DEA
Development and
Energy in Africa

TANZANIA TRADITIONAL ENERGY DEVELOPMENT AND ENVIRONMENT ORGANIZATION (TaTEDO)

DEVELOPMENT AND ENERGY FOR AFRICA (DEA)

Evaluating the Sustainable Development Impacts of Renewable Energy Interventions "The Case Study on Small Scale Irrigation Schemes powered by Wind/ Solar in Ukerewe District, Mwanza Region, Tanzania"

The Solar PV powered pumping system

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FINAL REPORT
19 January 2007

ACKNOWLEDGEMENT

I wish to express my gratitude to Tanzania Traditional Energy Development and Environment Organization (TaTEDO) for offering me the opportunity to undertake this study, which was challenging and interesting. I would like to sincerely thank the Executive Director, Mr. E.N. Sawe with all TaTEDO staff. Specifically, I would like thank Ms. G. Ngoo, the DEA Project Coordinator and Mr. Emmanuel Michael whom I worked closely with during the whole research period. I am also grateful to Dr. Gordon Mackenzie, the DEA Energy Policy Coordinator, RISO National Laboratory, Denmark, his critical comments on the draft report provided valuable input for this report.

My grateful thanks also go to the following institutions and key resource persons:

The National Coordinator UNDP/GEF Small grants Programme, Mr. Nehemiah K. Murusuri.

The Ukerewe District Council Office; Dr. L. M. Masale (DED), Mr. Samson Ibrahim (DALDO), Mr. T. B Ndunguru (DPLO) and Mr. M.C. Wa-Mjungu (DLO).

The success of this study is greatly attributed to many other institutions and individuals (the leaders of the two Water User Associations Nakatunguru Mwanzo Mgumu and Namagubo Nguvu Kazi in Ukerewe and the beneficiary farmers) who rendered their invaluable support and time to the study team. I am greatly indebted to all.

Many grateful thanks go to Mr. Masatu Magafu (DCrO) and Mr. Issa Mugengi (WEO) for providing valuable information and cooperation during the data collection period.

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LIST OF ABBREVIATIONS

AF	Assessment Framework
CBO	Community Based Organization
DALDO	District Agricultural and Livestock Development Officer
DCrO	District Crop Officer
DEA	Development and Energy in Africa
DED	District Executive Director
DLO	District Livestock Officer
DPLO	District Planning Officer
EC COOPENER	

ECN	Energy Centre of Netherlands
GEF	Global Environmental Facility
GNI	Gross National Income
MDGs	Millennium Development Goals
M&EED	Monitoring and Evaluation for Energy and Development
MoAF	Ministry of Agriculture and Food Security
NC	National Coordinator
NGO	Non Governmental Organization
NSC	National Steering Committee
NSGRP	The National Strategy for Growth and Poverty Reduction
PAF	Preliminary Assessment Framework
PV	Photovoltaic
RETs	Renewable Energy Technologies
RISO	
SACCOS	Savings and Credit Association
TaTEDO	Tanzania Traditional Energy Development and Environment Organization
UNDP	United Nations Development Programme
UNV	United Nations Volunteer
USD	US Dollar
WEO	Ward Extension Officer
WP	Work Packages

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EXECUTIVE SUMMARY

Background

This study was commissioned by Tanzania Traditional Energy Development and Environment Organization (TaTEDO) in order to identify and analyze the impacts of the demonstrational irrigation projects, which uses solar and wind technologies for pumping water from the Lake Victoria using the Preliminary Assessment framework under development by the Development and Energy in Africa (DEA) project. The study aimed at testing the DEA Assessment Framework.

The Terms of Reference for the Study are included as Appendix I herein.

Methodology and Approach

The study is based on information collected from primary sources in the field where 46 respondents were interviewed. The secondary data included the review of project documents and other available documented reports, information and studies that were thought of relevance to this study. Field visits to the projects provided useful information in the form of discussions with the beneficiary farmers, their leaders, the Ukerewe District Officials and various other key persons. The study was complemented by physical site visits to the sites where solar and wind equipment are installed. Stakeholders' analysis was conducted to understand the interests, stakes and responsibilities of all the stakeholders involved in designing and implementing these projects.

Main findings

Two renewable energy projects (solar and wind powered water pumps) in Ukerewe District were studied. Both projects accessed pumped water for a very short period of time (three months) to warranty measuring of tangible impacts. The drastic falling of water level on the Lake Victoria during the past three to four years due to drought conditions (rains account for 85% of water inflow into the lake) is a major contributor to the unsuccessful projects operations. The lake water is now only 19 centimeters higher than the lowest level ever recorded since 1896[1].

Some of the Nakatunguru beneficiaries accessed pumped water for a period of three months, between December 2002 and January 2003. *The interviews conducted to beneficiaries revealed that access to water was increased during the three months when they were getting pumped water. Though it was difficult to quantify, but people were able to get a lot of water to fill their fields and could wait for two days before they needed water again. This reduced the drudgery of carrying water from the lake to the fields almost 250m away, therefore it was assumed that women were able to attend to other activities and children had more time for study and leisure. Also access of enough water made the farms more healthy possible for planting crops like paddy and all other kinds of vegetables.*

[1] The Guardian Wednesday, November 22, 2006.

The two projects aimed at demonstrating the use of renewable energy technologies which safeguard environment and hence reducing emissions of green house gases caused by the use of diesel engines, increase production of food crops in order to reduce and eventually eradicate food poverty to Lake adjacent communities, grow high value crops e.g. tomatoes, onions, sweet pepper etc., all year round in order to raise incomes with a view to addressing income poverty and reduce incidence of people being attacked by crocodiles.

Conclusions

The study analyzed effects of social, technical, economic, environmental and political influences on both projects' impacts. Environmental influence (climate change) has seen to have a greater negative impact on both projects.

To better understand why the identified impacts occurred, the study was complemented by the stakeholders' analysis highlighting the roles of the different actors, their activities and related institutions in determining project impacts.

Recommendations

Engineers should study the possibilities of re-designing the pumping systems (both solar and wind) to make sure that they operate as intended;

Studying of the rainfall pattern, underground water source and international water rights/ uses taking into consideration that Lake Victoria water falls under international waters is of crucial importance. A possibility of rain water harvesting should also be looked at;

There is a need for clearer responsibilities amongst stakeholders;

There is a need for more flexible solutions better adapted to the local context;

There is necessity for conducting further study in order to find out a way for incorporating Assessment Framework in the impact assessment and continue to modify the framework to broaden its application.

1.0 INTRODUCTION

1.1 Background

The **Development and Energy in Africa (DEA)** project is the project under EC COOPENER Programme; it's a 30 months programme, which started officially on 1st May 2005. The overall programme is implemented by RISO National laboratory Denmark (coordinator) and Energy Centre of Netherlands (ECN) in six African countries. DEA's goals are to provide evidence of development impact and to feed back into the policy and project implementation process. The project aims at identifying and examining the developmental impacts of energy innovations. The information obtained is used to improve on-going and future energy interventions.

Specifically, the project focus on examining the energy interventions in the six African participating countries with respect to development impact and methodological Assessment Framework (AF) (see fig. 1) in order to identify, document and evaluate the impacts of small and medium-sized energy projects in six African countries, working with multi-sector stakeholder groups. The Assessment Framework will be a planning tool, decision-making tool, impacts assessment tool, monitoring and evaluation tool for policy makers, energy and development planners. The results of the Assessment Framework are expected to feed back into inception and design of new projects. The AF will be formulated based on the assumption that energy interventions have (positive) impacts on community poverty alleviation and might be predicted with some degree of certainty.[2]

DEA aims at:

- establishing and applying an Assessment Framework for evaluating development and poverty alleviation impacts of energy interventions
- engage in a dialogue with energy policy makers and other stakeholders on the basis of the framework, with a view to incorporating these issues in energy policy.

In Tanzania DEA implementing centre is Tanzania Traditional Energy Development and Environment Organization (TaTEDO). TaTEDO is actively involved in promoting sustainable energy development services in rural areas. TaTEDO's vision, mission and goals are as follows:

Vision

TaTEDO's vision is to become a best practice sustainable energy organisation committed to the achievement of communities with access to reliable and sustainable modern energy services, poverty free, economically strong, environmentally secure and socially well-off.

Mission

The mission of TaTEDO is to develop and promote increased access to modern sustainable energy technologies and services through programmes development and

[2] Wilson S.K. Wasike and Miriam Hinostroza, Zero Draft, Towards a Preliminary Assessment Framework.

