# GENDER PERSPECTIVE IN EFFECTIVE UTILIZATION OF WATER FROM RUFIJI RIVER FOR SMALL SCALE IRRIGATION

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BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN RURAL DEVELOPMENT OF SOKOINE UNIVERSITY OF AGRICULTURE.

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## ABSTRACT

The study focused on factors constraining women from effective utilization of water from Rufiji River for improving small-scale irrigation farming. Specifically the study aimed at: (a) determining the types of irrigated crops (b) examining the women's affordability of irrigation infrastructure, (c) assessing women's knowledge and perception on irrigation farming, (d) identifying constraints to women's effective utilization of water for small scale farming. The study was undertaken in Rufiji District in three wards; primary data were collected from 120 women and men farmers, using a structured questionnaire. Secondary data were also collected. Analyses were performed using SPSS and Limped computer software. Hypothesis testing was undertaken at 5 percent level of significance using Chi-square. The study found that major types of irrigated crops in Rufiji District were tomato, paddy, and green vegetables. 89.7% of women cannot afford to purchase irrigation infrastructures. Also 61.64% of women farmers had weak attitude and behavior towards irrigation. The following constrained women from utilizing water from the river for small-scale irrigation: Low income, limited availability of resources, lack of irrigation training and heavy household chores. Results indicated significant relationship between the sizes of land irrigated and the attitudes of women on irrigation. Household income has a significant effect on irrigation farming. The Logistic regression model showed that, the following factors had positive influence on women's adoption of irrigation technology: size of land suitable for irrigation, primary occupation, irrigation training, income, education and farm's location. The study recommends the following: provision of irrigation's start up capital, improving women access to resources and increase in irrigation training.

## DECLARATION

I, GERALD JAMES KONDOWE, do hereby declare to the SENATE of Sokoine University of Agriculture that this dissertation is my own original work and has never been submitted nor concurrently being submitted for any degree award in any other University.

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The above declaration is confirmed

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## DEDICATION

This work is dedicated to my beloved parents Kolnaria James Kondowe and Emmiliana Mathias Kondowe who heightened my interest on education.

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## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| BTC | Belgian Technical Cooperation |
| DSI | Development Studies Institute |
| FAO | Food and Agriculture Organization |
| GoT | Government of Tanzania |
| HIV/AIDS | Acquired Immune Deficiency Syndrome |
| IFAD | International Fund for Agricultural Development |
| NGOs | Non-Governmental Organizations |
| NIMP | National Irrigation Master Planning |
| PWAIS | Productivity of Water in Agriculture and Interacting Systems |
| RUBADA | Rufiji Basin Development Association |
| RUDIDEA | Rufiji District Development Association |
| REMP | Rufiji Environment Management Project |
| SUA | Sokoine University of Agriculture. |
| TZS | Tanzanian Shillings |
| URT | United Republic of Tanzania |
| WARFSA | Water Research Fund for Southern Africa |

# CHAPTER ONE

## 1.0 INTRODUCTION

### 1.1 Background information

The economic future of Africa will depend on strong performance in the agricultural sector and particularly the role of small-scale farmers (Scott, 1996 as cited by Mamkwe, 2003). Agriculture depends on water since water is the most important requirement for the growth of plants. Crops can be raised successfully only if water is available in appropriate quantities, and at the right time depending upon the species of plants and climatic conditions (Sharma, 1985 as cited by Orota, 1993).

With respect to water used for agriculture the policy in Tanzania encourages use of irrigation water and rainwater harvesting for drought mitigation and ensuring food security for the population. It also recognizes the need for water to be used in producing high value crops to increase productivity of irrigation water (PWAIS, 2004). In the case of Tanzania, the available water resources are enough for the current use (URT, 2002). Water issues were addressed in the Millennium Development Goals. That is, eradication of poverty and hunger, in rural areas is strongly related to fair and equitable access of the most vulnerable people to basic livelihood assets including land and water, both for domestic purposes and for productive uses.

