

SEKAB BioEnergy (T) Limited

P. O. Box 23423, Dar es Salaam, Tanzania. Tel: +255 22 260 12 85, Fax: +255 22 260 46; www.sekab.com

Environmental and Social Impact Statement of the Proposed BioEthanol Production from Sugar Cane on the former Razaba Ranch, Bagamoyo District, Tanzania



DRAFT REPORT

Submitted to:
National Environment Management Council
Tancot House, P. O. Box 63154, Dar es Salaam.

Tel. +255 22 2134603

E-mail: nemc@nemctz.org or simbanet.net

July 2008



Consultants:

ORGUT Consulting AB, Svartmangatan 9
111 29 Stockholm, Sweden
Tel: +46(0)8 40676 35, Fax: +46 (0)8 21 02 69

in association with

Ardhi University
P.O Box 35176, Dar es Salaam, Tanzania
Tel +255 22 2775004, Fax +255 222775391

STUDY TEAM

Name	Responsibility	Signature
Ms. Melinda Fones-Sundell	Team Leader, ORGUT Consulting AB	
Dr. Rubhera RAM Mato	EIA Expert and Water Resources Specialist	
Prof. Gabriel R. Kassenga	EIA Expert Policy Analyst and Industrial Pollution Specialist	

EXECUTIVE SUMMARY

Environmental and Social Impact Statement of the proposed BioEthanol Production from Sugarcane on the former RAZABA ranch, Bagamoyo District, Tanzania

Proponent: SEKAB-BioEnergy (T) Limited, P. O. Box 23423, Dar es Salaam, Tanzania.
Tel: +255 22 260 12 85/86; Fax: +255 22 260 12 46

EIA Expert: Orgut Consulting AB, Svartmangatan 9, 111 29 Stockholm, Sweden.
Tel: +46 (0) 8 406 76 37; Fax: +46 (0) 8 21 02 69

In Association with

Ardhi University, P. O. Box 35176, Dar es Salaam, Tanzania.
Tel: +255 22 2775004; Fax: +255 22 2775391

INTRODUCTION

SEKAB BioEnergy Tanzania Limited is a company formed to develop large scale BioEnergy (BioEthanol) plants in Tanzania. BioFuels are one of the key mechanisms to meet the energy crisis of the world caused by fast diminishing fossil fuels. SEKAB plan to develop several estates in Tanzania for BioEthanol production, including Rufiji, Kilwa and Bagamoyo (the Razaba estate).

The Razaba sugarcane plantation and ethanol production plant will be the first in the development of BioEthanol/BioElectricity projects in Tanzania. An estimated area of about 15,000 ha will be planted with sugar cane at Razaba. Sugar cane yields are projected to be between 90 – 110 tons per ha, using available good technology and cane varieties. A seed cane nursery of 240 ha was established in 2007, about 500 ha of plantation is scheduled to be developed in 2008 and the remaining will be developed in 2008-2011 ready for ethanol production in year 2011. Outgrower capacity will be developed in parallel and is expected to add another 5,000 ha in 10 years time.

However, the current development policies in Tanzania require developers to carry out an Environmental Impact Assessment (EIA) for their proposed projects. This has become part of the project approval process for development projects in the country. SEKAB BioEnergy Tanzania approached ORGUT Consulting AB to conduct the EIA study, of which Orgut associated with Ardhi University, Dar es Salaam for the same cause. This study was conducted between November 2007 until February 2008.

OBJECTIVES AND METHODOLOGY

The main objective of this EIA is to identify, predict and evaluate potential impacts of the proposed development of a BioEthanol Production from Sugarcane on the former Razaba Ranch project in Bagamoyo District, Tanzania and incorporate mitigation and/or enhancement measures into the designs, establishment, operation and decommissioning processes and ensure project sustainability with least negative impact on the social, economic and ecological environment.

This EIA study was conducted according to recommendations given by the Tanzania's EIA and Audit Regulations of 2005. A standard approach for conducting EIA was followed that included scoping, public consultations, impact identification and analysis, development of mitigation measures and EMP for all project phases, setting a monitoring plan and resource evaluation.

Public participation was considered as an important element of the sustainable development process for the BioEthanol production. In this EIA study various stakeholders participated. Broad consultations that involved local communities, village, ward and key district officials were carried out. During these consultations, the local communities had opportunity to air their concerns. The concerns of each group have been addressed in this EIA report.

PROJECT DESCRIPTION

SEKAB BioEnergy Tanzania Limited intends to develop 20,000 ha concession for irrigated sugar cane production and a BioEthanol processing plant located on the former Razaba Ranch property in Bagamoyo District. The area is located in the west of Bagamoyo (about 20 km) along the Bagamoyo-Msata road, about 80 km from Dar es Salaam.

The Razaba Ranch was formally leased to the Revolutionary Government of Zanzibar and has already agreed to allocate 22,000 hectares of the ranch to SEKAB. The land under concession is the west of the Makarunge-Sadani road while most of the coastal strip to the east of the road will remain under the formal control of the Zanzibar Revolutionary Government.

The project will be a monoculture plantation using Natal varieties which already exist in Tanzania e.g. N19 and N25 but they will also plant some N30, N27, N32 and N41 for test. These are varieties developed at South Africa Sugar Cane Research Institute (SASRI) in South Africa. An estimated area of about 15,000 ha will be planted with sugar cane. A seed cane nursery of 240 ha is being developed at present on a former prison farm south-east of the Razaba ranch.

The project will be implemented in phases. About 500 ha of plantation is scheduled to be developed in 2008 and the remaining will be developed in 2008-2011 ready for ethanol

production in year 2011. Outgrower capacity will be developed in parallel and is expected to add another 5,000 ha in 10 years time. In full production, this implies the processing of over 2 million tons of harvested cane during the eight production months.

The project is intending to use irrigation technologies such as sub surface drip, centre pivot and semi solid sprinkler types depending on the soil types. Drip irrigation is one of the most efficient technologies in terms of water use and uniformity. Drip irrigation, also known as *trickle irrigation* or *micro-irrigation* is an irrigation method that applies water slowly to the roots of plants, by depositing the water either on the soil surface or directly to the root zone, through a network of valves, pipes, tubing, and emitters, with the goal of minimizing water and fertilizer usage. It is becoming more widely used for row crop irrigation especially in areas where water supplies are limited or recycled water is used for irrigation. The project will use PVC pipes for the main pipelines and polyethylene in the laterals. Drain water from the farm will be directed into ponds (natural and/or management) and the water recycled back to irrigation ponds to minimise the leakage of nutrients and other substances to the surrounding waters.

According to SEKAB BT plans, the first 850 ha plot of the 15,000 ha sugarcane plantation is expected to start being irrigated from around June 2009. The daily maximum water requirement for this 850 ha plot is estimated at 0.59 m³/s. The irrigation expansion will continue over the following year until the full potential of the estate is developed. Water for irrigation will be drawn mainly from the Wami River.

The processing plant for bio-ethanol will be located approximately 6°19'30"S 38°46'11"E, at the former Razaba Ranch near Bagamoyo, approx. 80 km northwest of Dar es Salaam .

The ethanol processing plant will be in full operation for eight to nine months, approx July through February (early March). Then harvesting slows down (typically during March) as the rain period approaches. During the rain period, maintenance is carried out. This includes cleaning of vessels (chafs, coke) and replacement of worn parts.

Different parts of the plant may be operated different from the main cane-to-ethanol plant. Some other type of secondary biomass may be used to run the boilers to make electricity outside the harvesting season. During the semi-wet period, production will be lower and intermittent, leading to lower emissions

Ethanol will be produced during a 9 month harvesting period, the dry season. It is possible to extend this period by storing sugar juices or using molasses from sugar production produced at other sugar estates.

The processed ethanol will be stored on the industrial plant site however the ESIA study team did not have access to technical specifications of size and type of storage infrastructure. Nor was any specific information available on how the ethanol will be treated to prevent its use as alcohol for consumption.

Produced Ethanol will initially be exported. Ethanol fuel will be distributed for domestic use as a national market develops. The majority of the product will be exported by means of rail car and transferred onto tanker ships in the port of Tanga, approx 200 km north of Bagamoyo (Figure 2.3).

POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

In the EIA several sectoral policies and laws that in one way or another affect the proposed BioEthanol project have been reviewed. The main legislative drivers for conduction of EIA for development projects in Tanzania are the National Environmental Policy, NEP (1997) and the Environmental Management Act, EMA (2004) and its subsequent national EIA and Audit Regulations (2005). Both NEP and EMA stipulate mandatory conduction of EIA for all development projects in Tanzania. The EIA and Audit regulations are instituted to operationalize the EMA.

The policies that are relevant to the proposed Bioethanol project include;

- National Environmental Policy (1997)
- The Wildlife Policy of Tanzanian (1998)
- National Forestry Policy (1998)
- The National Water Policy (2002)
- National Gender Policy (1999)
- The National Energy Policy (2003)
- National Land Policy of (1995)
- Agriculture and Livestock Policy (1997)
- The National Investment Promotion Policy (1996)
- The National Science and Technology Policy for Tanzania
- Sustainable Industrial Development Policy-SIDP (1999-2020), 1996
- National Transport Policy (2003)

Similarly key laws that area relevant to this project include;

- Environmental Management Act No. 20 of 2004
- National Environmental Impact and Auditing Regulations (2005)
- The Village Land Act No. 5 of 1999
- Land Use Planning Commission Act of 1984
- Land Act (1999)
- Sugar Industry Act (2001)
- The Food Security Act, 1991
- The Land Acquisitions Act of 1967 and the Land Ordinance
- Forest Act (2002)
- The Water Utilization (Control and Regulation) Act (1974) as amended in 1981
- Energy and Water Utilities Regulatory Authority Act (2001)
- Occupation Health and Safety Act (2003)
- Industrial and Consumer Chemicals Act (2003)
- The Town and Country Planning Ordinance Cap 378 of 1956 (as amended in 1961)

- Wildlife Conservation Act No. 12 of 1974 (as amended in 1978)
- Protected Places and Areas Act (1969)
- Local Government Act of 1982 (Urban and District Authorities)
- Agriculture Act (2003)
- Employment and Labour Relations Act (2004)

There are also relevant national strategies and programmes that give impetus to the development drive, these include;

- The National Strategy for Growth and Reduction of Poverty (NSGRP),
- The Tanzania Development Vision 2025
- National Environment Action Plan (NEAP, 1994)
- Agriculture Sector Development Programme (ASDP, 2003)
- Rural Development Strategy (RDS, 2001)

The institutional arrangement for environmental management in Tanzania is well defined in the EMA (2004). There are seven (7) institutions mentioned by the act, of which the minister responsible for environment is the overall in-charge for administration of all matters relating to the environment. Part III, Section 13(1) of EMA (2004) states that “the Minister responsible for environment shall be the overall in-charge of all matters relating to the environment and shall in that respect be responsible for articulation of policy guidelines necessary for the promotion, protection and sustainable management of environment in Tanzania”.

The legal institutions for environmental management in the country include;

- National Environmental Advisory Committee;
- Minister responsible for Environment;
- Director of Environment;
- National Environment Management Council (NEMC);
- Sector Ministries;
- Regional Secretariat;
- Local Government Authorities (City, Municipal, District, Township, Ward, Village, sub-village “*Mtaa and Kitongoji*”)

BASELINE CONDITIONS

Relief and soils:

The Razaba farm is located in an old, uplifted and dissected coastal plain. Its topography is largely gently undulating to rolling, characterised by extensive plains, low hill or ridges bottomlands and shallow valleys. The terrain is rising gradually from the coastal mudflats to about 30-40 m above sea level at the western border of the area.

The soils are based on old, dissected sand dunes, with grey sandy soils (locally called mbuga) on the main central areas, falling away to alluvial sands and clays along the Wami river (northern boundary) and the Ruvu river (south-eastern boundary). The sandy topsoil which is prevalent is susceptible to erosion during farming operations. Organic

matter (OM), phosphorus and potassium are the most limiting parameters for all soils in the Razaba area.

Climate:

The average temperature in the Razaba area is between 20°C to 32°C. June to August is the coolest season while the hottest season runs from December to Mid-March. The rainfall pattern in the area is bimodal with two rain periods in a year. The long rains occur during March to May/June while the short rains happen during the period September/October-December. The annual average rainfall is estimated at 800-1000mm. The short rains are unreliable and poorly distributed. However there is no month without rainfall.

Water resources and pollution:

The project is sandwiched in the lower reaches of the Wami River and Ruvu River. The two rivers form the Wami/Ruvu River basin, which is among the 9 river basins draining Tanzania mainland. The main source of irrigation water for the Bioethanol project in Bagamoyo will be the Wami River. The Wami River is one of the major rivers draining the Eastern Arc Mountains and the basin area extends from the upper catchments in semi arid Dodoma region through the humid inland swamps in Morogoro region to discharge into the Indian Ocean at Saadani in Bagamoyo just north of the study area.

There is incomplete information on the amount of water available in Wami River, despite existence of abstraction licenses upstream to the Razaba ranch. Throughout the Wami river sub-basin, water abstractions are spatially non-uniform and the amount abstracted depends on the total requirement which is, in turn, is affected by the local climatic conditions. Two type of surface water abstractions are therefore distinguished in the sub-basin, the dammed and direct-from-river abstractions. The former is usually practiced in the arid climate in upper catchments of Wami in Dodoma where several reservoirs storing river water are operational. These reservoirs store considerable amounts of flow that could otherwise be available to downstream reaches through to the Indian Ocean. Direct abstractions from the river include both licensed and illegal abstractions. Currently, there is little quantitative information on the illegal abstractions. The licensed abstractions are done by users with water rights. About 99 abstractions from various rivers and 14 from springs in the sub-basin have been given water rights. The amount necessary for environmental flows has not been adequately determined by the Wami/Ruvu basin authority.

Available data is not sufficient to make a firm estimation of the groundwater availability at the Razaba ranch, despite the fact that in the vicinity, there are operating boreholes. Considering the locations and depths of the existing boreholes in the area, the trend is decreasing salinity of the groundwater with increasing distance from the Indian Ocean.

Surface water quality data for Wami River is monitored by the Chalinze water supply scheme at the Manderu point. Water samples were collected from two points on Wami River and three dams in the Razaba farm (Figure 4.4). Judging from the analysis results given in Table 2, the Wami River is fresh water that is suitable for irrigation purposes

primarily due to absence of salinity. These indicative data generally show a very good water quality suitable for both domestic/industrial water supply source (for treatment) and irrigation. However, a salinity of 0.1-.2% observed for dammed water samples, indicate potential salinity changes upon inundation.

Flora and fauna:

Bio-geographically the Razaba area belongs to the East African Coastal Forests zone that occurs in a narrow belt along the Indian Ocean from southern Somalia to Mozambique. However, the activities of humans and their domesticated animals has long ago turned the coastal forest in the Razaba area into a semi natural woodland habitat with bushland, dry grassland, forest tickets, seasonally flooded plains, cultivation plots and a number of modified, but still surviving natural habitats such as mangroves and riverine forests. The closest relatively intact coastal forest fragment is the Zaraninge Forest in Sadani National Park about 20 km north of the study area.

In the northern part of the area there are forest remnants dominated by various species known as African ebony: *Diospyros bussei*, *Diospyros cornii* and *Manilkara mochisia*. However, the majority of the Razaba area is covered by acacia woodlands mixed with other species such as *Spirostachys africana* and *Terminalia*. Vegetation types dominated by pure stand of *Acacia zanzibarica* are found on the black cotton soils in a belt from the Ruvu River through the eastern part of the area to the other side of the Wami River continuing into Sadani National Park. The persistence of coarse grasses hinders the spread of the thickets to make continuous woodland.

Mangroves occurs at the estuaries of Ruvu and Wami Rivers dominated by five species: *Avicennia marina*, *Bruguiera gymnorrhiza*, *Sonneratia alba*, *Ceriops tagal* and *Rhizophora mucronata*. The mangrove areas are harvested for building poles, boat building, charcoal and export trade. Ecologically, the mangroves trap terrestrial sediments, litter and nutrients and are thus very important for the protection of other near-shore ecosystems such as sea-grass beds and coral reefs.

Azelia quanzensis, *Pterocarpus angolensis* and *Dalbergia melanoxylon* that are found in the northern part of the Razaba area are valuable timber species and products from these species have a very high market value. However, the species are also threatened by both local and international demand and the abundances of these species in Tanzania have declined dramatically.

Most rare and endemic species are found within the forest thickets and in the riverine vegetation in the northern part of the project area. Such species include the endemic *Encephalartos hildebrandtii* (Cycad tree) and important timber trees such as *Dalbergia melanoxylon* (African Ebony) and *Trichalysia sp.* which are threatened by unsustainable harvesting.

The project area is potentially rich in wildlife and shares many species with the adjacent Saadani National Park. All taxonomic groups including mammals, birds, reptiles, amphibians, fish and many invertebrate groups are represented. The area has high

diversity of both resident and migratory bird species with the composition and abundance of species changing with seasons due to intra-Africa and Palaeartic migrations. The importance of Makurunge area for bird conservation is indicated by the high abundance of birds observed during the EIA survey. More than 20 different large mammals are reported from the area. Warthog, duiker Sykes monkey and yellow baboons were physically observed during the EIA survey while elephants, hippos, bushpigs, buffalos, reedbuck galagos were recorded through animal signs. Local hunters and other local people further report the presence of such notable mammals as lion, leopard, cheetah, black and white colobus, sable antelope and wild dog.

At least 34 species of mammals occurring in the project area are threatened according to the IUCN redlist. Most are at Lower Risk (LR) but at least four species including the lion, cheetah, African elephant and hippopotamus are Vulnerable (VU). Observations suggest that most species are threatened by loss of habitat and overexploitation.

Socio-Economic and Cultural Environment

The Razaba area has a long history of settlement of farmers, hunters, traders and fishermen. The area has probably been inhabited for at least 1500 years, and until about 1900 the village of Sadani just north of the area was an important trade and harbour town. In 1974 the Razaba area was given to the Revolutionary Government of Zanzibar for the purpose of establishing a cattle ranch, and the inhabitants were compensated and resettled outside the area. The ranch was stocked with about 7000 herd of livestock and it employed about 300 workers.

The ranching strongly affected the area as many forest thickets were cleared to eliminate tsetse flies. Natural wetlands were modified to establish water reservoirs and several roads were constructed. A ranch headquarter was constructed with several buildings including a primary school which is still in use. The ranch also established a coconut plantation which still exists. The cattle ranch was given up in 1994, partly due to problems with tsetse flies. The remaining livestock was shipped to Zanzibar and the ranch was closed. Many of the present woodland thickets started growing up as the cattle was removed and the ranch management ceased. This semi wilderness attracted pastoralist, who used the area as a seasonal grazing land.

In 2005 the former Sadani game reserve just north of the study area was gazetted as a national park including part of the southern bank of the Wami River in the former Razaba area. (Government Notice No 281 of 2005). This area was included in the national park to protect the mangrove swamps near the estuary and ensure better water access for the wildlife during the dry seasons.

The Socio-economic survey has documented a number of activities in the area by both people who are still living in the ranch or villagers and people who are living outside the ranch. Almost 1,000 of the peasants in the sub-villages of Mtoni, Razaba, Kitama, Gama, Mkwajuni (Makurunge Village) and Mzambarau (Matipwili) cultivate paddy near the former Razaba ranch. The human settlements that are found in the former Razaba ranch

are, most of them, of a temporary nature. The majority of the “houses” are simply mud and wattle huts roofed with grass thatch or coconut leaves.

Three villages (Makurunge, Kidomole and Matipwili) and 4 sub-villages (Gama, Razaba, Kitame and Mkwajuni) have land bordering the Razaba area. *Makurunge village* has a total population of 1,762. The village is the home of five major ethnic groups: Wakwere, Wadoe, Wazigua, Wanyamwezi, and some Wagogo. *Kidomole village* has a total population of 1,266 of which 30% of the total population are children. The village is comprised of six major ethnic groups: Wakwere, Wadoe, Wazaramo, Wasukuma, Parakuyu and Barabaig pastoralists, and some Wagogo. *Matipwili village* has a total population of 2,769 belonging to six major ethnic groups: Wakwere, Wadoe, Wanyakyusa, Wazaramo, some Wagogo and Waluguru.

Makurunge village has 3 primary schools, while Kidomole and Matipwili villages have one and 2 primary schools, respectively. Nevertheless, the primary schools lack adequate classrooms, competent teachers and are short of teaching materials. Only Matipwili has a secondary school. Only Makurunge and Matipwili villages have one ill-equipped dispensary each. The dispensary at Makurunge also serves the population in Kidomole. People in Makurunge and Kidomole have to walk long distances to Bagamoyo town to get better health services.

Prevalent diseases are malaria, diarrhea, bilharzia, typhoid and malnutrition especially among the under-fives. HIV/AIDS prevalence is still minimal. On average only two people die annually of diseases with AIDS-related symptoms.

The villages surrounding the proposed sugarcane plantation have no provision for clean and safe water. They depend on Ruvu and Wami River (e.g. Gama Village) or other seasonal streams. Some fetch water from the dams within the Razaba Ranch (the project farm area) – Mwakanga, Razaba Headquarters (no longer functioning after erosion of the embankment), Kwa Makonge and Tambwezi. In all villages, open dug wells are commonly used. However, these wells are not protected and therefore they are prone to pollution.

The major source of lighting is kerosene. Over 95% of the population use kerosene for illumination. Fuel wood is by far the major source of energy for cooking. Dependency on fuel wood range from 79% for Makurunge to 100% in Kidomole and Matipwili. The use of charcoal is insignificant in all villages. However, charcoal making activities are quite significant in Makurunge and Kidomole villages, most of which is targeted for Bagamoyo and Dar es Salaam markets.

STAKEHOLDER INVOLVEMENT

Stakeholders were identified using simple methods such as scoping, networks, literature review and interviews. The following stakeholders were identified.

Institutional stakeholders;

- Bagamoyo District Council Authority,
- Villages' Governments in the project area,
- Communities and individuals in the villages surrounding the project area,
- Ministry of Energy and Minerals,
- Ministry of Natural Resources and Tourism,
- Ministry of Agriculture and Food Security,
- Ministry of Regional Administration and Local Governments,
- Pastoralists crossing through the farm with their cattle on the way to markets in Dar es Salaam,
- Ministry of Planning and Economic Empowerment,
- Office of the Vice President, Division of Environment,
- National Environment Management Council (NEMC),

Individual stakeholders;

- Villagers
- District Commissioner,
- District Executive Director,
- District natural Resource Officer
- District Agricultural and Extension Officer
- District Administrative Officer,
- District land officer

IDENTIFICATION AND ASSESSMENT OF IMPACTS AND MITIGATION MEASURES

Using a simple matrix, the following impacts were identified:

Construction Phase:

- Soil erosion due to runoff effects and loosened top soil during ploughing and planting
- Changes in the quality of surface water due to chemical use.
- Changes in the level of crime due to increased number of people in the area
- Increase in the risk of communicable diseases (e.g. HIV/AIDS) and human health due to increased population of workers and social interactions
- Change in population level due to influx of workers and labourers causing pressure to social services, food and facilities.
- Change in the level of traffic due to increased vehicles.
- Benefits to communities resulting from employment and other economic activities linked to the project

- Loss in the village workforce to the project,
- Loss of biodiversity during clearing and establishment of the sugarcane plantations,
- Loss of land,
- Soil erosion due to run off effects and loosened top soil due to vegetation clearance,
- Ecological impacts of the project to the nearby forest reserve,
- Fair compensation for land and other properties to be affected by the project,

Operation Phase:

- Localised changes in surface and groundwater hydrology due to the project activities notably irrigation.
- Changes in the quality of surface and groundwater due to use of agrochemicals.
- Interference of migration routes of elephants.
- Increase in the level of crime due to increase in population in the area.
- Increased income generating opportunities due to introduction of sugarcane to outgrowers
- Interference with marine ecology.
- Increase in the risk of communicable diseases and human health due to increased population of workers and social interactions
- Increase in population due to influx of workers and labourers increasing pressure to social services, food and facilities.
- Increase in the volume of traffic due to project activities.
- Increase in income in the village will lead to youth resorting to prostitution, overdrinking and loss of morality.
- Benefits to the surrounding communities resulting from employment and other economic activities linked to the project.
- Increased resource use conflicts, particularly land and water
- Loss in the village workforce to the project,
- Loss of rights to land resources especially cultivation, grazing and settlement, within Razaba Ranch.
- Food insecurity due to sugarcane cultivation on land used for food production

Decommissioning Phase:

- Soil erosion due to run off effects and loosened top soil due the removal of sugarcane,
- Changes in the scenic quality and in view shade due to removal of sugarcane.
- Loss of employment and income to workers, local economy and the nation
- Change in life style and quality of workers due to loss of employment

PROJECT ALTERNATIVES

The following alternatives have been considered.