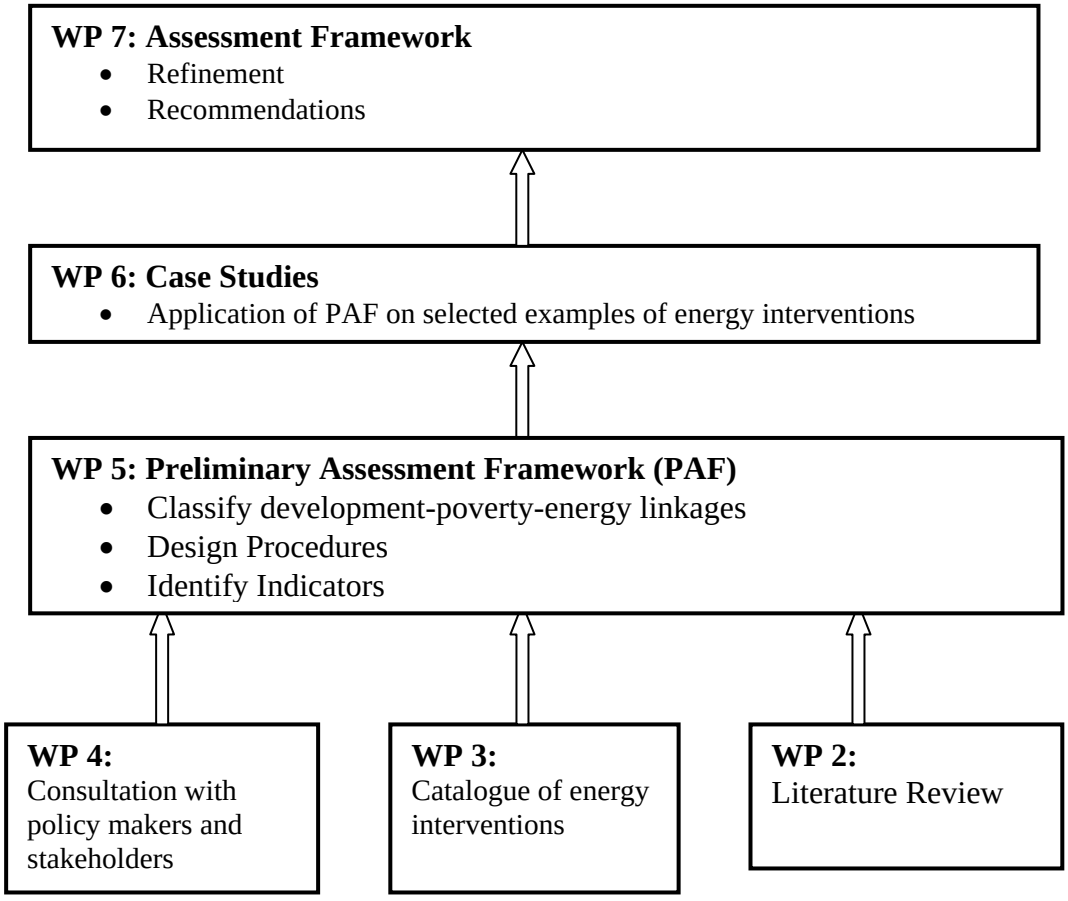
implementation to provide relevant information, knowledge, skills, developing strategic partnership and influence policy geared towards socio-economic development of communities, poverty reduction and environmental conservation.

Goals
TaTEDO's goals are to:

- Improve quality of life of Tanzanians by contributing to availability of improved and sustainable energy services, employment and income generating opportunities, which are essential for poverty reduction,
- Reduce environmental degradation resulting from increased use of wood and fossil fuels,
- Assist the country to reduce dependence on imported energy.

DEA in collaboration with TaTEDO, which is a national center for DEA project in Tanzania have selected a project on small scale pilot irrigation projects, which use wind and solar technologies for pumping water from lake Victoria in Nakatunguru and Namagubo villages in Ukerewe District as a case study for testing the assessment framework.

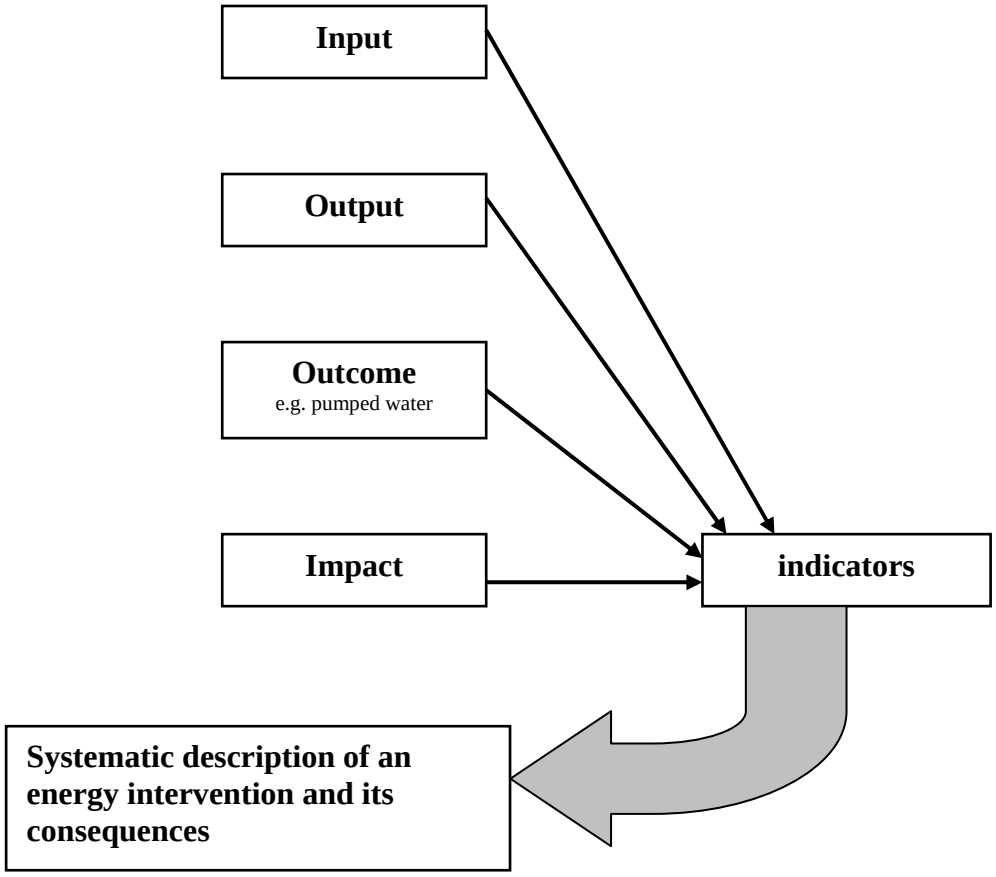
Figure 1: Process in developing the PAF



Source: www.deafrica.net

Fig. 2: Preliminary Assessment Framework four – level approach

The Preliminary Assessment Framework (PAF) is a four-level approach to carrying-out an impact assessment of a given energy intervention as follows[3].



[3] The framework was developed by the M & EED group.

1.2 Objectives of this study

The overall objective of the study was to use the DEA PAF in identifying and analyzing development impacts due to the installed pilot irrigation projects, which uses solar and wind energy for pumping water from the Lake Victoria.

Specific objectives are:

- To assess the development and poverty impacts of the Ukerewe wind and solar powered water pumping intervention;
- To assess the impacts of intervention to the Millennium Development Goals;
- To recommend how the Preliminary Assessment Framework could be improved to be able to measure the development and poverty links
- To recommend how can the information gained improve the design of ongoing and future energy projects
- To recommend how can energy and other relevant policies be enhanced to take these issues into account**.**

1.3 Study methodology

1.3.1 Sampling and Data collection

The study has used both primary and secondary sources of data.

The secondary data included a review of available documentations and studies that we have thought of relevance to this study. These included project documents for the GEF Small Grants Programmes which were funded between 2001 and 2003, the Ukerewe District Profile, Development and Energy in Africa: WP 4.2.4 – Policy Makers' Needs, Synthesis Report, Monitoring and Evaluation for Energy and Development – Template for Technology Specific Modules and the Sustainable Pathways to Attain the Millennium Development Goals – Assessing the Key Role of Water, Energy and Sanitation.

1.3.2 Primary data collection:

Participatory data collection tools and structured questionnaires were used to collect primary data for the study. At least 46 men and women respondents were contacted and interviewed using structured questionnaires, focus group discussions or workshop setting discussions as indicated below:

Due to time constraint (5-day field work), the time was not on the researchers favour to do a proper random selection of interviewees but all farmers were informed and interviews were conducted to those who showed up. The interviewees 11 farmers (4 women, 7 men) from Nakatunguru Wind powered irrigation system and 12 farmers (4

women, 8 men) from Namagubo Solar powered irrigation system. Due to small number of farmers participating in these two projects, the researchers wished to interview (if possible) all farmers but time did not permit, and also researchers had to observe that interviews are conducted at times which caused least disruption to farmers' daily routines. Farmers' interviews took place near their gardens.

Sixteen (16) projects committee members (Naktunguru 9 and Namagubo 7) were interviewed at a Focused Group Discussion setup.

Six (6) officials from the Ukerewe District Council were consulted in workshop setting where the researchers presented findings of the study and gathered their views and comments. The officials were District Executive Director, District Planning Officer, District Agricultural and Livestock Development Officer, District Crop and Irrigation Officer, District Livestock Development Officer and Ward Extension Officer.

One (1) key informant from the UNDP/GEF Small grants Programme was consulted and provided insights about the two GEF funded projects.

Two district council's officials (District Crop & Irrigation Officer and Ward Extension Officer) acted as key informants and accompanied all visits to interview farmers and provided background information on the two projects.

The questionnaires were designed to test the intended outcomes and impacts of the two projects in order to help test the Preliminary Assessment Framework (PAF), with the hypothesised development impacts resulting from the wind or solar irrigation pumping project in terms of reduced income poverty, reduced hunger, improved social relations, gender and sustainable environment (see figure 2).