Out of the active population engaged in agricultural production, 75% are women (FAO, 1994). According to Boserup (1989), as cited by Epaphra (2001), women in third world countries play significant roles in agriculture. Africa could be described as the region of female farming "par excellence". She drew on several case studies to show that women do more than half of the agricultural work. In some cases they were found to do around 70% and in one case nearly 80% of food production. But in most African countries women participation in agricultural labour does not necessarily translate into women control over resources. Women are considered completely ineligible to various resources ownership independent of marital status. However, a study conducted in Shinyanga, Mara and Mwanza districts, CARE International in Tanzania (1995), as cited by Epaphra (2001) found that women constraints were based on limited access to resources, infrastructures, social services and the means of production.

Before the introduction of cash crops, members of the family both males and females used to assist each other in all aspects of food crop production. With increasing emphasis on cash crop production such as cotton, coffee, cocoa, etc., it was common for male farmers to move into cash crop production, usually accompanied with labour saving devices, while the burden of growing food crops for the family fell heavily on women (O'kting'ati, 1985 as cited by Epaphra, 2001). Food crops most often remain with traditional tools and techniques that are labourious and time-consuming.

A study of three small-scale schemes in Burkina Faso,Mali and the United Republic of Tanzania found that irrigation improved incomes, diets and health. For example, when women no longer had to fetch water from far away, they had time to start market gardens, thereby improving their incomes and diets (FAO, 2000).

According to the UN medium projection, in 2025 the population on the earth will be 7.8 billion. Water resources on the other hand are decreasing at an alarming rate (Molden and Sakthivadiel, 1999). These changes may have strong impact on food requirement and food production. (World Water Forum, 2000).

Information already available about the potential for irrigation of the lower Rufiji basin, most agricultural activities are carried out on the basin. Wide ranges of crops are grown. Therefore irrigation must be developed because it is the key activity for improving productivity and an important factor for improving profitability in agriculture (ECA, 2002 as cited by Kasambala, 2004).

The agricultural potential of the lower Rufiji has long been recognized and the suitability of the area for irrigated agriculture was identified by the F AO Rufiji Basin survey of 1956- 61. Development of the considerable agricultural potential of the area has hitherto been hindered by the frequent occurrence of damaging and devastating floods of the Rufiji River. The people of the area have managed to make only a precarious living by adapting their agricultural practices to the vagaries of flooding (RUBADA, 2004).

## 1.2 Problem statement and justification

Rain fed agriculture has been a major traditional way of farming in Tanzania. Production from such a technique is often coupled with irregular fluctuations caused by unreliable rainfall. The major drawback is the prediction of both time of assurance of adequate rain and the quantity expected. This requires appropriate farming techniques to avoid crop yield fluctuations caused by natural climatic hazards. In sub-Saharan Africa, only 4 percent of cropland is irrigated (FAO, 2000). Almost 98% of agricultural production in Tanzania is rain fed (Rwehumbiza *et al.* 2000). The existing agricultural practices in Lower Rufiji Valley depend on the yearly floods of the Rufiji River. Although the Rufiji has been described as an area of irrigation potential (GoT, 2003), surprisingly there is no active irrigation. In years when the floods fail there is suffering and famine (REMP, 2001)

Out of the total active population engaged in agricultural production, 75% are women. But many studies done throughout the developing world (Rocheleau, 1988) have shown that in most cases, women have been excluded while they are the ones who produce subsistence crops with inferior farming technologies. Women are also the ones who suffer most from the consequences of food shortage.

"Weakened agriculture will cause failure of hundreds sectors" (Tiep, 2002). Rufiji District has been chosen due to the fact that unlike in many other river basins in developing countries, where there are conflicts over water uses, this problem is not found in Rufiji, and water is flowing into the Indian Ocean without any other uses

for national interest. Therefore, it is the aim of this research to examine the reasons why in Rufiji there are no active irrigation activities compared to other areas. Major focus is on women who constitute greater portion of agricultural labour.

Many researches have been conducted by several scholars on irrigation and water resource management, both under rainfed and under irrigated agriculture. This research aims at generating information concerning the factors limiting the growth of small scale irrigation farming run by women, therefore, the findings will be vital to policy makers for the purpose of promoting irrigation agricultural in the area.

