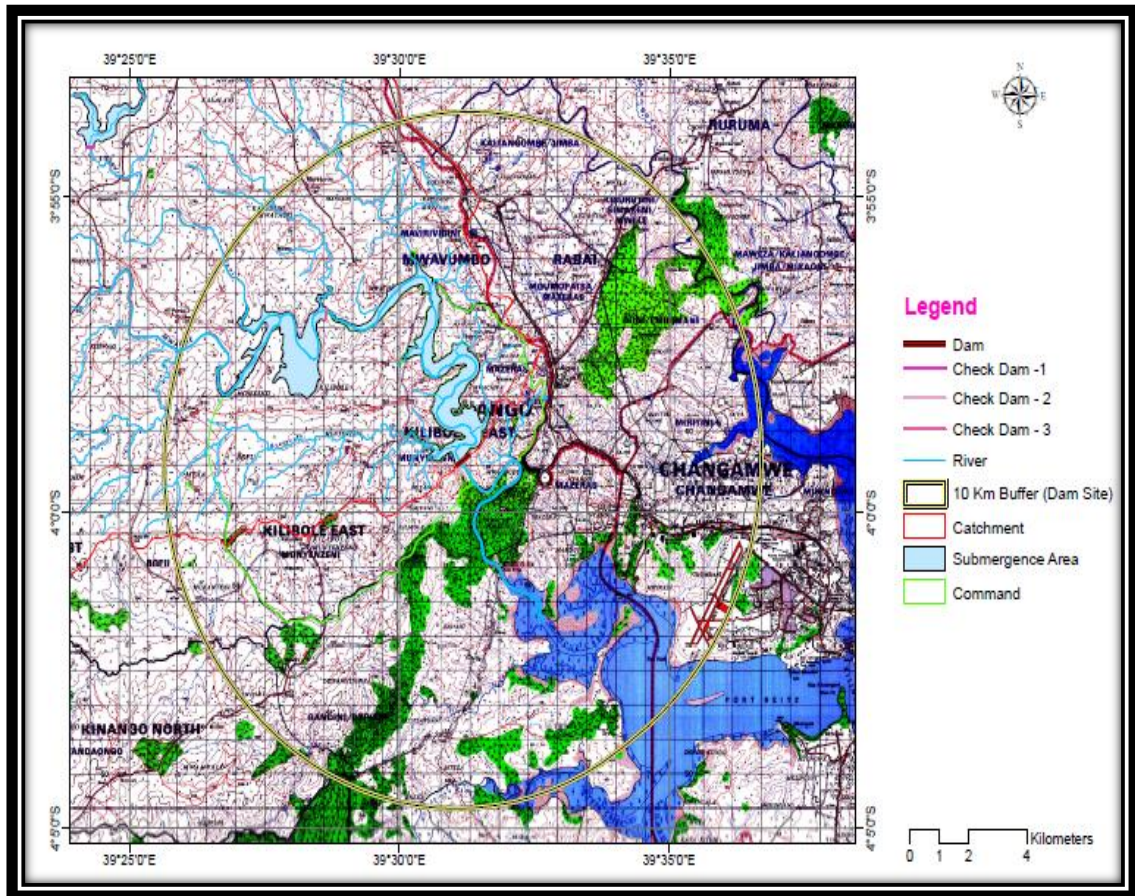
1.4.7 Public Consultations

Interaction with the stakeholders and communities living around the project area was a continuous process at scoping, and findings of detailed ESIA study was also presented to stakeholders for their feedback. Among the interactions include informal contacts on basic inquiries and engaging local youth in the study activities. Among the formal forums undertaken were sensitization and stakeholder feedback sessions involving all levels of stakeholders, social and economic surveys at household levels and public participation forums that were open to all residents. Additional sessions involved the PAPs who were interviewed for purposes of compensation on land acquisition.

1.4.8 Reporting

The reports (inception, draft final and final draft and final) were done within pre-agreed time frames such as to cover the requirements of the National Environmental Management Authority (NEMA) guidelines. The report schedule comprised a scoping report, draft final ESIA study report and final ESIA study report. The scoping report and the final study report were submitted to NEMA review. Besides continuous briefings to the Client and local NEMA office also undertaken.

MAP 1: Project Impact Area of Mwache Dam – 10 km Radius



CHAPTER 2: PROJECT DESCRIPTION

2.1 Project Location

The “Project” in terms of location include the entire Kwale and Mombasa Counties which are expected to benefit from water for domestic, industrial, commercial and irrigation purposes. The project therefore includes the dam component; irrigation component; and urban and rural water supply and sanitation component all to be located in different areas within the 2 Counties.

The exact locations of the water infrastructures in Kwale and Mombasa Counties are not fully known at the point of preparing this ESIA. In the case of the transmission line for water supply to Mombasa County including the treatment plant, tentative sites have been identified and feasibility studies and designs are on going. In the case of Kwale, these are entirely unknown at this point in time and will only be known when the Kwale Water Master Plan is finalized. Therefore, the description of the project location at this point only encompasses the location for the dam and the pilot irrigation component of the “project”. Separate ESIA studies will be conducted for the sub components mentioned once their locations and designs are completed.

Dam Location

The Mwache multipurpose dam project is located in Fulugani and Miyani areas of Kasemeni Division of Kinango District. The northern areas of Mwache river stream falls in Mazeras sub-location and Kasemeni location while the southern side is in Rombo Location and Kinguluni location while the upstream zones are in Mwatate location of the same Division. The catchments, however, extends far to the west, northwest and southwest. The location coincides with 3° 59’ 12”S and 39° 31’ 07”N on a straight stretch of the river before discharging into the ocean via Mwache Forest. The location is off Mazeras about 22km from the City of Mombasa bordering the Indian Ocean to the east at approximately 10km from the main Mombasa – Nairobi highway. The table below presents the administrative areas of Kinango District:

Table 1: Project Administrative Location Details

| Division | No. of Locations | Names of Locations | No of Sub-Locations | Area (Km ²) |
|--------------|------------------|--|---------------------|-------------------------|
| Kinango | 3 | Kinango, Puma, Vigurungani | 6 | 1060.8 |
| Ndavaya | 1 | Ndavaya | 4 | 555.9 |
| Kasemeni | 5 | Kasemeni, Mwatate, Mwavumbo, Gandini, Mtaa | 13 | 562 |
| Samburu | 5 | Samburu, Taru, Chengoni, Mackinon road, Makamini | 5 | 1803.2 |
| TOTAL | 14 | | 28 | 4011.7 |

Source: *Kinango District Year 2010 Farm Management Guideline*

The following sections briefly present an outline of the main environmental and social features from observations.

2.2 Project History

Following acute shortage of water in most parts of the country, it has become necessary that alternative mechanisms are developed to harness available sources to supplement the little available. With intensive surface runoff during heavy rains, significant volumes of storm water are lost. Dam construction has been identified as an alternative way of increasing storage in order to use the run off from heavy rains throughout the year. The “project” is among the flagship projects identified in the Kenya Vision 2030 geared towards closing the gap in supplementing water to Mombasa, providing water to the local communities as well as other economic activities.

2.3 The Proponent and Key Stakeholders

The proposed project is to be implemented by the Ministry of Environment, Water and Natural Resources (MEWNR) *State Department of Water* through the Coast Development Authority (CDA). It is also appreciated that the value of the resource cuts through various other stakeholders. While most stakeholders may not be directly involved in the implementation of the project, there are key players in addition to MEWNR and CDA who are expected to feature prominently during the development and operation of the facility. These include;

- (i) Water Resources Management Authority (WRMA),
- (ii) Kwale County
- (iii) Mombasa County
- (iv) Coast Water Services Board (CWSB),
- (v) Kenya Forest Service
- (vi) Ministry of Agriculture, Livestock and Fisheries
- (vii) Ministry of Health
- (viii) Kwale Water and Sewerage Company
- (ix) Provincial Administration
- (x) Kenya Marine Fisheries and Research Institute
- (xi) Mombasa Water and Sewerage Company (MOWASCO)

2.4 Project Justification

COASTAL WATER SUPPLY STATUS AND ISSUES

The total water demand for the Coastal region has been projected at 364,243 m³/d for 2015, and is expected to more than double by 2035 (887,253 m³/d). Currently, the Coastal region shows a water supply deficit of about 215,043 m³/d. The situation is particularly critical in Mombasa, where the existing supply satisfies only 30% of the demand.

Mombasa City and its surrounding environs is provided water from four sources including Baricho Water Works in Malindi District providing 47,000 m³ /day), Mzima Springs (providing 35,000m³/day, Marere river (bringing in 6,900³ per day) and Tiwi boreholes (producing 3,900³ per day). The sources provide only 35% of the total water demand of the city. The total demand for Mombasa City is estimated about 206,000m³ per day but only 92,800m³ per day is available). There is also significant unaccounted for water (ufW) arising from poor integrity of the distribution network, illegal connections and poor tracking of accessibility. There is, therefore, a strong need to supplement the available water to meet the demand. The community at the project area relies on the limited connections from the Mzima Springs pipeline to a few communal water points that is hardly enough to meet their requirements.

THE COASTAL WATER SUPPLY INVESTMENT PLAN AND PRIORITIZATION OF MWACHE

A Water Supply Master Plan study for the Coast / Mombasa was carried out under the Water Supply and Sanitation Improvement Project (WaSSIP), financed jointly by the World Bank and AfD. This and other studies have confirmed that the Coastal region has water resources available to satisfy the water demand of the region at least until 2035. Those studies have also confirmed that the Mwache Dam is a priority source of water to meet demand and increase water security for Mombasa.

This section described the salient feature of the project area including project impact area as depicted in Map 1.

2.4.1

Catchment Area Upstream of the Dam

Mwache River is the main stream feeding into the proposed dam. The river basin spanning to as far as the Taita hills to the west covers an estimated catchment of 2,250km² with a total length of 110km and elevation of between 300m a.s.l. down to 20m a.s.l. at the dam. The river comprises of various tributaries including Ngoni originating from Pemba and Taita hills joining with Mto wa Nguro rising from Mabesheni hills to the south of upstream of the dam area. Mnyenzi River rises from a series of hills among them Chigato, Mukanyeni, Kikuyu and Mabesheni hills to join Mwache River at Miyani area a short distance upstream of the proposed dam wall axis. Mwangombe River is also a major basin originating from hills on the northeastern covering Tsavo areas and joining the Mwache basin at Ngoni section.

Figure 1: Sections of Mwache River Basin



A sections of the Mwache River immediately upstream of the dam site



Mwangombe River bed (tributary from the north)



Mnyenzi River Basin (Tributary to Mwache River)



2.4.2 Dam Site and Buffer Areas

The dam site is characterized with deep cliffs standing out to about 14m above sea level (\approx 14m above riverbed). The area is mainly rural residential comprising mainly of villages or family homesteads. Despite the deep cliffs, there is notable number of residents undertaking limited farming along the river flood plains or grazing along the riverbanks while both banks of the river are characterized with limited farming. The land required for the dam will cover the buffer zones on both sides of the banks. The allowed buffer zones cover a minimum of 30m according to the Water Rules but will effectively vary with topography and the surrounding land use practices. While the dam has been designed to a water crest level of 86 m, the total area acquired will be 100 m to allow for adequate buffer area that will be planted with trees. This will also be an extension of Mwache forest system.

Figure 2: Sections of the dam location



The Dam Site Outlook





The Dam Site Neighborhoods and Related Land Use Features

2.4.3 Area to be Served and the Adjoining Land

The areas to be served by the dam water are classified into two, namely water supply coverage for rural and urban Kwale County for domestic, commercial, sanitation and irrigation scheme. The irrigation scheme with a pre-determined maximum land per family will be allocated for production of food crops. The area covers Mnyenzi area, Miyani area and Chigato and other areas.

2.4.4 Downstream of the Dam

Immediately downstream the dam is characterized with small-scale farming along the riverbanks with main crops being kale, pepper, okra, etc. while the riverbed is normally dry during the dry weather. It is notable that significant heavy flows are experienced during the wet season with notable silt deposition and riverbed scouring from strong storm flows. There are, however, notable pools of stagnant water along the riverbeds that are beneficial to the farmers, watering livestock as well as limited fishing. Further downstream is the Mwache River estuary that begins from the Bonje Bridge into the dense mangrove forest of Mwache Creek that gives way into the sea at Port Reitz. The whole section from Mwache Forest into the Creek displays the following features;

- (i) Notable stagnant water pools on deep river beds used by the local residents for small scale farming and fishing. The farmers come to work the areas from their homes in the elevated areas, some from the proposed dam area,
- (ii) A large section of the river in this zone traverses through Mwache Forest, apparently providing a lifeline for the ecosystem. Sustenance of certain plants and wildlife is an important aspect of this section of the river,
- (iii) Downstream of Mwache Forest, the river enters an inter-phase with the seawater. The water in the section, therefore, is salty and unsuitable for any

domestic purposes or livestock. It, however, has high potential for fishing with fish moving upstream to feed on the fresh components of incoming water as well as breeding in the water inter-phase zones.

- (iv) The brackish water inter-phase and salty level fluctuations in the creek are an important factor for the development of the mangrove forest system that in turn acts as the sediment trap for the safety of the harbor and the port shoreline,
- (v) An expansive mangrove forest system characterizes the Creek towards the main sea. Close observation reveals that this zone is highly productive, particularly in terms of aquatic life breeding habitats,
- (vi) The creek also has a linkage to Kilindini harbor and the Port.

Figure 3: Sections Of Mwache River Downstream the Dam Site



2.5 Design Concepts

2.5.1 Basic Consideration

Basic dam design principles are driven by safety and economic feasibility and sustainability. The key principles adopted for Mwache dam include;

- (i) Utilization of available construction materials.
- (ii) Structural stability of the dam
- (iii) Ensuring minimum seepage through the embankments,
- (iv) High enough crest level to prevent overtopping and wide enough to prevent breaking,
- (v) Adequately sized and firm spillway structures.
- (vi) The treatment works are also anticipated to comprise of flocculation, sedimentation, filtration and disinfection units.

Hydrology Criteria

It is noted that the Mwache River and all the tributaries feeding into it are seasonal by nature and flows are dependent of the rainfall in the middle and high watersheds discharging into Indian Ocean via Mwache Creek and Port Reitz. The sizing of the dam and its component, therefore, is being determined on the discharge of the catchments flash floods as opposed to a constant flow of the river. Most of the rainfall in this catchment occurs between March – July and then in October – December with peak rainfall session in May and November. The average rainfall is 500mm – 1,200mm. The hydrological concept adopted is based on synthetically generated monthly stream flow with average observed annual flow as 113.41 MCM. The design flood has been worked out as 2,760 cumecs and a diversion flood of 80 cumecs. The full reservoir capacity based on an elevation of 82.2 amsl is about 118.7 MCM and is facilitated by the local topography (a separate hydrological report has been prepared).

Geology

The interpretation of log of bore holes reveals that Mwache dam site and surroundings comprise of sedimentary rock formations named Duruma sandstone series. Mariakani sandstones are exposed in the river bed. Bedrock is intersected by two sets of perpendicular joint dipping vertical. A third set of joint is sub-horizontal bedding joints. Joints are very tight as indicated by zero permeability recorded in all the drill holes during percolation tests. The core recovery is almost 100 percent. Zero permeability indicates that the bedrock neither possesses primary permeability nor secondary permeability.

Land Use

It is noted that the current land use practices within and around the dam area do not have significant influence on the dam design. Subsistence farming land use practices, settlements and institutional development are the major features. However, the interaction with specific land use features will be determined by the 100m a.s.l.

elevation proposed to cover the highest water level mark and the buffer area (through the buffer area may vary from one zone to another)

Water Demand

The priority need from the proposed dam is domestic water supply for Kwale and Mombasa Counties. The need to supplement water supply into Mombasa as well as the Kwale is the main focus for the design though there is still a challenge in supplying Kwale from the dam due to the energy requirements for pumping the water. It is for this reason that among the major component is a water treatment plant, a storage tank and a collector pipeline linking to storage tanks. Along with this, there is a strong recommendation to have the Mzima Springs and other sources to be improved through a different project to supply the local water demand in order to release most of the proposed Mwache dam water to Mombasa. This option is being considered from a management level and involving a wide range of the stakeholders and communities involved.

2.5.2

Dam Description and Components

Location

The dam site is located across the Mwache River at the Fulugani village (Kwale County), about 22 km west of the city of Mombasa in the Coastal region of Kenya and near the coastline. The chosen location of Mwache Dam at Fulugani area is the most physically suitable for the following reasons;

- (i) Mwache River basin is the best choice since it is the largest basin and all other streams discharge into it. Kombeni river (earlier considered as an alternative) on the other hand is a lesser basin with smaller catchment and also with a much smaller storage capacity,
- (ii) The location is the lowest feasible point of Mwache River basin to capture the maximum surface runoff from an optimum catchment. The low rainfall patterns and the characteristic storm flows demands that as much of it is intercepted as possible,
- (iii) The location has a characteristic gorge suitable for safe and appreciable storage of water. The gorge running for about 5km upstream and about 75m deep backed up with firm banks on both sides is the single most important factor favoring the site. Upstream, the basin becomes shallower and increasing reducing storage capacity while downstream, the rivers get into the unfavorable interface with the sea.

Dam

The proposed dam is a concrete gravity dam with height of 77.9m-crest length of 425 m and with a reservoir capacity of 118 million m³.

Spillway

Spillway designed is an ungated ogee spillway centrally located. The crest of the spillway is kept at FRL (82.2 m). The length of the spillway is 194 m.

Diversion Works

The dam being concrete gravity dam, diversion of river water during construction will be the major issue. The detailed diversion has been explained in the dam design chapter.

Buffer Zone

The dam will also be provided with a tree buffer zone all around the inundated areas spanning at least 30m from the highest water level mark. This will be in compliance with the provisions of the Water Act 2002 and the Water Rules. The buffer zone, to be planted with indigenous trees and vegetation and an extension of Mwache Forest ecosystem, will provide protection to the water from surface runoff pollutants, siltation and also conserve water.

2.5.3 Water Use Options

The water obtained from the multipurpose dam has three major intended uses listed in order of priority;

- (i) Water supply for the local communities as well as augmentation of Mombasa water requirements. Both the local demand and Mombasa area and its surroundings are facing serious gaps that need to be closed from any available sources. Irrigation for food security and income generation of the local communities through a Small Scale Irrigation Schemes arrangement.
- (ii) Water requirement for irrigation purposes of an adjoining 100-ha pilot command area.
- (iii) Other economically viable opportunities including fishing, tourism activities, conservation initiatives. Related upstream opportunities would include sand harvesting from sand trap check dams provided under the project.

2.5.4 Water Supply

The Need

Demand for Mombasa and Kwale is far beyond the supply capacity of the existing systems. This situation has major implications on the industrial and commercial productivity and overall sanitation of both Counties especially in urban areas and the overall general public health. The coastal town being a major tourist destination for the country and the region is also highly affected by inadequate supply of water. This shortfall needs to be met through improving the existing water sources as well as integrating alternative sources. The proposed Mwache Dam is among such alternative sources. The dam is expected to supply 186,000 m³/day (67.9 MCM/year) for urban water supply (for Kwale and Mombasa County), as well as 20.4 MCM/year for irrigation in Kwale County.

Water Treatment Plant

A water treatment plant would be constructed as a part of the project consisting of the following:

- (i) Flocculants' chemical dosing of raw water for removal of suspended matter,
- (ii) Flocculation and sedimentation basins or tanks,
- (iii) Filtration units comprising of rapid sand filters,
- (iv) Disinfection comprising of chlorination and pH correction units,
- (v) Backwashing system for the filters (with collection of the wash water for re-treatment and use to avoid wastage)
- (vi) Treatment works buildings and associated accessories and support services.

After treatment the water will be transmitted to the existing / new tanks for supply to the three district of coastal area. Other components of the treatment plant will also comprise the following features;

- (i) Chemicals for water treatment (chlorine aluminum or other flocculants and soda Ash) will be stored in a masonry storehouse,
- (ii) Operators houses (pump attendants, chemical attendants, water operators and general labourers,
- (iii) Utility water reticulation for the treatment plant premises,
- (iv) Access roads and in-house walkways, parking lots and vehicles service bays,
- (v) Security arrangement and facilities,
- (vi) Sanitation (septic tanks and soak pits or small wetlands for in-house sewage,
- (vii) Appropriately designed drainage system,
- (viii) Safety aspects (in-house and external)

2.5.5

Water Transmission Pipeline

From the treatment plant, treated water will be transmitted through pipelines running along the current access roads towards the Mazeras – Kinango road to Mazeras Township and then run along the main highway towards Miritini and Jomvu areas.

While the pipeline will be confined within the road reserve, there are potential conflicts, especially between Miritini and Changamwe tanks. Among the conflicts include the following;

- (i) Small scale traders such as open air markets, food kiosks, motor garages, car wash and general vehicles parking on the potential pipeline routing,
- (ii) There are few cases of encroachments into the road reserve of temporary and permanent building structures including walls along where the pipeline would be expected to pass,
- (iii) Miritini – Jomvu sections is also characterized with truck parking along the road reserve where the pipeline would be expected to pass,
- (iv) Significant underground and above ground service lines are also found along the road reserve, particularly the Miritini – Jomvu section, the entire Airport

Road within Magongo areas. The services comprise among others power lines (underground cables and overhead lines), water pipelines, communication cables and open drains to mention a few.

- (v) Entrance passages into premises are also features for consideration while designing the pipeline.

Figure 4: Sample Features on the Transmission Pipeline Route to Changanwe Tanks



Overhead Power Line



Activities on a Section of Target Road Reserve



A section of the Target Road Reserve



Open Inspection chamber of current Pipeline

2.5.6

100 Ha Demonstration (Pilot) Irrigation Scheme

Component 1: Development of Irrigated Agriculture and Livestock

This component would combine the development of irrigation infrastructure (check dam #2, gravity water distribution system to 100 ha, and the on-farm irrigation system) with the initial implementation of the RAP, intensive training of farmers through participatory approaches, adaptive agricultural research introducing the new HVCs (with KARI support), a marketing study, the development of market linkages, strengthening of the irrigation service providers, formation, and capacity building for the irrigation water users' association (IWUA) as follows:

Irrigation infrastructure: The Demonstration (Pilot Irrigation) will include the construction of the Component 1 proposed check dam #2 of the designed Mwache Dam and the development of up to 100 ha of irrigation with gravity water. It would benefit up to 200 households for producing food crops for self-consumption as well as horticultural crops for the local and export markets. The component will start implementation in 2014 and would be completed and commissioned in early 2015, about 2 to 3 years before impoundment in the reservoir³. The pilot area would give priority to benefit the 167 households to be displaced by the dam, and selected farmers who could become lead farmers for training others, each on an average of 0.5 ha of irrigated land. Simple technologies including: dragline sprinklers, conventional hand-move sprinklers, hosepipe irrigation, bubbler irrigation, and drip irrigation will be tested with the proposed irrigated food and HVCs to be introduced, to demonstrate new practices and train farmers.

The principal component of the pilot project will be: (1) a 100 ha pilot irrigation scheme. The pilot will also include [the first phase of] accompanying measures for: (2) environmental management; (3) livelihoods improvement; and (4) project coordination and M&E. The pilot aims at identifying best intervention strategies for natural resource management and irrigation development, in preparation of the implementation of KWSCR-2 enhancing the impact of the project. The Pilot will advance the construction of the check dam #2 of Component 1, and initiate implementation of Components 2 and 3. With a water storage capacity of 1.2 million cubic meters (MCM) the check dam will allow starting irrigation activities about 3 years before the up to 2,000 additional ha will be made available.

Objectives: The MPIS would test:

- (a) The land tenure and use aspects of irrigation development in the area, including the options of a single irrigation block or the alternative of discrete irrigation blocks, and the mechanisms by which parcels may be reorganized within the irrigable area to achieve equitable distribution (of 0.5-1 hectare per household).

³ Detailed development of the main irrigation area, up to a total of 2 000 ha, would capitalize on the findings of the Pilot review by the end of 2017, after two full years of operation of the Pilot area.

- (b) The market for the high value crops (HVCs) that would have to be grown to recover the O&M costs of the infrastructure, and the profitability of irrigated farming
- (c) The irrigation technologies proposed (drip, sprinklers, *zai* planting pits) and hence the assumptions for overall irrigation efficiency that will determine the gross irrigation requirements and therefore how much land can be irrigated with the amount of water available from the dam. The pilot will also test the cost of water and the effectiveness of the institutional arrangements (management of water supply, WUAs, cost recovery etc.)
- (d) Farmers' ability to adapt to, and adopt the technology for the production of high quality, HVCs for the local and export markets, as well as their capacity to pay the full O&M costs through volumetric water tariffs. It will also pave the way for the early compensation of the farmers to be displaced by the reservoir by resettling them in the pilot area.

Cropping pattern, irrigation water requirements and maximum irrigable area

The irrigation water requirements and the gross quantities to be diverted for the irrigation component would be estimated at appraisal, and would be refined by testing under the Pilot Project.

It is assumed, for planning purposes, that the cropping pattern for the Pilot Project would typically consist of cereals, pulses and vegetables, all double-cropped, as well as a small area of perennial fruit trees, at an intensity of 180 percent. The use of simpler irrigation technology than that proposed in the Feasibility Report would result in a lower overall irrigation efficiency and therefore higher gross irrigation requirement. Again, for the purpose of planning, it is assumed that dragline sprinklers would replace the 'surface/sprinkler' combination referred to in the feasibility/design report and that hosepipe irrigation would replace drip. The overall irrigation efficiency for these two irrigation types, taking account of the relatively short distances involved in the water supply to field edge, may be assumed as 65 percent and 50 percent respectively.

Table 2: Indicative cropping pattern

| Season | Crop Type | Crop | Area (ha) |
|---|------------|------------|-----------|
| Long Rains | Cereals | Maize | 20 |
| | Pulses | Green Gram | 10 |
| | | Cowpeas | 10 |
| | Vegetables | Capsicum | 10 |
| | | Tomato | 10 |
| | | Watermelon | 10 |
| | | Amaranthus | 10 |
| Total Area Planted - Long Rains | | | 80 |
| Short Rains | Cereals | Maize | 20 |
| | Pulses | Green Gram | 10 |
| | | Cowpeas | 10 |
| | Vegetables | Capsicum | 10 |
| | | Tomato | 10 |
| | | Watermelon | 10 |
| | | Amaranthus | 10 |
| Total Area Planted - Short Rains | | | 80 |
| | Fruits | Banana | 10 |
| | | Mango | 10 |
| Total Area Planted to Perennial | | | 20 |
| Total Irrigable Area | | | 100 |
| Cropping Intensity (%): | | | 180 |

On this basis, using the data for net irrigation from the feasibility/design reports, the average gross irrigation requirement for 100 ha would be 14,400 m³ per ha per year, or 1.44 million m³ per year for the 100 ha. Assuming the review at the end of PY4 (2017) indicates that the Pilot Project and accompanying studies have provided favorable results, in terms of the need or otherwise for land reorganization, the market for high value crops, irrigation technology, and farmers' ability to adapt to it and produce high value crops, as well as pay the full O&M costs, the irrigable area would then be expanded.

If proven successful during the Pilot Project, the use of drip irrigation would also be scaled up to achieve higher overall irrigation efficiency. In this case, assuming an overall efficiency of 75 percent for drip, the gross irrigation requirements would be reduced to approximately 10,900 m³ per ha per year. On this basis for an upper limit of water availability of 20.4 million m³ per year the upper limit of expansion would be 1,870 ha. Should more water be available (as assumed in the feasibility/design reports) consideration could be given at the time of the 2017 review to expanding further.

Formation of and capacity building for irrigation farmers' organizations: Technical support for the formation of IWUA(s) and other farmers' organizations will help empower them to (a) operate and maintain the irrigation system and (b) contract with the market for improved access to agricultural inputs and to marketing of their products. Training would include 'training for transformation' (a form of civic education that prepares people for participation and includes topics such as 'how to

conduct meetings', leadership and so on), as well as the basics of business and contracts. Implementation of this and the following subcomponents would commence with development of irrigation and with the support of the on-going Kenya Coastal Development Project (KCDP) operating in the region.

Marketing and development of market linkages: This subcomponent would provide for a study of the potential local and export markets to absorb horticultural and livestock produce from the project, to be completed prior to the Pilot review at the end of 2017. It would also provide for promotion of market linkages between irrigation farmers and agribusinesses, including exporters (such as VEGPRO) and local processors (such as the Mariakani Dairy plant being recovered by CDA), to support a sustainable and inclusive agricultural production and the development of value chains, including efficient on-farm production and pertinent post-harvest infrastructure and equipment for adding value to the farm produce through adequate handling, packing, processing and marketing.

Strengthening Public Extension Service: In addition to the support provided through market linkages (e.g. through private sector partners such as VEGPRO), the Farmer Field School (FFS) approach will be adopted as a group-based, intensive and hands-on extension methodology. The FFS approach to learning ensures that the work is relevant to the needs of resource-poor farmers, enabling them to make their own decisions on best crop management practices that are within their means and environmental context. Some CDA, AD-CKG, KARI and other public extension service provider activities will be funded.

Establishment of a fund to provide seed capital for production: This would function as a revolving fund to be co-managed with farmers' organizations, will facilitate accessing inputs and services to 'kick-start' irrigated and livestock production⁴.

⁴ Kinango Constituency do not have any banking services. Kwale Teachers SACCO and Kenya Women Finance Trust are the only Micro-Finance Institutions in the county.

Figure 5: Sections of the Irrigation Command Areas



2.5.7 Other Benefits

Other benefits include the following;

- (i) Fishing activities in the reservoir for the local community groups is potentially a viable undertaking that may improve the income and food security of the community. This component, however, would require a detailed evaluation for quantified long term benefits in terms of water availability and capacity of the community to get organized in economically productive groups,
- (ii) The buffer zone of the dam that will be planted with vegetation include a forest cover will be an extension of the existing Mwache Forest housing in addition to biodiversity elements, is also home to Kaya Mswakara. This will not only present enhanced biodiversity conservation in the area but also provide climatic moderation for the immediate region,
- (iii) Tourism and recreation opportunities are also noted potential benefits to the communities directly through investments and indirectly through employment and supplies to related investments.

2.5.8 Water Supply and Sanitation Infrastructure

The objective of this sub component is to enable Kwale County to increase access to safe water service in urban and rural areas.

Urban water supply– Kwale population in urban centers is estimated to be in the order of 137,863 by the year 2013; of which 10% are estimated to have access to potable water services. According to its County Integrated Development Plan (CIDP), the objective of Kwale County is to increase coverage to 30% in its main urban areas by the year 2017. Doing so will imply that the county needs financial resources to improve water infrastructure to service an additional 30,227 people in the period 2014-2017. The project will contribute with financial resources for the preparation and implementation of an urban water rehabilitation and improvement project that will cover the additional urban population at an additional average cost of US\$546 per connection serving households of 5 persons. The costs include preparation and implementation of urban water supply subcomponent. Criteria for the selection of Urban Centers (or borrows within urban centers) will be decided upon discussions with Kwale County Officers.

Table 3: Kwale Urban Population in three main urban towns

| Town | 2009 | 2012 | 2013* | 2017* |
|-------------------------------------|----------------|----------------|----------------|----------------|
| Ukunda/Diani | 62,529 | 68,644 | 75,357 | 80,193 |
| Kwale | 28,252 | 31,015 | 34,048 | 36,233 |
| Kinango | 7,958 | 8,736 | 9,591 | 10,206 |
| Lunga | 3,670 | 4,029 | 4,423 | 4,707 |
| Msambweni | 11,985 | 13,157 | 14,444 | 15,371 |
| Total | 114,394 | 125,581 | 137,863 | 146,710 |
| With Access to water services | | | 13,786 | 44,013 |
| Additional people to achieve target | | | 30,227* | |

Source: Kwale County CIDP. Last two rows are estimates of consultants. * projected

Rural water supply– Population in rural areas in Kwale County is estimated to be 585,155 by the year 2013, of which only 1% has access to safe water. Rural population is expected to reach 667,053 by the year 2017, and Kwale County intends to increase access to safe water for 10% of the rural population. Doing so, will mean that an additional 60,854 in Kwale County will need to be provided with infrastructure for accessing to safe water. The main means for accessing to safe water in rural areas are boreholes, which in average can serve about 300 people. At an average cost of about US\$14,700 per borehole, that means that Kwale County will need about US\$ 3 million to be able to achieve its target of increasing access to safe water for about 60,000 additional persons during the period 2014-2017. Criteria for the selection and rural areas will be discussed with Kwale County officers.

Table 4: Rural Population and Access to Safe Water

| | 2013 | 2017* | Increment 2013-17* |
|----------------------|---------|---------|--------------------|
| Rural population | 585,155 | 667,053 | 81,898 |
| Access to safe water | 5,852 | 66,705 | 60,854 |

| | | | |
|--------------------------|----|-----|----|
| Access to safe water (%) | 1% | 10% | 9% |
|--------------------------|----|-----|----|

Source: Figures from Kwale CIDP and Coastal Water Master Plan, Final Design Report, August 2013.

Sanitation Infrastructure in Urban Areas– Communal sanitation facilities in critical spots of main urban centers will be financed, based on discussions with county officers in charge of sanitation affairs and urban development planning.

The exact locations, designs and scope of the water supply and sanitation infrastructure (urban and rural) are not yet fully known nor firmed since a feasibility study of the same has not been prepared. In this regard, for this component (water supply and sanitation), the Environmental and Social Management Framework (ESMF) and Resettlement Policy Framework (RPF) prepared for the Kenya Water Security and Climate Resilience Project (KWSCR 1) will be used to ensure that safeguard issues are incorporated during the project design. A detailed ESIA will be conducted for the water supply and sanitation component once the locations, designs, scope etc. of the project are known and submitted for approval by the Bank prior to construction.

2.7 Project Activities

2.7.1 Planning and Feasibility Studies

The dam project began with the concept development that involved desk and field assessment with a view to establishing the need for the project. A wide range of considerations including the capacity of the existing water sources to satisfy the demand, water demand trends and uses as well as social and economic linkages of water in the target area have been undertaken. This was achieved by the MEWNR as a reference for the feasibility study and has not been discussed further under this report.

Development of the concept was followed and like typical environmental scoping process, this study involved determination of the viability of the proposed dam project with respect to sustainability of water feed, environmental suitability, social acceptability and economical justifications. Preliminary physical surveys, measurements and social evaluations were carried out in conjunction with all stakeholders and in reference to all other social and economic initiatives in the project area. The feasibility report so produced was a fulfillment of the desires of the communities’ dream of water availability while the positive implications over-ride the negative impacts that would otherwise be mitigated through integrated measures during the dam construction and use of the water therefrom.

2.7.2 Design Work

While design work was mainly a desk activity, there are significant ground activities that took place. Topographical surveys, cadastral surveys, hydrological evaluations

and measurements, geological and soils tests and other environmental considerations are among the physical activities. The activities involve partial clearing of vegetation in some sections for clear way during surveys, intrusion onto private lands and excavations in some parts to determine geological profiles among others. Interactions with the stakeholders and local communities for first hand information particularly with respect to specific physical features, land ownership and desired design considerations was also undertaken during this stage.

The rest of the work was carried out at the desk level such as to include design calculations and drawings, consultations between various stakeholders and the client, design reporting and development of project costs estimates. Implementation schedules and responsibilities were also prepared under this stage. Environment and social impact assessment study utilized the design outputs, particularly at the preliminary stage, in determining quantified impacts and appropriate preventive action plans. The environmental management plan development was guided by the details of the design principles.

2.7.3 Construction Phase

Dam construction is the most notable phase due to the involved activities. This construction activity will cover the entire project area that will be inundated, water transmission pipelines and distribution storage tank sites. Among the significant features of the phase would include;

- (i) Displacement and resettlement of the residents in the affected area that will include among others demolition of the houses, removal of the building debris and relocation of the residents to alternative areas,
- (ii) Decommissioning of pollution point sources throughout the area proposed for inundation. Pollution point sources include pit latrines, septic tanks (where they exist), cattle pens, graves and any waste dumping sites,
- (iii) Vegetation clearing of the area covered including extraction of root zone and the removal of all dead plant matter away from the project area to suitable disposal areas,
- (iv) Excavations and earth moving as per the design including removal of spoils to the designated dumping locations. This will also overlap with vegetation removal and decommissioning of the point sources of pollution,
- (v) Construction of access roads, workmen camps, construction sites (workshops, offices, machinery yards, material sites, etc.), communication facilities, water storage facilities, etc.,
- (vi) Masonry works and erection of structural components at the various locations as per the designs.
- (vii) Rehabilitation works of the affected areas including deep excavations and material sites, re-vegetation of appropriate zones, polluted sites, etc.

2.7.4 Commissioning

This will be the formal hand-over and operationalization of the dam upon completion. Among other activities, the contractor and the client will ensure there are no unresolved social concerns, the facility has been completed to the design details, affected sites have been well rehabilitated and that all components are operational. In addition to the paper work, there will be a physical evaluation of the facility that will involve the contractor, MEWNR, relevant Government departments and the design consultant.

2.7.5 Dam Operations

The very initial stage of the dam operation will be to ensure it is relieving water from the catchment through the rivers and runoff during the rains. This could take up to one year during which there will be strict management of flows in the river to ensure dependants and ecosystems downstream are sustained. Upon the dam filling, the water will be utilized in accordance to established guidelines and regulations agreeable to the Water Act and other regulatory authorities. Long-term operation will also ensure environmental flows for downstream ecosystems.

2.8 Key Linkages

The design considerations with respect to environmental and social aspects are expected to include the following among others:

- (i) The water requirements and productivity of Mwache Creek and its ecosystem should be appreciated and appropriate average base flows retained from the dam. Accordingly minimum flow downstream of dam (ecological release) considering the present lean period discharge of the river is designed equivalent to 0.1 cumec and it account for 3.2 million cubic meter d/s release over a year. This is over and above the flood discharge.
- (ii) Productivity at the creek and associated ecosystem is partly determined by the level of nutrient received through silt deposition. The design should, therefore, consider limited discharge of silt into the creek at a rate based on the nutrient demand against average water quality. Project is designed in a way that the silt is being flushed out during the high flows which carries high dose of sediments containing nutrients from the catchment area.
- (iii) The aquatic life of Mwache River, especially when flowing with water is likely to be disrupted, particularly with respect to fish movement beyond the dam site during floods (it is noted that the movement is hampered by the seasonal nature of the river).
- (iv) The geological profile comprises of non-solid rock that has potential to lose water through seepage effectively potential loss of resources. It would also be in the design interest to prevent such a scenario,

- (v) In order to provide a semblance of the existing ecological features along Mwache River, the design should provide a minimum of 30m buffer zone around the reservoir. This will enable not only protection of the dam water but also provide an important biodiversity belt around the dam,
- (vi) At the social level, the design of the dam would be expected to consider the water requirements of the local residents even as the resource benefits other areas such as Mombasa City. Water abstraction points or a water supply, areas for watering livestock and other physical needs associated with water will need to be considered in the design,
- (vii) While recognizing that some residents will be displaced, the design option should ensure minimal social disruption including homesteads and institutions as well as social amenities,

2.9 Decommissioning Phase

The decommissioning of the project could be viewed in three stages comprising of the immediate (after completion of construction), maintenance and expansions (during operations) and ultimate removal. In each case the responsibility will lie with the then operator and MEWNR. Decommissioning will take the following forms;

Construction Installations

Upon completion of the project, the contractor will need to remove the construction structures including workers campsites (offices, stores and associated sanitation facilities), equipment parking camps and workmen camps. The material sites will also need to be decommissioned and rehabilitated (quarry, sites and gravel borrow pits) back to near original status. The sites are not known at the time of this study and the decommissioning plans will be dependent on the physical locations. Note that should any of the installations be found useful to the community (e.g. offices), they may be retained for public use such as health centers or other functions).

Removal/Modification of Dam Components

During operation, it might be necessary to remove parts of the project or modify certain components. Among such components would include the spillway, intake diversions, water treatment plant, pipeline (raising mains) and the storage tank area. Other additional components would be defined for removal or modification.

Dam Decommissioning

After the project life span, decommissioning of the dam may be required. It is suggested that a comprehensive decommissioning audit is undertaken to provide an implementable decommissioning plan at appropriate time.

2.10 Project Estimated Cost and Implementation Schedule

Table 5 : Total project cost and pilot project cost

| Component | Total cost (USD) M |
|---|--------------------|
| Dam | 170.0 |
| Irrigation | 28.3 |
| Livelihoods | 3.6 |
| Water resources management and watershed management | 3.4 |
| PIU | 3.5 |
| Total | 208.8 Million USD |

2.11 Analysis of Alternative

The ESIA considered specific design alternatives including alternative **water supply options, potential dam sites, alternative dam types (mixed RCC and rock fill is referred from a technical perspective)**, irrigation types, as well as **No Project Option**; as well as alternative **dam site options**, which were considered at two levels. The rationale for selection of Mwache Dam as an option (most viable) for water supply to Mombasa and Kwale Counties was based on cost implication of other potential options, availability of adequate water quantities and environmental considerations among others.

Alternative Water Supply Options For Mombasa and Kwale Counties

The Water Supply Master Plan for Mombasa and Other Towns within the coastal region, prepared under the Water and Sanitation Service Improvement Project (WaSSIP), evaluated five scenarios for meeting the water demands of Mombasa and the coastal region. These scenarios included different combinations, and phasing, of potential sources of water, including well fields, springs, aquifers and dams. A multi-criteria analysis consisting of four parameters (engineering, economics, environmental and social aspects, and political economy) was used to evaluate these scenarios. The scenario selected (Scenario "B1") has advantages from an economic, environmental and engineering point of view, and includes the priority development of Mwache Dam. Ultimately, the dam is expected to provide 186,000 m³/day (67.9 MCM/year)⁵ for urban water supply to Mombasa County and Kwale County. Below, is a description of the other water supply options that were reviewed and rejected.

⁵ An additional potential supply of 55,700 m³/day (about 20 MCM/year) will be available from the dam. Based on the results from the 100 ha demonstration (pilot) scheme, the economic and financial viability of full development of the proposed irrigation scheme (currently estimated at 2,000 to 3,000 ha) in the project area will be assessed after two full years of operation in the demonstration area (i.e. by early 2018). This will, in turn, allow the GoK to make a decision on how best to allocate the additional supply of water available from the dam.

Baricho System

The Baricho Waterworks, located in Kilifi County, consists of eight boreholes with an approximate total potential yield of 83,000 m³/d (8 BH of 470 m³/h, with 22 h/d). The Baricho Waterworks abstract water from the Sabaki Aquifer, which is composed of the old Baricho River Channel (palaeochannel), underlying the present riverbed. This aquifer is mainly recharged from the Baricho River. In fact, the close location of the boreholes (dedifferentiated into two groups, 5 and 3) to the bank of the river makes the palaeochannel act as a filter prior to the BH pumps.

There are eight boreholes, which are equipped with KSB electro-submersible pumps rated at 470 m³/h. Total borehole production capacity (for 24 hour operation per day) is therefore about 90,240 m³/d (for 22 h/d, 82,720 m³/d). However, according to the Monthly Report for Baricho for December 2012, the average production per day for the period August 2012 to December 2012 was only 68,046 m³/d, corresponding to an average of 17 h/d of operation for each borehole. The borehole water is pumped to a 2,000 m³ contact tank at the site, where the water is chlorinated. After chlorination, the water flows into an attached 3,000 m³ balancing tank. From the balancing tank, the water flows to a water sump, with a capacity of 3,000 m³, from which the water is pumped directly to the District of Malindi in the Kilifi County, by a HLPS, equipped with three deep-well turbine pumps, only two of which are duty pumps running at 583 m³/h, or at about 28,000 m³/d. The city of Kilifi receives its supply today from the Sabaki pipeline as well (i.e., part of the 53,000 m³/d). This conveyance to Mombasa can increase to 65,000 m³/d, if the well field operational hours are increased. This 65,000 m³/d is also approaching the carrying capacity of the existing 800 mm pipeline (installed in 1982).

Therefore, any further transmission of water to Mombasa from this source would have to include not only additional boreholes and expansion of the HLPS, but also a new water conveyance system hence does not make it an ideal option.

For Kilifi County, Malindi and the other smaller townships, the current supply, via a 600 mm pipeline, is about 15,000 m³/d (today, two pumps can deliver some 583 m³/h x 2 = 1,150 m³/h). The conveyance to this group of towns can increase to 30,000 m³/d, if the well field operational hours are increased (equal to some 1,500 m³/h). Thus, this transmission pipeline to Kilifi County is capable of conveying even larger quantities (under good hydraulic conditions).

In summary, the Baricho is not a viable and immediate alternative for water supply in the near term to Mombasa and Kwale Counties because the conveyance system from Baricho to Mombasa is approaching the carrying capacity of the existing pipeline (800 mm 95 km 600 mm 12 km); thus, any further transmission of water to Mombasa from this source will have to include additional boreholes, expansion of the high-lift pumping station (HLPS) and a new water conveyance system. Operation of the Sabaki pipeline is costly since the water is pumped to a 24 bar pressure.

Mzima System

The Mzima Springs are located in Taita Taveta County, southwest of the Chyulu Hills in Tsavo National Park. The Mzima Springs outflow is a consequence of rainfall on the Chyulu Hills and percolating recharge over and through the volcanic mass overlaying the Chyulu Hills bedrock floor. The spring water flows through three large pools (Hippo, Long and Chalk Beach pools) before discharging to the Mzima River some 4 km upstream of its junction with the Tsavo River. Spring outflows have been measured at the Mzima River since 1951. Changes of flow are slow from month to month, with the variation over any 12-month period about 1 m³/s. The response-time between rainfall on the Chyulu Hills and outflow at Mzima is 3–4 years. Therefore, it is possible to predict spring flows in advance, with relative accuracy.

Construction of the existing headworks (named Mzima 1) was completed in 1956. The intake consists of a 672 m long subsurface weir, consisting of a sheet pile cutoff wall upstream of the Hippo Pool, having an elevation of 684.58 masl at the top. The sheet pile is emplaced at depth within the regolith loams for the full cross-section of the saturated lava; the regolith loams are regarded as having negligible permeability. The weir is connected with an upstream trench to divert the groundwater to a collection chamber. Approximately 1.1 m³/s gravitates from this intake to an overflow chamber located some 850 m from the head of the Long Pool, or some 1,300 m from the Collection Chamber. At the overflow chamber some 0.7 m³/s is returned to the Mzima River System, and about 0.4 m³/s is diverted to the Sabaki-Mombasa Pipeline. Excess water from the Mzima Springs flows over the top of the cutoff wall and discharges to the Hippo Pool and to the upper end of the Long Pool.

As it stands now, the total water released from the Mzima Springs to the Mzima River System is = {(the flow over the weir) + 0.7 m³/s}. Therefore, the minimum amount released to the River system is {(2.6 – 1.1) + 0.7} = 2.2 m³/s, where 2.6 is the minimum spring outflow. This is well in excess of the 1.4–1.6 m³/s, which is the Minimum Allowable Environmental Discharge. Analysis of the flow through the headworks and pipe interception trench, upstream of the sheet pile cutoff wall, indicates that the present headworks might sustain the additional abstraction required, as indicated below. The total water abstracted from the Mzima Springs reaches Mombasa by gravity. The total distance along the pipeline route from the springs' intake to the Mazeras reservoirs is 218.5 km, of which the headworks transmission line, consisting of pipelines and tunnels, is only some 3km long.

According to documents recently presented to CWSB (Preparation of Investment Plan & Associated Feasibility Studies Feasibility studies/Identification of institutional support, BRL Ingenierie/GIBB Africa Ltd 2008), the current flow rate is limited by the capacity of the Mzima Pipeline. With the hydraulic study made along the pipe, it was found that there is a bottleneck that limits the conveyance to only some 35,000 m³/d. According to this study, only some 70% of the total potential daily volume from the pipeline reaches the Mazeras Water Tanks, as the rest of the water is either lost, leakage or consumed by upstream consumers. The available supply to Mombasa

has been declining over time due to the rise in demand in the upstream towns. Most of these demands are not metered, so it is impossible to evaluate this water abstraction and its trend. Current plans by the Taveta-Voi Water and Sewerage Company (TAVEVO) to abstract an additional 2,500 m³/d of water from the Mzima Pipeline will further worsen the situation in Mombasa.

The age of the Mzima transmission pipeline should be considered; the pipeline was laid in the late 1950s and it is about 60 years old at present. The pipeline is of a locally manufactured pre-stressed concrete gravity pipeline and ranges in diameter from 30" (upstream) to 21" (downstream) (i.e., from DN 760 to DN 530). The total distance along the pipeline route is 215 km. Together with the 3 km source works tunnel, the distance along the pipeline to Mazeras reservoirs is 218 km; half of the pipeline is laid within the Tsavo National Park.

With the consideration of the Mzima 2 Pipeline as part of the development plan, it was assumed that the current Mzima Pipeline will not be able deliver water after the year 2025 (at that time, the pipe age will be 65 years). It was assumed that the new Mzima 2 Pipeline will be constructed to meet the full daily abstraction from the spring.

The WSMP calls for the increase of the supply to Mombasa from Mzima Springs from the present 0.4 m³/s (34,560 m³/d) to 105,000 m³/d (1.22 m³/s) starting from year 2030. By 2030, the current pipe will be over 65 years old and will have passed its useful and efficient lifespan. This calls for laying of a new pipeline (Mzima 2). The new Mzima pipeline will have to deliver the total required daily volume of 105,000 m³/d.

For such an increase in supply the existing 1,300 m, 30" (762 mm) pipeline, between the intake and the overflow chamber, will have to be replaced as well with a new 48" (1,219 mm) pipeline. This replacement will allow the capacity of the Mzima Waterworks to increase to 1.5 m³/s, well above the 1.22 m³/s supply required by the plan, and will leave an additional 0.28 m³/s to be released from the overflow chamber to the Mzima River System. The total proposed water abstraction from the Mzima Pipeline to the downstream consumers, with a total daily volume of 105,000 m³/d (an additional 70,000 m³/d) requires full coordination with the WRMA of the Athi River Authority so the CWSB water allocation will be approved.

The new Mzima 2 Pipeline will serve, in addition to the city of Mombasa also the townships of Voi, Mwatate and Wudanyi. Additional water consumers along the Mzima pipeline will consume some 35,000 m³/d (including Mariakani), allowing the city of Mombasa to enjoy some 54,000 m³/d from the Mzima spring. By 2030, the Mzima Pipeline will be over 65 years old and will have passed its useful and efficient lifespan. This calls for laying of a new pipeline (Mzima 2). The total water abstracted from the Mzima Springs reaches Mombasa by an 800 mm concrete gravity pipeline. The total distance along the pipeline route from the springs' intake to the Mazeras reservoirs is 218.5 km, of which the headworks transmission line, consisting of

pipelines and tunnels, is only some 3km long. This resource is shared by several towns along the pipeline, in Taita Taveta County (At present, only the town of Voi is connected to the BWSS from the Mzima Pipeline), Kilifi and Mombasa Counties. While it has a mean sustainable flow of 3.5 m³/s, the current rate of abstraction is only about 0.4 m³/s. This flow rate is limited by the capacity of the Mzima Pipeline. The available supply to Mombasa has been declining over time due to the rise in demand in the upstream towns as well as leaks and bursts along the pipeline. This makes the Mzima springs an option that is not viable due to the demand it has to supply water to other areas and the costs involved.

Marere Springs

Marere Springs is located in the foot of the Shimba Hills Game Reserve in Kwale County. While the daily yield from these springs is 12,000 m³, only 8,000 m³/d is currently abstracted. Both Kwale and Mombasa Counties share the resource. Some of the water is pumped from the pipe to the local supply system of Kwale District (to a local water tank). The current abstraction is limited due to the connecting 425 mm gravity pipeline, which limits the flow to about 350 m³/h. Under the WaSSIP project, some segments of the pipeline, as well as the intake structure near the springs, are to be replaced and repaired. The available supply to Mombasa has been declining over time due to a rise in demand in Kwale County and thus Marere is not a viable option.

Tiwi and Msambweni Well fields (Coastal Aquifer)

The Tiwi Aquifer (known also as the Coastal Aquifer) is located in Kwale County, between the Ukunda and Ngombeni areas. There are 12 boreholes in the well fields, with a total production of approximately 10,000–12,000 m³/d. According to the Water Resources Report prepared by the Consultant, the groundwater potential determined for the aquifer in the Tiwi and Msambweni areas are approximately 20,000 m³/d (7.5 MCM) and 30,000 m³/d (11 MCM), respectively. The analysis indicates that additional well fields may be developed south of Msambweni. However, in order to sustain the proposed yield of the two aquifers, a more detailed groundwater demand study is required. Such a study should be based on a monitoring plan that will serve as the basis for the analysis. It should be noted that much of this potential in the Msambweni area is not utilized today because of the presence of the titanium mine in the area. The water from the Msambweni Well field will be incorporated in the BWSS only towards the horizon year (2035), when the mining activities will be finished.

Both Kwale and Mombasa counties share the Tiwi Aquifer. Some of the water is diverted to the Tiwi area and Diani Beach, while the rest flows to the Likoni neighborhood of Mombasa. The Tiwi Well field is under massive rehabilitation activities at present, as part of the WaSSIP project. Within this framework, a renewal of all current equipment is being carried out, including the drilling of several new boreholes. These boreholes are located close to the current ones, within the same yard. The average flow of each borehole in this field is around 35–40 m³/h, and the

total abstraction is about 8,000 m³/d.

The Tiwi Well field is divided into two groups of boreholes, as follows:

- The southern group, supplying water through the Magodzani Water Tank, in which most of the water goes to the local villages, the Tiwi area and Diani Beach
- The northern group, supplying water through the Kaya Bombo Water Tank, in which most of the water is conducted to Mombasa via a 250 mm pipeline. It should be emphasized that this 250 mm pipeline supplies water up to Likoni District only.

The available water supply to Mombasa has been declining over time due to the rise in water demand in Kwale County, mostly due to the rapid development of the hotel industry in the Diani and Tiwi beach areas.

Mkurumudzi Dam

The Mkurumudzi River originates in the Shimba Hills Hills and flows southeast to the Indian Ocean. It drains a catchment area of about 200 km², and recharges the Coastal Aquifer in the Mesambweni area. The purpose of the Mkurumudzi Dam, which is being built on the Mkurumudzi River, is to supply water for the new titanium mine owned by the Australian company Base Titanium. The quantity of titanium in the mine is assumed to suffice for 15 years of mining operations. During this period, the water from the Coastal Aquifer in the Mesambweni area and from the Mkurumudzi Dam will not be available for water supply to other consumers in the area.

Alternative Analysis of Dam Site and Axis

The design consultants compared three dam axis options and adopted the downstream axis due to favourable topography. Taking into account the topography and the geological conditions, the DSPE believes that the dam site selected does not have any “fatal flaws” such as faults, seismic risk, reservoir leakage or reservoir slope instability.

- Location – Based on reconnaissance visits, detailed topographical survey and geological investigations of the project area, the dam site located near village Fulugani at latitude 3°59'12" S and longitude 39°31'07"E is found to be the best site amongst all the possible sites identified on river Mwache. In this context, it may be mentioned that no suitable dam site could be identified in the upper reaches of Mwache River, since the banks there are found to be very flat.
- The proposed dam site falls in a straight stretch of the river, located inside a deep gorge. The right bank is stiffer than the left bank. The riverbed and right bank along dam axis are having exposed jointed hard sandstone. The left bank rock is generally masked with terrace deposits. The actual depth of the loose material has been ascertained during geological exploration was found to be of very shallow depth, as appended in the relevant drawings of this report.