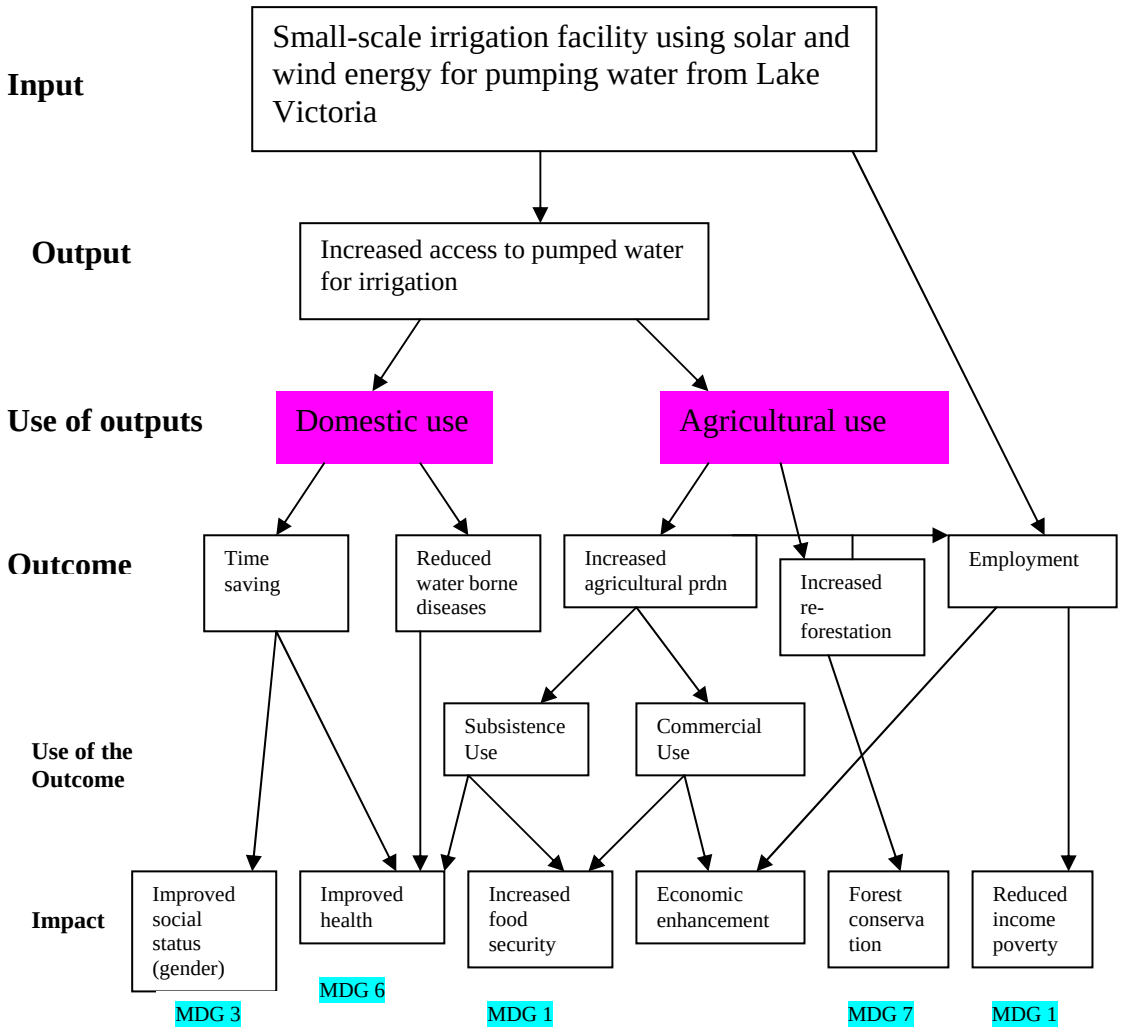
* For all the interview guides see Appendices

The analysis of responses from the respondents was done using just a simple statistical method using Ms Access software.

1.3.2.1 Application of DEA framework and Stakeholders Analysis

To apply the DEA framework and assess project outputs and outcomes, questions were based on selected indicators. Due to the fact that the input was not functioning as a result of sudden fall of water level at the Lake Victoria, the study was complemented by analysing the different roles of various stakeholders (see chapter 5).

Fig. 3: Hypothesized development chain for small-scale wind/ solar powered irrigation projects.



1.4 Scope and Limitations

The study focused on the Ukerewe solar/ wind powered irrigation schemes. The application of the DEA framework to assess project outputs and outcomes could not be done due to the fact that the energy components were not functioning as a result of drastic fall of water level at the Lake Victoria, the study was complemented by analysing the different roles of various stakeholders (see chapter 5).

Also no baseline data was collected during project design and therefore no target indicators were set for the purpose of measuring project impact to the intended beneficiaries.

As a result of the above reasons the study focuses on why the present project has failed and tries to establish a baseline, which may be of use at a later stage when the energy components will be fully operational.

This research has been conducted during the dry season when water level in Lake Victoria was historically low; it would be wise to conduct the same research during the rainy season for comparison.

Despite these facts, the research team believes that the information analysed and presented form a sufficient base for the conclusions arrived at and the recommendations made.

1.5 Presentation of the rest of the report

Apart from this introductory chapter, the rest of the report is organized in six chapters.

Chapter two presents overview of the Ukerewe district, Chapter three describes the projects and the beneficiaries of the two projects, and this chapter also reviews the intended outcomes and impacts of the two studied projects.

Chapter four presents research findings for the demonstrational renewable energy technologies in the Ukerewe district.

Chapter five analyses the different roles of various projects stakeholders and

Chapter six provides conclusions, recommendations and way forward for the use of renewable energy technologies in the Ukerewe district.

1.6 Field Work

One week (27 September to 2 October 2006) was spent in Ukerewe Island. Information discussions and interviews were held with farmer beneficiaries of the energy interventions, the two projects' committee members and District council officials (DED, DALDO, DCrO and WEO). For more details see appendix: IV.

2.0 BRIEF OVERVIEW OF THE UKEREWE DISTRICT

2.1 Location

Ukerewe District is one among eight districts of Mwanza region in the western part of Tanzania. Other districts are Magu, Misungwi, Kwimba, Geita, Sengerema, Nyamagana and Ilemela. The Ukerewe district is an island in Lake Victoria located between latitudes $1^0 45^/$ and $2^0 15^/$ S and longitude $32^0 45^/$ and $33^0 45^/$ E. The district comprises of 27 islands located in Lake Victoria. In the North and east Ukerewe district is bordered by Musoma Rural and Bunda districts in Mara region, while in the south it is bordered by Magu and Ilemela districts and Sengerema district lies on the west. The district headquarters is Nansio which also serve as the main gateway into Ukerewe.

2.2 Size

The district is an agglomeration of islands and consists of 27 islands amongst which 16 are permanently inhabited by people and the rest 11 islands are temporarily inhabited by people and used as fishing camps. The district occupies a total area of 6400 square kilometers out of which 640 square kilometers is land and 5760 (or 90%) is water.

2.3 Basic Land Use

There are about 38,000 farm families in Ukerewe district, with an average of 6 members. The average farm size is 1 – 3 acres but there are variations, few farmers have less than 0.5 ha. About 80 percent of the total cultivated land is planted by crops especially food crops.

2.4 Communication

The overall performance of any sector depends on communication facilities like roads, telephone etc. Being an island the greatest means of transport are boats, ferries and ships. The District can communicate with other districts through, land line telephone services and mobile phones. But in case of communicating with rest of the island mobile phones are being used.

The transport services between Nansio town and Mwanza city are being done by TRCs ships namely MV Serengeti, MV Butiama & MV Clarias. These ships use 2.30 to 3.00 hours for 54 km.

The single and only road leading outside the District connected by way of ferry which communicates between Lugezi in Ukerewe and Kisorya in Bunda district of Mara Region.

The District has an air strip by which plane services could buffer the road and water constraint. The plane also could serve for transporting agricultural products to the market. Nonetheless, the airdrome is small, operates only seasonally and is not well maintained due to lack of funds.

Internally, the district roads have a road network with a total length of 315 kms. Since the soil type of the island is sand loam, most roads are not good due to easily erosion by rainfall. The best solution for the situation is to use the water seal sand or compacted morum. With limited resources of the Council it can't afford unless assisted.

2.5 Forests

Forests occupy an area of 92.38 square kilometers of which 29 square kilometers are reserved forests and 89.48 are natural. Forests in the district are used for fuel wood, timber, soil and water conservation purposes. The rate of deforestation is high compared to the rate of afforestation. Many trees are cut for drying fish, burning bricks, land preparation and as fuel woods.

2.6 Economy

The economy of the district is twofold, fishing activities and agriculture.
Ukerewe is famous for fishing activities, fishes are used as subsistence products but mostly as a cash product within and outside Tanzania.

However, agricultural activities are dominant. The district has favorable conditions for a wide range of crops. The crops grown include: cassava, sweet potatoes, paddy, banana, legumes, maize, sorghum, groundnuts, green vegetables, citrus, pineapples, bambaranuts, mangoes, coffee, palm, cocoa, sisal, cotton, simsim and sunflower.

The main food crop is cassava followed by sweet potatoes. Cassava is now used as cash crop and at the same time used as main staple food. The neighboring districts depend on Ukerewe for Cassava.

The district has a big potential in fruit production. The common fruits produced include: citrus, orange, pineapple and mangoes. The neighboring districts including Mwanza city and Musoma depend on Ukerewe for fruits. One of the major problems of fruits production in the district is the old age of the trees and varieties. Most of the trees are old thus leading to low production, but also the varieties are not the ones which meet international market standards. There is a great need to introduce good varieties. The varieties are available at Sokoine University of Agriculture in Morogoro.

3.0 PROJECTS DESCRIPTION

In year 2001, UNDP/ GEF Small Grants Programme funded some 8 small scale irrigation projects that use wind and solar power in the Lake Zone (Ukerewe, Magu, Bunda and Musoma), to address food poverty as well as income poverty. The main objective was to promote wide adoption of renewable energy technologies specifically wind energy and solar power for water pumping and irrigation farming for villages that are located adjacent to Lake Victoria. It was argued that villagers living on the shores of Lake Victoria continued to suffer from food shortages due to deficient rain pattern while there was plenty of water in Lake Victoria. From this premise the secondary objectives are:

- To increase production of food crops in order to reduce and eventually eradicate food poverty to Lake adjacent communities;

- To grow high value crops e.g. tomatoes, onions, sweet pepper etc., all year round in order to raise incomes with a view to addressing income poverty;

- Wide use of renewable energy technologies will reduce emissions of green house gases. This will impact positively on global atmosphere.

The two projects in Ukerewe are managed by an executive committee comprised with the chairperson, secretary, treasurer and three members. The United Nations Volunteer Irrigation Engineer who is based at Bunda and assisted by District Irrigation Technicians from each participating district coordinates implementation.

Projects funds were disbursed directly to the groups. Group treasurers were trained to increase the accounting skills. For control purposes, funds were not drawn unless minutes are provided to show that the respective Project Committee endorsed the transaction being presented and checks prepared by the groups are counter-signed by an authorized officer at the District Council.

The following is the description of the two water pumping projects in Ukerewe District, Mwanza Region.

Nakatunguru Wind powered Small scale irrigation scheme.

The scheme is located at Nakatunguru village, about 2 km south west of Nansio Township and owned by Nakatunguru Farmers Association group.

Nakatunguru farmers came together as a group in the year 2000 with 6 members and 3 acres, to date the group has grown to 36 members owning 50 acres.

The group received funding from UNDP/GEF Small Grants Programme in October 15, 2001.