No project: The no project option entails retaining the current *status quo* without a biofuel project. Adopting this option would mean avoiding most of the negative impacts associated with the project in Bagamoyo District such as excessive use of water, emissions to air and water and the impairment of biodiversity. This option will also entail missing all the positive benefits such as increased revenue, better and quality services, increased, introduction of a new cash crop and employment opportunities. Further more, through the stalled displacement of fossil gasoline and diesel, a cessation of the project would imply increased CO₂ emissions from transport corresponding to amount of gasoline not displaced. The plantation represents a carbon sink which will be renewed and represent some carbon savings. In the absence of the project, the sugarcane plantation, which is a carbon sink will not be available.

Relocation of sugar cane plantation: It is relatively difficult to find 15,000 to 30,000 ha plots of land near a source of surface water in Tanzania that are not already inhabited. Most of these areas are legally occupied and the developer is faced with an arduous compensation process that could take years to and where the total cost is not known. Neither of these conditions is conducive for the investment.

Relocation of the processing plant: The project is a pilot plant for a large number of projects planned to be set up in the Rufiji and Kilwa districts. The plant could be relocated there, but would suffer from the present lack of infrastructure and raw material. The processing plant should be placed close enough to the biofuel raw material as to minimize field to plant transportation.

Alternative Technologies: The project, both in itself and as a precursor to the rollout of the vision of a 400 000 hectare Biofuels Cluster, has a potential to increase rural employment, contribute to the security of supply of vehicle fuels in Tanzania.

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Table 1 summarizes the environmental and social management plan for the identified impacts.

Table 1: Environmental and Social Management Plan

Identified Impact	Enhancement Measures	Responsible Institution	Time of mitigation	Estimated Relative cost (US\$)
Enhancement measures of positive impacts associated with establishment of bioethanol production project				
Change in life style	-Awareness on savings schemes -Provide on job training to workers	Developer/Contractor	During bioethanol project establishment	-
Change in Employment level	-Recruitment to consider local communities. -Employment should be on equal opportunities for both gender -On job training.	Developer/Contractor	During bioethanol project establishment	Low US\$ (3,000)
Economic benefit to local communities	-Formulation of specific strategies for linking the project development with local economy (fishing, agriculture, livestock) - Ensure good governance pertaining to mechanisms of benefit sharing. - Provision of extension services to contracted and individual sugarcane outgrowers	-Bagamoyo District Council - Developer/Contractor	During bioethanol project establishment	Medium US\$ (5,000)
Enhancement measures associated with operation phase				
National policies	-Government to introduce labour laws that will compel developers to employ local staff with relevant qualifications. -Provide conducive environment and infrastructure development of more bioethanol projects	MNRT ME-VPO Development partners	-	
Change in life style and quality of life	-Provide awareness to workers to initiate income generating activities and SMEs. -Encourage establishment of SACCOS at work place. -Provide on job training.	-Developer -Workers	During operation	Medium US\$ (5,000)

Identified Impact	Enhancement Measures	Responsible Institution	Time of mitigation	Estimated Relative cost (US\$)
Increase in levels of employment	-Recruitment to consider local communities. -Employment should be on equal opportunities for both gender -On job training. -Encourage establishment of SACCOS at work place.	-MNRT -MLYD -Developer -Workers	During operation and beyond.	Low US\$ 3000
Level of benefit to national economy	-Ensure different and efficient taxes collection systems.	-MoF (TRA) -Developer MNRT , MAFS	During operation and beyond	Medium US\$ 5,000
Economic benefits to local communities	-Communities to be encouraged to produce quality goods (agricultural, livestock products) -Government to be encouraged to apportion a certain amount of tax from these development activities to benefit the relevant district. -Ensure good governance and accountability pertaining to mechanisms of benefit sharing.	Bagamoyo District Community Development Office NGOs/CBOs Developer MNRT, MAFS	During Operation	Medium US\$ 5,000 per annum
Enhancement Measures for positive impacts associated with decommissioning				
Compliance with national policies and laws	-Ensure mitigation measures for decommissioning are effectively implemented.	-Developer -NEMC, Bagamoyo District Council	During decommissioning phase.	Medium US\$ 5,000

ENVIRONMENTAL AND SOCIAL MONITORING PLAN

The monitoring schedule for the proposed BioEthanol production in Bagamoyo is summarized in Table 2 below;

Monitoring of Social and Environmental Enhancement Measures						
S/N	Identified positive impacts	Enhancement measure	Responsibility for monitoring	Time and frequency of monitoring	Indicators	Estimated costs (US\$)
1.	Change in life style and quality of life	-Awareness on serving schemes -On job training, -Reasonable wages/salaries	-Developer -Bagamoyo District Council -NEMC	Through out the life of the project, once every year to monitor change.	-Number of workers trained on job -Type of skills acquired - Proxy indicators for changes in life style such as quality of houses improved diets, more time for leisure, and schooling for children, asset ownership - Per capita availability of clean potable water - Number of interaction channels designed for local communities to participate and influence decision-making	Low 5,000 per annum to be covered by Bagamoyo District
2	Change in employment levels	-Recruitment to consider local communities -Equal opportunities to all gender -On job training -Formation of SACCOS at work place.	-Developer, Bagamoyo district Community Development Office -NEMC -MLYD -MNRT	Once every year throughout the life of the project	-Number of employees from local community -Employment levels by gender disaggregating -SACOOS formed and operating - Number of households with individuals employed in the Razaba Farm	Low 5,000 to be covered by developer
3	Economic benefit to local communities	-Strategies to link project development with local economy -Good governance in benefit sharing	-Bagamoyo District Council -NEMC -MNRT	Once every year throughout the life of the project	-% change of household income derived from Razaba Farm activities _Strategies developed and used Good _Governance practices developed and used -Local products sold to the project and others (values calculated over time) - Number of investment programmes for improvement of social infrastructure - Number of training programmes planned for the willing out-growers - Number of opportunities/avenues available for local communities to mobilize resources that are required to improve livelihoods and	Low 10,000 to be covered by government

Monitoring of Social and Environmental Enhancement Measures						
S/N	Identified positive impacts	Enhancement measure	Responsibility for monitoring	Time and frequency of monitoring	Indicators	Estimated costs (US\$)
4	Level of benefits to national economy	- Introduce efficient tax collection system -Promote product diversification	-MOF (TRA) -MNRT	During Operation and throughout the life of the project	resource management -efficient tax collection systems introduced and used --Conservation measures developed and applied - Quantity of bioethanol exported sold locally	To be covered by Government
5	Support to National Policies	-Policies for employment of qualified local personnel -Strategies linking project development and local economy	-MNRT, ME- VPO, - Bagamoyo District Council	During Operation and throughout the life of the project	-Policies developed and applied -Strategies developed and applied	cost to be born by Government

Monitoring of Social and Environmental Impact Management Measures.

	Identified negative impacts	Mitigation measure	Responsibility for monitoring	Time and frequency of monitoring	Indicators	Estimated costs (US\$)
6	Loss of Biodiversity	- Careful planning and conservation of belts of natural vegetation between sugarcane fields. - Provide specific protection measures for existing habitats for endemic species such as the cycad tree (<i>Encephalartos hildebrandtii</i>). - Protect existing water sources and maintain a 60 m wide river bank buffer zone as stipulated in EMA. - Limit clearing on the core areas only. - Maintain some wildlife dispersal areas and/or corridors. - Proper choice and application	Developer/Contractor MNRT, Department of Environment - VPO	Once per year during bioethanol project establishment and operation	- Continued use of wildlife corridors and wildlife dispersal areas - Elephant numbers visiting the project area and adjoining areas - Trends in wildlife-human conflicts (number of incidents, problem animal species, level of destruction) - Trends in hunting activities in nearby areas - Number of individuals or - reproduction success of specific endemic, rare or threatened plant species e.g. cycad tree and African ebony species. - Changes in freshwater flora and fauna of natural and artificial ponds and water reservoirs - Bird species richness and abundance - Other fauna and wildlife species richness and abundance	

Monitoring of Social and Environmental Enhancement Measures						
S/N	Identified positive impacts	Enhancement measure	Responsibility for monitoring	Time and frequency of monitoring	Indicators	Estimated costs (US\$)
		of herbicides and fertilizers. - Formulate special measures to support the protection of the coastal mangrove ecosystem.				
7	Land expropriation	- Effect compensation based on land users rights to the area effected in collaboration with the local land management and administration authorities - Exercise vigilance and watchfulness against encroachment to the project site	Developer Bagamoyo District Council	During sugarcane plantation establishment and bioethanol plant construction	Number of compensation plans to address dislocations associated with the Project's activities	
8	Change in surface and ground water quality	- Use efficient irrigation techniques - Provide a contingency plan for containing oil/fuel, spillage and leakages - Practice good house keeping within material storage compounds or vehicle maintenance yards	Developer/Contractor	At least thrice a year during bioethanol project establishment and operation	-Incidences of diseases associated with water quality -Change in specie diversity - Changes in observed values of priority parameters such as Turbidity, pesticide, fertilizers, nitrogen, phosphorus, salinity.	
9	Soil erosion	- Concentrate construction activities within the site of the distillery - Plant indigenous species in disturbed areas not meant for sugarcane plantation and construction of the distillery	Developer/Contractor	During sugarcane plantation establishment and bioethanol plant construction	- Gullies, run off	Low 5,000
10	Air, noise and vibration pollution	- Chose proper type of plant and machinery (i.e. fitted with noise silencers and dust reducers) - Sprinkle water periodically on working sections	Developer/Contractor	During sugarcane plantation establishment and bioethanol plant construction	- Air pollutants, noise and vibration levels	

Monitoring of Social and Environmental Enhancement Measures						
S/N	Identified positive impacts	Enhancement measure	Responsibility for monitoring	Time and frequency of monitoring	Indicators	Estimated costs (US\$)
11	Reduction in water quantity	-Use water more efficiently (drip irrigation), - Drilling of boreholes to supplement water supply - Allocation water rights in relation to water availability - use revenues accrued from taxes from the project to expand water supply services - Water abstraction from Wami River and Ruvu River should take into strict consideration the environmental flows	Developer/Contractor Wami/Ruvu Basin Office, Bagamoyo District Council	Monthly during bioethanol project establishment and operation	- Monitoring of flows in Wami River and Ruvu River - Monitoring of seasonal fluctuations of groundwater levels in relation to borehole pumping	
12	Compatibility with International Conventions	-Adhere to national and international conventions	-Developer -NEMC, MNRT	During bioethanol project establishment and operation	-	Low 2000
13	Increased incidences of diseases and ill health	-Provide awareness to workers on pathways for HIV/AIDS and other diseases -Provide protective gear	-NEMC -Bagamoyo District Medical Officer, Village health centre	Once every year during operation	-Number of cases reported -Number of awareness programs and workers involved	Low 5,000 per annum
14	Food insecurity	- Assist employees and surrounding communities in food crop production through provision of farm inputs - Encourage traders to supply food in the district from other sources through eliminating check points and unnecessary levies.	Developer Bagamoyo District Councils	At least two times per year during bioethanol project establishment and operation	- Acreage for food production per household - Food prices - Food production	

Monitoring of Social and Environmental Enhancement Measures						
S/N	Identified positive impacts	Enhancement measure	Responsibility for monitoring	Time and frequency of monitoring	Indicators	Estimated costs (US\$)
Monitoring of Social and Environmental Impact Management Measures during Decommissioning Phase						
	Identified negative impacts	Mitigation measure	Responsibility for monitoring	Time and frequency of monitoring	Indicators	Estimated costs (US\$)
15	Soil Erosion	Plant indigenous trees	-Developer, -NEMC as per EMA	Once during decommissioning	Site restored to original condition	High 15,000 to be covered by developer
16	Change in life style and quality of life	-Awareness on investment opportunities Bagamoyo District Council	-Developer	During decommissioning	Awareness programmes offered and number of workers involved	Low 2,000

RESOURCE EVALUATION OR COST BENEFIT ANALYSIS

Benefits related to the project:

- The proposed project will generate employment opportunities during establishment and operation, which may be filled by local people with relevant skills. From employment, workers will gain incomes that will improve their quality of life and perhaps change their life style and although it is not clear for now how much will be paid to each worker and for each qualification.
- The project is introducing a new cash crop in the area. This is a significant move given the fact that cashew nuts market and production is declining. Introduction of sugarcane out-growers is likely to increase among farmers.
- The project will also generate revenue to the Government in the form taxes and levies including Value Added Tax (VAT).
- Local and national economy in the form of supply of materials for the project, transport, agriculture and livestock goods and services, and, taxes and levies that the Tanzania Revenue Authority (TRA) will be collected from various services.

Benefits related to the nation:

- The proposed project will introduce a significant capital investment in renewable bioenergy production into an underdeveloped geographical region, resulting in sizeable employment creation, increased socio-economic development, domestic production of renewable electricity, increased export potential and improved balance of trade.

Benefits related to the world:

- The proposed project will establish the first large scale renewable bioenergy project in Tanzania, which will demonstrate the valuable contribution Africa can make towards the global climate challenge by leading the way for sustainable biofuel production.

DECOMMISSIONING

There is not yet an actual time frame that is set for decommissioning but in the event it is done, the developer will have to close it from use and rehabilitate the site back to its original environmental status by doing the following:

- Demolition of all unwanted infrastructure, including any barriers hindering wildlife movement if present
- Remove all debris, waste, scrap from project area to safe or appropriate disposal
- Remove all introduced plant species to the project area
- Engage in intensive habitat restoration programme to bring the area to its original state
- Allow natural regeneration of vegetation in disturbed areas

CONCLUSION

Although there are some limited negative environmental implications of the project, the project will have significant socio-economic and environmental benefits to the people of communities surrounding the project, Bagamoyo District and the Nation. The associated negative impacts, to a large extent have been minimized through good project design and envisaged farm operation practices. Specific mitigation measures have been suggested in this report to offset some of the inherent adverse impacts especially those linked to ecological and groundwater pollution. Implementing these mitigation measures would increase environmental soundness of the project on biofuel development. The overall conclusion of this EIA is that the construction and operation of the ethanol plant, in and of itself, will not create major irreversible environmental hazards. The focus will be on mediation measures to mitigate the negative environmental consequences of 20,000 ha of irrigated sugar cane production on previously uncultivated land.

It is, therefore, concluded that, implementation of the proposed Biofuels production in Bagamoyo District will entail no deterrent impacts provided that recommended mitigation measures are put into place in an adequate and timely manner.

SEKAB has expressed its commitment to implementing all the recommendations given in this EIA and further carrying out internal and external environmental auditing and monitoring schedules to ensure project sustainability with least negative impact on the social, economic and ecological environment.

ACKNOWLEDGEMENT

The EIA Study Team, on behalf of SEKAB BioEnergy Tanzania Limited (SEKAB BT), wishes to extended sincere thanks to everyone who supported this study in one way or another. We would specifically like to acknowledge invaluable assistance, candid support and hospitality extended by the officials of Bagamoyo District Council, Ward and Village leaders as well as residents of the project area. To all of you we say thank you very much, *Asante Sana!*

ACRONYMS

BOD	Biochemical Oxygen Demand
CBOs	Community Based Organisations
DED	District Executive Director
DED	District Executive Director
EIA	Environmental Impact Assessment
EMA	Environment Management Act
MNRT	Ministry of Natural Resources and Tourism
MoF	Ministry of Finance
EMP	Environmental Management Plan
NGO	Non Governmental Organization
URT	United Republic of Tanzania
SACCOs	Savings and Credit Cooperatives
SME	Small and Medium Enterprises
TIC	Tanzania Investment Centre
TRA	Tanzania Revenue Authority
USAID	United States Agency for International Development
VAT	Value Added Tax
VEO	Village Executive Officer
VPO	Vice President's Office

TABLE OF CONTENTS

STUDY TEAM	I
EXECUTIVE SUMMARY	II
ACKNOWLEDGEMENT	XXIII
ACRONYMS	XXIV
TABLE OF CONTENTS	XXV
LIST OF TABLES.....	XXX
LIST OF FIGURES.....	XXXI
LIST OF PLATES.....	XXXII
1.0 INTRODUCTION.....	1
1.1 PROJECT JUSTIFICATION AND BACKGROUND	1
1.2 OBJECTIVES OF THIS EIA	2
1.3 STUDY METHODOLOGY.....	2
1.3.1 Public participation.....	3
1.3.2 Direct Observation	3
1.3.3 Specialist studies.....	4
1.3.4 Criteria for significance determination	5
1.4 ASSUMPTIONS AND LIMITATIONS.....	5
1.5 SCOPE OF THE STUDY	6
2.0 PROJECT BACKGROUND AND DESCRIPTION.....	10
2.1 PROJECT BACKGROUND	10
2.2 PROJECT AREA.....	10
2.3 SUGARCANE FARM DEVELOPMENT	11
2.3.1 Irrigation of Sugarcane Plantation.....	11
2.3.2 Water Rights and Other Users:	14
2.3.3 Crop Water Requirements and Irrigation Demand	14
2.3.4 Bulk Water Supply Requirements and Distribution Options.....	16
2.4 ETHANOL PROCESSING PLANT	17
2.5 STAFF AND SUPPORT	19
3.0 POLICY, LEGAL ADMINISTRATIVE FRAMEWORK.....	20
3.1 SECTORAL POLICIES.....	20
3.1.1 National Environmental Policy (1997).....	20
3.1.2 The Wildlife Policy of Tanzanian (1998).....	20
3.1.3 National Forestry Policy (1998).....	22
3.1.4 The National Water Policy (2002).....	23
3.1.5 National Gender Policy (1999).....	23
3.1.6 The National Energy Policy (2003).....	23
3.1.7 National Land Policy of (1995).....	24
3.1.8 Agriculture and Livestock Policy (1997).....	25
3.1.9 The National Investment Promotion Policy (1996).....	25
3.1.10 The National Science and Technology Policy for Tanzania	26
3.1.11 Sustainable Industrial Development Policy-SIDP (1999-2020), 1996	26
3.1.12 National Transport Policy (2003).....	26
3.2 LEGAL FRAMEWORK	27
3.2.1 Environmental Management Act No. 20 of 2004.....	27
3.2.2 National Environmental Impact and Auditing Regulations (2005)	27
3.2.3 The Village Land Act No. 5 of 1999.....	28

3.2.4	<i>Land Use Planning Commission Act of 1984</i>	28
3.2.5	<i>Land Act (1999)</i>	28
3.2.6	<i>Sugar Industry Act (2001)</i>	29
3.2.7	<i>The Food Security Act, 1991</i>	29
3.2.8	<i>The Land Acquisitions Act of 1967 and the Land Ordinance</i>	29
3.2.9	<i>Forest Act (2002)</i>	29
3.2.10	<i>The Water Utilization (Control and Regulation) Act (1974) as amended in 1981</i>	30
3.2.11	<i>Energy and Water Utilities Regulatory Authority Act (2001)</i>	30
3.2.12	<i>Occupation Health and Safety Act (2003)</i>	31
3.2.13	<i>Industrial and Consumer Chemicals Act (2003)</i>	31
3.2.14	<i>Other Laws</i>	31
3.2.15	<i>Measures and regulations related to sustainable agricultural development</i>	31
3.2.16	<i>Tanzanian Environmental Standards</i>	32
3.3	STRATEGIES/PROGRAMMES	33
3.3.1	<i>The National Strategy for Growth and Reduction of Poverty (NSGRP)</i> ,.....	33
3.3.2	<i>The Tanzania Development Vision 2025</i>	33
3.3.3	<i>National Environment Action Plan (NEAP, 1994)</i>	33
3.3.4	<i>Agriculture Sector Development Programme (ASDP, 2003)</i>	34
3.3.5	<i>Rural Development Strategy (RDS, 2001)</i>	34
3.4	INSTITUTIONAL FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT	35
3.4.1	<i>Overall management responsibility</i>	35
3.4.2	<i>National Environmental Advisory Committee</i>	35
3.4.3	<i>Minister Responsible for Environment</i>	36
3.4.4	<i>Director of Environment</i>	36
3.4.5	<i>National Environment Management Council (NEMC)</i>	36
3.4.6	<i>Sector Ministries</i>	37
3.4.7	<i>Regional Secretariat</i>	38
3.4.8	<i>Local Government Authorities</i>	38
4.0	BASELINE OR EXISTING CONDITIONS	40
4.1	OVERVIEW OF BAGAMOYO DISTRICT	40
4.1.1	<i>Location</i>	40
4.1.2	<i>Climate: Temperature and Rainfall</i>	40
4.1.3	<i>Population</i>	40
4.1.4	<i>Social and infrastructural services</i>	40
4.2	EXISTING PHYSICAL CONDITIONS SURROUNDING THE PROJECT AREA	41
4.2.1	<i>The Physical Features</i>	41
4.2.2	<i>The Climate: Rainfall and Temperature</i>	43
4.2.3	<i>Water Resources</i>	44
4.2.4	<i>Biological Environment</i>	49
4.2.5	<i>Agro-ecological suitability for Sugar Cane production</i>	57
4.3	SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT	58
4.3.1	<i>The History of the Razaba Area</i>	58
4.3.2	<i>Current Land Use Pattern in the Former Razaba Ranch</i>	59
4.3.3	<i>Demography of Adjacent Villages</i>	62
4.3.4	<i>Economic Activities in Adjacent Areas</i>	63
4.3.5	<i>Physical and Social Infrastructure</i>	64
5.0	STAKEHOLDER INVOLVEMENT	67
5.1	STAKEHOLDERS IDENTIFIED	67
5.2	SPATIAL, TEMPORAL AND INSTITUTIONAL BOUNDARIES OF THE PROJECT	67
5.2.1	<i>Institutional boundaries</i>	67
5.2.2	<i>Temporal boundaries</i>	68
5.2.3	<i>Spatial boundary</i>	68

6.0 IDENTIFICATION AND ASSESSMENT OF IMPACTS AND MITIGATION MEASURES

69

6.1	INTRODUCTION.....	69
6.2	IMPACT IDENTIFICATION	69
6.3	IMPACTS ASSOCIATED WITH THE SUGARCANE PLANTATION ESTABLISHMENT AND BIOETHANOL PLANT CONSTRUCTION PHASE	69
6.4	IMPACTS ASSOCIATED WITH OPERATION PHASE	70
6.5	IMPACTS ASSOCIATED WITH DECOMMISSIONING PHASE	70
6.6	IMPACTS ASSOCIATED WITH THE SUGARCANE PLANTATION ESTABLISHMENT AND BIOETHANOL PLANT CONSTRUCTION PHASE	71
	<i>Positive Impacts</i>	71
6.6.1	<i>Support to National Policies and Laws</i>	71
6.6.2	<i>Changes in the level of employment</i>	71
6.6.3	<i>Enhancement and changes in lifestyle and quality of life</i>	71
6.6.4	<i>Benefits to community and local economy</i>	72
6.6.5	<i>Compatibility with international conventions</i>	72
	<i>Negative Impacts</i>	72
6.6.7	<i>Loss of Biodiversity</i>	72
6.6.8	<i>Change in water quality</i>	73
6.6.9	<i>Soil Erosion</i>	74
6.6.10	<i>Air, noise and vibration pollution</i>	74
6.6.11	<i>Land expropriation</i>	74
6.7	IMPACTS ASSOCIATED WITH OPERATION PHASE	75
	POSITIVE IMPACTS.....	75
6.7.1	<i>Support to National Policies and Laws</i>	75
6.7.2	<i>Changes in the level of employment</i>	75
6.7.3	<i>Changes in life style and quality of life</i>	75
6.7.4	<i>Benefits to community and local economy</i>	75
6.7.5	<i>Compatibility with international conventions</i>	76
	<i>Negative Impacts</i>	76
6.7.6	<i>Interference with Marine Ecology</i>	76
6.7.7	<i>Interference with Elephant Migration Routes</i>	76
6.7.8	<i>Change in Water Quantity</i>	79
6.7.9	<i>Change in Water Quality</i>	81
6.7.10	<i>Soil erosion, water logging or salinity from irrigation</i>	82
6.7.11	<i>Air Pollution</i>	83
6.7.12	<i>Food Insecurity</i>	84
6.7.13	<i>Water Pollution from ethanol production plant</i>	85
6.7.14	<i>Air Quality change</i>	90
6.7.15	<i>Noise and Vibration Pollution</i>	91
6.7.16	<i>Changes in level of crime and in population size</i>	91
6.7.17	<i>Increased incidences of diseases and ill health</i>	92
6.7.18	<i>Increased pressure on social services</i>	92
6.8	IMPACTS ASSOCIATED WITH DECOMMISSIONING PHASE	92
6.8.1	<i>Impairment of aesthetic value</i>	92
6.8.2	<i>Air, water and soil pollution</i>	92
6.8.3	<i>Loss of employment</i>	93
6.8.4	<i>Change in life style and quality of life</i>	93
6.9	IMPACT EVALUATION.....	93
6.10	<i>Analysis of Impact significance</i>	93
7.0	PROJECT ALTERNATIVES.....	98
7.1	OVERVIEW	98
7.2	NO PROJECT	98
7.3	RELOCATE THE PROJECT TO OTHER SITES	99