- Type of dam and spillway – Considering topography, geological condition, availability of construction materials and cost criteria, a straight concrete gravity dam with central ogee spillway has been proposed. The alternative of proposing a rock fill dam was studied. It was observed that since the gorge is very narrow, diversion tunnels were required to divert the flood during construction period, if a rock fill dam is constructed, whereas the flood can be allowed to pass over the unfinished dam body, in the case of a concrete dam, Hence the choice was for constructing a concrete dam as constructing tunnels for diverting flood water during construction period is time taking and costly.
- The full reservoir level of the dam is fixed at El 82.2m with capacity 118.7 Million cum which is found to be optimum considering water availability and sediment management strategy by constructing three check dams in the catchment.

Three dam locations suggested by previous consultant (M/S Samez) were considered. All three alternative dam options are located within a reach of about 1 Km south of Mazeras Township. Physiographically, the area exhibits an undulating topography forming a plateau through which river Mwache flows, making sharp turns deeply incising into the bedrock.

Geologically, the three dam locations studied in the past and reconnoitered during the present study are located in similar geological terrain, exposing older sandstones and laminated by splintery shale alternations in the river bed overlain by younger fine grained, light grey sub-horizontally bedded sandstones in the higher reaches of the hill slopes. The merits and demerits of the three dam options are mainly related to the site conditions and topography rather than geology. These are discussed below:

Alternative 1: Lower Site A. It is located in the narrowest section of the river gorge where the river flows through a straight course downstream. The dam alignment is perpendicular to the flow direction of the river. A channel spillway is envisaged on the left bank of the dam by cutting the NE-SW trending ridge at its narrowest section and allowing the spill water to follow a ESE – WNW trending dry stream draining into Mwache river. Thus, a river bed spillway may be avoided. This site would afford maximum storage capacity and submergence / loss of private property and biomass per cubic meter of water stored is found lowest at this site.

Alternative 2: Middle Site B. Though the dam is located in a straight course of the river, the alignment itself is askew to the flow direction, which is not desirable. On either side of this alignment, the river makes two sharp bends. This site will provide a lower storage capacity than the lower site A as it excludes a sub-catchment of a tributary joining Mwache river on its right bank upstream of lower site. Here also a channel spillway may be considered as an alternative to river bed spillway. Submergence / loss of private property and biomass per cubic meter of water stored at this site is found higher than Lower Site A.

Alternative 3: Upper Site C. The upper site is located just downstream of the confluence of a tributary stream with Mwache river. The alignment at this site is also askew to the river flow direction – an undesirable situation. There is a problem in locating the spillway at this site as the river makes a U-shaped bend downstream of the conceived dam alignment. This site will also provide less storage capacity than the lower site. Submergence / loss of private property and biomass per cubic meter of water stored at this site is found higher than Lower Site A.

Site Selection Principles and ES Constraints

To support the evaluation of alternatives for the Mwache Dam Project, environmental and social principles were identified to guide the technical design and act as criteria for evaluating and decision making on alternatives.

Environmental and social site selection principles for the dam

| Theme | Description |
|--|--|
| Resettlement, ecology, greenhouse gases | Keep the reservoir surface area as small as possible (relative water stored) |
| Resettlement | To the extent possible, avoid involuntary resettlement of communities and restriction of access to natural resources and means of livelihood, through careful siting of the dam and consideration of the extent of the reservoir which is likely to cause the most impacts |
| Indigenous peoples | Avoid altogether, if possible, areas inhabited by indigenous peoples |
| Ecology/ biodiversity, cultural heritage | Avoid altogether, if possible, the major areas of highest amenity value namely internationally and nationally recognized conservation sites, critical natural habitats and endemic species, and known archaeological sites or sites of cultural significance |
| Water quality | Reduce the mean water retention time during normal operation as far as possible. This is the number of days it takes for a complete exchange of water in the reservoir. |
| Ecology, greenhouse gases, water quality | Minimize flooding of forests with high biomass content, even if they are cleared before reservoir filling. |
| Ecology | Minimize the length of river (main stem plus tributaries) impounded by the even if they are cleared before reservoir filling. Minimize the length of river (main stem plus tributaries) reservoir (measured during high flow periods) |
| Ecology, livelihoods, water, resources, health, safety | Minimize the length of 'dry' river |

| | |
|--|--|
| Ecology/ biodiversity | Maximize the number of upstream-undammed tributaries. |
| Ecology, livelihoods, water quality | Site dams on upper tributaries if possible as this is often the most environmentally benign option; this should be tested on a case by case basis |
| General | Maximize the useful life of the reservoir. In general, reservoirs with the longest useful life are relatively deep and situated on rivers with low sediment loads. |
| Livelihoods, water resources, health, safety | Choose sites where impacts on downstream water users are least when compared with power output |
| Livelihoods and wellbeing | Avoid impairment of navigation |
| Social, safety | Minimize effects of new infrastructure on communities by having particular regard to safety, noise and construction traffic. |

Second level of Alternative Analysis – Dam Type

In light of the above, Lower Site A is considered as the optimal site. Therefore, Lower Site A was considered for two options:

Option 1: Rock Fill Dam.

Option 2: Concrete Dam

Comparison of the environmental and social aspects of these two options are summarized below:

| Concrete Dam | Rock Fill Dam |
|---|---|
| Required volume of natural resources for dam construction material is less | Required volume of natural resources for dam construction material is more as compared to concrete dam |
| All the raw material will be available within a radius of 25 km. | Adequate quantity of rock fill material is to be transported from far off places that will require more energy resources (petroleum). |
| Carbon Emission to carry out the construction material is estimated to be less for concrete dam construction. | Carbon Emission to carry out the construction material is estimated to be more as compared to concrete dam option |
| Area to be rehabilitation for quarry site is less | Area to be rehabilitation for quarry site is more as compared to concrete dam |
| Environmental and social risk related to flood overtopping is more | Environmental and social safety out of flood overtopping is less as compared to concrete dam |
| Possibility of expanding the dam | Possibility of expanding the dam height and |

| Concrete Dam | Rock Fill Dam |
|--|--|
| height and storing more water for ecological releases in future are more | storing more water for ecological releases in future are more |
| Loss of biodiversity due to quarry site is less | Loss of biodiversity due to large area of quarry site is more as compared to concrete dam. |

In light of the above advantages of concrete dam over rock fill dam, the concrete dam has been chosen as best alternative and project has been designed for concrete dam.

Alternative Dam Type

- Four type of dams were considered namely:
- Rockfill Dam with a Clay Core;
- Roller Compacted Concrete (RCC) Dam;
- Concrete Face Rockfill dam (CFRD) and
- Conventional Concrete Gravity (CCG) dam

The CCG dam was selected while the rockfill, CFRD and RCC dams were discarded largely based on non - availability of the appropriate construction materials. The Design consultants ruled out the RCC because of a lack of fly ash or natural pozzolans in Kenya, and because of a perceived need for specialized labour to construct the dam. However, the DSPE recommended that RCC should be carefully considered for construction of the Mwache gravity dam, as it could significantly reduce the time required to construct the dam.

Irrigation Options

Based on the area elevation, the pilot irrigation system can be gravity irrigated given current design parameters. For the pilot, two irrigation strategies have recently been considered and one discarded i.e. pumping water for irrigation from the dam (higher infrastructure cost). Irrigation through gravity using water from the check dams is the preferred option for the 100 Ha pilot irrigation.

The Irrigation and Drainage Infrastructure works would allow taking water from the check dam # 1 of the Mwache Dam - Mwache Dam and Related Investments through headworks (diversion weir, intake structure and connecting channel); emergency spill weir and cross regulator, sand trap and head regulator, main canal; secondary canals and tertiary canals/field canals; drainage canals; related irrigation and drainage structures; on-farm development works; and farm roads along the main, secondary and tertiary canals.

No Project Option

Kwale and Mombasa Counties is provided water from four sources including Baricho Water Works in Malindi District providing 47,000 m³ /day), Mzima Springs (providing 35,000m³/day, Marere river (bringing in 6,900³ per day) and Tiwi boreholes

(producing 3,900³ per day). The sources provide only 35% of the total water demand of the city. The total demand for Mombasa City is estimated about 206,000m³ per day but only 92,800m³ per day is available). There is also significant unaccounted for water (ufW) arising from poor integrity of the distribution network, illegal connections and poor tracking of accessibility. There is, therefore, a strong need to supplement the available water to meet the demand. The community at the project area relies on the limited connections from the Mzima Springs pipeline to a few communal water points that is hardly enough to meet their requirements. It is hoped that the proposed project will be able to supply water to residents of Kwale County and further supplement the water supply into Mombasa County.

The 'base case' or 'no Project' is an alternative. If the Project is not developed, in order to meet demands, water could still be generated locally by alternative sources. However the economies of scale and integration achievable through the multipurpose Project could not be realised. There would be no basis for the proposed value addition initiatives of fisheries and community tourism development.

On the contrary, the no Project alternative would avoid the typical adverse impacts associated with large scale multipurpose dam projects in pristine rural contexts: long term changes to river hydrology; habitat and biodiversity loss; physical and economic displacement of communities and risk of community health hazards; risk of dam safety and related hazards. A no Project option would mean that the status quo and impacts associated with inadequate water supply for both Counties continue to be manifested.

CHAPTER 3: POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

3.1 An Overview

Environmental Impact Assessment is a tool for ensuring new projects and programmes incorporate appropriate measures to mitigate adverse impacts to the environment and peoples' health and safety as well as enhancing sustainable operations with respect to environmental resources and co-existence with other socio-economic activities in their neighborhood. Recent GOK efforts aimed at formulating a clear policy strategy has culminated in the enactment of a new legislation on water management. The Water Act 2002 is aimed at harmonizing and streamlining the management of water resources, water supply and sanitation services. Necessary policies and legislation that ensures annual environmental audits (EA) are carried out on every running project, activity or programme and a report submitted to National Environmental Management Authority (NEMA) for approval and issuance of relevant certificates.

According to the Kenya National Environment Action Plan (NEAP, 1994) the Government recognized the negative impacts on ecosystems emanating from industrial, economic and social development programmes that disregarded environmental sustainability. Following on this, establishment of appropriate policies and legal guidelines as well as harmonization of the existing ones have been accomplished and/or are in the process of development. The NEAP process introduced environmental assessments in the country with among the key stakeholders being industrialists, business community and local authorities. This culminated into the development of the Policy on Environment and Development under the Sessional Paper No. 6 of 1999.

3.2 Policy Provisions

3.2.1 Constitution of Kenya

Article 42 of the Bill of Rights of the Kenyan Constitution provides that 'every Kenyan has the right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative and other measures'. Under Chapter 5 (land and Environment), Part 1 is devoted to land. It requires that land be used and managed in 'a manner that is equitable, efficient, productive and sustainable, and in accordance with the following principles;

- (i) Equitable access to land
- (ii) Security of land rights
- (iii) Sustainable and productive management of land resources
- (iv) Transparent and cost effective administration of land
- (v) Sound conservation and protection of ecologically sensitive areas

Part 2 of Chapter 5 of the constitution is dedicated to Environment and Natural Resources. Article 69 in Part 2 provides that the state shall;

- (i) Ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits
- (ii) Work to achieve and maintain tree cover of at least ten per cent of the land area of Kenya
- (iii) Encourage public participation in the management of, protection and conservation of the environment
- (iv) Protect genetic resources and biological diversity
- (v) Establish systems of environmental impact assessment, environmental audit and monitoring of the environment
- (vi) Eliminate processes and activities that are likely to endanger the environment
- (vii) Utilize the environment and natural resources for the benefit of the people of Kenya

Further, Article 70 states that if a person alleges that a right to a clean and healthy environment recognized and protected under Article 42 has been, is being or is likely to be, denied, violated, infringed or threatened, the person may apply to a court for redress. The sub-project should ensure compliance with the constitution in so far as equitable sharing of the resources, between the stakeholders. Further, the project should ensure the sustainability of livelihoods and biological resources within the project areas are protected. Any development proposals should also be cognizant of the increased powers under the Constitution given to communities and individuals to enforce their rights through legal redress

3.2.2 The Kenya Vision 2030

Kenya Vision 2030 is the current national development blueprint for period 2008 to 2030 and was developed following on the successful implementation of the Economic Recovery Strategy for Wealth and Employment Creation which saw the country's economy back on the path to rapid growth since 2002. GDP growth rose from 0.6% to 7% in 2007, but dropped to between 1.7% and 1.8% in 2008 and 2009 respectively. The objective of the vision 2030 is to transform Kenya into a middle income country with a consistent annual growth of 10 % by the year 2030". The 2030 goal for urban areas is to achieve "a well-housed population living in an environmentally-secure urban environment." This will be achieved by bringing basic infrastructure and services namely roads, street lights, water and sanitation facilities, storm water drains, footpaths, and others.

One of the aims of the vision is to make Kenya to be a nation that has a clean, secure and sustainable environment by 2030. This will be achieved through promoting environmental conservation to better support the economic pillar.

Improving pollution and waste management through the application of the right economic incentives in development initiatives is critical. The current land use practices in the country are incongruent with the ecological zones. For instance, large portions of land in high potential areas have been subdivided into uneconomic parcels, while some parts of land in the medium and low potential areas are rapidly being converted into agriculture, despite the fragile environment they are located in.

3.2.3 National Environment Action Plan (NEAP)

According to the Kenya National Environment Action Plan (NEAP, 1994) the Government recognized the negative impacts on ecosystems emanating from economic and social development programmes that disregarded environmental sustainability. In this regard, establishment of appropriate policies and legal guidelines as well as harmonization of the existing ones have been accomplished and/or are in the process of development. Under the NEAP process, EIA was introduced and among the key participants identified were the District Development Committees.

3.2.4 National Policy on Water Resources Management and Development

The National Policy on Water Resources Management and Development (Sessional Paper No. 1 of 1999) was established with an objective to preserve, conserve and protect available water resources and allocate it in a sustainable rational and economic way. It also desires to supply water of good quality and in sufficient quantities to meet the various water needs while ensuring safe disposal of wastewater and environmental protection. The policy focuses on streamlining provision of water for domestic use, agriculture, livestock development and industrial utilization with a view to realizing the goals of the Millennium Development Goals (MDGs) as well as Vision 2030. To achieve these goals, water supply (through increased household connections and developing other sources) and improved sanitation is required in addition to interventions in capacity building and institutional reforms

While the National Policy on Water Resources Management and Development (1999) enhances a systematic development of water facilities in all sectors for promotion of the country's socio-economic progress, it also recognizes the by-products of this process as waste water. It, therefore, calls for development of appropriate sanitation systems to protect people's health and water resources from institutional pollution. Development projects, therefore, should be accompanied by corresponding waste management systems to handle the waste water and other waste emanating there from. The same policy requires that such projects should also undergo comprehensive EIAs that will provide suitable measures to be taken to ensure environmental resources and people's health in the immediate neighborhood and further downstream are not negatively impacted by the emissions.

In addition, the policy provides for charging levies on waste water on quantity and

quality (similar to polluter-pays-principle) in which case those contaminating water are required to meet the appropriate cost on remediation, though the necessary mechanisms for the implementation of this principle have not been fully established under the relevant Acts. However, the policy provides for establishment of standards to protect the water bodies receiving wastewater, a process that is ongoing.

3.2.5 Sessional Paper No. 6 of 1999 on Environment and Sustainable Development

Among the key objectives of the Sessional Paper No. 6 of 1999 on Environment and Sustainable Development (1993) are;

- (i) To ensure that from the onset, all development policies, programmes and projects take environmental considerations into account,
- (ii) To ensure that an independent environmental impact assessment (EIA) report is prepared for any development before implementation,
- (iii) To ensure that effluent treatment standards which will conform to acceptable health standards?

Under this paper, broad categories of development issues have been covered that require sustainable approach. These issues include the waste management and human settlement sectors. The policy recommends the need for enhanced re-use/recycling of residues including wastewater and increased public awareness raising and appreciation of clean environment as well as the participation of stakeholders in the management of wastes within their localities. Regarding human settlement, the paper encourages better planning in both rural and urban areas and provision of basic needs such as water, drainage and waste disposal facilities among others for decent housing of every family.

3.2.6 The Agricultural Policy

In Kenya the agricultural policy revolves around key areas of policy concern including increasing agricultural productivity, especially for small-holder farmers, emphasis on irrigation, encourage diversification into non-traditional agriculture commodities, enhancing food security, encourage private sector led development and ensure environmental sustainability.

The policy observes that droughts and floods have increased in frequency and intensity in the past three decades resulting in high crop failure and livestock death. Increased land degradation has decreased land resilience thereby exacerbating the effects of drought and floods leading to devastating famine that has taken a toll on human and animal lives. Some of the famine experienced could have been avoided or their impacts significantly mitigated. Inadequate early warning systems, disaster unpreparedness, farming practices that are environmental unfriendly, destruction of rainfall catchment areas mostly as a result of human activities (settlement, farming).

Involvement of women in small-scale agriculture (with over 75% of the labour force)

is appreciated as an important factor towards improvement improve agricultural performance. However, despite their contributions women still face a number of hindrances especial limited access to productive resources like land ownership, inputs, extension services and marketing services that need to be addressed.

Environmental degradation and rising poverty is of major concern for agricultural development. The continued scarcity of productive land and increasing poverty levels has led to an increase in agricultural practices that conflict with the environment particularly in the rural areas. Pressure on high potential areas is pushing people to migrate into ASAL lands where they practice inappropriate farming practices leading to environmental degradation and thereby creating a vicious cycle of environmental degradation and poverty.

3.2.7 The Land Policy

To restore the environmental integrity the government shall introduce incentives and encourage use of technology and scientific methods for soil conservation and maintain beaches at high and low water mars and put in place measures to control beach erosion. Fragile ecosystems shall be managed and protected by developing a comprehensive land use policy bearing in mind the needs of the surrounding communities. Zoning of catchment areas to protect them from further degradation and establishing participatory mechanisms for sustainable management of fragile ecosystems will also be done. It will also develop procedures for co-management and rehabilitation of forest resources while recognizing traditional management systems and sharing of benefits with contiguous communities and individuals. Lastly all the national parks, game reserves, islands, front row beaches and all areas hosting fragile biodiversity are declared as fragile ecosystems.

Conservation and sustainable management of land based natural resources. The sustainable management of land-based natural resources depends largely on the governance system that defines the relationships between people, and between people and resources. To achieve an integrated approach to management of land based natural resources, all policies, regulations and laws dealing with these resources shall be harmonized with the framework established by the Environmental Management and Coordination Act (EMCA1999).

3.2.8 CDA Strategic Plan

Coast Development Authority aims at enhancing provision of integrated development planning, coordination and implementation of programme and projects for sustainable exploitation of the coastal natural resources within the overall structure of the Regional Development Policy. With a vision to be the Lead Agency in promoting sustainable utilization of coastal natural resources for increased food production, employment and wealth creation in her jurisdiction, CDAs mission is to exploit and develop sustainably coastal natural resources for the benefit of the communities therein.

The key strategic objectives for the Coast Development Authority in this regard include the following;

- (i) To contribute to food self-sufficiency,
- (ii) To contribute to the creation of wealth and employment and improvement of socio-economic well being of the communities,
- (iii) To conserve and manage the natural resources for sustainable development,
- (iv) To strengthen CDAs financial base for self-sustainability.

To achieve the above objectives, CDA is charged with the functions of implementing integrated regional development programmes and projects including;

- (i) Research, planning, coordination and development,
- (ii) Community support and empowerment
- (iii) Water catchments, water bodies and river banks protection and conservation,
- (iv) Entrepreneurship and business development, mineral resources exploration and exploitation,
- (v) Monitoring and evaluation of programmes and projects
- (vi) Consultancy

3.3 Legal Framework

Applications of national statutes and regulations on environmental conservation suggest that the Coast Development Authority will have a legal duty and social responsibilities to ensure the proposed dam development is carried out without compromising the status of the natural resources in the area, environment resources, social and cultural setting as well as the economic potential of the local communities health and safety. This position enhances the importance of this environmental impact assessment for the proposed site to provide a benchmark for its sustainable operation. The key national laws that govern the management of environmental resources in the country have been briefly discussed below. It is noteworthy that wherever any of the laws contradict each other, the Environmental Management and Co-ordination Act 1999 prevails.

3.3.1 The Environment Management and Co-ordination Act, 1999

Part II of the Environment Management & Coordination Act, 1999 states that every person in Kenya is entitled to a clean and healthy environment and has the duty to safeguard and enhance the environment. In order to partly ensure this is achieved, Part VI of the Act directs that any new programme, activity or operation should undergo environmental impact assessment and a report prepared for submission to

the National Environmental Management Authority (NEMA), who in turn may issue a license as appropriate. The second schedule of the same Act lists water programmes and sewage disposal works among the key activities that must undergo environmental assessments.

Part VIII section 72 of the Act prohibits discharging or applying poisonous, toxic, noxious or obstructing matter, radioactive or any other pollutants into aquatic environment. Section 73 require that operators of projects which discharges effluent or other pollutants to submit to NEMA accurate information about the quantity and quality of the effluent. Section 74 demands that all effluent generated from point sources be discharged only into the existing sewerage system upon issuance of prescribed permit from the local authorities or from the licensee. Finally, section 75 requires that parties operating a sewerage system obtain a discharge license from NEMA to discharge any effluent or pollutant into the environment.

Section 87 sub-section 1 states that no person shall discharge or dispose of any wastes, whether generated within or outside Kenya, in such a manner as to cause pollution to the environment or ill health to any person, while section 88 provides for acquiring of a license for generation, transporting or operating waste disposal facility. According to section 89, any person who, at the commencement of this Act, owns or operates a waste disposal site or plant or generate hazardous waste, shall apply to the NEMA for a licence. Sections 90 through 100 outline more regulations on management of hazardous and toxic substances including oils, chemicals and pesticides.

Finally the environmental impact assessment guidelines require that study be conducted in accordance with the issues and general guidelines spelt out in the second and third schedules of the regulations. These include coverage of the issues on schedule 2 (ecological, social, landscape, land use and water considerations) and general guidelines on schedule 3 (impacts and their sources, project details, national legislation, mitigation measures, a management plan and environmental auditing schedules and procedures.

3.3.2 EMCA Regulations

Water Quality Management Regulations, 2006 (Legal Notice No. 120)

These regulations were drawn under section 147 of the Environmental Management and Coordination Act 1999. In accordance with the regulations, every person shall refrain from acts that could directly or indirectly cause immediate or subsequent water pollution and no one should throw or cause to flow into water resources any materials such as to contaminate the water. The regulation also provides for protection of springs, streams and other water sources from pollution.

Waste Management Regulations, 2006 (Legal Notice No. 121)

The regulations are formed under sections 92 and 147 of the Environmental Management and Coordination Act, 1999. Under the regulations, a waste generator is defined as any person whose activities produces waste while waste management is the administration or operation used in handling, packaging, treatment, conditioning, storage and disposal of waste. The regulations requires a waste generator to collect, segregate and dispose each category of waste in such manners and facilities as provided by relevant authorities. Regarding transportation, licensed persons shall operate transportation vehicles approved by NEMA and will collect waste from designated areas and deliver to designated disposal sites.

Noise and Excessive Vibration Pollution Control Regulations, 2009

Part II section 3(l) of these Regulations states that: no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment and section 3(2) states that in determining whether noise is loud, unreasonable, unnecessary or unusual. Part II Section 4 also states that: except as otherwise provided in these Regulations, no person shall (a) make or cause to be made excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others and the environment; or (b) cause to be made excessive vibrations which exceed 0.5 centimeters per second beyond any source property boundary or 30m from any moving source.

Part III, Section 11(1) states that any person wishing to (a) operate or repair any machinery, motor vehicle, construction equipment or other equipment, pump, fan, air-conditioning apparatus or similar mechanical device; or (b) engage in any commercial or industrial activity, which is likely to emit noise or excessive vibrations shall carry out the activity or activities within the relevant levels prescribed in the First Schedule to these Regulations. Any person who contravenes this Regulation commits an offence.

Section 13(1) states that no person shall operate construction equipment (including but not limited to any pile driver, steam shovel, pneumatic hammer, derrick or steam or electric hoist) or perform any outside construction or repair work so as to emit noise in excess of the permissible levels as set out in the Second Schedule to these Regulations. These purposes include emergencies, those of a domestic nature and /or public utility construction.

Section 14 relates to noise, excessive vibrations from construction, demolition, mining or quarrying sites, and states that: where defined work of construction, demolition, mining or quarrying is to be carried out in an area, the Authority may impose requirements on how the work is to be carried out including but not limited to requirements regarding (a) machinery that may be used, and (b) the permitted levels

of noise as stipulated in the Second and Third Schedules to these Regulations. It further states that the relevant lead agency shall ensure that mines and quarries where explosives and machinery used are located in designated areas and not less than two kilometers away from human settlements and any person carrying out construction, demolition, mining or quarrying work shall ensure that the vibration levels do not exceed 0.5 centimeters per second beyond any source property boundary or 30 metres from any moving source.

Air Quality Regulations

Under the general prohibitions (Part II), section 5 states that no person shall act in a way that directly or indirectly causes immediate or subsequent air pollution. Among the prohibitions are priority air pollutants (as listed under schedule 2 of the regulations) that include general pollutants, mobile sources and green house gases. Odours are also prohibited under section 9 of the regulations (offensive emissions). Emissions into controlled areas such as schools, hospitals, residential areas and populated urban centers are also prohibited.

Part VII on occupational air quality limits in section 29 states that an occupier of premises shall ensure that exposure of indoor air pollutants does not exceed the limits stipulated under the Factories and Other Places of Work rules or under any other law. Other sources are recognized at sections 32 and 33 are those arising from construction equipment and materials as well as particulate matter from demolitions of structures and buildings as well as stockpiled dry materials.

Biodiversity Regulations

Part II of Regulations, section 4 states that no person shall engage in any activity that may have adverse impacts on ecosystems, lead to introduction of exotic species or lead to unsustainable use of natural resources without an EIA license. The regulation puts in place measures to control and regulate access and utilization of biological diversity that include among others banning and restricting access to threatened species for regeneration purposes. It also provides for protection of land, sea, lake or river declared to be a protected natural environmental system in accordance to section 54 of EMCA, 1999.

3.3.3 The Factories Act (Cap. 514)

This Act deals with factories and other places of work. Sections 21 and 22 of the Act provide that moving parts of machinery should be secured so as to be safe to every person employed or working at the premises. Part VI of the Act provides for the general welfare of the workers with respect to supply of drinking water, washing facilities and first aid among other aspects. Related to the workers welfare, Part VII section 51 states in part “every work place in which there is given off any dust or fumes or other impurity of such a character and to such an extent as to be likely to be injurious or offensive to the persons employed, or any substantial quantity of dust

of any kind, all practicable measures shall be taken to protect the persons employed against inhalation of the dust or fume or other impurity and to prevent its accumulation in any workroom, and in particular, where the nature of the process makes it practicable exhaust appliances shall be provided and maintained as near as possible to the point of origin of the dust or fumes

Section 4 of Kenya subsidiary legislation of 2004, Legal Notice No. 31 of Kenya Gazette Supplement No. 25 of 24th May, 2004 of the Factories Act Cap 514, requires that, all workplace owners to establish a safety and health committee, which shall consist of safety representatives from the management and the workers. The number of the committee members will range from 3 to 7 depending on the size (number) of employees. The Act also requires the management to appoint a competent person who is a member of the management staff to be responsible for safety, health and welfare in the workplace. Section 13 goes ahead to state that a health and safety audit of the workplace be carried out every twelve months by a registered health and safety adviser. If the owner(s) or management contravenes any of the rules, he/she shall be guilty of an offence.

3.3.4 The Water Act 2002

Part II section 18 provides for national monitoring and information systems on water resources. Following on this, sub-section 3 allows the Water Resources Management Authority to demand from any person, specified information, documents, samples or materials on water resources. Under these rules, specific records may be required to be kept and the information thereof furnished to the authority on demand.

Section 25 of the Act requires a permit to be obtained for among others any use of water from a water resources, discharge of a pollutant into any water resource. According to section 29 of the same Act, application for such a permit shall be subject to public consultation as well as an environmental impact assessment as per the Environmental Management and Coordination Act, 1999. The conditions of the permit may also be varied if the authority feels that the water so used is causing deterioration of water quality or causing shortage of water for other purposes that the authority may consider has priority. This is provided for under section 35 of the Act.

Section 73 of the Act allows a person with a license to supply water (licensee) to make regulations for purposes of protecting against degradation of sources of water, which he is authorized to take. Under the Act, the licensee could be a local authority, a private Trust or an individual and the law will apply accordingly under the supervision of the Regulatory Board. Section 75 and sub-section 1 allows a licensee for water supply to construct and maintain drains, sewers and other works for intercepting, treating or disposing of any foul water arising or flowing upon land for preventing water belonging to the licensee or which he is authorized to take for supply from being polluted. However, if the proposed works will affect or is likely to

affect any body of water in the catchment, the licensee shall obtain consent from the Water Resources Management Authority.

Section 76 states that no person shall discharge any trade effluent from any trade premises into sewers of a licensee without the consent of the licensee upon application indicating the nature and composition of the effluent, maximum quantity anticipated, flow rate of the effluent and any other information deemed necessary. The consent shall be issued on conditions including the payment rates for the discharge as may be provided under section 77 of the same Act.

3.3.5 Water Rules

One of the outcomes of the water sector reforms has been improved regulatory framework for water resource management and use. In addition to the Water Act 2002, the main document outlining the regulations is the Water Resource Management Rules 2007. The rules set out the procedures for obtaining water use permits and the conditions placed on permit holders. Sections 54 to 69 of the Water Resources Management Rules 2007 impose certain statutory requirements on dam owners and users in regard.

Other sections within the rules imply that WRMA can impose water quality sampling requirements from the water sources and impacts to the hydrology, water chemistry and river morphology downstream basin. Section 16 of the Water Rules requires approval from the Water Resources Management Authority (WRMA) for a variety of activities that affect the water resources, including the storage of water in dams and pans. Approval by WRMA is conferred through a Water Permit. A permit is valid for five years and must be renewed.

Section 104 of the Water Resource Management Rules requires certain water permit holders to pay water use charges. The intention of the water use charges was to raise revenue for water resource management, raise revenue for catchment conservation activities, improve efficiency of water resource abstraction and provide a system of data collection on water resource usage.

3.3.6 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 Local Authorities to take all lawful, necessary and reasonably practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable for injurious or dangerous to human health. Such nuisance or conditions are defined under section 118 and include nuisances caused by accumulation of materials or refuse which in the opinion of the medical officer of health is likely to harbor rats or other vermin.

3.3.7 The 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. 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

3.3.8 The Agriculture Act

Part IV no. 48 states that if the Minister considers it necessary or expedient so to do for the purposes of the conservation of the soil of, or the prevention of the adverse effects of soil erosion on, any land, he may, with the concurrence of the Central Agricultural Board, make rules to ensure the preservation of the environment. These rules may include,

- (i) Breaking or clearing of land for the purpose of cultivation is prohibited
- (ii) Control, regulation or prohibition of grazing or watering animals.
- (iii) With this prohibiting rules, the clearing or destruction of vegetation is deemed necessary by the minister for the preservation of soil and its fertility

Part IV no. 48(b) state the act require the regulating or controlling of

- (i) The afforestation or reforestation of the land,
- (ii) The protection of slopes, catchment areas or areas where rules made under (e) stating- for the maintenance of water in a body of water within the meaning of the Local Government Act
- (iii) Rules made under section 48 may provide for the seizure and forfeiture of any stock pastured in contravention of a land preservation order.

3.3.9 Pest Products Control Act

CAP 346, of the act says that no pest control product shall be sold without a label which has been approved by the board. Each label shall show name of pest control product and a description of its form and name of its active ingredients.(b)the class designation of the pest control product in capital letters and shall be classified as the first schedule.(C)information detailing the nature and degree of hazard identified by appropriate precautionary symbol (j)information identifying any significant hazards in respect to handling, storage, display and disposal of the pest control product with information that will include instructions respecting procedures to alleviate hazards and when required by the board, instructions respecting decontamination procedures and disposal of the pest control product and the empty package. Pest control product is to be used only In accordance with the directions on the label. It is an offence under the pest control products act to use or store a pest control product under unsafe conditions

3.3.10 Physical Planning Act (Cap286)

Section 24 of the Physical Planning Act gives provision for the development of local physical development plan for guiding and coordinating development of infrastructure facilities and services within the area of authority of County, municipal and town council and for specific control of the use and development of land. The plan shows the manner in which the land in the area may be used. Section 29 of the physical Planning Act gives the county councils power to prohibit and control the use of land, building, and subdivision of land, in the interest of proper and orderly development of its area. The same section also allows them to approve all development applications and grant development permissions as well as to ensure the proper execution and implications of approved physical development plans. On zoning, the act empowers them to formulate by-laws in respect of use and density of development.

Section 30 states that any person who carries out development within an area of a local authority without development permission shall be guilty of an offence and the development shall be invalid. The act also gives the local authority power to compel the developer to restore the land on which such development has taken place to its original conditions within a period of ninety days. If no action is taken, then the council will restore the land and recover the cost incurred thereto from the developer. In addition, the same section also states that no person shall carry out development within the area of a local authority without development permission granted by the local authority. At the same time, sub-section 5, re-enforce it further that, no licensing authority shall grant under any written law, a license for commercial use for which no development permission had been granted by the respective local authority.

Section 36 states that if in connection with development application a local authority is of the opinion that, the proposed activity will have injurious impact on the environment, the applicant shall be required to submit together with the application

an Environmental Impact Assessment report. The environmental impact assessment report must be approved by the National Environmental Management Authority (NEMA) and followed by annual environmental audits as spelled out by EMCA 1999. Section 38 states that if the local authority finds out that the development activity is not complying to all laid down regulations, the local authority may serve an enforcement notice specifying the conditions of the development permissions alleged to have been contravened and compel the developer to restore the land to its original conditions.

3.3.11 The Land Act (Cap. 303)

Section 9 of the subsidiary legislation (The development and use of land regulations 1961) requires that before the local authorities submit any plans to the Minister for approval, steps should be taken as may be necessary to acquaint the owners of any land affected by such plans. Particulars of comments and objections made by the landowners should also be submitted. This is intended to reduce conflict with other interests such as settlement and other social and economic activities.

3.3.12 The Penal Code (Cap. 63)

Section 191 of the Penal Code states that any person or institution that voluntarily corrupts or fouls water for public springs or reservoirs, rendering it less fit for its ordinary use is guilty of an offence. Section 192 of the same act says a person who makes or vitiates the atmosphere in any place to make it noxious to health of persons/institution in dwellings or business premises in the neighborhood or those passing along public way, commit an offence.

3.4 Institutional Structure of the Water Sector

The National Policy on Water Resources Management and Development and the Water Act 2002, presently guides water resources management. The overall goal of the national water development policy is to facilitate the provision of water in sufficient quantity and quality and within a reasonable distance to meet all competing uses in a sustainable, rational and economical way. This policy separates policy formulation, regulation and services provision and defines clear roles for sector actors within a decentralized institutional framework and includes private sector participation and increased community development.

Under the policy, the Ministry of Environment, Water and Natural Resources is responsible for policy development, sector co-ordination, monitoring and supervision to ensure effective Water and Sewerage Services in the Country, sustainability of Water Resources and development of Water resources for irrigation, commercial, industrial, power generation and other uses. The MWI executes its mandate through the following sector institutions:

3.4.1 Water Services Regulatory Board (WASREB)

The regulatory Board is responsible for the regulation of the water and sewerage services in partnership with the people of Kenya. The mandate of the regulator covers the following key areas;

- (i) Regulating the provision of water and sewerage services including licensing, quality assurance, and issuance of guidelines for tariffs, prices and disputes resolution.
- (ii) Overseeing the implementation of policies and strategies relating to provision of water services licensing of Water Services Boards and approving their appointed Water Services Providers,
- (iii) Monitoring the performance of the Water Services Boards and Water Services Providers,
- (iv) Establish the procedure of customer complaints,
- (v) Inform the public on the sector performance,
- (vi) Gives advice to the Minister in charge of water affairs.

3.4.2 Water Resources Management Authority (WRMA)

The authority is responsible for sustainable management of the Nations Water Resources;

- (i) Implementation of policies and strategies relating to management of Water resources
- (ii) Develop principles, guidelines and procedures for the allocation of water,
- (iii) Development of Catchments level management strategies including appointment of catchments area advisory committees,
- (iv) Regulate and protect water resources quality from adverse impacts,
- (v) Classify, monitor and allocate water resources.

3.4.3 Water Services Trust Fund (WSTF)

This body assists in the financing of the provision of Water Services to areas of Kenya, which are without adequate water services. This shall include providing financing support to improved water services towards;

- (i) Capital investment to community water schemes in underserved areas
- (ii) Capacity building activities and initiative among communities
- (iii) Water services activities outlined in the Water Services Strategic Plan as prioritized by the Government
- (iv) Awareness creation and information dissemination regarding community management of water services
- (v) Active community participation in the management of water services

3.4.4 Water Services Boards (WSBs)

The WSBs are responsible for the efficient and economical provision of water and sewerage services in their areas of jurisdiction. CWSB is among the seven catchment Boards established under the Act mandated to;

- (i) Develop the facilities, prepare business plans and performance targets
- (ii) Planning for efficient and economical provision of Water and sewerage services within their areas of jurisdiction;
- (iii) Appointing and contracting Water Service Provider
- (iv) Asset holding of Central Government facilities

3.4.5 Water Services Providers

Water Service Providers are the utilities or water companies. They are state owned but have been commercialized to improve performance and run like business within a context of efficiency, operational and financial autonomy, accountability and strategic, but minor investment.

3.5 NEMA Compliance

The government established the National Environmental Management Authority (NEMA) as the supreme regulatory and advisory bodies on environmental management in Kenya under EMCA 1999. NEMA is charged with the responsibility of coordinating and supervising the various environmental management activities being undertaken by other statutory organs. NEMA also ensures that environmental management is integrated into development policies, programmes, plans and projects.

3.6 Sectoral Integration

This integration encourages provision of sustainable development and a healthy environment to all Kenyans. The key functions of NEMA through the NEC include policy direction, setting national goals and objectives and determining policies and priorities for the protection of the environment, promotion of cooperation among public departments, local authorities, private sector, non-governmental organizations and such other organizations engaged in environmental protection programmes and performing such other functions as contained in the act.

Other stakeholder authorities include Ministries of Water Resources and Irrigation, Agriculture, Environment and Natural Resources, Tourism and Wildlife, Lands and Settlement, Social and Cultural Services, Livestock as well as the Provincial Administration. The Kenya Wildlife Services is perhaps the ultimate authority over the wildlife management and works closely with the communities in respect of interactions of wildlife and the operations of water works.

3.6.1 Project Institutional Management Structure

The proposed Project would be implemented under the KWSCRIP, which falls under MEWNR. Responsibility for execution would be delegated to CDA. [M 23A]

PIU within CDA

Component 4 of the project will establish and finance a Project Implementation Unit (PIU) within the Coastal Development Authority (CDA). It is currently envisioned that the PIU will take the lead on execution of project activities (including preparation of tender and design documents, technical supervision of works, and contract management as well as planning, coordination and reporting for all project activities.

CDA would then, in accordance with its mandate, partner with other Government ministries, departments, authorities (such as the Water Resources Management Authority, especially for watershed management) and parastatals (such as CWSB and the Kenya Forestry Service, also for watershed management) to implement those subcomponents that fall within their respective areas of responsibility, under memoranda of understanding.

Implementation Support Consultants

The PIU will be supported by an Implementation Support Consultant (ISC), which could be a consortium of firms with relevant national and international experience. The ISC will be embedded in the PIU and will be responsible for supporting CDA to deliver key activities, including project planning and reporting, civil works supervision, implementation of social and environmental safeguards instruments, etc. The ISC will also provide capacity building, including in technical areas and for general fiduciary and safeguards functions (in coordination with PMU).

Role of the KWSCRIP PMU

The central Project Management Unit (PMU), established under Phase 1 of the program, will maintain overall fiduciary responsibility and supervise execution, including the delivery of contracts.

While the CDA PIU will be responsible for coordinating the execution of environmental and social safeguards instruments (including the ESMP, RAP and VMGP), the PMU will be responsible for supervising and reporting on timely and appropriate implementation of safeguards instruments.

The specific mandate and role of the PIU and PMU relative to other key stakeholders (including CWSB, MOWASCO, Mombasa County, and Kwale County) will be clarified in a Memorandum of Agreement that is currently under preparation.

3.6.2 The Contractor

The contractor will be required to establish an environmental office to continuously

advise on environmental components of the project implementation. Elements in the environmental and social management plan are expected to be integrated in the project with appropriate consultations with MEWNR/CDA through the supervising environmental expert. The environmental officer of the contractor is also expected to full understand the engineering and management aspects of the project for effective coordination of relevant issues.

3.6.3 The Supervisor

The supervisor will be engaged by MEWNR (as the project proponent) to ensure effective implementation of the environmental management plan. It is expected that supervisor engages the services of an environmental expert who should in return understand the details of the recommendations on environment management and especially the proposed action plans, timeframes and expected targets of the management plan. The environmental supervisory expert should be the liaison person between the contractor and MEWNR on the implementation of environmental concerns as well as issues of social nature associated with the project.

3.6.4 The CDA Environmental Division

This division was established within the organization to facilitate compliance of water projects with environmental regulations. The office advises the projects on compliance and is also a direct liaison with NEMA. Project reports could reach this office directly or through the supervisor while on the other, NEMA (or any other environmental stakeholder) is expected to address the project related issues through the same office. The office, therefore, is expected to be well informed of all project related issues at all times.

3.6.5 Project Management Responsibility Inter-Relationship

The overall responsibility of the project implementation is the MEWNR while the implementing agency is the Coast Development Authority (CDA) through a proposed position of Project Manager with environment and social function being among the various components of the management structure. It is also proposed that there be two triads for environmental and social integration into the project implementation focused on the environment function each with specified responsibilities. The implementation triads will comprise the following (also illustrated in the figure 4 below);

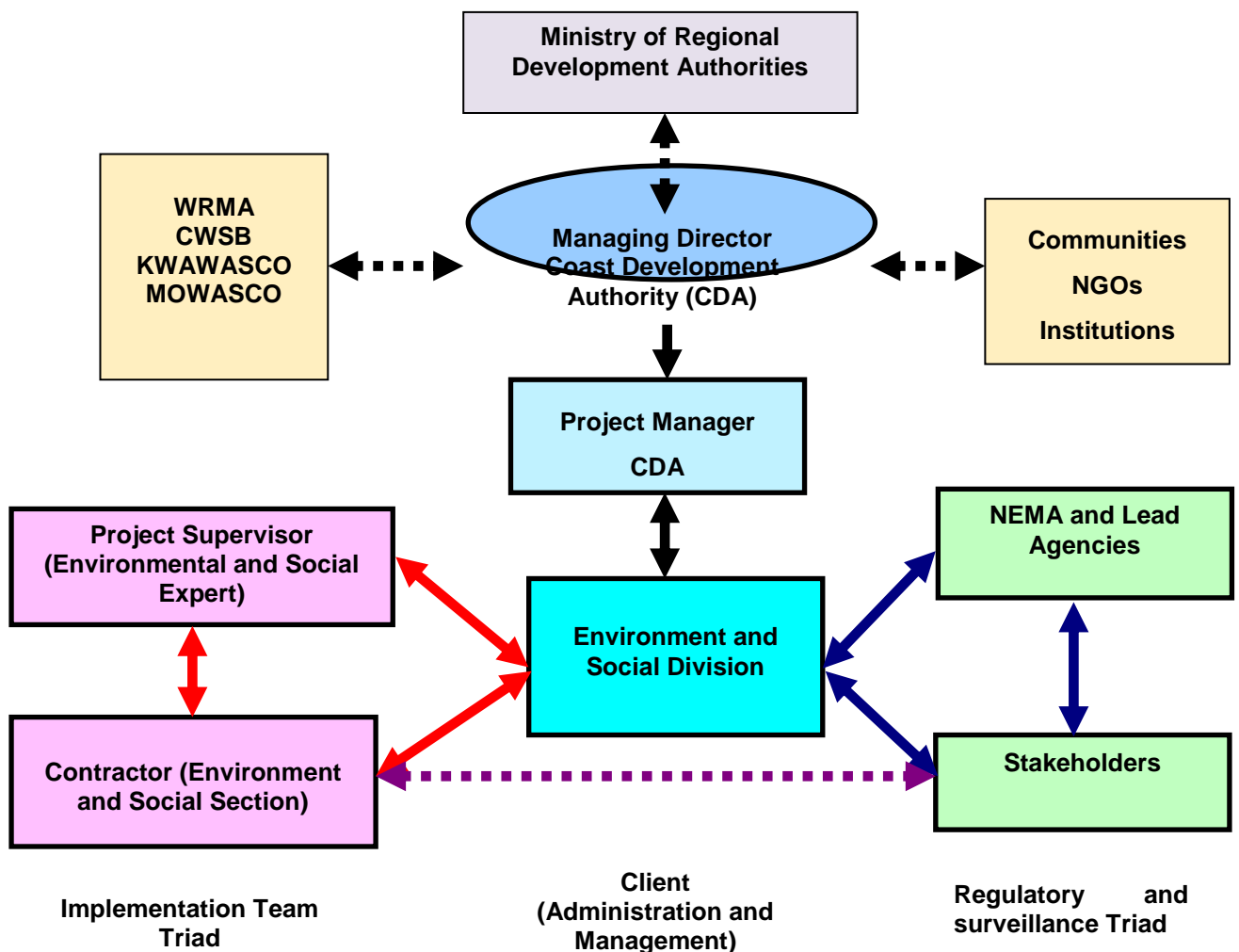
- (i) The implementation team consisting of the Contractor (who should appoint a competent environmentalist and a social expert), the Project Supervision (that should also appoint an environmentalist and sociologist to ensure prompt attention on matters of environment and social linkages). The third element of the triad shall be the environmental function at CDA from where coordination for compliance with the ESMP will be undertaken,
- (ii) The Regulatory triad will comprise of NEMA and other relevant Lead

Agencies who will have the responsibilities of overseeing compliance with the established national and sectoral policies and regulations. The public and stakeholders will also play a major role of ensuring that the project meets the expectations of the communities through what may be constituted as Project Welfare Committee. Again the third component of the triad is the environmental function where concerns and opinions will be received for onward attention to the Supervision and the Contractor.

The actual implementation institutional setting should be prepared at project commencement such as to involve all the involved interests.

The Responsibility inter-relationship of the above can be illustrated as follows;

Figure 6: Project Environment Management Framework



3.7 The World Bank Environmental Safeguards

3.7.1 OP/BP 4.01 (Environmental Assessment)

The World Bank has well-established environmental assessment procedures, which apply to its lending activities and to the projects undertaken by borrowing countries, in order to ensure that development projects are sustainable and environmentally sound. Although its operational policies and requirements vary in certain respects, the World Bank follows a relatively standard procedure for the preparation and approval of an environmental assessment study, which:

- (i) Identifies and assesses potential risks and benefits based on proposed activities, relevant site features, consideration of natural/human environment, social and trans-boundary issues
- (ii) Compares environmental pros and cons of feasible alternatives
- (iii) Recommends measures to eliminate, offset, or reduce adverse environmental impacts to acceptable levels (siting, design, technology offsets)
- (iv) Proposes monitoring indicators to implement mitigation measures
- (v) Describes institutional framework for environmental management and proposes relevant capacity building needs.

The environmental assessment evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. The assessment takes into account: the natural environment (air, water, and land); human health and safety) social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources); and trans-boundary and global environmental aspects. Preventive measures are favored over mitigation or compensatory measures, whenever feasible. This approach is universally applied in many institutional projects.

The World Bank considers environmental impact assessment (EIA) as one among a range of instruments for environmental assessment. Other instruments used by the World Bank include regional or sectoral environmental assessment, strategic environmental and social assessment (SESA), environmental audit, hazard or risk assessment, environmental management plan (EMP) and environmental and social management framework (ESMF). The Bank undertakes environmental screening of each proposed project to determine the appropriate extent and type of environmental assessment. Proposed projects are classified into one of three categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts:

- **Category A:** the proposed project is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works. For a Category A project, the Proponent is responsible for preparing an EIA report.
- **Category B:** the proposed project has potential adverse environmental impacts on human populations or environmentally important areas such as wetlands, forests, grasslands, and other natural habitats - but these are less adverse than those of Category A projects. These impacts are site-specific; few if any of them are irreversible; and in most cases, mitigation measures can be designed more readily than for Category A projects. Like Category A the environmental assessment examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance.
- **Category C:** the proposed project is likely to have minimal or no adverse environmental impacts. Beyond screening, no further environmental assessment action is required for a Category C project.

Environmental Assessment is used in the World Bank to identify, avoid, and mitigate the potential negative environmental associated with Bank lending operations. The purpose of Environmental Assessment is to improve decision making, to ensure that project options under consideration are sound and sustainable and that potentially affected people have been properly consulted. The magnitude of the proposed Mwache Multi-purpose dam falls under category A and hence full ESIA and RAP was required.

Table 6: OP/BP 4.01 Environmental Assessment

| Objectives | Operational Principles |
|---|--|
| To help ensure the environmental and social soundness and sustainability of investment projects. Also referred to as scoping. | Apply the screening process for each proposed project, as early as possible, to determine the appropriate extent and type of environmental assessment (EA) so that appropriate studies are undertaken proportional to potential risks and to direct, and, as relevant, indirect, cumulative, and associated impacts. Use sectoral or regional environmental assessment when appropriate. |
| To support integration of environmental and social aspects of projects into the decision making process. | Assess potential impacts of the proposed project on physical, biological, socio-economic and physical cultural resources, including trans-boundary and global concerns, and potential impacts on human health and safety. |
| | Assess the adequacy of the applicable legal and institutional framework, including applicable international environmental agreements, and confirm that they provide that the cooperating government does not finance project activities that would contravene |

| Objectives | Operational Principles |
|------------|--|
| | such international obligations. |
| | Provide for assessment of feasible investment, technical, and siting alternatives, including the "no action" alternative, potential impacts, feasibility of mitigating these impacts, their capital and recurrent costs, their suitability under local conditions, and their institutional, training and monitoring requirements associated with them. |
| | Where applicable to the type of project being supported, normally apply the Pollution Prevention and Abatement Handbook. Justify deviations when alternatives to measures set forth in the handbook are selected. |
| | Prevent, minimize, or compensate for adverse project impacts and enhance positive impacts through environmental management and planning that includes the proposed mitigation measures, monitoring, institutional capacity development and training measures, an implementation schedule, and cost estimates. |
| | Involve stakeholders, including project-affected groups and local non-governmental organizations, as early as possible, in the preparation process and ensure that their views and concerns are made known to decision makers and taken into account. Continue consultations throughout project implementation as necessary to address EA-related issues that affect them. |
| | Use independent expertise in the preparation of EA where appropriate. Use independent advisory panels during preparation and implementation of projects that are highly risky or contentious or that involve serious and multi-dimensional environmental and/or social concerns. |
| | Provide measures to link the environmental assessment process and findings with studies of economic, financial, institutional, social and technical analyses of a proposed project. |
| | Provide for application of the principles in this Table to subprojects under investment and financial intermediary activities. |
| | Disclose draft EA in a timely manner, before appraisal formally begins, in an accessible place and in a form and language understandable to key stakeholders. |

3.7.2 OP/BP 4.04 (Natural Habitats)

The policy is designed to promote environmentally sustainable development by supporting the protection, conservation, maintenance and rehabilitation of natural habitats and their functions. The policy seeks to ensure that World Bank-supported infrastructure and other development projects take into account the conservation of biodiversity, as well as the numerous environmental services and products, which natural habitats provide to human society. The policy strictly limits the circumstances under which any Bank-supported project can damage natural habitats (land and water area where most of the native plant and animal species are still present). This project interacts with among other features Mwache Creek to downstream towards

the sea and Mwache Forest located between the dam site and the creek. The creek provides a potential breeding ground for marine species migrating from the deep sea while Mwache Forest is home to some local animal species including monkeys, snakes and limited grazers. However, the dam will not displace any of these ecosystems but appropriate management measures will need to be integrated to minimize conflicts.

3.7.3 OP/BP 4.11 (Physical Cultural Resources)

This policy is meant to assist in preserving physical cultural resources including the movable or immovable (above or below ground, or under water) objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance including sites and unique natural values. Physical cultural resources are important as sources of valuable scientific and historical information, as assets for economic and social development, and as integral parts of a people's cultural identity and practices.

The objective of this policy is to avoid or mitigate adverse impacts on physical cultural resources from development projects. As observed from the baseline conditions, there are sensitive cultural areas in the areas neighbouring the dam that need to be protected e.g. Kaya Mswakara in Mwache Forest and grave sites within the immediate areas. This policy is operationalized by undertaking the following steps:

- (i) Identify Category A (any project involving significant excavations, demolition, movement of earth, flooding, or other environmental changes) and/or B (any project located in, or in the vicinity of, a physical cultural resources site) projects that fall under this OP policy
- (ii) Identify the likely physical cultural resources issues, if any, to be taken into account by the EA and develop the ToRs for the EA.
- (iii) If the project is likely to have adverse impacts on physical cultural resources, identify appropriate measures for avoiding or mitigating these impacts as part of the EA process. These measures may range from full site protection to selective mitigation, including salvage and documentation, in cases where a portion or all of the physical cultural resources may be lost.
- (iv) Develop a physical cultural resources management plan that includes measures for avoiding or mitigating any adverse impacts on physical cultural resources and provisions for managing chance find.

3.7.4 OP/BP 4.12 (Involuntary Resettlement)

The policy states that "Where large-scale of population displacement is unavoidable, a detailed resettlement plan, timetable, and budget are required. Resettlement plans should be built around a development strategy and package aimed at improving or at

least restoring the economic base for those relocated. Experience indicates that cash compensation alone is normally inadequate. Voluntary settlement may form part of a resettlement plan, provided measures to address the special circumstances of involuntary resettlers are included. Preference should be given to land-based resettlement strategies for people dislocated from agricultural settings. If suitable land is unavailable, non land-based strategies built around opportunities for employment or self-employment may be used”.

Involuntary resettlement is triggered in situations involving involuntary taking of land and involuntary restrictions of access to legally designated parks and protected areas. The objective of this policy is to avoid or minimize involuntary resettlement, though participation in resettlement planning and implementation and, where this is not feasible, to assist displaced persons in improving or at least restoring their livelihoods and standards of living in real terms relative to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher. The policy prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to Bank appraisal of proposed projects. There are potential displacements by sub-projects such as solid waste disposal sites, wastewater treatment plants, markets and parks that are all space intensive. RAP studies are, therefore, considered for such projects.

3.7.5 OP/BP 4.36 (Forests)

The policy on forest safeguards seeks to realize the potential of forests to reduce poverty in sustainable manner, integrate forests effectively into sustainable economic development and protect the vital local and global environmental services and values of forests. Among the principles is to screen as early as possible for potential impacts on forest health and quality and on the rights and welfare of the people who depend on them.

3.7.6 OP/BP 4.10 (Indigenous Peoples)

This policy contributes to the Bank’s mission of poverty and sustainable development by ensuring that the development process fully respects the dignity, human rights, economies and cultures of indigenous peoples. For all projects that are proposed for Bank financing and affect indigenous peoples, the Bank requires the borrower to engage in a process of free, prior, and informed consultation. The broad support of the project by the affected Indigenous Peoples such as Bank-financed projects includes;

- (i) Preventive measures to adverse effects to the indigenous cultures and practices,
- (ii) Avoid potential adverse effects on the Indigenous Peoples’ communities;
- (iii) When avoidance is not feasible, minimize, mitigate, or compensate for such effects.

Bank-financed projects are also designed to ensure that the Indigenous peoples receive social and economic benefits that are culturally appropriate and gender and inter-generationally inclusive.