Figure 4: The Wind powered water pumping system

During that time the group had already grown to 12 members plus 8 who had applied for membership.

Total project cost was TShs. 43,277,908 while group's contribution was TShs. 1,910,316 and grant requested was TShs. 40,519,006. Project expected to expire by December 31, 2003.

A wind and gravity irrigation system was recommended since wind is not available in constant magnitudes and direction. A 20 ft Kijito windmill (from BHL Thika Kenya) was installed close to the Lakeshores whereby water is being pumped through a mains pipeline to a 120,000 liters storage tank from where water flows by gravity to gardens and farms.

Due to non-completion of project activities (works that could not be finished due to changes in the price level and procurement and delivery problems), consolidation funds amounting to TShs. 3,750,000 were provided to this project in 2005.

Other intended purposes for consolidation funds were extension of main water inlet, provision of domestic water supply lines so that the project can cater for both irrigation farming and domestic water supply and farmers' re-training in agronomy, marketing and finance management.

Namagubo Solar powered small scale irrigation Scheme

The scheme is located at Namagubo village, about 1.5 km east of Nansio Township and owned by Namagubo Farmers known as Mwanzo Mgumu group.

Namagubo farmers came together as a group in 2000 with 5 members and 5 acres of land, to date the group has grown to 60 family members owning 50 acres of land.
This project received funding from UNDP/GEF Small Grants Programme in October 15, 2001 when the group was already grown to 14 members.

Total project cost was TShs. 44,224,630 while group's contribution was TShs. 2,050,000 and grant requested was TShs. 42,174,630. Project was expected to expire by December 31, 2003.

A demonstrational solar and gravity irrigation system was recommended and installed. The installed capacity is 1920Wp with 16 pieces module KYOCERA KC 120-1 manufactured by Kyocera Corporation Japan. The system was installed close to the Lakeshores whereby water is being pumped and stored in an elevated tank during the day (solar pumps can only operate during the day light part of the day). Water collected in the tank can flow by gravity to the desired parts of the farming areas. Water is pumped through a mains pipeline to a 100,000 liters storage tank from where water flows by

gravity to gardens and farms.

Construction work for wells, canals and reserve tank was completed in 2003 but installation of Solar panel could not be done before September 2004 due to delayed shipment from Japan.

Consolidation funds amounting to TShs. 6,250,000 were provided to this project in 2005 for extension of inlet main, provision for domestic water supply, extension of main canal to increase command area and farmers re-training in agronomy, marketing and finance management.

Three capacity building trainings were provided to the Namagubo group:

1. Some of the group members attended the Tengeru horticultural training programme (this was conducted twice);

2. Some group members attended training on how o manage and maintain an irrigation facility (ditches, wind/ solar facility);

3. Leadership training on how to lead and enhance group cohesion, how to conduct group meetings, writing of minutes, the meaning of quorum and change of leadership.

3.1 Expected Impacts of the Ukerewe projects

The expected impacts of the two projects include:

- To facilitate the economic growth of the Nakatunguru and Namagubo communities through increased agricultural productivity as a result of irrigation using water from Lake Victoria;
- To promote self employment as a result of permanent economic activities in the area and contribute in reducing rural-urban migration of youths (job creation);
- To ensure self sufficiency in food to the children and to the beneficiary communities by creating a year round production of several types of crops;
- To improve nutritional and health levels of the two communities through the availability of different kinds of crops;
- To encourage proper utilization of Lake Victoria which is the second largest fresh water in the world for agriculture as Tanzania own 51 percent of the Lake's area; and
- To increase food security in the Ukerewe district.

3.2 Expected projects outcomes

The expected outcomes of the two projects encompass:

- Increased crop (cash and subsistence crops) yields per unit area;
- Improved living standards;
- Increase in number of people involved in farming activities;
- Experiences worth to consider in the review of National policy on irrigation;

- Increased farmers' incomes;
- Access the multiple-use of the water available from the pumping facilities;
- Reduce workload in the part of women; and
- Reduce incidence of people being attacked by crocodiles.

Though project documents do not indicate any baseline indicators to be used to measure impact to beneficiaries during project implementation, the results of this present study can be used as proxy baseline indicators since the results capture current projects status.

3.3 Expected projects output

The expected output of both projects is increased access to solar/ wind-powered pumped water.

3.4 Projects activities

The following project activities were implemented:

- Recruiting contractors for topographic survey and equipment procurement, installation and user's training;
- Agree on district administration support and coordination roles;
- Conducting topographic survey of the project site;
- Planning and sitting the windmill/ solar PV System;
- Procurement of equipment;
- Construction of water storage tanks;
- Construction of intake channel, drainage ditches and canals;
- Windmill/ Solar panel installation and on-the job training of at least four members from each group;
- Excavation of trenches, laying of pipes & refilling of trenches; and
- End of installation users' training seminar

4.0 RESEARCH FINDINGS

This chapter is based on the collected data from the survey; the analysis helps to point out the assessment of the preliminary assessment framework and major constraints in the water pumping systems from the two projects studied.

For the purpose of this study, the research findings are organized in three sections namely; technical findings, economic findings and environmental findings.

4.1 Technical findings

It was important for the researchers to gather technical information for the two projects because on the arrival to the two project sites it was clear that the equipments are not functioning.

4.1.1 The wind powered water system

Status:

- Shaft connected to the sanction pump is disconnected;
- The system needs lubrication;
- Water position shifted by 90 meters from the original position;
- Water depth has fallen by 1.55 meters for the past 4 years
- Water depth falling rate over the past 4 years is 38.75 cm/year;
- During the operation the system was able to fill $120m^3$ a day;
- The well has been moved to 48 meters from the original position, construction is underway.

Remedial Actions:

- Complete the on going installation of the new position and see the results

4.1.2 The Solar PV powered system

Status:

- One module (120W) stolen reducing the power from 1920W to 1800W;
- Water position shifted horizontally by 120 meters from the original position;
- Current distance from the pump to the lake is about 140 meters;
- Originally the lake was about 20 meters from the pump position;
- The canal inlet is dry (approximately 1 meter depth);
- During the operation the system was able to fill $100m^3$ per 1.5days i.e. $67m^3$/day;
- With 1800W the system can pump $63m^3$ of water per day.

Remedial Actions:

- Increase the depth of the well to get the level of the lake so that water can be drawn by gravity towards the well;

- Shift the well position to near the lake (100 meters) and use of a larger cable (recommended 35mm^2) to reduce electrical losses and system instability;
- Replace the stolen module to increase system pumping capacity.

The following should be expected when trying to do modification:

- Losses due to transmission distance;
- Losses due to increased dynamic head from 16 meters to approximately 17 meters;
- A total loss of approximated 10% should be expected (1920W down to 1728W) and hence more time to fill the tank;
- Difficulty in security undertakings since the pump and the panel will be situated at two different locations.

4.2 Core problem for both systems

The major problem faced by both projects is a considerable reduced depth of Lake Victoria water; this is contributed by various factors. The major reason is a climate change that caused drought in the past three to four years; high rate of evaporation and environment mismanagement by communities within vicinity of the lake.

4.3 Possible long term solution

Developing deep bore holes to get underground water instead of depending on the lake water which seems to be unreliable due to climate changes.

4.4 Establishment of a baseline data for future impact assessment

Due to the fact the two energy components were not working, then the researchers had no alternative but to capture information on the current status (baseline) to be used at a later stage to measure impact when the components are fully operational.

4.4.1 Current status of the two projects that can be used as a baseline to measure performance at a later stage when the energy components are working.

The primary data collected and analyzed during the survey was based on the PAF's intended outcomes and impacts as well as the expected projects outputs as described in both projects documents. Since both of the energy components were not working due to drastic fall of lake water, the researchers established baseline indicators that can be used as a baseline for future impact assessment. The baseline indicators aim at assessing the development and poverty impacts of both the wind and solar water pumping interventions. The questionnaires were aimed at gathering baseline data on the following intended projects' outputs, outcomes and impacts to the beneficiaries:

Output: - Increased access to solar/ wind pumped water

Outcomes: - Time Saving
- Reduced Water borne Diseases

- Increased Agricultural Production as a result of increased acreage and access to water hence reduced income poverty and reduced hunger
- Employment creation (increased number of households using/ accessing pumped water)

Impacts:
- Improves Social Status (gender)
- Reduce Income Poverty
- Increased Food Security
- Economic Enhancement
- Forest Conservation
- Improved Health

Both projects accessed pumped water for a very short period of time to measure tangible impact. For example, the construction for the Nakatunguru wind pumping system and reserve tank was completed in December 2002 and worked for only three months before water position shifted horizontally by 90 meters from the original position and water depth fallen by 1.55 meters. For the Namagubo solar system, construction of well and reserve tank was completed in 2003 but there was a delay on the installation of the solar panel. The initial agreement was for the supplier (Likungu Investments (T) Ltd) to supply and install the solar powered pump between October and December 2001 but due to reasons beyond the capacity of the supplier (confusion on HS Code made by pre-shipment Inspection Company (Cotecna), the supplier was able to supply and install the solar pumping system in September 2004. Very few farmers (whose farms are located near to the reserve tank were able to access pumped water and for a very short period of time before water position shifted from the original position and water depth fallen;

The study team found no baseline quantitative data which could be used to monitor changes during project implementation, nevertheless based on the questionnaires developed, the team constructed proxy indicators and baseline status which in future could be used as a reference point to measure changes. The below farmer responses (1 to 5) can be used as current baseline indicators.

The evaluation concentrated on farmers who benefited or expected to benefit from wind / solar water pumping systems. Given the previously identified input, outputs and outcomes, the following section considers the likelihood of the hypothesized impacts resulting from wind /solar pumped irrigation projects in terms of poverty reduction, gender and the environment: *See fig: 2.*

Due to time constraint (a total of 5-day field work – see work plan), only 23 farmers were contacted and interviewed. For Nakatunguru project 11 farmers (4 women and 7 men) interviewed represent 30.5% of all farmer members and for Namagubo project the 12 farmers (4 women, 8 men) interviewed represent 20% of total population. A sample of between 20% – 30% is large enough to be a representative sample for the whole population.