7.3.1	<i>Relocation of Sugar Cane Production</i>	99
7.3.2	<i>Relocation of the Processing Plant</i>	99
7.4	ALTERNATIVE TECHNOLOGIES	99
7.4.1	<i>Change of Feedstock Type</i>	100
7.4.2	<i>Technical Alternatives</i>	100
8.0	ENHANCEMENT AND MITIGATION MEASURES	102
8.1	ENHANCEMENT MEASURES	102
8.1.1	<i>Support to National Policies and Laws</i>	102
8.1.2	<i>Changes in the level of employment</i>	102
8.1.3	<i>Enhancement and changes in lifestyle and quality of life</i>	102
8.1.4	<i>Benefits to community and local economy</i>	102
8.1.5	<i>Compatibility with international conventions</i>	103
8.2	MITIGATION MEASURES	103
8.2.1	<i>Loss of Biodiversity</i>	103
8.2.2	<i>Land expropriation</i>	105
8.2.3	<i>Loss of biodiversity during clearing of the construction site</i>	105
8.2.4	<i>Change in water quality</i>	105
8.2.5	<i>Soil Erosion</i>	106
8.2.6	<i>Air, noise and vibration pollution</i>	106
	<i>Mitigation measures of impacts associated with Operation Phase</i>	106
8.2.7	<i>Interference with Marine Ecology</i>	106
8.2.8	<i>Interference with Elephant Migration Routes</i>	107
8.2.9	<i>Reduction in Water Quantity</i>	107
8.2.10	<i>Change in Water Quality</i>	108
8.2.11	<i>Soil erosion, water logging or salinity from irrigation</i>	108
8.2.12	<i>Food Insecurity</i>	109
8.2.13	<i>Water Pollution</i>	109
8.2.14	<i>Air Quality change</i>	111
8.2.15	<i>Noise and Vibration Pollution</i>	111
8.2.16	<i>Changes in level of crime and in population size</i>	111
8.2.17	<i>Increased incidences of diseases and ill health</i>	112
8.2.18	<i>Increased pressure on social services</i>	112
	<i>Mitigation of Impacts associated with Decommissioning Phase</i>	112
8.2.19	<i>Impairment of aesthetic value</i>	112
8.2.20	<i>Air, water and soil pollution</i>	112
8.2.21	<i>Loss of employment</i>	113
8.2.22	<i>Change in life style and quality of life</i>	113
9.0	ENVIRONMENTAL AND SOCIAL IMPACT MITIGATION PLAN	114
9.1	IMPACT MITIGATION PLAN	114
10.0	ENVIRONMENTAL AND SOCIAL MONITORING PLAN	119
10.1	OVERVIEW	119
10.2	MONITORING INDICATORS	119
10.2.1	<i>Ecological Indicators</i>	120
10.2.2	<i>Surface Water Quality and Availability</i>	121
10.2.3	<i>Socio Economic Indicators</i>	123
11.0	RESOURCE EVALUATION OR COST BENEFIT ANALYSIS	130
11.1	BENEFITS RELATED TO THE PROJECT	130
11.2	COSTS RELATED TO THE PROJECT	130
12.0	DECOMMISSIONING	132
13.0	SUMMARY AND CONCLUSION	133

13.1	SUMMARY	133
13.2	CONCLUSIONS	134
13.0	BIBLIOGRAPHY	136
14.0	APPENDICES.....	139
	APPENDIX 14.1: TERMS OF REFERENCE	139
	APPENDIX 14.2: LIST OF PERSONS CONSULTED	155

LIST OF TABLES

Table 2.1: Crop Water Requirement calculations for Bagamoyo Bioethanol Estate (10,500 ha)15

Table 2.2: Crop Water Requirement calculations for Bagamoyo Bioenergy Estate. (15,000 ha).....16

Table 4.1: Climatic Data for Razaba Farm.....44

Table 4.2: Water quality for samples taken from various locations at and around the Razaba Ranch and analysed at the Ardhi University, Environmental engineering laboratory, Dar es Salaam.....49

Table 4.3: Estimated wood volume as an indicator for Biomass.....52

Table 4.4: Wildlife species of conservation significance in Makurunge study area, Bagamoyo.....55

Table 4.5: Age structure of the population of Makurunge, Kidomole and Matipwili (%).....63

Table 6.1: Vehicles to be used at Bagamoyo during development phase (estimated figures)83

Table 6.2: Construction machines and equipments to be used during operational phase (Estimated figures)84

Table 6.3: Typical characteristics of the condenser effluents in a closed system operation.....87

Table 6.4: Impact Correlation Matrix for the proposed development of Bioethanol project in Bagamoyo.....95

Table 9.1: Plan for Implementation of Environmental and Social Enhancement Measures the proposed Bioethanol Project.....113

Table 9.2: Environmental and Social Impact Management Plan for Bioethanol Project.....115

Table 10.1: Important eco-geomorphologic indicators of river flow regime relevant for Lower Wami121

Table 10.2: Social and Environmental Monitoring Plan for Implementation of Enhancement options and mitigation measures for Bioethanol Project124

LIST OF FIGURES

Figure 1.1: The Razaba Area in Bagamoyo District.....7

Figure 1.2: Proposed Project Area.....8

Figure 1.3: Proposed Processing Plant Location.....9

Figure 2.1a: Water flow at Mandera during dry (drought) year.....12

Figure 2.1b: Water flow at Mandera during average year.....12

Figure 2.1c: Water flow at Mandera during wet year.....12

Figure 2.2: Proposed Processing Plant Location.....18

Figure 2.3: Overview of location of SEKAB BT Bagamoyo plant and Tanga harbor with rail network.....19

Figure 4.1: Population, Village centres and educational facilities in Bagamoyo District.....41

Figure 4.2: Geology Map of Razaba.....42

Figure 4.3: Razaba Soil Map43

Figure 4.4: Location of the Wami River sub-basin.....45

Figure 4.5: Wetlands system of Wami.....46

Figure 4.6: Water Sampling Points.....48

Figure 4.7: Vegetation types in the Project Area51

Figure 4.8: Variation of in abundance of the dominant species in the ranch.....52

Figure 4.9: Villages in Razaba and Sadani Areas.....62

Figure 6.1: Elephant movement in Makurunge and Saadani area78

Figure 6.2: Estimated daily irrigation water requirements for the SEKAB BT-sugarcane plantation in Bagamoyo80

Figure 6.3: Predicted modification of daily flows due to sugarcane irrigation water abstraction by the operational year 2009/1081

Figure 6.4: Waste streams from Ethanol Processing Facility.....88

LIST OF PLATES

Plate 4.1: Baobab tree in the northern Razaba landscape53

Plate 4.2: Razaba coastline during the low tide period57

Plate 4.3: cattle grazing in the Razaba area61

Plate 4.4: A typical open dug well in the project area65

1.0 INTRODUCTION

1.1 Project justification and background

World BioEthanol production and usage is growing very fast, with national legislation enforcing mandatory usage to meet climate change targets. In global terms, the European Union has the highest capacity and demand for uptake of fuel ethanol and the lowest production capacity. Sweden, as a leader in this development, has committed to be 50% fossil-independent by 2020. Energy efficiency and BioFuels are the key mechanisms to meet this challenging target however a key limiting factor is a lack of BioFuels on the market, coupled with a relatively low domestic production capacity in a medium time horizon.

While Sweden has a need for sustainable BioEthanol for fuel, Tanzania has the potential to become a large net exporter. In discussions with the Government of Tanzania the Swedish investor SEKAB has pointed out that a National BioEthanol and BioElectricity Platform based on 2 million hectares of land developed over the next 20-25 years, has the potential to deliver up to 16 billion litres of BioEthanol, additional 16 TWh BioElectricity and about five hundred thousand new jobs.

The key to unlocking this potential is to demonstrate commercial viability of large-scale Tanzanian production systems. Since the domestic market for BioEthanol is not large enough to activate this potential it has to be based on export. SEKAB offers to be part of this and the commercial development of agro-energy could extend the long history of development co-operation between Sweden and Tanzania from aid into trade, in the form of a sustainable and mutually beneficial business partnership.

SEKAB BioEnergy Tanzania Limited (SEKAB BT) is a company formed to develop large scale BioEnergy plants in Tanzania. The objective is to produce a number of plants, grouped together in blocks to form a cluster of up to 15 plants in order to create the critical mass needed to be able to carry such heavy investments. The plan includes development of a cluster in Rufiji and Kilwa area but the Razaba area in Bagamoyo district has been assessed to have good opportunities as an area for initial development.

The Bagamoyo BioEnergy Project located on parts of the former Razaba Ranch will be the first in the development of BioEthanol/BioElectricity projects in Tanzania. In Razaba, an estimated area of about 15,000 ha will be planted with sugar cane. Sugar cane yields are projected to be between 90 – 110 tons per ha, using available good technology and cane varieties. A seed cane nursery of 240 ha was established in 2007, about 500 ha of plantation will be developed in 2008 and the remaining will be developed in 2009-2011 ready for ethanol production in year 2010-2011. Outgrower capacity will be developed in parallel and is expected to add another 5,000 ha in 10 years time.

The justification to start in Bagamoyo is that it will provide an excellent learning ground for a full scale project, despite the limitation to only one factory. The proximity to Dar es

Salaam and better communication makes it easy to start and develop the concept while developing the cluster concept in Rufiji and Kilwa will require more time.

However, the current development policies in Tanzania require developers to carry out an Environmental Impact Assessment (EIA) for their proposed projects. This has become part of the project approval process for development projects in the country. SEKAB BioEnergy Tanzania approached ORGUT Consulting AB to conduct the EIA study. This study was conducted between November 2007 until February 2008.

1.2 Objectives of this EIA

The main objective of this EIA is to identify, predict and evaluate potential impacts of the proposed development of a BioEthanol Production from Sugarcane on the former Razaba Ranch project in Bagamoyo District, Tanzania and incorporate mitigation and/or enhancement measures into the designs, establishment, operation and decommissioning processes and ensure project sustainability with least negative impact on the social, economic and ecological environment. Specifically, the assessment would consider among other things, the following:

- Impact of the project on the environment
- Compatibility of project with national and sectoral policies;
- Potential impacts of the project on socio-economic of surrounding communities,
- Assessment of project alternatives
- Costs and benefits to developer, the local community, the nation and at international level
- Potential impacts of the project on the surrounding biodiversity;
- Mitigation options for negative impacts and enhancement options for positive ones;
- Environmental Management and monitoring issues related to the project.

1.3 Study Methodology

The Terms of Reference (ToR) that are attached in the **Appendix I** guided this EIA. The first activity in this EIA process was scoping. This early activity of the EIA process was intended to determine the scope and boundary of the study. Scoping helps to avoid unnecessary data collection, costs and subsequent production of unhelpful report. More specifically, scoping included the following activities:

- Determination of spatial, temporal and institutional boundaries of the project;
- Identification of main problems, constraints and issues associated with the project;
- Identification of the likely positive and negative impacts of the project;
- Identification of stakeholders and their concerns
- Identification of project alternatives.

In considering project alternatives, special attention was given to what would happen without the project (status quo). This information is useful in determining what the impacts of the project would be if the project is developed. The study provided an opportunity to identify and involve relevant and key stakeholders likely to affect or be affected by the project. Stakeholders here refer to all those people and institutions with interest in the design, implementation and sustainability of the project and include those that will be positively or negatively affected by the proposed development.

1.3.1 Public participation

Public participation was considered as an important element of the sustainable development process. In this EIA study various stakeholders participated. Broad consultations that involved local communities, village, ward and key district officials were carried out. During these consultations, the local communities had opportunity to air their concerns. The concerns of each group have been addressed in this EIA report.

During reconnaissance, the EIA team made physical observations, site specific visits (off- road sites) and interviews with stakeholders in the project area as well as meeting District officials and local government leaders in Bagamoyo District (Figure 1 and Appendix II).

The socio economic impact assessment involved obtaining views of key informers who in this study, happened to be the local leaders or representatives of the people. The study therefore adopted more of qualitative data collection techniques to get the required information. Meanwhile some quantitative information in this study was obtained through review of secondary data.

Physical visits and dialogue with key stakeholders was the main method followed in this EIA study for both scoping exercise and full EIA. Section 89 of the Environmental Management Act (EMA, 2004) provides directives on public participation issues and its importance in the EIA. EIA and Audit Regulation 17 (URT, 2005) provides further details and procedures for public participation in the EIA process.

In this report and the EIA process stakeholders included a broad definition and encompass all different government agencies, beneficiaries and all other formal or informal groups or individuals associated with a project. A checklist and semi-structured questionnaires was developed to collect data.

1.3.2 Direct Observation

Some facts were observed direct from the study area, which were useful for the study. Some of the observation has been derived from the existing social relations, profile of the area, available properties and assets as well as observable behavioural patterns. The

information obtained from this technique assisted the study team to have the starting point during one-to-one interviews with key informers for the purpose of verifications.

1.3.3 Specialist studies

Detailed specialist studies for collection of information on socio-economic situation, hydrology, biological phenomena, human settlements and natural resource use were conducted. The inventory of physical environment covered wildlife, habitats, flora and biomass and the siting/construction of the ethanol processing plant with its transport and byproduct impacts on the physical environment. Each specialist study contained a diagnostic survey or inventory and predictions of likely environmental and socio-economic impacts both positive and negative that can be attributed to the project.

The information collected during the field studies for establishment of the environmental baselines and served as the basis for ESIA recommendations included:

- General classification of plant ecosystems, forests and habitats (riverine, savannah, coastal, miombo woodland, protected area etc.) within and adjacent to the farm boundaries, GPS coordinates and digital maps
- Inventory of animal and plant populations: types and estimated density
- Diversity of animal communities and plant ecosystems, potential threats to diversity
- Critical Habitats or ecosystems, location and importance, GPS coordinates and digital maps
- Existing human population characteristics: density, age and gender composition, religious and ethnic affiliations, growth rates
- Human settlement characteristics, including services and infrastructure (roads, telecommunications, potable water, electricity, markets, etc.) in proximity to the Razaba farm, GPS coordinates and digital maps
- Local economic activities, in order of importance, with a special focus on employment opportunities in the formal and non-formal sectors and gender disaggregated income distribution
- Human health problems, in order of importance
- Incidence of Crime and/or violence, local conflicts
- Natural Resource Use at the household level, types and importance

- Water quality and availability
- Current land use or settlements on the farm

1.3.4 Criteria for significance determination

In this EIA impacts were considered to be significant if they met the following criteria:

- Are extensive over time and space
- Are intensive in concentration or proportion to assimilative capacity
- Exceed environmental standards or thresholds
- Do not comply with environmental policies, land use plans, sustainability strategy
- Adversely and seriously affect ecologically sensitive areas
- Adversely and serious affect other land uses and communities.

Ratings were used to determine level of impacts as follows:

+3	Very high positive impact
+2	High positive impact
+1	Minor positive impact
0	No impact
-1	Minor negative impact
-2	High negative impact
-3	Very high negative impact

Mitigation measures and enhancement options were proposed for impacts that were rated to be +2, -2 and above. The report provides information on mitigation and monitoring plan with details of responsibilities to ensure effective implementation of the mitigation measures as required by the EMA, 2004.

1.4 Assumptions and Limitations

This ESIA has been commissioned by the developer at a very early stage in the planning process. This has both distinct advantages and some disadvantages. The most obvious advantage is that the findings from the studies of potential adverse environmental effects can be dealt with by the developer already in the planning stages. It may be possible to mitigate potential adverse effects before they occur if technologies or other planning details are altered. The other side of the coin is that, because project planning is still at an early stage, some detailed information necessary to accurately predict impacts is not available.

It should be pointed out that there seem to be a number of common misconceptions about what “early on in the planning process” means. Some developers and national authorities would really like the answer to the question, is the proposed project a strategic investment? This type of question is better answered by feasibility studies and/or a Strategic Environmental Analysis (SEA). Nor is an ESIA a substitute for feasibility studies which answer the more specific questions of technical feasibility and return on investments and should be carried out by the developer prior to detailed planning of the activity.

1.5 Scope of the study

The ESIA focuses on the project area which is a parcel comprising a large portion of the former Razaba Ranch. (see Figure 1.1) The areas adjacent to the project area have been studied insofar as they are important to the future functioning of the project. Thus, to take one example, while inventories of flora and fauna restrict themselves to the project area, the identification of human activity and natural resource use in the surrounding areas is significant in terms of species protection, alternative migration routes, etc.

There is a great confusion as to what the “project area” actual entails. In this study we use the term to refer to the land concession that SEKAB BT has requested. The former Razaba Ranch is a larger area including this concession and the “Razaba area” refers to an even larger area comprised of the former Razaba Ranch and contiguous areas. (Figures 1.2 and 1.3)

As the ESIA focuses on the project area, it addresses questions of planned activities and their potential positive or negative impact. It does not deal, except in a superficial way, with strategic questions of whether or not bio-fuel development is an acceptable development strategy for Tanzania. The go-ahead for the project is dealt with as a given; the ESIA study details what the consequences of the project might be.

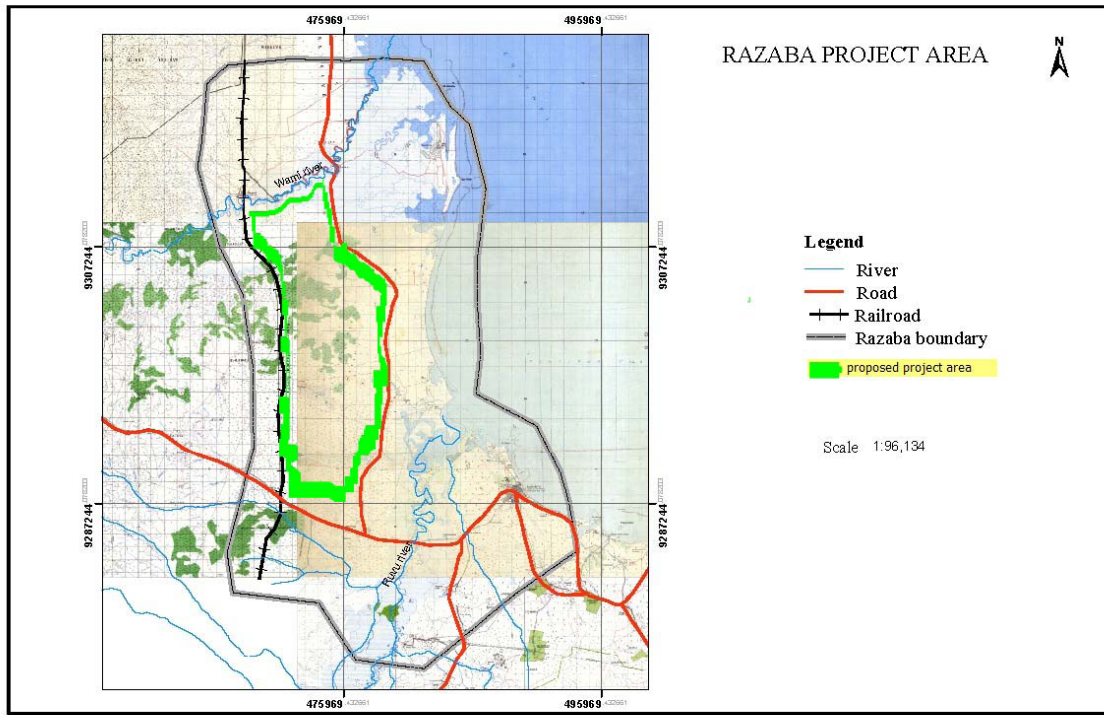


Figure 1.1: The Razaba Area in Bagamoyo District

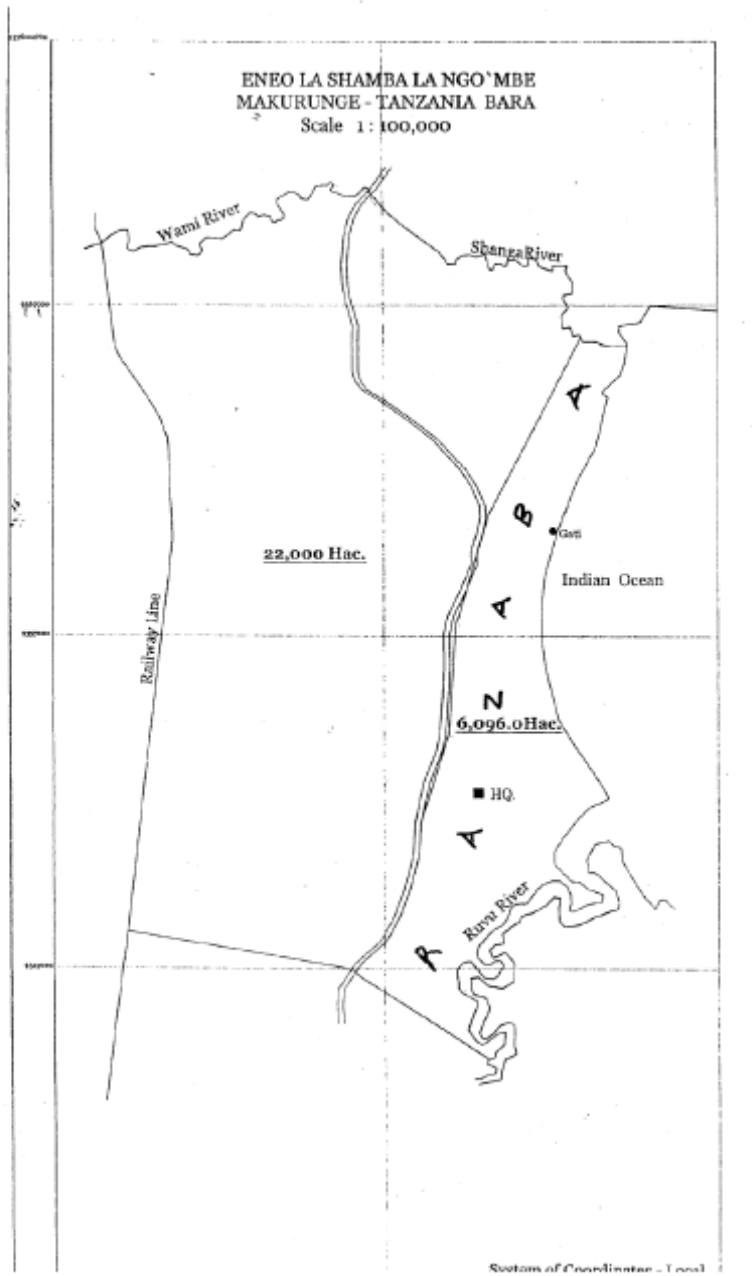


Figure 1.2: Proposed Project Area

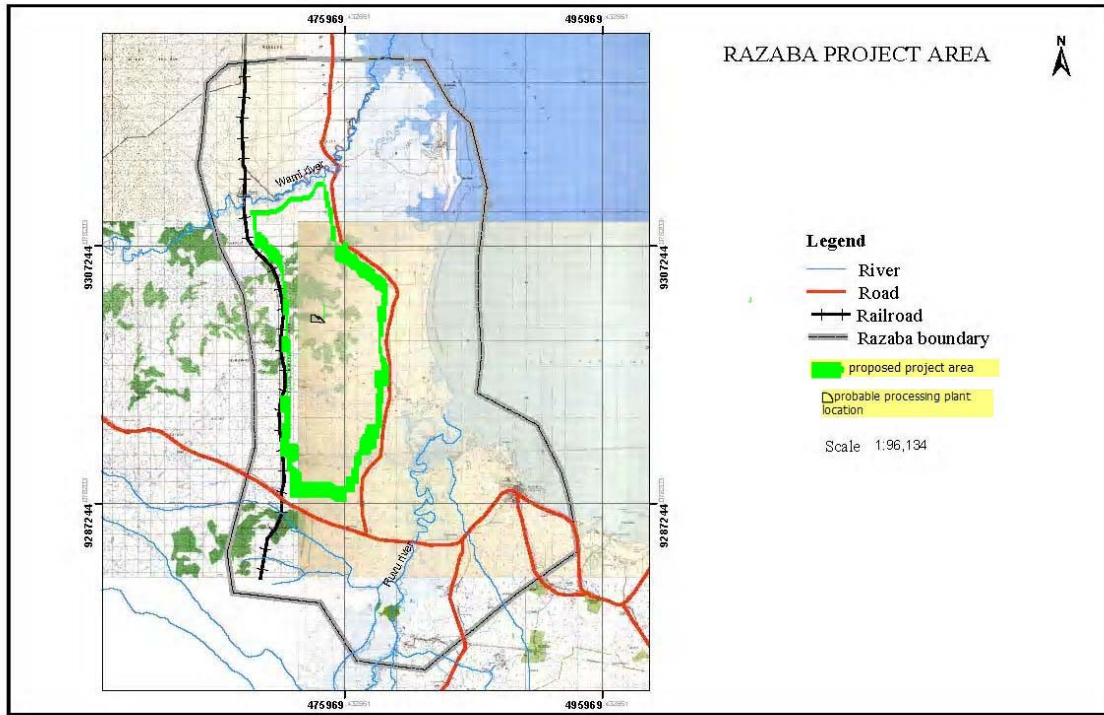


Figure 1.3: Proposed Processing Plant Location

2.0 PROJECT BACKGROUND AND DESCRIPTION

2.1 Project Background

SEKAB BioEnergy Tanzania Ltd, the proponent commissioning this ESIA, is a company formed following the signing of a Memorandum of Understanding between the Government of Tanzania and Swedish Ethanol Chemistry (SEKAB), BioAlcohol Fuel Foundation (BAFF), and Community Finance Company (CFC) to kick-start the development of a long term and sustainable BioEnergy platform in Tanzania. **Community Finance Company (CFC)** is a company fully owned by Tanzanians, focused on establishing a model for rural development in Tanzania by encouraging community-based farming.