The objective of this policy is to design and implement projects in a way that fosters full respect for Indigenous Peoples’ dignity human rights and cultural uniqueness and so that they receive culturally compatible social and economic benefits and do not suffer adverse effects during the development process. Space intensive sub-projects such as solid waste dumping sites, wastewater disposal areas and commuter rail stations has a potential for disruption of indigenous people. Improved Social and economic systems across the metropolitan leads to potential intrusion to existing cultures.

3.7.7 OP/BP 4.09 (Pests Control Management)

The policy is meant to minimize and manage the environmental and health risks associated with pesticides use and promote and support safe, effective and environmentally sound pest management. This being partly an Agricultural based project, this policy is relevant due to the anticipated application of various levels of pesticides and herbicides.

3.7.8 Activities Triggering World Bank Safeguards

The schedule below justifies the extent to which the World Bank safeguards apply to the implementation of the proposed project implementation. This implies, further investigations may be necessary to ensure compliance with the World Bank requirements.

Table 7: Safeguards Triggering Matrix

| Policy | Criteria in the Project | Discussions |
|---|-------------------------|---|
| Environmental Assessment (OP 4.01, BP4.01, GP 4.01) | Yes | The project components will trigger EA safeguards and is Category A due to the intense interaction with the physical, biological and social setting within the immediate surroundings and direct and indirect influence social and ecosystems |
| Forestry (OP4.36, GP 4.36) | Yes | Proximity of Mwache Forest and the associated cultural and ecological importance as well as the climatic values, is a factor that triggers the World Bank safeguard policy on forestry |
| OP/BP 4.04 (Natural Habitats) | Yes | Appreciating the biological importance of Mwache Creek in terms of fish breeding grounds and the intensive mangrove forest cover triggers the World Banks Natural Habits policy and safeguards. |

| Policy | Criteria in the Project | Discussions |
|--|-------------------------|--|
| Involuntary Resettlement (OP4.12, BP 4.12) | Yes | Over 200 families are likely to be displaced by the project. The effects of this phenomenon are likely to affect the residual settlers who may get separated with close family members or friends. World Bank Safeguards, therefore, are triggered for assessments on Resettlements. |
| Physical Cultural Resources (OP/BP 4.11) | Yes | Kaya Mswakara (one of the cultural sites held with high regard by the Mijikenda community of the Coast Region), numerous grave yards (usually located on communal family clusters) and other points of traditional prayers are among cultural resources typically found within the proximity of the dam. This, therefore, triggers the need for implementation of the World Bank safeguards on physical cultural resources. |
| Indigenous Peoples Policy OP/BP 4.10 | Yes | Duruma Community found around the project area have their traditions running many year. It is also notable that the traditions of the community are not confined to the Duruma community only, but through the entire Mijikenda society of the Kenya's Coastal region. The small Duruma community has high cultural values that may come into conflict with the dam during construction and thereafter. Among the notable features, include graveyards, at least one Kaya Site and at least one traditional consultation site. These cultural considerations will be fully addressed and integrated into the dam project implementation and operations. In accordance with the definition under the World Bank Policy OP/BP 4.10, therefore, the cultural status is sufficient to declare the Duruma Community Indigenous. |
| OP/BP 4.09 (Pests Control Management) | Yes | The agricultural component for the proposed dam project is significant. Application of various agrochemicals during the use of the dam water for irrigation is notable, hence triggering the World Bank Policy of Pest Control management. |

This report is prepared in compliance to NEMA guideline and WB safeguard policies

CHAPTER 4: ENVIRONMENTAL BASELINE CONDITIONS

4.1 General Overview

This section provides the environmental baseline conditions in respect to the dam and pilot irrigation component of the “project” and does not at this point include baseline conditions for water related infrastructure, which will be reflected in the subsequent ESIA studies to be prepared at a later stage.

4.2 Topography and Physiography

Mwache River is the main determinant of the drainage in the project area and the immediate adjoining areas. The slope is predominantly west east towards the sea shoreline (Mwache River discharges into Mwache Creek) from Taita hills in the west where Mwache River originates. Kombeni River basin to the north of the Mwache river basin has similar characteristics (discharging into Tudor Creek just north of Changamwe). The two rivers and their tributary streams are seasonal but carry high storm water flows during rains (combined catchment will be reported from the hydrology report). The general topography is relatively flat with breaks of medium valleys with seasonal flows. The local landforms are influenced by the rivers and mild slopes towards the flood plains.

4.3 Drainage and Hydrology

4.3.1 Drainage

The drainage of Kasemeni Division and Kinango District in general is influenced by the Sea that determines the easterly surface slope. While there are no permanent rivers and streams, the district is characterized with notable dry streams and rivers, among them Mwache river and its tributaries originating from the neighboring highlands including Taita hill, Mabesheni hill and Ngoni. Most of the dry streams are collectors of surface runoff discharging from numerous drains from the immediate catchment and watershed, most of which have developed as a result of land degradation (soil erosion that has left notable gullies especially on steep sloppy areas). Other than some sections of the larger riverbeds that tend to retain water after floods, there are no possibilities of flooding around the project areas. This implies a well-drained area in both surface as well as the largely porous geological formations.

4.3.2 Hydrology

The coastal region is drained by the two major rivers, Tana and Athi (Sabaki), which rise from the central highlands in the interior. Other rivers draining the coastal areas include Mwache, Kombeni, Rare and Ramisi rivers. One of the notable aspects of the drainage of the coastal area is the fact that the water table is very close to the ground surface. Sea water seeps underground from the sea towards the land and as a result, the coastal waters tend to be salty and hard. The coastal areas also experience a general problem of water scarcity due to problems associated with the sandy soils, deficient rainfall and that there are not any perennial rivers flowing within

the coastal area.

The Mwache River Basin

Mwache river basin covers an area of 2,250 km² within the 3MA river drainage basin. Mwache river basin lies between 300 to 14 m.a.s.l. and exhibits gentle slopes in the upper regions and flat in the lower regions. The proposed dam site is located near Fulugani Village of Kasemeni Division, in Kinango District.

Catchment Characteristics of the Mwache River

| | |
|------------------------|------------------------|
| Drainage Area | = 2250 km ² |
| Length of river | = 110 km |
| Average slope (m/100m) | = 0.27 |

The Catchment

A plan of the catchment with main river network is shown in **Drawing No. 2010059/WR/MWA/FR/GEN-001**. The catchment unto proposed Mwache Dam site is Fan-shaped. This catchment plan has been prepared using 1:50,000 Survey toposheet.

Natural vegetation in the project area is reflected through the ecological range of vegetation due to the difference in rainfall and soil zones. Different types of vegetation in the coastal fringes are as under:

- Mangrove vegetation is found in the tidal creeks and in the river estuaries; immediately behind the mangroves is vegetation comprising woodlands and bush. Broad-leaved evergreen and deciduous shrubs are characteristic of this vegetation.
- Forest vegetation is found in isolated areas along the coast. In the past, the forests were extensive but have cleared and reduced, as more land has been brought under cultivation,
- The savanna grassland of dry type is found further inland behind the forest belt. This consists of mainly grassland, dotted with a few bushes and shrubs.
- At the western inland margin of the coastal region the Nyika (wildness) area begins. This is the driest part of the coast and it carries its own type of dry land Nyika vegetation consisting of semi-ever green thickets and bushes separated in some parts by grass. The baobab tree is most characteristic of this type of vegetation.

Kinango District is not endowed with surface water sources since all rivers and streams are dry. Mwache River is the main stream collecting from all other streams that transport runoff from the catchments. Due to the seasonal nature of the rivers and streams, none of them has any historical discharge data and any analysis has to estimate on the catchment discharge. Among the major seasonal tributaries into Mwache River, include the following;

- (i) Mto wa Nguro rising from Mabesheni hills on the southern zones of Kinango District. This river joins the main Mwache River along the western edge of Kasemeni Division,
- (ii) Ngoni River is considered the main stream of Mwache from the catchments and rises from Pemba hills along the western edge of the district with the farthest watersheds being the Taita Hills and collects numerous seasonal streams along its length,
- (iii) Mwangombe River rises from the northwest of the project area in Tsavo and Voi areas and collects numerous seasonal tributaries before joins Mwache River downstream the confluence with Ngoni stream,
- (iv) Mnyenzi River also originates from Mabesheni hills and runs parallel to the Mwache basin to join a short distance from the proposed dam wall location. The river depicts a wide basin in the upstream.
- (v) One more seasonal stream, Bome River discharges downstream the dam location.

The greater catchment hydrology, however, has significantly been affected by changing land use patterns with increasing demand for settlement and agricultural land, large tracts of land that originally were covered with vegetation has been cleared and left fallow leading to uncontrolled surface runoff during heavy rains. The results have been soil erosion and general; land degradation. Unless effective measures are undertaken on catchment management and conservation where the communities are participants, the situation will only continue to degrade the watershed but also affect the sustainability of the proposed Mwache Dam.

Soil erosion and sedimentation issue is given high priority at design level and effective measures are taken for the project. The sedimentation rate in m³/sq km/yr considered for the project varied from 500 (forest), 1000 (grass land) and 1500 (habitants and roads). Based upon the latest land use of the catchment area, sedimentation load is estimated and three check dam at suitable site is proposed to trap the silt and dispose it off at 2-3 years interval. The details of sedimentation estimate and its disposal plan is given in Sedimentation Management Plan.

4.4 Water Resources

4.4.1 Overview

Mwache River is the main water body (though it is seasonal by nature) in the project area with its source in the Taita hills. The main tributaries (also seasonal) discharging into the river include Bome river from the south immediately downstream of the proposed dam axis lines while Mnyenzi river also from the southwest immediately upstream of the dam axis. There are also numerous dry surface drains into Mwache River but seemingly flows with water only during rainy seasons. The main uses of the

water resources including Mwache River are;

- (i) Washing usually in stagnant water pools along the seasonal rivers beds among Mwache river,
- (ii) Domestic uses obtained from the Mzima Springs pipeline to Mombasa through communal water points,
- (iii) Watering livestock mainly within the stagnant water pools in the seasonal river beds
- (iv) Fishing (in deep sections) was observed downstream the dam site and within the upper reaches of Mwache Creek. Typical fishing is of ordinary fish and the high values oysters and lobsters,
- (v) Sand harvesting in some location is mainly undertaken on the higher elevations riverbeds effectively damaging the water sources. This, however, seems to be short lived, as the sand transporting inflows have to wait for heavy rainy events.

Figure 7: Public Water Point from Mzima Pipeline to Mazeras



4.4.2 Surface Water Sources

The project area is not endowed with surface water sources as almost all the streams and rivers are seasonal including the target Mwache River and are characterized with flush floods, normally influenced from the highlands including Taita Hills, Mambesheni hills and Pemba hills among others. The flush floods discharges into the sea since there is minimal storage save for limited pools along the riverbed with little benefits to the residents. The local surface area may not be suitable to trap storm water in any quantified forms due to topographical and geographical conditions.

Water quality of surface sources varies with location with a particular difference between the fresh water and the brackish water from Mwache Creek. The quality of

water taken from pools along the Mwache River bed is indications that the bulk water in the river during the rains is fresh. The samples shows generally neutral, fresh water, clear and well aerated water with potential to support life. The parameters, however, would be expected to change during rains when high levels of suspended matter and silt are transported causing turbidity. Dissolved solids would, however, be lower from dilution factors. On the other hand, water in the creek and the ground water are generally brackish, a situation that is likely to remain constant under varying conditions. Samples taken for Laboratory analysis gave the quality characteristics in the table below;

Table 8: Water Quality Samples

| Parameter | Units | Sample Source | | | | | Remarks |
|-------------------------|--------|---------------|--------------|---------------------|---------------------|-----------------------|---|
| | | B/H | Mwache Creek | Mwache River (Bofu) | Mwache River (Site) | Mwache River (Bridge) | |
| pH | | 6.59 | 6.6 | 6.52 | 6.66 | 6.77 | Water generally neutral in river and the creek (6.0 – 9.0) |
| Color | °H | 10 | 350 | 380 | 600 | 400 | Surface water is highly coloured compared to ground water (<25mgPt/l) |
| Electrical conductivity | uS/cm | 8,000 | 40,000 | 3,000 | 327 | 276 | Ground water and creek brackish (<2,000mg/l) |
| Turbidity | F.T.U. | 8 | 120 | 110 | 240 | 250 | Surface water is highly turbid compared to ground water (<5NTU) |
| Total Hardness | Mg/l | 290 | 720 | 5,390 | 86 | 80 | Water pools on Mwache River soft (<250mg/l) |
| Total Alkalinity | Mg/l | 274 | Nil | 101 | 56 | 77 | |
| Dissolved Oxygen | Mg/l | 5.8 | 2.4 | 3.6 | 4.0 | 5.2 | Surface water and ground water is fresh (>5mg/l) |
| Iron | Mg/l | 0.4 | 0.6 | 0.6 | 0.4 | 0.8 | Low iron contents (<0.1mg/l) |
| Manganese | Mg/l | Nil | Nil | Nil | Nil | Nil | – |
| Fluoride | Mg/l | 0.2 | Nil | Nil | Nil | Nil | Within limits (<1.5mg/l) |
| Sulphate | Mg/l | 60 | 110 | 80 | 90 | 70 | Aspect within acceptable limits (250mg/l) |
| Phosphate | Mg/l | 0.02 | 0.04 | 0.03 | 0.03 | 0.03 | Aspect within acceptable limits |
| Silica | Mg/l | 65 | 80 | 70 | 80 | 60 | Aspect within acceptable limits |
| Nitrates | Mg/l | 0.8 | 0.9 | 1.0 | 2.0 | 1.0 | Aspect within acceptable limits |

| | | | | | | | |
|------------------------|------|-------|--------|-------|-----|-----|---|
| | | | | | | | (<10mg/l) |
| Chlorides | Mg/l | 8,700 | 38,800 | 4,600 | 172 | 143 | Groundwater and Mwache creek water has high levels, Mwache pools fresh (<250mg/l) |
| Total Dissolved Solids | Mg/l | 2,960 | 32,240 | 350 | 520 | 550 | Ground water and creek saline. Mwache pools are fresh (<1,500mg/l) |
| Suspended Solids | Mg/l | nil | 300 | 150 | 60 | 50 | High suspended matter clear due to settlements) - <30mg/l |
| Total Solids | Mg/l | 2,960 | 31,940 | 500 | 580 | 600 | – |

4.4.3 Ground Water

Groundwater in the area has not been exploited to any significant levels either due to high costs involved and potentially undesirable quality associated with the seawater intrusion. This aspect has, therefore, not been discussed in detailed under this report and even the feasibility study process. Indications of ground water quality are shown on Table 2 above. Note the high salinity levels but otherwise clear and neutral water quality status.

4.4.4 Rainwater

The project area and Kinango District in general is highly limited in the amount of rain received. While there are no initiatives to trap rainwater in the area, the option is expected to provide a significant opportunity for water supply sustainability. However, investment in rainwater harvesting has not been fully exploited and is confined to institutions including schools. This is perhaps an important component to be integrated into the proposed project as a back-up measure towards drinking water sustainability. It was not possible to sample rainwater for laboratory testing during this assessment process.

4.5 Biodiversity

There are no endangered or endemic species in the project influence area. All animal and plant types found in the area are indigenous spread out in wider areas as the species banks (forest, ocean and the surrounding ecosystems playing the balancing act for human interference. Specific features are described below.

4.5.1 Animal Species - Fauna

There is no significant presence of wildlife in the project influence area. Among the notable animal species include Baboons, snakes, dikdiks, dears, rabbits, etc. Wildlife sanctuary and national park outside the project influence area are studied to

understand the regional migration route and likely impact of project, if any.

Shimba Hills National Reserve to the south west of the project influence area located in coastal province, 33 km from Mombasa and 15 km from the coast is the habitat for larger species that often migrate into the adjoining Mwalunganje Elephant Conservancy in Kwale District, The reserve is an area of coastal rainforest, woodland and grass land. It is a nationally important site for birds and butterfly. There are estimated to be approximately 700 elephants in the reserve. North of the Reserve, the Mwalunganje elephant sanctuary has been established to provide a route for elephants to leave the park. The remainder of the park boundary is fenced to prevent the elephants from invading farmland. **No species of this reserve will be at risk due to project.**

Mwalunganje Elephant Sanctuary located in Kwale district of coastal province of Kenya. This sanctuary is outside the project influence area. Mwalunganje Elephant Sanctuary is a mere 45 kilometers southwest of Mombasa and around 25 km from the dam site. The sanctuary has an area of 36 km², and it, along with the adjacent Shimba Hills National Reserve combine to form the Shimba Hills Ecosystem. Mwalunganje is located in an ecosystem characterized by rolling hills, steep ridges, cliffs and winding water shades. The Mwalunganje forest is part of the current sanctuary, and the beautiful Mwalunganje Travelers Tented Camp is in the forest reserve. Mwalunganje Elephant Sanctuary was created in 1993 to conserve the serene surroundings, which house the rare and endangered African elephants, moist deciduous forest, riparian vegetation, and other special attractions available in the ecosystem. **No species of this sanctuary will be at risk due to project and project structures will not create any obstacle in the movement of the wildlife of this sanctuary.**

Tsavo East National Park located adjoining catchment area on north and it is around 200 km north -west to the dam site and far from the submergence area. Tsavo East National Park is one of the world's largest game reserves, providing undeveloped wilderness homes to vast numbers of animals. A comprehensive list of the animal types found in Tsavo East Park includes the aardwolf, yellow baboon, bat, cape buffalo, bush baby, bushbuck, caracal, African wildcat, cheetah, African Civet, dik-dik, African hunting dog, African dormouse, Blue Duiker, bush duiker, Red duiker, eland, African elephant, bat-eared fox, greater galago, gazelle, large-spotted genet, small-spotted genet, gerenuk, giraffe, African hare, springhare, Coke's hartebeest, hunter hartebeest, East African hedgehog, spotted hyena, striped hyena, rock hyrax, tree hyrax, impala, black-backed jackal, side-striped jackal, klipspringer, Lesser Kudu, leopard, lion, banded mongoose, dwarf mongoose, Egyptian Mongoose, marsh mongoose, slender mongoose, white-tailed mongoose, black faced vervet monkey, Sykes' monkey, fringe-eared oryx, clawless otter, ground pangolin, crested porcupine, cane rat, giant rat, naked mole rat, ratel, bohor reedbuck, black rhinoceros, serval, spectacled elephant shrew, bush squirrel, East African red squirrel, striped ground squirrel, unstriped ground

squirrel, suni, warthog, waterbuck, common zebra and Grevy's zebra. This National Park is home to most of the larger mammals, vast herds of dust –red elephant, Rhino, buffalo, lion, leopard, pods of hippo, crocodile, waterbucks, Lesser Kudu, Gerenuk and Hirola. Migration route of wildlife is far from the project created structures and project related activities. The wildlife of the national park will not be affected and at risk due to project's structure and project activities.

Aquatic life of the Mwache River ecosystem includes fish, rodents and other lesser species associated with coastal water systems. There is no endangered and endemic species of aquatic life in the Mwache River likely to be affected and at risk due to project.

Wildlife of Mwache forest to the immediate east of the dam site are monkeys, snakes, squirrels, birds and rodents that will be not be not be at risk due to project. Moreover, no any project's structure come in between the migration route of the mammals of this forest.



Bird and Migratory Route

Bird species recorded in Mwache forest and adjoining ecosystem like Shimba hills, etc can be listed as below

- Southern Banded Snake-eagle *Circaetus fasciolatus* (Near Threatened)
- Brown-headed Parrot *Poicephalus cryptoxanthus* (least concern)

- Fischer's Turaco *Tauraco fischeri* (Near Threatened)
- African Green-tinkerbird *Pogoniulus simplex* (Least Concern)
- Mombasa Woodpecker *Campethera mombassica* (Least Concern)
- Chestnut-fronted Helmet-shrike *Prionops scopifrons* (Least Concern)
- Black-bellied Glossy-starling *Lamprotornis corruscus* (Least Concern)
- Spotted Ground-thrush *Zoothera guttata* (Endangered)
- Plain-backed Sunbird *Anthreptes reichenowi* (Near Threatened)
- Sokoke Pipit *Anthus sokokensis* (Endangered)

It is observed that there is no any risk to the above species due to project because neither project structure nor project activities are near to the location of these bird species. It is also noted that there is no any migratory bird location in the project impact area.

4.5.2 Aquatic and Marine Life

Mwache River system and Estuary systems: These two contrasting systems reflect the aquatic ecosystem diversity of the study area. The Mwache River enters the ocean roughly upper part of Gazi. Before it does, part of the freshwater flow branches off about 30 km upstream of the mouth into a complex network of tidal creeks, savannah-like flood plains, coastal lakes and mangrove swamps known as the Mwache Estuary. This system covers ~ 8 km² and has no permanent human settlements. Freshwater inputs in the Delta occur via a small creek. The main ecological issues in this ecosystem relate to: Temporal fluctuations in water levels; River mouth fluctuations (drawdown) affecting the movement of marine, brackish and riverine fishes; silt loading affecting marine life downstream and; an ever increasing mangrove population. The very erratic water level affects the existence of brackish species and limits migration of potamodromous species such as the Eel *Aguilla* spp. Frequent low river levels and high tides causes the intrusion of sea water into the river. This results to movement of marine and brackish fishes to immediate upstream areas, which also impact on the mangrove ecosystems.

Sediment flows and flooding regime: During the flooding period, sediments are transported from the highland areas and deposited within the delta contributing to detritus which form the food items in the diet of prawns, crabs and fish. Adequate flooding periods however also provide the cues that trigger upstream fish migrations for spawning and feeding.

Nutrient loading from delta in form of surface runoffs: High primary productivity is only realized when adequate nutrients especially of the form of nitrogen and phosphorous are made available from within the delta. These provoke high primary production in the inshore areas, which is food for fish, crabs and prawns. The main causes of the above ecological issues will be associated with water regulation in the upstream areas as well as climate change impacts. The proposed dam ensures a regular supply of water to sustain the downstream biodiversity.

Brackish water environment

The Mwache River Delta is a major estuarine and deltaic ecosystem in Kenya with a perennial but strongly seasonal and double peaked freshwater inflow that can cover vast freshwater and coastal floodplains that form the brackish water ecosystems. The health of the brackish water ecosystem depends on the freshwater, nutrients and sediments from delta runoffs and river inputs coming from River Mwache as well as other inputs from seasonal streams especially during the rainy season. This supports extensive and diverse mangrove systems and marine brackish and freshwater intertidal areas, pristine beaches and shallow marine areas in Kwale forming productive and functionally interconnected ecosystem. Mangroves and intertidal mudflats and shallow brackish water creeks are well known feeding and nursery areas for fish but also for crustaceans (crabs and prawns) on which many fish species in the coastal area depend.

The fishery in the brackish water environment is dominated by Prawns (Kamba). Occasional catches of marine fishes are realized from Rabbit fish (Tafi), scavengers (Tangu), Mulletts (Mkizi), Sardines (Simu), Snappers (Pali) and Sharks (Papa) that migrate into the brackish water environment. Artisanal fishers use crafts consisting of Dug out (Mtumbwi), Foot fishers, Pointed crafts (Mashua) and Hori with gears such as gillnets, seine nets, hand lines, beach seines, traps and fence. Trawling also takes place in the deep areas (> 5 nm) also targeting prawns. The main prawn species targeted are *Penaeus indicus*, *Metapenaeus monoceros*, *P. semisulcatus*, *P. monodon* and *P. japonicas*.

Mwache River Estuary

The Mwache River Delta/estuary covers upstream and drains Mazeras area in Kwale District. Further upstream from the coastal strip, there are braided channels, shifting meanders and deep valleys with saline groundwater at shallow depth indicating a probably recent deltaic past. The definition of the delta / estuary is therefore somewhat pragmatic one with easily identifiable boundaries but the shifts in ecosystem types are gradual rather than abrupt.

The Mwache River Delta and particularly the proposed site for the new dam construction is a deep valley that upon being filled with water will be an important reservoir suitable for aquacultural practices such as cage culture and other important economic activities. The flood regime in the delta is bimodal, with a major flood in April-June, following rains over the catchments in May-March, and a minor flood in November to December.

Fishing in the Mwache River and Indian Ocean coastline, is one of the major activities within the delta. Marine turtles: Five species of threatened marine turtles have been recorded in the Delta. These are: the Hawksbill Turtle *Eretmochelys imbricata* (Critically Endangered), the Green Turtle *Chelonia mydas* (Endangered A2bd), and the Olive Ridley Turtle *Lepidochelys olivacea* (Endangered A1bd but will

be reclassified vulnerable this year) and the Leatherback turtle *Dermochelys coriacea* (Critically Endangered A1abd). The Loggerhead Turtle *Caretta caretta* (Endangered 1Abd) occurs in the area with the first two species potentially breeding. Fish: *Pristis* species, probably *Pristis zijsron* (CITES Appendix 1), *Pristis pectinata* (CITES appendix 1), *Anoxypristis cuspidate* (CITES Appendix 1). Other deficient fish species found within the Mwache River are *Nothobranchius microlepis*, *Nothobranchius patrizii*, *Nothobranchius willerti* and *Barbus paludinosus*.

The delta is regionally important in terms of its mangrove communities. The mangroves and intertidal flats provide habitats for a number of coastal and marine prawns, shrimps, bivalves and fish. Many invertebrates that enrich the region biodiversity and support other biodiversity particularly in the food chain and webs are believed to occur in the Mwache Delta and may include crustaceans, snails and insects, which are probably a major food source for the birds and fish of the Mwache Estuary.

The delta is a critical nursery ground for juveniles (early life stages) of Penaeid shrimps of the Giant tiger prawn *Penaeus monodon* (Fabricius, 1798), Indian white prawn *Penaeus indicus* (H. Milne Edwards, 1837), Kuruma shrimp *Penaeus japonicus* (Bate, 1888), Green tiger prawn *Penaeus semisulcatus* (De Haan, 1844) and Speckled shrimps *Metapenaeus monoceros* (Fabricius, 1798). Molluscs species such as the mangrove whelk *Terebralia palustris* (Linnaeus, 1758) among others are likely abundant. The fresh and brackish water prawns that live in clear streams and rivers but returns to the sea to release larvae such as (*Macrobrachium scabriculum* (Heller, 1862), *Macrobrachium rude* (Heller, 1862) are also utilizing this region.

Mwache River

The Mwache River is an important breeding, nursery and feeding ground for a number of coastal, estuarine and marine species, some of economic importance i.e. shrimps, prawns and fish species that make up the rich fishery of the estuary, in particular for Penaeid shrimp. These habitats provide shelter, food and protection.



Figure 8: Mwache River Valley

Mwache River Basin Fishery

Inventory of the Mwache River Fishes

An inventory of Mwache River fish species shows that there are 4 common fish species in the main river trunk, 5 prawn species and 1 crab species along the river continuum. These species are distributed in various ecological habitats that include brackish water, riverine and tributaries. The main commercial species include: prawn species. Other species are tilapia, catfish and barbus. The Mwache River Reservoir will help establish a vibrant fishery because water temperature ranges are conducive from a minimum of 25° C in the morning to a maximum of 35° C at 3.00 p.m.

Marine and brackish water

Mangroves and intertidal mudflats and shallow brackish water creeks are well known feeding and nursery areas not only for fish but also for crustaceans (crabs and prawns) on which many fish species in the coastal area. The fishery in brackish water environment is dominated by Prawns (Kamba). Occasional catches are realized from Rabbit fish (Tafi), scavengers (Tangu), Mulletts (Mkizi), Sardines (Simu), Snappers (Pali) and Sharks (Papa) that migrate into the delta. Artisanal fishers use crafts consisting of Dug out (Mtumbwi), Foot fishers, Pointed crafts (Mashua) and Hori with gears such as gillnets, seine nets, hand lines, beach seines, traps and fence. Trawling also takes place in the deep areas (> 5 nm) also targeting prawns. The main prawn species targeted are *Penaeus indicus*, *Metapenaeus monoceros*, *P. semisulcatus*, *P. monodon* and *P. japonicus*.

Delta

The delta holds populations of *Pristis pectinata*, *P. zijsron*, *Oreochromis spilurus spilurus*, The most important prawn and shrimp species are Giant tiger prawn *Penaeus monodon*, Indian white prawn *Penaeus indicus*, Kuruma shrimp *Penaeus japonicus*, Green tiger prawn *Penaeus semisulcatus*, Speckled shrimps *Metapenaeus monoceros*, *Macrobrachium scabriculum*, and *Macrobrachium rude* which are dependant on the extensive and varied mangroves in the Mwache River Delta. Mangroves and intertidal mudflats are well known feeding and nursery areas for fish but also for crustaceans (crabs and shrimp) on which many fish species in the coastal area depend. If there are sea grass beds these are also very important nursery areas.

Marine turtles: Five species of threatened marine turtles have been recorded in the Delta. These are: the Hawksbill Turtle *Eretmochelys imbricata*, the Green Turtle *Chelonia mydas*, and the Olive Ridley Turtle *Lepidochelys olivacea* and the Leatherback turtle *Dermochelys coriacea* (Critically Endangered A1abd). The Loggerhead Turtle *Caretta caretta* occurs in the area with the first two species potentially breeding.

Fish: *Pristis* species, probably *Pristis zijsron*, *Pristis pectinata*, *Anoxypristis cuspidate*, *Synodontis manni*, and *Pardiglanis tarabini*. Two un-described new species the Red-tailed Labeo and a *Synodontis* sp. are restricted to the range. The

river also has rare Anguillidae (*A. bicolor bicolor* and *A. mossambicus*). Other data deficient fish species found within the Mwache River are *Nothobranchius microlepis*, *Nothobranchius patrizii*, *Nothobranchius willerti*, *Barbus paludinosus*, *Awaous aeneofuscus*, and *Glossogobius giuris*.

River Trunk

Fishing in the riverine zone (river channel) upstream of the delta is restricted to subsistence level fishery using hooks and line. It supplements the protein in the diet of the local communities but is not a significant income source. Fishing activities in the river are carried out during periods of low water levels. Many of the fish which are found in this zone breed within the flood plain during the seasonal floods. Indeed, while this reach is not important in terms of fish catch, it may be seen as the breeding ground for the downstream fishery. Many of the fishes are stimulated to start spawning by increasing water flows as the seasonal flood approaches (the rising limb) and moving into the flood plain as the flood peaks.

Fish Biology / characteristics

Migratory fish species

The major commercial species in the Mwache River that are short distance migrators include *Barbus spp* and *Clarius gariepinus*. The anadromous fish species such as *Barbus spp*. migrate upstream for short distances (< 5 km) to reach their spawning areas. The maximum distance is determined by target destination (spawning or feeding grounds) or barriers (natural or artificial). *Anguilla spp.* will have the potential to migrate upstream when water availability is more assured due to reservoir water management and downstream (catadromous) to reach the sea to spawn while the young will move to the freshwater environment to feed and grow to maturity before heading back to the sea to spawn. The deeper coastal areas are considered to be very important for the migration of various fishes such as Anguillidae (*Anguilla mossambica* and *Anguilla bicolor bicolor*), Gobiidae (*Glossogobius giuris*, *Oligolepis acutipennis*, *Awaous aenofuscus*), Eleotridae (*Eleotris fusca*), Mugilidae (*Liza macrolepis*, *Valamugil buchanani*), Lutjanidae (*Lutjanus argentimaculatus*), Ambassidae (*Ambassis gymnocephalus*) and pelagic fish. Mangroves are well known feeding and nursery areas for fish but also for crustaceans (crabs and shrimp) on which many fish species in the coastal area depend. If there are sea-grass beds these are also very important nursery areas.

Resident / Rheophilic species

All the three species are known to exhibit endemism in the Mwache River ecosystem.

Endangered fish species and threatened fish

Fish species resident in Mwache River Basin marine environment belong to the family of Sawfishes (*Pristis pectinata*, *Pristis zijsron*, *Anoxypristis cuspidate*) are threatened and listed in CITES appendix 1 and IUCN Red list. These are associated with marine environment and are not available within the river system due to low water levels. Mwache River Delta is also important due to fish diversity and

biogeographically contributes to ecosystem conservation. In addition the large mangrove forests that act as an important habitat and breeding ground for juvenile fish and shrimps, the Mwache delta is a fishing area for the ethnic communities. Previous studies have variably listed the number of fish species in Mwache River system, including the fish rich delta. These species are distributed in various ecological habitats that include brackish water, riverine and estuary. Commercial fisheries exist in Mwache River providing a valuable livelihood opportunity. Those of commercial importance include catfish and tilapia and Penaeid Prawns. The common gears used are traditional traps and sizes 7 to 9 hooks, which target all commercial species. Fishing in the riverine zone (river channel) upstream of the delta is restricted to subsistence level fishery using hooks and line; it supplements the protein in the diet of the local communities but is not a significant income source.

Fish catches

Catches landed include Catfishes. Many of the fishes which are found in this zone, and which ultimately feed the delta fishery, breed within the flood plain during the seasonal floods. Indeed, while this reach is not important in terms of fish catch, it may be seen as the breeding ground for the downstream fishery. Many of the fishes are stimulated to start spawning by increasing water flows as the seasonal flood approaches (the rising limb), moving into the flood plain as the flood peaks.

The Coastal system is one of the most important fisheries in Kenya, providing both artisanal and commercial fishing opportunities. The average annual fish production from Mwache River Gazi region and its associated aquatic ecosystems averages about is anticipated at 1000 mt valued at Ksh. 600 million exclusive of prawn production. It will provide livelihoods to an estimated 2,000 fishermen in the prawn fishery alone. The fish from River Mwache Reservoir will serve the international market (for prawns) and several markets both locally and distant towns including Garsen, Hola, Malindi, Gongoni, Mombasa. Most of the fish will be processed either as smoked, fried or sun dried. Mwache River has various ecosystems along the river continuum, which support the fishery of the River. These ecosystems are; (i) Brackish water environment, (ii) River trunk fishery and (iii) Estuary fishery:



Figure 9: Prawn species (*P. indicus*) identified at Gazi

The fishermen sell the prawns to traders who later sell them to beach hotels at the coast. Each fisherman lands at least 12 tins of prawns with each tin fetching about Ksh 120. The main challenges facing fishermen include:

1. Lack of boats to access the deeper parts of the creek
2. Gears
3. Exploitation by middlemen

Fish of commercial importance in Mwache River include Penaeid Prawns. Fishermen are organized into Beach Management Units (BMUs) that manage fishing effort and streamline marketing. At Kwale, particularly at Gazi an estimated over 50 fishermen, are operating 15 boats with an average income of Ksh 2100 per boat daily thus fetching a total annual income of between Ksh. 8-16 million (assuming 5 – 7 days of fishing per week).

Culture fishery

Prawn culture is prevalent in the coastal delta of Mwache River in Kwale District. This kind of culture will be implemented at the MRD reservoir. Available data indicates that most of the rivers entering the Indian Ocean e.g. the Tana River have fish supported under similar climatic conditions.

Despite migratory fish species being a small component of fish assemblages in the Mwache River, these species are often among the most economically and culturally important. For downstream mitigation options to conserve fish stocks there is need to maintain downstream flow (environmental flows) releases during impoundment to match the seasonal flow patterns, in order that the ecosystem integrity in the river is maintained. Naturally River Mwache has peak flows in May during the long rains in the catchment and November during the short rains. The rising water levels in April stimulate breeding in migratory species. During the short rains the rising water levels stimulate secondary breeding in October. In order to minimize impacts and ensure sufficient flows downstream, to stimulate fish breeding, filling should take place in the wet season and the reduction in downstream flow should not exceed 10%. The maintenance or restoration of downstream habitats can be supported by periodic opening of dam gates to create artificial floods that regulate sedimentation, allow migration, rehabilitate wetlands and mimic the natural hydrological conditions of the river as well as achieving salinity balance within the estuarine environment.

Aquatic life found in the fresh Mwache river water is mainly different type of fish species. These are *Tilapia*, *Clarias sp.*, *Barbus sp.*, *Labeo sp.*, *Eels*, *Momyrus sp.* Kwale Area where Mwache River Delta enters Indian Ocean is amongst the most productive marine ecosystem and is influenced by freshwater inflows and supply of sediments and nutrients making it an extension of the brackish water environment.

The main species found are Barracudas, King fish, Milk fish, Scavenger, Snapper, Parrot fish, Rabbit fish, mollusks, crustaceans (prawn and crab). A few places,

particularly south of the area, have scattered rocky and coral reef substrate. Terrigenous sediments from the rivers dominate the bottom in the area. The high fishery production is a result of the topography of the continental shelf in the area and inflow of nutrient rich fresh water from the rivers. The Mwache River Delta is one of the major estuarine and deltaic ecosystems in Kenya with a perennial but strongly seasonal and double peaked freshwater inflow that can cover vast freshwater and coastal floodplains that form the brackish water ecosystems. Extensive and diverse mangrove systems and marine brackish and freshwater intertidal areas, pristine beaches and shallow marine areas in Kwale forming productive and functionally interconnected ecosystem are the main features. Mangroves and intertidal mudflats and shallow brackish water creeks are well known feeding and nursery areas for fish but also for crustaceans (crabs and prawns) on which many fish species in the coastal area depend.

4.5.3 Vegetation and Flora

Following plant species are domesticated and grown in the project influence area and command area

- Maize (green)
- Maize
- Cow peas
- Cassava
- Sisal
- Water melon
- Banana
- Sukuma wiki (Kales)
- Tomato
- Groundnut
- Coconut

Flora of the project area are influenced by the ecosystems namely Mwache forest, Coastal vegetation, Shimba hills as well as Arabuko Sokoke to the north. The ASAL conditions to the west (Tsavo National Park) also influences the western zones of the project area and the part of the watersheds.

Among the trees and plant species noted around the project influence area are

- Tamarind tree,
- Neem tree,
- Frame Tree,
- *Acacia ssp*,
- *Diospyros ssp*,
- Cynometra-Manilkara type,

- Cashew nut. (others in local languages Mwawa, Mwanga, Mkanju, Mporojo, Kikwata, Mkone, Mnyubu, Mkilifi, Mbuyu (Boabab), Mfune, Mchonge Mahana and Mkwakwa among others).

Riverline plants observed are

- reeds,
- grasses / sedges among others.

Mwache Creek also presents species of mangroves. The typical species of creek and mangroves in the Kenya coast include

- *Aricennia marina*,
- *Bruguera gymnorohiza*,
- *Rhizophora mucronata*,
- *Ceriops tagal and Sonnerata alba*.
- *Rhizophora mucronata*,
- *Ceriops taga*

These are reportedly the predominant species across the Kenyan Coastal zone and highly used for construction and other purposes.

Around 50 % of the 159 rare plants in Kenya are found in the Shimba Hills south west to project influence area, where endangered species of [cycad](#) and [orchids](#) are also found. But the Shimba hills are outside project influence area and there is no any risk to these endangered species due to project.

Figure 10: Vegetation Influencing Ecosystem



Typical Forest Vegetation (Mwache Forest)

Typical Riverine Vegetation (Mwache River Flood Plain)

4.6 Geology, Topography and Soils

4.6.1 Geology Characteristics

The coastal zone is generally underlain by a base rock of sedimentary origin (shells, sandstones and clays). In general, the boundary between the geological systems or groups and their sub-divisions run parallel to the coastline, the rocks becoming progressively older as one travels inland. This series could fall into three well marked divisions as presented below in order of their succession:

- (i) The Duruma Sandstone Series consisting of grits, sandstone and shales. The division is divisible into three broad lithological units with coarse sandstones at the top and bottom of the succession and finer sandstone and shales in the middle.
- (ii) The Jurassic rocks that are entirely of marine origin and consists of limestone, mudstones, shales and occasional thin sandy beds. The airport largely lies within this division.
- (iii) The Cainozoic rocks that include a thick series of sand and gravels, coral reef with associated lagoon deposits of coral, calcareous sands and beach sands and various subsidiary sandy beds.

A critical study and review of the secondary data contained in "Preliminary Design Report on Mwache Dam, Kenya" prepared by Samez Consultants Ltd., Nairobi for National Water Conservation and Pipeline Corporation has been made. The salient points which emerged on clause 6.0: "Foundation Geology and Seismicity of Mwache Dam" are:

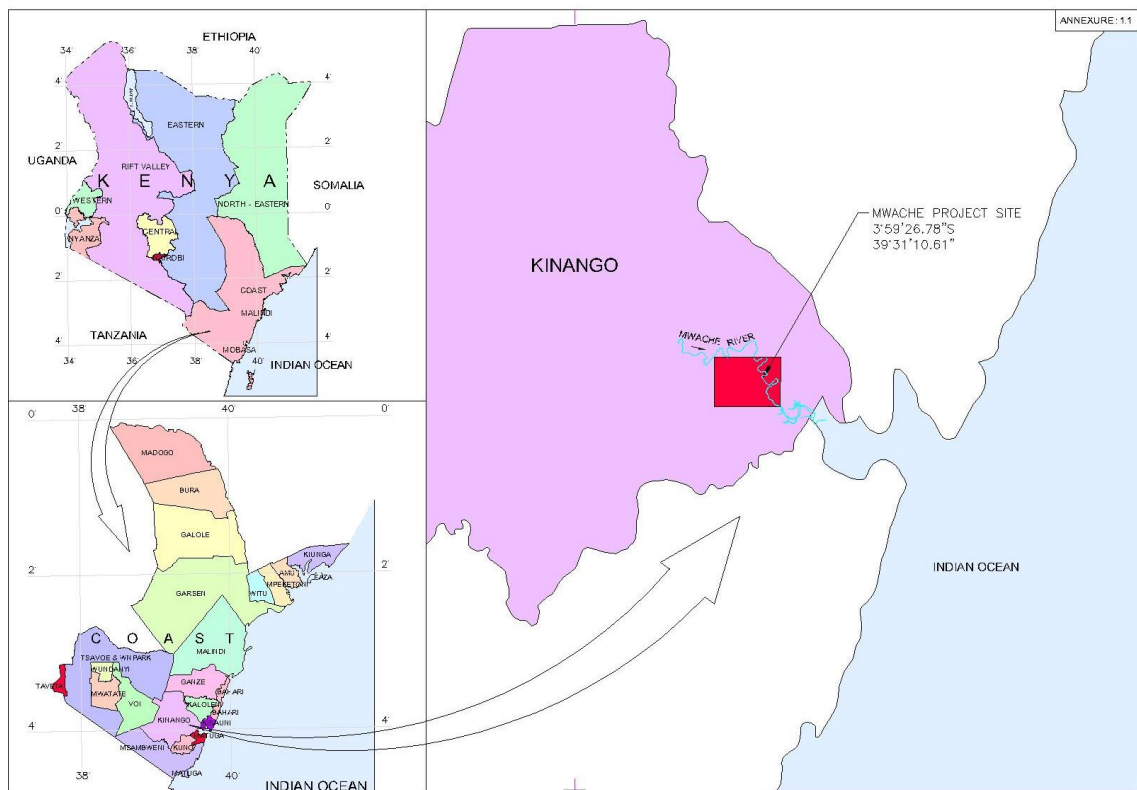
- Mwache Dam site is located within the close proximity of Mazeras trading centre in the newly created Kinango district of Coast Province.
- The dam site and surrounding is composed of the rocks of sedimentary origin, ranging in age from Triassic to Recent, are exposed in Kilifi-Mazeras area and studied in detail by P.V. Caswell, 1956.
- The Triassic rocks are known as Duruma Sandstones and subdivided into three members – Lower (Taru grits), Middle (Mariakani Sandstones and Majiya-Chumvi beds) and Upper (Mazeras Sandstones and Shimba grits). These were deposited under lacustrine and subaerial conditions with minor marine facies.
- The Jurassic rocks are of marine origin and consist of limestones, mudstones, shales and thin bands of sandstones. The Jurassic rocks have easterly regional dip, but these are downfaulted against the older Duruma Sandstone Series. Jurassic rocks are subdivided into five stratigraphic units (Caswell, 1956):
 - Changamawe Shales
 - Rabai Shales
 - Maritini Shales
 - Kibiongoni Beds

- Kambe limestone
- Cainozoic rocks occur on the coastal strip of land bordering Indian Ocean and include stratigraphic units belonging to Pliocene, Pleistocene and Recent periods. These are composed of sands, dune sands, raised coral reef, crags, red wind-blown sands and raised alluvial deposits. These rocks are flat bedded and rest unconformably upon the older rocks.
- Jurassic and Cainozoic rocks are not present in the Mwache Dam site area. Jurassic rocks occur at the foot of the plateau between Duruma Sandstones and the Cainozoic rocks to the east. These rest on Duruma Sandstones with an unconformity.
- In the Mwache river area, the middle unit of Duruma Sandstone Series, named Mariakani Sandstones is exposed in the river valley, which, in turn, is overlain by the upper unit of Duruma Sandstone Series, named Mazeras Sandstones. The contact between these two horizons is an unconformity, which is also faulted.
- In general, the rocks in Kilifi – Mazeras area dip gently towards the coast, i.e., east or east-northeast. Thus, older formations are seen exposed progressively in the west as one moves inland from the east.
- In the report three prospective dam sites on Mwache River were discussed within approximately 1 km stretch south of Mazeras Township (Figure 4.1). On comparative study and techno-economic evaluation, the Consultants, with the agreement of the Client, carried out the preliminary design of Mwache Dam which was found to have a firm geological foundation.
- The report recommended a 76 m high rockfill dam on the basis of:
 - a) Availability of construction material in abundance in the form of boulders and cobbles of sandstone
 - b) Results of laboratory testing on a rock sample from the dam site having a crushing strength of 42 N/mm².
 - c) Absence of structural weakness in the dam site area
- The report has recommended further evaluation of foundation geology by carrying out geophysical and geotechnical investigations and search of the sources for core-fill material (clay-rich soils) as these are not readily available in the vicinity of Mwache Dam site area.
- In the seismic zoning Map of Kenya, Mwache dam site falls in Zone-VI which had experienced the seismic events of low to medium intensity. On the basis of evaluation of available seismic data, Samez Consultant has concluded the earthquake loading conditions for the structures of Mwache Dam in the following ranges:

- a) Peak ground acceleration, DBE, $a_{max} = 0.12g$ to $0.13g$, and
 - b) Maximum credible earthquake (MCE), Magnitude $M = 7.5$, associated with a ground acceleration, $a_{max} = 0.25g$ to $0.40g$,
- Historical data indicate that no induced earthquake of magnitude greater than 5.0 have occurred for dam lower than 100m in height. As such, Samez Consultant has concluded that filling of proposed Mwache Dam reservoir is not expected to generate induced earthquake of magnitude more than 5.0.

Topography

The Mwache dam development area is a plateau, which gently rises from Mombasa near Indian Ocean coast of Kenya and from EL 0.0m (mean sea level) towards east from Pemba to Mwache – Chigate area and thereafter flows southeast before joining Indian Ocean Mwache Creek. Throughout its course the river Mwache makes several meanders. In the upper reaches, the riverbanks are not very high. From Kilibole – Munzeni area onwards, the river forms deep and steep gorges passing through Mwache River trending NW-SE between villages Fulugani and Miyani.



Index Map of the Study Area

4.6.2 Soils

Previous reports carried out elsewhere in the region shows that top soil gradually changes to sandy clayey gravel at depths of 2 – 2.5m deep. The soil types have a strong correlation with the geology and topography of the region and differ widely in depth, texture, physical and chemical properties with variations running parallel to the coastal line due to sedimentation process. The significance of this geological and soil

characteristics is the porosity associated with the sedimentary type of soils. Infiltration to the groundwater aquifers of polluting substances from the ground surface is also highly likely.

4.6.3 Mineral Resources

The project area is reportedly endowed with limited minerals' deposits though not significantly exploited has due to the low economic deposits but appropriate investigation however, is yet to be carried out. Among the minerals present in Kwale County include Titanium (found around Mdumba and Ngulwa areas and currently being investigated for exploited), Lead, Zinc and Copper (found in Dumbule, Mwale and Mkarigbe). Gemstones are usually found in Kuranze, Chidi and Mtsunga areas while Silica sand is found in Dalgabe, Ramisi and Msabweni areas and Barite in Lungalunga. Economic deposits of building sand are found in most of the riverbeds and particularly in Ramisi, Matuga, Tiwi and Msambweni. Lead, Zinc and Copper are among the minerals reportedly found around the project area. Mazeras sandstone slabs cover a large section of Kinango District commonly extracted and used for construction purposes.

Figure 11: Sample Geological nature and Economic Value



Typical Geological Formations at the Dam Site



Mazeras Slabs on Sale at Maji ya Chumvi

4.7 Climatic Conditions

4.7.1 Rainfall

Annual Average precipitation of Kinango district is 852mm. The precipitation is highest in the months of April and May while no or little precipitation occurs from March to December. 75% Dependable Annual rainfall is 610 mm.

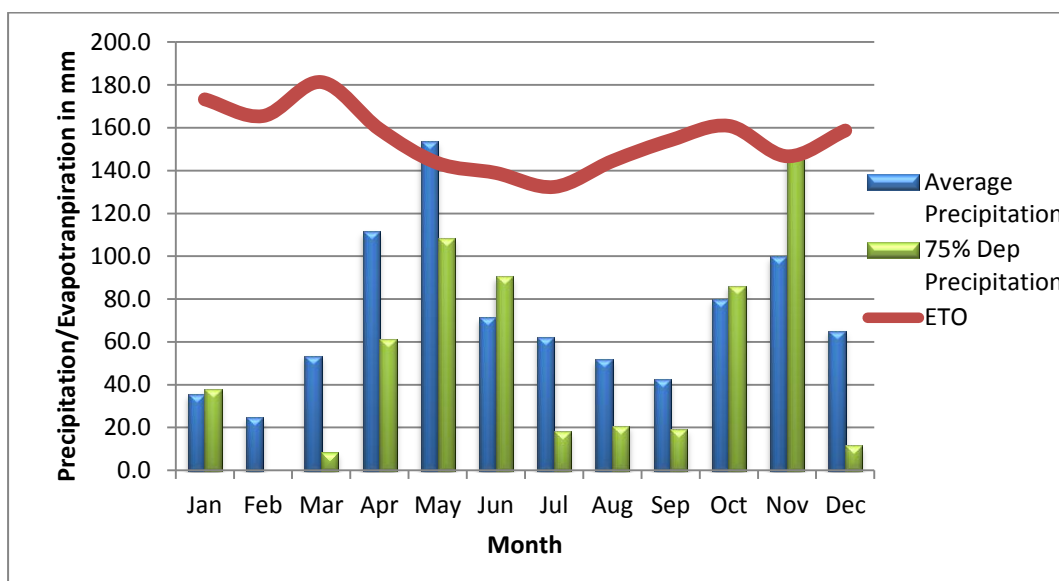


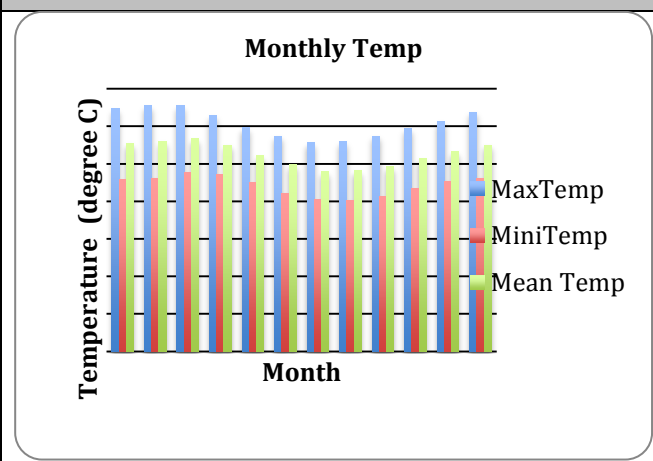
Figure 9b: 49 year Average and 75% Dependable year Monthly Precipitation/ Evapotranspiration–Kinango District

4.7.2 Temperatures

The annual minimum temperatures in the area range between 22.5°C and 24.5°C while the maximum temperatures vary between 27°C and 32°C along the coastal belt. The district is generally hot and humid all the year round with a relative humidity of about 60% along the coastal belt due to the high evaporation rate and availability of surface water.

Table 9: Monthly Average Temperature data at Kinango

| Month | Max.Temp (deg. C) | Mini Temp (deg. C) | Mean Temp (deg. C) |
|---------|-------------------|--------------------|--------------------|
| Jan | 32.4 | 22.9 | 27.65 |
| Feb | 32.8 | 23.1 | 27.95 |
| Mar | 32.8 | 23.9 | 28.35 |
| Apr | 31.4 | 23.6 | 27.5 |
| May | 29.8 | 22.5 | 26.15 |
| Jun | 28.7 | 21.1 | 24.9 |
| Jul | 27.8 | 20.2 | 24 |
| Aug | 28 | 20.1 | 24.05 |
| Sep | 28.7 | 20.7 | 24.7 |
| Oct | 29.7 | 21.7 | 25.7 |
| Nov | 30.6 | 22.7 | 26.65 |
| Dec | 31.9 | 23.1 | 27.5 |
| Average | 30.4 | 22.1 | 26.258 |



Source: Hydrological Report

4.7.3 Precipitation and Evapo-transpiration

The precipitation is highest in the months of April and May while no or little precipitation occurs from March to December Annual Average precipitation is about 900mm against an average 1,860mm evapo-transpiration in the region with 75% Dependable Annual rainfall equivalent to 610 mm. Evaporation rates recorded at the Moi International Airport provide the appropriate parameter to describe evaporation variation in the project area. The mean monthly evaporation variation in the project area is shown in Table 4. The results indicate that the mean daily evaporation rates vary from 3.5 mm in July to 6.3 mm in February

4.7.4 Humidity

The Relative humidity data shows the Coastal nature of climate. Relative humidity varies between 70% - 75% from January to March and 65% – 67% from April to December.

Table 10: Relative Humidity Data at Kinango

| Month | Relative Humidity (%) |
|----------------|-----------------------|
| Jan | 67.5 |
| Feb | 65.5 |
| Mar | 67.9 |
| Apr | 73.3 |
| May | 76.6 |
| Jun | 75.6 |
| Jul | 77.3 |
| Aug | 75.5 |
| Sep | 73.2 |
| Oct | 72.9 |
| Nov | 73.8 |
| Dec | 71.4 |
| Average | 72.54 |

Relative Humidity (%)

Source: Hydrological Report

4.8 Status of the Catchment and Silt Transportation

It was observed that there is a degradation of the catchments and watersheds following poor land use practices in steep and fragile location. The communities' settles in villages but have different cultivated land parcels. Most of the areas have been cleared of vegetation for farming though there is general lack of extension support on suitable crops and mode of cultivation. Due to the poor rainfall and hence poor agricultural production, non-farming land use activities also take place such as to include charcoal burning, gazing activities and extraction of building materials among others also comes into play in an effort to supplement the incomes.

The nature of soils in the project areas (described as sandy-loam), is relatively less cohesive and poor vegetation cover exposes the surface to erosion during rains.

There is soil erosion in most parts of the catchments leading to heavy loads of silt in the rivers towards the dam location and eventually onto Mwache creek. The volume of productive soils lost into the sea, therefore, is significant. Photographs in figure 10 below is testimony enough of this situation.

Figure 12: Sample Catchment Degradation



Special attention is given to silt management plan. Silt amount annually to be transported is estimated. Three check dam at appropriate locations are designed to harness the silt. Silt removal from these check dam at regular interval is to be made at operation phase. It is proposed that coarse silt may be used in construction sector and fine silt can be used as soil additive to improve the soil structure of sandy soil and raise the water productivity in agriculture sector.

CHAPTER 5: SOCIAL AND ECONOMIC SETTING

5.1 Background

This chapter describes the socio-economic setting of the dam and pilot irrigation component of the “project” located in Kinango District and does not at this stage include specific socio-economic description of sites where other water related infrastructure including, water supply and sanitation infrastructures in Kwale and Mombasa County.