## 1.3 Objectives

### 1.3.1 General objective

The general objective of this study is to identify gender constraints to effective utilization of water from Rufiji River for improving small-scale irrigation.

### 1.3.2 Specific objectives

(1) To determine types of irrigated crops in Rufiji District.

(2) To examine women's affordability of irrigation infrastructure.

(3) To assess women's knowledge and perception on irrigation farming.

(4) To identify constraints to women's effective utilization of water for small scale farming.

## 1.4 Hypothesis

**Null hypothesis ($H_0$=0)**

(i) Size of land irrigated does not differ significantly between women having unfavorable attitudes and those having favorable attitude towards irrigation.

(ii) There is no significant relationship between irrigation farming and the household income.

**Alternative hypothesis ($H_1 \neq 0$)**

(i) Size of land irrigated differs significantly between women having unfavorable attitudes and those having favorable attitude towards irrigation.

(ii) There is significant relationship between irrigation farming and the household income.

## 1.5 Conceptual Framework

The conceptual framework is a narrative outline presentation of variables to be studied and hypothetical relationships between and among the variables. The types of variables shown in the conceptual framework for the research are: background variables that include age of the household head, marital status, education, and household composition.

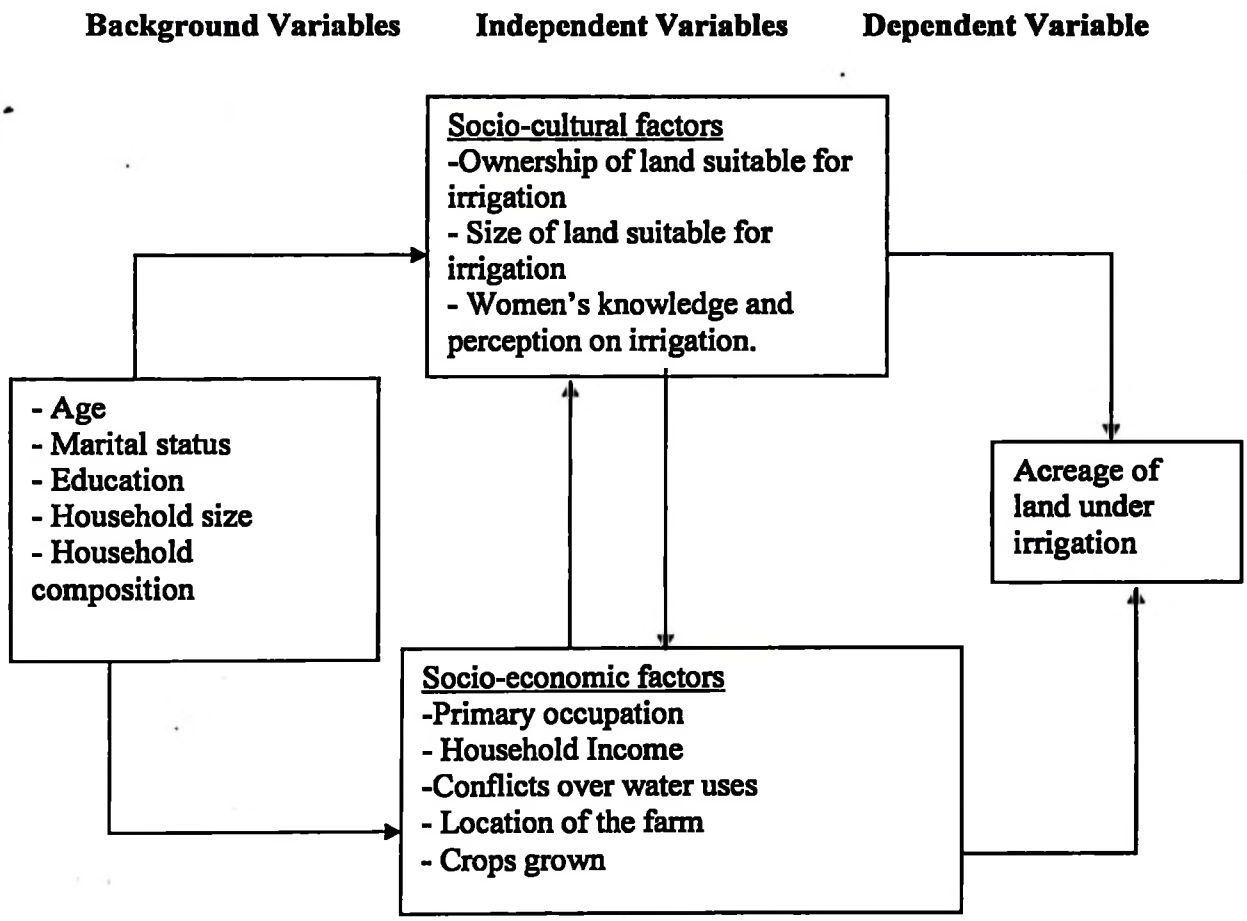


**Figure 1: Conceptual framework**

From Figure 1 above, there is indirect relationship between background variables (Age, Marital status, Education level, Household size, and Household composition) and the dependent variable (Acreage of land under irrigation). Also there is direct relationship between the Independent variables (Ownership of land suitable for irrigation, size of land suitable for irrigation, women's knowledge and perception on irrigation, Household income, conflicts over water uses, location of the farm and crops grown) and the dependent variable (Acreage of land under irrigation).

## 1.6 Operational Definition of Key Variables

| Variables | Definitions | Possible measurable Indicators |
|---|---|---|
| Accessibility and acquisition. | - Ability of an individual to own land | -Acreage of land owned |
| Control | Power or ability to dictate the uses | |
| Irrigation farming | Artificial supply of water to the plants so as to stabilize agriculture and improve production for all areas where rainfall is scanty and unevenly distributed. | -Land size watered<br>-Availability of water in terms of number of months per year or hours per day |