Swedish Ethanol Chemistry AB (SEKAB) is a large producer and distributor of ethanol, representing 15% of the European and 75% of the Scandinavian ethanol markets, providing low blends, E85, ETBE, and bus fuels. SEKAB is owned by three Swedish public utility energy companies, namely Skellefteå Kraft, Örnköldsvik Energi, and Umeå Energi and the largest oil distributing company in Sweden OK, a cooperative owned by 1,6 million motorists, and private entities.

SEKAB and CFC have formed SEKAB BT BioEnergy Tanzania Ltd (SEKAB BT) to establish large-scale sustainable ethanol and electricity generation projects, which will support the development of a Tanzanian BioEnergy Industry generating major social and economical development. **SEKAB BT BioEnergy Tanzania Ltd (SEKAB BT)** is committed to implementing the first regional role-model cluster with up to 400'000 hectares under cultivation by rolling out a number of role-model projects (around 15'-30'000 hectares) phased in a series of development blocks (80'-100'000 hectares), initiating the first pilot project during 2007. This Environmental and Social Impact Analysis (ESIA) report is focused on the first of SEKAB BT's role model projects, the approximately 20,000 ha concession for irrigated sugar cane production and a BioEthanol processing plant located on the former Razaba Ranch in Bagamoyo District.

2.2 Project Area

The proposed SEKAB BT biofuel development Bagamoyo Bio-Energy Project is expected to lease land rights to all of the Razaba Ranch area to the west of the Makarunge-Sadani road (approx 20.000 ha) while most of the coastal strip to the east of the road will remain under the formal control of the Zanzibar Government. The Revolutionary Government of Zanzibar has already formally agreed to allocate 22,000 hectares of its former RAZABA ranch to SEKAB BT. SEKAB BT was informed of the Government decision to allocate the land in November 2007. In the year 2007, the Ministry of Lands, Housing and Human Settlements Development was instructed by the Government of Tanzania to survey the area and issue SEKAB BT with a title deed. SEKAB BT will be responsible for paying for the cost of: land surveying of the area; preparation of a title deed and paying compensation to the Revolutionary Government of

Zanzibar. The exact amount of compensation that is to be paid would be notified to SEKAB BT once the land surveying exercise has been completed.

2.3 Sugarcane Farm development

The project will be monoculture using Natal varieties which already exist in Tanzania e.g N19 and N25 but they will also plant some N30, N27, N32 and N41 for test. These are varieties developed at South Africa Sugar Cane Research Institute (SASRI) in South Africa. An estimated area of about 15,000 ha will be planted with sugar cane.

Sugar cane yields are projected to be between 90-110 tons per ha, using available technology and cane varieties. A seed cane nursery of 240 ha is being developed at present on a former prison farm south of Razaba and production will thus be increased annually by planting shares of the total area.

About 500 ha of plantation will be developed in 2008 and the remaining up to 15 000 ha will be developed in 2009 till 2010 ready for ethanol production in year 2011. Outgrower capacity will be developed in parallel and is expected to add another 5,000 ha in 10 years time. In full production, this implies the processing of over 2 million tons of harvested cane during the eight production months.

2.3.1 Irrigation of Sugarcane Plantation

The project is intending to use irrigation such as sub surface deep, center pivot and semi solid sprinkler types depending on the soil types technology. Drip irrigation is one of the most efficient technologies in terms of water use and uniformity. Drip irrigation, also known as *trickle irrigation* or *micro-irrigation* is an irrigation method that applies water slowly to the roots of plants, by depositing the water either on the soil surface or directly to the root zone, through a network of valves, pipes, tubing, and emitters, with the goal of minimizing water and fertilizer usage. It is becoming more widely used for row crop irrigation especially in areas where water supplies are limited or recycled water is used for irrigation. The project will use PVC pipes for the main pipelines and polyethylene in the laterals.

The planting will be done with a dual row system at 60 cm spacing on 200 cm permanent track spacing. The irrigation will be placed as a sub-surface irrigation in the centre of the planting bed. The irrigation equipment (PVC pipes for the main pipelines and poly ethylene in the Laterals) will be installed in blocks of about 200ha size and will have continuous supervision and recording of irrigation data for improvement of the system. Drain water from the farm will be directed into ponds (natural and/or management) and the water recycled back to irrigation ponds to optimize the use of irrigated water and minimize the leakage of nutrients and other substances to the surrounding waters.

According to SEKAB BT plans, the first 850 ha plot of the 15,000 ha sugarcane plantation is expected to start being irrigated from around June 2009. The daily maximum water requirement for this 850 ha plot is estimated at 0.59 m³/s. The irrigation expansion will continue over the following year until the full potential of the estate is developed. Water for irrigation will be drawn mainly from Wami River.

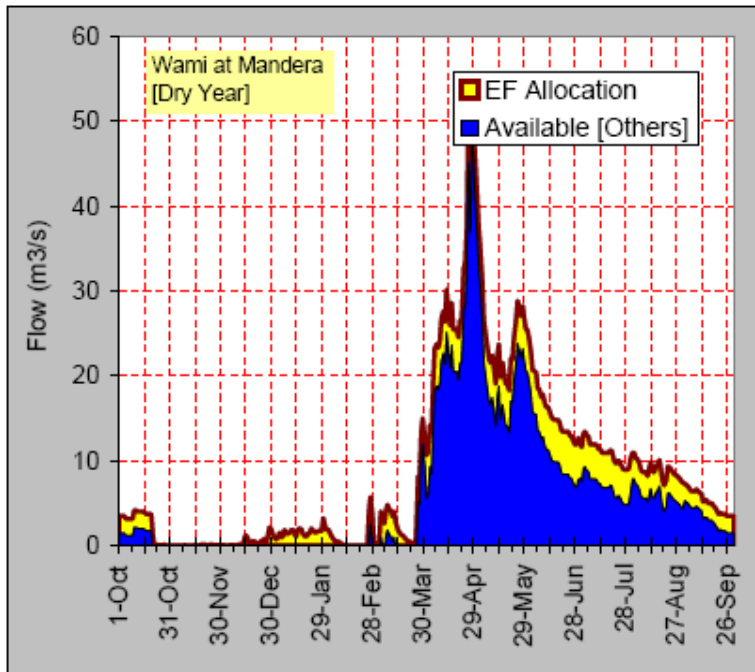


Figure 2.1a: Water flow at Mandera during dry (drought) year.

Source: Wami River Environmental Flow initiative – <http://wami.fiu.edu>

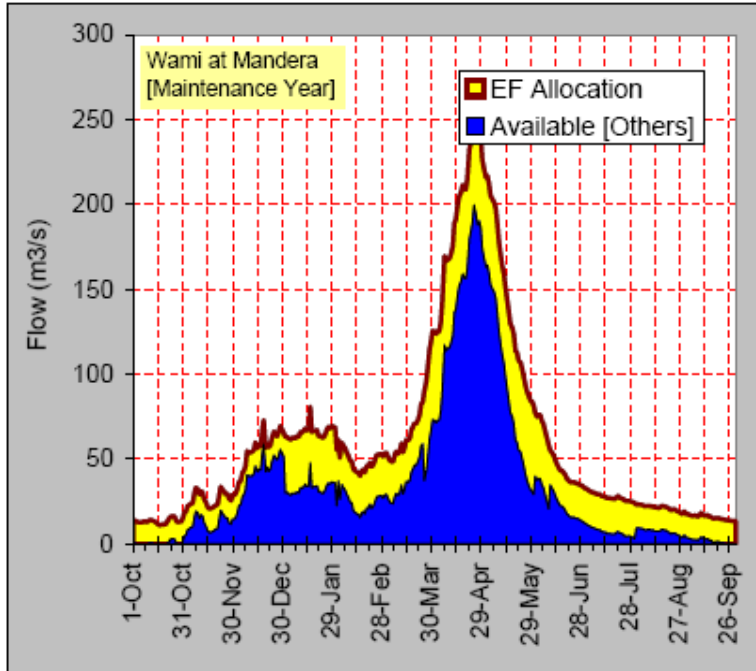


Figure 2.1b: Water flow at Mandera during average year.
Source: Wami River Environmental Flow initiative – <http://wami.fiu.edu>

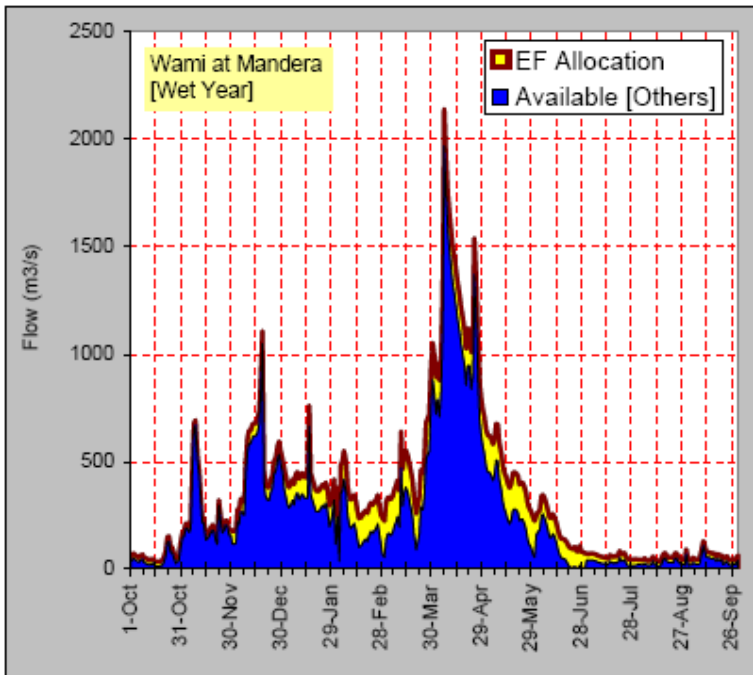


Figure 2.1c: Water flow at Mandera during wet year.
Source: Wami River Environmental Flow initiative – <http://wami.fiu.edu>

2.3.2 Water Rights and Other Users:

All water usage in Tanzania is governed by the National Water Sector Development Strategy (NWSDS, 2006). Water rights for the Bagamoyo BioEnergy Project (BBP) will be issued by the Wami Ruvu Basin Board. However the amount of water to be abstracted will be preceded by upstream users, many of whom have also applied to increase their abstractions from the Wami (Mtibwa Sugar Estate is the largest potential user).

Water availability for BBP will mainly be determined by upstream users and river hydrology. The BBP will affect downstream users towards the Wami discharge into the ocean at Sadaani. The Wami Ruvu basin Board has the full responsibility of ensuring water availability in the Wami, both for upstream users, BBP and water discharge into the ocean at Saadani. One preliminary study made by an interdisciplinary team of Tanzania experts supported by USAID to establish environmental flows in Wami River has recently been submitted to the Wami Ruvu basin Board and the Government of Tanzania for preliminary review. Figure 2.1 provides a visual representation of these flows during dry, average and wet years from one of the sites i.e. **Wami** River at Manderu. Figure 2.1 shows the relative amounts of water needed for environmental flow.

Allocations are indicated in (yellow), and then the amount of water that can be allocated for extractive uses are indicated in (blue).

Two important factors need to be outlined, as they directly relate to the way that rivers is to be managed.

- The first is that environmental flow recommendations differ between months of the year to mimic natural variations in flow.
- The second is that flow recommendations differ between dry, average (maintenance), and wet years, to account for intra-annual differences inherent to a river's natural flow regime.

These and many more studies in the future will be useful documents for establishing environmental water flows in the Wami River. The documents will also serve as important data bank for Wami Ruvu basin Board.

2.3.3 Crop Water Requirements and Irrigation Demand

Sugarcane crop water requirements depend on the harvesting season, due to the need to dry-off the crop to improve sucrose content at harvest. A 8-9 month harvest season was adopted for the BBP, commencing in June after the main rains, and ending in February. The short rainy season in December was not included as a project shutdown, and harvest operations may have to be delayed to reduce damage to wet soils. Crop water requirements for sugarcane in the BBP were calculated using the Penman-Monteith equation, from Dar es Salaam climate data and Bagamoyo rainfall. These results are outlined shown in Table 2.1 and Table 2.2.

Crop water requirements for sugarcane in the BBP were calculated using the Penman-Monteith equation, Dar es Salaam and Tanga climate data and Bagamoyo rainfall figures. The crop water requirement were then used for the calculation of the monthly water demand for irrigation. These results are outlined below for the estate when 10500 ha is under irrigation:

Table 2.1: Crop Water Requirement calculations for Bagamoyo Bioethanol Estate. 10,500 ha

Month	Irrigation demand (million m³/month)	Factory demand (million m³/month)	Domestic demand (million m³/month)	Total water abstraction demand (million m³/month)
January	9.9	0.5	0.6	11.0
February	11.6	0.5	0.6	12.6
March	9.1	0.5	0.6	10.2
April	0.5	0.5	0.6	1.6
May	0.5	0.5	0.6	1.6
June	9.8	0.5	0.6	10.9
July	10.7	0.5	0.6	11.8
August	10.8	0.5	0.6	12.0
September	12.1	0.5	0.6	13.2
October	9.1	0.5	0.6	10.2
November	7.5	0.5	0.6	8.6
December	5.6	0.5	0.6	6.7
Total demand (million m³/year)	97.2	6.1	7.2	110.6

Table 2.2: Crop Water Requirement calculations for Bagamoyo Bioenergy Estate.
15,000 ha

Month	Irrigation demand (million m ³ /month)	Factory demand (million m ³ /month)	Domestic demand (million m ³ /month)	Total water abstraction demand (million m ³ /month)
January	14.6	0.8	0.6	16.0
February	17.1	0.7	0.6	18.3
March	13.5	0.8	0.6	14.8
April	0.8	0.7	0.6	2.1
May	0.8	0.8	0.6	2.1
June	14.5	0.7	0.6	15.8
July	15.8	0.8	0.6	17.2
August	16.0	0.8	0.6	17.4
September	17.8	0.7	0.6	19.2
October	13.4	0.8	0.6	14.8
November	11.0	0.7	0.6	12.3
December	8.3	0.8	0.6	9.6
Total demand (million m ³ /year)	143.5	9.1	7.2	159.8

2.3.4 Bulk Water Supply Requirements and Distribution Options

Water demand by the whole estate will depend on the overall irrigated area developed. It is estimated that the overall area for BBP will be about **15,000 ha**.

- B Nursery** – along the south bank of the Wami River and approximately 700 ha in extent
- Main Estate** – the main section of Razaba ranch and 8000 ha in extent
- Block Wami (A)** – near the Wami river, west of the railway, and 1 800 ha in extent
- Block Ruvu (D)** – south of Razaba ranch and 1 300 ha in extent

Table in 2.1 and Table 2.2 show that overall estate water demand varies from month to month with the highest demand in February corresponding to 13,1 million m³ (5,3 m³/s) for 10 500 ha and 19,2 million m³ (7,7 m³/s) for 15 500 ha. Water demand for outgrowers have not been included in these estimates as these will decide themselves on where they will grow their cane-this might be close to Ruvu River or based on rainfed system. Harvesting at BBP is scheduled to take place every year after the main rains. A project shut down is planned for the short rainy season to reduce potential damage to the soils while these are softened by the rains.

As shown in all the graphs in Figure 2.1 Wami river flows are least reliable during the period of October – November. Bulk water demands during the initial BBP development will depend on development rate and sequences as well as the source of water for a

particular block. Demand during this development phase is expected to be lower than the above figures in tables 2.1 and 2.2.

Generally to reduce the abstraction during the low flow months on site reservoirs will be used to store harvest and to water from the month with high flows in the river when the Wami River has adequate quantities of water as per graphs in Figure 2.1. It is planned to fill up the reservoirs (water storage ponds) during the main rainy season in March to April to cater for the shortfalls in October to November.

2.4 Ethanol Processing Plant

The processing plant for bio-ethanol will be located approximately 6°19'30"S 38°46'11"E, at the former Razaba Ranch near Bagamoyo, approx. 80 km northwest of Dar es Salaam .

The ethanol processing plant will be in full operation for eight to nine months, approx July through February (early March). Then harvesting slows down (typically during March) as the rain period approaches. During the rain period, maintenance is carried out. This includes cleaning of vessels (chafs, coke) and replacement of worn parts.

Different parts of the plant may be operated different from the main cane-to-ethanol plant. Some other type of secondary biomass may be used to run the boilers to make electricity outside the harvesting season. During the semi-wet period, production will be lower and intermittent, leading to lower emissions

Ethanol will be produced during a 8-9 month harvesting period, the dry season. It is possible to extend this period by storing sugar juices or using molasses from sugar production produced at other sugar estates.

The processed ethanol will be stored on the industrial plant site however the ESIA study team did not have access to technical specifications of size and type of storage infrastructure. Nor was any specific information available on how the ethanol will be treated to prevent its use as alcohol for consumption.

Produced Ethanol will initially be exported. Ethanol fuel will be distributed for domestic use as a national market develops. The majority of the product will be exported by means of rail car and transferred onto tanker ships in the port of Tanga, approx 200 km north of Bagamoyo (Figure 2.3).

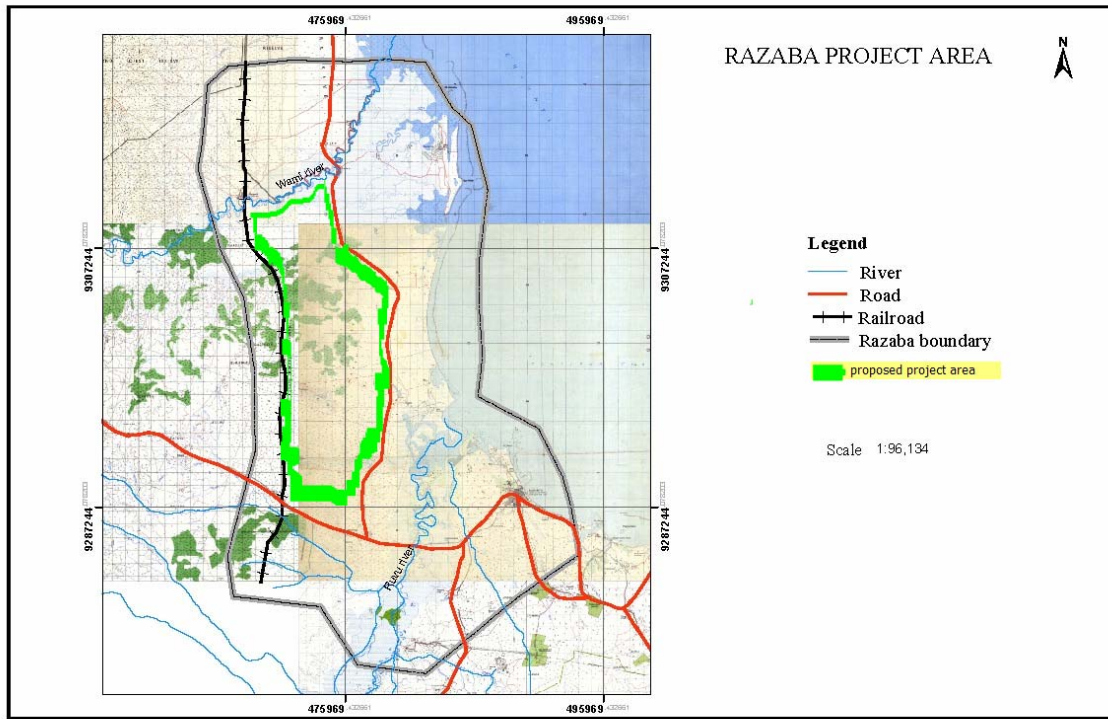


Figure 2.2: Proposed Processing Plant Location

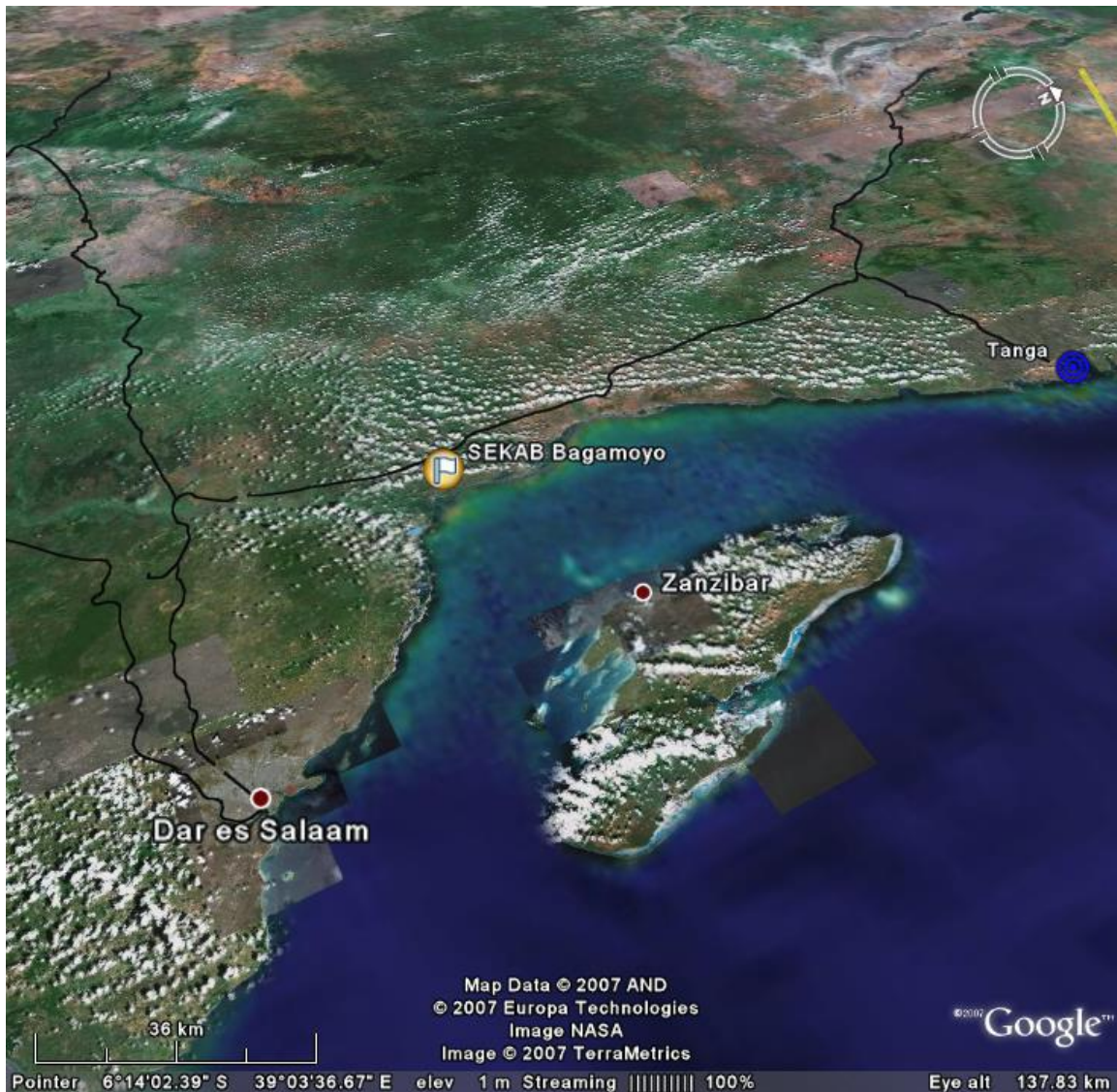


Figure 2.3: Overview of location of SEKAB BT Bagamoyo plant and Tanga harbor with rail network.

2.5 Staff and Support

It is estimated around 200 senior staff will work year round, most of whom with cultivation. A number of additional staff will work at the process plant and harvesting during the production season. Additionally, a limited number will work with administration.

3.0 POLICY, LEGAL ADMINISTRATIVE FRAMEWORK

3.1 Sectoral Policies

Tanzania is committed to attaining sustainable development goal. This urge is envisaged in the recent policy review and formulation processes to incorporate environmental management aspects in their lattice. Among others, the objective of these policies is to regulate the development undertaken within respective sectors so that they are not undertaken at the expense of environment. Some policies that are relevant to the proposed project are briefly analysed below;

3.1.1 National Environmental Policy (1997)

The environmental policy document seeks to provide the framework for making fundamental changes that are needed to bring environmental consideration into the mainstream of decision- making in the country.