5.2 Administrative Location and Population

Coast Province covers an area of 82,816km² and has a total of 13 Districts with 21 political constituencies and 184 electoral Wards spread in 13 Local Authorities. Six of the 13 Districts were created in the year 2008 and are therefore new. Kinango is one of them. Mombasa City is the Provincial Headquarters of Coast Province (one of the former eight provinces of the Republic of Kenya). Coast Province borders Eastern Province to the west, Rift Valley to the west, North Eastern to the North East, the Republic of Tanzania to the south, the Indian Ocean to the East and Somalia Republic to the North East. Table 11 below presents a summary on administrative areas and associated population with focus on Kasemeni Division (Project Location). Kinango District with a density of 87 persons has Kasemeni (population of 67,901) having highest population density of 108 with a majority of people living in abject poverty mainly due to food deficiency.

5.2.1 The Dam Site

The project area is in Kinango District of Kwale County with specific locations as follows (administrative setting within the current constitutional dispensation will be established in the course of the detailed studies). The dam extends from the northern banks to the southern banks of Mwache River while throw-back distances will extent about 6 – 9km to the west. The affected administrative zones are shown on Table 11 below while the approximate water line and buffer zone would follow the 95m contour line from the dam wall as shown in Annex III of this report. Please note that most of the dry valleys entering Mwache River will also be partially flooded.

Table 11: Administrative Locations Covered by the Dam/Irrigation

| Northern side of the dam site | Southern side of the dam site | Western Side of the dam site |
|-------------------------------|-------------------------------|--------------------------------|
| Fulugani Village | Miyani Village | Mnyenzi, Chigato sub-locations |
| Mazeras Sub-location | Rombo Sub-location | Mtaa & and Mwatate Locations |
| Kasemeni location | Kiguluni location | Kasemeni Division |
| Kasemeni Division | Kasemeni Division | Kinango District |
| Kinango District | Kinango District | Kwale County |
| Kwale County | Kwale County | |

5.2.2 Service Area

The area anticipated to be served by the dam through irrigation spans for over 5,000ha. with 4,676ha, being the low lying I zone to the south of the project while about 1,037ha will be on the northern and western zones. These areas cover almost the entire Kasemeni Division as far as Bofu areas and parts of Mwatate location to the west. The proposed mode of irrigation will be small scale where farmers are provided water to grow food crops on an average of 1ha per household for food sustainability and income generation

5.3 Land Ownership and Settlements Patterns

The landownership in the area is being addressed in detail under the RAP process on a separate report. Observations shows that land in the area is not registered to individual ownership and are still a Trust Land under Kwale County Council as part of the larger Miji Kenda Trust Land. The process of adjudicating land rights for individual ownership is going on and so far, an area list has been prepared by the Kinango District Land Adjudication and Settlement Officer (DLASO), but not finalized. There is an ongoing pilot settlement scheme in Mazeras area affected by this project but it is yet to get finalized. Land use is subsistence farming with very low land productivity value, due to poor rainfall, poor soil quality and the people's culture.

Land ownership in the project area is clan based and this influences the settlement trends. Family homestead clusters are generally distributed on all sides of the dam site creating a significant interaction and potential conflict with the dam components. Kasemeni of Kinango District (project location) is among areas least developed in terms of infrastructure such as road network, electricity and water supply.

5.4 Population Trends

Population distribution and settlement pattern in the Coastal Districts are influenced by infrastructure network such as roads, water, electricity, availability and accessibility of areas of gainful employment, availability of cheap housing, security and land tenure. High population densities are found in Mombasa Island Division and along the major highways such as Mombasa – Lunga Lunga road in Likoni Division, Mombasa – Nairobi road in Changamwe Division and Mombasa – Malindi road in Kisauni Division. Sparsely populated areas are found at the outskirts of the Districts including Mwakirunge, Maunguja, Mwangala and Mkupe. Most of these areas are well served by infrastructural services and their people will directly benefit from the water project especially for domestic water requirements.

Table 12: Population Trends

| Division | Location | Area km ² | No. of HH | Farm Families* | Population | | | Density |
|--------------|---------------|----------------------|--------------|----------------|--------------|---------------|---------------|-----------|
| | | | | | Male | Female | Total | |
| KINANGO | Kinango | 200.4 | 3555 | 3555 | 9213 | 10043 | 19256 | 96 |
| | Puma | 134.5 | 910 | 910 | 2880 | 3284 | 6164 | 46 |
| | Vigurungani | 725.9 | 2252 | 2252 | 6675 | 7021 | 13696 | 19 |
| KASEMENI | Gandini | 105.0 | 2162 | 2162 | 6259 | 7056 | 13315 | 127 |
| | Kasemeni | 78.5 | 4064 | 4064 | 11070 | 12229 | 23299 | 297 |
| | Mtaa | 131.4 | 1771 | 1771 | 4772 | 5571 | 10343 | 79 |
| | Mwatate | 112.2 | 2243 | 2243 | 6863 | 7775 | 14638 | 130 |
| | Mwavumbo | 134.9 | 2662 | 2662 | 8229 | 9035 | 17264 | 105 |
| SAMBURU | Chengoni | 321.9 | 1906 | 1906 | 6379 | 7414 | 13793 | 43 |
| | Mackinon Road | 403.3 | 1731 | 1731 | 5013 | 5006 | 10019 | 25 |
| | Makamini | 293.5 | 1700 | 1700 | 4993 | 5746 | 10739 | 37 |
| | Samburu South | 375.6 | 2905 | 2905 | 8748 | 10100 | 18848 | 50 |
| | Taru | 408.9 | 1737 | 1737 | 4987 | 5383 | 10370 | 25 |
| NDAVAYA | Ndavaya | 555.9 | 4406 | 4406 | 13288 | 14528 | 27816 | 50 |
| TOTAL | | 4011.7 | 34004 | 34004 | 99369 | 110191 | 209560 | 52 |

Source: Kinango District Year 2010 Farm Management Guideline

Mwache Dam will be located in Kasemeni Location of Kasemeni Division-Kinango District. According to the Office of the Chief the population in 2011 by sub-location and villages is as outlined below:

Table 13: Mnyenzi Location Population

| SUB-LOCATION | MALE | FEMALE | TOTAL |
|--------------|-------------|-------------|--------------|
| Mnyenzi | 602 | 506 | 1108 |
| Peku | 429 | 545 | 974 |
| Gona | 572 | 608 | 1180 |
| Vikolani | 654 | 622 | 1276 |
| Vyogato | 470 | 514 | 984 |
| Mwangaraba | 408 | 520 | 928 |
| Migoweni | 513 | 549 | 1062 |
| Kilibole | 418 | 498 | 916 |
| Yowani | 401 | 468 | 869 |
| Miyani | 411 | 408 | 819 |
| Chigojoni | 502 | 457 | 958 |
| TOTAL | 5380 | 5695 | 11075 |

Table 14: Mazeras Location Population

| SUB-LOCATION | MALE | FEMALE | TOTAL |
|--------------|-------------|-------------|-------------|
| Mbuyuni | 384 | 435 | 819 |
| Mpirani | 426 | 435 | 861 |
| Mwachipa | 235 | 239 | 474 |
| Fulugani | 586 | 410 | 996 |
| Bahakanda | 189 | 195 | 384 |
| Shaurimoyo | 261 | 244 | 505 |
| Bokole | 420 | 513 | 933 |
| Mabirikani | 283 | 278 | 561 |
| Manyu | 114 | 136 | 250 |
| Mulungungera | 392 | 406 | 798 |
| Mgalani | 387 | 420 | 807 |
| Mazeras“ E” | 260 | 523 | 783 |
| TOTAL | 3937 | 4234 | 8171 |

Table 15: Chigato Location Population

| SUB-LOCATION | MALE | FEMALE | TOTAL |
|--------------|-------------|-------------|-------------|
| Chikomani | 310 | 335 | 645 |
| Majengo | 364 | 395 | 759 |
| Mwache | 352 | 361 | 713 |
| Chinguluni | 300 | 274 | 574 |
| Chigomeni | 282 | 315 | 597 |
| Chigato “C” | 282 | 315 | 597 |
| Hanje | 749 | 700 | 1449 |
| Madeni | 194 | 191 | 385 |
| Mtulu | 222 | 226 | 448 |
| TOTAL | 3055 | 3112 | 6167 |

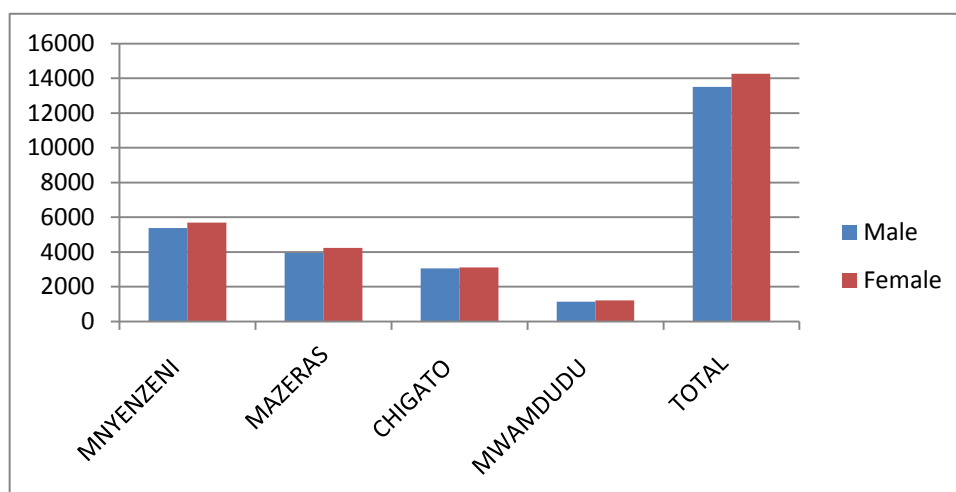
Table 16: Mwamdudu Population

| SUB-LOCATION | MALE | FEMALE | TOTAL |
|--------------|-------------|-------------|-------------|
| Chongongwe | 442 | 545 | 1027 |
| Bonje | 442 | 462 | 904 |
| Nyando | 208 | 210 | 418 |
| TOTAL | 1132 | 1217 | 2349 |

Table 17: Population Summary Table

| SUB-LOCATION | MALE | FEMALE | TOTAL |
|--------------|--------------|--------------|--------------|
| MNYENZENI | 5380 | 5695 | 11075 |
| MAZERAS | 3937 | 4234 | 8171 |
| CHIGATO | 3055 | 3112 | 6167 |
| MWAMDUDU | 1132 | 1217 | 2349 |
| TOTAL | 13504 | 14258 | 27762 |

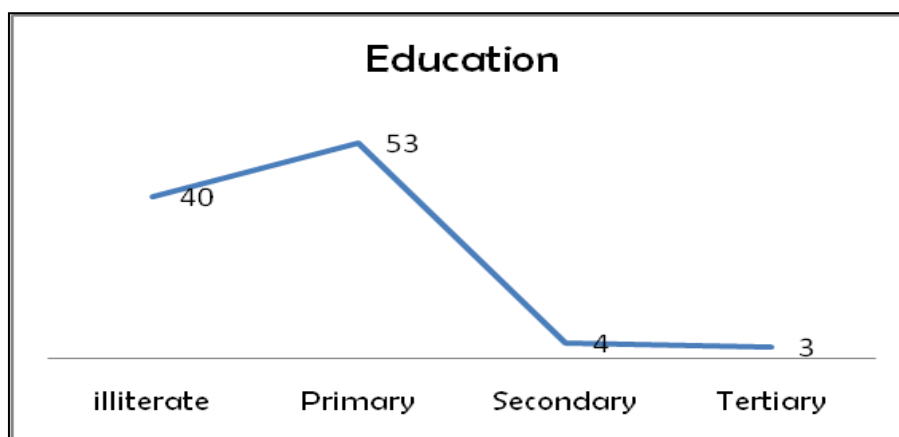
Pictorial presentation of population of affected inhabitants are given as below



5.5 Education

There are 8 primary schools, 2 nurseries and 2 secondary schools in the division. School enrolment levels appeared to be generally low and were attributed to acute unemployment and lack of household financial capacity while primary schools enrolments rose to over 50%, secondary schools and tertiary colleges is quite low (down to 3 -5%). This contributes to very high illiteracy levels in the area. They said that children didn't want to learn due to lack of role models, poor influence and parental irresponsibility. It was pointed out that children from poor families were likely to repeat a grade, be expelled or suspended from school or drop out of high school due to financial problems. Marriage at young age and premature pregnancies are also indicators of poor school enrolment levels.

Figure 8: Education Trends in Kinango District



Source: Socio-Economic Survey, July 2011

5.6 Water Supply

Kasemeni Division is not endowed with adequate surface water sources since all streams and rivers are seasonal. Flash floods originating from the highlands flows into the area during the rains (though the project area also receives limited rainfall). It has not been possible to quantify how much water is effectively drawn from the rivers for social and economic use. The seasonal Mwache River, the main stream in the area is characterized with stagnant pools in most sections on which most of the residents relies on for washing, watering livestock and limited farming along the river flood plain.

55% of the households rely on the limited piped water (mainly from Mzima pipeline), while 42% depends on water from Mwache River and other sources. Reliance on river water is due to erratic piped water flow and cost, that has led to water-related diseases like schistosomiasis worms and bilharzias. Piped water (where applicable) is used for drinking while water fetched from the river is used for domestic purposes like bathing and washing. The Katundani – Miyani water project (a community-based organization) aims at ensuring that all households in the division access piped water.

5.7 Health

5.7.1 Health facilities

The location has two major dispensaries that are within safe physical reach for the population i.e. Mwache and Mnyenzeni. Mazeras dispensary is the only appropriately equipped health care in the area that provides affordable services. There are also numerous private health facilities in Mazeras town while main services are offered in Kinango District Hospital. Coast Provincial Hospital is located in Mombasa, some 20km from the project area. There are several pharmacies and drug shops in Mazeras, Mombasa and almost all the shopping centers in the area.

Around the Dam area, there are two Government medical facilities namely Mazeras

dispensary and Mnyenzi Health Centre. In Mazeras town there are no private medical services on the side of Kinango District but there are two clinics on the side of Kaloleni District. The table below shows Staffing at Mazeras Dispensary;

Table 18: Health Centers in the Dam Area

| Position | Current Staffing Level | Ideal Number Required |
|--------------------------|------------------------|-----------------------|
| Clinical Officer | 1 | 2 |
| Nurses | 4 | 5 |
| Public Health Technician | 1 | 2 |
| Records Officer | None | 1 |
| Laboratory Technician | 1 | 3 |
| VCT Counselor | 1 | 2 |
| TOTAL | 8 | 15 |

The dispensary has piped water from Mzima pipeline and has two storage tanks of 10,000 and 3,000 liters respectively. No water shortage is experienced.

5.7.2 Diseases

The common diseases in the command area are Malaria, bilharzias, diarrhea, cholera, ringworms, flu/colds and typhoid. Numerous vector-borne diseases are associated with stagnant water. Schistosomiasis (or Bilharzia) spread through snails breeding in still or slow moving waters was a significant public health problem. The community was highly predisposed to malaria infections caused by water impoundments that increased favorable vector sites since water is essential for the breeding of mosquitoes. Other common diseases include;

- (i) Bilhazia especially during rain seasons but many patients do not report so frequency appears low.
- (ii) Diarrheal diseases-between 40-50% cases reported daily during dry season and 60-70% during wet season.
- (iii) Malaria
- (iv) Respiratory diseases-40-50% of cases reported daily
- (v) Intestinal worms
- (vi) Skin infections
- (vii) HIV and AIDS

5.7.3 Sanitation and Hygiene

The absolute poverty of the people in the area has had a direct link to lack of basic sanitation facilities. Without improved sanitation, people continue to suffer from ill health, lost incomes, inconveniences and indignity. Lack of access to improved sanitation facilities has forced the community to resort to open defecation or other unsanitary forms of defecation. Open defecation is mostly done in the bush and

cultivated land as well as in deep valleys including the river beds. Over 60% use bushes for toilets and only less 30% have access to pit latrines and >5% with flush or sanitary facilities. Such practices do not ensure hygienic separation of human excreta from human contact and the river water. The outcome of this practice presents substantial adverse public health risks as the waste could contaminate drinking water in the river and cause life-threatening forms of diarrhea and other water borne related diseases or direct infection, especially to children

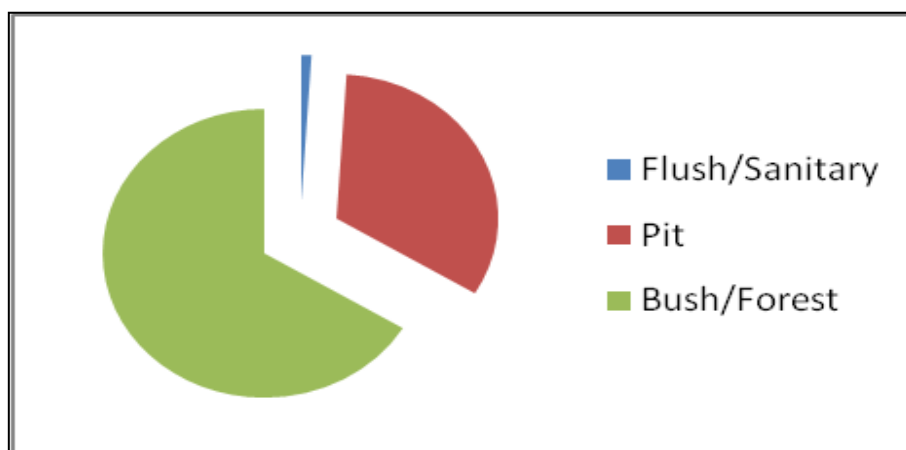


Figure 12: Modes of Sanitation

Source: Socio-Economic Survey, July 2011

Sanitation

Generally sanitation is low. About 38% of homesteads in Kasemeni Location have pit latrines. Reasons include:

- (i) Poverty
- (ii) Traditional belief that man should not share toilet with daughter in-law etc
- (iii) Rock structure just about 2 feet deep making it difficult to dig a hole
- (iv) Loose soils leaving toilets collapsing during rainy seasons
- (v) Availability of bushes and shrubs in the villages as opposed to Mazeras where there are no bushes and toilets have been built.

Hygiene

It is low estimated at 40% and thus a lot of education is required in:

- (i) Personal hygiene i.e. bathing ,cutting nails, keeping hair clean, washing clothes, brushing teeth
- (ii) Household hygiene i.e. sweeping the house, cleaning furniture, having clean beddings and use of ventilation
- (iii) Environmental hygiene i.e. disposal of household waste is generally poor as many homesteads do not have designated places for disposal.
- (iv) Hand washing before eating and after visiting toilet.

5.8 Institutions and Development Agencies

The main administration office in the area is Kasemeni District Officer and the Chief's Office. The other administrative structures are the sub chiefs and village elders' offices. There are four NGOs, namely KOINS (focusing its efforts on poor, Rural Villages in the Kinango District, Red Cross Society (food for work program) and Sombeza's Rural Support Program. A number of CBOs are implementing various community development projects in the location. Six churches and three mosques are also found within the project area. Specific institutions found within proximity of the project site are as follows;

East

Mwache forest, the Indian Ocean Creek, a few Settlements Mwamdudu villages, Mwamdudu Primary school, Assistant Chief's Office-Mwamdudu, Bonje Village, Bonje Primary School

South

School for the deaf, Miyani Village, Assistant Chief's Office Miyani, Mosque, Day Care Center, Katundani village, Mnyenzi Village Densely populated settlements.

North

Fulugani Village, Fulugani Primary School, Office of the DO-Kasemeni, Mazeras High School, Mazeras Dispensary, Bombolulu Memorial Girls High School, Mazeras High School, Mazeras Primary School, Kasemeni Shopping Center, Kasemeni Slaughter house and Mazeras Mission. The area has densely populated settlements.

West

Majengo Shopping Center, Mnyenzi Shopping Center, Koins International, Mnyenzi Dispensary, Mnyenzi Secondary School, Mnyenzi Primary School, Chigato Assistant Chief's Office, Bofuvillage, Bofu Primary School, Bofu Dispensary, Mabesheni village, Mabesheni village Polytechnic, Mabesheni Primary School, Mtaa Market, Mtaa Dispensary, Mtaa Primary School, Nunguni village, Nunguni Primary School, Kisuvini Village, Guro Village, Guro Primary School, Settlements are scattered.

5.9 Economic Setting

5.9.1 Natural Resources

Generally, Mwache Dam aims at benefiting Mombasa city water supply system. The city faces acute shortage of water with daily demand of 181,000m³ against available supply of between 55,000m³ and 60,000m³ of which 20 – 25% goes into industrial and commercial use. Among key water demand zones in Mombasa water demand include Mtwapa in Kilifi, Mazeras, Rabai/Kaloleni and Shika Adabu in Likoni. The main sources for this water are Marere Pipeline commissioned in 1927, Mzima

springs pipeline commissioned in 1953 and Sabaki scheme commissioned in the 1980s. These supply schemes are in dire need of expansion to meet the steadily increasing population of Mombasa, which are currently over 1 million and the surrounding areas. There is also a steady increase in industrialization both in Mombasa and in Mazaruni towards Mariakani. All these require water upon the already stretched supply and Mwache is a noble idea.

Among the economic potential in the area include the following;

- (i) Potential deposits of Zinc, Copper and Lead in the area though the economic value has not been established.
- (ii) Sandstone slabs commonly used for building are found in sections of the project area,
- (iii) Sand harvested for construction in sections of Mwache river basin,
- (iv) Potential for irrigation in parts of Kasemeni Division (though this is faced with topographical challenge),
- (v) Improved livestock keeping (the area project is reportedly targeted for the "Disease Free Zone" project).

5.9.2 Poverty and Income Levels

The Mwache Multipurpose Dam is located in Kinango District, which is one of the poorest districts of Kenya. Poverty is defined as inability to afford daily basic needs to support life, comprising of food and non-food items (e.g. clothing, shelter and food), inability to access basic services (e.g. education, health, water and sanitation) and inability to access and control productive resources (e.g. land, capital, information, life skills, employment etc.). The poor see themselves as lacking opportunity to sustain life and being deprived of any voice, right and value in society. They associate their state of poverty with hopelessness, powerlessness, insecurity and lack of integrity.

Although smallholder farming is indisputably the primary occupation and source of income and subsistence for the majority of the population in the project area, non-farm livelihood and income generating activities play a role in the local economy and in the livelihoods of households in the project area. These include activities such as small-scale trade and the collection and sale of firewood, daily wage labor, etc.

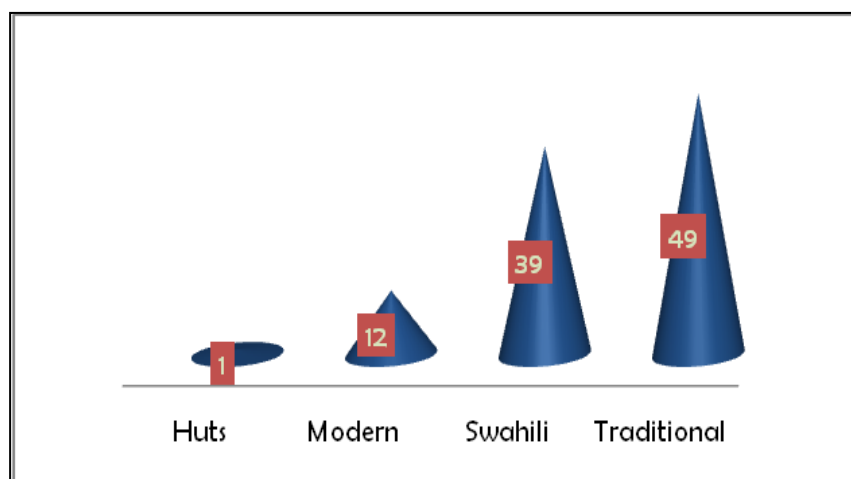
In general incomes are very low and poverty is widespread and deep in many parts of the project area. The housing structures depicts that 49% of the houses are traditional, an indicator of the poverty levels in the area. This is due to a combination of factors and causes such as;

- (i) Low and dwindling resource base (land productivity, water resources, livestock, etc.);
- (ii) Backward technology,
- (iii) Low productivity and the subsistence nature of production;

- (iv) Limited access to public services and amenities; and
- (v) Exposure to shocks and vulnerability (drought, human and livestock disease)

Agriculture (crop) and livestock keeping (livestock) as a base livelihood activity. Both heads of the households and other household members engage in wide ranging nonfarm economic activities to provide for their families. Small-scale trade, masonry, quarry and casual labor are amongst the most widely practiced non-farm livelihood activities in the households.

Figure 9: Housing Types as Poverty Indicators



Source: Socio-Economic Survey, July 2011

Figure 10: Typical Housing as Poverty Level Indicator

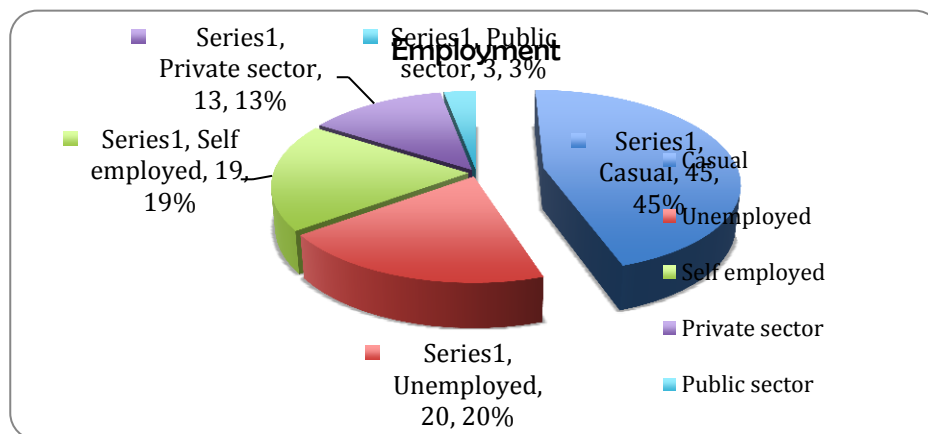


5.9.3 Labour Force and Economic Occupation

The overall average monthly cash income for households in the project-affected area is estimated to be KShs. 5,000 per household, varying significantly from household to household. Crop production including, vegetables, tubers, fruits and cereals is the major economic activity contributing to over 57% of total annual cash income for the

households. The second most important economic activity is nonfarm activities (casual laborers in private sector, masonry, quarrying, livestock selling) that contributed about 29% of total annual cash income of the households.

Figure 11: Employment Categories in the Project Area



Source: Socio-Economic Survey, July 2011

5.9.4 Agricultural Production

Erratic and unreliable rainfall has destroyed the community's productive bases in agriculture giving rise to food shortages, leading to hunger and malnutrition. There are different farming systems which are influenced by agro-climatic and socioeconomic constraints and these include vegetable-based mixed farming systems and retreat flood cultivation in the Mwache river basin. Maize is the major food crop that is cultivated in the division.

Flood recession agriculture is also practiced: The Mwache River rises during the rainy season and overflows its banks to flood the land on the plains bordering the river; permitting crops to grow on the residual soil moisture after the floods recede. Further upstream where the valley slopes are too steep to allow large scale flooding, areas of recession crops are grown on the river banks, especially where silt has been deposited at bends in the river.

Figure 12: Sample Agricultural Activities in Project area



Sample Maize Cultivation around the dam site



Sample horticulture on Mwache River Flood Plain downstream dam site

5.9.5 Livestock and Fishing

Given the scarcity of grazing land and extreme levels of poverty, few households currently keep large numbers of cattle and goats. Livestock is kept for milk and for meat for instance is greatly influenced by the Kasemeni slaughterhouse that has limited capacity. Local demand for poultry product and goat meat also keeps production low. Fishing takes place in Mwache Creek at varying levels depending on water quality. Small-scale fishing also takes place in pools on Mwache riverbed. Other limiting factors include lack of support facilities, lack of water and dwindling holding

Figure 13: Sample Livestock and Fishing Features



Grazing observed along Mwache River basin

It is said that historically Duruma were pastoralists leading nomadic type of life in the vast rangeland situated west of Mombasa District. This partly explains the many group ranches in the neighborhood of Kasemeni which include Mwavumbo group ranch in Mwatate sub-location, Samburu South group ranch in Samburu Division and Kilibole group ranch which has been subdivided into individual ownerships. The Kilibole group ranch is the one that has been adjudicated in the areas of Mazeras, Chigato and Mnyenzi and issuance of Title Deeds is being awaited by the residents. According to the District Livestock Office-Kinango, the population of livestock in Kasemeni Division in 2011 is as summarized below in Table 19.

Table 19: Livestock Population in Project Area

| TYPE: | | NUMBER |
|----------------------------|---------------|--------|
| CATTLE: | Dairy | 201 |
| | Zebu | 16650 |
| Goats: | Local | 48180 |
| | Dairy Crosses | 580 |
| | Meat Crosses | 300 |
| | Galla | 570 |
| Sheep: | Local Hair | 14500 |
| | Crosses Hair | 30 |
| Pigs: | | 21 |
| Donkeys: | | 56 |
| EMERGING LIVESTOCK: | Guinea Fowls | 966 |
| POULTRY: | Layers | 5080 |
| | Indigenous | 30700 |
| | Boilers | 3500 |
| | Ducks | 5120 |
| | Turkeys | 285 |
| | Geese | 1300 |
| BEE HIVES: | KTBH | 73 |
| | Langstroth | 485 |
| | Log hives | 266 |

5.9.6 Other Livelihoods

Non-farm economic activities include small-scale trade, local brew tapping (Mnazi drink) and quarry activities e.g. crushing stones and collecting sand from the river. Selling of traditional brooms, firewood and vegetables. Given scarcity of agricultural land and extreme levels of poverty, non-farm livelihood diversification is a necessity and not a choice. Livelihood activities such as small-scale trade like selling of fish, groundnuts, and vegetables are widely practiced by women in the project area.

5.10 Infrastructure and Communication

The area lacks electricity power yet a major electricity line pass over their roofs. These lines carry high voltage, which hinders local distribution and consumption due to the absence of transformers. Basic functional infrastructures are available, mainly rough roads, public transport vehicles, piped public water, dispensaries, shopping centre and schools. The region lacks financial services e.g. banks and M-PESA to allow easy access to financial transactions. Mobile phones reception and coverage is good, though there are no mobile phones communication satellites boosters. Specific infrastructural facilities include;

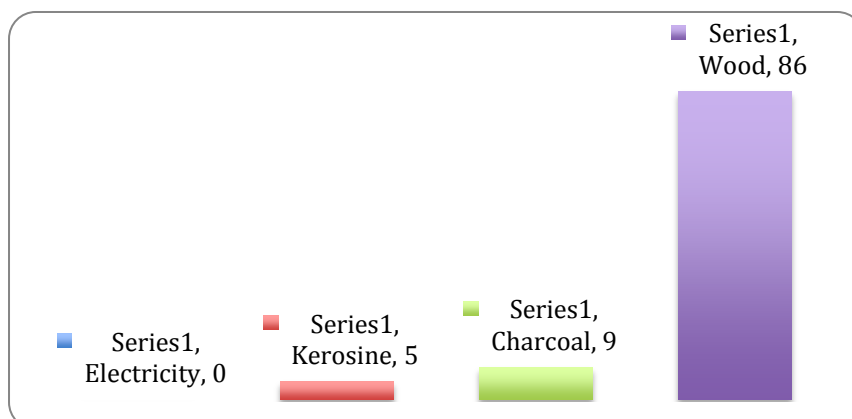
- (i) Telephone lines that only poles are found but currently with limited use due to the widespread use of mobile phones
- (ii) Power lines of high voltage traverse the area limiting access for small scale domestic use,
- (iii) Available roads and bridges only major roads mainly crossings on Mazeras – Kinango road. Other roads are served with drifts limiting use during the rains
- (iv) Railway line passes on the northern direction of the dam site to run parallel towards Mariakani and Nairobi via Voi.
- (v) Water pipelines comprising of the Mzima springs system serving Mombasa with several off takes to serve the project areas. Marere pipeline also runs on downstream of the dam site but has no connection to the projec5t areas perhaps due to the topographical orientation.

5.11 Sources of Energy

Lack of affordable energy alternatives and intense poverty has contributed to High level of direct reliance on firewood as source of energy. Forests are disappearing at an accelerating rate; the only forests remaining are the protected Kayas in the region. The scarcity of firewood had made this source of energy very dear to the communities. The main energy sources include;

- (i) Firewood/charcoal is the most common sources of energy, though with potential serious implications to the environment
- (ii) Electricity poorly served to the low income areas and is limited to institutional premises and the rich few of the area
- (iii) Fuel normally applied for lighting)kerosene) and running posho mills and water pumps as well as power generators at selected household levels (diesel),
- (iv) Solar with very limited use.

Figure 14: Forms of Energy Sources



The use of wood for energy is not healthy for environment. This will accelerate the pressure on adjoining forest and reduce the biomass coverage. This energy consumption pattern will increase soil erosion. Project is unlikely to alter the energy use pattern. However, it is observed that the energy pattern is directly related to the level of income. Project will raise the income level of the beneficiaries and substitution of wood with kerosene is possible. Moreover, it is provisioned under the project to raise the environmental awareness of people in the catchment area and discourage the use of wood for energy purposes. Thus, indirectly project will reduce the pressure on wood tree for energy and hence soil erosion.

5.12 Cross Cutting Issues

5.12.1 Gender

Owing to interplay of historical, socio-cultural, economic and environmental factors that are at work against the interests of women in general, gender relations are unfavorable to women in the project area. The household is the basic unit of economic activity where, productive and domestic activities are organized mainly on the basis of gender and age. While leadership within the household and management of household economic and social activities is the responsibility of household heads (who are usually men), women and children play a vital role in economic and domestic activities.

Women and children are disproportionately burdened by displacement. Gender socialization directly dis-empowers women, because typically women are much less able within the family to influence decisions related to how family income is to be spent.

5.12.2 Cultural Issues

The project area is mainly habited by the Duruma People (a section of the wider Miji Kenda) and is expected to have certain cultural characteristics that cannot be ignored

during the project implementation. The main cultural features observed at the project area include the following,

- (i) Mwache forest that extends to a short distance from the dam site hosts one of the Kayas (Kaya Mswakara). The level of interaction of the project likely to be significant, part with respect to accessibility,
- (ii) Vita Kafiri is a traditional site on the immediate northwest of the dam site where the local people reportedly go to consult on personal matters,
- (iii) There are graveyards in the project areas mainly clustered in families. The cultural desires in handling such facilities need to follow advise from the elders,
- (iv) Cultural sites and their locations along the main Mwache river streams will also have a link with the project.

5.12.3 HIV/AIDS and Other Communicable Diseases

The community exhibited a considerable high rate of awareness on HIV/AIDS. The community lacks access to accurate and personalized HIV information and prevention services. The health center offering HIV services is Mazeras dispensary. The community lacks access to accurate and reliable information. One CBO (Nanga football club) is said to be solely responsible for HIV/AIDS awareness in the area. Effective prevention of HIV transmission in rural setups requires innovative educational methods and materials designed to reach the target audiences with high prevalence rates reaching as high as in the rural areas. Community partnerships involving organizations such as schools, churches, and youth organizations appear to be an effective means of promoting HIV preventive behavior.

Possibility of HIV /AIDS spread through construction workers can't be ignored. Therefore, appropriate educational and awareness measures are to be formulated as part of EMP to check the spread of HIV/AIDS in the project area in general and adjoining construction site in particular.

5.12.4 Disadvantaged People

While there are no notable numbers of disadvantaged people, significant number of aged persons and children could be faced with challenges during construction and use of the dam. Relatively low clusters of disadvantaged person are the disabled and drunkards who may be faced with safety challenges during the dam use

CHAPTER 6: RESETTLEMENT ISSUES

6.1 General

This chapter describes the resettlement issues related to the construction of the dam and pilot irrigation component and provides the abstract of the RAP highlighting the measures adopted for rehabilitation and resettlement of the project affected people in order to sustain their livelihood and ensure zero negative impact on their economic life.

Most of the project-affected people are poor (per capita income < \$ 1.5/day). There are indigenous people likely to be affected due to project due to the fact that the community in the area is Duruma, which has a traditional lifestyle with a rich cultural fabric. The project area is generally poor in agricultural productivity and crops in the farms dries up before they mature due to lack of moisture. The soils are shallow and of poor quality to support any farming activities. The area is sparsely populated and the traditional housing is made of mud walls with makuti roofs, patterned in clusters. The settlements looked recently established, as there were absence of dilapidation and redevelopments in the homesteads. Enquiries at the District Land Adjudication and Settlement Office at Kinango revealed that the area is not registered and no occupant holds a land certificate in his/her personal name. There are plans to issue land titles. Three registration sections (Chigato, Mazeras and Mnyenzi) have been declared for the purpose.

Empirically, few homesteads that exist in clusters of specific families have been found vulnerable to be affected by the impounded dam water; as the valley for the proposed level is deep enough. This is evidenced by steep slopes in most of the sections of the riverbank along the 100 m contour line. Most of these homesteads will however comprise largely of the households that will be within the area to be created for the tree buffer to protect the dam against pollution from the settlements. The depth of the tree buffer will be determined on the basis of the legal provision for riparian reserves or the terrain above the high water mark of the proposed dam.

Poor sanitation and public hygiene was observed as a big challenge within the catchment area of the proposed dam as there was little evidence of human waste disposal system in form of pit latrines. Public facilities, such as schools, health, places of worship were considered within safe distance from the high water mark (86m. contour) from the dam area. This will however be subject to detailed delineation of the high water mark level and the tree buffer boundary being pegged on the ground.

The proposed location for the dam retaining wall was found very near the Mwache Forest and it will be prudent for any land acquisition to extend the buffer area to merge with the forest for continuity and ensure effective protection and conservation of the ecologically fragile flora and fauna found in the area.

6.2 Objectives of the Resettlement Action Plan

The main objectives of the resettlement action plan include among others to:

- (i) Set out strategies and programmes to provide the affected persons with alternative opportunities to continue with their lives and ameliorate the suffering.
- (ii) Harmonize the project design with the displacement of the affected persons and their assets with a view to mitigate the social and economic losses of the persons.
- (iii) Estimate the costs necessary for the re-settlement programme including any other facilities that may programme including any other facilities that may be required to achieve an acceptable level of living standard for the project beneficiaries including the displaced persons.
- (iv) Sensitize the affected communities and the general public on the implications of the project vis-à-vis the national policies of the government as they apply to the project specific.
- (v) Conducting the process in a participatory manner and provide appropriate grievance redress mechanism to project affected people

6.3 Project Location

The proposed Mwache Dam Multi-Purpose Project is situated in Kinango County within the Kasemeni Division. It comprises of the drainage system of the seasonal rivers of Mwache and Mnyenzi and their seasonal tributaries. These rivers, during the rainy season; turn into large torrential rivers that drain through Mwache Creek into the Indian Ocean at Kilindini Harbour; sometimes with devastating effects of displacing people who live along the river banks and destroying their properties.

River Mwache is the drainage system that will be affected directly by the impounding of the river for the dam. It traverses the sub – locations of Mtaa, Mwatate, Matumbi, Chigato, Mazeras, Mwamdudu, Bofu and Mabesheni. River Mnyenzi traverses the sub – locations of Mnyenzi on the right bank of the proposed dam.

6.4 The Legal and Institutional Framework

The basis of undertaking the Resettlement Action Plan, although a requirement of the International Lending Agencies such as the World Bank and the African Development Bank (AfDB); is provided for in the legal regime dealing with matters on land and the Constitution of Kenya provisions on rights of the individual vis-à-vis the general public. These include among others:

- (i) The Constitution of Kenya (2010)
- (ii) The Kenya Vision 2030
- (iii) Registered Land Act – Cap. 300

- (iv) Land Act 2012
- (v) The Survey Act – Cap. 246

These Acts of Parliament have made provision for making of Regulations to facilitate the implementation of the various sections of the different laws (See also chapter 8).

The process of identifying the individual land rights for registration purposes has not been completed in the general area where the dam is to be developed. Only the registration unit of Mazeras has reached an advanced stage of the adjudication of claims with the Preliminary Index Drawing (PID) being submitted to the Director of Survey for final verification before the individual parcels are demarcated on the ground as provided for in the Registered Land Act, Cap 300. This has the significance in the determination of the mode of compensation to the affected persons.

6.5 Social and Economic Consideration

According to the 2009 Population Census, Kasemeni Division has a population of 78,859 comprising of 12,902 households. These are the people to benefit from the completed project while also some of them are to be displaced from the area to be impounded by the dam water. The latter group is of significance as the target group for re-location and compensation for loss of their land and property. Besides the private interests that would require direct compensation, other social facilities and amenities such as schools, religious places, health and commercial facilities that enhance the residents' welfare have to be restituted in new places.

To determine these different categories of the affected persons, it was necessary to carry out a household survey for all the households below the 95m contour line (the high water mark for the completed dam). All households within an empirically delineated strip of land area above the perceived high water level that would constitute the tree buffer to protect the dam water from pollution were also included. This was necessary because the dam area had not been pegged on the ground and the information gathered will be revised as soon as the two areas are determined and demarcated on the ground. This information was collected by use of:

- (i) Questionnaires were designed to enquire of the socio-economic characteristics of the households.
- (ii) Topographical maps with the high water level contour (95m) superimposed were used in conjunction with a scanning of satellite images of the area to delineate the possible affected settlement clusters.
- (iii) Photographs were taken to provide evidence of the characteristics of the settlements and to augment information derived from an analysis of the questionnaires.
- (iv) Formal consultations were held with the opinion leaders at two forums and informal discussions were held with the affected persons during the

household survey including also the opinion leaders who are part of the affected persons' category.

The questionnaires are being analyzed and the findings will be included in the final report for re-settlement of the affected persons.

6.6 Infrastructure and Public Services

Preliminary findings indicate that all the social facilities comprising of schools, health dispensaries, mosques and churches, roadside shops and kiosks are not affected by the impounding of the dam area. However, the main road from Mombasa Highway to Kinango that traverses the area will be affected by the dam once it is completed. Mwache Bridge will be submerged and sections of the existing alignment will also be covered under water. This will entail relocation or re-alignment of the road as an integral part of the infrastructure development for the irrigation within the command area. Details on the respective social amenities will be presented when the household survey data is analyzed.

6.7 Community Participation and Consultation

The process of sensitizing and involving the community in the project design as well as other stakeholders entailed identifying the group clusters of representation necessary and their perceived roles. These groups include:

- (i) Mainly public officers who deal with sectoral programs that will in one way or other have a direct bearing on the dam project and the anticipated benefits to the community.
- (ii) Local people with expertise in either of the project components including representatives of the community based organizations and non-governmental organizations operating in the area.
- (iii) Individuals and their representatives who will be directly affected by the dam project as a result of displacement or as beneficiaries within the command area.

The following groups of people have been involved at the forums held in the project area to discuss the project at different times. These meetings have been facilitated by the Client representative and the Consultants. These include:

- (i) Central government officials in the agriculture, lands, forestry, education, provincial administration, water, local government, health, etc.
- (ii) Community based and non-governmental organizations working in Kwale County; e.g. World Vision, Plan International, Aga Khan Foundation, Kaya Elders, etc.
- (iii) Opinion leaders selected at random through consultation by the CDA field officers with local knowledge of social working groups and net-works.

Following steps were taken during public participation and consultation of the above categories of stakeholders

- Focus Group Discussion has been conducted to record the social and environmental issues, prioritization of issues, aspiration, perception and expectation of the project affected people, sharing the initial project features
- Individual Households Survey of project affected families was conducted to collect their agro-socio-economic profile, loss of properties and house, present level of income, employment and livelihood status, respondent opinion and choice on the resettlement site and measures, etc.
- Consultation Meetings were conducted to share the measures designed under SAP and EMP to offset the negative impact and enhance the positive impact of project on social and environmental condition and provision of R&R and get the feedback of PAPs, project beneficiaries and stakeholders

The feedback of the project affected people, project beneficiaries and stakeholders were used to finalize the SAP, EMP and RAP. The details of public participation and consultation are described in more detail in subsequent chapter.

6.8 PAPs Characteristics

The household survey was conducted to find out the characteristics of the project affected household and people, in terms of literacy, social–economic status, level of income and employment, value of property and land lost under the submergence and household livelihood status. PAP household survey was conducted with the help of well-designed close and open-ended questionnaires. Total numbers of project affected households are found to be 167.

Majority of the respondents had not gone to school implying a high level of illiteracy with only 12 (7.5%) respondents who had attained post-primary education.

In terms of age for the respondents, 10% respondents were over 70 years, 40% were between 40-70 years and 50% respondents were between 20 and 40 years. This connotes a relatively young population that is consistent with the national patterns of population composition. The majority of the respondents were involved in subsistence farming as only 12 of the households were reported to be engaged in formal employment. These were involved in education, construction, hotel industry and as drivers and mostly working outside the project area. The break down of the PAFs is given as below in Table 20.

Table 20: Distribution of Project Affected Families

| Village | No of PAFs |
|--------------------------|------------|
| Bokole | 13 |
| Chigomeni | 6 |
| Chenguluni | 34 |
| Fulugani | 13 |
| Miyani | 2 |
| Mnyenzeni | 4 |
| Mwache | 38 |
| Mwachipa | 11 |
| Mwashanga | 4 |
| Nunguni | 8 |
| Rombo | 16 |
| Vikinduni | 12 |
| Scattered | 6 |
| All | 167 |
| Religious Breakup | |
| Muslims | 78 |
| Atheist | 4 |
| Christian | 18 |
| Gender Breakup | |
| Women Headed PAFs | 26 |
| Men Headed PAFs | 78 |

6.8.1 Partial Displacements

The survey was conducted in the area considered from empirical evidence to be potential for impounding and the creation of a tree buffer to protect the dam water from pollution and encroachment by irregular human activities. Very few people will be partially displaced within the project. All homesteads considered vulnerable to displacement were captured in the household survey. As majority of the residents cultivated seasonal crops on the alluvial deposits at the bottom of Mwache River, these may be considered as potential for partial displacement but would relocate all the same once the land adjudication and registration of individual land rights is completed. Number of trees affected due to project is given below Table 21.

Table 21: Affected Number of Trees Due to Project

| Tree/Crop | Affected Numbers |
|------------|------------------|
| Coconut | 2430 |
| Cashew nut | 388 |
| Mango | 1202 |
| Orange | 108 |
| Pawpaw | 100 |

| | |
|---|------|
| Guava | 360 |
| Neem | 270 |
| Mutomoko | 135 |
| Eucalyptus | 193 |
| Gravillia | 320 |
| Baobab | 184 |
| Natural hedge | 32 |
| Graves | 35 |
| Other trees (Timber and Wood fuel) | 3146 |
| Other perennial crops that were valued include: cassava, sugarcane and bananas. | |

6.8.2 Displacements of Families

Total number of project-affected families affected due to project is observed to be 167 comprised of 1310 person. The distribution of project-affected families under different settlements is given below in Table 22.

Table 22: Distribution of Project Affected Families

| Village | Total No of PAFs |
|---|------------------|
| Bokole | 13 |
| Chigomeni | 6 |
| Chenguluni | 34 |
| Fulugani | 13 |
| Miyani | 2 |
| Mnyenzeni | 4 |
| Mwache | 38 |
| Mwachipa | 11 |
| Mwashanga | 4 |
| Nunguni | 8 |
| Rombo | 16 |
| Vikinduni | 12 |
| Scattered Houses | 6 |
| Other Land affected including buffer area | |
| All | 167 |

6.8.3 Displacements of Houses

All the households that are subject to total displacement are interviewed with the help

of designed questionnaire to assess the loss of their houses. Total numbers of houses lost in the impounding reservoir under different administrative unit are observed to be 438 as given below

| | | |
|-----------|---|-----|
| Mazeras | : | 088 |
| Chigato | : | 285 |
| Mnyenzeni | : | 065 |
| Total | : | 438 |

Distribution of houses lost under different settlements identified during census of PAFs are listed below in Table 23

Table 23: Distribution of Displaced Houses under different Settlements

| | No of displaced Houses |
|------------------|------------------------|
| Bokole | 28 |
| Chigomeni | 18 |
| Chenguluni | 86 |
| Fulughani | 30 |
| Miyani | 6 |
| Mnyenzeni | 20 |
| Mwache | 93 |
| Mwachipa | 40 |
| Mwashanga | 15 |
| Nunguni | 17 |
| Rombo | 40 |
| Vikinduni | 27 |
| Scattered Houses | 18 |
| All | 438 |

There are more losses of house structure in the Chinguluni, Mwache, Mwachipa, Rombo and Fulugani settlements. Compensation for house losses is evaluated and given in standalone RAP report.

6.8.4 Loss of Land due to Project

It is estimated that the total land loss under impounding reservoir and buffer area would be **1109 ha**. Registration of the parcel is on-going, therefore, it is difficult to estimate the land area lost in each settlements. The land loss of each project affected families would be possible to estimate once the parcel registration is complete. Therefore, at this point of time, compensation for the total lost land is assessed and given in RAP report. However, the details of land parcel affected under different registration office is given as below in Table 24.

Table 24: Number of Land Parcels Affected due to Project

| Registration Unit | Total Parcels Registered | No. Of Parcels to be Affected and Acquired | No. of Parcels Partially to be Affected and Acquired | No. Of Parcels Built with house | No. Of Houses affected |
|-------------------|--------------------------|--|--|---------------------------------|------------------------|
| Mazeras | 1253 | 212 (16.9%) | 58 | 30 | 88 |
| Chigato | 1240 | 326 (26.3%) | 61 | 61 | 285 |
| Mnyenzi | 2780 | 92 (3.3%) | 27 | 12 | 65 |
| TOTAL | 5273 | 630 (11.9%) | 146 | 103 | 438 |

6.9 Compensation Factors

The main components for compensation payment to the project affected persons comprises of the value for land that would be expropriated for the dam and the tree buffer area including the developments on the land. The mode for determining the payment for each projected affected families is militated by the lack of adjudication of individual right records on the affected area. In light of this no single head of household could accurately give the area of land in his possession that would be lost to the dam. Detail exercise is made to fix the land price as elaborated in standalone RAP report. The price of land for compensation is fixed at USD 3000/ acres (Kshs 257100/acres).

Payment for developments is more straight-forward as it is represent by the traditional houses that were enumerated in each of the homesteads. There were cash and orchard crops at different ages - mangoes, cashew nuts, coconuts, paw paws and citrus trees. The actual values are valued at prevailing rate in the markets and bench-marked by the agricultural sector as elaborated in subsequent section.

6.9.1 Land and Developments

The project-affected area is a marginal agro ecological zone characterized by rocky and denuded poor top soils. There is evidence of sub subsistence food crops mainly maize cultivation. Coconut plantations are found in alluvial deposits at water heads or the river bed of Mwache River. The homesteads are developed in cluster form with close family members and a patriarch. Other than housing in the homesteads, there was little other developments in the project area. A detailed analysis of the farming activities in the area that will be affected is being dealt with in the chapter on agriculture and livestock farming that is due to benefit from the irrigation activities. The same is considered while fixing the land price for the compensation.

6.9.2 Housing Structures

The housing in the general project area is traditional in character being mainly mud and wooden poles for walling with mainly makuti roofing. Of the housing stock 438

housing units were enumerated. Out of these, 74 households had galvanized corrugated roofs; 24 had improved cement floors and 24 households had improved cement walls. Generally, majority of the houses in the homesteads comprised of at least two (2) units one serving as a kitchen and the other as a main house. Few were observed to have windows for ventilation and there was poor sanitation in form of pit latrines. Domestic solid waste was disposed off in the open bushes that pose serious threat to public hygiene and water portability. As indicated earlier, the settlements were established as clusters with a patriarch/matriarch as head of the homestead and were the only one allowed to answer questions.

6.9.3 Livelihoods

The main livelihood for the local community is subsistence farming. Few people are involved in non-farming activities. As there are no industries in the project area, those reported to be in formal employment worked away from the area and repatriated their incomes to the dependants in the project area. As Mwache River is a seasonal river, there was no evidence of commercial fishing as a way of livelihood although three (3) heads of household described their occupation as fishermen.

Majority of the youth in the area were involved in the gathering of building materials and sand harvesting for their livelihood. This activity thrived along Mwache riverbed where the rains on subsiding dumped sand material that was collected and sold to the construction industry away from the project area. It is found that majority of the PAPs are living under international poverty line (USD 1/capita/day)

6.10 Entitlement Matrix for PAPs

Entitlement Matrix designed for the PAPs as per the WB and National Policy as given as Table 25 below

Table 25: Entitlement Matrix for PAPs for Mwache Dam Multi Purpose Project

| Type of loss | Entitlement Unit | Description of Entitlement and Implementation Procedures | Remarks |
|-------------------------------------|---|---|---|
| Loss of houses and other structures | <ul style="list-style-type: none"> • Home owner/ • Tenant/Son/Relative • Squatters | <ul style="list-style-type: none"> • Compensation for full value of the asset depending on the quality and type of structure • Compensation for loss of business with allowance for period to find alternative accommodation • Payment of a disturbance allowance of the total compensation at the rate of 15% | <ul style="list-style-type: none"> • Replacement cost of the structure as determined by the official valuer and compared with the claimant's independent valuer or PAP accepting official valuation • The home owner will be allowed to salvage the |

| | | | |
|-----------------------------------|---|--|---|
| | | | material for re-use at new site. |
| Loss of land | <ul style="list-style-type: none"> The registered owner according to register with committee | <ul style="list-style-type: none"> Compensation for agricultural value of land per acre based on market value or a negotiated value in the absence of recognizable values | <ul style="list-style-type: none"> The land is classified as agricultural in use and no non-agricultural land was identified among the assets |
| Loss of trees and perennial crops | <ul style="list-style-type: none"> Land owner Tenant(lessee) | <ul style="list-style-type: none"> Advance notice to harvest crops Compensation at market rate for produce Net value of anticipated yield if crop not harvested Compensation to rightful claimant to produce/trees | <ul style="list-style-type: none"> Crop market value determined by agricultural expert/valuer Each claimant to receive compensation as appropriate based on quantity of trees/crop |
| Loss of non-perennial crops | <ul style="list-style-type: none"> Land owner Tenant | <ul style="list-style-type: none"> Advance notice to harvest crops Value of anticipated yield based on benchmarks Value at prevailing market price of the produce | <ul style="list-style-type: none"> Crop market value is based on benchmarks applicable by the agricultural crops valuer |
| Loss of business | <ul style="list-style-type: none"> Operator/Tenant Squatter | <ul style="list-style-type: none"> Compensation for loss of anticipated income based on previous business performance Loss of business projected over reasonable period to mitigate suffering Compensation for all immovable fixtures on premises | <ul style="list-style-type: none"> Stock in trade to be removed by owner Operator may salvage the immovable fixtures from the business premises Compensation for removal of machinery to be paid to PAP. |
| Damage to public infrastructure | <ul style="list-style-type: none"> The public in project area | <ul style="list-style-type: none"> Contractor bound to maintain the infrastructure as existing and improve as social responsibility <ul style="list-style-type: none"> Where damaged, reinstate at own cost | <ul style="list-style-type: none"> Compensation in kind and restoration of the facility by project |
| All project impacts | <ul style="list-style-type: none"> All persons within the project area | <ul style="list-style-type: none"> Sensitization of all people on: <ul style="list-style-type: none"> Project impact Construction schedules Compensation and | <ul style="list-style-type: none"> All project affected persons to be enlightened on the issues |

| | | | |
|--|--|---|--|
| | | grievance resolution mechanism <ul style="list-style-type: none"> ○ Construction procedures ○ Development initiatives by the local people | |
|--|--|---|--|

6.11 Summary of Affected Properties and Person Due to Project

Summary of affected properties, assets, families and person due to project for which compensation is accounted for is given as below in Table 26.