1. Improved access to water for irrigation: little change

Table 4.1: Irrigation status of interviewees (Nakatunguru 11, Namagubo 12)

	Nakatunguru		Namagubo		Total	
	Number	%	Number	%	Number	%
1. Were you irrigating before participating in this project?	8	73	6	50	14	61
2. Are you currently irrigating using wind/ solar water pumping?	0	0	0	0	0	0
3. Are you irrigating using buckets?	11	100	12	100	23	100
4. Of those who were irrigating before this project, how many are still irrigating?	8	100	6	100	14	100
5. Of those who were irrigating before this project, how many are **no longer** irrigating?	0	0	0	0	0	0

Source: Field Survey, October 2006

Box 4.1: Table interpretation

1. Out of the 11 interviewed Nakatunguru farmers, 8 of them (73%) were irrigating before participating in this project and out of the 12 Namagubo farmers, 6 of them (50%) were already irrigating before participating in this project. Collectively, 61 percent of all farmers were irrigating using buckets before introduction of wind or solar water pumping in the area.

2. Nobody is currently irrigating using wind/ solar water pumping system.

3. All farmers are currently irrigating using buckets.

4. All who were irrigating before this project are still irrigating, (even though the intended equipment are not functioning), nobody dropped.

Note: Information in this box can be used as current baseline.

Some of the Nakatunguru beneficiaries accessed pumped water for a period of three months, between December 2002 and January 2003. *The interviews conducted to beneficiaries revealed that access to water was increased during the three months when they were getting pumped water. Though it was difficult to quantify, but people were able to get a lot of water to fill their fields and could wait for two days before they needed water again. This reduced the drudgery of carrying water from the lake to the fields almost 250m away, therefore it was assumed that women were able to attend to other activities and children had more time for study and leisure. Also access of enough water made the farms more healthy possible for planting crops like paddy and all other kinds of vegetables.*

On contrary without pumped water only a few liters could be accessed due to the work load, below table gives an estimates of the quantity of water that form human energy.

Table 4.2: Amount of water used for irrigation purposes

	Nakatunguru		Namagubo	
	Respondent	20litre Buckets	Respondent	20litre Buckets
1. How much water per day do you fetch for irrigating your crops?	1	-	1	-
	2	100	2	-
	3	30	3	-
	4	-	4	-
	5	-	5	100

	Nakatunguru		Namagubo	
	Respondent	20litre Buckets	Respondent	20litre Buckets
	6	120	6	-
	7	200	7	120
	8	60	8	30
	9	40	9	30
	10	-	10	200
	11	24	11	-
			12	300
Average:		**96**		**65**

Source: Field Survey, October 2006

Most farmers do not keep records of amount of water they fetch for irrigating their crops. At Nakatunguru 7 farmers (64%) were able to respond to this question and at Namagubo only 6 farmers (50%) were able to respond to this question (see above table).

Box 4.2: Table interpretation

1. Amount of water fetched by farmers for irrigating crops per day in Nakatunguru ranges from a minimum of 480 liters (24 buckets) to a maximum 4,000 liters (200 buckets). Average 1,920 liters (96 buckets).

2. Amount of water fetched by farmers for irrigating crops per day in Namagubo ranges from a minimum of 600 liters (30 buckets) to a maximum 2,000 liters (100 buckets). Average 1,300 liters (65 buckets).

Note: Information in this box can be used as current baseline.

As there is no access to pumped water both Nakatunguru and Namagubo farmers irrigate by using 20 litre buckets whereby they fetch water from the lake and hand carry to their fields.

2. Farm sizes (acreage): no baseline for comparison purposes

Table 4.3: Farm sizes

	Nakatunguru		Namagubo	
	Respondent	Acres	Respondent	Acres
1. How many acres of land do you use for irrigation purposes?	1	3.7	1	0.5
	2	3.7	2	0.75
	3	2.5	3	0.25
	4	2.0	4	0.4
	5	1.0	5	1.0
	6	1.5	6	1.25
	7	1.5	7	0.75
	8	1	8	1.0
	9	0.5	9	1.0
	10	1.5	10	2.0
	11	0.5	11	0.75
			12	2.5
Total:		**19.4**		**12.15**
Average:		**1.76363636**		**1.0125**

Source: Field Survey, October 2006

The interviewed Nakatunguru farmers have a minimum of 0.5 acres, maximum 3.7 acres and average 1.8 acres while the Namagubo farmers have a minimum of 0.4 acres, maximum of 1.25 acres and average 1.0 acres.

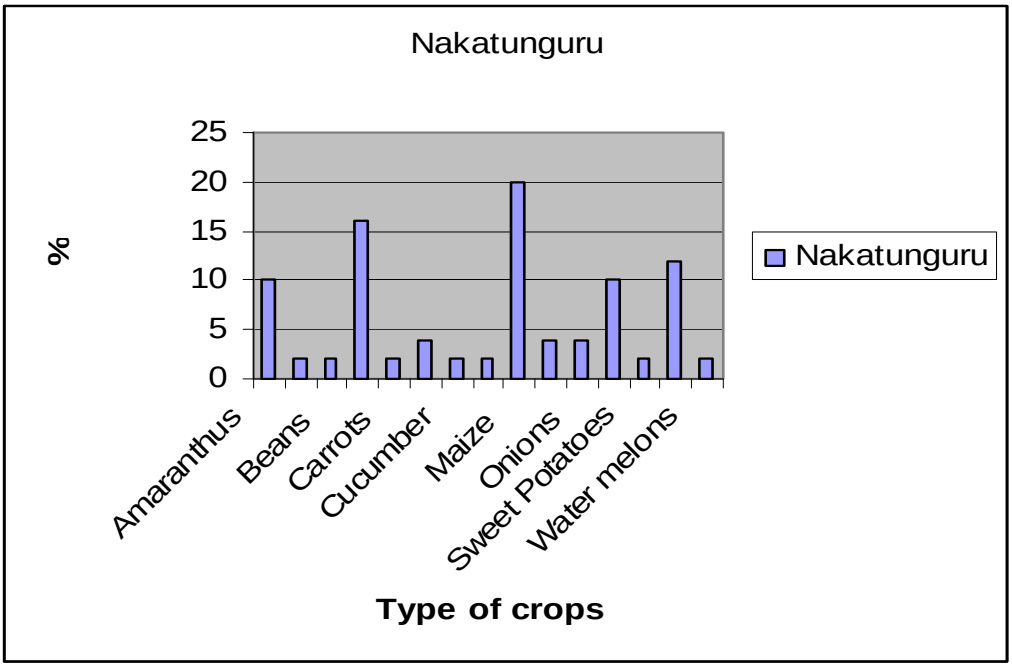
Note: Information on current acreage can be used as baseline data to measure performance at a later stage when pumped water will be accessed.

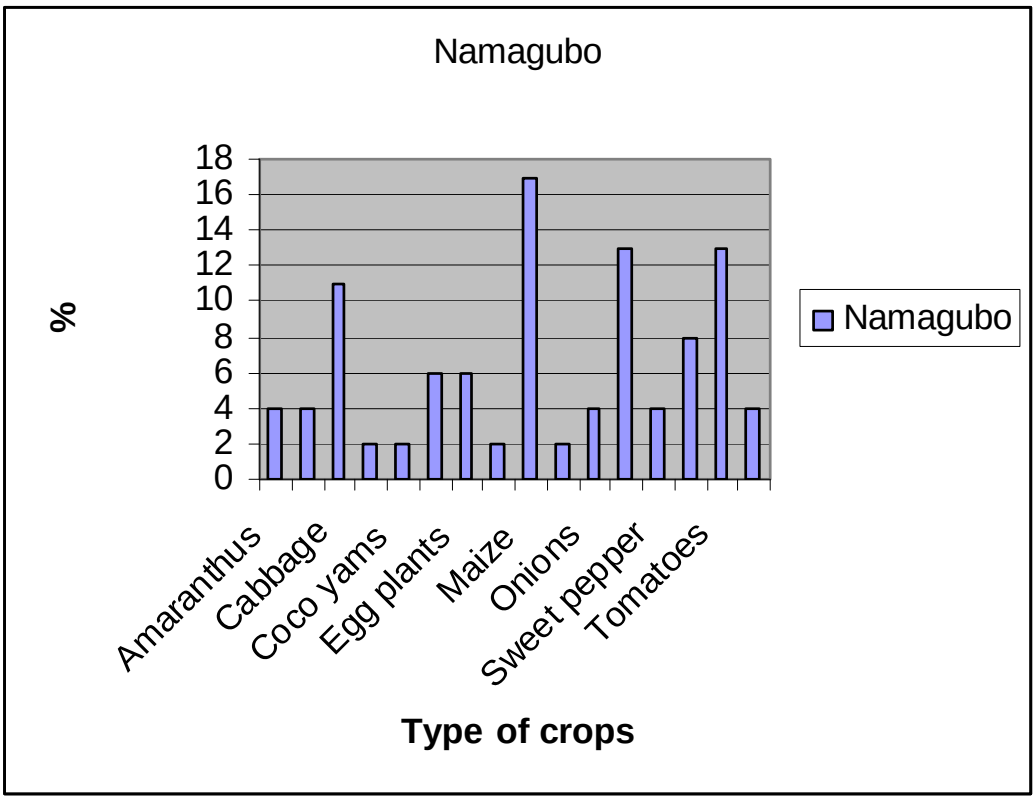
3. Types of crops grown

Table 4.4: Types of crops grown by farmers

TYPE OF CROP	Number of responses			
	Nakatunguru	**%**	**Namagubo**	**%**
Amaranthus	5	10	2	4
Bananas	1	2	0	0
Beans	1	2	2	4
Cabbage	8	16	6	11
Carrots	2	4	0	0
Chinese spinach	4	8	1	2
Coco yams	0	0	1	2
Cucumber	1	2	3	6
Egg plants (aubergines)	1	2	3	6
Hot pepper	0	0	1	2
Maize	10	20	9	17
Okra	2	4	1	2
Onions	2	4	2	4
Paddy	5	10	7	13
Sweet pepper	0	0	2	4
Sweet potatoes	1	2	4	8
Tomatoes	6	12	7	13
Water melons	1	2	2	4
Total Responses	**50**	**100**	**53**	**100**

Source: Field Survey, October 2006





At Nakatunguru, the crop that is grown by most farmers is maize (corn), followed by cabbage, tomatoes, paddy and amaranthus, same as at Namagubo the crop that is grown by most farmers is maize (corn), followed by paddy, tomatoes, cabbage and sweet potatoes. In both villages maize is normally sold fresh for roasting purposes.