The National Environmental Policy as a national framework for environmental management emphasized the sound management of the impacts of energy development and use in order to minimise environmental degradation. The objectives to be pursued pertaining to the energy sector are:-

- Minimisation of woodfuel consumption through the development of alternative energy sources and wood fuel efficiency;
- Promotion of sustainable renewable resources;
- Assessment and control of development and use of energy; and,
- Energy efficiency and conservation.

Since the proposed project aims at producing bioethanol (a renewable energy resource), therefore, it supports the implementation of this policy.

Regarding the agriculture sector, the environmental policy document emphasizes on strengthening of environmentally sound use of agrochemicals to minimise pollution of water, efficiency use of water in irrigation, soil erosion control and minimisation of encroachment in forests, woodlands, wetlands and pastures among others. Therefore, planning, designing and establishment of the sugarcane plantation for the proposed project should seriously take into consideration the provisions of the policy regarding the agriculture sector to minimise environmental impacts to the project area.

3.1.2 The Wildlife Policy of Tanzanian (1998)

The vision of the wildlife sector for the next 20 years conforms to the Development vision 2025 for Tanzania on sustainable environment and socio-economic transformation. Among others, the vision of the wildlife sector is to:

- Promote conservation of biological diversity;
- Administer, regulate and develop wildlife resources;

- Involve all stakeholders in wildlife conservation and sustainable utilization, as well as in fair equitable sharing of benefits;
- Promote sustainable utilization of wildlife resources; and
- Contribute to poverty alleviation and improve the quality of Tanzania.

The Wildlife Policy envisages addressing the following national challenges:

- To conserve areas with great biological diversity which are representative of the major habitats of Tanzania;
- To continue to support and where necessary, enlarge the protected area network as the core of conservation activities;
- To promote involvement of local communities participation in wildlife conservation in and outside the protected area network;
- To increase foreign exchange earnings;
- To integrate wildlife conservation with rural development;
- To foster sustainable and legal use of wildlife resources;
- To ensure that wildlife conservation competes with other forms of land use;
- To enhance the recognition of the intrinsic value of wildlife to rural people; and
- To minimize human-wildlife conflicts whenever it occurs

There is need to synchronize and implement strategies to protect and utilize wildlife, management and development of protected areas and promotion of international cooperation. In order to address the mentioned challenges above; among others, the strategies to be undertaken includes:

- Continue to establish the protected area on the basis of ecosystem planning;
- Stress maintenance and development of protected area network in order to enhance biological biodiversity.
- Promote conservation of wildlife and its habitat outside core areas by establishing wildlife management areas;
- Transfer for management of wildlife management area to local communities thus taking care of corridors, migration routes and buffer zones;
- Prevent illegal use of wildlife;
- Promote the use of protected areas to provide government revenue, employment and other benefits to Tanzania;
- Create the opportunities for Tanzania to become involved in wildlife industry;
- Create an enabling environment which will ensure that legal and sustainable wildlife scheme directly benefits local communities;
- Promote greater public awareness and understanding of wildlife issues;
- Retain sufficient revenue from wildlife utilization in the protected areas for management and development purposes.
- Encourage involvement of donors to support the country to conserve wildlife resources;
- Encourage participation in implementation of relevant treaties concerned with conservation of wildlife;

- Co-operate with neighbouring countries in the conservation of transboundary ecosystem; etc.

Since the proposed bioethanol project is located close to the Saadani National Park, care shall be exercised to minimise interference with migration routes and grazing areas of wild animals. Sufficient buffer zones shall be created between the Saadani National Park and the proposed project area in accordance with the standing provisions in the wildlife regulations.

3.1.3 National Forestry Policy (1998)

The national forest policy is based on macro-economic, environmental and social framework. Its overall aim is to manage Tanzania's forest resources as a national heritage on an integrated and sustainable basis to optimize their environmental, economic and social and cultural values. The policy drives towards implementing the directives contained in the National Environmental Policy (1997) in regard with forest resources management. For instance, the forest policy advocates and directs the conduction of EIA for development projects. The new forest policy also strives to ensure sustainable supply of forest products and services as well as environmental conservation. The issues of control of environmental degradation and protection and enhancement of biodiversity are well addressed by the policy.

The policy underscores the importance of ecosystem conservation and management. In line with this, the policy recognizes that:

- New Forest reserve for Biodiversity conservation will be established in areas of high biodiversity values. Forest reserves with protection objectives of national strategic importance may be declared as nature reserves;
- Biodiversity conservation and management will be included in the management plans for all protection forests. Involvement of local communities and other stakeholders in the conservation and management will be encouraged through joint management agreements;
- Management of forest reserves will incorporate wildlife conservation and that wildlife resources assessment will be intensified; and
- Environmental Impact Assessment will be required for the investments which convert forest land to other land use or may cause potential damage to the forest environment.

The proposed project will convert the forest land into a sugar plantation consequently compromising the ecological integrity of the forest. The EIA study for which this report was prepared, therefore, is in agreement with the provisions of the Policy. Plant species of ecological importance shall be identified in the project area and conserved where feasible inline with the requirements of the Forest Policy.

3.1.4 The National Water Policy (2002)

The overall objective of the policy is to develop a comprehensive framework for sustainable management of the national water resources. The policy seeks to ensure that water plays important role in poverty alleviation. Also water plays a key role in agro-forestry projects. The policy calls for integrated water resources management whereby a wider scope of uses for water is considered in the overall plan of the water resources.

The policy recognises that irrigation is a highly consumptive water user and makes greatest impact on net water resources and that agricultural activities also contribute to pollution from the use of agrochemicals. Irrigation is also at the centre of many water conflicts. It also recognizes that the growth in the industrial sector will have significant impact on water supply and also in terms of potential pollution and degradation of water resources if industrial wastes are not properly managed. Maintenance of environmental flows in surface watercourses is emphasised by the policy for sustaining riparian biodiversity, wetland systems, freshwater-seawater balance in deltas and estuaries. Protection and wise use of wetlands is also underscored in the policy.

The proposed project will strive to avoid conflicts, which may arise from competition for water with other users and also minimise pollution of water by rational use of agrochemicals and proper management of effluents from ethanol production plant. Abstraction of water from rivers for irrigating sugarcane plantations will take into consideration environmental flow for maintaining integrity of downstream ecosystems. Destruction of wetlands in the project area will be minimised during the project implementation.

3.1.5 National Gender Policy (1999)

The key objective of the policy is to provide guidelines that will ensure that gender sensitive plans and strategies in all sectors and institutions are developed. While the policy aims at establishing strategies to eradicate poverty, it puts emphasis on gender quality and equal opportunity of both men and women to participate in development undertakings and to value the role-played by each member of the society. The gender dimension in this project will be aligned so as to provide equal opportunity to both men and women.

3.1.6 The National Energy Policy (2003)

The National Energy Policy, emphasizes the role of government, namely to provide an enabling environment for the private sector to participate in energy development and distribution. It advocates independent power producers to generate electricity from different sources including new and renewable sources of energy, particularly for the rural population of Tanzania. The energy policy stresses the need to

- have affordable and reliable energy supplies for the whole country, reform the market for energy services and establish an adequate institutional framework,

which facilitates investment, expansion of services, efficient pricing mechanism and other financial incentives,

- enhance the development and utilization of indigenous and renewable energy sources and technologies,
- adequately take into account environmental considerations for all energy activities,
- increase energy efficiency and conservation in all sectors,
- increase energy education and build gender-balanced capacity in energy planning, implementation and monitoring.

The energy policy also emphasizes the establishment of an institutional framework that can cope with the diversity and manage and coordinate the future efforts in development of rural energy services. In view of the above, the Policy avails an opportunity for development of indigenous and renewable energy sources and technologies. The policy encourages Independent Power producers (IPPs) because they are allowed to feed electricity to the national grid. In view of this, biofuel industries may take advantage of this policy provision to generate electricity for selling to power distribution companies. The policy also offers support to rural energy schemes, which also include biofuels production for local/domestic use.

3.1.7 National Land Policy of (1995)

The overall objective of the policy is to promote and ensure a secure land tenure system, to encourage the optimal use of land resources, and to facilitate broad-based social and economic development without upsetting or endangering the ecological balance of the environment. Specifically, the policy aims at ensuring that existing rights in land especially customary rights of small holders are recognized, clarified, and secured in law and that land is put to its most productive use to promote rapid social and economic development of the country among others. The proposed project will abide to the provisions of the policy in land acquisition and management. It is envisaged that growing of sugarcane for ethanol production will boost socio-economic conditions of the project area through creation of employment and introduction of a new cash crop to small holders.

The policy has proposed the formation of an Inter-Ministerial Co-ordination Committee for Consultation on issues of granting of mining claims, hunting licenses, timber harvesting licenses, water rights and other leases. The issuing of such permits or leases and claims normally conflicts with other land uses.

The policy directs protection of sensitive areas which include water catchment areas, small islands, border areas, beaches, mountains, forests, national parks, rivers, river basins and bank, seasonal migration routes of wildlife, national heritage and areas of biodiversity. These areas or parts of them should not be allocated to individuals. The project will ensure that ecologically sensitive areas such as Saadani Game Park, wetlands,

riverine and coastal forests are minimally disturbed by the project activities in compliance with the stipulations of the policy.

3.1.8 Agriculture and Livestock Policy (1997)

Objectives of the Agriculture and Livestock Policy (1997) are to promote integrated and sustainable use and management of natural resources, ensure basic food security and improve standards of nutrition and improve standards of living in rural areas and promote access of women and youths to land, credit, education and information.

The focus of the policy is to commercialise and intensify agriculture sector so as to increase income levels. This will be achieved through development of new technologies and products, as well as integrated use of feedstock and mechanization consistent with the national biofuels initiative (Econ Pöyry AB, 2007).

The policy support increased productivity and profitability of industrial (non-edible) vegetable oils, which could be considered as a precursor to biofuels (Econ Pöyry AB, 2007).

The policy advocates the creation of conducive environment for establishment of private sugar estates and small scale processing plants are facilitated. This policy statement supports the establishment of the private sugarcane plantations although in this particular project sugarcane will be used for ethanol production rather than processing of sugar.

The policy also aims at ensuring basic food security for the nation. In view of this, the potential for conflict over productive agricultural land between food production and bioenergy production needs to be considered (Econ Pöyry AB, 2007) taking into account also the potential of income as a means to access food and become food secure.

The policy also recognizes the dependence of agriculture on environmental resources, hence the need for environmental protection. It identifies the need for developing mechanism for linking agriculture sector with other sectors in protecting and enhancing the environment. The policy also recognizes the important role played by women in agriculture, hence the need for gender sensitization.

3.1.9 The National Investment Promotion Policy (1996)

The policy encourages investment of all possible commercial and alternative sources of energy with emphasis of utilization of domestic resources with aim of ensuring security and continuity of supplies as well as reducing dependence on biomass fuels. It also promotes adoption of system of production, procurement, transportation, distribution and end-use of energy which are efficient and not detrimental to the environment. The

proposed project, therefore, subscribes to the stipulations of this policy since bioethanol complies with the above.

3.1.10 The National Science and Technology Policy for Tanzania

This is a tool for development and management of Science and Technology in a manner consistent with physical and human endowment of the Country. One of the broad objectives of the policy is to ensure rational utilisation of natural resources, including energy resources, and environmentally sound technologies in order to maintain sustainable ecological and social balance. The Policy advocates the development and utilisation of renewable and alternative energy resources such as solar, wind and nuclear power wherever feasible. The policy, however, does not specifically mention biofuels as one of the potential renewable energy resources. Notwithstanding this observation, the proposed project is inline with the provisions of the policy since it aims at producing ethanol, which is a renewable and climate friendly fuel.

3.1.11 Sustainable Industrial Development Policy-SIDP (1999-2020), 1996

Main objectives of the policy are to promote human development and creation of employment; to promote economic transformation for sustainable economic growth; and to increase sector's contribution to equitable development and environmental sustainability. It recognizes the need for promoting environmentally friendly and ecologically sustainable industrial development as one of the important policy strategy.

3.1.12 National Transport Policy (2003)

Objectives of the policy are to improve rural transport infrastructure to reduce rural travel burden; raise environmental awareness among the rural people; carry out an Environmental Impact Assessment (EIA) for all transport projects and ensure that construction and maintenance works adhere to environmental protection guidelines; ensure continuous environmental impact assessment in the provision of transport services; ensure that both local and foreign investors and operators are involved in the development of infrastructure and operations coupled with environmental protection; and, to influence the use of alternative energy sources to wood such as bio-gas and solar. The policy also addresses the need for private sector involvement; gender issues; environmental sustainability and eradication of diseases and literacy. The use of biofuel for powering motor vehicles is implied in the policy as it advocates environmental sustainability in the transport sector.

3.2 Legal Framework

This section gives brief description of the existing legislation on environmental management in Tanzania, with special focus to EIA conduction. In principle, there are several enacted laws that provides for environmental protection in Tanzania. The umbrella framework is the Environmental Management Act (2004), which requires conduction of EIA for all development projects in the country. Legislations pertinent to the proposed project are also reviewed.

3.2.1 Environmental Management Act No. 20 of 2004

The Environmental Management Act (EMA) forms an umbrella law on environmental management in Tanzania. Its enactment repealed the National Environment Management Council Act. 19 of (1983) while providing for continued existence of the National Environment Management Council (NEMC).

Among the major purposes of EMA are to provide for legal and institutional framework for sustainable management of environment in Tanzania; to outline principles for management, impact and risk assessment, prevention and control of pollution, waste management, environmental quality standards, public participation, compliance and enforcement; to provide basis for implementation of international instruments on environment; to provide for implementation of the National Environmental Policy; to provide for establishment of the National Environmental Fund and to provide for other related matters.

Part VI of EMA deals with Environmental Impact Assessment (EIA) and other Assessments, and directs that EIA is mandatory for all development projects. Section 81(2) states that “An Environmental Impact Assessment study shall be carried prior to the commencement or financing of a project or undertaking”.

The functions of NEMC under this new legislation is mentioned in Sections 17 and 18, and includes undertaking enforcement, compliance, review and monitoring of environmental impact assessments. NEMC shall specifically review and recommend for approval environmental impact assessment statements.

Strategic Environment Assessment is not stipulated for agricultural development, which will be necessary in a large scale national biofuels programme (Econ Pöyry AB, 2007).

3.2.2 National Environmental Impact and Auditing Regulations (2005)

Theses regulations set procedures for conducting EIA and environmental audit in the country. The regulations also require registration of EIA experts.

3.2.3 The Village Land Act No. 5 of 1999

The Law defines the legal framework for distribution, occupation and management of land designated as village land under the Land Act, as well as settlement of conflicts over land issues. Different types of tenure systems (pre-Vijiji, post Vijiji, customary, etc) are described in the Act. It declares that all land in Tanzania to be “Public land” and are held by the state for public purposes. The Act empowers the President of the United Republic of Tanzania, to revoke the “Right of Occupancy” of any landholder for the “public/national interest” should the need arise. The Act also declares the value attached to land, as opposed to the former legislation. The Act recognises the village land and empowers villages the right of occupancy.

Compensation for “title” transfer and lease schemes are specified in the Act. However, it is unclear in the Act how compensation levels are decided. The Act is mostly intended for individual smallholders (Econ Pöyry AB, 2007).

3.2.4 Land Use Planning Commission Act of 1984

The National Land Use Commission was established under this act as the principal advisory organ of the Government on all matters related to land use. Among other things, it recommends measures to ensure that the Government policies including those for development and conservation of land, take adequate account of their effects on the land use, seek the advancement of scientific knowledge of changes in land use and encourages the development of technology to prevent, or minimize adverse effects that endanger man's health or welfare, specify standards, norms and criteria for the protection of beneficial uses and the maintenance of the quality of the land. In accordance with the functions mentioned above, the commission can indirectly help to prevent or minimise pollution by restricting location of potential and actual pollution sources and not otherwise.

3.2.5 Land Act (1999)

The Act defines the legal framework for distribution and tenure of all lands. Description of land right transfer processes and describes the land right transfer processes. It integrates customary and statutory land rights. The shortcomings of the Act are that the specified land right transfer is complex and there is little information on process and basis for compensation (Econ Pöyry AB, 2007). These shortcomings may cause unnecessary delays in acquisition of land for project implementation.

3.2.6 Sugar Industry Act (2001)

The Act provides for establishment of the Sugar Board of Tanzania and National Sugar Institute and their functions. It advocates growing of different varieties of cane and setting of standards pertaining to the sugar industry among other things. However, it only focuses on manufacturing of sugar (Econ Pöyry AB, 2007). Other uses of cane such as production of ethanol are not covered in the Act.

While the Act is geared towards sugar producers, many aspects are relevant and applicable to producers of biofuels from sugarcane, such as regulations for cane plantations, crop varieties and R&D on sugar cane agricultural practices and systems (Econ Pöyry AB, 2007).

3.2.7 The Food Security Act, 1991

The Act provides for establishment of the Board of Trustees and the Department of Food Security and their responsibilities. It aims at creating an effective food security system for the whole country.

One of the mandates of the Food Security Department is to oversee and develop policy for food security issues arising from development in the agriculture sector. The Department is, therefore, an important actor in any future land allocation master plan for biofuels to ensure that there is not inherent conflict between energy crops and food crops/pastures (Econ Pöyry AB, 2007).

3.2.8 The Land Acquisitions Act of 1967 and the Land Ordinance

The Land Acquisition Act gives powers to the President to take "Land" from private occupants for public purpose when in the public interest to do so. The Land Ordinance declares all land in Tanzania "Public land" to be held by the state for public purposes.

3.2.9 Forest Act (2002)

The Act controls forestry development in Tanzania. The Act also controls forest plantation management and conservation of natural trees genes. It also supports integrated land use planning and environmental monitoring. The permit process for planned deforestation, as well as the land management of designated forest land will be relevant for large scale bioenergy plantations (Econ Pöyry AB, 2007).

3.2.10 The Water Utilization (Control and Regulation) Act (1974) as amended in 1981

The Act defines the legal and regulatory framework for water rights, water allocation and conflict arbitration regarding water use. Under this law, the prominent Water Right holders include: large-scale farmers; those irrigating their lands; hydroelectric Power Stations; Industries; Mining concerns. Persons abstracting water for domestic use, without building water works are not regulated by this law. The law regulates access and pollution by those abstracting water directly from controlled waters. It stipulates that water from public lands (e.g. rivers) has to be returned in same quantities and free of pollutants. This Act is applicable to the proposed project since it involves large scale irrigation of sugarcane plantation.

The Act also aims at prevention of water pollution by specifying Standards for Receiving Waters and Effluent Standards. Although they are no specific standards for ethanol production, but the compliance of these standards is compulsory for all projects.

3.2.11 Energy and Water Utilities Regulatory Authority Act (2001)

This Act defines the legal and institutional framework for the establishment of the Energy and Water Utilities Regulatory Authority, as well as its powers and mandates. It also contains provisions for regulating independent power producers.

The government is responsible for issuing licenses to Independent Power Producers (IPPs) and controlling prices in electricity and petroleum sub sectors. The law governing electricity is contained in the Electricity Ordinance of 1931 and in the 1957 amendment. A new Electricity Act (to replace the Electricity Ordinance) has been drafted and is awaiting approval. To address the problems facing the power sub-sector, a number of reforms including commercialization, introduction of IPPs, Contract Management, and privatization of non-core assets are being pursued. With the development of a modern biofuels industry in Tanzania, there are potential benefits in terms of both increased access to liquid biofuels as well as to electricity from combined heat and power generation from the industries producing liquid biofuels (Econ Pöyry AB, 2007).

A new Petroleum Supply Act is also under preparation. The new Act will contain provisions for biofuels.

The Government is currently preparing Guidelines for Sustainable Development of Liquid biofuels and cogeneration in Tanzania. They provide guidance on existing regulations and relevant processes that need to be followed by potential investors. Among others, the Guidelines will cover issues pertinent to resettlement, land acquisition process, conduction of EIA and handling of wastes generated from biofuel production activities.

3.2.12 Occupation Health and Safety Act (2003)

This Act repealed the Factories Ordinance; to make provisions for the safety, health and welfare of persons at work in factories and other places of work; to provide for the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with activities of persons at work; and to provide for connected matters. It is a comprehensive legislation on occupational health and safety, which is divided into 10 parts. It contains provisions for appointment of factory inspectors and their powers. It regulates registration of factories and workplaces. It sets forth safety, health and welfare provisions. The Act also contains special provisions regarding safety. It deals with hazardous materials and processes. Provisions for chemical substances, offences, penalties and legal proceedings are also covered. All existing and proposed industries are required to abide to the provisions of Act.

3.2.13 Industrial and Consumer Chemicals Act (2003)

The Industrial and Consumer Chemicals Act (2003) provides for proper management and control of industrial and consumer chemicals in Mainland Tanzania. It requires that any person dealing in industrial chemicals e.g. ethanol, corrosion inhibitors in this case to register with the Industrial and Consumer Chemicals Management and Control Board. The Act requires that any person wanting to erect a storage facility for bulk chemicals should undertake an EIA. The Act requires also that there be in place contingency plans and procedures for managing accidents, spills and contaminated sites. The Project Proponent will have to observe the provisions of this Act.

3.2.14 Other Laws

Other laws of the land that relate with the intended Biofuel project development include;

- The Town and Country Planning Ordinance Cap 378 of 1956 (as amended in 1961)
- Wildlife Conservation Act No. 12 of 1974 (as amended in 1978)
- Protected Places and Areas Act (1969)
- Local Government Act of 1982 (Urban and District Authorities)
- Agriculture Act (2003)
- Employment and Labour Relations Act (2004)

3.2.15 Measures and regulations related to sustainable agricultural development

Environmental regulations on use of water resources

According to The Environmental management Act (2004) “every applicant for water use permit issued under the relevant laws governing management of water resources abstraction and use of water shall be required to make a statement on the likely impact on the environment due to the use of water requested”.

Further the Basin Water Boards are responsible for reporting on compliance by water use permit holders on:” obligation to return water after its use to the body of water from which it was taken”, “ensuring that the water that is returned to any specified source is not polluted” and “taking precautions to the satisfaction of the water officer to prevent accumulation in any river stream or water course silt, sand, sewage or any other substance likely to injuriously the use of such water by human or any other component of the environment”. In addition “basin water boards shall ensure that adequate water is made available for environmental purposes”.

Environmental Protection of River Banks

According to The Environmental Management Act (2004) the Environmental Council and the local government authorities responsible for environmental matters shall “issue guidelines and prescribe measures for the protection of riverbanks, lakes and shorelines” –and the Minister may in consultation with other relevant ministries by notice published in the Gazette “impose any restrictions as he considers necessary for the protection of the river, river bank and shorelines from environmental degradation”.

Further no human activity of a permanent nature or which may compromise or adversely effect conservation and protection of oceans or natural lake shorelines, river banks, water dams or reservoirs shall be conducted within sixty metres (60 m).

Environmental considerations for sustainable use of areas adjacent to protected areas According to the Environment Management Act (2004) the Minister may in consultations with the relevant sector ministry make regulations providing for in-situ conservation of biological diversity such as the promotion of environmentally sound and sustainable development in areas adjacent to protected areas with a view to further protection of these areas.

Protection of Mangrove Areas

According to the Forestry and Beekeeping Division of the MNRT (1991): “Mangrove Management Plan of Bagamoyo District, Management Plan for the Mangrove Ecosystem of Mainland Tanzania all Tanzanian mangrove ecosystems are protected. However, the mangrove areas are divided into a number of zones ranging from strictly protected to permission for various degrees of local and industrial uses.

3.2.16 Tanzanian Environmental Standards

According to the Environment Management Act (2004) section 140 (1) The Tanzanian Bureau of Standards is responsible for environmental standards in Tanzania. The following standards are relevant to this project:

- a. discharge of effluent in water
- b. air quality
- c. control of noise and vibration pollution

Enforcement of environmental standards is the responsibility of NEMC, which according to the law may take any necessary measures to ensure that the industry and other facilities adopt cleaner production measures to meet the requirements of the standards. A detailed discussion of the relevant standards is shown in Annex 2.

Not all national standards have been formulated, however, when national standards are missing international standards such as WHO are adopted instead.

Provisional air quality standards for Tanzania have been proposed by NEMC in which both ambient air limits and limit for emission sources for various pollutants are given (see Annex 2). The project is required by the law to abide to these standards.

3.3 Strategies/Programmes

The purpose of this sub-section is to determine how environment and energy issues are addressed in various national strategies/programmes.

3.3.1 The National Strategy for Growth and Reduction of Poverty (NSGRP),

The NSGRP paper recognizes that energy is critical for the attainment of the NSGRP and Millennium Development Goals targets. Provision of reliable, affordable and efficient energy and alternative rural energy schemes is identified as one of the strategies for reducing income poverty of both men and women in rural areas. It also recognises the role of other sectors in poverty eradication and the need for mainstreaming environment as one of the crosscutting issues into those sectors.