Table 26: Summary of Affected Families, Assets and Community Property

| Particular | Unit | Quantity |
|---------------------------|------|----------|
| Project Affected Families | No | 167 |
| Project Affected Person | No | 1310 |
| Land Lost | ha | 1910 |
| Houses Submerged | No | 438 |
| Tree Affected | No | 12940 |
| Submerged Kayas | No | 2 |
| Submerged Graves | No | 27 |
| Affected Kiosks | No | 5 |
| Submerged Latrine pits | No | 35 |
| Submerged pipe line | No | 2 |

The compensation for lost land, house, trees, community properties and cultural resources are provisioned and elaborated in the standalone report. The RAP budget allocated for the same is given in subsequent section of this report.

CHAPTER 7: CONSULTATION AND PUBLIC PARTICIPATION

1.1 Initial Interviews

Consultations and public participation as described in this chapter refer to the dam and pilot irrigation component of the “project” and additional consultation related to the other components of the “project” will be conducted upon finalization of feasibility studies and designs which will identify locations, scope and extent of the sub components.

A rapid interview of the stakeholders was undertaken during the initial stage of the ESIA study process. The principle was to assess the initial opinions and attitude of the stakeholders to the dam project. Categories of stakeholders contacted include:

- (i) Villagers encountered within and around the project area such as homeowners, livestock keepers, women, children, sand harvesters, etc.,
- (ii) Government and Organizational Officials in Mombasa, Kwale and Kinango that also involved requests for data,
- (iii) Consultations with other Consultants within the team.

1.2 Social and Economic Surveys

Surveys on the social linkages of the proposed Mwache Dam involved observations as well as direct interactions with the local communities and other stakeholders. Part of this interaction involved face to face interviews through a questionnaire that sought to obtain the basic household status, particularly for those communities within the areas to be sub-merged.

A quantitative survey was conducted at village level using structured questionnaire and it was designed to generate data and information. The data was to be generated on among other things, the availability or lack of social service facilities, existing levels of access to education, health, potable water and related services, local market prices as well as agricultural production and productivity, all of which were useful in valuation of assets and computation of compensation rates. A series of consultations were held using both formal and informal meetings with carefully selected members of the communities and all PAPs.

The purpose of this survey was to identify types of impact and accordingly categorize displaced persons, develop entitlements and prepare resettlement plan for each family. The following information about each family was collected.

- (i) Human resource base of each family.
- (ii) Economic status of each individual member of the family.
- (iii) Ownership of property – movable and immovable.

- (iv) Property including lands, structures, trees and houses either occupied or owned with tenancy rights or even as encroachers or those de-facto in possession.
- (v) Means of livelihood due to stagnation of developmental activities soon after the project, loss of property, loss of access to clientele, loss of jobs due to physical re-location, loss of gainful employment, loss of access to income generating resources.
- (vi) Community life, community properties and resource base, community amenities and services, socio-cultural value.
- (vii) Loss of habitats and lands, degradation of land and water resources, environmental degradation, adverse impact on health etc. as an after effect of the project.

1.3 Public Consultative Forums

1.3.1 Consultation Schedules

Stakeholder Sensitization

Formal public consultations were undertaken in two sessions that included a sensitization forum followed by consultation meetings. The sensitization forum was designed in an attempt to bring the project concept down to the people and stakeholders as an initial formal contact. The sessions were held as follows;

- (i) Fulugani Secondary school on 20th April from 10am
- (ii) Mnyenzi Market at KOINS for Kenya premises on 21st April from 10am.
- (iii) A supplementary session tied to the unveiling of the CDA Charter by the then Minister for Regional Development Authorities held in April 2011 at Fulugani area.

Public Consultation

This session was also held in two sub-sessions at different locations within the project area. The objective was to present the proposed project concepts and early anticipated linkages to the stakeholders. It was anticipated that the stakeholders would react and provide their views and opinions on the project to add value to the design and planning as well as enhancing social and economic benefits as well as avoiding potential cultural conflicts. The meetings were held as follows;

- (i) Fulugani area at the dam site location and was chaired by the District Commissioner on 27th July 2011 starting from 10am,
- (ii) Mnyenzi market outside KOINS for Kenya premises chaired by the area Chief on the 28th July 2011 starting from 10am
- (iii) Project Affected Persons (PAPs) were also consulted during forums held around the dam site between 12th June 2012 and 16th June 2012

1.3.2 Participation

Participants to the meetings were drawn from the following groups and organizations (full list of individual participants is attached in annex IV & V)

- (i) Government Departments (The District Commissioners Office, Ministry of Health, Ministry of Lands, District Development Office, Water Department, Culture and Social Services Department, etc.)
- (ii) Non-Government Organizations
- (iii) Public institutions (Coast Water Services Board, Water Resources Management Authority, NEMA, Kenya Airports Authority, Kenya Forest Service, etc.)
- (iv) The local Leadership including Area Councilors, Member of Parliament, Village Elders),
- (v) Cultural Leaders, among the Kaya Elders,
- (vi) Landowners and home owners in the Division
- (vii) Water users upstream and downstream

1.4 Emerging Issues

From all the Consultation forums, various opinions and views were collected. Among the emerging issues ranged from personal linkages, community linkages to regional and national issues. The project is generally acceptable to a majority of the stakeholders and members of public but conditions of acceptance were as varying as were the stakeholder categories. The following sub-sections have presented the key perceived benefits, fears and concerns as well as suggestions and opinions on improvements and enhanced acceptability.

1.4.1 Perceived Benefits

- (i) The dam is expected to create significant economic and social benefits to the communities and contribute to the attainment of the country's priority goals and ongoing national efforts to accelerate economic growth and alleviate poverty.
- (ii) Construction and Operation Labor Requirements of the scheme will provide employment and career opportunities for the local people. During the construction period, dam projects require a large number of unskilled workers and smaller but significant numbers of skilled personnel (though the latter may not be sufficiently available in the area). New jobs will, therefore, be created both for skilled and unskilled workers during the construction phase. The beneficial effect on local communities is often transient due to the short-lived impact of the construction economy on dam construction sites.
- (iii) Irrigated agriculture will contribute to enhanced food security and improved nutrition at the household level. Surplus will be marketed to generate income for the families and, hence, added value to the crops,
- (iv) The community will be assured an all year round access to water from the dam, directly or through alternative distribution systems (piped supply, canal system or other) than before.

- (v) Utilization of the reservoir buffer area for fisheries, aquaculture farming and other related resources is a potential opportunity for landowners within the immediate neighborhood of the dam,
- (vi) The dam wall will also provide a new bridge over Mwache River linking Fulugani and Miyani areas effectively easing movement between communities, accessing institutions, public amenities and market centers.

1.4.2 Fears and Concerns

- (i) The local communities have lived on Mwache River for many years through fishing, sand harvesting and watering livestock. Some members of the community undertake small-scale farming in the lower parts of the river that also supports their families for food and income generation. Upon completion of the dam, this situation will change the situation to deny the residents the opportunity unless matching alternatives are provided
- (ii) The people to be displaced expressed concern on where the alternative settlements will be. Is there government land available for the affected people? Will the affected people be facilitated to buy land within the locality? Will it be possible to remain within the neighborhood? How will the graveyards be handled? An appropriate plan, therefore, should be undertaken in which the affected persons would be involved with a clear flow of information,
- (iii) Regarding the abstraction of water from the dam, the residents wondered what mechanisms will be put into place to enable all to access water for all their requirements without compromising the law. Formation of community groups and obtaining permits would perhaps need to be facilitated,
- (iv) Landowners expressed hope that the land adjudication will be completed and title deeds issued before the people are relocated. This will preempt the legal/social conflict that could face land acquisition that would in return complicate the project progress
- (v) The landowners in the affected areas expressed concern that the extent of the dam water and buffer area had not been marked on the ground. This makes it difficult to visualize how much land and development they are likely to lose
- (vi) Members of the community, particularly women groups need to be sensitized on the actual value of water for enhanced appreciation and conservation. In this regard, community education and awareness raising should be undertaken through involvement of the local people who understands their own

- (vii) With enhanced water availability and land productivity, there is a possibility more people will move into the areas. This scenario will exert stress and pressure on resources including land, forests, water supply and energy as well as infrastructure,
- (viii) The water body will have the capacity to attract new species of animals among them crocodiles, hippos, snakes, birds and new insect types. This scenario may partly contribute to safety risks to the residents from dangerous animals such as crocodiles and hippos unless collaboration with relevant authorities (e.g. KWS) is considered during the operation stage.
- (ix) Impairment to environmental aesthetics .e.g. loss of trees. The pipeline will be buried throughout most of its length, and the land restored to its original condition. Tree cutting will be avoided wherever possible; if this cannot be avoided replacement trees will be planted to compensate for the losses. Also the value of trees will be compensated with to private owners.
- (x) Potential damage to and loss of productive farmland. Destruction of community productive bases in agriculture, fisheries and income generating potential will give rise to food shortages, leading to hunger and malnutrition.
- (xi) Widened gender disparities will be experienced. This will be occasioned by either imposing a disproportionate share of social costs on women or through an inequitable allocation of the benefits generated. The general impoverishment of communities and the social disruption, trauma and health impacts resulting from displacement will typically have more severe impacts on women. The employment created during the construction of large dams generally benefits men.
- (xii) The project is likely to separate kinship, disrupt social networks and interfere with traditional support systems leading to serious conflicts at various levels within the project area and at host destinations.
- (xiii) A majority holds that 'real economic returns from water resource development projects may be seriously compromised by enhanced disease transmission of vector-borne diseases.
- (xiv) Land acquisition is expected to lead to physical and economic displacement of people and loss of access to the land that provides for economic resources as well as shelters. The land already identified for the construction is owned by different individuals who are utilizing the pieces of land into various land uses ranging from shelter/home, livestock keeping and subsistence agriculture.

1.4.3 Key Suggestions and Opinions

- (i) Generation of fugitive dust in the atmosphere during excavation and civil works construction should be contained. Mitigation measures should be incorporated into the contracts to provide for dust control by providing water spraying during excavation and filling, by surfacing access roads with non-dust generating materials, and by proper stockpiling and cover for construction materials.
- (ii) Necessary plantation of inhabited areas should be taken up under social forestry or agro-forestry schemes;
- (iii) Potentially adverse environmental and socio-economic effects in the form of displacement, disruptions of livelihoods and loss of assets and property of project affected persons (PAPs) will be experienced. A Resettlement Action Plan (RAP) is one of the major means of addressing these problems in a planned and coordinated manner.
- (iv) The established potential significance and often irreversible losses of cultural resources due to dam construction should be adequately considered in the cultural heritage management planning process.

Figure 15: Stakeholder Consultation Forums



Members of Public being conducted to a tour of the dam site



A section of Public Consultations at Fulugani Area



A Section of Public Consultations at Mnyenzi Area



Former Minister for Regional Development Conducted to a Tour of the Dam Site and Addressed the Residents

Figure 16: PAPs Consultation Forums



Consultations with PAPs at Mnyenzi Area



Consultations with Kaya Elders



Consultations with Affected Women Groups



Project Presentation Sessions

CHAPTER 8: ANTICIPATED IMPACTS AND MITIGATION MEASURES

8.1 General Overview

Construction of large dams provides ecological as well as social challenges even though the ultimate facility is generally beneficial to the stakeholders and the country in general. Impoundment of large volumes of water has implications on the upstream systems through shifting of ecosystem boundaries upstream as a result of changes in flood regimes. At the dam site itself and the inundated areas, implications ranges from slowed silt, nutrients and pollutant transportation rate to downstream zones, potential loss and/or introduction of species (both plants and animals), displacement of social and economic features and land use changes for the residual riparian landowners. Finally, downstream impacts are associated with regulated flows of the affected rivers/streams, shifting of species to upstream areas, safety risks and land use changes due to the constant flows trends introduced by the dam. The above impact concepts guide the identification of the impacts associated with the proposed Mwache dam such as to focus on the following aspects;

- (i) Hydrological patterns of the affected river basin,
- (ii) Hydraulic characteristics at the dam site associated with the dam designs,
- (iii) Water quality issues with respect to the watershed and catchment land use practices,
- (iv) Geological trends studies in regard to physical water retention,
- (v) Aquatic ecosystems and habitat requirements,
- (vi) Riparian land use trends and natural features,
- (vii) Social features (land use, settlements, economic activities, cultural features, etc.).
- (viii) Social trends including population and settlement dynamics, social integration and kinship relations, cultural values, displacement and relocation, Gender equity and disease notably HIV/AIDS prevalence
- (ix) Economic trends namely economic activities, poverty levels and livelihood changes

Impacts to the social and environmental aspects vary from one area to another depending on specific settings. General impacts associated with the proposed Mwache dam are discussed below;

8.2 Environmental Impacts and Mitigation Measures

The overall impacts arising from the dam construction are positive in all respects of environmental, social and economic perspective. Once constructed, Mwache dam will supply water to Kwale and Mombasa Counties. This will have major positive impacts on economic growth, tourism development, people's livelihoods, incomes and food security. The above scenario reveals that females, who form majority of the population and undertake most of the water-related activities, and men who own the land, should be actively involved in the project implementation. Further, as part of the

projects efforts to enhance gender equity, there is need to mainstream gender in all project activities.

Provision of water from the proposed dam has the potential to enhance development and growth of the markets as more economic and social interests arise. More important is the opportunity to improve sanitation and hygiene in these markets as opposed to the currently potential threat of diseases in almost all the markets. This conclusion follows from the justification criteria.

Among the key positive linkages include;

- (i) The dam is expected to moderate water flows downstream of Mwache river throughout the year with potential ecological stability and constant availability of water to the downstream dependants and ecological productivity within Mwache Creek,
- (ii) With the proposed sand check dams, downstream, the dam will also help control siltation into Mwache Creek downstream, which is a significant benefit to the ecological status. However, complete cut-off of silt entry could also have negative implications following reduced nutrients and potential minerals necessary for fish,
- (iii) The dam water has the potential to sustain ecological habitats (particularly indigenous) including vegetation and aquatic and terrestrial wildlife (fish, crocodiles, hippos, snake species, etc.),
- (iv) The general hygiene and sanitation of the project area and the service area will significantly improve as a result of readily available water, and particularly from the treated water supply,

Cumulative Impact Assessment

Cumulative impact is defined by the US Council on Environmental Quality as "the impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions (RFFA) regardless of what agency undertakes such other actions." Thus the practice of Cumulative Effects Assessment (CEA) of projects in a region began. Various aspects of CEA began to be studied.

The impact of human activity or a project on an environmental resource or ecosystem may be considered insignificant when assessed in isolation, but may become significant when evaluated in the context of the combined effect of all the past, present, and reasonably foreseeable future activities that may have or have had an impact on the resources in question. The Council for Environmental Quality established under the US National Environmental Policy Act of 1969 (NEPA) came to the view that a conventional project and site-specific approach to environmental assessment has its limitations when it comes to assessing potential cumulative effects on environmental resources.

This ESIA addresses cumulative impacts that may arise from the incremental impact of the proposed Project when added to other closely related past, present and probable future projects.

Cumulative impacts associated with the development of the Project are likely to be combined effects and induced growth and spatial and temporal crowding. Combined effects are those likely to occur at areas where there is a concentration of activity. The main construction impacts with combined effects are likely to include: land take, traffic impacts, waste management, landscape and visual effects, and community health and safety. Strategic induced growth refers to the greater demand and availability of irrigation, which will be an inevitable outcome. Spatial and temporal crowding occurs when many activities are carried out in too small an area at the same time. These effects will be considered in the siting of labour accommodation and layby areas particularly to minimise the need for economic displacement.

Water abstraction from the Mwache River will marginally reduce the net water volume available in the River (because of consumptive use for domestic and agricultural purposes). The proposed location of the dam is downstream and in effect, no down stream water users are going to be impacted negatively. However, when combined with other existing and planned water abstractions from the Mwache River, it will contribute to significant impacts on overall water availability in the sub-basin in dry years.

Abstraction of water from the Mwache River combined with other irrigation schemes within the same River will cumulatively impact on the hydrology of the River especially downstream therefore, Environmental Flows must be observed to ensure that the integrity of the river is maintained. An Environmental Flow Analysis (EFA) has been determined for this project as per the Water Resources Management Authority (WRMA) requirements.

In terms of water use by the communities along Mwache River, abstraction of water for domestic and irrigation combined with other on-going abstraction projects may cause adverse impacts and conflicts by communities who depend on the water for domestic purposes. Especially the populations living downstream whose livelihoods may be affected by dam-induced alterations of river flows especially during the dry season.

Induced Impacts

Globally, there are over 100 identified cases of earthquakes that scientists believe were triggered by reservoirs (see Gupta 2002). The most serious case may be the 7.9-magnitude Sichuan earthquake in May 2008, which killed an estimated 80,000 people and has been linked to the construction of the Zipingpu Dam.

In a paper prepared for the World Commission on Dams, Dr. V. P Jauhari wrote the

following about this phenomenon, known as Reservoir-Induced Seismicity (RIS): "The most widely accepted explanation of how dams cause earthquakes is related to the extra water pressure created in the micro-cracks and fissures in the ground under and near a reservoir. When the pressure of the water in the rocks increases, it acts to lubricate faults which are already under tectonic strain, but are prevented from slipping by the friction of the rock surfaces."

Given that every dam site has unique geological characteristics, it is not possible to accurately predict when and where earthquakes will occur. However, the International Commission on Large Dams recommends that RIS should be considered for reservoirs deeper than 100 meters. The Mwache Dam's reservoir is less than 100 meters and the site is not prone to seismicity since the area is not a seismic active region. The following sections provide an outline of specific negative impacts that require attention during the project implementation.

8.2.1 Sedimentation

Construction

Construction activities will involve massive earth moving within the river flood plains and sections of the adjoining riverbanks and lands. This loosening of the soil creates a situation where any heavy rains will freely wash down the silt into the downstream areas including Mwache Creek. The silt so washed down may contain high levels of organic matter and deposition of this may lead to anoxic conditions in the lower water levels with potential risks to the associated aquatic life.

Operations

Typically, dams and reservoirs intercept close to 90% of sediments from the catchments. Sediments loads, that are dependent on the catchment characteristics (geology, soil nature, topography and vegetation cover), is likely to be the major challenge to Mwache dam considering the high potential of Mwache River to generate sand. A visual estimate at the confluence with Mnyenzi River just upstream of the dam wall shows a significant sand deposit during rainy sessions with about 80% originating from Mwache River. The slope of the river is estimated at less than 1% and the flow is physically sluggish, a situation that indicates a higher retention and storage capacity and ability compared to the transportation speed (no measurements were carried out in this regard). In addition to overloading the dam and gradual reduction of its storage capacity, the effects could be felt upstream due to the flow back along the river basin and its tributaries.

Mitigation Measures

- Construction activities should take place during the dry conditions. Top soil removed will need to be transported away from the site to a location not accessible to storm water. Training of the river during construction should be such that silt transportation downstream is minimized,

- Provide a soil trap downstream the dam site to intercept excessive silt during the construction. This may be in form of a pan,
- Provide sand check dams upstream of the dam and more specifically along Mwache river basin to intercept excessive silt from the catchment and effectively increase the capacity of the dam in the long term. The dam could be located at east every 5 – 10km from each other depending on the topography, accessibility and availability of space,
- The check dams should also be provided downstream of every major tributary to not only provide additional sand dams for water storage to serve the immediate communities upstream of the dam, but also as silt traps.
- The sand dams could also serve as approved sand harvesting points to be managed through organized community groups that will also enhance conservation of the river flood plains and acceptability by the local communities,
- The communities at the dam site could also be assisted to get organized into groups for an economic disposal of the accumulated sand ahead of the dam construction. Access to the site, is however a limiting factor in this regard,
- While holding sand back for the safety of the dam, modalities should be established to ensure that economic interests of downstream dependants of the sand are also addressed.

8.2.2 Water Quality

Water stored in a dam or reservoir is subject to undergo certain physical, chemical and biological transformations overtime caused by varying conditions. These phenomena are induced by climatic conditions (heat exchanges, extent of aeration, etc.), chemical exchanges from geological formations, aquatic chemical reactions and material degradations among others as well as biological reactions associated with the organic materials decaying in the water (biomass and humic matter decomposition). Massive potential for sand generation in the catchment, high vegetation cover that also leads to potential humic content of the soils, variations in weather conditions and exposure to atmospheric conditions are among other conditions with potential effect to water quality. Mwache dam location will be faced with all such scenarios. Among the anticipated water quality aspects of interest for the dam would include;

Construction

- (iv) The vegetation (biomass accumulation) in the dam area could render high humic (organic concentration) conditions in the dam water and Mwache Creek downstream if not removed during construction period. It also has a potential to increase the nutrients and other minerals associated with plant decaying matter.
- (v) There are graveyards around the dam area (locations based on family villages) that would not be inundated in the dam water due to the actual and perceived implications on water quality. This situation should be addressed during construction phase,
- (vi) Like the graveyards, pit latrines in the settlement areas will not be inundated due to their long-term potential contamination of water, but will be decommissioned and the earth scooped for safe disposal to pre-agreed sites. The exact locations for all pit latrines, therefore, will be established to enable smooth relocation,

Operations

- (vi) Residual faecal and organic matter from pit latrine, open-air toilets and waste holding sites from the displaced and residual homesteads and social locations. This would particularly impact on the health of the water consumers and their animals within the dam area as well as the ultimate piped destinations in the long-term,
- (vii) Nutrients (nitrogen, phosphorous potassium) among other trace elements in the soil are expected from the geological discharges, organic decompositions of plants matter and surface runoff discharges from farms, settlement areas and markets around the dam. This could create potential for eutrophication of the dam water,
- (viii) Turbidity and suspended settleable matter of water from the inflows, surface runoff discharges and organic reactions among other sources is also a potential challenge to water quality. This situation may lead to limited light penetration that has got direct linkage to biological quality of the water,
- (ix) Limited water mixing, aeration and light penetration reduces available oxygen resulting into anoxic conditions at the lower layers of water in deep reservoirs. Anaerobic conditions in the lower layers of the water generate carbon dioxide, methane, hydrogen sulphide and create low pH scenarios, particularly if the organic content is high. Due to the lowered pH, the geologically held iron and manganese and other heavy metals are likely to be released into the water effectively changing the water quality,
- (x) Implications on water quality would be felt by the water consumers in the immediate location of the dam as well as social and ecological dependants of Mwache River downstream in terms of habitat pollution, people's health and cost of water treatment at various stages.

Mitigation Measures

- Institute a broad water quality monitoring system such as to focus on the catchment sources, incoming flows, entire dam water quality variations, treated water and water downstream of the dam location. Maintain appropriate records on water quality as required by the law upon commissioning of the dam, including the implications of the dam to the water quality downstream (mainly tidal waters in Mwache River mouth) need to be monitored,
- All vegetation materials (live and dead) at the dam site shall be cleared and removed before the area is excavated and inundated. This will ensure controlled release of organic matter into the dam water. Proliferation of aquatic macro-flora could be encouraged along the periphery of the dam to ensure natural aeration and purification of the water,
- Pit latrines in the acquired land will not be inundated due to their long-term potential contamination of water, but will be decommissioned and the earth scooped for safe disposal to pre-agreed sites. The exact locations for all pit latrines, therefore, will be established to enable smooth relocation. Identify specific point sources of water pollution during construction (cattle pens, market centers, agro-chemical use points, etc.) for isolation and safe management,
- All identifiable graves falling within areas to be inundated will require be decommissioning and relocating to prevent contamination of water. The exercise will, however, be undertaken in full observance of traditional rites as well as the wishes of the affected families.

8.2.3 Water Loss

The general rate of surface water loss from the dam area could increase through exposure to weak geological points and increased surface area. The surface to sub-surface geology of the project area is characterized with discontinuous fractures and fissures at the contact between the basement system rocks and the sedimentary geological type. The fractures and fissures could provide a potential for infiltration of water into the sub-surface and possibly creating springs on the lower areas. This possibility should be established further during construction for remedial preventative measures.

Other modes of water loss would include;

- (iv) Evaporation associated with high temperatures experienced most of the year in the project districts. Effectively this raises the average humidity in the surrounding areas (currently reported at over 15%),
- (v) Transpiration through aquatic plants and vegetation on the surrounding area that are also necessary for environmental and water quality conservation.
- (vi) Wastage of water through the distribution network and at consumer points resulting from perception of abundance, poor appreciation of value of water and low knowledge in wise use water.

The implications of the evaporation would be more pronounced on increased surface

area of water exposure. While this could not be quantified at this point, it is expected to be relatively significant. Other water loss pathways effectively imply;

- (v) Unaccounted for water losses from the dam structures such as seepage through possible fissures in the base rock and hence unachieved desired dam expectations,
- (vi) The scenario could also cause possible weaknesses to housing foundations downstream of the dam location, though there are no significant settlement downstream and the few present are likely to be relocated,
- (vii) Micro-climate moderation (lower temperatures and higher humidity) through increased atmospheric moisture arising from evaporation and transpiration. This would be enhanced by the breeze arising from the sea blowing westwards,
- (viii) Potential losses of water at consumer points through wanton wastage, leakages in the distribution pipelines and over use in the farms in the case of irrigation.

Mitigation Measures

- Geological profiles throughout the area proposed for inundation should be continuously monitored and areas of weaknesses noted for incorporation of appropriate strengthening measures (this constituted an important part of the feasibility and design stages of the project),
- Sub-surface water infiltration trends on affected areas should be monitored over a period of time with respect to effects on houses and other structures downstream. However, it is noted that there might be no residuals on the lower zones of the dam,
- Indigenous trees and shrubs with low water dissipation capacity should be encouraged around the dam buffer zone to minimize loss of water through evapo-transpiration processes,
- Ensure enhanced monitoring maintenance of the transmission and distribution pipelines upon commissioning to ensure minimal loss of water through leakages,
- Introduce economic and financial initiatives towards water saving and responsible utilization at all consumer points. Water Service Providers have a significant role in this regard.

8.2.4 Air Quality

Main implications to air quality will be expected from the construction activities due to intensive earth moving and handling of materials as well as emission from construction equipment. No significant emissions are anticipated from the completed dam.

8.2.5 Species Diversity

Construction

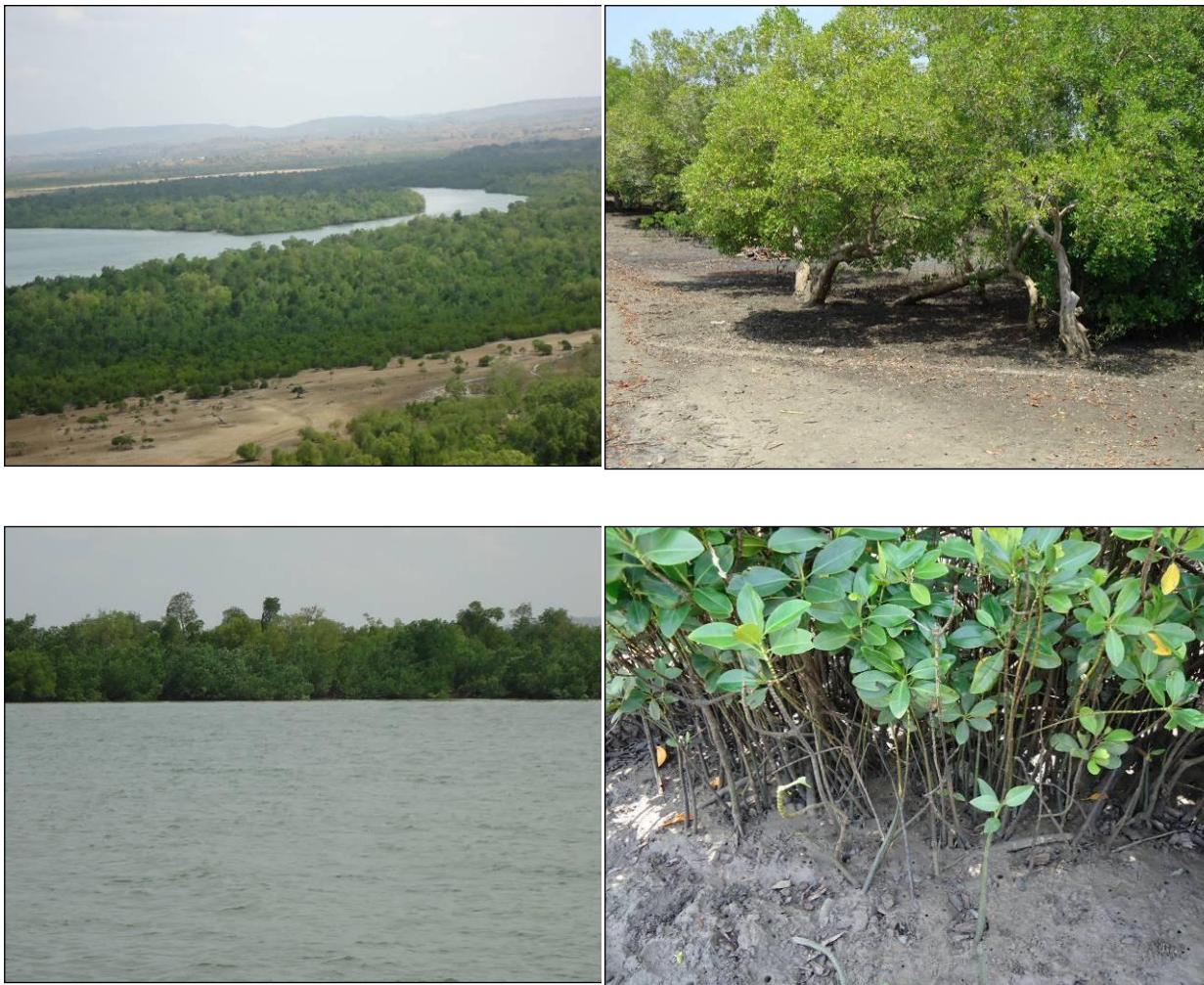
Construction of the dam implies removal of existing vegetation while clearing the areas to be inundated and/or possibility of submerging of others potentially losing certain species. It is likely that certain plant species will get extinct especially those in sensitive zones (close to river edges and riverbed of the rivers, especially Mwache stream) while others are likely to get introduced. There is also potential disruption of habitats downstream of the dam area as a result of construction activities (discharge of excessive particulate matter, cement residuals and other construction materials) as well as interrupted flood flow downstream into the Mangrove ecosystem and habitats of Mwache Creek.

Operations

Upon inundation of the dam area, the following impacts are anticipated;

- (vi) Riparian aquatic vegetation could develop on the new water/land transition zones with new species introduced and flourishing of the existing species (e.g. grasses, reeds, cyprus spp., etc.). Completely new ecosystem will possibly be established around the inundated areas including planktons, periphytons and aquatic macrophytes established and changing the characteristics of the current aquatic life,
- (vii) Inundated land may also have a linkage to the overall water quality of Mwache River that will range from improved aeration, pollutant accumulation (nutrients and heavy metals) and reduced settleable matter from extended settling. Decaying aquatic organic matter from submerged residual plant matter and humic residuals in the soil may also affect water quality negatively by imparting undesirable odor, color and turbidity),
- (viii) Indigenous fishery species, aquatic animals such as to include frogs, birds and other micro-organisms are potentially going to thrive while larger species including crocodiles and hippos could migrate from other areas to the project area and perhaps in specific locations of the dam,
- (ix) Presence of water might also attract other species of wildlife from as far as Shimba hills and the coastal strip, especially grazers with potential transformation of the ecological characteristics. This situation could create a new human-wildlife conflict that need to be addressed through a collaborative interventions,
- (x) Vectors are part of the biodiversity, but with negative implications to the residents. These include mosquitoes (associated with stagnant water), snails (carriers of bilharzias) and microorganisms carrying other disease causing germs (typhoid, cholera, dysentery, skin infections, eye infections, etc.).

**Figure 17: Sensitive Mangrove Ecosystem in Mwache Creek
(Dependent on Mwache River Characteristics)**



Mitigation Measures

- Develop a database of animal and plant species found in the dam area as a basis for conservation and monitoring of newly introduced species in the future. The inventory and monitoring register should be maintained by CDA Water Service Board in collaboration with the environmental office and other interested parties,
- An ecologist would need to be engaged to oversee monitoring and management of ecological changes around the dam ecosystem and downstream during construction as well as upon commissioning,
- The role of the Kenya Wildlife Services (KWS), Kenya Marine and Fisheries Research Institute (KMFRI) and the Kenya Forest Service (KFS) would be crucial in monitoring the new habitats in the river basin and the Mwache Forest characteristics around the dam area,
- Establish community interests and values in the evolving ecological setting and enhance economic benefits and cultural values from the same. Fishing, irrigation, livestock keeping are notable economic benefits while conservation of the Kaya cultural activities will be in agreement with the UNICEF initiatives already in

place.

8.2.6 Impacts on Hydrology

Construction

Construction activities are not anticipated to manifest any impacts to the local hydrology. However, training of the river and its tributaries may have limited implications to the local flow regimes that will, only last during the construction period.

Operations

Depending on the dam design, the flow regime of Mwache River could change for considerable distance downstream. Currently, the flow in the river occurs only during the rainfall periods with peak flows during high rainfall intensity periods and no flows observed during the dry conditions that affect both the main stream and the associated tributaries that are also dry. With the construction of the dam, the flows downstream will most likely be regulated to a relative constant flow rate over longer durations of time as opposed to the current conditions when no flows are observed for long periods of time. The hydrological implications to downstream environmental setting will be;

- (v) Reduced average high water levels downstream the basin and hence minimal deposition of silt on the flood plain where ecological and limited food production takes place. Constant but reduced distribution of silt deposition (land fertility for downstream habitats) will be confined to a narrower flood plain since flood flows will be reduced and not enough to spread over the current flood plain. Potential reduced recharge of silt into Mwache Creek may also effectively reduce the productivity of Mwache Creek through reduced nutrients, affected breeding zones and food for aquatic animal species present,
- (vi) On the other hand, current aquatic ecosystems are likely to be compromised on the higher flood plain zones of the river basin thus slightly changing the basin characteristics (this change in trend has not been quantified at this stage),
- (vii) One advantage is the reduced channel erosion during high peak flows, reduced water quality (turbidity and suspended matter) and delta protection further downstream at the river mouth.
- (viii) Upstream, the main Mwache stream and the lower tributaries will be permanently flooded all year around. This change in hydrological pattern will reduce scouring of the streambeds as well as controlled bank erosion. It will, however, create new habitats with new aquatic vegetation and possible animal species. The extent of land flooded during the rains rising up to the 95m elevation will increase with implications on naturally dry land converted wet areas. This will also effectively raise the extent of sub-surface water

levels in the adjoining areas.

Minimum Annual release for ecological considerations-Environmental Flows

As per Draft DDR (May 2013) stage was: Minimum Annual release for ecological considerations to maintain minimum flow in the d/s of the dam @ 0.1 Cumec 3.154 MCM.

On the issue of environmental flows, WRMA has not developed clear methods for calculations. What is generally done is to define the Reserve the portion of the water resources that is set aside to meet demands for ecological and basic human water needs. For perennial rivers, the Reserve quantity is the flow value that is exceeded 95% of the time as measured by a naturalized flow duration curve at any point along the watercourse. Based on this definition, the reserve loses meaning in case of Mwache since the minimum flow is zero. The provision of 0.1 cumec ensures the availability of some flow downstream of the dam during the dry seasons, which is about 2.3% of natural mean annual flow.

Mitigation Measures

- Ensure compliance with the water resources regulations at all times. At least 30% of the base flow should always flow in the stream to sustain ecological and social requirements downstream. The flow would be necessary for sustenance of Mwache Creek ecosystem,
- With effects on the level of flood levels upstream, it may be necessary to review the riparian land ownership to provide the mandatory buffer area for conservation and the extent of associated sub-aquatic ecosystem such as to include plant and animal species on the buffer zone,
- River gauging stations around the dam and upstream including the key tributaries may require to be reactivated (or installed where none exists) to monitor effects of the dam to the river basin over time as well as enable taking stock of water balances at any given time against the rainfall in the catchments.

8.2.7 Effects to Mwache Creek and Tidal Waters

Reduction in silt discharge and alterations in flow regimes of freshwater into Mwache Creek could cause changes in nutrient cycling in the creek ecosystem effectively disrupting the marine life trends and the associated productivity including the mangrove development, breeding habitats and buffering capacity of Port Reitz and Likoni channel in the long term. On the other hand, the tidal water fluctuations may interrupt the intake of the dam water and other operation if appropriate structural measures are not taken. Quantified detailed investigations, however, were not undertaken during this study.

Mitigation Measures

- A detailed study on Mwache Creek ecological characterization and quantified linkages to Mwache River would be necessary,
- Integrate simulated flood release programmes in the dam operations to sustain the nutrient requirements and freshwater feed into the creek ecosystem. The simulation should be part of the detailed investigation of the creek system
- Involve and collaborate at the highest levels with possible technical mechanisms for sustained conservation of Mwache Creek and safety of the surrounding infrastructure. Among the players would include KMFRI, WRMA, KPA, KAA, KFS, CWSB, MAWASCO, Mombasa County etc.
- Ensure that the minimum release provisioned for the project equivalent to 0.1 cumec (3.2 million cubic meter) is followed during dam operation.

8.3 Social Impacts and Mitigation Measures

8.3.1 Positive Impacts

The positive impacts anticipated from the project include;

- (viii) The standard of living of the beneficiary residents will improve such as to include income generation and productivity, housing, health and hygiene, etc.,
- (ix) The distances traveled and time spent in search of water will be reduced hence the beneficiaries (especially women and children) using the energy and time on economically and socially viable activities for the families,
- (x) Areas suitably situated to receive water for irrigation will not only help the local communities in sustaining food production but also all the residents of the neighboring districts in food supply. It is proposed that farmers will be supported on Small Holder Irrigation Programme system to provide food sufficiency at family levels,
- (xi) The dam will also moderate the micro-climatic conditions of the immediate surrounding areas through increased humidity and/or cooling effects to the comfort of the residents,
- (xii) Overall increase of the total population and density as people are attracted by the high potential in economic production. This will provide ready markets for goods and services and reduced rural-urban migration as people are employed in the upcoming opportunities in the area.
- (xiii) Raising the population growth and density resulting from natural growth and immigration that further enhances the availability of cheap labour and provision of ready markets for goods and services thereby spurring economic growth of the area

- (xiv) Upgrading of certain roads, necessary for the construction and maintenance of the dam, will also contribute to a better transport and travel networks in the area. This will have positive social and economic impacts in the area.

8.3.2 Potential Displacements of People

- (v) Potential displacements and re-settlement of people to alternative locations. While some may be marginally displaced to different locations on the same land, those whose land wholly falls within the dam area will have to be shifted to other parts of the district or country. This will have far reaching repercussions including:
 - Those to be displaced feared that their community as well as kinship and social associations would be fragmented in the host area leading to disturbance and possible disintegration. Further, they would like to be resettled near their kin and previous support system and that the socio-economic infrastructure in the host area may not be adequate for their needs. Further, there was a feeling that there may be conflicts between themselves and the host communities.
 - There are possibilities of disenfranchising and interfering with livelihoods especially for the weak members of the society especially widows, the disabled persons and the poor who are not able to sustain court cases in-order to retain their land and other rights
- (vi) It could not be predicted at this stage how the hosts to the displaced persons would receive the displaced persons, especially considering that migration goes into exerting pressure onto the natural resources such as water, land and energy among others. This issues will be adequately addressed through a comprehensive resettlement action plan (RAP),
- (vii) Potential dissatisfaction to the project affected persons (PAPs) on the mode of compensation and quality of alternative settlements may be a challenge to the project. This could arise from inadequate preparation and sensitization of the PAPs,
- (viii) The transmission pipelines and distribution tank locations could also have implications to the immediate landowners and residents. Considering that majority of the people live below the poverty line, it would mean that prior relocation without support would not be possible unless support is made available,

Mitigation Measures

- Involvement of the residents through consultations and participation will be necessary to ensure acceptability and ownership of the project by all

stakeholders, irrespective of the implications to the individuals,

- Initiate a public education and awareness forums on the catchment management and protection of the dam, especially the immediate neighboring landowners. Involving school children in this regard would also see long-term sustainability.
- Preparation and inclusion of the affected persons into existing social associations of their choice in the “new” settlement alternatives through education, awareness creation and facilitation. There may be need to pay for disturbance costs to those affected
- An all inclusive participatory Land Acquisition and Resettlement Action Plan (LAP & RAP) should be systematically conducted to establish who owns (interested parties and shareholders) what so as to determine the rightful owners who should benefit and the share each should receive
- Provide counseling services and spiritual support to those affected by the inundation and reburial activities. Further those wishing to pay respects to their departed on agreed periodic basis either annual or five year periods should be facilitated

8.3.3 Potential Social Disruptions

The dam construction and operations thereafter will have permanent impacts on the social features across the area of coverage. Among the effects will include the following;

- i. Social facilities including playgrounds, passages from one end to the other and social resting or recreation points (e.g. under-tree meeting points for village elders). Such locations are under threat of displacement or lost all together,
- ii. Bridges and crossing points on affected rivers and streams (Mazeras – Kinango road bridge on Mwache and Mnyenzi rivers) will be relocated or redesigned to prevent conflicts with the inundation of the dam coverage area,
- iii. Settlement areas with residential houses, stores, toilets and cattle pens as well as small-scale trading points (kiosks) will be relocated or partially affected. This will not have disrupted the co-existence of the villagers but also the attachments to their homes,
- iv. Social and economic linkages to the resources associated with the riverine zones (domestic water sources, watering of livestock, sand harvesting, building stones collection) will also be affected.
- v. Graves are potentially emotive issues, which may lead to rejection of the project by those to be displaced as it is traumatic for many households in the community and carries with it the added burden of potentially upsetting the ancestors. In this area, some graves constitute part of the cultural Kaya lineage,
- vi. Angry ancestors are often regarded as responsible for misfortunes such as illness,

drought, cattle dying, crop failure, loss of employment, etc. The disturbance of graves is, therefore, regarded as a serious matter and belief dictates that when graves are disturbed a sacrifice should be made to the ancestors to appease the spirit.

- vii. The nature of the sacrifice usually depends on the role that the ancestor is seen to play in the lives of living descendants. The disturbance of a grave of great significance might call for sacrifice of a goat; provision of traditional beer and hiring of a customary expert to “transfer” the grave among others. The monetary and time costs to periodically visit new burial sites will be prohibitive especially for those preferring reburial on cemeteries.

Mitigation Measures

- i. Restore to the extent possible any public infrastructure or amenities that is disrupted to enable continuity of the residual PAPs. Among these include;
 - Relocate and/or raise the Mazeras – Kinango Bridge to a safe crossing upstream but still being easily accessible by the residents. Similar interventions should be undertaken for all other streams affected,
 - Provide a public crossing over the embankment of the dam to facilitate movements of residents who would otherwise move far upstream to reach the bridge,
 - Consult with the leadership and other authorities in selecting suitable locations for the new crossings
- i. Provide appropriate alternative watering points for the communities and their animals for any facility disrupted,
- ii. The project construction and operations thereafter should bring the communities on board for awareness and consultations on the most suitable alternatives for the disrupted services and amenities,

8.3.4 Safety Issues

- i. Human-wildlife conflicts cases will potentially increase from the increase in populations of aquatic animals notably crocodiles and hippopotamus that may pose threat to the safety of the residual residents,
- ii. There will be a link to the health and safety of the residents from possible enhanced vector breeding (mosquitoes, snails, etc.), attraction of wildlife to the area and water contamination,
- iii. With a huge mass of water, there are potential risks of drowning for the residents, especially children, the aged as well as their livestock. This is a safety risks that need to be addressed. The risk would even be higher when the residents attempts to reach the water and watering their livestock,
- iv. In order to ensure safety, there is need to fence the dam and educate the communities on co-existence with wildlife. This also includes adopting economic

activities that co-exist with wildlife such as eco-tourism affecting children, the aged as well as animals.

- v. Take off flight path for Moi International Airport covers over the dam site. Potential attraction of birds into the fresh water dam zone is a risk to the safety of the aircrafts, particularly the highflying species. This aspect may be investigated further based on the characteristics of the birds as well as the height of the airplanes at that points,
- vi. There is a large population crossing from both sides of Mwache Creek, at the Marere pipeline crossing and at the Bonje crossing point downstream the bridge. Fluctuation in downstream flows in Mwache dam may affect safety at the two locations

Mitigation Measures

- In order to ensure safety, there is need to fence the dam and educate the communities on co-existence with wildlife. This also includes adopting economic activities that co-exist with wildlife such as eco-tourism
- It will be necessary fence-up the dam and its buffer zone to isolate it from the public for their safety
- Provide safe access points to the water for the local residents and their livestock to enhance their safety from drowning and potential attaches by wild animals
- Initiate continuous consultations with the Kenya Airports Authority and by extension the airline operators who fly over the dam area to discuss potential safety risks and agree on preventive measures,
- Inform members of public (crossings and anglers) downstream of the dam location on any un-usual releases or discharges from the dam's spillway for appropriate safety precautions.

Figure 18: Social Features to be disrupted



Access Roads and Play grounds



Bridge over Mwache (Mazeras – Kinango)



Homesteads



Sources of water for domestic and livestock



Sand harvesting for income



Building stones collection for income

8.3.5 Potential Cultural Disruption

The communities living in the project areas are very strict to their cultures. The attachment to their departed ones evidence to the reverence with the graves yards, the Kaya sites and associated “Beacons” around the sites and certain traditional sites including traditional medicine men premises are among the cultural sites that are likely to be affected. Among these include graveyards within areas to be inundated, Kaya Mswakara that even if it will not be reached could be indirectly affected. Other impacts include;

- i. Graves are potentially emotive issues that may lead to rejection of the project by those to be displaced as it is traumatic for many households in the community and carries with it the added burden of potentially upsetting the ancestors. In this area, some graves constitutes part of the cultural Kaya lineage,
- ii. Angry ancestors are often regarded as responsible for misfortunes such as illness, drought, cattle dying, crop failure, loss of employment, etc. The disturbance of graves

is therefore regarded as a serious matter and belief dictates that when graves are disturbed a sacrifice should be made to the ancestors to appease the spirit.

- iii. The nature of the sacrifice usually depends on the role that the ancestor is seen to play in the lives of living descendants. The disturbance of a grave of great significance might call for sacrifice of a goat; provision of traditional beer and hiring of a customary expert to “transfer” the grave among others. The monetary and time costs to periodically visit new burial sites will be prohibitive especially for those preferring reburial on cemeteries

Mitigation Measures

- Involve the communities in identifying and advising on acceptable handling procedures of the traditional and cultural sites to avoid conflicts,
- Identify the cultural sites and support the communities to conservation for posterity (UNESCO has already intervened in the conservation of the Kaya site in Mwache Forests,
- Liaise with the relevant departments (Culture and Social Services) to identify and control genuine cultural facilities and sites.

Figure 19: Cultural Features to be Disrupted



Typical Grave yards found in every village

Traditional Kaya Site (Kaya Mwakara)

8.4 Economic Impacts and Mitigation Measures

8.4.1 Positive Impacts

- i. In addition to water supply, the dam has numerous economic benefits to the local residents such as to include fishing, tourism,
- ii. Potential appreciation of property values including significant increase the price of land and associated development.
- iii. The project will be a major boost to realizing the vision 2030 and achievement of the

- MDGs through eradication of extreme poverty and hunger by enhancing income sources and food security,
- iv. Farm management is likely to improve as possibilities for capacity building are likely to accompany increased potentiality of the land. This will result to increased crop yield and food security,
 - v. Enhanced crop yield and food security resulting from change in farming practices with more reliance on irrigation, as opposed to reliance on rainfall, and increased use of inputs including certified seeds and fertilizer.
 - vi. Further, farm management is likely to improve as possibilities for capacity building are likely to accompany increased potentiality of the land. By providing direct and indirect local employment, the project will ease the direct resource dependency pressures in the district's sectors especially agriculture thereby easing soil erosion.
 - vii. Provision of water from the proposed dam has the potential to enhance development and growth of local markets as more economic and social interests arise. More important is the opportunity to improve sanitation and hygiene in these markets as opposed to the currently potential threat of diseases in almost all the markets.
 - viii. Reduced poverty levels, increased incomes and improved livelihoods resulting from dam construction and maintenance employment and consumption from the local markets, emergence of other associated economic opportunities and activities including tourism, fishing, trade, production of high value crops and transport among others. Further, these will increase the Gross Domestic Product (GDP) of the area as well as the tax base for the government

8.4.2 Negative Impacts

- Some access roads will be inundated breaking means of internal communication from one community to another. However, alternative routes will be established as part of the project.
- Significantly increase the price of land, which may deny those displaced the ability to purchase it.

Those with farms next to the river will be denied access to it and therefore substantially lose high value and productive farmland on the river.

Mitigation Measures

- A programme should be established to enable affected communities benefit from the economic potential of the resources in the area before displacements. This would include controlled burning of charcoal and making briquettes, cutting wood for construction, harvesting building materials (sand and stones) and any other movable natural resources,
- Appropriate compensations and/or provision of alternative settlements and

livelihoods for the affected communities shall be accomplished before commencement of the project.

- Undertake detailed risk assessment of the dam to downstream ecosystems, social and economic setting.
- Organization of the community into a strong unit to control local resources as well as social and economic benefits resulting from construction of the dam including sand harvesting and marketing of products such as fish, crops and livestock
- Put in place supportive and cushioning mechanisms and programmes for those affected such as training, enhancing access to alternative resources and livelihood means

8.5 Dam Safety

8.5.1 Overview

While full risk assessment study has not been undertaken this report provides general pointers for detailed evaluation and quantification of potential damages from various components of the project. It will, however, be necessary to undertake a comprehensive risk assessment of the project covering all aspects of human life, social setting and economic trends linked with the dam. Damages to environmental features, human life and properties could arise from the following scenarios;

- I. The dam breaking,
- II. The spillways giving in,
- III. Collapsing of the raised storage tanks,
- IV. Overflows onto upstream roads and bridges,
- V. Accidental drowning of residents and their livestock.

Risk impacts associated with these scenarios varies depending on location, public awareness and preparedness, habitats and land use affected and duration of occurrence.

8.5.2 Immediate Upstream

- (i) There are a number of farmers along the banks of Mwache River immediately downstream the embankment wall with vegetables being the main crops. The farmers and their crops are at risk of damage in the event of a dam break,
- (ii) The local communities graze and water their animals on residuals of water left after the floods. The dam instability also poses a risk to the grazers and their livestock,
- (iii) Section of Mwache Forest, that also harbors Kaya Mswakara, spans from downstream the dam site. Together with the associated ecosystem, the section of the forest is at risk from the dam instability,

- (iv) The lower zones of Mwache River before confluence with the sea water provide a breeding environment for certain aquatic animal species including fish. In the event of a dam break, the breeding habitats could get destabilized,

8.5.3 Downstream Areas

- (i) Further downstream is the sea ecosystem comprising of mangrove forest and habitats of numerous aquatic animal species among them fish, crabs, lobsters, etc. within Mwache creek. The habitats and the animal species may get disrupted in the event of dam breaking,
- (ii) There is a pipeline transmitting water from Marere springs to Mazeras tanks for the supply of water into Mombasa city and its surroundings. This pipeline that is anchored on steel structures could get broken or damaged in the event of the dam break,
- (iii) Without a bridge on the section of Mwache River at the downstream the dam site, the residents use small boats to cross from one side of the river to the other of Mwache Creek at a small fee. This crossing point and to some extent the residents stand a risk of their lives in the event of dam break,
- (iv) The public commercial jetty at the mouth of the river at Mwache Creek and the boats that serves the public are also at risk of damage
- (v) Moi International Airport grounds lies directly ahead of the Mwache River entrance into the Mwache Creek and right onto the proposed Mwache Dam embankment wall. It would potentially suffer serious damage in the event of dam break when at full capacity.
- (vi) Kilindini Harbor at Port Reitz that is link of Mwache Creek with the ocean could be affected in the event of accidental dam break, particularly the stability of the docking ships and vessels.
- (vii) Shock siltation of Mwache creek and Port Reitz is also a risk to not only the habitats but also the activities associated with the zones.

Figure 20: Potential Features at Risks Downstream



Marere Pipeline crossing towards Mazeras

Public Crossing Point at Bonje Bridge

8.5.4 Dam Components

The dam will be provided with in addition to the support infrastructure, the key facilities including water treatment plant, power generation turbines, powerhouse, operation rooms as well as staff operating among facilities. These are perhaps the most immediate victims of a dam break or other malfunctioning

8.5.5 Health Risks

Breeding of water borne vectors will potentially thrive in the dam water threatening the health of the local communities. The water quality is also an issue to the health of the local communities including their livestock. Appropriate social interventions may be necessary.

8.5.6 Risk Preventive Measures

The Following interventions will be necessary for minimization or preventive. It should however, be noted that detailed risk assessment study would be necessary for the dam as a separate task. The broad interventions;

- (i) Undertake a detailed Assessment study for the proposed dam and establish quantifiable risks to social, economic and ecological features at dam site and downstream. The assessment will involve an evaluation of the dam features including the dam wall, inventory of the features at risk downstream, capacity of the risk features to withstand and establish appropriate precautionary measures among other considerations,
- (ii) Initiate awareness and sensitization campaign for residents, institutions and public installations downstream the dam site on potential risks associated with the dam. Appropriate measures would also be correctively instituted on continuous basis. Among these would include Kenya Airports Authority (KAA), Kenya Ports Authority (KPA), Kenya Marine Fisheries Research Institute (KMFRI), Kenya Forest Service (KFS), Coast Water Services Board (CWSB), Mombasa Water and Sewerage Company (MoWASCO) and Mombasa City Council. Other include Community Groups (e.g. Mkupeni-Maweni Beach Management Unit at Bonje), Home owners at risk, etc.,
- (iii) Institute an early warning system for any indications on dam weakness and emergency response measures necessary. Among the measures would include emergency release of water from the dam, evacuation plans for the affected population and protection measures for the critical installations downstream.

8.5.7 Protection of Archaeological and Historical Sites'/Chance Find Procedures

Excavation in sites of known archaeological interest should be avoided. Where this is unavoidable, prior discussions must be held with the Directorate of Antiquities in order to undertake pre-construction excavation or assign an archaeologist to log

discoveries as construction proceeds. Where historical remains, antiquity or any other object of cultural or archaeological importance are unexpectedly discovered during construction in an area not previously known for its archaeological interest, the following procedures should be applied:

- a) Stop construction activities.
- b) Delineate the discovered site area.
- c) Secure the site to prevent any damage or loss of removable objects. In case of removable antiquities or sensitive remains, a night guard should be present until the responsible authority takes over.
- d) Notify the responsible foreman/archaeologist. Who in turn should notify the responsible authorities, the General Directorate of Antiquities and local authorities (within less than 24 hours).
- e) Responsible authorities would be in charge of protecting and preserving the site before deciding on the proper procedures to be carried out.
- f) An evaluation of the finding will be performed by the General Directorate of Antiquities. The significance and importance of the findings will be assessed according to various criteria relevant to cultural heritage including aesthetic, historic, and scientific or research, social and economic values.
- g) Decision on how to handle the finding will be reached based on the above assessment and could include changes in the project layout (in case of finding an irrevocable remain of cultural or archaeological importance), conservation, preservation, restoration or salvage.
- h) Implementation of the authority decision concerning the management of the finding.
- i) Construction work could resume only when permission is given from the General Directorate of Antiquities after the decision concerning the safeguard of the heritage is fully executed.