4. Family size

Table 4.5: Family size

	Nakatunguru		Namagubo	
	Respondent	Family size	Respondent	Family size
1. How big is your family?	1	14	1	13
	2	14	2	13
	3	12	3	12
	4	14	4	5
	5	11	5	5
	6	12	6	11
	7	3	7	7
	8	7	8	9
	9	5	9	6
	10	5	10	7
	11	4	11	8
		0	12	6
Total:		**101**		**102**
Average:		**9**		**9**

Source: Field Survey, October 2006

According to this study, Nakatunguru farmers have a minimum of 3 family members, a maximum of 14 and average 9 members. Namagubo farmers have a minimum of 5 family members, maximum 13 and average 9 members.

5. Income obtained from irrigated crops (in one season)

Table 4.6: Income obtained from irrigated crops

	Nakatunguru		Namagubo	
	Respondent	Income	Respondent	Income
1. How much income do you obtain from selling of your irrigated crops?	1	950,000	1	195,000
	2	509,500	2	12,000
	3	540,000	3	18,000
	4	1,375,000	4	662,500
	5	502,500	5	2,058,400
	6	274,000	6	614,000
	7	380,000	7	1,425,000
	8	230,500	8	3,130,000
	9	50,000	9	30,000
	10	40,000	10	587,000
	11	450,000	11	0
		0	12	1,371,000
Total:		**5,301,500**		**10,102,900**
Average:		**481,955**		**841,908**

Source: Field Survey, October 2006

According to farmers, most of the irrigated crops they grow have the life span of three months, so this is considered as a three-month income to farmers. The above table indicates that Nakatunguru farmers in three months time they earn between TShs. 40,000 to TShs. 1,375,000 and average TShs. 481,955 or a monthly income of TShs. 160,651 from irrigated crops only. The Namagubo farmers in three months time they earn between TShs. 12,000 to TShs. 3,130,000 and average TShs. 841,908 or a monthly income of TShs. 280,636 from irrigated crops only. It is important to note that the current GNI for Tanzania is USD 248.

During the survey it was noted that only few farmers were keeping financial records and they came to the interview with their record keeping books, majority of farmers just tried to remember what they had earned. This means that although the researchers tried to gather income data but it is still a true challenge that getting accurate financial information from farmers is a difficult and unreliable process.

6. Major Constraints

To both the projects, the major problem is a sudden drop of water level at the Lake Victoria, this happened by the time the construction of the project was not completed thus slowing down the moral for completing the projects. This situation was difficult to foresee by the project organization because according to information by the district officials and the elder natives of the Ukerewe Island, a situation similar to this

occurred during early 1960s, now it has sudden appeared after 40 years. The Government of Tanzania is aware of this crisis and is working on plans to mitigate the effects of falling water level[4]. An article from the Guardian News Paper of Wednesday, November 22, 2006 reveals that the lake water is now only 19 centimeters higher than the lowest level ever recorded since 1896.

During the time of this study, major rehabilitations in both of the energy components were taking place. When the research team arrived at Nakatunguru wind project site, they found project beneficiaries busy shifting the position of the well to near the lake. The well has been moved to 48 meters from the original position, construction is underway.

4.5 Environmental findings

4.5.1 The Geography of Lake Victoria

Lake Victoria is the second biggest fresh water lake in the world, and has a surface area of 68,800 km^2 and adjoining catchments of 184,000 km^2. Lake Victoria touches the Equator in its northern reaches, and is relatively shallow, reaching a maximum depth of about 80 m, and an average depth of about 40 m. The lake's shoreline is long (about 3,500 km) and convoluted, enclosing innumerable small, shallow bays and inlets, many of which include swamps and wetlands which differ a great deal from one another and from the lake itself. Because the lake is shallow, its volume substantially less than that of other Eastern African lakes with much smaller surface area. Lake Victoria holds about 2,760 km3 of water, only 15 percent of the volume of Lake Tanganyika, even though the latter has less than half the surface area[5].

4.5.2 Source Lake water

It is important to note that the water balance in Lake Victoria is dominated by evaporation and rainfall in the lake; with minor contributions from river inflow and outflow. The outflow of water, into the River Nile through the Owen Falls Dam, account for only 20 per cent of water loss from the lake. The remaining 80 per cent is taken by evaporation. Similarly, the inflow through the many rivers from the catchments area only contributes 15 - 20% while rainfall on the lake accounts for 80 - 85%. Of the inlets, the River Kagera, which flows from Rwanda, contributes about 46%, Kenya's River Nzoia and Sondu/Miriu River about 15% and 8% respectively and Tanzania's Mara River about 10-15%[6].

4.5.3 Ukerewe Rainfall Distribution

The Ukerewe District receives a bimodal rainfall ranging from 900 mm to 1200 mm annually. The first rains occur between October and January and second between March and May. The district being an island is surrounded by Lake Victoria's water. The water level is lower than the ground surface, that's why energy is needed to

[4] The Guardian Thursday November 2, 2006
[5] www.gefweb.org
[6] www.angelfire.com

transfer the water from the lake to the ground for irrigating crops. Ukerewe have temporary rivers, formerly some rivers were permanent but due to tree cutting around water sources and on top of the hills led to all rivers becoming temporary.

During recent years lake water outflow has been greater than inflow due to less rains and high rate of evaporation, dry up of small inlet rivers and reduced water in the large rivers (Kagera and Mara). This issue of falling water level in Lake Victoria is now of the national concern, see below articles.

Plans to cushion effects of lake shrinkage

Source: The Guardian

From JOHN KULEKANA in Dodoma

THE government is working on plans to mitigate the effects of falling water level in Lake Victoria and other inland water bodies on millions of people in the country, the National Assembly was told here yesterday.

Minister of State in the Vice-President's Office (Environment) Mark Mwandosya attributed the trend to climate change and said all lakes, including Tanganyika, Natron, Manyara and Rukwa were reportedly declining.

The minister was responding to questions in which several MPs expressed concern on the falling water level on Lake Victoria. Ms Kidawa Salehe (CCM -- Special Seats) had in the main question wanted to know reasons behind the dwindling of water, the impact on millions of people around the lake and measures being taken to reverse the trend.

Deputy Minister for Water Shamsa Mwangunga told the House that drought experienced for three years consecutively contributed to the drying up of Lake Victoria.

She said rains accounted for 85 per cent of water inflow into the lake. Drought also had affected several rivers and tributaries washing into the world's second largest lake, she added.

The deputy minister further said there had been increased consumption of water from the lake following the construction of a hydropower generation station at Jinja, Uganda.

She said as of October 21, this year, water level was 1,131.7 metres above the sea, down from an average of 1,132.2 metres above the sea, a 0.5 metres drop or billions of cubic litres of lost water.

The deputy minister said that transportation on Lake Victoria has been adversely affected because vessels failed to anchor at some piers in Mwanza and at Nansio. Ships were also forced to load cargo below their capacity leading to operational losses.

She said water supply authorities in Mwanza City, Bukoba and Musoma municipalities were forced to reduce output.

The deputy minister said in Mwanza water supply down to 38,000 cubic metres from 42,000 cubic metres, while in Bukoba supply was now 4,000 cubic metres only, down from 7,000 cubic metres a day.

In Musoma, the intake point was shifted to a new location to enable pumping but the move led to increased operational costs.

The deputy minister had earlier said that the problem was also being addressed jointly with East African Community (EAC) member states under the Lake Victoria Environmental Management Project (LVEMP).

MS Kidawa Salehe

MR Mark Mwandosya

Source: The Guardian Thursday November 2, 2006

Lake Victoria ports closer to closure

By Emmanuel Chacha, Mwanza

WATER level in Lake Victoria has fallen to a critical point. It is now only 19 centimetres higher than the lowest level ever recorded since 1896.

The dire situation is threatening the closure of three major ports of Mwanza in Tanzania, Kisumu in Kenya and Port Bell in Uganda.

In 1923, the lake's level hit an all-time low of 1133.19 metres above sea level.

The National Project Coordinator of Lake Victoria Environmental Management Project, Dr. Raymond Mngodo, said the declining altitude was impacting negatively on socio-economic patterns of more than 30 million people, whose livelihood solely depended on the lake.

"The latest measurement was taken two weeks ago in Jinja, Uganda," he said.

He said the highest water point of the world's second largest freshwater lake had been monitored since 1896. He added that the lowest mark was noted in 1923.

He attributed the falling level of the world's largest tropical lake to prolonged drought, evaporation and significant hydropower shortfalls in Uganda.

"Eighty per cent of the lakes water comes from the rains and the rest is poured in by rivers. However, weather changes have led to rain shortage while evaporation is quite high. However, the abstraction of water for power generation by Uganda has contributed a lot to the problem," he said.

Dr. Mngodo said the increased hydropower capacity at Nalubaale and Kiira power stations in Uganda had allowed more water to be released for power generation, hence lowered lake levels to unsustainable levels.

"The water usage for hydroelectric power has reached 1,050 cubic metres per day. The dams have not adhered to the agreed discharge of water levels (agreed curve). We strongly urge Uganda to return to old curves. They were using 1,050 cubic metres per day. Currently, they are utilizing up to 750 per day. We still urge them to reduce the amount to at least 500 for the sake of water levels," he said.

"There is a need for Uganda to invest in alternative sources of energy, including thermal, natural and solar. A speedy implementation of the proposed East African Power Master Plan is desirable," Dr. Mngodo said.