3.3.2 The Tanzania Development Vision 2025

The vision recognizes that investments in energy (and other forms of infrastructure) need to be given highest priority by the government as it is central to the stimulation of local and foreign investments and for creating wealth and employment-generating activities.

3.3.3 National Environment Action Plan (NEAP, 1994)

The NEAP provides analysis and guidelines for dealing with environmental management problems at sectoral level. It also addresses the six key problems outlined in the National Environmental Policy (1997), which are land degradation; lack of access to good quality

water for both urban and rural inhabitants; environmental pollution; loss of wildlife habitats and biodiversity; deterioration of aquatic systems; and deforestation. It gives strategic approach for mainstreaming environmental issues into decision-making process and the need for defining sector policies and action plans.

3.3.4 Agriculture Sector Development Programme (ASDP, 2003)

The ASDP identifies the need to streamline crosscutting issues and multi-sectoral activities. The programme identifies the following as important crosscutting issues:

- Environment;
- HIV and AIDS;
- Gender;
- Forestry;
- Fisheries;
- Education;
- Health;
- Water supply; and
- Rural infrastructure (e.g. rural roads).

The ASDP (2003) underscores the importance of promoting environmental research through linkage with the Vice President's Office and NEMC. It recognize the linkage between subsistence agriculture and poverty, hence the need for promoting agricultural productivity and farm income as well as household food security. Thus, sustainable development of biofuel will increase the income of rural communities without jeopardising the food security.

3.3.5 Rural Development Strategy (RDS, 2001)

The RDS provides strategic framework to facilitate coordinated implementation of various sector policies and strategies that focus on development of rural communities. The strategy identifies the need to fight against poverty, ignorance, diseases including HIV and AIDS.

Furthermore, it addresses the problem of unemployment/underemployment, environmental degradation, food insecurity as well as rural-urban migration. On environment, the RDS recognizes the need for improved capacity for environmental management and conservation for local authorities and local communities. It relates environment with economic growth, vulnerability, empowerment and health aspects. In addition, the RDS outlines strategic interventions into various sectoral issues including energy.

3.4 Institutional Framework for Environmental Management

3.4.1 Overall management responsibility

The institutional arrangement for environmental management in Tanzania is well spelt out in the EMA (2004). There are seven (7) institutions mentioned by the act, of which the minister responsible for environment is the overall in-charge for administration of all matters relating to the environment.

Part III, Section 13(1) of EMA (2004) states that the Minister responsible for environment shall be the overall in-charge of all matters relating to the environment and shall in that respect be responsible for articulation of policy guidelines necessary for the promotion, protection and sustainable management of environment in Tanzania.

The legal institutions for environmental management in the country include;

- National Environmental Advisory Committee;
- Minister responsible for Environment;
- Director of Environment;
- National Environment Management Council (NEMC);
- Sector Ministries;
- Regional Secretariat;
- Local Government Authorities (City, Municipal, District, Township, Ward, Village, sub-village “Mtaa and Kitongoji”)

3.4.2 National Environmental Advisory Committee

The National Advisory Environmental Committee is comprised of members with experience from various field of environmental management in the public, private sector and the civil society. The advisory committee advises the Minister on any matter related to environmental management. Other functions include:

- Examine any matter that may be referred to it by the Minister or any sector Ministry relating to the protection and management of the environment;
- Review and advise the Minister on any environmental plans, environmental impact assessment of major projects and activities to which environmental impact review is necessary;
- Review the achievement by the Council (NEMC) of objectives, goals and targets set by the Council and advise the Minister accordingly;
- Review and advise the Minister on any environmental standards, guidelines and regulations;
- Receive and deliberate on the reports from Sector Ministries regarding the protection and management of the environment;
- Perform other environmental advisory services to the Minister as it may be necessary.

3.4.3 Minister Responsible for Environment

The Minister is responsible for matters relating to environment, including giving policy guidelines necessary for promotion, protection and sustainable management of environment in Tanzania. The Minister approves EIS. The Minister may also delegate the power of approval for EIA to the DOE, Local Government Authorities or Sector Ministries. The Minister also:

- Prescribes (in the regulations) the qualifications of persons who may conduct EIA;
- Reviews NEMC reports on the approval of EIS;
- Issues EIA certificate for project subject to EIA;
- Suspends EIA certificate in case of non-compliance.

3.4.4 Director of Environment

The Director of Environment heads the Office of the Director of Environment and is appointed by the President of the United Republic of Tanzania. The functions of the Director of Environment include:

- Coordination of various environmental management activities undertaken by other agencies;
- Promotion of integration of environmental considerations into development policies, plans, programmes, strategies, projects;
- Undertaking strategic environmental risk assessment with a view to ensuring the proper management and rational utilization of environmental resources on a sustainable basis for the improvement of quality of human life in Tanzania; · Advise the Government on legislative and other measures for the management of the environment or the implementation of the relevant international environmental agreements in the field of environment;
- Monitoring and assessing activities undertaken by relevant Sector Ministries and agencies;
- Preparation and issuing of reports on the state of the environment in Tanzania through relevant agencies;
- Coordination of issues relating to articulation and implementation of environmental management aspects of other sector policies and the National Environment Policy

3.4.5 National Environment Management Council (NEMC)

The NEMC's purpose and objective is to undertake enforcement, compliance, review and monitoring of EIA and to facilitate public participation in environmental decision-making.

In reference to EMA (2004), NEMC:

- Registers experts and firms authorized to conduct EIA;

- Registers projects subject to EIA;
- Determines the scope of the EIA;
- Set-ups cross-sectoral TAC to advise on EIA reviews;
- Requests additional information to complete the EIA review;
- Assesses and comments on EIA, in collaboration with other stakeholders,
- Convenes public hearings to obtain comments on the proposed project;
- Recommends to the Minister to approve, reject, or approve with conditions specific EIS;
- Monitors the effects on the environment of activities;
- Controls the implementation of the Environmental Management Plan (EMP);
- Makes recommendations on whether to revoke EIA Certificates, in case of non-compliance;
- Promotes public environmental awareness;
- Conducts Environmental Audits

3.4.6 Sector Ministries

Under the existing institutional and legal framework the Sector Ministries are required to establish Sector Environmental Sections headed by the Sector Environmental Coordinator.

The Sector Ministries Environmental Sections;

- Ensure environmental compliance by the Sector Ministry;
- Ensure all environmental matters contained in other written falling under sector ministry are implemented and report of their implementation is submitted to the DOE;
- Liaise with the DOE and the Council (NEMC) on matters involving environment and all matters with respect to which cooperation or shared responsibility is desirable or required;
- Ensure that environmental concerns are integrated into the ministry or departmental development planning and project implementation in a way which protects the environment;
- Evaluate existing and proposed policies and legislation and recommend measures to ensure that those policies and legislation take adequate account of effect on the environment;
- Prepare and coordinate the implementation of environmental action plans at national and local levels;
- Promote public awareness of environmental issues through educational programmes and dissemination of information;
- Refer to the Council (NEMC) any matter related to the environment;
- Undertake analysis of environmental impact of sectoral legislation, regulation, policies, plans, strategies and programmes through strategic environmental assessment (SEA);
- Ensure that sectoral standards are environmentally sound;

- Oversee the preparation of and implementation of EIA required for investments in the sector;
- Ensure compliance with various regulations, guidelines and procedures issued by the Minister responsible for environment and;
- Work closely with Ministry responsible for local government, to provide environmental advice and technical support to district level staff working in the sector.

3.4.7 Regional Secretariat

The Regional Secretariat, which is headed by the Regional Environmental Management Expert, is responsible for coordination of all environmental management in their respective regions. The Regional Environmental Expert:

- Advises the local authorities on matters relating to the implementation of and enforcement of environmental By-laws/ Act;
- Creates a link between the region and the DOE and the Director General of the Council (NEMC).

3.4.8 Local Government Authorities

Under the Local Government Act of 1982 (Urban and District Authorities), Local Government Authorities include the City Councils, Municipal Councils, District Councils, Town Councils, Township, Kitongoji, Ward, Mtaa and Village.

The Environmental Management Committee of each jurisdiction:

- Initiates inquiries and investigation about any allegation related to the environment and implementation of or violation of the provisions of the Environmental Management Act;
- Requests any person to provide information or explanation about any matter related to the environment;
- Resolves conflicts among individual persons, companies, agencies non-governmental organizations, Government departments or institutions about their respective functions, duties, mandates, obligations or activities;
- Inspects and examines any premises, streets, vehicles, aircraft or any other place or article which it believes or have reasonable cause to believe that pollutant or other articles or substances believed to be pollutant are kept or transported;
- Requires any person to remove at own cost without causing harm to health and;
- Initiates proceedings of civil or criminal nature against any person, company, agency, department or institution that fails or refuses to comply with any directive issued by any such Committee.

As EMA (2004), the City, Municipal, District and Town Councils are headed by Environmental Inspectors who are responsible for environmental matters. The functions of the inspectors are to:

- Ensure enforcement of Environmental Management Act in their respective areas;

- Advise the Environmental Management Committee on all environmental matters;
- Promote awareness in their areas on the protection of the environment and conservation of natural resource;
- Collect and manage information on the environment and utilization of natural resources;
- Prepare periodic reports on the state of the local environment;
- Monitor the preparation, review and approval of EIA for local investors;
- Review by-laws on environmental management and on sector specific activities related to environment;
- Report to the DOE and the Director General of the Council (NEMC) on the implementation of the Environmental Management Act and;
- Perform other functions as may be assigned by the local government authority from time to time.

4.0 BASELINE OR EXISTING CONDITIONS

4.1 Overview of Bagamoyo District

4.1.1 Location

Bagamoyo is located in Coast Region of the United Republic of Tanzania north of the capital, Dar- es- salaam. The District has an area of 9847 km² (984700 ha). Bagamoyo Town is roughly 65 km from Dar Es Salaam City Centre and has a population of more than 40,000.

4.1.2 Climate: Temperature and Rainfall

There is little fluctuation throughout the year in both the maximum and the minimum monthly air temperatures. Analysis of a 21-year temperature record (1986-2006) shows the minimum mean temperature to vary from 18.5 °C in July/ August to 24 °C in January/February and it is not as low as ideally desired for maturation of the sugarcane. The maximum mean temperature ranged from 29 °C in July to 32.5 °C in February. The mean annual temperature is 26.1 °C.

The long term mean annual precipitation (1971-2006) at Bagamoyo is of the order of 965 mm. The mean monthly distribution of rainfall over that 36-year period is shown in Fig 2. The annual rainfall distribution is bi-modal with the first wet period occurring in April and May, these two months in fact the wettest months (175 to 225 mm monthly). There is another wet period occurring from November to January (75 to 100 mm monthly). The driest months are June to September when monthly rainfall of the order of less than 50 mm is generally recorded.

4.1.3 Population

According to the Census of 2002 Bagamoyo District as a whole has a total population of 228 967, made up of 113991 men and 114976 women respectively. A population increase is expected so that the total population is projected to be 289859 persons by 2012. The district is composed of 16 wards and covers 82 villages. Bagamoyo District has one District Hospital, five medical centres and 49 dispensaries.

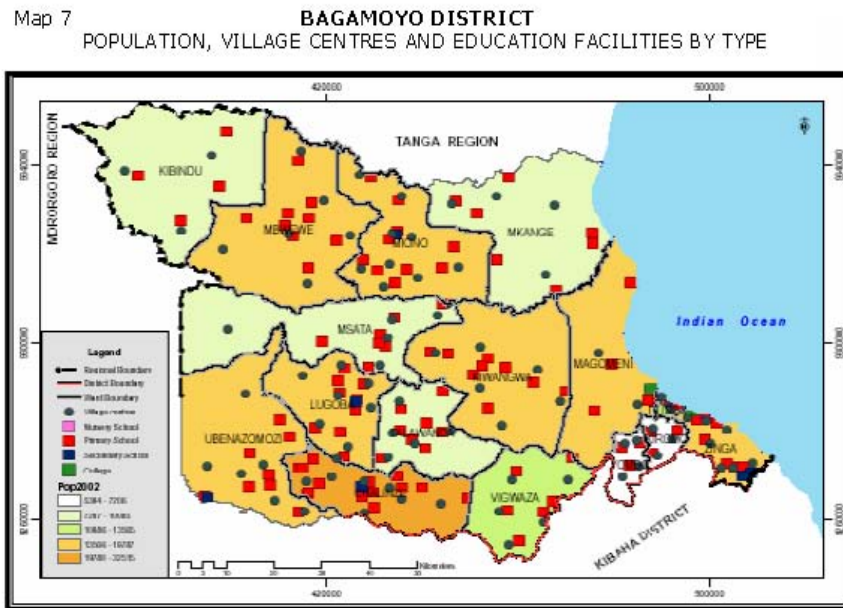
4.1.4 Social and infrastructural services

The district has a total number of 38 health facilities of which 71% (27/38) are owned by the Government. According to the 2007 estimates, every medical center serves 4,719 people. Hereby, in 2002, there was one doctor for 32710 patients as a district wide average.

No specific infection rate of HIV for Bagamoyo was available at the time of preparing this report. However, an average of 5.1 to 10 % of all 15 to 49 year olds are HIV positive

in Coast Region. Of this the average prevalence rate amongst men in Coast Region is 2.1-5% and 10.1-16 % for women.

At the time of the 2002 census there were 121 registered primary schools, with 44 students to each one teacher. For secondary schools the picture was 26 schools district wide, with a teacher to student ratio of 1:18. Figure 4.1 shows the distribution of educational facilities in the District. According to the Tanzanian Bureau of Statistics, in 2004 the district had a total of 140 water pipes, 43 covered wells, 61 open wells, 9 natural wells, 52 swamps (open waters), one dip and 10 water tanks.



Chanzo: Ofisi ya Taifa ya Takwimu

19

Figure 4.1: Population, Village centres and educational facilities in Bagamoyo District

4.2 Existing Physical conditions surrounding the project area

4.2.1 The Physical Features

Geology, Topography and Soils

The Razaba Ranch is located in an old, uplifted and dissected coastal plain. Its topography is largely gently undulating to rolling, characterised by extensive plains, low hill or ridges bottomlands and shallow valleys (see Figure 4.2). The terrain is rising gradually from the coastal mudflats to about 30-40 m above sea level at the western border of the area.

The soils are based on old, dissected sand dunes, with grey sandy soils (locally called mbuga) on the main central areas, falling away to alluvial sands and clays along the Wami river (northern boundary) and the Ruvu river (south-eastern boundary). The sandy topsoil which is prevalent is susceptible to erosion during farming operations. Organic matter (OM), phosphorus and potassium are the most limiting parameters for all soils in the Razaba area (see Figure 4.3).

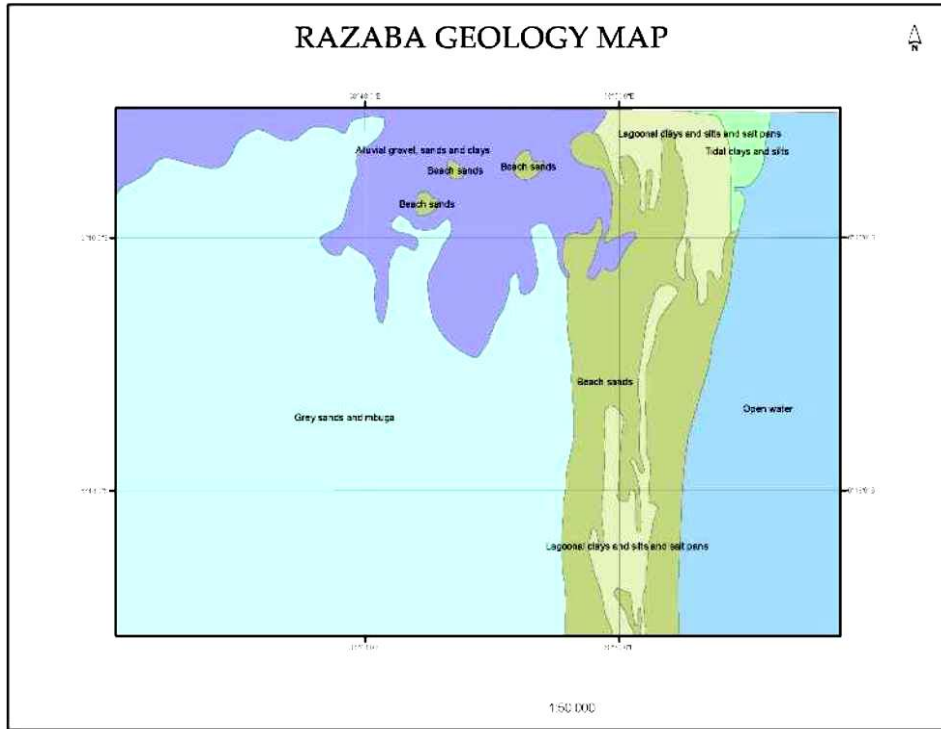


Figure 4.2: Geology Map of Razaba

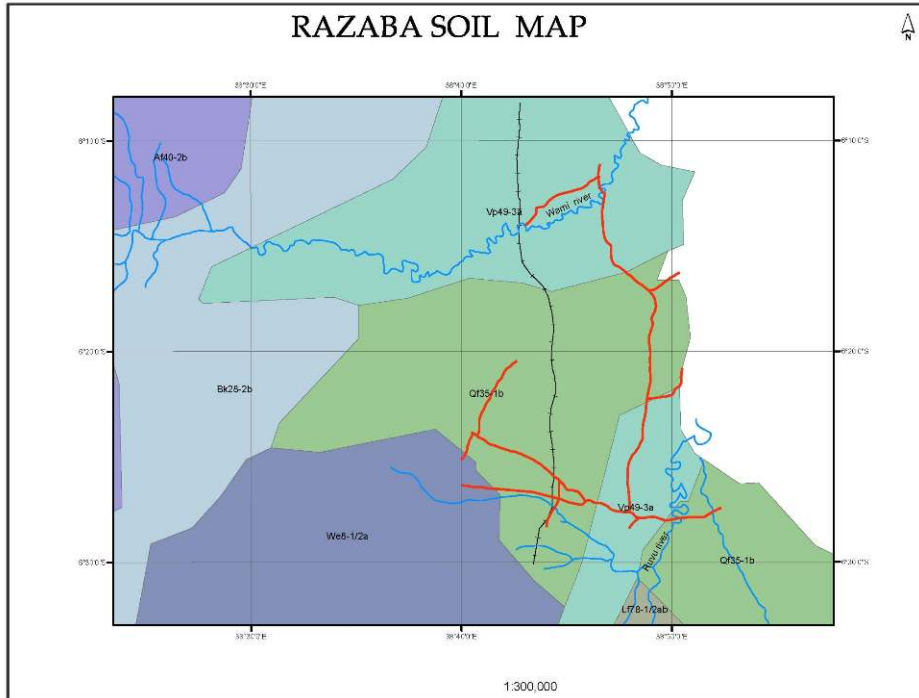


Figure 4.3: Razaba Soil Map

4.2.2 The Climate: Rainfall and Temperature

The climate of the study area is not very much different from that of other areas in Bagamoyo District. The average temperature in the Razaba area is between 20°C to 32°C. June to August is the coolest season while the hottest season runs from December to Mid-March.

The rainfall pattern in the area is bimodal with two rain periods in a year. The long rains occur during March to May/June with an average of 800-1000mm per annum. This rain may fall over longer periods prompting flooding over large part of the Razaba area. The long rains accounts for approximately 60% of the annual rainfall. The short rains happen during the period September/October-December. The short rains are unreliable and poorly distributed. However there is no month without rainfall. Climate data for Razaba farm area are represented in the table below.

Table 4.1: Climatic Data for Razaba Farm

CLIMATIC DATA

Characteristic	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Wind speed	km/day	156.	146	112	102	108	128	143	147	158	162	145	156
Maximum T	Celsius Scale	32	33	32	31	30	29	29	30	31	31	32	32
Minimum T	Celsius Scale	23	23	23	23	22	20	19	19	20	21	22	23
Sunshine	Hours/day	6.8	8.6	6.2	3.9	8.8	8.4	8.0	7.4	8.2	9.0	8.7	5.5
Mean R H	%	61	60	67	75	67	59	56	55	54	54	58	60
ETo	mm/month	158	171	138	105	129	125	131	140	160	173	167	148
Effective rainfall	mm/month	55	45	129	147	100	27	6.3	15.6	8.7	70	67	74
Mean rainfall	mm/month	62	49	183	238	125	29	6.4	16.3	8.8	80	76	85

Source: Kibaha Meteorological station.

4.2.3 Water Resources

Surface Water Hydrology

Water availability is one of the most important aspects in relation to the planned irrigation scheme for sugar cane production in the proposed biofuel project. The main source of irrigation water will be the Wami River where it flows in what is known as the lower Wami catchment. A lot of the following data is based on the Wami/Ruvu Basin Water Office, Florida International University, University of Dar es Salaam, Tanzania Coastal Management Partnership & Coastal Resources Center, University of Rhode Island (2008) Wami River Environmental Flows Initiative which can be found on <http://wami.fiu.edu> and was supported by USAID and the CocaCola Company.

The Wami River is one of the major rivers draining the Eastern Arc Mountains and the basin area extends from the upper catchments in semi arid Dodoma region through the humid inland swamps in Morogoro region to discharge into the Indian Ocean at Saadani in Bagamoyo just north of the study area (see Figure 4.4).

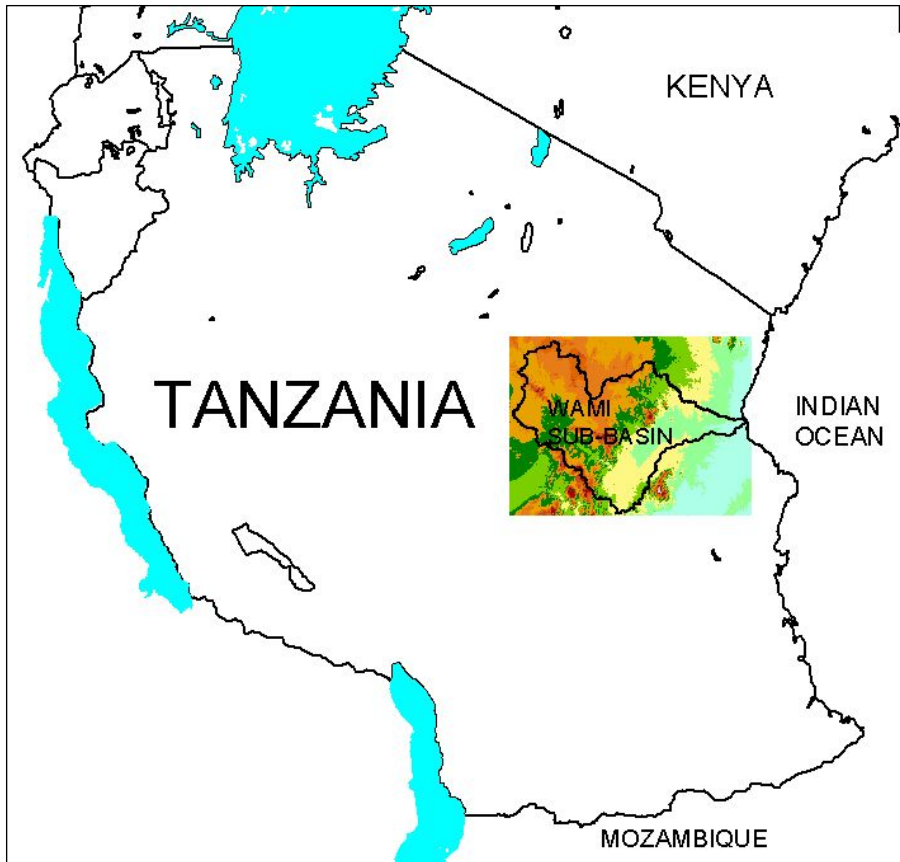


Figure 4.4: Location of the Wami River sub-basin

The largest part of flow in the main River Wami from Dakawa to Saadani is contributed by flows from the River Mkondoa catchment (Figure 4.4). Flows from this catchment at its outlet at Kilosa constitute more than 80% of flows recorded in River Mkata. River Mkondoa enters the Tendigo swamps where it joins River Mkata (Figure 4.5). The comparison of average monthly flows into Mkata from Rivers Mkondoa and Myombo and those measured at Mkata indicates significant loss of flow volume during the short-rains or “*Vuli*” as known locally (October-December) and intermediate January-February seasons. The flow volume loss during this early rainy season is considered to be used in filling up the vast Tendigo swamps to their highest levels before contributing to flow increase at the downstream Mkata flow gauge since April through July.