CHAPTER 9: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

9.1 Management Plan Principles

This project is geared towards enhancing social and economic benefits to the people living within beneficiary areas and the region in general. The project, however, should also observe environmental conservation requirements in accordance to the established laws and regulations. To realize this goal, acceptability by a majority of the beneficiaries and minimal effects to the physical environment will need to be integrated in the project through constant consultations, evaluations and review of the design aspects throughout the project implementation. It is recommended that guiding principles specific to this project and the regulations governing water resources management be developed that will allow integration of environmental management considerations in the construction, maintenance of the facility components and public amenities. Among the factors that need to be considered in this particular project implementation will include:

- (i) Ensure soil erosion control, prevention of siltation and discharge of pollutants into the water sources (mainly seasonal rivers and streams),
- (ii) Enhancing integration of environmental, social and economic functions in the project implementation,
- (iii) Compensations or appropriate acquisition process of any land and/or property affected by any of the projects is in accordance with the laid down guidelines,
- (iv) The contractors and other players in the project activities be prevailed upon to implement the EMP through a sustained supervision and continuous consultations,

In view of the above principles, CDA will need to integrate the same into the corporate strategy implementation and establish a project specific implementation policy with respect to the environmental and social aspects. The policy should take into consideration other stakeholders' interests including Ministry of Agriculture, Water Authorities, Ministry of Livestock Development, Public Health, etc.

9.2 Management Responsibilities

In order to implement the management plan, an expert will be identified to oversee environment and management aspects including the dam conservation, soil erosion control, re-vegetation whenever appropriate, water conservation and equity in distribution, enhanced sanitation and hygiene measures throughout the project area. The expert would also be expected to co-ordinate and monitor environmental management during construction and post monitoring audits. Other recommended participants could include the respective District Environmental Officers, District

Water Officers and the District Planning Officers and the County Councils among others. The distribution of responsibilities and the interaction between the various actors would be as follows;

- (i) Coast Development Authority will liaise with the Coast Water Services Board for the responsibilities in the coordination activities in regard to the resource development, construction, quality control and social issues during the project implementation,
- (ii) The District Water Offices in Kinango District representatively will ensure that the contractor is observing all measures for protection of water resources. Water Resources Management Authority (WRMA) and the Coast Water Services Board (CWSB) would also be among the institutions to be involved,
- (iii) MEWNR/CDA will liaise with the beneficiary communities who would be take partial responsibility in overseeing that the implementation of the environmental management plan established under this report. Stakeholder Project liaison Committees will be fully responsible for sensitizing the respective project beneficiaries and local stakeholders on matters associated with the project.
- (iv) A Public Relations Person would be selected on the basis of ability (preferably a MEWNR/CDA staff) to directly interact with the local communities on social, economic and cultural matters for long-term sustainability of the water projects. In this regard, a community liaison committee would be established for ease of communication of concerns to the project management,
- (v) The National Environmental Management Authority (NEMA) through the District Environment Office shall be responsible of surveillance of environmental and social aspects of the project implementation. It will be expected that the concerns will be communicated through the public relations person for prompt attention whenever they arise,

9.3 Environmental Management Guidelines

Upon completion and commissioning of the dam, it will be necessary to establish appropriate operational guidelines on environmental conservation and social linkages to enable the management to identify critical environmental and social issues and institute appropriate actions towards minimizing associated conflicts. Basically, the guidelines would cover among other areas environmental management programmes, standard operation procedures, compliance monitoring schedule and environmental audit schedules as required by law. Social harmony of the dam and associated component will be achieved through collaborations with the stakeholders or community management committees introduced at various water consumption points.

9.4 Environmental Education and Awareness Raising

Coast Development Authority, the water consumers and all other beneficiaries need to understand the basic environmental, water use sanitation and hygiene principles. In this regard, therefore, the following steps will be considered:

- (i) Create liaisons on all matters related to environment, utilization of water, health, safety, sanitation and hygiene issues of the water resource development,
- (ii) Encourage contribution of improvement ideas from the beneficiaries on specific issues related to the dam management, water distribution systems, water availability, sharing, etc. say through a questionnaires or direct interactions,
- (iii) Establish initiatives that would instill a sense of ownership of the dams and related components to all beneficiaries,

9.5 HIV/AIDS Issues

During the operations, the management would be expected to integrate HIV/AIDS program into the dam management framework. In addition, other common social health issues may be also integrated. The contractor would be expected to incorporate HIV/Aids programmes during construction such as to include a VCT centre, information and education materials and initiatives. The VCT Centre will be integrated to the Construction camp, but easily accessible to the local communities while associated data and information should be channeled into the national records. Equally important will be dissemination of information for enhanced awareness to all stakeholders and member of public on HIV/AIDS control.

9.6 The Environmental and Social Management Plan

The matrix below outlines the action plans and responsibilities on key negative impacts anticipated from the project activities. It is a presentation of the main environmental issues and proposed management actions with corresponding responsibilities, implementation timeframes and costs indications where applicable. The matrix covers the construction and operation of the dam.

Table 23: Environmental and Social Management Plan Matrix

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|--|--|--|---|---|
| <p>Project Design</p> <ul style="list-style-type: none"> ▪ Feasibility Studies ▪ Project Designs ▪ ESIA and RAP Process | <ul style="list-style-type: none"> ▪ Potential suspicion among the Communities ▪ Possible missing links in the studies ▪ Acceptability by the Communities | <ul style="list-style-type: none"> ▪ All villages in the project area ▪ Institutional premises ▪ Cultural sites (the Kaya) | <ul style="list-style-type: none"> ▪ Recognition of various social stakeholders on site ▪ Stakeholders engagements and consultations (Part of this ESIA process) ▪ Development of mitigation measures and this EMP) <p>Responsibility MEWNR, CDA, Consultant</p> | <p>Entire Feasibility Study To be continued during implementation</p> <p>No additional cost</p> |
| <p>Preparation Activities</p> <ul style="list-style-type: none"> ▪ Site Surveys ▪ Camp site setting ▪ Setting material holding sites | <p>Potential Social and cultural conflicts</p> <p>Conflicts from Land lease processes for camp sites</p> | <ul style="list-style-type: none"> ▪ The delineated dam coverage area of Kasemeni Division) – along the Mwache River, Mnyenzi river and all valleys affected ▪ Identified construction camp site | <ul style="list-style-type: none"> ▪ Notify all affected land owners before surveying their land, ▪ Involve the local administration and other social groups in recruitments ▪ Undertake detailed EIA for the selected Construction Camp Site for approval by NEMA. ▪ A similar EIA process should be undertaken for the materials holding sites, | <p>Preparatory stages</p> <p>No Direct Cost (Cost on EIA for the material sites to be borne by the Contractor)</p> |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|---|--|--|---|---|
| | | | <ul style="list-style-type: none"> ▪ Involve affected landowners on the assessments. <p>Responsibility: MEWNR, CDA, Contractor, Project Supervisor</p> | |
| <p>Preparation Activities</p> <ul style="list-style-type: none"> ▪ Land acquisition, ▪ Resettlement of displaced people ▪ Catchment alignment | <ul style="list-style-type: none"> ▪ Loss of land for the dam construction ▪ Loss of land for buffer zone, water treatment, water tanks, transmission pipelines, sand traps in the catchment ▪ Compatibility of camp sites with other land use features, ▪ Willingness of land owners for identified construction cam sites, | <ul style="list-style-type: none"> ▪ Entire area delineated for inundation by the dam ▪ The buffer areas along the predicted water reservoir line ▪ Identified locations for construction of camp site (not known at this time) | <ul style="list-style-type: none"> ▪ Undertake a comprehensive land acquisition and resettlement action plan Resettlement Action Plan (RAP) as a basis for compensations, ▪ Compensate appropriately any land acquired for the main dam, buffer zones, water treatment plant, sand traps in the catchment, the pipelines and storage tanks, ▪ Sensitize landowners on necessary land use changes for the protection of the dam. <p>Responsibility: MEWNR, CDA, Contractor,</p> | <p>RAP designed. Ksh 514 million will be spent on R&R of PAPs</p> |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|--|--|--|--|---|
| | <ul style="list-style-type: none"> ▪ Limiting access to water for residents | | Local Leadership Public participation | |
| Preparation Activities <ul style="list-style-type: none"> ▪ Site Clearing ▪ Vegetation removal, ▪ Biodiversity disruption, | <ul style="list-style-type: none"> ▪ Loss of Riverine vegetation, ▪ Damage to related aquatic biodiversity, ▪ Potential disruption of existing access to the river by the residents, ▪ Potential blockage watering and mineral licking locations for livestock ▪ Conflicts with cultural values of the lost biodiversity ▪ Potential loss of | <ul style="list-style-type: none"> ▪ Downstream of the proposed dam wall alignment ▪ The dam site location ▪ Parts of upstream Mwache and Mnyenzi Rivers ▪ Mwache Forest edges | <ul style="list-style-type: none"> ▪ Confine vegetation removal to the surveyed dam extent and buffer area only, ▪ Plan for vegetation of the delineated buffer zones with suitable indigenous tree species, ▪ Involve community on dam clearing activities for income earning and ownership enhancement. ▪ Allow landowners dispose trees and other vegetation on their land through controlled commercial options, ▪ Removal for offsite disposal all plant matter and organic residual to ensure acceptable dam water quality safety | During the Initial construction preparation period No direct costs involved (part of the Contractors fee) |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|--|---|---|--|---|
| | plant and animal species | | <ul style="list-style-type: none"> ▪ Take note of species and volumes/numbers disrupted and plan compensation/replacements <p>Responsibility: MEWNR, CDA, Contractor</p> <p>NEMA and MWI for surveillance</p> <p>Participation by local communities and landowners</p> | |
| <p>Preparation Activities</p> <ul style="list-style-type: none"> ▪ Removal of houses, structures, sanitary facilities and cattle pens, ▪ Relocation of graves and other cultural sites affected | <ul style="list-style-type: none"> ▪ Potential environmental pollution from human waste residuals, ▪ Health problems ▪ Environmental pollution at sanitation waste disposal sites ▪ Cultural conflicts of | <ul style="list-style-type: none"> ▪ Fulugani settlements, ▪ Settlements along Mnyenzi river basin, ▪ Kikomani areas | <ul style="list-style-type: none"> ▪ Undertake a controlled and supervised decommissioning of pit latrines (current and abandoned) on the affected settlement locations, ▪ Undertake a procedural relocation of all identifiable grave yards to locations pre-agreed and identified by each of the relevant families, ▪ Comply with the cultural expectations of the local communities in handling of | <p>During the initial construction preparation stages</p> <p>Actual costs is established and given in RAP.</p> |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|--|---|---|---|---|
| | graves relocation to alternative yards, <ul style="list-style-type: none"> ▪ Future effects to water quality from manure residuals ▪ Chance Finds/Accidental Discoveries | | grave yard <ul style="list-style-type: none"> ▪ Allow the landowners to dispose of manure from cattle pens at market rates or otherwise, ▪ Follow Chance Find procedures and process as outline in section 8.5.7 <p><u>Responsibility:</u> MEWNR, CDA and Contractor</p> Public Health, WRMA and NEMA for surveillance | |
| <p>Preparation Stage</p> Material Sites identification and securing Quarry sites Gravel borrow areas Water abstraction | <ul style="list-style-type: none"> ▪ Potential conflicts with neighboring land use trends ▪ Possible misplacement of responsibilities ▪ Loss of productive | Material sites yet to be established – (Contractor to identify sites and negotiate with landowners and then seek approvals) | <ul style="list-style-type: none"> ▪ Undertake Environmental Assessment for each site identified and submit to NEMA for approval before extraction ▪ The Contractor to provide a rehabilitation plan for each material site established ▪ Negotiate and enter into agreements with landowners showing appropriate | During the preparation stage <p>No additional costs anticipated. EIA costs in this regard to be part of the</p> |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|---|--|--|--|--|
| points | land <ul style="list-style-type: none"> ▪ Loss of biodiversity | | responsibilities supervisor and CDA. <ul style="list-style-type: none"> ▪ Identify suitable locations for spoil dumping and obtain agreements with the landowners <p><u>Responsibilities</u> The Contractor NEMA to approve</p> | Contractors costs) |
| <p>Construction Works and related components</p> <p>Earth moving</p> | <ul style="list-style-type: none"> ▪ Potential siltation of river downstream and related features including pools of fresh water, public crossing points, habits in the creek), ▪ Potential Pollution of surface and sub-surface water (shallow wells) from lubricants and oil spills from construction machinery, | <ul style="list-style-type: none"> ▪ Stagnant pools of Mwache River basin downstream, ▪ Siltation of Bonje crossing on Mwache River mouth (with small boat services) ▪ Siltation of Mwache Creek downstream and its habitats ▪ Oil spills at equipment workshops at Camp Sites OR Services areas | <ul style="list-style-type: none"> ▪ Carry out construction works during the dry seasons only to reduce massive silt transport, ▪ Any oil spills from machines to be contained for safe disposal to prevent environmental pollution, ▪ Control earth moving to avoid siltation of the Mwache river bed, the public crossing points and habitats downstream of the dam site, ▪ Construction to stick to the schedule or shorter period to | <p>During the construction period</p> <p>No additional costs anticipated (Part of the construction costs)</p> |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|--|--|---|---|--|
| | <ul style="list-style-type: none"> ▪ Trenching for the water transmission pipelines ▪ Illegal disposal of spoil materials (spoil dumping). ▪ Unearthing of graves and other archeological related artifacts | | <p>reduce total volume of silt transported,</p> <ul style="list-style-type: none"> ▪ In cases of chance finds, follow procedures as outlined in section 8.5.4 <p>Responsibility: Contractor, Supervisor, MEWNR, CDA, NEMA, WRMA and MWI for surveillance</p> | |
| <p>Construction Works and related components</p> <p>Materials sites Management (gravel and hard stone quarries)</p> | <ul style="list-style-type: none"> ▪ Dust emission ▪ Noise and vibrations to the neighborhood ▪ Loss of vegetation cover ▪ Physiological deformation | <p>At identified gravel borrow areas (not known at the moment)</p> <p>At quarry sites (None identified at the moment)</p> | <ul style="list-style-type: none"> ▪ Material sites be fenced up for the safety of the neighboring communities, ▪ Implement the rehabilitation plan for the materials sites ▪ Rehabilitate the material sites upon exhaustion of completion of the project ▪ Contractor to implement material extraction agreements with in the EMP | <p>During the entire period of material extraction</p> <p>No additional costs (integral part of the contract costs)</p> |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|--|---|--|---|---|
| | <ul style="list-style-type: none"> ▪ Public safety risks ▪ Acceptability by the landowners and community in general | | <ul style="list-style-type: none"> ▪ Control dust emissions as well as noise and vibrations from material sites <p><u>Responsibility</u> Contractor</p> <p>CDA, Project Supervisor and NEMA for surveillance</p> | |
| <p>Construction Works and related components</p> <p>Dam formation</p> | <ul style="list-style-type: none"> ▪ Safety risks from possible explosives ▪ Noise and vibrations from construction machinery threatening structural stability of buildings, ▪ Dust emission from earth works and construction equipment | <ul style="list-style-type: none"> ▪ The dam wall location at Fulugani location and across at Miyani areas, ▪ Housing structures in Kasemeni and Mnyenzi areas, ▪ Housing and schools on certain locations in Chigato areas | <ul style="list-style-type: none"> ▪ Construction work to be undertaken during day-time only to the extent possible, especially within reach of settlements ▪ Earth moving and excavations be under damp conditions. Dry dusty materials be stored covered, ▪ Control dust emission from earth works points and equipment <p><u>Responsibility:</u> Contractor and supervisor to isolate site form public</p> | <p>Attention on this throughout the construction period</p> <p>No addition costs anticipated (integral part of the project cost)</p> |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|---|---|---|---|---|
| | <ul style="list-style-type: none"> Safety risks at the dam site and downstream areas | | MEWNR, CDA, NEMA, WRMA and MWI for surveillance | |
| <p>Construction Works and related Components</p> <p>Social conflicts</p> | <ul style="list-style-type: none"> Potential threat to safety of the workers and adjacent communities, Possible intrusion to the local communities privacy by construction workers, Possible immigration into the project area (from within Kinango district and Kwale County as well as other parts of the country) | <ul style="list-style-type: none"> Kasemeni Division Mazeras Township Mnyenzi market Miyani market Bokole Market Chigato area Fulugani areas | <ul style="list-style-type: none"> Provide workers with appropriate personal protective gear and enforce application of the same at all times while at work Provide an awareness and sensitization forum for the workers as well as the neighboring communities, especially on communicable social infections such as HIV/AIDS, TB, etc., Collaborate with the local leadership on selecting camp site locations. <p><u>Responsibilities</u> Contractor</p> <p>CDA, Project Supervisor,</p> | <p>During construction period</p> <p>KShs. 5M on sensitization and awareness raising</p> |
| Construction Works and related | <ul style="list-style-type: none"> Loss of fishing opportunities, | <ul style="list-style-type: none"> River basins (Mwache and Mnyenzi Rivers) | <ul style="list-style-type: none"> Provide leadership in assisting identification of alternative livelihoods (CSR initiative) | Transition period between construction |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|--|---|--|--|---|
| <p>Components</p> <p>Economic Linkages</p> | <ul style="list-style-type: none"> ▪ Loss of sand harvesting and other building materials ▪ Lost opportunities for cultivation on the river basin, ▪ Loss of coconut trees ▪ Loss of livestock watering and grazing areas | <ul style="list-style-type: none"> ▪ Mwache and Mnyenzi River beds where sand harvesting has been allowed ▪ Pools of fresh water left from seasonal flows on rivers and natural drains | <ul style="list-style-type: none"> ▪ Involve the communities (especially the youth) in identifying alternative income generating activities ▪ Employment opportunities be made available to the local communities ▪ Suggest alternative for grazing and watering areas for livestock <p><u>Responsibilities</u> CDA, WRMA, NEMA and DAO to guide</p> | <p>and the commissioning of the project.</p> <p>No additional Costs anticipated</p> |
| <p>Construction Works and related Components</p> <p>Cultural Linkages</p> | <ul style="list-style-type: none"> ▪ Potential conflicts with cultural features including Kayas and special grave yards ▪ Possible moral decay following social interactions ▪ Intrusion into | <ul style="list-style-type: none"> ▪ Kaya Mswakara in the Mwache Forest areas ▪ Selected grave yards in the area of cultural importance ▪ Vita Kafiri at Fulugani areas | <ul style="list-style-type: none"> ▪ Respect the boundaries of Mwache Forest identified for conservation as a cultural site ▪ Involve the traditional leaders (Kaya Elders and Vita Kafiri sites) on management of cultural sites <p><u>Responsibilities</u> Contractor</p> | <p>Throughout the construction period</p> <p>KShs. 2M for conservation initiatives</p> <p>In Addition, a separate budget is provisioned for the</p> |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|--|---|---|---|---|
| | sensitive social locations | | CDA, Culture and Social Services Dept. for surveillance | relocation of Kaya and grave yards (See RAP Budget) |
| <p>Construction Works and related components</p> <p>Machinery, materials and waste management</p> | <ul style="list-style-type: none"> ▪ Dust emissions and depositions into settlements and cultivated land, ▪ Emissions from construction machinery into the atmosphere, ▪ Noise and vibrations from construction activities and machinery ▪ Waste discharges from construction camp sites ▪ Waste dumping sites and environmental pollution | <ul style="list-style-type: none"> ▪ All construction areas ▪ Construction camp sites ▪ Construction material sites ▪ Spoil dumping areas | <ul style="list-style-type: none"> ▪ Ensure dust is controlled from earth moving activities ▪ Provide appropriate sanitation facilities and waste holding bins at the camp sites and around the construction areas ▪ Isolate the wastes into categories for appropriate handling. Undertake environmental assessment for identified spoil dumping areas ▪ Construction related noise and vibrations be kept minimal at the nearest receptor. Inform the affected communities on extra-ordinary noise and vibration levels <p><u>Responsibilities</u> Contractor CDA, WRMA and NEMA for</p> | <p>During Construction period</p> <p>No additional costs anticipated</p> |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|--|---|--|--|--|
| <p>Dam Operations</p> <p>Sustainability and equity in water abstraction</p> | <ul style="list-style-type: none"> ▪ Wastage of water along the transmission systems and at consumer points ▪ Reduced opportunity to other potential dependants of Mwache river downstream (mainly Mwache Creek ecosystem), ▪ Unequal accessibility of water by all. Limitations in connecting from treated supply and restriction in direct access the dam water. ▪ Varying ability and willingness to pay | <ul style="list-style-type: none"> ▪ Entire dam neighborhood community ▪ Ecological dependence | <p>surveillance</p> <ul style="list-style-type: none"> ▪ Provide safe locations for water abstraction and watering livestock for residents upstream and adjacent to the dam, ▪ Provide adequate water kiosks for enhanced accessibility to treated water by the communities ▪ Review water tariffs to ensure affordable access of water to all. Sensitize the communities in value of water and the need to pay for water ▪ WUA formation and capacity building for sustainable and equitable water use <p>Responsibility CDA, KWAWASCO, CWSB</p> <p>WRMA for water abstraction permitting</p> | <p>A continuous activity upon commissioning of the facility</p> <p>WUA formation and capacity building for enhanced water accessibility to the community. Cost included in CB for project.</p> |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|---|--|---|---|--|
| | for treated water by the communities | | | |
| Dam Operations Water transmission to Changamwe Tanks for Mombasa Water supply | <ul style="list-style-type: none"> ▪ Potential water losses through illegal connections and burst pipes ▪ Potential damages to land from burst pipes ▪ Conflicts on the water pipeline way leave and BPTs locations ▪ Management of off-takes where they exist | <ul style="list-style-type: none"> ▪ Entire pipeline corridor ▪ Any off-takes locations where they exist ▪ The way leave | <ul style="list-style-type: none"> ▪ Mark, delineate and preserve the pipeline way leave and intermediate BPTs (not identified at time of this study) ▪ Ensure continuous surveillance of the water pipeline corridor. ▪ Monitor the land use trends along the corridor. <p>Responsibility CDA, MOWASCO, CWSB</p> <p>WRMA for water abstraction permitting</p> | A continuous action System maintenance part of project cost for O&M of the system |
| Dam Operations Health and Sanitation | <ul style="list-style-type: none"> ▪ Possible contamination of water from the catchment and illegal direct access to the dam, ▪ Potential increased Vector breeding | <ul style="list-style-type: none"> ▪ All areas neighboring the dam waters ▪ Water use points | <ul style="list-style-type: none"> ▪ Control vector breeding (mosquitoes, etc.), ▪ Sensitize the communities on protecting the water source from pollution sources, ▪ Encourage provision of sanitation facilities at | A continuous actions upon commissioning of the dam Health and Hygiene |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|---|---|--|--|---|
| | <p>(mosquitoes, etc.),</p> <ul style="list-style-type: none"> ▪ Pollution discharging from settlements, agricultural lands, markets and institutions neighboring the dam, ▪ Low ability and willingness of the communities to maintain hygiene around the dam sites ▪ Lack of appropriate sanitation provisions to match the increased water | | <p>homesteads and markets. Immediate landowners to improve sanitation facilities (pit latrines, discharging surface runoff, waste disposal, etc.).</p> <ul style="list-style-type: none"> ▪ Advise the beneficiary communities on the need to boil or disinfect the water before use if obtained directly from the dam. <p><u>Responsibility</u> CDA, WRMA, Public Health Dept. KWAASCO, MOWASCO</p> <p>The beneficiary communities</p> | <p>Plan (HHP) with cost of Ksh 15.14 million is designed and enclosed as Annex VIII. The cost for this activities included as part of HHP interventions</p> |
| <p>Dam Operations Safety risks</p> | <ul style="list-style-type: none"> ▪ Potential injuries to the operators and visitors, ▪ Safety risks of a dam break to | <ul style="list-style-type: none"> ▪ All identified water access points | <ul style="list-style-type: none"> ▪ Undertake a comprehensive risk assessment study or the dam as part of the pre-commissioning stage. Develop provide clear emergency preparedness strategies | |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|---|---|--|--|---|
| | <ul style="list-style-type: none"> downstream aquatic ecosystems, social and economic features. ▪ Safety risks to settlements and farmlands along the transmission pipeline, ▪ Risks of drowning into the dam to children, the aged and livestock ▪ Potential risks of wildlife attacks (hippos and crocodiles) | <ul style="list-style-type: none"> ▪ The dam embankment area ▪ Public facilities downstream ▪ Mwache Creek | <ul style="list-style-type: none"> ▪ Maintain a fence around the dam with provision for limited and/or controlled access to the dam water, ▪ Enhance close surveillance by the community, especially those living on risk prone areas. Sensitize the communities on dam safety issues associated with the dam. <p><u>Responsibility</u> CDA</p> | <p>Continuous action</p> <p>Cost for safety control measures included in Dam Operation Cost</p> |
| <p>Dam Operations</p> <ul style="list-style-type: none"> ▪ Social ▪ Economic issues, | <ul style="list-style-type: none"> ▪ Sand harvesting from the dam area and upstream ends, ▪ Tree harvesting | <ul style="list-style-type: none"> ▪ Surrounding market centres ▪ Institutions within the area ▪ Irrigation farmlands | <ul style="list-style-type: none"> ▪ Encourage beneficiaries to give priority to domestic and livestock. Irrigation should only be undertaken on the recommended mode and areas, | <p>Continuous attention</p> |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|--|---|---|---|--|
| <ul style="list-style-type: none"> ▪ Downstream dependants, | <ul style="list-style-type: none"> from the buffer zone ▪ Access to biodiversity resources in the area | | <ul style="list-style-type: none"> ▪ Comply with water resources management regulations (See the Water Rules, 2007), ▪ Sand harvesting to take place from authorized locations only (e.g. sand interception dams in the catchment) <p><u>Responsibility</u> CDA, MEWNR</p> | <p>~KShs. 3M</p> |
| <p>Dam Operations</p> <p>Water use trends and accountability,</p> <p>Agriculture chemical use in command area</p> | <ul style="list-style-type: none"> ▪ Wastage of water at user points will translate into loss of money , ▪ Illegal water abstraction for illegal connections, ▪ Illegal water vending (especially if obtained from the dam), ▪ Additional agriculture | <ul style="list-style-type: none"> ▪ Potential water kiosks, ▪ Irrigation farmlands ▪ Supplied institutions and private premises ▪ Soil and water pollution due to additional chemical use in the command area | <ul style="list-style-type: none"> ▪ Develop water use guidelines and costing structures for all consumers and beneficiaries, ▪ Collaborate with other players in the region on sanitation, health and hygiene awareness creation. ▪ Sensitize the public to appreciate the cost of water ▪ Agriculture chemical use reduction plan <p><u>Responsibility</u></p> | <p>Initiate action upon commissioning and the continuous</p> <p>~KShs. 23.05M (Annex VII)</p> |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|--|---|--|--|--|
| | chemical load in the command area and possibility of ground water quality deterioration in long term | | CDA, MEWNR | |
| Dam Operations Institutional Aspects | <ul style="list-style-type: none"> ▪ Non-compliance with water abstraction regulations, ▪ Natural Resources Utilization, ▪ Water use linkages among the beneficiary communities, | <ul style="list-style-type: none"> ▪ Around the dam (applying to surrounding communities) ▪ Ecological resources downstream (Mwache Creek) ▪ Management of irrigation water at farm level | <ul style="list-style-type: none"> ▪ Comply to the provisions of the Water Resources Management Authority, ▪ Comply with sand harvesting regulations, ▪ Organize communities for effective and sustainable utilization of natural resources associated with the dam. ▪ Establish appropriate water user associations in the areas neighboring the dam, ▪ Establish a specific monitoring system for the dam and its water <p><u>Responsibility</u></p> | Initiate action upon commencement of construction and enhance during operations <p>No direct costs estimates</p> |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|---|---|---|---|--|
| <p>Dam Operations</p> <p>Downstream Ecology</p> <p>Disruption of social income</p> | <ul style="list-style-type: none"> ▪ Changes in hydrological regimes into the aquatic systems ▪ Reduced silt loads into the ecosystem ▪ Effects to aquatic productivity (fish, general biodiversity) ▪ Reduced agricultural productivity from the river flood plain ▪ Reversed nutrient cycling and disruption of habitats | <ul style="list-style-type: none"> ▪ Mwache Creek ▪ Mwache river flood basin immediate downstream of the dam site | <p>CDA,</p> <ul style="list-style-type: none"> ▪ Simulate the dam to allow designed ecological release provisioned for project (3.2 million cubic meter over a year) and ensure silt flush as designed to ensure water quality regulation and silt feed into Mwache Creek ▪ Liaise with relevant authorities to establish detailed ecological and social characteristics of Mwache Creek ▪ The flood releases will also replenish silt and nutrients on the flood plains for higher agricultural productivity <p><u>Responsibility</u> CDA Support from KMFRI, WRMA, NEMA, KFS and affected communities</p> | <p>Integrate into the dam an operation manual and implement regularly</p> <p>~KShs. 5M annually</p> |
| <p>Catchments' Management</p> | | | <ul style="list-style-type: none"> ▪ Immediate landowners to be motivated into maintaining | |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|--|--|---|--|--|
| <ul style="list-style-type: none"> ▪ Pollution control from the watershed into the dam, ▪ Enhancing efficient runoff interception into streams, ▪ Soil erosion control and reduced silt transportation ▪ Re-vegetation of the watersheds | <ul style="list-style-type: none"> ▪ Enhanced vegetation cover ▪ Changed land use practices, ▪ Changes agricultural practices, including controlled application of agro-chemicals ▪ Enhanced vegetation, ▪ Influenced sanitation trends in the neighboring homesteads around the dam site ▪ Silt interception in the catchment | <p>All areas to be irrigated in Kasemeni Division</p> <p>The entire catchment areas for Mwache River and its tributaries.</p> | <p>buffer zones along the river and the dam itself banks,</p> <ul style="list-style-type: none"> ▪ Guide landowners in the catchment in changing their land use practices including mode of agricultural and irrigation methods as well as application of agrochemicals. ▪ Initiate afforestation programmes of slopes and other steep sections of the Mwache river watershed area in collaboration with landowners, ▪ Consider sand interception dams along the main tributaries in the catchments for control of silt discharge into the dam, ▪ Undertake a comprehensive catchment management plan for the entire Mwache River basin and involve landowners and all stakeholders, | <p>A continuous activity for 3 years intensive period of implementing the CAT (Annex VI)</p> <p>Catchment Area Treatment Plan designed and given in Annex VI and an estimated cost of KShs. 53.96 allocated for the Catchment Area Treatment Plan</p> |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|------------------------------|--|--|---|--------------------------------------|
| | | | <ul style="list-style-type: none"> ▪ Integrate a comprehensive Land Use Management Plan, Pest Control Management Plan and a Water Use Plan. <p><u>Responsibilities</u> CDA Support from Ministry of Agriculture, KFS, WRMA Community Groups.</p> | |
| Decommissioning Phase | <ul style="list-style-type: none"> ▪ Removal of construction sites (housing, toilets, waste dumps, etc.), ▪ Removal of construction residual material holding sites, ▪ Effects of material borrow pits left open ▪ Disposal effects of wastes and debris | <ul style="list-style-type: none"> ▪ Dam construction camp sites ▪ Materials sites ▪ Material holding sites | <p>The contractor to prepare a decommissioning plan of all construction installations and associated sites at least 3 months prior to end of construction.</p> <p><u>Responsibilities</u> CDA</p> | <p>During construction</p> |
| | <ul style="list-style-type: none"> ▪ Removal of part or all of the water treatment plants | <ul style="list-style-type: none"> ▪ Dam component locations (water pumps, WTP, Power | <ul style="list-style-type: none"> ▪ Notify NEMA at least one year before the intention to decommission | |

| Project Activity and Issues | Key Impacts | Areas of Concern | Management Actions and Responsibilities | Timeframe and Cost Estimates (KShs.) |
|-----------------------------|---|--|---|--|
| | <ul style="list-style-type: none"> ▪ Demolition of the water distribution tanks, ▪ Demolition of the dam structure, ▪ Removal of the transmission pipeline | <p>houses, tanks, etc.,</p> <ul style="list-style-type: none"> ▪ The dam itself | <ul style="list-style-type: none"> ▪ Undertake a decommissioning audit at least six months before the activity and provide a decommissioning plan, ▪ Undertake the decommissioning following the decommissioning plan and under supervision by NEMA, ▪ Rehabilitate the affected locations to the satisfaction of NEMA and other stakeholders. <p><u>Responsibility</u> CDA</p> | <p>At decommissioning stage and surveillance thereafter (could be over 50 – 60 years upon commissioning assuming nothing h extraordinary happens to the dam)</p> |

Key environmental interventions proposed under environmental management plan for which the monetary provision is made are summarized as below

- Catchment Area Treatment Plan for checking soil erosion in the catchment area. The details of the same is given in Annex VI
- Agriculture Chemical Use Reduction Plan for reducing use of agriculture chemical in the command area in order to check soil and ground water pollution. It is likely that high use of agriculture chemical may pollute the soil and ground water in long term. The detail of the plan is described in Annex VII
- Health and Hygiene Plan to reduce the likely impact of impounding reservoir water on the inhabitants' health living in close proximity as well as minimizing these inhabitants impact on the water quality of reservoir. The details of this plan is given in Annex VIII
- Water Supply System's Environmental Management Plan and Associated Cost is given in Annex X. This is to enhance the positive impact and offset the negative impact due to water supply system activities of the project.
- Cultural Sites Management measures involving traditional leaders like Kaya leaders in Vita Kafiri sites. Ksh 5 million is allocated for this measure (Above matrix)
- Construction Workers Safety measures during construction period. Ksh 2 million is allocated for this measures (Above matrix)
- Ecological releases and downstream biodiversity conservation measures. Ksh 8 million (3+5) is allocated for this measures (Above matrix)

In addition to above intervention, environmental monitoring will be carried out to spot any deviation of environmental situation from its base line condition. The details of the same are described in subsequent section.

9.7 Resettlement Action Plan

A detailed Resettlement action plan (RAP) is under preparation to compensate the loss of land and properties of the PAPs and rehabilitate the PAPs to restore / improve their present level of income. Total project affected families due to project will be determined by the detailed RAP. Budget allocated for the proposed rehabilitation and resettlement of the PAPs is presented below in Table 24. The initial cost of rehabilitation and resettlement is estimated to be Kshs 514 million; however, this figure will be adjusted once the RAP is finalized. The final estimate will be part of ESIA cost and will be part of the project cost.

9.8 Environmental and Social Monitoring Plan

Monitoring of key environmental and social parameters will be conducted in order to ensure integration of environmental management plan and social action plan throughout the project cycle and spot any deviation of environmental condition from its base line situation. Some of the key parameters that will be monitored are a) surface water quality of reservoir, b) ground water quality of command area, c) soil quality of the command area, d) air quality adjoining construction site, e) patches of severe soil erosion in the catchment area. Details of Environmental Monitoring Plan designed for the project is given in Annex IX. The cost of environmental monitoring is estimated to be \$ 25180 that will be part of EMP cost and project cost. In addition, the monitoring and evaluation of the RAP is designed and given as Appendix 8 of RAP. Similarly, separate monitoring plan is prepared for the water supply system and is given as Annex X. Monitoring and evaluation will be the joint responsibility of PMCU-AES Unit & ME Unit.

9.9 Institutional Capacity and Capacity Building Plan

Institutional capacity of key stakeholders (MEWNR, CDA, CWSB) knowledge for environmental and social safeguards was evaluated and their training need was assessed during the present study. Officials of MEWNR and CDA sought number of study trip to India on environmental and social issues, concerns and measures for multipurpose dam project under the present project agreement. These study trip have empower the decision and policy makers of the MEWNR and CDA to appreciate and act for the environmental concerns.

Capacity Building Need Assessment

During training need assessment, it is noticed that few upper and most of the middle and field level officials of the stakeholders lack appreciation for the environmental and social issues for the dam project. More specifically, capacity building need for the following is identified.

- Sufficient orientation on Environmental Management Framework and Plan
- Mobilization of stakeholder participation for Environmental Monitoring Program
- Adequate participation and co-ordination for successful implementation of RAP
- Legal and policy provisions for the environmental and social related issues
- Required awareness on agriculture chemical management plan
- Modern means of soil erosion and silt management
- Ample awareness on health and hygiene concern of water resources project
- Enough concern for wastewater management plan
- Biodiversity concern and appreciation

- Participatory technique in water resources management
- Improved resource use efficiency and optimum allocation of water
- Climate change adaptation and mitigation measures
- Sufficient co-ordination for the interdisciplinary activities

Similarly, it was found that beneficiaries and affected person lacks awareness about the environmental and social concern and care less about the same. Major gap found with targeted community may be summarized as below

- Poor awareness on the proper waste (liquid and solid) handling and its consequences on their health and on the natural resources (especially water and soil)
- Lack of awareness about preventive method from the water born and pathogen related diseases
- Value of water for self and needy one
- Safety, healthy and sanitary provisions
- Safe handling for agriculture chemicals
- Environmental friendly agriculture practices like IPNM and IPM to reduce the use of agriculture chemical in farming
- Less sensitivity for flora and fauna

Capacity Building Plan

Considering the capacity building need of the stakeholders and community, capacity building plan is designed for the project with aim of i) sensitizing stakeholders on key environmental and social issues of the project ii) empowering CDA and CWSB officials to appreciate and take full part in implementation and monitoring of EMP and RAP, iii) enabling stakeholders to adopt to challenging and dynamic environmental and social issues at ground level, iv) activating CDA and CWSB officials to integrate environmental and social issues in economic, institutional and technical activities of the project, and iv) mobilizing wide group of stakeholder participation for joint action to address environmental and social issues after completion of the project.

To achieve the above aim, following capacity building activities are designed for the project for the officials of CDA, CWSB, DA; farmers; beneficiaries of irrigation and water supply and PAPs.

- On the job training with environmental expert for officials of CDA and CWSB (A separate budget for the environmental and social expert is allocated, Annex XII)
- Imparting knowledge and skill from hired environmental and social consultant (A separate budget is allocated for the environmental and social consultant, Annex XII)
- Learning by participation in the study designed under the project for the

- officials of CWSB (Wastewater reclamation and alternative use, Annex XI)
- Field trip to the demonstration field and pilot project for practical exposure (IPM, IPNM, bio-fertilizer study trip of farmers to demo plot, Annex VII)
- Training workshop for specialized environmental and social topics such as i) Environmental datasheet preparation, impact evaluation and project appraisal, ii) Environment monitoring, supervision and reporting, and iii) Community participation for CDA and CWSB officials (refer Annex X); Environmental friendly agriculture practices for CDA and DA officials (refer Annex VII)
- Awareness campaign for sensitization of environmental and social issues like health and hygiene for construction workers and PAPs (Annex VIII), beneficiaries of WSS (Annex X); environmental awareness for the irrigation water beneficiaries (Annex VII) to reduce the agriculture chemical load in command area.

9.10 Implementation of EMP and RAP

Effective and timely implementation of EMP and RAP is important to reduce the negative environmental and social impact of the project and enhance the associated positive impact. Annex XI is prepared and enclosed with this report that describes in detail implementation arrangement and implementation schedule for the EMP and RAP including associated cost.

9.11 Environmental and Social Management Cost

Environmental and social management cost is estimated to be Kshs 656 million. The detail of the cost is given in Appendix XIII. For implementing the environmental management plan, social action plan and environmental monitoring plan designed for this project, Environmental and Social Management Consultancy Services (ESMCS) will be hired that will assist the different organ of the PMCU in implementing EMP and RAP. The overall environmental and social management cost is calculated and given as below in Table 25

Table 24: Environmental and Social Management Cost

| Sr No | Cost Item | USD | Ksh | Remarks |
|-------|---|---------|-------------|-----------------|
| 1 | Total EMP Cost | 1655680 | 141891767.4 | sum of 1.1..1.7 |
| 1.1 | Catchment Area Treatment Plan | 634793 | 54401760 | Annex VI |
| 1.2 | Agriculture Chemical Use Reduction Plan | 246000 | 21082200 | Annex VII |
| 1.3 | Health and Hygiene Plan | 178100 | 15263170 | Annex VIII |
| 1.4 | Environmental Monitoring Cost | 25180 | 2157926 | Annex IX |
| 1.4 | Social and Environmental | 81000 | 6941700 | Annex XI |

| Sr No | Cost Item | USD | Ksh | Remarks |
|--------------|---------------------------------------|----------------|--------------------|---|
| | Experts Cost | | | |
| 1.5 | Water Supply System EMP cost | 200000 | 17140000 | Annex X |
| 1.6 | Others | 211765 | 18148261 | ESIA Section 9.6/9.7 |
| 1.7 | EMP Implementation Agency (EMCS) Cost | 78841.9 | 6756751 | @ of 5% of item 1.1&1.6 |
| 2 | Total R&R Cost | 5998580 | 514000000 | Initial figures to be revised when RAP is finalized |
| 3 | Over All EMP and R&R Cost | 7654259 | 655891767.4 | |

CHAPTER 10: CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions

The following conclusions have been arrived at in regard to the proposed multipurpose project and its components;

- (i) The dam is acceptable to a majority of the local residents, most of whom appreciate the value it will have on the social and economic wellbeing of the area. However, there is a section of the community who also feels affected through the potential displacements and loss of land although appropriate compensation will be done,
- (ii) The local community has indicated their desire to have water for domestic and irrigation needs though the water may not necessary be abstracted from Mwache dam and could be supplied from alternative sources such as Mzima Springs line. There are other potential social economic opportunities from the dam project to the communities. It is apparent, however, that the members of society might not identify these without appropriate support guidance to exploit,
- (iii) A significant biomass volume will be lost from the dam site area targeted for inundation calling for appropriate compensation, particularly through facilitation of tree planting initiatives including a buffer zone around the dam perimeter,
- (iv) The project will cause displacement of 167 households and affect the residual residents who would have to live with the new aquatic environment. The exact situation details have been dealt with in the full Resettlement Action Plan (RAP) while provision of CSR will deal with the residual communities,
- (v) Mwache dam sits immediately upstream of Mwache Creek, a marine ecosystem featuring mangrove forest cover, highly productive and an economic lifeline for a section of the local community, that need to be protected. Therefore, dam will need to be operated allowing ecological release provisioned under the project during lean period.
- (vi) Downstream the dam site, there are strategic social and economic installations that are at risk in the event of a dam break among them Moi International Airport, Kilindini Harbor, Likoni Channel and the western zone of Mombasa island. Dam break resistance measures designed for the project is to be carefully considered and checked during construction as per the design norms.
- (vii) Catchment area treatment plan designed for the project is to be implemented

under the strict supervision of the SEC, to ensure soil erosion and siltation issues of the project.

- (viii) Health concern of the inhabitants surrounding impounding reservoirs need to be effectively addressed as per the health and hygiene plan designed under the project.
- (ix) Additional load of the agriculture chemical due to irrigated farming in the command area of the project is to be reduced through effective implementation of Agriculture Chemical Use Reduction Plan designed under the project.

10.2 Recommendation

From the foregoing, the following recommendations are made:

- (i) Adopt dam characteristics that will enhance enrichment of biodiversity through increased moisture, proliferation of appropriate vegetation and create appropriate habitats for fish as social value adding components. Facilitate the establishment of vegetated zones as compensation of the lost biomass that should include a sizeable buffer around the dam comprising indigenous tree species,
- (ii) Initiatives on the conservation and protection of the immediate catchment should also be formulated and integrated into the dam operations guidelines,
- (iii) To enhance social Integration, the local communities and all the stakeholders involved should be sensitized on the benefits and risks of the project so that they are all on board in advance for effective participation and sustainability. A social component, therefore, needs to be built into the overall project implementation. Entrench ownership of the project upon the residents through participation during construction and thereafter when they can report negative activities within the project area. In this endeavor, local sensitization committees should be developed from the communities to act as liaison between the project implementation group and the stakeholders.
- (iv) Compensation and resettlement of the project affected persons (PAPs) should be finalized before commencement of the project to ensure minimal social conflict over the project in future. Land matters are rather a sensitive and thorny issue. Acquisition and related compensation aspects should be approached with caution through a well-defined inclusive process involving identification of the true target beneficiaries, awareness creation and political will. Consultations especially with all affected landowners, household members, valuation processes, negotiations, awards. Within the compensation component, there is also need to develop livelihood restoration

programs and those moved from their land to settled near the rest of their clansmen subject to availability of land. The PAPs would be provided an opportunity to buy alternative land of their choice,

- (v) There is need to undertake capacity building for the local communities so as to enable them to competitively exploit opportunities that arise from construction of the project (employment, supplies, etc.) as well as utilization of their resources. The Government through the Authorities in-charge of water resources should come on board to support the local communities' access water through established procedures.
- (vi) It is highly recommended that a full Risk Assessment Study is undertaken on the proposed dam with a view to identifying pre-cautionary measures and collaboration mechanism for safety of the affected zones.
- (vii) EMP and RAP measures designed for Kshs 236 million should be effectively implemented during construction and operation phase of the project under the strict supervision of SEC consisting of international and national environmental and social experts in order to minimize the environmental and social concern of the project and maximize the project impact on human and natural resources.

ANNEX I

ESIA Terms of Reference ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY FOR THE PROPOSED MULTI-PURPOSE MWACHE DAM (KWALE COUNTY)

Introduction

The development and management of water resources in Kenya is based on the view that water is a social good and is a catalyst for economic development. The current access to clean water in the country is estimated at about 90% in urban areas and approximately 44% in the rural areas while the national average stands at about 57%. At the same time, provision for safe sanitation stands at a national average of 80% (95% urban and 77% rural). The Government of Kenya (GOK) has recognized the need for comprehensive institutional reform and increased investment in the water and sanitation sector in order to remove bottlenecks in its programme to alleviate poverty and create employment and wealth.

The proposed Mwache Dam was identified by the Government as a flagship project under the Kenya Vision 2030 mission and also as a necessary facility to supplement water supply for Mombasa City and the adjacent areas in Kinango District in Kwale County. Feasibility studies covering the project area has established that water is a priority to all the residents in terms of livelihoods and social requirements. The overall ecosystem will also be transformed to the benefit of the communities. The dam is proposed to be located immediately upstream of Mwache Creek (~4km) on Mwache river in Kasemeni Division, Kinango District of Kwale County (Coast Province).

Harnessing of the fluctuating flows in Mwache River and the seasonal waters from its tributaries would complement water supply for Mombasa and provide for irrigated farming and local livestock requirements and other economic activities as the resource may accommodate in the area. The proposed dam is expected to cover an area including the river flood plain to store a maximum of 118.70 MCM at an elevation of 82.20 m asl, with a catchment spanning about 2,250km², from the dam site to the Taita hills and comprising of Mwangombe, Maji ya Chumvi, Nyongoni, Dambola and Mnyenzi sub-catchments. It will cover among other locations Kasemeni, Mwatate, Mwavumbo, Gandini and Mtaa.

The Project Background

Following acute shortage in water in most parts of the country (Kenya being a water scarcity country), it has become necessary that alternative mechanisms are developed to harness available sources to supplement the little available. With intensive surface runoff during heavy rains, significant volumes of storm water are lost. Dam construction has been identified as an alternative to harness the storm water for storage and use during the dry conditions. Mwache Dam is among the flagship projects identified in the Kenya Vision 2030 geared towards closing the shortage gap in supplementing water to Mombasa, providing water to the local communities as well as other economic components. The design of the dam is taking into consideration all the possible but viable components to ensure maximum benefits. The dam was slated for implementation in the plan period 2008 – 2012 through the Ministry of Regional Development Authorities.

Project Justification

Mombasa City and its surrounding environs is provided water from four sources including Baricho Water Works in Malindi District providing 47,000m³, Mzima Springs (providing 35,000m³/day, Marere river (bringing in 6,900³) and Tiwi boreholes (producing 3,900³). The sources provide only 35% of the total water demand of the city. The total demand is estimated about 206,000m³ per day but only 92,800m³ is available). There is also significant unaccounted for water (ufW) arising from poor integrity of the distribution network, illegal connections and poor tracking of accessibility. That beside the point, there is strong need to supplement the available water to meet the demand. The community at the project area relies on the limited connections from the Mzima Springs pipeline to a few communal points that is hardly enough to meet their all round requirements. The projected domestic and industrial water demand of cost region for the year 2030 will be about 375,370m³/day. The water deficit will be about 282,570m³/day against that demand.

The allocated water supply from the Mwache Dam system will be 186,000 cum/day for the target population of Mvita, Kisauni and Changamwe Districts. The forecast water demand including population projections for the three areas of Mombasa County are given in detail in the design chapter. Projected Water Demand for Changamwe, Mvita and Kisauni Districts of Mombasa County for medium growth Scenario is estimated as 186,000 cum/day for year 2030.

The project in Kinango District (Kwale County) is habited by a community who are basically farmers. However, agricultural production is poor due to poor rains and soils of inadequate quality. Farmers lose their crop (mainly food crops) before it matures, leaving the community's poverty levels and level of living declining over time. The proposed Multipurpose Mwache Dam is being designed to support the local community in food production through small scale irrigation scheme. The annual irrigated area will be about 4725 ha. There will also be other socio-economic development such as fishery in the dam reservoir and tourism.

Proposed Project Coverage

Mwache River is the main stream feeding into the proposed dam. The river basin spanning to as far as the Taita hills to the west covers an estimated catchment of 2,250km² with a total length of 110km and elevation of between 300m a.s.l. down to 20m a.s.l. at the dam. There is no notable information on the river characteristics in terms of hydrology, ecological and water quality conditions of the river basin. The river comprises of various streams including Ngoni originating from Pemba and Taita hills joining with Mto wa Nguro rising from Mabesheni hills to the south a short distance upstream of the dam area. Minyenzeni River rises from a series of hills among them Chogato, Mukanyeni, Kikuyu and Mabesheni hills to join Mwache River at Miyani area a short distance upstream of the proposed dam wall. The actual catchment area from the tributaries will be established during this study.

The areas to be served by the dam water are classified into two, namely water supply coverage, command area for irrigation. The command area for irrigation spans for 946 ha and 4,138 ha on the left and right hand banks respectively where both would be served through a designed pumping scheme from the dam. Water supply in the area is currently from Mzima Spring pipeline through various communal water points managed by community groups while others (mainly washing, livestock and irrigation) obtain their water from stagnant pools on the river beds. This system would be enhanced on the one hand while mechanisms of supplementing the same would be a component to the proposed Mwache dam.

Project Activities

The dam project begins with the concept development that involved desk and field assessment with a view to establishing the need for the project. A wide range of considerations including the capacity of the existing water sources, water demand and uses as well as social and economic linkages of water in the target area have been undertaken. This was achieved by the MORDA as a reference for the feasibility study and has not been discussed further under this report. The concept is followed by a detailed feasibility study. Like this environmental scoping process, this study involved determination of the viability of the proposed dam project with respect to sustainability of water feed, environmental suitability, social acceptability and economical justifications.

Preliminary physical surveys, measurements and social evaluations were carried out in conjunction with all stakeholders and in reference to all other social and economic initiatives in the project area. According to the feasibility report so produced, the project is a fulfillment of the communities long time dream of water availability while the positive implications over-rides the negative impacts that would otherwise be mitigated through integrated measures through the dam construction and use of the water therefrom. Actual activities will include bush clearing, decommissioning of point sources of pollution, earth moving and excavations, embankment construction, inundation period and commissioning of the dam.

The EIA Study

Overview

The ultimate goal of this EIA study is to identify impacts resulting from the proposed project to the environment and social setting. The impacts will be determined on the basis of the baseline conditions established during the field work and information obtained from the documents reviewed as well as interviews of the stakeholders. For subjective predictions of the impacts, the site area will be subjected to environmental scoping process. This will be a process of evaluating the overall magnitude of the project and the significance of the anticipated impacts and possibilities of handling the same. Detailed evaluation of the project area will be undertaken such as to focus on any significant environmental and social issues as established in the scoping process.

A scoping process was undertaken leading to a Project Report to provide a preliminary view of the environmental and social status. The report presented the overall project concepts, anticipated magnitude, key stakeholders and the implementation plan outline. It also involved establishment of the diversity on physical environment, climatic conditions, demographic trends as well as the hydro-geological status in the area. Relevant policy and legal requirements were also listed. The study team strived to share experiences on water resources and social issues in that part of the country and in particular with regard to water demand and utilization. The report has provided the basic considerations that could be emphasized on during the detailed and consultation session at the ESIA study stage.

ESIA Methodology

In accordance to the ESIA regulations the objectives of the study should include the following key issues;

- (viii) A clear description of the proposed project including its objectives, design concepts, proposed water uses and anticipated environmental and social impacts,
- (ix) Description of the baseline conditions in the project areas such as to cover the physical location, environmental setting, social and economic issues,
- (x) A description of the legal, policy and institutional framework within which the proposed dam project will be implemented,
- (xi) Description of the project alternatives and selection criteria,
- (xii) Details of the anticipated impacts to the environment, social and economic aspects of the area covered by the project.
- (xiii) Appropriate mitigation and/or corrective measures,
- (xiv) Develop an environmental management plan (EMP) presenting the project activities, potential impacts, mitigation actions, targets and responsibilities, associated costs and monitoring indicators,

Detailed evaluation of the project area will be undertaken to focus on any significant environmental issues. The communities living within the proposed dam coverage area will be interviewed during consultation and participation process during the detailed study process. Among the tools that will be used include questionnaires, self-writing forms, photographs, etc. Overall, the study was undertaken through the stages below;

Scoping Process

This process has been designed to provide a preliminary view of the environmental and social status. It involves establishment of the diversity on physical environment, climatic conditions, demographic trends as well as the hydro-geological status in the area. Relevant policy and legal requirements will be identified listed. The study team is striving to share experiences on water resources and social issues in that part of the country, and in particular with regard to water demand and utilization. This will enable determination of project elements that would be emphasized on. Among the aspects will be discussed in detail under this ESIA Study report;

Environmental aspects including

- (i) Submergence of various streams including the related ecosystems (unique indigenous vegetation species and habitats for indigenous micro and macro organisms and breeding areas),
- (ii) Potential sand transportation and storage in the dam and immediately upstream,
- (iii) Excavation of biomass (live and dead) accumulated over hundreds of years before inundation,
- (iv) Water quality effects from point sources dotted all over the project area including among others pit latrines, grave sites, livestock pens, settlement and market centers,
- (v) Emergence of new species in the area such as to include vectors, wild animals and plant species,
- (vi) Effects on micro climatic conditions in the neighboring areas,

Social and Economic addressing the following

- (i) Land issues with respect to land ownership, land acquisitions, compensations and resettlement of the landowners,
- (ii) Social linkages of the dam such as to include public health (HIV/AIDS, Malaria, typhoid, bilharzias, etc.), income generation (employment, economic opportunities, irrigation, etc.) and access to water,
- (iii) Cultural linkages including relocation of graves and interference with other cultural sites,
- (iv) Economic values of existing natural resources (biomass, sand, soils, stones, etc.),

Documentary (Literature) Review

Various relevant documents are being reviewed for a clear understanding of the terms of reference, environmental status of the project area and the target river systems, data on demographic trends (for the project area, the beneficiary areas and the adjoining districts), land use practices in the affected areas (either as catchments, dam location or the beneficiary areas), development strategies and plans (local and national) as well as the policy, legal and institutional documents.

Field Assessment

Field assessment has been designed to address the physical and biological environment as well as the project affected persons (PAPs). Determination of the affected environmental and social features would not only be felt within the dam area but also in the neighbouring districts (upstream, around the dammed area and downstream). The field work session is, therefore, focused on establishing the anticipated positive and negative impacts in terms of physical and biological environment (hydrology, climatic patterns and water resources related aspects), social and economic trends, (population trends, settlement trends, economic patterns, cultural setting and linkages, land ownership issues, etc.). Specific objectives of the field assessment will include;

- (iv) Obtain any available information and data from the local public offices including environment, water, lands and agriculture. Public consultations were also organized with the stakeholders both in the rural and urban setting,
- (v) Evaluate the environmental setting around the proposed site. General observations were focused on the topography, land use trends, surface water sources, public amenities, wetlands, settlements, forests, soils, etc. Also to identify climatic and land cover variations along the affected areas,
- (vi) Evaluate social, economic and cultural settings in the entire project areas,
- (vii) Undertake comprehensive consultative public participation exercise such as to reach a large section of the project affected persons as well as other stakeholders.