The Nalubaale power station (formerly known as Owens Falls Dam) was expanded under the Owens Falls Extension Project, which was renamed as Kiira power station. The station has increased lake water consumption.

Kiira

Continues on Page 2

From Page 1

Power Station, located one-kilometre downstream from Nalubaale, was inaugurated in 2000. It was targeted to meet additional power demands.

In the 1990s, the Ugandan government proposed five priority hydropower projects, which included the renovation and expansion of the Nalubaale Dam from 180 MW (10 units of 18 MW) to 380 MW (with Kiira Power Station producing 200 MW), Bujagali Hydro Facility (200 MW), Karuma Dam (100–200 MW), and a number of smaller hydropower projects.

Further downstream is the Bujagali (200 MW) hydroelectric power scheme, which is currently under construction. It will be opened in 2009 at the earliest.

According to reports, drought accounts for 45 per cent of the loss of water levels, while discharge at Kiira and Nalubaale dams in Uganda accounts for 55 per cent. The excess water discharge has almost gone up six times since 1999, causing water levels to decline by 1.68 metres in between 1999 and 2005.

The recession of waters has left ferries stranded far from jetties, fish boats mired, in mud and towns running low on water, whereas the three major ports on the lake are threatened with closure unless immediate efforts are made to salvage the situation.

Mwanza City is among the most affected areas as it is currently experiencing severe water rationing. Pumping machines are working under capacity due to decrease in the water level of the lake.

Source: The Guardian Wednesday, November 22, 2006

5.0 STAKEHOLDERS ANALYSIS

In the case of the Ukerewe solar and wind water pumping projects, four main stakeholders were found to have a common interest to see that intended projects' impacts occur to intended beneficiaries. These are the UNDP/GEF, the Ministry of Agriculture and Food Security, the two CBOs (Nakatunguru Mwanzo Mgumu and Namagubo Nguvu Kazi) and the beneficiary farmers.

In analyzing the stakeholders' interests, contributions to project outcome and commitment, the following key questions were analyzed:

1. What are the interests and stakes of the stakeholders?
2. What was the stakeholders' involvement during project design and implementation?
3. What were stakeholders' responsibilities?
4. Who controls and disseminate information, measure performance, monitor compliance and determine success?
5. Enabling conditions for the institutions needed for project success to work and achieve the objectives of the projects.

Table 5:1 Formal Objectives of Stakeholders

UNDP/GEF[7]	**MoAF**	**CBOs**	**FARMERS**
To promote adoption of renewable energy (solar and wind energy for water pumping) and small scale irrigation on the shores of Lake Victoria to replace highly polluting technology of diesel powered pumping, hence prevent pollution of international waters. *To increase the capacity of CBO's and District Irrigation Technicians for the utilization of these new technologies.*	*The Ministry of Agriculture and Food Security is the initiator of the intervention with the main objective of implementing the agricultural policy which states "The Government's primary policy objective on the development of Irrigation Sector is improved food security starting at household level up to national levels. Specifically, the aim is to increase the income of farmers involved in irrigated agriculture starting with small holders by assisting them to achieve an environmentally sustainable increase in their agricultural production particularly in existing traditional irrigation schemes".*	*To promote the national and district efforts to increase agricultural productivity, the CBO's promote small-scale irrigation in the two villages of Namagubo and Nakatunguru.*	*To benefit from the interventions by using of the input*

[7] It is important to note that UNDP seeks to support the Tanzania government priorities and policies.

Table 5.2 Stakeholders' involvement during project design and implementation

UNDP/GEF	MoAF	CBOs	FARMERS
The United Nations Volunteer Irrigation Engineer who is based at Bunda and assisted by District Irrigation Technicians from each participating district coordinates implementation.	*Avail necessary expertise in irrigation and funds management i.e. to ensure fund's expenditure as per planned activities. To ensure proper fund's expenditure as per the planned activities, funds were not drawn unless minutes are provided to show that the respective Project Committee endorsed the transaction being presented and checks prepared by the groups are counter-signed by an authorized officer at the District Council.*	*Day to day activities is supervised by project management committees of the Water Users Associations. These committees work very closely with District Irrigation technicians from the Department of Agriculture.*	*Provided labour for clearing project site, supplying water for construction and other concrete works, construction of field canals, excavation of still basins and diversion boxes, loading and unloading stones, aggregates and sand to and from lorries and security guarding the installations.*

Table 5.3 Stakeholders' responsibilities (please not that some of the responsibilities are jointly shared between stakeholders)

UNDP/GEF	MoAF	CBOs	FARMERS
Provided project funds(95.5%). *Employed the United Nations Volunteer Irrigation Engineer who coordinates implementation.* *Responsible for farmer technical support and project implementation.* *Responsible for equipment maintenance.*	*District Crop and Irrigation Officer from the District Department of Agriculture work very closely with the management committees of the water users groups.* *Responsible for farmer training.* *Responsible for farmer technical support and project implementation.* *Responsible for equipment maintenance.*	*Contributed 4.5% of project funds.* *Project management through a management committee comprised by an executive committee comprised with the chairperson, secretary, treasurer and three members.* *Responsible for farmer training.* *Responsible for farmer technical support and project implementation.* *Responsible for equipment maintenance.*	*Use of the input.* *Contributed 4.5% of project funds.* *Responsible for equipment maintenance.*

Day to day activities, dissemination of information, measuring performance, monitors compliance and determine success.

The projects are supervised by an International UNV Irrigation Engineer who is based at Bunda. Bunda is at the center of all the four participating districts.

Day to day activities is supervised by project management committees of the Water Users Associations (Nakatunguru and Namagubo). The committees are working very closely with District Crop and Irrigation Officer from the Department of Agriculture.

The UNDP National Coordinator and National Steering Committee (comprising representatives from NGO, Government of Tanzania, Academia and Embassies) follow up implementation on quarterly basis.

According to the above analysed stakeholders' analysis, there is a joint responsibility' between the government of Tanzania through MoAF & the Ukerewe District Council, UNDP/GEF and the two assisted CBOs in the implementing and assuring that the two projects succeed.

6.0 CONCLUSIONS, RECOMMENDATIONS AND WAY FORWARD

a. CONCLUSIONS

- Given the sudden fall of Lake Victoria water level, no impact was identified at both sites.

- Future interventions could include a more thorough due diligence assessment on historical trends of various factors influencing the fall of Lake Victoria; identification of ground water source could be an alternative when choosing a spot for installing pump.

- The study analyzed effects of social, technical, economic, environmental and political influences on both projects. Environmental effects (climate change) has seen to have a greater influence on both projects.

- The study was complemented by stakeholders' analysis highlighting the roles of the different actors, their activities and related institutions.

b. RECOMMENDATIONS AND WAY FORWARD

- The information gained through this study calls for the need to conduct a thorough due diligence assessment on the availability of water and its characteristics in the Ukerewe District. The Ukerewe District Agriculture and Livestock Development Office in collaboration with the District Water Engineer need to write a proposal for re-designing of the projects by carefully studying the rainfall pattern, underground water source and international water rights/ uses taking into consideration that Lake Victoria water falls under international waters. A possibility of rain water harvesting should also be looked at;

- Engineers should study the possibilities of re-designing the pumping systems (both solar and wind) to make sure that they operate as intended;

- There is necessity for conducting further study in order to find out a way for incorporating Assessment Framework in the impact assessment and continue to modify the framework to broaden its application;

- There is a need for clearer responsibilities amongst stakeholders;

- There is a need for more flexible solutions better adapted to the local context.

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APPENDICES

APPENDIX I: TERMS OF REFERENCE

The Development and Energy in Africa (DEA) is a project of the EC COOPENER programme, which started officially on 1st May 2005. The project is implemented and coordinated by the RISØ National Laboratory, Denmark and supported by the Energy Research Center of the Netherlands (ECN) and Six African NGO Centers from six participating countries: Botswana - EECG, Ghana – KITE, Mali - MFC, Senegal – ENDA, Tanzania – TaTEDO and Zambia – CEEZ.

The DEA project is a two and half years project (30 months) which aim to develop an operational assessment framework for identifying and quantifying how energy interventions and projects can contribute to sustainable development, including achieving the Millennium Development Goals (MDGs).

The immediate objectives are (i) to establish and apply an assessment framework for evaluating development and poverty impacts of energy interventions and (ii) to engage in dialogue with energy policy makers and other stakeholders in the basis of framework with a view to incorporate this issue in energy policy. More specifically the project will explore the potential for synergies between development, poverty and energy objectives in order to investigate alternative ways of designing energy interventions at the policy and project levels to create and maximize such synergies.

Under this project, wok package 5 involved developing Preliminary Assessment Framework (PAF) for assessing development and poverty impacts of energy interventions, including developing indicators for assessing energy poverty and development links. Work packages 6 require the center organization to conduct a case study to test the PAF in real situation.

In this regard, TaTEDO, which is a national center for DEA project in Tanzania, has selected a project on small-scale pilot irrigation projects, which use solar energy for pumping water from the Lake Victoria in Nakatunguru village in Ukerewe District as a case study for testing the aforementioned PAF. In this case the consultant will be required to undertake the study on the selected case study to:

- Assess the development and poverty impacts of the Nakatunguru solar water pumping intervention based on the attached PAF?
- Assess the impacts of intervention to the Millennium Development Goals?
- Recommend how could the PAF be improved to be able to measure the development and poverty links?
- Recommend how can the information gained improve the design of ongoing and future energy projects?
- Recommend how can energy and other relevant policies be enhanced to take these issues into account?