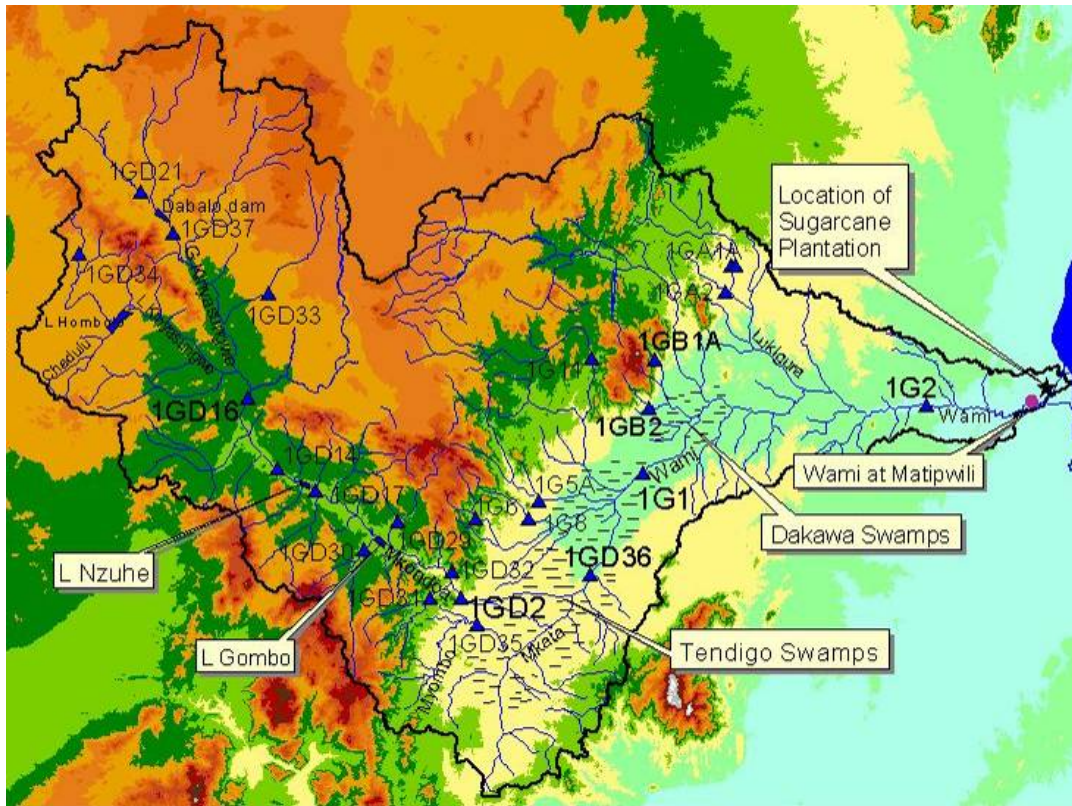


Figure 4.5: Wetlands system of Wami.

Water availability in Wami reaches downstream of these vast swamps depends mainly on the process related to river-swamps water exchanges and water uses in fertile areas upstream and around the swamps. Therefore, flows from Wami Dakawa are slightly increased by flows from River Diwale, which feeds the Dakawa swamps before joining Wami some 29 km downstream of 1G1, and River Lukigura, which joins the Wami some 47 km from the Wami-Diwale confluence and is transported some 47 km to Mandera.

Another important factor that determines the amount of water that is available in downstream reaches of the river is the level of water abstraction to cater for various uses such as agriculture and municipal water supplies. Throughout the Wami river sub-basin, water abstractions are spatially non-uniform and the amount abstracted depends on the total requirement which is, in turn, affected by the local climatic conditions. Two type of surface water abstractions are therefore distinguished in the sub-basin, the dammed and direct-from-river abstractions. The former is usually practiced in the arid climate in upper catchments of Wami in Dodoma where several reservoirs storing river water are operational. These reservoirs store considerable amounts of flow that could otherwise be available to downstream reaches through to the Indian Ocean.

Direct abstractions from the river include both licensed and illegal abstractions. Currently, there is little quantitative information on the illegal abstractions. The licensed abstractions are done by users with water rights. About 99 abstractions from various

rivers and 14 from springs in the sub-basin have been given water rights. Despite the lack of coordinates of exact locations of almost all abstraction points, the rivers which they abstract water are known. According to available information at the Ruvu/Wami Water Basin Office, most of the abstractions are located in *Wami Dakawa* ($5.25 \text{ m}^3/\text{s}$), *River Myombo* ($3.84 \text{ m}^3/\text{s}$), *Kinyasungwe* ($2.58 \text{ m}^3/\text{s}$) and *River Lumuma* ($2.59 \text{ m}^3/\text{s}$) and *Wami Mandera* ($2.50 \text{ m}^3/\text{s}$).

Increasing agricultural activities upstream and around the swamps (Tendigo and Dakawa) may increase the amount of water that is used for agriculture and losses from agricultural water uses and therefore decreases water availability to downstream reaches. This might have significant impacts on the total amounts of water that are available in downstream reaches as well as flow seasonality.

The comparison of the total abstraction and amounts of water that are seasonally available in the rivers indicates that, for some rivers like Mkondoa and Wami at Mandera, the available is sufficiently large to cater for the total issued water rights (Valimba, 2007). For others like Kinyasungwe, the licenced abstractions cannot be practical during the dry season when most reaches of the river are completely dry. Analysis of drought flows (given by that flow which has been equalled or exceeded 70% of the time, Q70) indicated that in some perennial rivers like Lumuma (Abstractions: $2.59 \text{ m}^3/\text{s}$; Q70: $2.30 \text{ m}^3/\text{s}$), the issued abstractions have already exceeded Q70 suggesting the possibility of dry up of the rivers if water rights are put in full operation. In others like Wami Dakawa (Abstractions: $5.25 \text{ m}^3/\text{s}$; Q70: $7.00 \text{ m}^3/\text{s}$), the licensed amounts are slightly less than Q70.

Groundwater Hydrology

In the vicinity of the Razaba area there are existing dug and shallow wells as well as boreholes. According to data obtained from the DDCA (2007), there are two existing boreholes at Matipwili village; one of 70 m deep constructed in 2005 and the other was drilled in 2004. Both boreholes have highly saline water. Other boreholes constructed 1977 are found in Saadani and Msata. The Saadani borehole is having saline water while that of Msata has freshwater.

Considering the locations and depths of the existing boreholes in the area, the trend is decreasing salinity as the distance from the Indian Ocean increases. Available data is not sufficient to make a firm estimation of the groundwater availability. However, it is likely that ground water salinity continues under a considerable part of the Razaba area.

This salinity is probably a layer between what is called floating ground water (which depends heavily on available surface water and rainfall) and the true groundwater, which is separated from this saline or brackish water layer by a layer of heavy clay or stone. This means that bore holes require heavy duty drilling equipment, must be very deep and that extraction tubes must be completely intact.

Water Quality and Existing Sources of Pollution

Surface water quality data for Wami River is monitored by the Chalinze water supply scheme at the Manderu point. Water samples were collected from two points on Wami River and three dams in the Razaba farm (Figure 4.6). Judging from the analysis results given in Table 4.2, the Wami River is fresh water that is suitable for irrigation purposes primarily due to absence of salinity. These indicative data generally show a very good water quality suitable for both domestic/industrial water supply source (for treatment) and irrigation. However, a salinity of 0.1-0.2% observed for dammed water samples, indicate potential salinity changes upon inundation.

JICA (2006) reported turbidity levels of 16-216 NTU for samples collected between July and November. The high value was observed in the samples collected in November after the short rains had begun.

- Existing sources of pollution / upstream activities:
- Chalinze water supply project
- legal and illegal irrigation activities,
- livestock use,
- Industrial use (Mtibwa Sugar Industry)

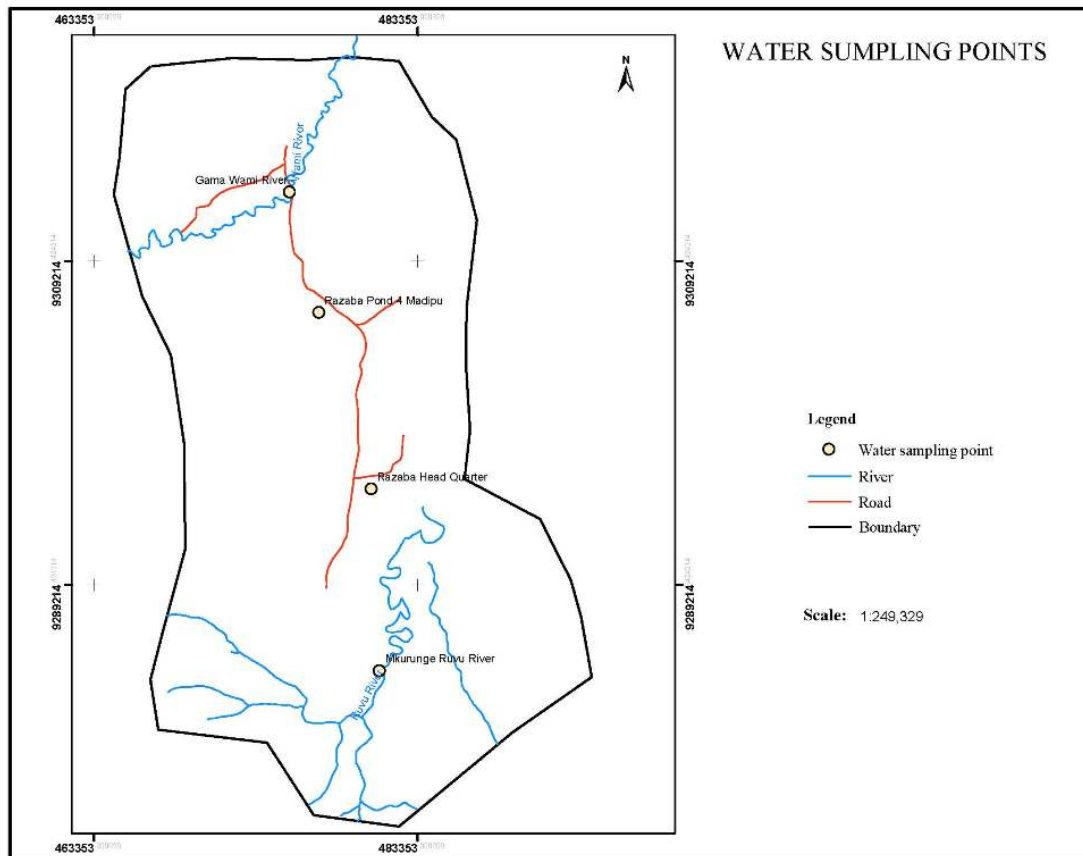


Figure 4.6: Water Sampling Points

Table 4.2: Water quality for samples taken from various locations at and around the Razaba Ranch and analysed at the Ardhi University, Environmental engineering laboratory, Dar es Salaam

S/N	Parameter	Unit	Ruvu River- At the Bridge	Wami River Upper-Mandera	Wami River Upper-Gama village	Razaba Dam No. 1	Razaba Dam No. 4	Razaba Head Quarter
1	pH	-	7.42	7.63	7.32	6.52	6.65	7.36
2	Conductivity	µS/cm	69.9	93.1	83.0	187.0	157.8	386.0
3	Salinity	‰	0.0	0.0	0.0	0.1	0.1	0.2
4	Total dissolved solid (TDS)	mg/l	34.9	46.6	41.5	93.5	79.0	192.8
5	Phosphate	mg/l	0.56	0.38	0.57	0.68	0.37	0.66
6	Nitrate-Nitrogen	mg/l	0.40	0.5	0.0	0.10	0.40	0.40
7	Nitrite -Nitrogen	mg/l	0.007	0.009	0.002	0.008	0.001	0.020
8	Ammonia-Nitrogen	mg/l	0.09	0.03	0.01	0.36	0.76	1.22
9	Iron	mg/l	1.30	0.64	0.52	3.07	2.93	0.70
10	Sulphate	mg/l	4.90	8.3	0.0	42.9	0.1	55.3
12	Total hardness	mg/l	47.8	67	96	84	128	196
13	Calcium	mg/l	34	39	56	37	74	116
14	Total Alkalinity	mg/l	47	110	54	42	122	190
15	Magnesium	mg/l	12.92	20.12	20.80	19.13	27.54	37.10
16	Potassium	mg/l	2.48	4.860	3.973	10.01	24.55	24.34

4.2.4 Biological Environment

A. Flora

Bio-geographically the Razaba area belongs to the East African Coastal Forests zone that occurs in a narrow belt along the Indian Ocean from southern Somalia to Mozambique. However, the activities of humans and their domesticated animals has long ago turned the coastal forest in the Razaba area into a semi natural woodland habitat with bushland, dry grassland, forest tickets, seasonally flooded plains, cultivation plots and a number of modified, but still surviving natural habitats such as mangroves and riverine forests. The closest relatively intact coastal forest fragment is the Zaraninge Forest in Sadani National Park about 20 km north of the study area.

In the northern part of the area there are forest remnants dominated by various species known as African ebony: *Diospyros bussei*, *Diospyros cornii* and *Manilkara mochisia*. However, the majority of the Razaba area is covered by acacia woodlands mixed with other species such as *Spirostachys africana* and *Terminalia*. Vegetation types dominated by pure stand of *Acacia zanzibarica* are found on the black cotton soils in a belt from the

Ruvu River through the eastern part of the area to the other side of the Wami River continuing into Sadani National Park. The persistence of coarse grasses hinders the spread of the thickets to make continuous woodland.

Riverine vegetation occurs in narrow strips of land following the riverbanks or streams and is dominated by evergreen thickets of fig trees (*Ficus sur*) and other species indicating abundant ground water. The streams cause siltation and temporary swamps during the rainy seasons. These swamps are important for the biodiversity of the area and are used as sources of water for both wild and domestic animals.

The vegetation on the coastal flood plain is dominated by palm species with *Hyphaene compressa* as the most dominant species. Most water logged areas covered by grasses especially elephant grass (*Pennisetum purpureum*) following re-current bush fires. Part of the coastal plain is seasonally flooded. Most of the ponds and dams established by the Razaba ranch still exist and supply water to livestock and human use (see further in the wildlife report). The Razaba area is also used for temporary cultivation of maize and other crops especially in the Wami flood plains and in the southern area near the railway. Cultivated land plots (permanent or temporary) are scattered randomly in the area, but only covering a very small percentage of the total area. This temporary cultivation practice has also resulted in the spread of cultivated trees including guava, mango, custard apple and other in the area.

Mangroves occurs at the estuaries of Ruvu and Wami Rivers dominated by five species: *Avicennia marina*, *Bruguiera gymnorrhiza*, *Sonneratia alba*, *Ceriops tagal* and *Rhizophora mucronata*. The mangrove areas are harvested for building poles, boat building, charcoal and export trade. Further the mangroves trap terrestrial sediments, litter and nutrients and are thus very important for the protection of other near-shore ecosystems such as sea-grass beds and coral reefs. Mangroves form nutrient rich environments and function as feeding and nursery ground to many species of fish, shellfish, prawns and crabs. Furthermore it has been proven that mangroves are very important for coastal protection as well as for biodiversity conservation. Vegetation Survey results including lists of species identified and detailed information on the various vegetation types and estimates of biomass.

Figure 4.7 gives an indication of the distribution of the different vegetation types in the area. It should be noted, however, that Figure 4.6 gives an overview of vegetation types found in the Project Area as data collected during the field survey were not sufficient for development of a detailed vegetation map.

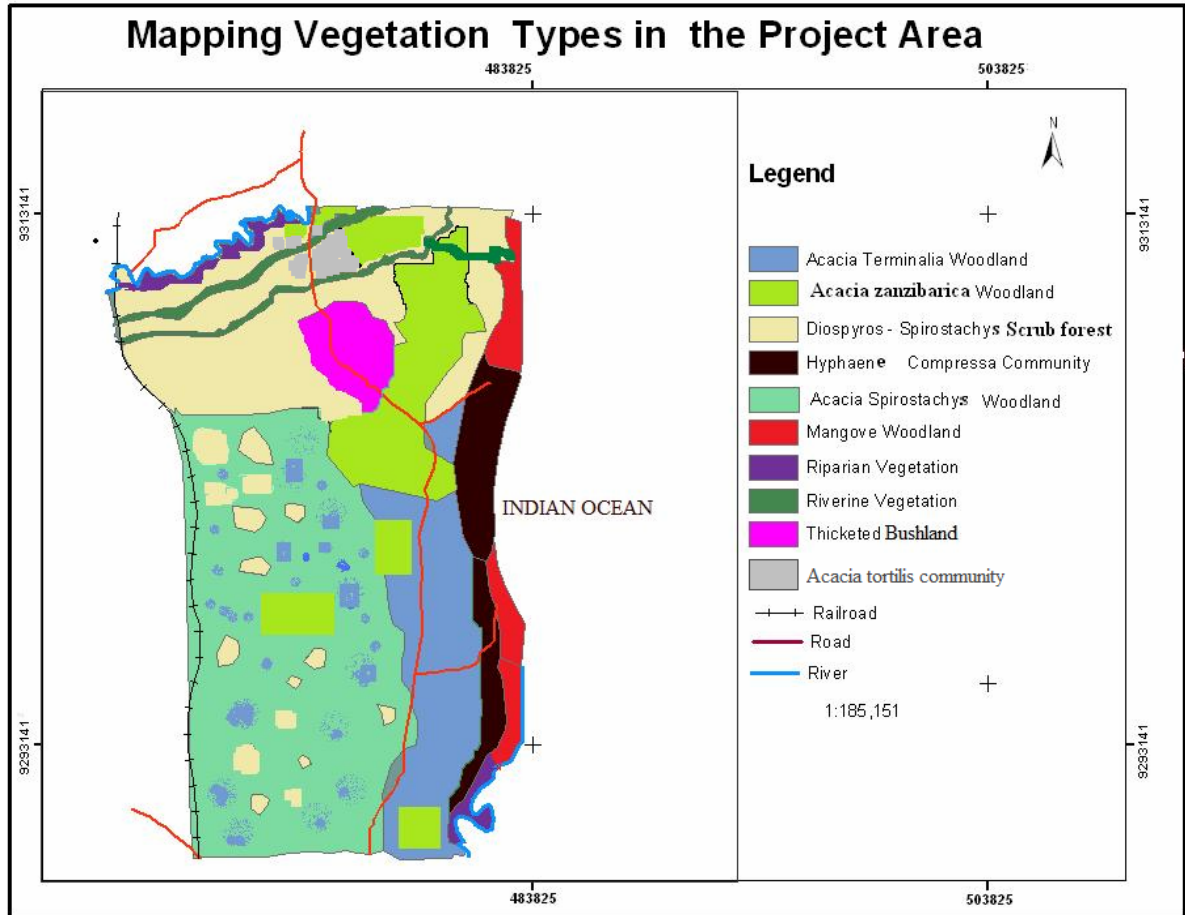


Figure 4.7: Vegetation types in the Project Area

Species of Commercial Value (Flora)

Azelia quanzensis, *Pterocarpus angolensis* and *Dalbergia melanoxylon* that are found in the northern part of the Razaba area are valuable timber species and products from these species have a very high market value. However, the species are also threatened by both local and international demand and the abundances of these species in Tanzania have declined dramatically. Figure 4.8 shows the abundance and the estimated biomass of the economical dominant species observed in the area. (Please refer to Annex 3, Flora and Biomass, for further information).

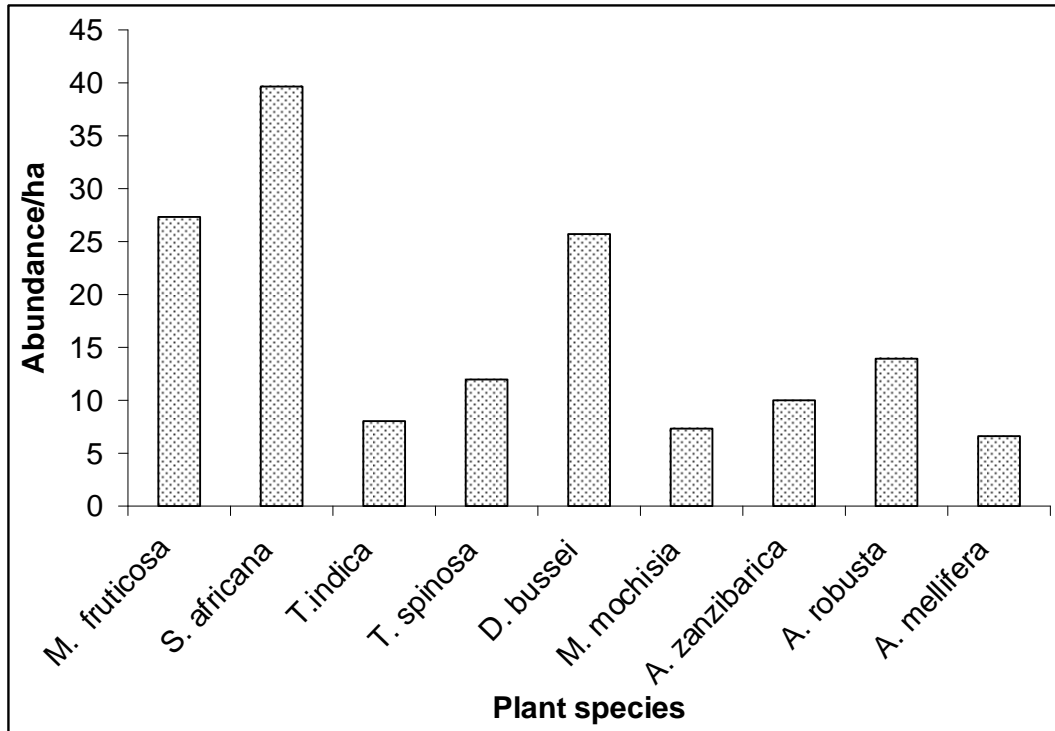


Figure 4.8: Variation of in abundance of the dominant species in the ranch

Estimated wood volumes as an indicator for biomass for important timber tree species in the sample plots are shown in Table 4.3, showing African ebony and Tamarind tree to be the most common timber trees.

Table 4.3: Estimated wood volume as an indicator for Biomass

Species name	Common name	Estimated wood volume in m ³ for the sample plots (total of 2.6 ha)
<i>Diospyros cornii</i>	African Ebony Mkululu, Mkururu, Mkulwe (Sw)	168.92
<i>Tamarindus indica</i>	Tamarind, Mkwaju (Sw)	99.16
<i>Spirostachys Africana</i>	“Tamboti”, Msalakana (Sw)	63.23
<i>Manilkara mochisia</i>	“milk-berry”, Mgambo-kapu (Sw).	12.45
<i>Dalbergia melanoxylon</i>	African Ebony, Zebrawood, Mpingo (Sw)	7.79
<i>Manilkara sulcata</i>	Mchedi, Mcheji-dume (Sw).	3.79
<i>Mimusopsis fruticosa/</i> <i>Mimusops obtusifolia</i>	Mgambo-kapu (Sw).	3.11
<i>Acacia nilotica</i>	Mgunga (Sw)	0.66

Other timber species such as *Pterocarpus angolensis*, *Milicia excelsa*, and *Pteleopsis myrtifolia* were not in the transect lines employed but were occasionally spotted outside the study area. (Please note that the common name “African Ebony” refers to a number of different species).

Sensitive habitats and species (Flora)

Most rare and endemic species are found within the forest thickets and in the riverine vegetation in the northern part of the project area. Such species include the endemic *Encephalartos hildebrandtii* (Cycad tree) and important timber trees such as *Dalbergia melanoxylon* (African Ebony) and *Trichalysia sp.* which are threatened by unsustainable harvesting.

The mangroves at the Razaba area are outside the proposed project area. However as they are at the mouths of the Wami and Ruvu Rivers it is very important to ensure that these areas are not destroyed by silt or chemicals transported from the project area by the water. Also it is important to ensure that the project does not cause large changes in water flow which may influence the mangroves. Scattered large baobab trees (Plate 4.1) and, in the northern part of the area, also acacia trees give the area its unique character and will therefore be spared wherever possible.



Plate 4.1: Baobab tree in the northern Razaba landscape

B. Wildlife

The project area is potentially rich in wildlife and shares many species with the adjacent Saadani National Park. All taxonomic groups including mammals, birds, reptiles, amphibians, fish and many invertebrate groups are represented.

The area has high diversity of both resident and migratory bird species with the composition and abundance of species changing with seasons due to intra-Africa and Palaearctic migrations. The importance of Makurunge area for bird conservation is indicated by the high abundance of birds observed during the EIA survey (see the wildlife Survey for more information).

More than 20 different large mammals are reported from the area. Warthog, duiker Sykes monkey and yellow baboons were physically observed during the EIA survey while elephants, hippos, bushpigs, buffalos, reedbuck galagos were recorded through animal signs. Local hunters and other local people further report the presence of such notable mammals as lion, leopard, cheetah, black and white colobus, sable antelope and wild dog. A complete list of mammals is provided in the wildlife report.

Most of the mammals are resident in the area while a few are migratory. Buffaloes, waterbucks, greater kudu, reedbucks, bushbucks and primates and other mammals are mostly resident and only do daily movements in search of food, water and avoidance of predators.