Detailed ESIA Study Activities

This assignment involves a series of activities carried out in liaison with the Client, relevant government departments, local authorities, community groups and other organizations in the area with a view to sharing their experiences and information with respect to environmental resources and social aspects. Effective evaluation of the social baseline status achieved through interviews (consultative meetings and discussions) and physical inspections of the entire project area. The baseline conditions provide the starting point for the impacts predictions and benchmark for the mitigation measures.

Details of the activities are listed under the original terms of reference are as follows;

- (vi) Review of the proposed dam project details to understanding of the dam project magnitude and the overall implementation plan by the client.
- (vii) Establishment of the current baseline conditions to provide a documented foundation for the impact predictions and a benchmark for the development of mitigation measures
- (viii) Update of the legislative and regulatory requirements as a basis for drawing a compliance monitoring protocol for the construction and commissioning phases.
- (ix) Environmental and social impacts assessments for the identification of significant impacts to the environment and the nearby communities. Types and levels of impacts as well as criteria for developing suitable mitigation measures and an environmental management plan.
- (x) Environmental management plan on mitigation measures, responsibilities, timeframes, environmental costs and a comprehensive environmental management plan.

Public Consultations

Interaction with the stakeholders and communities living around the project area has been a continuous process. This commenced immediately upon commissioning of the assignment upon realization that the feasibility study and design activities would involve physical access to the project site and the outlying zones. Among the interactions include informal contacts on basic inquiries, engaging local youth in the study activities. Among the formal forums undertaken were sensitization sessions involving all levels of stakeholders, social and economic surveys at household levels and public participation forums will be open to all the residents. Addition sessions involved the PAPs who will be interviewed for purposes of compensation on land acquisition.

Reporting

The reports (inception, draft final and final draft and final) will be done at pre-agreed timeframes such as to cover the requirements of the National Environmental Management Authority (NEMA) guidelines. The report schedule comprises a scoping report, draft final ESIA study report and final ESIA study report. The scoping report and the final study report will be submitted to NEMA review.

Key Potential Anticipated Impacts

General

Construction of large dams provides ecological as well as social challenges even though the ultimate facility is generally beneficial to the stakeholders and the country in general. Impoundment of large volumes of water has implications on the upstream systems through shifting of ecosystem boundaries upstream as a result of changes in flood regimes. At the dam site itself and the inundated areas, implications ranges from slowed silt, nutrients and pollutant transportation rate to downstream zones, potential loss and/or introduction of species (both plants and animals), displacement of social and economic features and land use changes for the residual riparian landowners. Finally, downstream impacts are associated with regulated flows of the affected rivers/streams, shifting of species to upstream areas, safety risks and land use changes due to the constant flows trends introduced by the dam.

The above impact concepts guide the identification of the impacts associated with the proposed Mwache dam such as to focus on the following aspects;

- (x) Hydrological patterns of the affected river basin,
- (xi) Hydraulic characteristics at the dam site associated with the dam designs,
- (xii) Water quality issues with respect to the watershed and catchment land use practices,
- (xiii) Geological trends studies in regard to physical water retention,
- (xiv) Aquatic ecosystems and habitat requirements,
- (xv) Riparian land use trends and natural features,
- (xvi) Social features (land use, settlements, economic activities, cultural features, etc.).
- (xvii) Social trends including population and settlement dynamics, social integration and kinship relations, cultural values, displacement and relocation, Gender equity and disease notably HIV/AIDS prevalence

- (xviii) Economic trends namely economic activities, poverty levels and livelihood changes

Impacts to the social and environmental aspects vary from one area to another depending on specific settings. General impacts associated with the proposed Multipurpose Mwache dam are discussed below;

Environmental Impacts

The overall impacts arising from the dam construction are positive in all respects of environmental, social and economic perspective. Once constructed, Mwache dam will supply water to the target areas of Mombasa and the local areas (mainly Kasemeni Division) whose main constraint to development has been scarcity of water that has contributed to hardships and poverty due low income of the people within the area. This will have major positive impacts on economic growth, tourism development, people's livelihoods, incomes and food security. The above scenario reveals that females, who form majority of the population and undertake most of the water-related activities, and men who own the land, should be actively involved in the project implementation. Further, as part of the projects efforts to enhance gender equity, there is need to mainstream gender in all project activities.

Provision of water from the proposed dam has the potential to enhance development and growth of the markets as more economic and social interests arise. More important is the opportunity to improve sanitation and hygiene in these markets as opposed to the currently potential threat of diseases in almost all the markets. This conclusion follows from the justification criteria. Among the key positive linkages include:

- (v) The dam is expected to moderate water flows downstream of Mwache river throughout the year with potential ecological stability and constant availability of water to the downstream dependents and ecological productivity within Mwache Creek,
- (vi) With the proposed sand check dams, downstream, the dam will also help control siltation into Mwache Creek downstream, which is a significant benefit to the ecological status. However, complete cut-off of silt entry could also have negative implications following reduced nutrients and potential minerals necessary for fish,
- (vii) The dam water has the potential to sustain ecological habitats (particularly indigenous) including vegetation and aquatic and terrestrial wildlife (fish, crocodiles, hippos, snake species, etc.),
- (viii) The general hygiene and sanitation of the project area and the service area will significantly improve as a result of readily available water, and particularly from the treated water supply,

Detailed impacts and associated mitigation measures will be identified through the ESIA Study process and report

Management Issues

This project is geared towards enhancing social and economic benefits to the people living within beneficiary areas (Kinango district) and the region in general. The project, however, should also observe environmental conservation requirements in accordance to the established laws and regulations. To realize this goal, acceptability by a majority of the beneficiaries and minimal effects to the physical environment will require to be integrated in the project through constant consultations, evaluations and review of the design aspects throughout the project coverage. It is recommended that guiding principles specific to this project and the regulations governing water resources management be developed that will allow integration of environmental management considerations in the construction, maintenance of the facility components and public amenities.

In order to implement the management plan, it is recommended that an expert is identified to oversee environment and management aspects including the dam conservation, soil erosion control, re-vegetation whenever appropriate, water conservation and equity in distribution, enhanced sanitation and hygiene measures throughout the project area. The expert would also be expected to co-ordinate and monitor environmental management during construction and post monitoring audits

Upon completion and commissioning of the dam, it will be necessary to establish appropriate operational guidelines on environmental conservation and social linkages to enable the management identify critical environmental and social issues and institute appropriate actions towards minimizing associated conflicts. Basically, the guidelines should cover among other areas environmental management programmes, standard operation procedures, compliance monitoring schedule and environmental audit schedules as required by law. Social harmony of the dam and associated component will be achieved through the collaborations with the stakeholders or community management committees introduce at various water consumption points.

Decommissioning Phase

The decommissioning of the project could be viewed in three stages comprising of the immediate (after completion of construction), maintenance and expansions (during operations) and ultimate removal. In each case the responsibility will lie with then operator and the MORDA. Decommissioning will take the following forms;

Construction Installations

Upon completion of the project, the contractor will need to remove the construction structures including operation camp sites (offices, stores and associated sanitation facilities), equipment parking camps and workmen camps. The material sites will also need to be decommissioned and rehabilitated (quarry, sites and gravel borrow pits) back to near original status. The sites are not known at the time of this study and the decommissioning plans will be dependent on the physical locations. Note that should any of the installations be found useful to the community (e.g. offices), they may be retained for public use such as health centers or other functions).

Removal OR Modification of Dam Components

During operation, it might be necessary to remove parts of the project or modify certain components. Among such components would include the spillway, intake diversions, water treatment plant, pipeline (raising mains) and the storage tank area. Other additional components would be defined for removal or modification.

Dam Decommissioning

After the design period (100 years) or other desired life span, it might require that the dam is removed or demolished. It is, however, not possible to predict the exact activities and costs at the time of this decommissioning. It will, therefore, require that a comprehensive decommissioning audit is undertaken to provide implementable decommissioning plan.

The overall impacts arising from the dam construction are positive in all respects of environmental, social and economic perspective. Once constructed, Mwache dam will supply water to the target areas of Mombasa and the local areas (mainly Kasemeni Division) whose main constraint to development has been scarcity of water that has contributed to hardships and poverty due low income of the people within the area. This will have major positive impacts on economic growth, tourism development, people's livelihoods, incomes and food security. The above scenario reveals that females, who form majority of the population and undertake most of the water-related activities, and men who own the land, should be actively involved in the project implementation. Further, as part of the projects efforts to enhance gender equity, there is need to mainstream gender in all project activities.

Provision of water from the proposed dam has the potential to enhance development and growth of the markets as more economic and social interests arise. More important is the opportunity to improve sanitation and hygiene in these markets as opposed to the currently potential threat of diseases in almost all the markets.

Environmental Management Plan

Management Plan Principles

This project is geared towards enhancing social and economic benefits to the people living within beneficiary areas and the region in general. The project, however, should also observe environmental

conservation requirements in accordance to the established laws and regulations. To realize this goal, acceptability by a majority of the beneficiaries and minimal effects to the physical environment will require to be integrated in the project through constant consultations, evaluations and review of the design aspects throughout the project coverage. It is recommended that guiding principles specific to this project and the regulations governing water resources management be developed that will allow integration of environmental management considerations in the construction, maintenance of the facility components and public amenities.

In view of the above principles, CDA will need to integrate the same into the corporate strategy implementation and establish a project specific implementation policy with respect to the environmental and social aspects. The policy should take into consideration other stakeholders interests including Ministry of Agriculture, Water Authorities, Ministry Livestock Development, Public Health, etc.

Management Responsibilities

In order to implement the management plan, it is recommended that an expert is identified to oversee environment and management aspects including the dam conservation, soil erosion control, re-vegetation whenever appropriate, water conservation and equity in distribution, enhanced sanitation and hygiene measures throughout the project area. The expert would also be expected to co-ordinate and monitor environmental management during construction and post monitoring audits. Other recommended participants could include the respective District Environmental Officers, District Water Officers and the District Planning Officers and the County Councils among others.

Environmental and Social Management Guidelines

Upon completion and commissioning of the dam, it will be necessary to establish appropriate operational guidelines on environmental conservation and social linkages to enable the management identify critical environmental and social issues and institute appropriate actions towards minimizing associated conflicts. Basically, the guidelines should cover among other areas environmental management programmes, standard operation procedures, compliance monitoring schedule and environmental audit schedules as required by law. Social harmony of the dam and associated component will be achieved through the collaborations with the stakeholders or community management committees introduce at various water consumption points.

HIV/AIDS Issues

During the operations, the management would be expected to integrate HIV/AIDS program into the dam management framework. In addition, other common social health issues may be also integrated. The contractor would be expected to incorporate HIV/Aids programmes during construction such as to include a VCT centre, information and education materials and initiatives. The VCT Centre will be integrated to the Construction camp, but easily accessible to the local communities while associated data and information should be channeled into the national records. Equally important will be dissemination of information for enhanced awareness to all stakeholders and member of public on HIV/AIDS control.

Monitoring

Environmentally sensitive aspects have been identified under this EIA report and the Resident Engineer together with the Contractor will need to integrate the mitigation measures in the project implementation. It is also recommended that during the construction period environmental reviews of the works are undertaken to determine the level of compliance with the recommendations of this EIA during construction, and eventually a completion audit report be filed to NEMA and other relevant authorities prior to commissioning of the airport.

A detailed ESMP will be presented in the full ESIA Study Report

Expected Actions

According to the terms of reference of this consultancy, the main objective of the assignment was to carry out an environmental and social impact assessment and preliminary resettlement plan associated with development of the dam and the associated components. The assessment was in compliance with the current requirements of international financing agencies in addition to the EIA

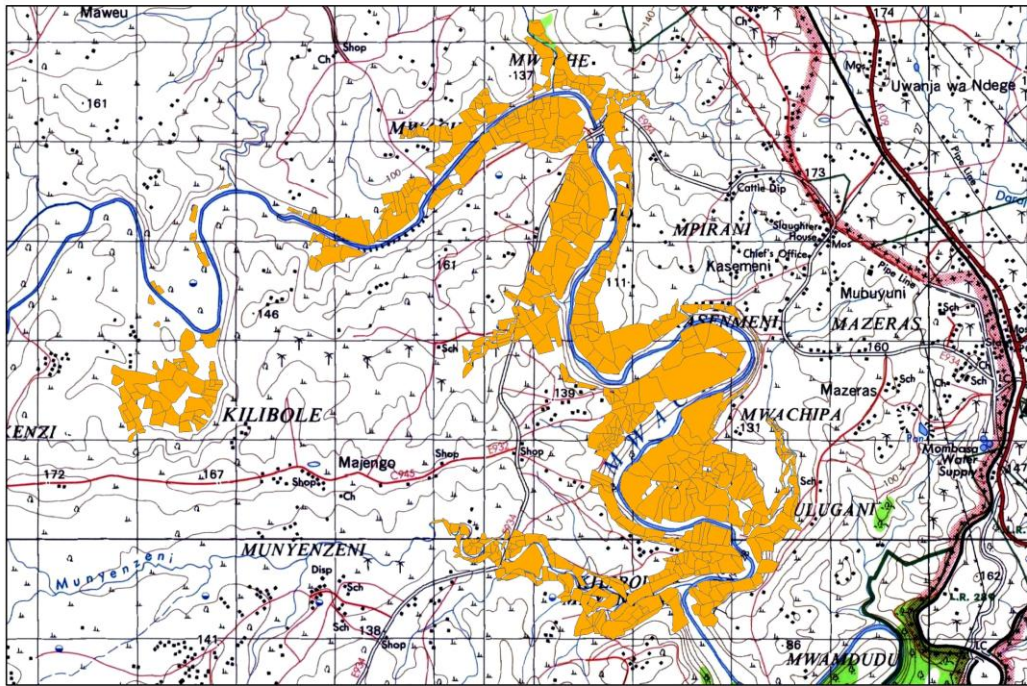
regulations of 2003 as established under the EMCA, 1999. Preliminary resettlement action plan entailed identification of the affected landowners and proposals on how the land could be acquired.

According to the Terms of Reference, the Environmental expert alongside the Sociologist and the Resettlement Action Plan Expert are expected to undertake the following;

- (i) Provide a background, scope, objectives of the project with respect to environmental and social aspects,
- (ii) Review and analyze policies, legal and institutional framework governing environmental resources management in Kenya,
- (iii) Review of documented information and data on the areas affected by the project,
- (iv) Examine and document the environmental and social baseline conditions of the project areas,
- (v) Identify all environmental and social impacts (positive and negative) associated with the project preparation, construction, operations and decommissioning stages and establish appropriate mitigation or preventive measures,
- (vi) Undertake detailed Public Consultations with all levels of stakeholders and affected sections of the public/society. This should also include sensitising the stakeholders and direct involvements,
- (vii) Develop a comprehensive environmental and social management plan (EMP) for integration into the project implementation process,
- (viii) Prepare an environmental and social monitoring plan (EMoP) covering all stages of the project lifecycle,
- (ix) Working with the RAP Expert, identify and quantify the Project Affected Persons (PAPs) and the associated property and establish a resettlement action plan outline including land acquisition and compensation factors,
- (x) Evaluate the catchment settings for Mwache Rivers with a view to identifying the key features that would influence the dam water and the use thereof. Develop intervention projects for implementation with appropriate comprehensive Terms of Reference.

ANNEX II

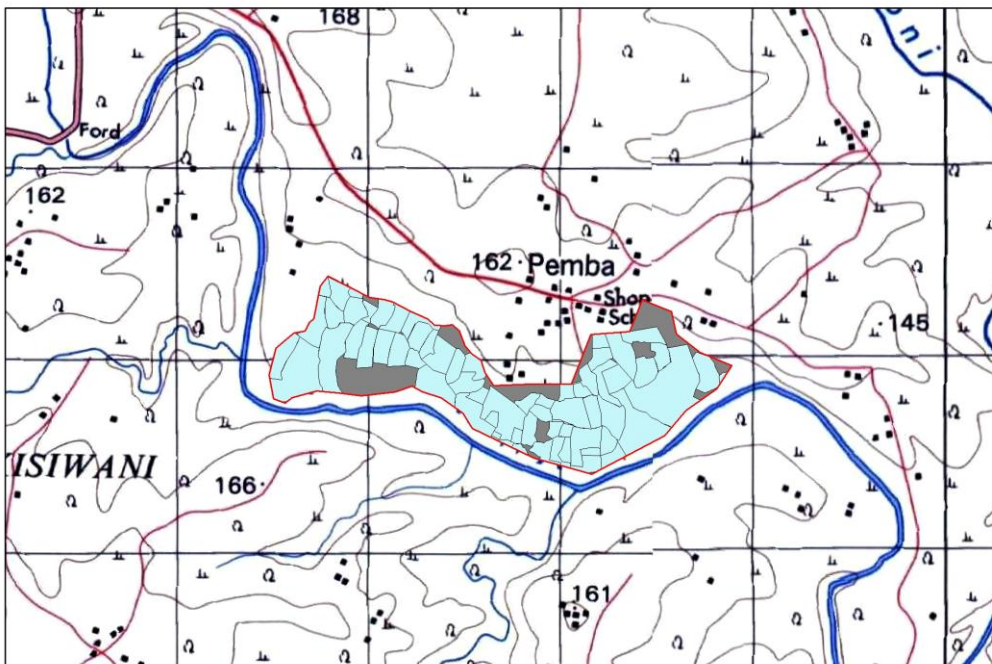
Project Location Maps and Layout



Legend

Mwache_parcel

0 0.27 0.55 1.1 1.65 2.2 Kilometers



Legend

Irrigation Area Land Parcels Disputed/Unenumerated Lands

0 0.12 0.25 0.5 0.75 1 Kilometers



ANNEX III

Project Description, Design Concept and Salient Features

1.1 Project Location

Mwache Multipurpose Dam Development project is situated in Kasemeni division of Kinango district under Coast Province. Mwache River spans between Kasemeni and Mwavumbo locations, approximately 22 km West of Mombasa Island by road. It is located between latitudes 39°E and 40°E and longitudes 3°30'S and 4°S. The river lies in undulating terrain, between sea level and 300 metres above sea level. The last 6 km length of the river is characterized by deep valley (50-100 m deep), which makes it the perfect site for constructing a dam. The river bed has numerous black rocks.

1.2 Project History

The Mwache Multi-purpose Project is one of the Flagship projects of Vision 2030 and is slated for implementation during the First Medium Plan (2008-2012). The Ministry of Regional Development Authorities (MoRDA) has received funds from the Government of the Republic of Kenya (GoK) towards the cost of Mwache Multipurpose Dam Development project on river Mwache.

1.3 Objective

The main objective of the Mwache Dam Development Project is to improve the living standards of Kwale and Mombasa residents through Poverty Alleviation and Sustainable Development.

A storage dam and reservoir is proposed to be constructed for providing Domestic water supply to coastal area (including Mombasa town) and irrigation facilities to nearby command area. The project will also help in other socio-economic developments such as livestock water requirement, fisheries and tourism.

1.4 Dam and spillway

1.4.1 Location:

The proposed dam site falls in Fulugani village of Kasemeni division. The site falls in a straight stretch of the river Mwache located inside a gorge. The dam site (3°59'12" S 39°31'07" N) is found to be the best site considering topography and geology of the dam site area. The right bank is very stiff and left bank is comparatively flat. The site is accessible by road from Mombasa City and located on the lower reaches just few kilometres away from outfall of Mwache river into the Indian ocean at Port Reitz. Full Reservoir Level (FRL) is fixed at El.82.2 m to get maximum storage and height.

1.4.2 Dam and Check dams

Depending on topography, availability of construction materials, safety and cost comparison it is decided to go for conventional concrete gravity dam. The height of the dam is about 75m.

Three check dams (height varying between 4m and 10 m) have been proposed in the catchment area at upstream of dam for control of sediment.

1.4.3 Spillway

The spillway is provided in the river bed portion. A ungated ogee over fall spillway is proposed. The Length of the spillway is 195m. A spillway bridge is planned for facilitating vehicular movement, laying of pipes carrying water for irrigation etc. over the dam. Spillway piers are planned for supporting the

spillway bridge. The spillway has been designed for passing a flood of 2755 cumec (PMF).

1.4.4 Basic Design Considerations

Basic dam design principles are driven by safety and economic sustainability. The key principles adopted for Mwache dam include;

- (vii) Utilization of available construction materials
- (viii) Structural stability of all components of the dam and appurtenant structures.
- (ix) Adequate size of spillway to pass the design flood.
- (x) Considering sediment capacity.

1.5 Project Area

The project location has been described in earlier paragraphs. The project area covers dam and appurtenant structures, power house, irrigation command area. The villages / locations under the project area Fulugani, Kasemeni, Mwachipa, Chigato, Mazengo, Mnyenzi, Mazeras, Kilibole, Bofu, Katundani, etc. The outer boundary lies between latitude (03°56'30"S to 04°01'54"S) and longitude (39°26'45"E to 39°32'45"E).

1.6 Hydrology:

1.6.1 General :

Mwache River comprises one of the main drainage basins that drain directly into the Indian ocean within the Athi River Basin. It drains into the Indian Ocean through Mwache Creek at Port Reitz south of Mombasa Island.

Hydrological data for Mwache River exists for the period 1976 to 1990 recorded at River Gauging Station (RGS) 3MA03, which was located a few kilometers upstream of the proposed dam on Mwache River. This station was later abandoned. There is no other river gauging stations established on Mwache River.

The proposed dam location in the sub-catchment falls within the coastal region of Kenya with elevation varying from 0m- 300m.a.s.l.

Mwache river basin covers an area of 2,250 km² and lies between 300m to 14 m.a.s.l. It exhibits gentle slopes in the upper regions and flat in the lower regions. The proposed dam site is located near Fulugani village of Kasemeni Division in Kinango District.

Most of the rainfall at the Kenyan coast occurs between March and July and in October to December with the maximum occurring in May and November. The coastal region receives an average annual rainfall ranging from 1200mm and 500mm.

Evaporation rates recorded at the Moi International Airport provide the appropriate parameter to describe evaporation variation in the proposed project area. The mean daily evaporation rates vary from 3.5 mm in July to 6.3 mm in February.

1.6.2 Catchment Area upstream of the dam

The catchment up to proposed Mwache Dam site is T- shaped with catchment area of 2250 km².

Natural vegetation in the project area is reflected through the ecological range of vegetation due to the difference in rainfall and soil zones. Different types of vegetation in the coastal fringes are as

under:

- (i) Mangrove vegetation is found in the tidal creeks and in the river estuaries; immediately behind the mangroves is vegetation comprising woodlands and bush. Broad-leaved evergreen and deciduous shrubs are characteristic of this vegetation.
- (ii) Forest vegetation is found in isolated areas along the coast. In the past, the forests were extensive but have cleared and reduced, as more land has been brought under cultivation,
- (iii) The savanna grassland of dry type is found further inland behind the forest belt. This consists of mainly grassland, dotted with a few bushes and shrubs.
- (iv) At the western inland margin of the coastal region the Nyika (wildness) area begins. This is the driest part of the coast and it carries its own type of dryland Nyika vegetation consisting of semi-ever green thickets and bushes separated in some parts by grass. The baobab tree is most characteristic of this type of vegetation.

1.6.3 Hydrological Data Availability:

Under the data limitations, synthetic generation of monthly stream flow series for Mwache is undertaken based on 14 years of monthly flow pattern besides considering the option of extending the flow series using upstream gauging station discharge data.

The water availability at Mwache dam is as follows:

Mwache Dam:

Dependable flow: The average, 75 % and 90 % dependable annual flows are 112.30 MCM, 88.40 MCM and 77.07 MCM respectively and are recommended for Mwache project planning

1.6.4 Reservoir capacity:

The Reservoir Elevation-Area-Capacity relationship for the proposed Mwache dam location has been developed on the basis of topographical surveys. The reservoir gross storage capacity at EL 82.2m (FRL) is found to be of 118.70 MCM.

1.6.5 Design Flood and Diversion Flood:

The design flood (PMF) for spillway has been worked out as 2755 cumec and diversion flood (25 year flood) as 80 cumec.

1.6.6 Sedimentation

The catchment up to proposed Mwache Dam site is 2250 km². The Mwache catchment covers both forest and non-forest area. In the feasibility study report the new zero elevation (NZE) after 100 years was estimated as EL 65.0 m assuming the sedimentation rate as 500 m³/Sq.km/yr. All the sediment from the entire catchment was supposed to settle at the reservoir of the dam.

It has therefore been decided to identify suitable site(s) to construct check dam(s) to arrest the silt load before it can reach the dam reservoir. Three suitable sites were identified and check dams of suitable height (between 4m and 10m) have been proposed. The silt deposited in the upstream of the check dams need to be cleared after the end of each rainy period. This silt would be used for various commercial purposes. The check dams proposed will enhance the life of the Mwache Dam and will continue to provide benefits to the region.

1.7 Geological Aspects

1.7.1 General:

The dam site and surrounding is composed of the rocks of sedimentary origin which belong to Triassic in age. These rocks are known as Duruma Sandstones and subdivided into three subgroups:

| | | |
|--------|-------|--|
| Upper | | Mazeras sandstones and Shimba grits |
| Middle | | Mariakani sandstones and Maji-ya-Chumvi beds |
| Lower | | Taru grits |

These rocks were deposited under lacustrine and subaerial conditions with minor marine facies. The detailed account of the geology of Kilifi-Mazeras area, in which the project is located, has been given by P V Caswell (1956). In Mwache-Mazeras area, only Mariakani and Mazeras subdivisions are exposed, the base of the former is not seen.

1.7.2 Geology along the Dam and Appurtenant Structures:

The interpretation of log of bore holes reveals that Mwache dam site and surroundings comprise of sedimentary rock formations named Duruma sandstone series. Mariakani sandstones are exposed in the river bed. Bedrock is intersected by two sets of perpendicular joint dipping vertical. A third set of joint is sub-horizontal bedding joints. Joints are very tight as indicated by zero permeability recorded in all the drill holes during percolation tests. The core recovery is almost 100 percent. Zero permeability indicates that the bedrock neither possesses primary permeability nor secondary permeability.

1.8 Project Outputs

Based on the water availability, a series of reservoir simulation studies have been conducted to firm up the project components (details given in design report). The project outputs will be as below:

1.8.1 Domestic Water Supply:

The allocated water supply from the Mwache Dam system will be for the target population of Mvita, Kisauni and Changamwe Districts. The forecaste water demand including population projections for the three areas of Mombasa County are given in detail in the design chapter. Projected Water Demand for Changamwe, Mvita and Kisauni Districts of Mombasa County for medium growth Scenario is estimated as 186,000 cum/day for year 2030.

The water supply components will consist of the following:

- a) Construction of an Intake Work in the left bank of the reservoir (with Access Bridge).
- b) From the intake the water will be sent to the treatment plants through pipeline / tunnel and distribution chamber.
- c) Treatment Works: It is designed for 186,000 m³/day capacity (3 pairs of treatment streams) - with 5% loss. + Works Buildings and Residence houses + all access roads + Pumping station with static head of +60m (3 pipes of 1,000mm dia) + several works network pipes ranging from 1,500mm to 300mm diameter + recirculating system for backwash water from settlement lagoon.

- d) Storage tank at elevation 100m asl
- e) Two Gravity flow transmission lines as follows:
 - (i) 1,200mm diameter for 36 km to Nguu Tatu tank (for Kisauni and Bamburi)

(ii) 1,100mm for 17 km and 600mm dia for 9 km to serve Chnagamwe and Mvita (with branch to feed Marere pipeline for Likoni area)

1.8.2 Irrigation:

The agricultural land for providing irrigation is mainly available on the higher reach (above EL 82m upto EI 140m). The following are the salient features of irrigation command area:

- Gross Command Area
 Left bank command = 1081.00 Ha
 Right bank command = 5592.00 Ha
- Cultivable Command Area
 Left bank command = 945.76 Ha
 Right bank command = 4137.84 Ha
- The total yearly water demand of irrigation water from dam is approximately 22.30 MCM.
- The area will be mostly irrigated by drip/sprinkler system.
- The water for irrigation from the dam reservoir shall be pumped and distributed in the area through underground laid pipe network.
- The command area consists of many valleys/stream which will provide a good drainage to the area.

1.8.3 Others:

Other benefits include livestock water supply in the command area, fishery due to created reservoir and tourism.

1.9 Salient Feature of the Project and Estimated Cost

| | | |
|-----------|--------------------------------------|---|
| 1. | Location | |
| | Country | Republic of Kenya |
| | County | Kwale |
| | District and Division | Kinango and Kasemeni |
| | Nearest Airport | Mombasa |
| | Nearest Rail Head | Mombasa |
| | Geographical Coordinates of Dam site | |
| | Longitude | 39°31'07"E |
| | Latitude | 03°59'12"S |
| 2. | Hydrology | |
| | Catchment Area | 2,250 Sq.km (upto dam site) |
| | Water Availability without storage: | |
| | Average Annual flow | 112.30 MCM |
| | 75% dependable annual flow | 88.40 MCM |
| | 90% dependable annual flow | 77.07 MCM |
| | Design Flood for Spillway (PMF) | 2755 cumecs |
| | Diversion flood | 80 cumecs |
| 3. | Dam and Spillway | |
| | Location of Dam | At Fulugani village across the river Mwache. The co-ordinates are |

| | | |
|-----------|---|---|
| | | given above. |
| | Type of Dam | Concrete Gravity dam |
| | Deepest River Bed Level at dam site | 14.0 m |
| | Deepest Foundation Level at dam site | 11.0 m |
| | Full Reservoir Level (FRL) / Spillway crest level | 82.2 m |
| | Maximum Water Level (MWL) | 86.0 m |
| | Top level of dam | 87.5 m |
| | Length of dam | 452.0 m |
| | Type of Spillway Structure | Ungated Ogee spillway |
| | Waterway of spillway | 194 m |
| | Dead storage (below EL 49.50m) | 20.53 MCM |
| | Gross storage at FRL (EL 82.20m) | 118.70 MCM |
| | Live storage | 98.17 MCM |
| 4. | Water Supply Aspects (Domestic) | |
| | Total Supply of water from Mwache Dam. The distribution is: | 186,000 m ³ /day |
| | Changamwe District (West Mainland) | 58,208 m ³ /day |
| | Mvita District (Island) | 19,373 m ³ /day |
| | Kisauni District (North Coast) | 108,418 m ³ /day |
| | Minimum operating level of the reservoir (for domestic water supply) | 49.50 m |
| 5 | Irrigation Systems | |
| | Gross Command area: | 6673.00 Ha |
| | Left Bank | 1081.00 Ha |
| | Right Bank | 5592.00 Ha |
| | Culturable Command Area: | |
| | Left Bank | 945.76 Ha |
| | Right Bank | 4137.84 Ha |
| | Annual Irrigated Area: | 5425.00 Ha |
| | Minimum operating level of the reservoir (for irrigation) | EL 57.00 m |
| 6. | Cost Estimate | |
| | Total Basic Cost of the project (without contingency). | 20,986.20 M Ksh (244.88 M USD, 1 USD = 85.7 Ksh) |
| | Major costs are: | |
| | Dam and appurtenant works | 8410.00 M Ksh |
| | Check Dams | 508.94 M Ksh |
| | Water Supply Systems (intake, pipe, storage tanks, treatment plant, pumps, tunnel, etc) | 5881.94 M Ksh |
| | Irrigation main systems upto storage tank for blocks (for about 40 ha) | 2868.60 M Ksh |
| | Micro Irrigation system for total 3525 ha land (inside blocks) | 763.75 M Ksh |
| | Electromechanical Works | 204.07 M Ksh |
| | Environmental plan & Resettlement | 656.00 M Ksh |
| 7. | Financial and Economic Aspects | |
| | a) Financial Internal Rate of Return (FIRR) | 12.13 % |
| | b) Financial Net Present Value (FNPV) | 282.47 M Ksh |
| | c) Economic Internal Rate of Return (EIRR) | 13.81 % |
| | d) Economic Net Present Value (ENPV) | 3,838.01 M Ksh |
| 8. | Construction Period | 48 Months |

ANNEX IV

Public Sensitization Minutes and Participation

MINUTES OF THE FUNCTION OF THE MINISTER FOR REGIONAL DEVELOPMENT AUTHORITIES ON THE MWACHE MULTIPURPOSE DAM

Date: 18th June 2011

Venue: Fulugani Primary School, Kasemeni Division, Kinango District Kwale County

Purpose of the Visit

Official launch of the service charter of the ministry of the Regional Development Authorities on Mwache Multipurpose Dam

Minute No. 1 Questions asked by the Minister

- What is the benefit of the Dam?
- How much water will a seasonal river add to the Dam?
- How much hydropower is expected to be generated from the Dam?
- Maize is withering, will there be enough water for utilization and domestic use
- When is the feasibility study likely to be ready to facilitate sourcing for funds?
- How is the consultancy work being done with a very poor road to the Dam site?
- Are any people going to be displaced by the project?
- How much is the project estimated to cost?

Minute No. 2 Responses to the Minister's Questions

- The Dam is 77m high and a reservoir will have a capacity of 133 cubic meters of water with a hydro-electric power generating capacity of 34MW. The river is 110km long with a catchment area of 2250km. It therefore has capacity to harvest enough water during the rain season.
- 1,536,000 people and 20,000 livestock will be served domestically
- 400 ha of land is estimated to be irrigated to improve the area's food security
- Initial drawings and inception reports are already with NEMA and the client. The final feasibility study, the socio-economic and valuation component will be ready by August 2011 and the Detailed Designs early next year 2012.
- After the designs are completed and compensation for Person Affected by the Project (PAPs) determined, a staggering 10 Billion was estimated. But the Minister referring to a similar project in the Republic of Iran estimated Kshs 30 – 40 billion.

Minute No. 3 The ministers Directions

- This was a viable project and the feasibility should be submitted by August 2011 so that he starts sourcing the funds for construction of the Dam.
- Coast Development Authority (CDA) and the Consultant should fix the 5KM stretch of the road from the junction to the Fulugani Primary school and the dam site as their corporate responsibility. This should be urgent for easy accessibility to the Dam site as more visitors will come to the area. Whoever wins the tender to build the Dam should then tarmac the road.
- The people in the area should be adequately informed and involved in the project so that they reap the anticipated benefit from the project.
- Every stage of the project should be done transparently as his ministry is corruption free and development oriented to benefit the people.
- The MD (CDA) and the Head teacher (Fulugani Primary School) should end the right shoe sizes of all the pupils in the school choir who were bare footed but put up a splendid performance. He offered each of them a pair of shoes

Minute No. 4 General Impression

The Minister is very happy with the project and will return in the company of the Area M.P and the Prime Minister. The Minister, the committee of Elders (Kaya) and CDA the client) are urging the consultant to move with speed in carrying the feasibility study so that funds are sought for construction to begin by June 2012.

The mood on the ground is set for implementation of the project especially given that the rains this season have failed and the project has an irrigation component. The songs carried important messages which also blessed the project

**MINUTES OF THE MEETING HELD AT THE DISTRICT COMMISSIONERS OFFICE
ON 18TH APRIL 2011**

PRESENT

1. Mr. Mwangi – Finance Manager representing the Md. CDA
2. Eng. Wainaina CDA
3. Rose Mweni CDA
4. Mr. Mkalla CDA
5. Eng. Kiarie APEC Consulting Engineers
6. Mr. Ngirigacha APEC Environmentalist
7. Mr. Wandera APEC Sociologist
8. Mr. Sanjeeve Representing CES India
9. Mr. A. O Okello DC Kinango District

Mr. Mkalla, CDA Kwale started by explaining on details on what concerns the project. He further explained that the team of experts and CES India is preparing the designs and concepts on what is to be implemented in the project. He then welcomed the District commissioner.

The D.C said that he cannot block any government development and that the goodwill for the project was given by cabinet to the Ministry of Regional Development to do the Mwache Project. He added that the inception report was submitted in November 2010 and he was aware of the project. The DC further expressed his joy that the people were involved from the beginning. He said that if implemented, it will have a big impact to the District.

Mr. Okello however, pointed out that politicians won't be avoided but will be managed to work with others. He added that his office is committed to the project and hopes that all components of the project proposed came on board unlike the Turkwel which only provides little power and not other components that were originally proposed.

Mr. Mwongo, emphasized that if the 400 ha of land is put in irrigation, then the area will greatly benefit. Eng. Wainaina felt that if the Dam comes in being than there will be a relief on Marere and Mzima water supplies.

**MINUTES OF THE STAKEHOLDES MEETING HELD AT MAZERAS HIGH SCHOOL
ON 20TH APRIL 2011**

Agenda

1. Preliminaries
2. Project briefings

Present

1. Managing Director CDA
2. Mr. Sanjeeve CES India Representative
3. Eng. Wainaina CDA
4. Mr. Wandera Sociologist
5. Mr. Mbarine Land Valuer
6. Members of the community

Minute 1: Preliminaries

The meeting started with introductions. The managing Director Coast Development Authority introduced CES team to the members. He further explained the purpose of the meeting and asked the members to be cooperative throughout the meeting. He then proceeded to present the project briefings to the rest of the members.

Minute 2: Project Briefings

The Managing Director (MD) said that the project is in Kasemeni Division but is surrounded by other Divisions such as Ndavaya, Kinango and Samburu Divisions, He added that the area of the dam is surrounded by environmental, physical features such as forests, streams, valleys, rocky surfaces, mild slopes and social and economic features such as settlements, institutions, cultural sites, cultivated lands, livestock, watering pints, access roads, grazing areas and sand.

He advised that there will be a series of consultative meetings due to the number of disruptions that have to be experienced by the community. Concerning the project, the MD CDA touched on the following issues;

a) Social Linkages

He explained that a project like this may have a lot of advantages depending on how the stakeholders decide to relate. He however, pointed that the project is likely to displace and resettle some persons where the dam will pass.

b) Cultural Issues

Concerning culture and traditions, the MD explained that during inception, the Wananchi had been talked to and they named such cultural sites as;

- Kaya Mswakara in Mwache forst
- Vita kafiri
- Grave sites
- Other cultural sites where important ceremonies take place

Challenges /Questions

The members asked question concerning the project which included;

1. What plans does CDA have to counter political interference?
2. How will the local community benefit from the project
3. What will happen to the tress in Kayas which take very long to mature?
4. Will locals be employed in the project?
5. Can a team of the ranch pan an exchange visit to a successful dam to appreciate the dam that in on the way?

**MINUTES OF THE PUBLIC MEETING HELD IN FULUGANI COMMUNITY COMMUTY
ON 27TH JULY 2011**

VENUE: Local Grounds

Agenda

1. Preliminaries
2. Project Briefings
3. Discussions and way forward

Present

- | | |
|--|----------------------------|
| 1. District commissioner | Kinango District. |
| 2. Division officer | Kasemeni Location. |
| 3. Mr. Mung'ong'o | Ag. Managing Director CDA. |
| 4. Eng. Wainaina. | CDA |
| 5. Mr. Harrison Ngirigacha | APEC. |
| 6. Mr. Wandera | APEC Project sociologist. |
| 7. Mr. Mbarine | APEC |
| 8. Mr. Sanjeeve | CES India Representative. |
| 9. Community members see attached list of attendees. | |
| 10. Mr. Mukala | CDA |

Minute 1. Preliminaries

The meeting kicked off with introductions from the CDA officer, Mr. Mukala

Minute 2. Project Briefings

CDA Ag. M.D. Mr. Mung'ong'o introduced the project to the community and members. He started by giving a brief of the project using the designs present. He said the project specific objectives include.

- Generating hydropower.
- Provide energy for industries development.
- Provide water for domestic use, irrigation and industrial use.

He further added that the proposed project is one of the visions 2030 by the government and that the project belonged to the community. He also said that committees should be formed to enhance awareness and to assist in implementing the project. The individuals should be chosen by the community. He also added and said that the culture of the local community in Mwache is highly respected. He urged the community that they have an obligation on the project to actively participate and cooperate with experts and promised room for open discussion on all matters including culture.

The DO of Kasemeni location clarified that the affected properties or households by the project will be fully compensated and relocated. She further commented on the development where she suggested that discussions and decision making should be done at the local community level and not only at the higher national levels. This would assist with implementation of the project since it will receive support from the local community. She concluded by inviting the DC Kinango.

The DC gave thanks to the CDA and asked the consultancy to help the local community understand the Dam project. He urged the community to listen carefully to what the project entails so that they can ask for clarifications and ensure that the project will best suit their interests. He emphasized to the community that the government works on a bottom-up approach to ensure that the communities' voice is heard and considered during decision making. He further explained that benefits of the project are for the current and future generations. He called for members to visit the project site.

Eng. Wainaina thanked the members for attending the meeting and introduced himself as one of the people concerned with the project. He gave measurements of the Dam to the local community and explained that the Dam is approximately 10km (which will be covered with water) with other land still under survey and those who will be affected by the project will be informed. He also told them that the water is expected to reach at a catchment of 95⁰ contour above sea level. He added that the reason of creating a Dam and that it will help the locals in irrigation, domestic consumption, possibility of fishing is high and there must be environmental conservation to allow for the continuous flow of water along the river. This may support the possibility of hydro-power production.

Mr. Ngirigacha (Project Environmentalist) presented on the environmental social impact assessment urging the community to ensure sustainable use of the environment. He gave a chance to the people he had gone along with to introduce themselves. He told the local community that the project is involved with certain companies in Kenya, for example the World Bank, CES and APEC. He told the locals that he had gone round to observe the catchment areas of the river (Mwache River) and the forest and that he had noted that Mwache River comes from two areas which are Guro River and Ngoni River. He added and told the locals that there are few things he had noted, for example ownership of the project and told the local community to have interest in the dam project. He also talked about the catchment areas and the problem of degradation and that the problem of degradation will be looked at because of the fertile soil that is being swept into the river which will affect the dam. He advised the community to plant trees to minimize soil erosion and establish toilets in their homes to improve on water sanitation. He further added that acquisition, resettlement and evaluation will be done to the affected locals will have to relocate and evaluation will be done on the items one owned in his piece of land and Resettlement Action Plan (RAP) will be effective after the surveys report is released.

Minute 3. Discussions and way forward

Questions from the community spearheaded by Mr. Mkala

1. River Mwache acts as a source of income to most of the inhabitants through fishing. What happens to those affected who are the fishermen?
2. What happens to the people not interrogated by the project enumerators?
3. What happens to the affected locals? Where will they be taken? What will happen to them?
4. Will the 30 billion be for the compensation of the people or the project? What amount will the affected be given as compensation?
5. Can PAPs be taken to areas with such Dams for awareness?
6. How is the process of relocation? What about the graves yet we have our cultures/traditions which cannot be broken?
7. They want to know the issue on birth certificates?
8. How will the project benefit the locals on the upper side of the river?
9. When are the title deeds coming so that one can be able to know individually if he/she is affected by the project?

Answers

Mr. Ngirigacha gave answers to the questions asked, saying that the Mwache Multipurpose Dam Project is integrated generating hydropower, provide energy for industrial development and domestic use. Concerning those not interrogated, he responded that the survey is not complete and that the community should allow surveyors to peacefully carry out their activities. Concerning a visit to other similar projects, he promised to check into that. He said culture is respected by the social community and that matters on grave relocation should be addressed by the community and the management on how they would want the graves to be moved as per the requirements by the Kaya. He added that the project will be responsible for their relocation. He advised the community to come up with committees to implement ways of ensuring benefit from the Dam. Water Users Association for example should be established. Concerning payment/compensation and he told them that at the mine time they can't tell the figure because the surveyor has not completed marking the areas the project will

cover; therefore it is not easy to tell how much one will get due to the fact that they also don't know how many people will be affected. He also told them the right procedures of the compensation process and that they will have to seat with the CDA and talk about their compensation. He also told them that they will ask the surveyor to put poles on the affected land of people so that one can know if he/she is in/out of the project boundary. He answered the issue of resettlement. He told them that no one at the moment has told them to move yet from their land because the plan is not yet completed there for they all have the right to continue with their daily activities on their land and he also emphasized on the question of the affected people that they will have a meeting with the CDA ministry of region development together with the DC so that one can be told about the Resettlement Action Plan (RAP) which will help them relocate without any problems. He answered on the issue of how the water will be used and he told the locals about WARMA, and that they should form committees so that the water can be distributed evenly and properly. He also explained to them how the water will be of used for Agriculture, and that they may decide to pump the water for irrigation. He said that the person in charge with Agriculture in Kinango District will be able to find out other types of crops that can grow quickly in the region. Mr. Eng. Wainaina also gave answers to the questions asked and he answered the question concerning fishing. He told the local community that fishing is been looked upon during the project and the fishing will be more improved than before due to the large capacity of water that the dam will carry. He also answered on the issue of the local community gaining knowledge on technology by visiting similar sites with such Dams, he told the members of the community to choose people who will represent them in the dam committee and those that will be chosen will be taken to other sites with dams and gain education on how dams operate .About the 30 billion, he told the community that the only people who will be paid will be the affected ones and that there is no amount that has been set yet that will be provided.

Mr. Wandera (Sociologist) gave an answer concerning surveying and the taking of name, and told them that the local community that if your name had not been written down that means that you are not affected project or someone who is a member in your house already gave out information that they required in your absence. The District Commissioner (Kinango District) gave an answer concerning title deeds and he told the locals that they will get them but they should not mix the issue of title did with matters concerning the project.

Minute 4. Final speech

Mr. Mukala encouraged the people to be attending such meeting concerning development projects in the community and he gave a vote of thanks to the community on behalf of the CDA.

Minute 5. Closing Prayer

MINUTES OF THE PUBLIC MEETING HELD IN MNYENZENI PRIMARY SCHOOL ON 28TH JULY 2011

Agenda

1. Preliminaries
2. Project briefings
3. Feedback from the members

Present

1. Mr. Mung'ong'o Acting Managing Director, CDA
2. Mr. Wainaina CDA
3. Ms. Jane District Development officer (kinango)
4. Mr. Sanjeeve Representative CES India
5. Mr. Wandera Sociologist, APEC
6. Mr. Mbarine APEC Physical Planner
7. Mr. Mkala CDA
8. Chiefs Kasemeni and Mtaa location
9. Community members (see attached list of attendants)

Minute 1: Preliminaries.

The meeting started with introductions. The CDA officers, Kwale, Mr. Mukala welcomed all members and later the team of experts was given the opportunity to introduce themselves. The CDA officer further explained the purpose of the meeting and asked the members to be co-operative throughout the meeting and the entire project briefings to the rest of the community.

Minute 2: Project Briefings

Eng. Wainaina presented the project clearly stating that the purpose of the Mwache Multi-purpose dam is integrated as will look at issues of water supply, irrigation, hydro-power, fishing, eco-tourism and industrialization.

Mr. Ngirigacha (project Environmentalist) then went ahead and presented the project taking into account the process that was going to be involved in the project implementation, stakeholders involved (Coast Development Authority, sociologist, valuers and agricultural experts) and the need to involve the community members of the Kasemeni location throughout the project implementation. He commented on the following issues:

i. Environmental Impact Assessment Act (EIA)

Mr. Ngirigacha said the EIA act came into being in 1989 and states that NO PROJECT WILL BE IMPLEMENTED WITHOUT CARRING OUT AN EIA TEST. The EIA test is only carried out by NEMA, but by donors too such as JICA and World Bank.

ii. Food production

The environmentalist said that productivity is very low. This is attributed to the high density and soil erosion. He urged the community to work hand in hand with experts to improve productivity and enhanced soil conservation.

iii. Persons affected by the project (PAPs)

He went ahead and commented on the issue saying that these are people found within the Dam Radius. They have to be relocated and that the Resettlement Action Plan (RAP) will be done and their development studies determined and compensated fully. He further added that the people's cultures and traditions will be paid respect to.

iv. Water usage

He thanked the Coast Water Service Board for their full support. He then urged the community through the CDA to come up Water Users Associations to control distribution of water distribution of water for irrigation and thus prevent usage conflicts (Water Acts; 2002)

v. Water and Sanitation

Mr. Harrison Ngirigacha informed the meeting that buffers will be added to enhance water purity and they will be at least 30 meters wide. Trees will also be planted to act as water cleaners and urged the community to come up with catchment management strategies to ensure sustainable use of the water source, soil conservation and water quality.

vi. Dam procession

He said that it is a government project through CDA. It however belongs to the community being the reason for the 100% community to formulate initiatives that will lead to maximum benefits from the project.

Minute 3: Feedback from members.

Mr. Mung'ong'o (Managing Director, CDA) moderated the question and answer session

i. Mr. Albert Katana – Ex-prison officer, former councilor.

He opened his comments by stating that he was happy about the project. He said the Duruma's have always been against the projects forwarded to them and added that those against the project only kill themselves and the action. He urged fellow community to support the project.

ii. Ali Kombo Mang'ali

He reminded the members that the project had been running for a while and with the implementation, hunger will be alienated. He opposed the councilors suggestion that the community be given license to cut wood for charcoal. In additional, he said that seeds should be provided to farmers prior to the onset of the rains. He also requested that something to be done about the lack of water and there are water tanks and pipes in place.

iii. Mwagwaru Michoma

He supports the project but wanted to know how many kilometers will be affected by the project.

iv. Hamisi Kazungu – Mzee wa Kaya

He insisted on how he strives to conserve the forests. He urged the Chief to call on all the Kaya men to discuss on the communities traditions and culture and asked for full participation of the kaya leaders for it to be effective. He requested that the project should pay 6 bulls, 6 sheep and 6 goats for the project to commence. He supports the project.

v. Mundu Harare.

He said that the community has not been involved and asked for a meeting in his community for sensitization. (Gona village). He does support the project.

vi. Mgeni Mukala

She said that she is a member of a Women's Organization and supports the program. She insists that the dam will improve water supply which is currently a major problem in the area, create jobs opportunities for the youth in the community and hydro – power will open up the area for development.

vii. Rashid Hassan Hamisi

He was surprised by the resistance of the Fulugani community.

He then asked how much one Acre plot would cost and the cost of grave relocation. He supports the project.

He was concerned about how the water from the dam would reach his land which was about 50km from where the dam will be located.

viii. Margaret Ruvuno

She supports the program but she requested that the women in the area to be united. Then she asked on the expected benefits of the dam.

ix. Mr. Hamisi Bandao

He wanted to be briefed on what to expect from the project.

He also enquired about the enumerators who were going round entering into peoples compounds asking questions.

ANSWERS

Mr. Harrison Ngirigacha started the sessions for answering questions asked by the villagers. He started by answering the question of where the survey had reached and he told the locals that the surveyor has not yet completed on the markings because the area is big and he has not yet placed poles/beckons due to lack of a meeting with members of the community. He also told the locals that permission had to be granted by the D.C to allow the process of placing poles, which will make work easy on which houses or land is on the dam area.

He also answered the question concerning the Kaya and he answered by letting the community know that their tradition is respected completely therefore the project members will have to seat with the Kaya for the processes on how to handle their grave sites.

He also told the locals that they should not form very many groups in order to have feasts; it will slow down the project because all that will be there is getting bulls, goats and sheep's to be eaten. Therefore the groups should be specific e.g. the Kaya.

Mr. Mbarine (Project Land Valuer) gave answers on the members' questions. He advised that the community should focus on what they contribute towards development but not what they receive from the government. He added that the water when full will be over the 95 m contour and that no school will be affected. he asked CDA that during land jurisdiction, public purpose plots (churches, mosque, schools, hospital) should be located in areas closer to the road. The roads should be wide enough. He commented on the amount of land to be irrigated quoting an approximately 6000Ha/15000Acres of land. He concluded by saying that all PAPs will be compensated in line with the present market price taking into consideration the communities culture and traditions.

The CDA officer Kwale then Mr. Mukala then requested the team to use the local youth so that the local residents can start gaining from the project. he then wined up the meeting and thanked everyone present for participation.

Minute 4: second question session

x. Samuel Duku (teacher)

He thinks two of his land may be at the dam location and will be affected and taken away but he is glad on the project.

His suggestion concerning graves was that walls to be built round the graves so that they don't have to move them.

The women in the village go a long distance to get water; therefore the dam will help the women not going to get water far areas.

He also said that the pipe of Zima has passed in their village but they don't get water yet the people in Mombasa get water. Therefore when the project begins the water should be provided to the people of Mwache before been pumped to Mombasa.

xi. A local in the area

He wants to know if the affected schools which may be near Mwache will have a bridge in order the children to cross from one side to the other.

Minute 5: response to the questions

Mr. Harrison Ngirigacha (Environmentalist) tackled the question concerning the affected schools and the safety of the students and he answered by letting the community know walls for protection will be put round the schools to provide safety for the children.

He tackled about the safety of the dam from children, the old, animals, drunkards from drowning in the dam.

He also encouraged the locals by telling them that they should contribute to work in the dam and not to let foreigners do the work for them.

He told the locals that priority of the dam is water in order to provide water for the locals in Mwache before been pumped to Mombasa.

He told the locals that there will be buffers to provide safety for the dam and the people in the community.

Mr. Wainaina (Engener) told the locals that the first people to get the water is the people in Mwache and Kinango District and that for the areas which are far water can be pumped there.

He also answered the question concerning roads near schools and he told the locals that the roads are very important therefore all the affected areas with roads, bridges will have to be relocated in order to allow transportation for future use.

Salim Kuria (plan international) talked about farming

He asked the locals to support the project

He congratulated the CDA for creating such a meeting for the local community to ask questions.

He also asked the government to be with the members of Kinango and to always bring up such developments plans.

Minute 6: AOB

Mr. Mungongo (M.D CDA) introduced members with the CDA;

1. Mr. Johnstone
2. Diana Wangombe
3. Mr. Mtano Marala (Agriculture)
4. Fwazia Muhamed

He told the locals that they have just started the work progress.

CDA will try and reach each one on the development plan.

He also told the locals that those who are affected with the dam project will be informed when the planning & surveying is completed.

He asked the community to not be greedy with money and asked for large amounts/millions of money.

He also told the locals that politics and development should be taken differently.

He talked about ownership of the project, that this is a government project through the CDA and it belongs to the community.

CDA will be the ones linking the local community and the government.

He also told the locals that plans will be put to place to look at the matter concerning the affected people who will lose their land and how they will be paid (compensated).

He told the locals that the development Authority is with the community and they will like at their problems.

Minute 7: Adjournment

CLOSING PRAYER By Rashid Makanzu Hamisi (member of the community)

ANNEX VA

Public Consultations Minutes and Participation

Minutes of meeting held on 12th June 2012 at Kasemeni D.O's Office with members of Mwache dam Dam Ad Hoc Committee and Village Elders starting at 10.20am:-

MINUTE 1/6: INTRODUCTION

The meeting was constituted by a word of prayer by one of the members. Self introductions were made by all present members. The participants were informed that the consultants had visited the Dam area in preparation of an Assets inventory for the PAPs. Secondly it was important to update the participants as the key opinion leaders bore to further meetings that had been planned with the PAPs thereafter.

Minute: 2/6: Delineation of the area for displacement

The meeting was taken through maps that had been pasted on the wall showing parcels of land that fell below the 100metres contour. They were informed that the individual parcels would either be submerged under the dam water or would be acquired for the tree buffer to protect the water from pollution. It was explained that the names for the parcel owners had been obtained from the records at Adjudication Office as a result of the work they had participated in during land demarcation. An appeal was made to the Ad Hoc Committee members and the Village Elders to assist in the exercise on Assets inventory that was to be carried out by accompanying the enumerators and ensuring all parcels and their details were exhaustively captured and documented.

MINUTE 3/6: DISCUSSIONS

During the discussions the community continued to express their support for the project. Their main concerns were not with the impending displacement from their land but included:-

- a) The expected commencement of the construction and how soon they would be paid their compensation to facilitate their relocation.
- b) They also raised the issue of employment for the local youth during the construction of the dam and ancillary facilities.
- c) They observed that the affected homesteads had graveyards. These would require special consideration in the relocation to conform to cultural norms of the Duruma people.
- d) They touched on possible displacement of social facilities in the area and feared that they might lose out unless the same were restituted as appropriate.
- e) They felt that over and above the compensation to the individual, it was necessary for the project to defray all expense incurred in the relocation of cultural sites and social facilities that would be affected by the dam project.
- f) The Dam Ad hoc Committee submitted an MOU seeking Coast Development Authority to guarantee payment of compensation for the assets lost in the involuntary displacement in the event the project starts before the payments had been made.