The consultant will be required to undertake the study under the proposed work plan below:-

Work plan

What	When work backwards from National W/Shop
Desk study	28-29th August
Designed questionnaires	30-31st August
Travel to research site	3RD September
Introduction of the study to District and village	4th September
Prepare focus group discussion	4th September
Elaborate data collection planning	4th September
Continuation desk study	
Interviews	5th – 8th September
Focus groups	
HH surveys	
Observation	
Documenting preliminary findings	9th – 10th September
Updating people involved in research on preliminary findings	
Travel back to DSM	11th September
Data analysis and report writing	12th – 16th September
Discussing draft report	20th September
Finalizing report	22nd September

APPENDIX II: MAP OF UKEREWE DISTRICT

APPENDIX III: INTERVIEW GUIDE

UKEREWE SMALL SCALE IRRIGATION SCHEMES

NAKATUNGURU WIND POWERED IRRIGATION PUMP & NAMAGUBO SOLAR POWERED IRRIGATION PUMP

QUESTIONNAIRE FOR FARMER BENEFICIARIES

A] INTRODUCTION

1. Name: _____Sex M[ ] F[ ]
2. Level of education: _____
3. Group: _____ Type of Technology Used:_____
4. When did you become the member of Nakatunnguru Mwanzo Mgumu/ Namagubo Farmers Association? _____

B] IRRIGATION STATUS

1. Were you irrigating before participating in this project? YES [ ] NO [ ]
2. Which irrigation facilities were you using?
   Diesel pump [ ]
   Foot pump [ ]
   Gravity [ ]
   Buckets [ ]
   Others [ ] Please mention:_____

3. Are you currently irrigating using the solar/wind pump? YES [ ] NO [ ]
   3(a) If the answer is NO, please explain why?

C] ACCESS TO PUMPED WATER

1. How much water do you access for irrigation purposes?
   (a) Before participating in this project:
   (b) After participating in this project:
2. How do you use the water you receive from the project?
   (a) Domestic [ ] How many buckets/litres? [ ]
   (b) Agriculture [ ] How many buckets/litres? [ ]

D] SELF SUFFICIENCY IN FOOD/ INCREASED AGRICULTURAL PRODUCTION

1. How many acres of land do you use for irrigation purposes?
   (a) Before participating in this project:_____

(b) After participating in this project: _____

2. What kinds of crops do you grow?

BEFORE PARTICIPATING IN THIS PROJECT		AFTER PARTICIPATING IN THIS PROJECT	
S/N	**TYPE OF CROP**	**S/N**	**TYPE OF CROP**
1.		1.	
2.		2.	
3.		3.	
4.		4.	
5.		5.	
6.		6.	
7.		7.	
8.		8.	
9.		9.	
10.		10.	

3. How much crops do you harvest?

BEFORE PARTICIPATING IN THIS PROJECT		AFTER PARTICIPATING IN THIS PROJECT	
TYPE OF CROP	**QUANTITY HARVESTED**	**TYPE OF CROP**	**QUANTITY HARVESTED**

4. Which months of the year do you irrigate your crops?
   (a) Before participating in this project:_____
   (b) After participating in this project:_____

5. How big is your family?_____
   (b) What you are getting from your irrigated farms is it sufficient for family consumption?

   Before participating in this project? YES [ ] NO [ ]
   After participating in this project? YES [ ] NO [ ]

E] INCOME

1. How much of your irrigating crops do you sell at the market place?

2. How much income do you obtain from selling your irrigated crops?

BEFORE PARTICIPATING IN THIS PROJECT			**AFTER PARTICIPATING IN THIS PROJECT**		
TYPE OF CROP	**QTY SOLD**	**INCOME**	**TYPE OF CROP**	**QTY SOLD**	**INCOME**

3. How has the income obtained from irrigated crops helped your family?

F] TIME SAVING

1. How much time did you use for irrigating your crops before participating in this project?
2. How much time do you spend now for irrigating your crops after participating in this project?

G] OTHER

1. What other benefits have you received from participating in this project? E.g.
   (i) Access to clean water and therefore reduction of water borne diseases
   (ii) Improved social relations [ ]
   (iii) _____
   (iv_____
   (v) _____
2. Do you understand the benefits of using solar/ wind technologies versus diesel engines?
   (i) _____
   (ii) _____
   (iii) _____
3. Do you think this project has helped you? YES[ ] NO[ ]
   If YES, how?
4. Any recommendation/ opinion?

UKEREWE SMALL SCALE IRRIGATION SCHEMES

NAKATUNGURU WIND POWERED IRRIGATION PUMP &
NAMAGUBO SOLAR POWERED IRRIGATION PUMP

QUESTIONNAIRE FOR PROJECT LEADERS

1. Name of the group: _____
2. Type of irrigation facility:_____
3. When did you come together as a group?: _____
4. What made you form the group? _____
5. How many were founder members? Male [ ] Female [ ]
6. How many acres of irrigated land did you own as a group? _____
7. How many members are there today? Male [ ] Female [ ]
8. How many acres of irrigated land do you currently own as a group? ___
9. Do the group members use other water pumping systems?
   (i) Diesel engine [ ]
   (ii) Foot pump [ ]
   (iii) Gravity [ ]
   (iv) Buckets [ ]
   (v) Others [ ] Please mention _____
10. Who are the signatories of the group's accounts?
    (i) _____
    (ii) _____
    (iii) _____
    (iv) _____
11. What are your daily activities as the leaders of the irrigation schemes?
    (i) _____
    (ii) _____
    (iii) _____
    (iv) _____
    (v) _____
12. When did you start construction work for this solar / wind powered irrigation pump?_____
13. When did the construction completed?_____
14. When did actual implementation of the project started? _____
15. How do you ensure security of the installed equipment? _____
16. How do you maintain the installed equipment? _____
17. What major constraints did you encounter in the process of implementing this project?
    (i) Technically
    (ii) Economically
    (iii) Socially
    (iv) Environmentally
    (v) Financially
18. What are your recommendations for tackling all these problems?
19. Do you have any other comment/ recommendation?

APPENDIX IV: WORK PLAN FOR THE STUDY

S/N	DATE	ACTIVITY
1.	Tuesday, September 26, 2006	Travel day, Dar es Salaam – Ukerewe, arrived at 17:30 pm. Brief discussion on status of projects by the District Crop and Irrigation Officer.
2.	Wednesday, September 27, 2006	Introductions: • District Council Office (DED, DALDO, DCrO, WEO) • Nakatunguru Leaders at project site (Wind) • Namagubo leaders at project site (Solar)
3.	Thursday, September 28, 2006	• Desk study – projects documents • Designing of data collection tools • Printing & photocopying
4.	Friday, September 29, 2006	Interviews: • Nakatunguru beneficiaries • Nakatunguru Project Committee • Visiting beneficiaries' farms/ gardens
5.	Saturday, September 30, 2006	Interviews: • Namagubo beneficiaries • Namagubo Project Committee • Visiting beneficiaries' farms/ gardens
6.	Sunday, October 1, 2006	Data Analysis Compilation of findings
7.	Monday, October 2, 2006	Presentation of research findings: • District Council Officials • Nakatunguru Project Committee • Namagubo Project Committee
8.	Tuesday, October 3, 2006	Travel day, Ukerewe – Dar es Salaam, arrived 22:15hrs.

APPENDIX V: LIST OF PEOPLE CONTACTED

A. NAKATUNGURU MWANZO MGUMU WIND POWERED IRRIGATION SCHEME – 29 September, 2006

S/N	NAME	DESIGNATION
1.	Mr. Anthony Mtesigwa	Association Chairperson
2.	Ms. Tabu Biringi	Association Secretary
3.	Mr. Mahelo Funda	Treasurer
4.	Miyango Tilubuzya	Committee member
5.	Elisha Biseko	Committee member
6.	Jacob Magagale	Committee member
7.	Mugele Mahelo	Farmer
8.	Gideon Mahelo	Farmer
9.	Samuel N. Mabina	Farmer
10.	Agnes Masaga	Farmer
11.	Nane Luzelela	Farmer
12.	Yusuf M. Tulubuzya	Farmer
13.	Ibrahim Swed	Farmer
14.	Baraka Malielo	Farmer
15.	Theodosia Tulubuzya	Farmer
16.	Silyvia Sylvester	Farmer
17.	Zole Mutobesya	Farmer
18.	Magali Crizanti	Farmer
19.	Miyango Kezilahabi	Farmer
20.	Masoud Hamisi	Farmer
21.	Mwizarubi Manyage	Farmer

B. NAMAGUBO NGUVU KAZI SOLAR POWERED IRRIGATION SCHEME – 30 September, 2006

S/N	NAME	DESIGNATION
1.	Mr. Mashaka William Nalubwa	Association Chairperson
2.	Mr. Ramadhani Omari	Assistant Chairperson
3.	Mr. Mawazo Juma Itutu	Association Secretary
4.	Ms. Rehema Salum	Committee member
5.	Nzinza Lwabya	Farmer
6.	Sadiki Nalubwa	Farmer
7.	Josephina Constantine	Farmer
8.	Chaula Ntego	Farmer
9.	Abbas H. Bituro	Farmer
10.	Ladslaus Ngereza	Farmer
11.	Kerenge Buchoti	Farmer
12.	Iddi Omary	Farmer
13.	Majaliwa Kelenge	Farmer
14.	Mkuru Dionis	Farmer
15.	Jibona Nalubwa	Farmer
16.	Emerensiana Makundi	Farmer
17.	Maneno Mariatabu Toto	Farmer

C. STAKEHOLDERS WORKSHOP – 2 October, 2006

S/N	NAME	DESIGNATION
1.	Dr. Leonard Moses Masale	District Executive Director (DED)
2.	Mr. Samson J. Ibrahim	District Agricultural and Livestock Development Officer (DALDO)
3.	Mr. T.B Ndunguru	District Planning Officer (DPLO)
4.	Mr. Masatu Magafu	District Crop & Irrigation Officer (DcrO)
5.	Mr. Issa Mugengi	Ward Extension Officer (WEO)
6.	Mr. M.C Wa-Mjungu	District Livestock Officer (DLO)
7.	Mr. Mahelo Fund	
8.	Mr. Mawazo Juma Itutu	Secretary, Namagubo Association
9.	Mr. Abbas H. Bituro	Farmer, Namagubo Association
10.	Ms. Tabu Biringi	Secretary, Nakatunguru Association
11.	Mr. Mashaka William Nalubwa	Chairperson, Namagubo Association
12.	Mr. Ramadhani Omari	Vice Chair Namagubo Association
13.	Mr. Anthony Mtesigwa	Chairperson Nakatunguru Association