Migratory mammal species include wildebeest, eland, giraffe and elephants. Wildebeest, eland and giraffe move from Saadani NP during the dry season cross river Wami at Kinyonga to reach Zenko area located between Gama and Kitame. The animals stay at Zenko until the rains start when they return to the park. It is said the dry season refuge area has water and suitable forage and browse (forest, bushes and grass) for the migrating animals.

Sensitive Habitats and Species (Fauna)

At least 34 species of mammals occurring in the project area are threatened according to the IUCN redlist (Table 4.4). Most are at Lower Risk (LR) but at least four species including the lion, cheetah, African elephant and hippopotamus are Vulnerable (VU). The most threatened species is the African hunting dog which is Endangered (EN) hence facing possible extinction in the wild. In the CITES Appendices the African elephant, leopard and cheetah are in Appendix I, the highest category in trading restriction, while the lion and hippopotamus are in Appendix II. Observations suggest that most species are threatened by loss of habitat and overexploitation.

Table 4.4: Wildlife species of conservation significance in Makurunge study area, Bagamoyo

Family/Species	Common name	Status (IUCN)	CITES (Appendix)
Cercopithecidae			
<i>Papio cynocephalus</i>	Yellow baboon	LR/lc	
<i>Colobus angolensis</i>	Black and White Colobus	LR/lc	
<i>Cercopithecus mitis</i>	Blue Monkey	LR/lc	
Galagidae			
<i>Galago senegalensis</i>	Lesser bushbaby	LR/lc	
Hystricidae			
<i>Hystrix cristata</i>	Porcupine	LC	
Viverridae			
<i>Civettictic civetta</i>	African civet	LR/lc	
<i>Genetta genetta</i>	Genet	LR/lc	
<i>Mungos mungo</i>	Banded mongoose	LR/lc	
Felidae			
<i>Panthera leo</i>	Lion	VU A2 abca	II
<i>Panthera pardus</i>	Leopard	LC	I
<i>Acynox jubatus</i>	Cheetah	VU C2 a(i)	I
Canidae			
<i>Otocyon megalotis</i>	Bat eared fox	LC	
<i>Lycan pictus</i>	African hunting dog	EN	
Hyaenidae			
<i>Crocota crocuta</i>	Spotted hyaena	LR/cd	
Mustelidae			
<i>Ictonyx striatus</i>	Zorilla	LR/lc	
<i>Mellivora capensis</i>	Ratel (Honey badger)	LR/lc	
Elephantidae			
<i>Loxodonta africana</i>	African elephant	VU A2a	I
Hippopotamidae			
<i>Hippopotamus amphibius</i>	Hippopotamus	VU A4cd	II
Bovidae			
<i>Syncerus caffer caffer</i>	Cape Buffalo	LR/cd	
<i>Madoqua kirki</i>	Dik dik	LR/lc	
<i>Aepyceros melampus</i>	Impala	LR/lc	
Pedetidae			
<i>Pedestes capensis</i>	Springhare	LC	
Cephalophinae			
<i>Cephalophus harveyi</i>	Red duiker	LRcd	

Family/Species	Common name	Status (IUCN)	CITES (Appendix)
Reduncinae			
<i>Redunca redunca</i>	Bohor reedbuck	LR/lc	
<i>Kobus ellipsiprymnus</i>	Common Waterbuck	LR/lc	
Alcelaphinae			
<i>Alcelaphus bucelaphus cokie</i>	Hartebeest	LR/lc	
<i>Connochaetus taurinus</i>	Wildebeest	LR/lc	
Tragelaphinae			
<i>Taurotragus oryx</i>	Eland	LR/cd	
<i>Tragelaphus scriptus</i>	Bushbuck	LR/lc	
<i>Tragelaphus strepiceros</i>	Greater kudu	LR/lc	
Hippotraginae			
<i>Hippotragus niger</i>	Sable antelope	LR/lc	
Equidae			
<i>Equus burchellii</i>	Zebra	LC	
Suidae			
<i>Potamochoerus porcus</i>	Bushpig	LR/lc	
<i>Phacochoerus aethiopicus</i>	Warthog	LR/lc	
Giraffidae			
<i>Giraffa camelopardalis</i>	Giraffe	LR/lc	
Crocodylidae			
<i>Crocodylus niloticus</i>	Nile crocodile	LR/lc	

The closed woodland patches and forest habitats near the permanent water bodies including the Wami River riparian forest are the most important areas for forest dependent bird species such as Red-caped Robin Chat, Tambourine Dove and Narina's Trogon (Listed in IUCN lists as LC (Least Concern or lower risk). While "Least Concern" is not considered a red listed category by the IUCN, the 2006 list still assesses risk levels of LC species.

Furthermore these relatively undisturbed forest remnants are important to support elephants and other mammals during the wet season.

C. Coastal and Marine Environment

The Razaba area coastline (Plate 4.2) is highly influenced by the outflow from the Wami and Ruvu rivers. In spite of both estuaries having healthy mangroves that help sediment catch, the water is to some extent turbulent and turbid because of freshwater and seawater mixing.



Plate 4.2: Razaba coastline during the low tide period

The existing coral reef is damaged by the turbid water and by past and present dynamite fishing while the seagrass beds and area with macroalgae are relatively undisturbed. A number of creeks including the Mtondwe Creek are dominated by mangrove forest and serve as nursery ground for fish and shrimps. Mtondwe creek feeds water into Kitame salt pans located some few kilometers from Wami River.

4.2.5 Agro-ecological suitability for Sugar Cane production

Judging from the parameters of physical environment (topography, soil, temperature, rainfall pattern and river and surface water) the suitability of the Razaba area for the proposed biofuel project is not optimal. In many places the top soil is sandy and susceptible to erosion during farming operations. Furthermore part of the area is susceptible to seasonal flooding. As organic matter (OM), phosphorus and potassium are limiting parameters for most soils in the Razaba area, the cultivation here will rely on substantial amounts of fertilizer, particularly Diammonium phosphate (DAP) and Urea. At the full operation (i.e. 17,000 ha) the project will use approximately 3400 tons of DAP and 5100 tons of Urea per year. This is a relatively high rate and may lead to environmental degradation and pollution of nearby water bodies and ecosystems if care is

not taken. These amounts can be reduced by re circulating the vinasse produced during the process.

Studies also indicate that optimal temperature requirement for sugar cane cultivation is 26-38°C (Mbogoni et al 2007), which is slightly higher than the average temperatures for the Razaba area.

4.3 Socio-Economic and Cultural Environment

4.3.1 The History of the Razaba Area

Although little can be seen today, the Razaba area has a long history of settlement of farmers, hunters, traders and fishermen who undoubtedly influenced the area by clearing land for cultivation and utilizing the wood. The area has probably been inhabited for at least 1500 years, and until about 1900 the village of Sadani just north of the area was an important trade and harbour town.

However, the area was never densely populated, and although there was cultivation, grazing and hunting activities (accompanied by bush fires to induce new grazing or to simplify the hunting process); disturbances were relatively limited as the frequency of burning was low and only small scale agriculture was practiced. In 1974 the Razaba area was given to the Government of Zanzibar for the purpose of establishing a cattle ranch, and the inhabitants were compensated and resettled outside the area. The ranch was stocked with about 7000 head of livestock and the ranch employed about 300 workers from the mainland and Zanzibar Islands to take care of the livestock.

The ranching strongly affected the area as many forest thickets were cleared to eliminate tsetse flies. Natural wetlands were modified to establish water reservoirs and several roads were constructed. A ranch headquarter was constructed with several buildings including a primary school. The ranch also established a coconut plantation which still exists. Both headquarter and plantation lies to the east of the Makarunge-Gama road on land which is not planned to be part of the biofuel plantation.

The cattle ranch was given up in 1994, partly due to problems with tsetse flies. Also there were problem with lions and leopards attacking livestock. The remaining livestock was shipped to Zanzibar and the ranch was closed. Many of the present woodland thickets started growing up as the cattle was removed and the ranch management ceased.

Since then the area has gradually turned into a semi wilderness used for legal and illegal hunting, charcoal burning and shifting cultivation. Also there has been an influx of pastoralists with a high number of livestock. Seasonal grazing has increased and today there may be a greater number of cattle (possible more than 50.000 heads of livestock in the peak season) in the area than there was during the operation of the ranch. Also there has been an increase in charcoal burning, pole cutting, lumbering and illegal hunting due to the increased demand for these resources from the neighboring towns and cities.

In 2005 the former Sadani game reserve just north of the study area was gazetted as a national park including part of the southern bank of the Wami River in the former Razaba area. (Government Notice No 281 of 2005). This area was included in the national park to protect the mangrove swamps near the estuary and ensure better water access for the wildlife during the dry seasons.

4.3.2 Current Land Use Pattern in the Former Razaba Ranch

Following the abandonment of the ranching project by the Revolutionary Government of Zanzibar (RGZ) in the year 1994 (i.e. 14 years ago), the land was no longer used for ranching purposes. Accordingly, most of the land is currently overgrown with bush. The land use plan of Bagamoyo District shows that Makurunge village is part of the Bagamoyo Township hence it is, in principle, an urban area. Keeping livestock is not allowed in urban areas. The resident herders are mainly of the ethnic group the Barbaig. According to the district authorities preparations are underway to relocate the pastoralists to Mkuranga District within the Coast Region.

The following are the most prominent land uses in the area:

Human Settlements

However, there are a few human settlements in the area such as at the former Razaba Ranch offices within the ranch and a few sparsely populated settlements, some of which are of a temporary or seasonal nature. It is estimated that around 60 former Razaba ranch employees still live in the ranch. According to the Razaba Ranch Manager stationed in Bagamoyo, the former Razaba employees continue living in the ranch without the sanctioning of Razaba. The employees took a personal decision to continue living in the ranch and their occupation of the ranch is not recognised by Razaba. Also, the former Razaba employees are no longer recognised by Razaba and, accordingly, they are not supported by Razaba in any way.

Human settlements that are found within the former Razaba ranch include:

- Former Razaba Cattle Ranch Headquarter buildings. These comprise an office building, 5 houses and a primary school;
- Batini fishing village by the South Eastern coast;
- Mfueni village
- Gama village by the Wami river to the North.

None of the above is within the proposed Bagamoyo BioEnergy Project area.

The Socio-economic survey has documented a number of activities in the area proposed for conversion to sugarcane as well as some activities which are conducted outside the area by both people who are still living in the ranch or villagers and people who are living outside the ranch. These include:

- Villagers from outside who graze their cattle in the Razaba Ranch Area;
- Almost 1,000 of the peasants in the sub-villages of Mtoni, Razaba, Kitama, Gama, Mkwajuni (Makurunge Village) and Mzambarauuni (Matipwili) who cultivate paddy near the former Razaba ranch;
- Cultivation of annual crops, vegetables and some perennial crops in the former Razaba ranch. Annual crops that are planted include maize, rice, and root crops (sweet potato, cassava). Perennial plants are plants that live for more than two years and they include sugarcane, pineapple, bananas, mango, coconut, pawpaw, and citrus fruits (oranges and limes), and cashewnut trees. Vegetables are short-term crops, usually harvested within six months. The vegetables that are grown include main crops e.g. cabbage, tomatoes, potatoes and spinach (*Amaranthus spp.*); legumes eg. peas, and beans; and root crops e.g. carrots and onions.
- Dependence on forest resources for the population living in and around the ranch is high for medicinal plants and charcoal production. The socio-economic study found out that 73 percent of the Makurunge population, 94% of the Kidomole population and 86% of the Matipwili population showed high dependence on forest resources. Charcoal production is a major economic activity in and around the former Razaba ranch.
- Some villagers use the former Razaba Ranch to hunt wild animals such as “Mbala”, “Tohe”, “Funo” (Antelope) and “Kuro” (Waterbuck).
- The Barbaig tribesmen trek through the former Razaba ranch with large cattle herds in search of pasture. They seem to have left the area and to have moved towards Kilwa in January 2008.

The human settlements that are found in the former Razaba ranch are, most of them, of a temporary nature. The majority of the “houses” are simply mud and wattle huts roofed with grass thatch or coconut leaves. These huts are not of substantial value.

Farming

In addition the people from the adjoining villages (Makarunge, Kidomole and Matipwili) use the area for permanent or temporary cultivation, mainly for maize banana and sorghum. The cultivated plots are scattered randomly in the area, but in total covering only a very small percentage of the total area. Cultivation density is highest in the flood plain of the Wami River and in the southwester corner of the area near the railway. It should be noted that the cultivation of crops that is going on in the former Razaba ranch is for subsistence agriculture.

Livestock keeping

The area is not traditionally a pastoral area and the first major livestock rearing programme was that of the Razaba Ranch in 1974. Activity on the Ranch declined during the 1980’s and by the 1990’s it was largely dysfunctional. However, during the last decade pastoralist from other areas of Tanzania including Arusha and Manyara has migrated to the area and today the Razaba area is used for sesonal grazing by a substantial number of cattle.

According to Makurunge village Chairperson, pastoralists are reported to have come to the village sometime in 2003. They were not welcomed to the village hence they had to leave. However, they did not go far and made a second comeback in September 2006. Most herders have settled within Kidomole village (Plate 4.3) land but to avoid conflicts with agriculturists many of these pastoralists graze and water their livestock in the former Razaba Ranch. There are no accurate figures of the livestock present in the village but the village authorities estimate that at any one time there is a minimum of 10,00 cattle in the village land. These numbers fluctuate due to nomadic nature of the pastoral people and at times livestock numbers reach in excess of 50,000 heads.

Livestock have invaded every part of the village land and no single place in the village that can be visited which has no livestock herders or their signs. Although no serious conflicts have been reported between pastoralists and farmers, reports suggest that farmers are not happy with their presence of the livestock in their areas. They complain of livestock raiding crops and destroying the good agricultural soil through trampling. Livestock also compete with wildlife for pasture and water resources.



Plate 4.3: cattle grazing in the Razaba area

4.3.3 Demography of Adjacent Villages

Three villages (Makurunge, Kidomole and Matipwili) and 4 sub-villages (Gama, Razaba, Kitame and Mkwajuni) have land bordering the Razaba area (Figure 4.9). *Makurunge village* has a total population of 1,762. The village is the home of five major ethnic groups: Wakwere, Wadoe, Wazigua, Wanyamwezi, and some Wagogo. The latter two groups are newcomers in search of agricultural land and employment opportunities. According to the Village Government records the village receives an average of 12 new people each year. *Kidomole village* has a total population of 1,266. Some 30% of the total population are children (Table 4.5). The village is comprised of six major ethnic groups: Wakwere, Wadoe, Wazaramo, Wasukuma, Parakuyu and Barabaig pastoralists, and some Wagogo. The latter two groups came into the village in the 1990's in search for agricultural and grazing land. *Matipwili village* has a total population of 2,769 belonging to six major ethnic groups: Wakwere, Wadoe, Wanyakyusa, Wazaramo, some Wagogo and Waluguru. The village still attracts new members to it. According to the Village Government records the village receives an average of 25 new people each year.

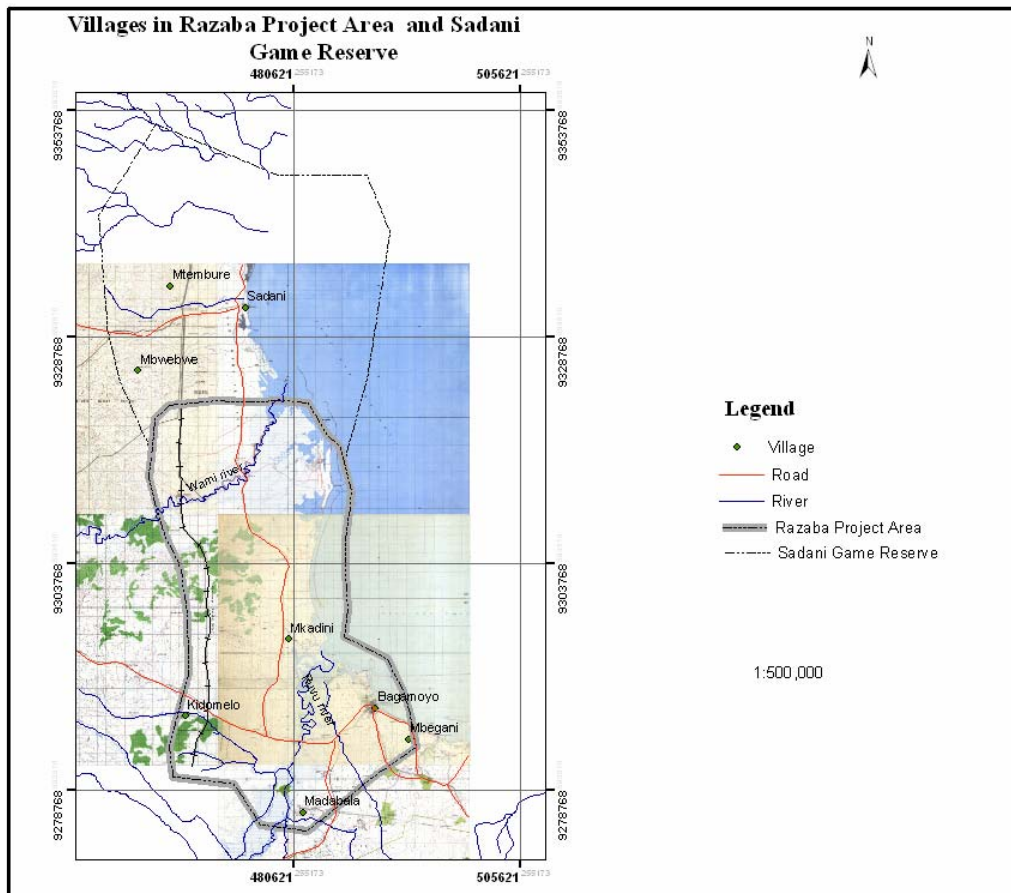


Figure 4.9: Villages in Razaba and Sadani Areas

Table 4.5: Age structure of the population of Makurunge, Kidomole and Matipwili (%)

Cohorts	Villages		
	Makurunge	Kidomole	Matipwili
Age 0 - 6	9	14	8
Age 7 -17	32	13	32
Age 18 -35	19	34	18
Age 36 - 45	18	26	17
Age 46 - 65	15	16	17
Age 66 and above	7	7	8
Total	100	100	100

Source: Field Data, December 25, 2007; Bagamoyo District Council (2006)

4.3.4 Economic Activities in Adjacent Areas

The economy in all villages and sub-villages is based on subsistence agriculture, artisan fishing and small businesses. The major crops grown include maize, paddy rice, millet, beans, cassava, cashew nuts, sesame, sweet potatoes and mangoes and other fruits. On average the size of the farms range from 0.25 to 10 acres. At present access to land is not a constraint and a high proportion of respondents get land through bush clearing especially in Kidomole, Matipwili and Gama. Also land is acquired through inheritance or through village government allocations. Many farmers follow a rotational fallow system involving a few years followed by some years of fallow.

Forest resources in this context include medicinal plants, fuel wood and building poles. A study by Swantz (1974) documented 77 potential medicinal plants along the coast and more recent studies (URT1994) show that the coastal people rely heavily on traditional medicine. The dependence on forest resources is high in all three villages of Makurunge (72.7%), Kidomole (94.1%) and Matipwili (85.7%). Charcoal production is the major forest use and a large proportion of the present charcoal burning takes place within the Razaba area.

Pests and destructive animals like monkeys; wild pigs and elephants are a problem to crop production. Cattle keepers are also posing a significant problem to crop production. Other significant sources of incomes include fishing, petty trading, wage employment and casual labour. A high proportion of the respondents in the sample villages mentioned that these activities are on full time basis. Most of the principal economic activities by respondents in all villages are carried out within the villages of residence.

4.3.5 Physical and Social Infrastructure

Education

Magomeni Ward had 8 primary schools in 2002 with a student teacher ratio of 37 teachers per student. In 2002 there were 4 secondary schools in the ward. Makurunge village, which is located in Magomeni Ward to the South of the proposed Bagamoyo BioEnergy Project area covers an area of 568.3 km² (56830 ha). The Village has 3 primary schools, while Kidomole and Matipwili villages have one and 2 primary schools, respectively. Nevertheless, the primary schools lack adequate classrooms, competent teachers and are short of teaching materials. Only Matipwili has a secondary school. Data from the household survey demonstrate that 52.9% of the respondent households had people with primary school education, 11.1% had children that were attending primary school, while only 1.0% had people who were attending secondary school. A total of 32.4% had no formal education.

Health

Only Makurunge and Matipwili villages have one ill-equipped dispensary each. The dispensary at Makurunge also serves the population in Kidomole. People in Makurunge and Kidomole have to walk long distances to Bagamoyo town to get better health services.

Apart from malaria, waterborne diseases such as diarrhea, bilharzias and typhoid are the main illnesses suffered by the people of this village possibly due to dependence on un-boiled river water. Malnutrition is prevalent and observable especially among the under-fives. According to the village health officers in Makurunge and Matipwili, prevalence of HIV/AIDS is still minimal. On average only two people die annually of diseases with AIDS-related symptoms.

Other neighbouring villages, both in Kiwangwa Ward, are Fukayosi with 245.55km² (24555 ha) and Kidomole with 68.77km² (6877 ha), respectively. An average 18 persons lived on every km² in 2002. Kiwangwa has neither hospital nor health centres. It has four dispensaries catering for an average 5365 people each.

Crime and Local Conflicts

Both information from the Focus Group Discussions and data from the household survey demonstrate that communities within the sample villages are relatively safe. Only 36.4%, 33.3% and 50.0%, for Makurunge, Kidomole and Matipwili, respectively, rated the security situation as moderate or bad. So is the case with social conflicts. The only conflict mentioned was the conflict between agriculturists and livestock keepers over grazing land. Kidomole was the main problem area in this case.

Water and Sanitation

According to the Bagamoyo District Council (20061), most of the villages adjoining Razaba are supplied with water. There are ten piped schemes which provide clean and safe water to 170, 000 people which is equivalent to 73%. Of the ten schemes, 8 of them are minor supplying a total of 50,000 people while the remaining two are giant systems comprising of the Bagamoyo Water Supply Scheme (750 m³/day) and Chalinze Water Scheme (7,200 m³/day). The former (old system) draws water from Ruvu River while the later (new system) abstracts from Wami River. Construction of Phase II of the Chalinze Water Scheme is anticipated and its implementation will benefit 38 villages in Bagamoyo District (and 4 villages in Kibaha District), including the villages of Kiwangwa, Kidomole and Makurunge that border the SEKAB BT sugarcane plantation.

However, Information collected from fieldwork connected with this EIA indicates that the villages surrounding the proposed sugarcane plantation have no provision for clean and safe water. They depend on Ruvu and Wami River (e.g. Gama Village) or other seasonal streams. Some fetch water from the dams within the Razaba Ranch (the project farm area) – Mwakanga, Razaba Headquarters (no longer functioning after erosion of the embankment), Kwa Makonge and Tambwezi. In all villages, open dug wells (Plate 4.4) are commonly used. However, these wells are not protected and therefore they are prone to pollution.



Plate 4.4: A typical open dug well in the project area

About 66.0% of the respondents in the sample villages rely on uncovered water sources for drinking water. None have access to covered water, communal standpipes; pipe outside or inside houses. The major source of drinking water for Makurunge and Matipwili is Ruvu and Wami Rivers, respectively, which are between 5 and 10km away. Water has as a result become a commodity. In Makurunge village, for example, water is selling at Tshs 200/- per 20-litre container.

Lack of unreliable and clean water has had negative impact on people's health. In the villages we conducted meetings the common diseases mentioned were typhoid, dysentery and diarrhoea. Providing improved water services in these villages would undoubtedly improve hygiene and reduce incidence of waterborne diseases.

Pit latrines are the commonest type of toilet for the people in the sample villages. More than 90.0% of the respondents in the sampled villages use covered pit latrines while an insignificant number uses the forest or other facilities.

Roads

Makarunge and Kidomole are accessible from Bagamoyo town via an all weather road that runs through both villages onto Msata. The road to villages north of Makurunge are, however, very poor; being passable only during the dry season. During the rain season Ruvu River is prone to flooding; making much of the area impassable. Also the road joining other villages north and south of Kidomole are, however, very poor; being passable only during the dry season. A much used motorcycle track goes north along the railway from Kidomole along the western side of Razaba.

Matipwili is accessible from Bagamoyo town via an all weather gravel road via Msata, Miono and Mkange. The road from Mkange is poor; being passable only during the dry season. It is also possible to reach Matipwili from Makurunge via a rough seasonal road across Wami River.

Energy

The major source of lighting is kerosene. Over 95% of the respondents use kerosene for illumination. Fuel wood is by far the major source of energy for cooking. Dependency on fuel wood ranged from 79% for Makurunge to 100% in Kidomole and Matipwili. The use of charcoal is insignificant in all villages. However, charcoal making activities are quite significant in Makurunge and Kidomole villages, most of which is targeted for Bagamoyo and Dar es Salaam markets.