MINUTE 4/6: RESPONSES

In response to the above matters raised by the Dam Ad Hoc Committee the Consultants advised that the timelines of the programme of works and commitment on the MOU was responsibility of CDA management.

However, they were assured that there are clearly laid down legal procedures for handling land acquisition matters. The bottom line being payment before land is taken possession by developer unless alternative arrangements are made with the affected persons.

They were informed that it was government policy for preference for employment to be given to local people on any publicly funded project and the Dam project would be no exception.

MINUTE 5/6: CONCLUSION

After lengthy deliberations, the meeting ended with the members commitment to support and participate in the exercise on Assets inventory.

CDA would be appraised on the MOU and encouraged to liaise with the community on its contents.

There being no other business, the meeting was closed by word of prayer at 1.15 pm.

MINUTES OF MEETING HELD ON 12TH JUNE 2012 AT KASEMENI DOS OFFICE WITH YOUTH GROUPS MEMBERS ON MWACHE DAM MULTI-PURPOSE PROJECT:

Present:

| | | |
|------------------------|---|------------|
| Harrison W. Ngirigacha | - | Consultant |
| Wandera Bink | - | Consultant |
| Nyamwanda A. | - | Consultant |
| M'Barine K. N. | - | Consultant |
| Matano Ngati | - | Enumerator |
| Nyamvula Evalyne | - | Enumerator |
| Dianah Mwangombe | - | CDA |
| Fauzya Mohamed | - | CDA |
| Mkalla | - | CDA |

MINUTE 1 /2: INTRODUCTION

The meeting started by word of prayer at 2.30 pm. Members present did self introductions. After introductions, the youth were informed that they had special sitting apart from their parents to afford them an opportunity to express their views and expectations on the Dam project.

They were taken through the maps and the delineation on the area that would be acquired and people displaced explained. They were encouraged to air their views freely on the displacement as they were key to the realization of the dam benefits during and after the construction.

MINUTE 2/2: DISCUSSIONS

In the ensuing discussions the youth who were present raised the following issues:-

- a) Employment opportunities – some of the youth groups in the area were involved in quarrying on the river bed for store blocks and sand harvesting that would be lost once the river is impounded. In response, they were informed that the youth constituted the pool for construction labour force. During the construction, they would acquire skills that would help them diversity employment opportunities. Once the dam is operational, they would be able to engage in farming activities of high value crops. There would also be opportunities in fishing and there would also be opportunities in fishing, recreation and tourism where the youth were best suited.
- b) Compensation for their developments – the youth raised concerns that during the compensation for assets, they stood to lose as they were not legal owners of land but their parents. Some had carried out developments that would be lost as a result of the dam. They were informed that during the assets inventory, those who had developments would be recorded separately as claimants of interests on land belonging to their parents. The law provided for their separate compensation of their rights to development on affected parcels.
- c) The youth members present disclosed that they had about six groups within Kasemeni division dealing in various activities. They sought to know how the project would empower them to benefits from the intended benefits of the dam once completed. They proposed imparting of skills in various fields, hence requiring vocational training facilities. Further, they will also require programmes entailing study tours to expose the youth like the other groups to areas where such projects have been developed.
- d) After the deliberations, the youth were encouraged to be more active on all matters of the dam. Their parents, who were the land- owners were making sacrifices by surrendering the land but the future benefits fell with the young people. The diversification in economic and social activities and innovations depended on the youth who were more attune with global technological changes. The youth have the energy to work at the construction site and the programme of work will require their

willingness to work, otherwise labour will be imported by the contractor appointed for the project. The youth observed that there would be disruption in accessing the social and public facilities for those people who cross river Mwache to the administration centre.

MINUTES OF MEETING HELD ON 14TH JUNE 2012 AT DOS OFFICE KASEMENI WITH WOMEN GROUP LEADERS ON MWACHE DAM MULTI-PURPOSE PROJECT STARTING AT 3.00PM.

PRESENT:

| | | |
|------------------------|---|------------|
| Harrison W. Ngirigacha | - | Consultant |
| M'Barine K. N. | - | Consultant |
| Wandera Bink | - | Consultant |
| Nyamwanda A. | - | Consultant |
| Matano Ngati | - | Enumerator |
| Nyamvula Evalyne | - | Enumerator |
| Diana Mwangombe | - | CDA |
| Fauzya Mohamed- | - | CDA |
| Mkalla | - | CDA |

MIN 1/3: INTRODUCTION

The meeting was taken through the maps showing the delineation of the dam high waste level and the protection tree buffer. They were informed that the Consultants were in the area to carry out an asset inventory as one of the components in determining compensation for those who would be displaced. The DO for Kasemeni Division, who was in attendance at the meeting, made her comments. She asked the ladies to give their views to ensure that their interests were considered in the implementation of the project. The ladies were reminded that together with the children they were considered vulnerable hence the opportunity offered to them to influence decision making. By virtue of their role as family makers they carried a bigger daily burden in their families' activities. With the development of the dam; they stood to benefit in several areas including time savings from organizing house-hold water demand; variation in food crops; opportunities for spare time to socialize and recreation; e.t.c.

MIN. 2/3: DISCUSSIONS

In the discussion the ladies at the meeting made the following observations:-

- a) Some of the groups were dependent on the river bed where there were alluvial deposits and pools of water to grow food crops that they sold for money and supplemented their domestic needs. They also participated in sand harvesting and quarrying at the river beds for economic sustenance. In response they were informed that completion of the dam would give them more opportunities to diversify into through other activities of less strenuous nature and more predictable within their homestead.
- b) Currently the women group depended on sale of water at various water points for their household incomes. They felt this is an economic opportunity that would be lost when all homesteads would have water as a result of the dam. They were informed that their participation in management of water as a resource would continue through the water associations and any maintenance guidelines that would be developed by the sector would be sensitive to their concern.
- c) The issue of the women groups attempting to connect the holdings and homestead to the water reticulation sounded a challenge due to their poverty level s. They were reminded that this is an area that as women groups would be most effective in mobilizing resources for the members to achieve their goals. As organized groups they were in a better position to access credit facilities for members for both water connection and modern farming on the farm holdings.
- d) The ladies like the other group raised the issue of infrastructure that would be submerged. In response, they were informed that all the infrastacture that would be lost would be restituted to ensure continued access to social facilities. As regards, the road to Kinango this would be realigned and improved by the road sector as part of the national roads programme.
- e) The ladies raised issue of the distribution of compensation precedes as their spouses who are the land owners might receive the compensation and default leaving the families destitute. This being a social issue, mechanisms would be put in place to educate the PAPs on how to manage the proceeds with a

view to restore their assets. The existing social structures would be empowered to sensitise the communities in handling the impacts.

- f) The ladies expressed desire to be exposed to similar developments to through field visits and education tours to see for themselves how such projects have impacted on peoples lives.

MIN. 3/3: CONCLUSION

The ladies resolved to mobilize and support the project. They offered to facilitate the enumerators in the absence of the head of household.

There being no other business the meeting was closed by prayers at 4.30

ANNEX VB

LIST OF PUBLICATION REVIEWED

1. **Sessional Paper No. 6 of 1999** ON ENVIRONMENT AND DEVELOPMENT, Ministry of Environment Conservation, Government of Kenya
2. Drinking water quality and effluent monitoring guideline, WSRB. Kenya
3. Farm Management Guidelines for Kinango District 2010 by the District Agricultural Officer (DAO) Kinango.
4. Kinango District, Rainfall Figures 2010 to 2005 by the DAO.
5. Background Information on Kinango District by the DAO.
6. Livestock Population by the Provincial Director of Livestock Production as at 31/12/2009
7. District Development Plan for Kinango District for 2008 – 2012 by the DDO.
8. Annual Report 2007 by the PDA Coast Province.
9. Annual Report 2009 by the PDA Coast Province.
10. The National Water Master Plan by JICA Sectoral Report on Agriculture and Irrigation, July 1992.
11. National Water Master Plan, Sector Report on Livestock, Wildlife and Fisheries by JICA July 1992.
12. The Inception and Feasibility Report of the Mwache Multipurpose Dam Development Project on River Mwache.
13. The T. O.R for the Mwache Multipurpose Dam Development Project.
14. Literature and documents from the Internet on Environment and Biodiversity of Coastal Kenya
15. KARI Mtwapa Annual Report 2009.
16. National Agricultural Services Extension Policy (NASEP).
17. Ministry of Agriculture Strategic Plan 2006 – 2010.
18. Strategy for Revitalizing Agriculture 2004 – 2014.
19. NEMA Guidelines
20. The Study on National Master Plan, July, 1992” by Japan International Cooperation Agency (JICA)
21. Previous SAMEZ Report
22. Economic Review of Agriculture 2010
23. Indigenous & Tribal Peoples’ Rights in Practice, ILO, 2009

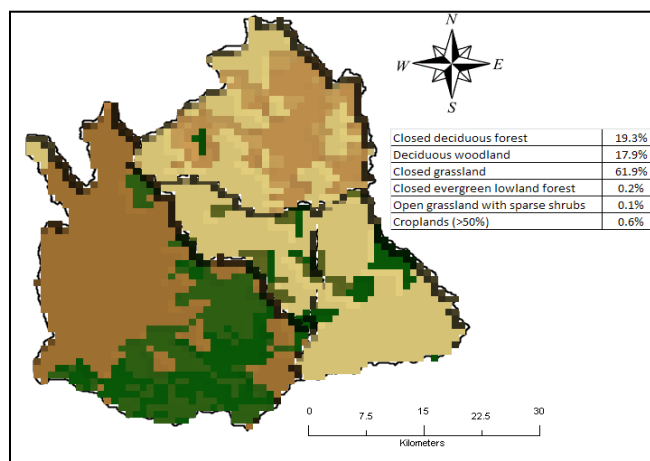
CATCHMENT AREA TREATMENT PLAN

1.0 Introduction

One of the main environmental concerns for the project is soil erosion and resultant siltation in the reservoir. To address this issue a catchment area treatment plan is design and described here in detail. The measures adopted for checking soil erosion in the catchment area and siltation of the reservoir are formulated and associated cost is given under this Annex.

2.0 Characteristics of the Catchment Area:

Based upon the Global Land Cover 2000 (GLC 200) for Africa data (European Commission, Joint research Centre: <http://bioval.jrc.ec.europa.eu/products/glc2000/products.php>). land use data for the Mwache basin is extracted and given as below



The area under major land use is categorized and estimated for Mwache and given below

| Land Use Type | Area (Sq Km) |
|-----------------------------------|--------------|
| Closed evergreen lowland forest | 4.2 |
| Closed deciduous forest | 345.1 |
| Deciduous woodland | 340.6 |
| Closed grassland | 1230.5 |
| Open grassland with sparse shrubs | 10 |
| Habitants and roads | 106.6 |
| Croplands | 213 |
| Total | 2250 |

It is noted that the soil erosion is low in forest area accounted for around 31% of the catchment area. The soil erosion for the grass land is found to be medium that accounted for 55% of the catchment area. Soil erosion is found more in crop land area that account for around 10 percent area (assume based upon the desk study and reconnaissance study) of the Mwache catchment area).

Based upon the land use pattern and other factors, vulnerable and fragile area of catchment area is located and described in subsequent section.

3.0 Identification of Vulnerable and Fragile Catchment Area

Reconnaissance survey of the catchment area is made by the consultant in order to assess

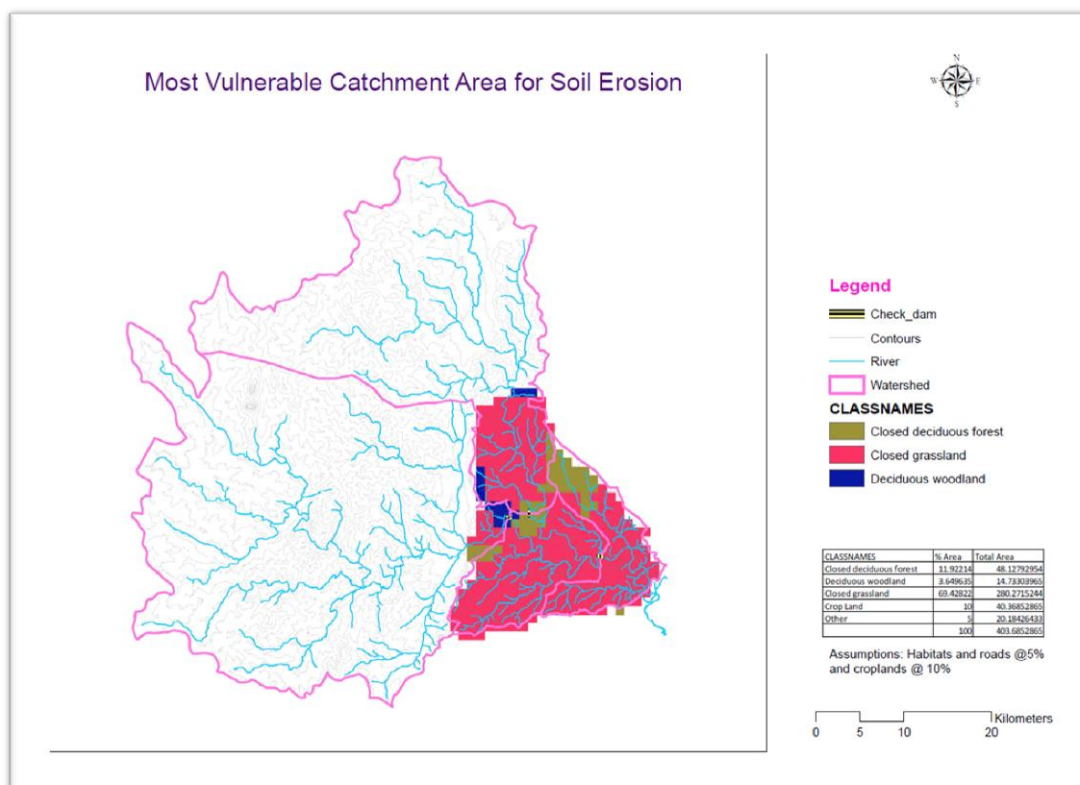
ground situation of the soil erosion and dominating factors as the main cause of the soil erosion. Following factors observed to be key one for the soil erosion.

- Land Use Pattern: Fragile grassland and crop land are found to be more prone to soil erosion
- Topography: Soil erosion is found more on steep slope
- Drainage: Area near to drainage line is found more prone to soil erosion
- Combined Factor: Grassland and crop land Area adjoining drainage line on steeper slope was found very vulnerable for soil erosion.

Based upon the above observation, desk study is made on the GIS platform to locate the area featured with multiple factors and grassland and cropland area adjoining drainage line of the steeper slope is located as portrays in subsequent map of this section.

Land use pattern of the vulnerable area is quantified and given as below:

| Land Use Type | Area (%) | Area (sq Km) |
|-------------------------|----------|--------------|
| Closed deciduous forest | 11.92 | 48.13 |
| Deciduous woodland | 3.65 | 14.73 |
| Closed grassland | 69.43 | 280.27 |
| Crop Land | 10 | 40.37 |
| Other | 5 | 20.18 |
| | 100 | 403.68 |



Based upon the land use and topography of the vulnerable area different set of soil erosion control measures are designed to check the siltation and described in subsequent section.

4.0 Soil Erosion Control Measures

Soil erosion measures are based upon the number of factors. Based upon the dominating factors like land use pattern, topography and drainage pattern of the vulnerable area, following measures can be adopted for checking soil erosion and siltation

- *Cultural practices*, such as contour plowing, minimum tillage, changes in timing or pattern of cropping, and intercropping.
- *Vegetative practices*, such as grass strips, strip-cropping, and vegetative barriers.
- *Mechanical measures*, such as check dam, terraces, cutoff drains, infiltration furrows, earth banks, and land leveling.
- *Land use changes and improvements*, such as afforestation and sustainable rangeland management (with fertilization, plantation, and deferred grazing).

Based upon the catchment features of Mwache, following measures are designed and proposed for the control of soil erosion and siltation.

| CAT Measures | Forest and Wood Land | Steep Grassland Area | Crop Land | Drainage Line |
|--|----------------------|----------------------|-----------|---------------|
| Environmental Awareness | √ | √ | √ | √ |
| Vegetative Practices | | √ | √ | |
| Capacity Building for Conservation Practices | | √ | √ | √ |
| Earthen Bund | | | √ | |
| Check Dam | | | | √ |

Three check dam are proposed for the projet. These check dams are designed for the project in order to check the soil erosion and siltation. Location of these check dam is shown in the map of section 3.0 above. Details and design of these check dam is given in Chapter 2 (Hydrology)

5.0 Cost Estimate for CAT

Cost for the CAT measures proposed for the project is estimated and given below. The cost of check dam is excluded from the CAT cost as the check dam cost is part of main project cost.

| Location of Intervention | Total Area | Unit Cost (\$ km ²) | Total Cost | Remarks |
|------------------------------|------------|---------------------------------|------------|---|
| Closed deciduous forest Area | 48.1 | 50.0 | 3143.0 | Assume density of 250/sq km. Cost includes preparation of awareness material, printing and distribution to inhabitants |
| Deciduous woodland area | 14.7 | | | |
| Grassland Area | 280.3 | 1800.0 | 504488.7 | Intervention include Grass plantation. The unit cost is adopted as per Magreath and Doolette 1990, Lutz Pagiola Rieche 1994 |
| Crop Land Area | 40.4 | 3100.0 | 125142.4 | Intervention includes capacity building of inhabitants on best cultural practices to check soil erosion (\$100/ sq km) and earth bund construction (\$3000 / sq km). Source: Lutz Pagiola Rieche 1994 |
| Other Area | 20.2 | 100.0 | 2018.4 | Intervention includes capacity building of inhabitants on soil erosion control |
| Total | 403.7 | 1572.5 | 634792.7 | Say \$ 634800 |

Total cost of catchment area treatment plan is estimated to be \$ 634800. More than 79 percent of this cost will be expand for the grossland area adjoining drainage line for the plantation of grasses.

5.0 Implementation of CAT

The intervention proposed for the CAT will be implemented by the local NGOs / contractor in co-ordination with concerned department of GoK. The work is to be monitored and supervision by Environmental and Social Experts attached with the project implementation agency / unit for as described in institutional arrangement section.

CAT will be implemented in first four years of the project implementation.

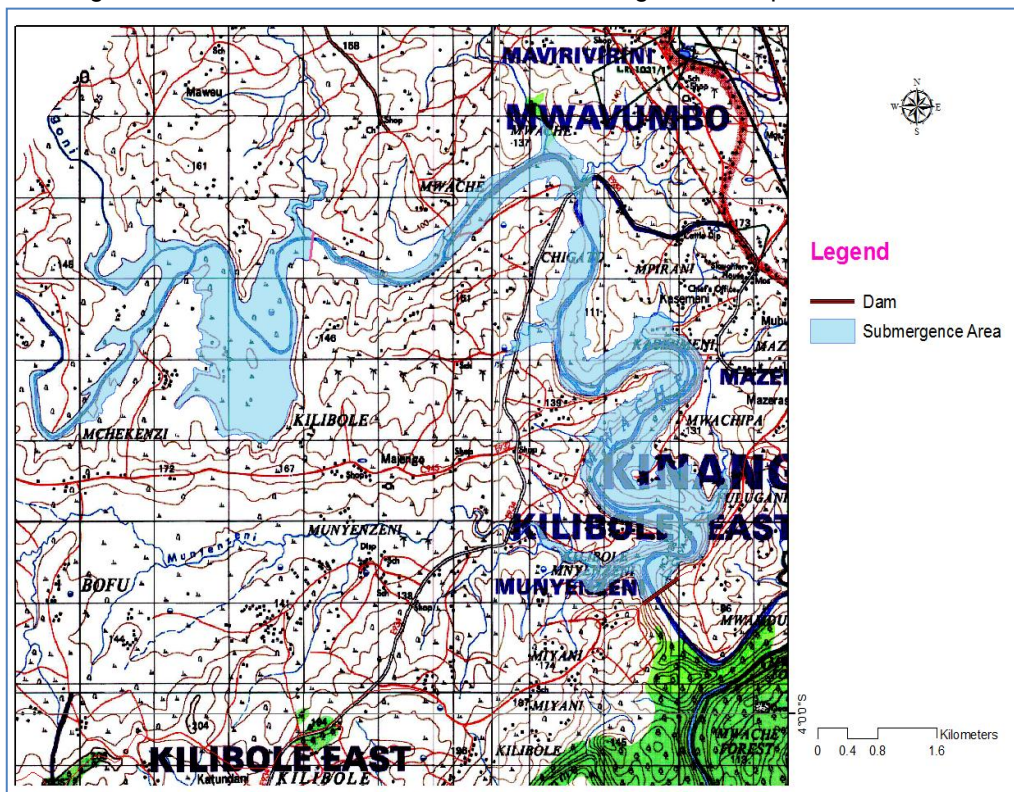
HEALTH AND HYGIEN PLAN - HHP

1.0 Introduction

This plan is prepared to address the health and hygiene impact of the project to the adjoining inhabitants of impounding reservoir. It is likely that the incidence of water vector and water born deseases to these inhabitants will increase.

2.0 Impounding Reservoir Affected Villages

Impounding area behind Mwache dam is delineated and given in Map below



The villages adjoining the impounding reservoirs in the vicinity of 500 meters are identified and are Mchekenzi, Killibole, Mwache, Chigato, Kasemeni, Mwachipa, Mnyenzi, Fulugani

These villages will be more impacted from the impounding reservoirs of Mwache. The population likely to be affected in these villages is estimated and given as below

| Affected Villages | Affected Population |
|-------------------|---------------------|
| Mchekenzi | 1150 |
| Killibole | 916 |
| Mwache | 713 |
| Chigato | 597 |
| Kasemeni | 597 |
| Mwachipa | 474 |
| Mnyenzi | 1108 |
| Fulugani | 996 |
| Total | 6551 |

Around 6550 person will be exposed to impounding water body of Mwache reservoir. Likely impact of the impounding water body behind Mwache dam is assessed and discussed in the subsequent section.

3.0 Impact of Mwache Impounding Reservoirs on Health and Hygien

Health and hygien practices adjoining the impounding reservoirs are poor. It is likely that the inhabitants will use the impounding water body as dumping ground for their solid and liquid waste. This will create unhealthy hygien for the inhabitants. Moreover, the occurrence of water vector and water born diseases to inhabitants exposed to the impounig water body behind Mwache dam will be more. The impact of Mwache Impounding water may be summarized as below

- Hygien Related Issues
 - More likely of waste dump in the impounding water body by adjoining villagers
 - Outflow of Sewage water of adjoining villages in the impounding water body
- Health Related Impact
 - More occurrence of Malaria and diarehea
 - More incidence of Typhoid
 - Higher frequency of viral infection
- Other Impact
 - Deterioration of water quality of impounding reservoirs
 - Poor asthetic condition adjoining impounding water body

Health and hygiene impact of the adjoining inhabitants of impounding water body created due to project may be reduced through effective measures and intervention. These interventions are discussed and formulated in subsequent section.

4.0 Health and Hygiene Improvement Intervention

Number of intervention will be implemented to minimize the negative health and hygiene impact of impounding reservoirs on the adjoining inhabitants. These interventions are listed as below

- Health and Hygiene awareness campaign to create awareness on preventive practices
- Supply of community dustbin to inhabitants living in close proximity to impounding reservoirs to check the solid waste dump in the impounding water body.
- Supply of malaria kits / mosquito net to inhabitants living in close proximity to impounding reservoir to reduce the incidence of malaria
- Construction of community latrine for inhabitants living in close proximity to impounding reservoir to check the outflow of sewage water in the impounding water
- Mobile medical aid for the treatment of water vector diseases

The above intervention like provision of latrine and dustbins to inhabitants for their liquid and solid waste management will also help in checking the water quality deterioration of impounding water.

5.0 Cost Estimate for Health and Hygein Improvement

Cost to be spent for the health and hygiene improvement intervention is estimated and given as below.

| Intervention | Unit | No of Intervention Unit | Unit Cost (\$) | Intervention Cost (\$) | Remarks |
|--------------|------|-------------------------|----------------|------------------------|---------|
| | | | | | |

| Intervention | Unit | No of Intervention Unit | Unit Cost (\$) | Intervention Cost (\$) | Remarks |
|---|----------------------------------|-------------------------|----------------|------------------------|--|
| Health and Hygiene Awareness Campaign | No of Campaign | 400 | 25 | 10000 | One campaign covering 100 exposed villagers, i.e. 66 campaign each. Campaign session twice in a year for 3 consecutive years. Includes 4 campaigns for construction workers also. |
| Community Dustbin | No of dustbin | 655 | 20 | 13100 | Two dustbins set each for a community consisting of 10 households (consisting 50 exposed persons) for all 1310 exposed households. Replacing dustbin alternative years to cover first 10 years |
| Community waste Disposal | No of waste disposal vehicle day | 520 | 75 | 39000 | Waste disposal once in a week covering all 8 exposed villages in a day. |
| Mosquito Nets | No of nets | 3930 | 10 | 39300 | One double size mosquito net @ 3 mosquito net per household for 1310 exposed households |
| Construction of Community Latrine | No of latrine | 131 | 200 | 26200 | Two latrine unit set for each community of 10 household (covering 50 person) |
| Mobil Medical Aid | No of Mobile Medical Van year | 5 | 8100 | 40500 | One mobile medical van consisting of two paramedical personnel spending \$ 1000 medicine per year for 5 year duration |
| Preparation of Health and Hygiene Awareness Material and sensitization of construction worker and affected person | Lump Sum | | | 10000 | Preparation of material covering preventive practices for well ness, domestic waste management, healthy hygiene practices, HIV/AIDS prevention from construction workers. |
| Total | | | | 178900 | |

The total cost of \$ 178900 will be spent for the health and hygiene plan that will also contribute to maintaining water quality of impounding reservoir. The HHP is designed and will be carried out for first five year. It is assumed that after 5 years, empowered and exposed inhabitants and state health department will be in a position to address the issue.

6.0 Implementation of HHP

The intervention proposed for the HHP will be implemented by the local NGOs / consultants in co-ordination with concerned department of GoK. The work is to be monitored and supervised by Environmental and Social Experts attached with PMCU as described in institutional

arrangement section.

HHP will be implemented for first five years starting dam construction.

Annex IX

ENVIRONMENTAL MONITORING PLAN

Environmental monitoring plan will be carried out during the construction and operation phase of the project. Environmental parameters to be monitored, estimated cost and monitoring agency and location of the monitoring is summarized below

Monitoring Indicators & Responsible Agencies

| Sl. No. | Environmental & Social Parameters | Benchmark Indicators (Before Implementation) | Output Indicators (During Implementation) | Impact Indicators (Post Implementation) | Frequency, Sample No. | Cost (\$) | Monitoring Agency ⁶ | Remark |
|---------|-----------------------------------|---|--|--|-----------------------|-----------|--------------------------------|---|
| 1 | Soil Erosion/Gully Formation | Area of waste / grass land of severe erosion | | Area of waste / grass lands of severe erosion | Annual, 10 | 800 | SEC, WUA, External Agency | Monitoring in vulnerable catchment area given in Annex VI |
| 2 | Soil Quality | Organic Matter Content / Nutrient Content / Pesticide residue | | Organic Matter Content / Nutrient Content / salinity | Seasonal, 180 | 1080 | SEC, WUA, External Agency | Monitoring in command area. 5% Irrigation Blocks (IB), i.e. 9 IB, 3 each at head middle and tail reaches. One sample from each selected IB. |
| 3 | Siltation | Silt load in catchment runoff water | Silt load in construction runoff & reservoir water | Silt load in catchment runoff water | Seasonal, 32 | 2560 | SEC, WUA, External Agency | Downstream of 3 check dams and dam for construction period |
| 4 | Surface Water Quality | Salinity, Nutrient content, Pathogens, BOD | Pathogens in Labour camp runoff | Salinity, Nutrient content, Pathogens, BOD | Seasonal, 120 | 5120 | SEC, WUA, External Agency | Five locations of reservoir – near Chigata, Kasemeni, Machipa, Mnyenzi, Fulugani and one at downstream of dam twice in year |

⁶ The PMCU shall decide the appropriate Monitoring Agency based on the nature and scale of likely impacts from sub-project activities in each irrigation scheme.

| Sl. No. | Environmental & Social Parameters | Benchmark Indicators (Before Implementation) | Output Indicators (During Implementation) | Impact Indicators (Post Implementation) | Frequency, Sample No. | Cost (\$) | Monitoring Agency ⁶ | Remark |
|---------|-----------------------------------|--|---|--|-----------------------|-----------|--------------------------------|--|
| 5 | Ground Water Quantity | Depth to Ground water | | Depth to Ground water | Seasonal, 120 | | SEC, WUA, External Agency | Three location each at head, middle and tail reaches four time in a year before and after rainy season – Sept, Jan, Mar, July. |
| 6 | Ground Water Quality | Salinity, Nutrient content, Pesticide residue, Presence of Industrial Effluents, Pathogens | | Salinity, Nutrient content, Pesticide residue, Presence of Industrial Effluents, Pathogens | Seasonal, 120 | | SEC, WUA, External Agency | Three location each at head, middle and tail reaches four time in a year before and after rainy season – Sept, Jan, Mar, July. |
| 7 | Water logging | Area under water logging | Temporary water logging | Area under water logging | Seasonal, 60 | | SEC, WUA, External Agency | Each at head, middle and tail reach of command area |
| 8 | Air Pollution | SPM, RPM | Air pollution levels | SPM, RPM | Monthly, 64 | 5120 | SEC, WUA, External Agency | Two location adjoining construction site during construction month |
| 9 | Noise Pollution | | Noise levels | | Monthly, 64 | | SEC, WUA, External Agency | Two location adjoining construction site during construction month |
| 10 | Fertilizer use | Average Fertilizer usage per unit field area | | Average Fertilizer usage per unit field area | Seasonal, 300 | 4000 | SEC, WUA, External Agency | Three locations. 10 farmers each at head, middle and tail reaches i.e., 30 farmers. |

| Sl. No. | Environmental & Social Parameters | Benchmark Indicators (Before Implementation) | Output Indicators (During Implementation) | Impact Indicators (Post Implementation) | Frequency, Sample No. | Cost (\$) | Monitoring Agency ⁶ | Remark |
|---------|-----------------------------------|--|--|---|-----------------------|-----------|--------------------------------|---|
| 11 | Pesticide use | Average Pesticide usage by type per field unit area | | Average Pesticide usage by type per field unit area | Seasonal, 300 | | SEC, WUA, External Agency | Three locations. 10 farmers each at head, middle and tail reaches i.e., 30 farmers. |
| 12 | Displacement | Number of people likely to be displaced & their socioeconomic status | Number of people displaced | Socioeconomic status of people after displacement | Annual, 300 | 6500 | SEC, WUA, NGO | Number of selected PAPs per year to be determined on completion of final RAP |
| 13 | Livelihood | Number of people likely to lose livelihood | Number of people with lost livelihood | Socioeconomic status of people after loss of livelihood | Annual, 300 | | SEC, WUA, NGO | Number of selected PAPs per year to be determined on completion of final RAP |
| 14 | Conflict | Number of conflicts & issues | | Number of conflicts & issues | Annual, 300 | | SEC, WUA, NGO | Number of selected PAPs per year to be determined on completion of final RAP |
| 15 | Public Health | Incidence & nature of water related diseases | Incidence & nature of water related diseases | Incidence & nature of water related diseases | Annual, 300 | | SEC, WUA, NGO | 30 selected inhabitants exposed to impounding reservoir |
| 16 | Total Monitoring Cost | | | | | | 25180 | |

Annex X

WATER SUPPLY SYSTEM'S EMP AND ASSOCIATED COST

Environmental enhancement and mitigation measures, monitoring plan, capacity building, and EMP cost specific to the water supply component is described in this section. Project water supply demand in m3/day to be met from the project and wastewater of different category likely to be generated are given below

| Year | Water Supply m3 | Wastewater Generation m3 | | | |
|------|-----------------|--------------------------|----------------------|------------------|--------|
| | | Light Grey Wastewater | Dark Grey Wastewater | Black Wastewater | Total |
| 2018 | 116251 | 37200 | 27900 | 27900 | 93001 |
| 2021 | 130331 | 41706 | 31279 | 31279 | 104265 |
| 2024 | 145995 | 46718 | 35039 | 35039 | 116796 |
| 2027 | 163376 | 52280 | 39210 | 39210 | 130701 |
| 2030 | 180000 | 57600 | 43200 | 43200 | 144000 |
| 2033 | 186000 | 59520 | 44640 | 44640 | 148800 |

Water supply system activities' impact will be both positive and negative. The negative impact will be mainly due to wastewater generated and associated health risk for the targeted community. The measures to enhance the positive impact and reduce the negative impact are describes in subsequent section.

Environmental Enhancement Measures

Possible enhancement measures that may enhance the beneficial impacts of the water supply component would include the following:

- Subproject construction should adhere to recommendable best construction practices that make effective and economical use of locally available resources including materials, expertise and labour.
- Highly reduce productions of solid, liquid and hazardous wastes is reduce through stakeholders awareness
- Give preference to local employment (youth, men and women) and local inputs (food, basic material) to the extent possible.
- Ensure that the poor and other vulnerable groups can continue to safely satisfy their basic water needs.
- Ensure that social services provide education to men and women on appropriate hygienic conditions and water conservation, taking into consideration gender particular roles and responsibilities.
- Establish management committees involving women and men in the management of water resources and supply facilities.
- Ensure that women are involved in user fee collection and allocation decisions.
- Consistently and appropriately provide HIV/AIDS awareness information and protection gears to discourage new infections.
- Carrying out periodic checks of different components of the water production, transmission and distribution system to initiate immediate rehabilitation whenever problems are identified to reduce system leakage losses and downtime.

Environmental Mitigation Measures

Possible mitigation measures for minimizing negative environmental impacts include the following:

- Avoid hampering natural drainage of surface water and plan for restoration measures after construction
- Water sources and intermediary point are checked for quality to confirm water quality standards are met.
- Construct the water supply distribution network contamination free
- Plan and set up on-site sanitary facilities for the disposal of wastewater.
- Construction activities should be scheduled appropriately to reduce high noise levels from overlapping noisy activities.
- Avoid areas sensitive to erosion.
- Avoid establishing access roads along steep slopes; instead, locate access roads perpendicularly or diagonally to the slope.
- At the end of construction works, level off the soils and facilitate vegetation regeneration.
- Design the water conveyance layout by taking into account ecologically sensitive and protected areas.
- Establish a perimeter of protection around sensitive ecosystems such as wetlands and unique habitats sheltering endangered species.
- Minimize land clearing areas
- Restore the vegetation in cleared areas.
- Design the water conveyance layout by taking into account wildlife reproduction areas and migration corridors.
- During subproject preparation, the safe yield and potential drawdown of water levels in the vicinity of boreholes and pumping stations should be checked to confirm that the proposed water source is sustainable and will not adversely affect nearby wells or wetlands or be affected by other abstractions.
- For surface water sources development, the sustainability of the proposed abstraction and the impact of withdrawals on downstream beneficial uses should be assessed.
- Pilot municipal wastewater treatment plant and carry out specific study for wastewater reclamation and alternative reuse study to develop the strategy for entering into wastewater reclamation and reuse market in order to enhance the positive impact and reduce the negative impact of the water supply system

Responsibilities and Time Frame for Implementation of the Enhancement and Mitigation Measures

Table 1 below provides a general implementation plan of the suggested enhancement and mitigation measures basing on detailed potential enhancement and mitigation measures for environmental and social impacts.

Table 1: Environmental and social management plan for the Water Supply System

| Impact | Mitigation and Enhancement Measures | Responsible institution | Mitigation Time frame |
|--|--|--|---|
| Water Resources | | | |
| <ul style="list-style-type: none"> • Interruption of surface water flows during construction. • Variations in the level of groundwater table resulting from changes in the drainage. • Contamination of surface and underground water quality by wastewater and hazardous materials, including stored chemicals products used for raw water treatment. • Risk of water pollution as a result of discharge of wastewater and filterwashing waters. • In coastal area, outflow of municipal waste water to sea • Poor water quality control due to lack of attention and over/under use of treatment agent | <ul style="list-style-type: none"> • Do not hamper drainage of surface water and plan for restoration measures after construction. • Plan and set up on-site wastewater disposal facilities. • Maintain vehicles, machinery and equipment in good condition in order to avoid leaks and spill of hazardous materials (hydrocarbons, chemical products, etc.). • Ensure a safe management of hazardous materials (hydrocarbons, chemical products, etc.). • Take all precautions during refuelling of vehicles and machinery, and forbid the refuelling near water bodies. • Avoid crossing permanent waterways; if necessary, locate the crossing where the banks are stable and the waterway the narrowest. • Conserve vegetation near water bodies and wetlands. • Plan emergency response measures in case of accidental spill. • Favour the recycling of filter-washing waters. • Regular and continuous water quality monitoring (twice in a year – dry and monsoon season) • Capacity building of WTP staff for adequate care and attention for mixing water treatment agent. | Contractors, CWSB Engineers, PMCU-AES Unit, NGOs | During Mobilization, Construction and after construction i.e. long term |
| Soil Resources | | | |
| <ul style="list-style-type: none"> • Runoff erosion resulting in sedimentation problems. • Change in the local topography. • Contamination of soils from spilling of hazardous materials. • Landslides and other types of soil movements in the works areas. • Soil compaction and erosion. • Reduction of soil fertility. • Soil destabilisation from excavation. • In limestone areas, risk of soil collapsing due to the creation of underground cavities following groundwater over-pumping. | <ul style="list-style-type: none"> • Avoid areas sensitive to erosion. • Carry out the construction works in the dry season. • Favour the establishment of water supply infrastructures on low-productive soils. • Limit circulation of heavy machinery to minimal areas. • Stabilise the soils in order to reduce potential erosion. • At the end of construction works, level off the soils and facilitate vegetation re-generation. • Lay down water conveyance and distribution systems on surface of adequate support capacity. | Contractors, CWSB Engineers, PMCU-AES Unit, NGOs | Construction Phase |

| Impact | Mitigation and Enhancement Measures | Responsible institution | Mitigation Time frame |
|--|---|--|---|
| Flora | | | |
| <ul style="list-style-type: none"> • Destruction of the vegetation cover. • Loss of forest products (fuel wood, timber, non timber forest products). • Decrease in the vegetation development that could enhance desertification. | <ul style="list-style-type: none"> • Minimise land clearing areas. • Plan for recuperating the forest products extracted from land clearing and identify mechanisms to distribute the products to the local population. • Protect trees from machinery along right-of-way. • Restore the vegetation in cleared areas. • Ensure the plantation of indigenous species. • Promote the development of community nurseries, ideally operated by women. | Contractors, CWSB Engineers, PMCU-AES Unit | During Mobilization, Construction and after Construction |
| Air quality | | | |
| <ul style="list-style-type: none"> • Degradation of air quality by dust and vehicles emissions. • Increase in ambient noise. | <ul style="list-style-type: none"> • Install and operate air pollution control equipment near residential area during construction • Near the residential areas, avoid noisy works after regular working hours. • Maintain vehicles and machinery in good condition in order to minimise gas, noise and dust emissions. • Use appropriate means for minimising dust dispersion during construction. • Use dust and noise attenuators, such as vegetation edges along transport corridors in order to minimise noise and the aerial transport of dust. | Contractors, CWSB Engineers, PMCU-AES Unit, NGOs | During Mobilization and Construction i.e. short term |
| Quality of life | | | |
| <ul style="list-style-type: none"> • Improvement in standard of living. • Disturbance of quality of life due to nuisances such as noise, dust and traffic related to construction works. • Degradation of the landscape by land clearing, construction works, new infrastructures, etc. • Disagreements caused by increased wastewater quantities. | <ul style="list-style-type: none"> • Involve the population (men and women) in the maintenance and management of new infrastructures to ensure their sustainability. • Provide information and education on monitoring and maintaining water supply systems, particularly for ensuring water quality preservation. • Establish a formal consultation mechanism with local authorities to discuss issues disturbing inhabitants and to find solutions satisfying all parties. • Use an architectural design integrating the new infrastructures into the landscape. • Plan wastewater management as part of the project | Contractors, CWSB Engineers, PMCU-AES Unit, NGOs | During Mobilization, Construction and after construction i.e. long term |

| Impact | Mitigation and Enhancement Measures | Responsible institution | Mitigation Time frame |
|---|--|---|--|
| <p>Information, education and Communication</p> <ul style="list-style-type: none"> • Exclusion of specific groups from the water management processes due to a lack of knowledge. • Development of skills in water conservation and management. • Lack of awareness on the importance of hygiene at water points. | <ul style="list-style-type: none"> • Assist groups of individuals who may lack the capacity to participate in water management processes. • Provide water suppliers, men and women, with the training required to preserve water resources and to maintain regular water supply. • Ensure that social services provide education to men and women on appropriate hygienic conditions and water conservation, taking into consideration gender particular roles and responsibilities. • Inform the local population on potential project benefits for the community and identify individual behaviours that would contribute to achieve those benefits. | <p>Contractors, CWSB Engineers, PMCU-AES Unit, NGOs</p> | <p>During Mobilization, Construction and after construction i.e. long term</p> |
| <p>Communicable diseases</p> | | | |

| Impact | Mitigation and Enhancement Measures | Responsible institution | Mitigation Time frame |
|---|--|---|--|
| <p>Changes in exposure to:</p> <ul style="list-style-type: none"> • Water borne diseases e.g.: diarrhea and cholera associated with contamination, intermittency and poor sanitation. • Water related diseases e.g.: malaria, filariasis, dengue associated with drainage, storage and wastewater disposal. • Water contact diseases e.g.: schistosomiasis and swimmer's itch associated with impoundment. • Water washed diseases e.g.: scabies and skin infections associated with insufficient supply. • Sexually transmitted infections e.g.: HIV/AIDS associated with migration, construction, economic change. | <ul style="list-style-type: none"> • Facilitate the implementation of appropriate latrines and other sanitation facilities at high contamination probability area • Information, education and communication about safe uses of drinking water. • Environmental management for vector control; contact avoidance via settlement location and design and use of bed nets and repellents; rapid diagnosis and treatment; focal insecticide application; covered water storage; reduced domestic storage; functional drainage. • Strengthen medical services to ensure rapid diagnosis and treatment. • Safe water and food storage and handling. • Implement HIV/AIDS prophylaxis through appropriate health promotion as well as wide distribution and use of condoms (for men and women); employment opportunities for project-affected women; provision of family accommodation for construction workers. • Assure continuous supply. • Avoid using contaminated water and unauthorized connections. • Avoid contamination via runoff and contamination of collection and storage equipment. • Ensure piped supply is accompanied by appropriate drainage and disposal. • Survey community opinion about taste of water and water collection preferences. • Refer to measures proposed under environment and poverty crosscutting themes as they address many health determinants of communicable diseases. | <p>Contractors, CWSB Engineers, PMCU-AES Unit, NGOs Local Health Facilities</p> | <p>During Mobilization, Construction and after construction i.e. long term</p> |
| <p>Non communicable diseases</p> | | | |
| <ul style="list-style-type: none"> • Poisoning associated with excess chemicals (e.g.: fluoride, nitrite, arsenic, chlorine). • Diseases associated with chemical deficiencies (e.g.: iodine is associated with goitre and cretinism). | <ul style="list-style-type: none"> • Monitor water quality and adjust chemical content as appropriate | <p>Contractors, CWSB Engineers, PMCU-AES Unit, NGOs</p> | <p>During Mobilization, Construction and after construction</p> |

| Impact | Mitigation and Enhancement Measures | Responsible institution | Mitigation Time frame |
|--|--|--|--|
| Natural resources | | | |
| <ul style="list-style-type: none"> Loss of or limited access to territory for some groups, particularly farmers and livestock herders. Reduction in the quantity of water available for other uses. | <ul style="list-style-type: none"> Design the project and coordinate work with other land users. Consult all groups of the population using water or rejecting effluents in water. Clearly define water rights in consultation with affected groups. Create water supply system management committees. Build on the respective knowledge and experience of women and men in water management. Restore productive lands into initial conditions. Ensure that water user fees and conditions are determined in consultations and well understood by all project beneficiaries. Plan water intake according to available water resources. Implement appropriate methods for water distribution. | Contractors, CWSB Engineers, PMCU-AES Unit, NGOs | During Mobilization, Construction and after construction |
| Municipal Waste Water | | | |
| <ul style="list-style-type: none"> Generation of municipal waste water Possibility of deterioration of water quality of groundwater aquifer/ waste water receiving surface water body – sea / river Affecting health and hygiene of the people of Mumbasa | <ul style="list-style-type: none"> Provision of Pilot Municipal Wastewater Treatment Plant / Infrastructure like conventional Secondary treatment processes may be used to treat municipal wastewater. Such processes include screening, primary sedimentation, conventional activated sludge, and secondary sedimentation. Newer wastewater treatment technologies like absorption-biodegrading process (AB process), anaerobic-aerobic activated sludge process (A/O), anaerobic-anoxic-aerobic activated sludge process (A/A/O), cyclic activated sludge system (CASS), sequencing batch reactor (SBR) plus activated sludge process, oxidation ditches, and stabilized pond may be also explored. Municipal waste water monitoring Provision of wastewater reclamation and alternative use study to develop the strategy for entering into the market of wastewater use | CWSB, PCMU-AES Unit | Operation phase of the project |

Wastewater Management Plan

Wastewater market is being developing in emerging and developed economy like never before due to freshwater shortage and water footprint issue. Project can get benefit out of this development taking place globally. Under this context, the wastewater management plan is designed for this project. Municipal wastewater likely to be generated due to project is estimated in the range of 93001-148800 m³. Out of this black wastewater (from latrine/toilet) likely to be generated is estimated in the range of 27900 – 44640 m³. During the first five year of the project operation, likely black wastewater to be generated from the project is estimated at 31279 m³. A provision to set up the pilot municipal wastewater treatment plan of 3000 m³ using the latest cost effective technology for black wastewater treatment coupled with reclamation aspect is made under the project. This will treat roughly 10% of the black wastewater to be generated in the span of first five year of project operation and will be generating sufficient information on the wastewater reclamation for the alternative use of the wastewater so that a strategy for green wastewater management can be formulated for the whole project in advance. A wastewater reclamation and alternative use study is proposed under the project to formulate the strategy to harness the benefit of emerging market of wastewater use in Mombasa for the garden, road cleaning, toilet flushing, etc. The study is supposed to submit its finding to CWSB and CDA by 2015 so that the wastewater management plan is developed for whole project covering 100% of the project generated wastewater in a profit earning mode in contrast to cost generating mode. It is to be noted that the operating cost of the pilot municipal wastewater treatment plant of the project will be recovered from the biofuel and earning from the reuse of treated water for industrial and commercial use.

Monitoring Indicators for Water Supply System

The national EIA guidelines require the project proponent to prepare and undertake monitoring plan and regular auditing. Monitoring is needed to check if and to what extent the impacts are mitigated, benefits enhanced and new problems addressed. The key verifiable indicators which will be used to monitor the impacts are presented in **Table 2** below.

Table 2: Key environmental and social monitoring indicators for water supply System

| Component | Indicators |
|-------------|--|
| Poverty | |
| Economy | Annual revenues generated by water supply operations compared to forecast revenues. |
| Environment | |
| Water | <ul style="list-style-type: none"> • Quality of Water based on National Standards (rinking water quality standards KS 05-459: Part 1: 1996, schedule 1-5) and WHO Standards • Quality of waste water affluent based on National Standard (The Environmental Management and Co-ordination (Water Quality) Regulations, 2006, schedule 6-7) • Quantity of water used compared to initial estimates. |

| Component | Indicators |
|---------------------------------------|--|
| Population | |
| Natural resources and land Management | <ul style="list-style-type: none"> • Number of conflicts among water users (upstream, on site and downstream). • Presence of a water user organisation, including men and women. • Revenues from water fee/tariff collection and allocation |
| Quality of life | <ul style="list-style-type: none"> • Level of satisfaction of beneficiaries toward water supply sources and facilities. |
| Health Outcomes | |
| Communicable diseases | <ul style="list-style-type: none"> • Prevalence rates (evolution over time) of diseases such as malaria, schistosomiasis, and diarrhoea. |
| Non communicable diseases | Prevalence rates of poisoning and goiter |
| Gender | |
| Roles and responsibilities | Time allocation of women before and after the project. |
| Income generating activities | Proportion of household income devoted to water supply and sources of funds – men or women (before and after the project). |

Capacity Building for Environmental Management of WSS

A specific training program for the key officials of the project, focused on the procedural and technical aspects of environmental assessment and management will be developed. This training would be mandatory for the CWSB engineers and managers as well as for the district-level environment experts.

The training will involve initial orientation, main training program and refresher training programs. The main and refresher training programs will be for duration of one week each.

Specific topics to be covered for the training workshop to the planner / manager, field officers and field operator of the CWSB may be summarized as below

- Environmental data sheet preparation, Impact evaluation and project appraisal
- Environment monitoring, supervision and reporting
- Community Participation

Environmental Awareness and Sensitization for Targeted Communities

The events for environmental awareness will be organized for beneficiaries and will be designed to reach extensively in the target communities. The programs will specifically include community representatives and water users' leaders in order to sustain environmental concepts beyond the project period. While these Community-level awareness programmes will be a part of the overall project IEC programme, the PMCU-AES Unit will be responsible for the development of communication materials

EMP Cost for Water Supply System

Cost associated to environmental management plan for water supply system is estimated and given in Table 3 below

Table 3: EMP Cost for Water Supply System

| Cost Component | Unit Quantity | Unit Cost (kshs) | Total Cost (kshs) |
|--|---|--------------------------|-------------------|
| Pilot Municipal Wastewater Treatment Plant (MWTP) with waste water reclamation component | 1 Plant with capacity of 3000 m ³ /day | Kshs 2857/m ³ | 8570000 |
| Waste water alternative use study | 1 | Lump sum | 3306400 |

| Cost Component | Unit Quantity | Unit Cost (kshs) | Total Cost (kshs) |
|--|---|----------------------|-------------------|
| Monitoring of water quality | Monitoring of 150 locations twice in a year, i.e. 300 samples | 8570/sample | 2571000 |
| Monitoring of wastewater quality | Monitoring of 25 locations twice in a year, i.e., 50 wastewater samples | 2142/sample | 107100 |
| Capacity Building of CWSB Staff and CDA officials | 3 training workshop of one week each for 20 participants, i.e. 300 participants day | 4285/participant day | 1285500 |
| Health and Hygiene Awareness and sensitization (HHAS) Campaign for target communities of water users | Targeting 2000 drinking water users through 100 HHA Events | 13000/ HHA Events | 1300000 |
| Total | | | 17140000 |

Reference for Water Quality Standard and Monitoring

Parameters for drinking water to be monitored as per Drinking water quality standards KS-05-459: Part 1: 1996 as per following schedule listed parameters and standards.

- Schedule 1: Aesthetic quality requirements for drinking water and bottled drinking water
- Schedule 2: Limits for inorganic contaminants in drinking water and bottled drinking water
- Schedule 3: Limits for organic constituents of health Significance in drinking water and bottled drinking water
- Schedule 4: Limits for radioactive materials in drinking water and bottled drinking water
- Schedule 5: Microbiological limits for drinking water and containerized drinking water

Parameters for waste water affluent to be monitored includes BOD₅, COD, pH, Suspended solids, Ammonia, NH₄, Nitrate NO₃, Nitrite NO₂, Total Dissolved Solids, E.Coli, Total coliform, etc. as per the Environmental Management and Co-ordination (Water Quality) Regulations, 2006 given specifically in following schedule WRBS

- Schedule 6: Guideline values for discharge into public Sewers
- Schedule 7: Guideline values for discharge into public Water

ANNEX XI

IMPLEMENTATION PLAN SUPPORT FOR EMP & RAP

1.0 Introduction

Effective and timely implementation of EMP and RAP is important to reduce the negative environmental and social impact of the project and enhance the associated positive impact. This Annex describe in detail implementation support and framework for the EMP and RAP and associated cost.

2.0 Implementation Arrangement and Support of EMP and RAP

Implementation of EMP and RAP will be the responsibility of PMCU. Different organ with PMCU like AES Unit, M&E Unit, RAP-IC and GRC will be established as described in institutional arrangement of the project to assist the PMCU in the implementation of EMP and RAP. Details of RAP implementation is given in RAP report. EMP will be implemented with the technical backstopping of the environmental expert and expert to be hired for the project as elaborated in subsequent section. EMP Implementation agency is to be contracted for implementation of EMP.

4.0 Environmental and Social Experts for the EMP and RAP

Environmental and social expert will be hired for the project as given below for the technical backstopping in the implementation of EMP and RAP.

| Sr No | Cost Particulars | Man Month | Unit Cost (\$) | Amount in US \$ |
|-------|------------------------------------|-----------|----------------|-----------------|
| 1 | Local Social Expert | 60 | 300 | 18000 |
| 2 | Local Environmental Expert | 60 | 300 | 18000 |
| 3 | International Environmental Expert | 5 | 7000 | 35000 |
| 4 | Capacity Building of Stakeholders | Lump Sum | | 10000 |
| 5 | Total | | | 81000 |

5.0 Implementation Schedule

Detailed implementation schedule for the RAP is given in RAP report. EMP implementation will be through out the construction period and during operation phase and follow the project implementation activities.

Annex XII

ENVIRONMENTAL AND SOCIAL MANAGEMENT COST

1.0 Introduction

Environmental and Social Management Cost will be part of Project Cost. The EMP and RAP interventions are huge and need outsourcing to assist the Environmental and Social Cell of Project Management and Consultation Unit (PMCU) for the proper implementation. For this purposes, Environmental and Social Management Consultancy services is to be hired as per World Bank guideline. RFP for Environmental and Social Management Consultancy Services (ESMCS) is to be formulated by the project proponent. And associated cost for the same and overall cost estimate for the environmental and social management of the project is described in subsequent section.

2.0 Environmental and Social Management Cost

A separate budget is allocated to account for environmental and social management cost as below. This will enhance the positive benefit and reduce the negative impact of the project on the environment and social condition of the project area.

Environmental and Social Management Cost

| Sr No | Cost Item | USD | Ksh | Remarks |
|-------|---|---------|-------------|-------------------------|
| 1 | Total EMP Cost | 1655680 | 141891767.4 | sum of 1.1..1.7 |
| 1.1 | Catchment Area Treatment Plan | 634793 | 54401760 | Annex VII |
| 1.2 | Agriculture Chemical Use Reduction Plan | 246000 | 21082200 | Annex VIII |
| 1.3 | Health and Hygiene Plan | 178100 | 15263170 | Annex IX |
| 1.4 | Environmental Monitoring Cost | 25180 | 2157926 | Annex X |
| 1.4 | Social and Environmental Experts Cost | 81000 | 6941700 | Annex XII |
| 1.5 | Water Supply System EMP cost | 200000 | 17140000 | Annex XI |
| 1.6 | Others | 211765 | 18148261 | ESIA Section 9.6/9.7 |
| 1.7 | EMP Implementation Agency (EMCS) Cost | 78841.9 | 6756751 | @ of 5% of item 1.1&1.6 |
| 2 | Total R&R Cost | 5998580 | 514000000 | RAP Report |
| 3 | EMP and R&R Cost | 7654259 | 655891767.4 | |

3.0 TOR for ESMCS

TOR for ESMCS is to be prepared by the project proponent following the WB procurement procedures and safeguard policies.