| Small-scale irrigation farming | Irrigation farming activities in pieces of land which does not exceed two hectares. | -Land size watered<br>-Done by female |
| Irrigation infrastructure | Facilities which support artificial supply of water to the plants | -Irrigation canals<br>-water pumping devices |
| Flooding | Over flowing of water from the river into the near by land | Flooding |
| Household | A group of people, who eat from a common pot, share dwelling house and has the unit command from the head of the household who is the decision maker. | -Number of Houses |
| Gender | Term describes the socially determined attributes of men and women, including male and female roles. | -Physical and biological differences between males and females |
| Education | Formal training | -Ability to read and write<br>-Number of years of schooling |
| Income | Net monetary values of products and services by all household members per year. | -Household cash income |

# CHAPTER TWO

## 2.0 LITERATURE REVIEW

### 2.1 Water Resources in Tanzania

Water is a basic natural resource required to sustain life and provide various social needs as well as for economic development (URT, 2002). Many parts of Tanzania face a water stress situation. Water stress here is taken as non-availability rather than under utilization of the available potential water resources. Water is important for food production not only because of its direct effects on yields and cultivated area, but because reliable water supplies induce farmers to invest in other essential crop inputs, such as improved germ plasma, fertilizers, and capacity building for better resource management (Rosegrant *et al.,* 1997). Water resources have a close relationship to food security. Therefore, food security cannot be separated from water resources security (Tiep, 2002).

The debate on the use of water is sharply divided. Agricultural scientists say that farm water use, especially irrigation, must be increased by 5-20 percent in the coming 25 years to maintain food security and reduce hunger and rural poverty for a growing world population. Environmental scientists, on the other hand, say that water use will need to be reduced by at least 10 percent to protect the rivers, lakes and wetlands on which millions of people depend for their livelihoods and to satisfy the growing demands of cities and industry. The truth is that both sides of this argument have strong cases to present, implying that there needs to be a critical

balance between water for agriculture and water for the environment (World Water Forum, 2000).

## 2.2 Irrigation in Tanzania

According to PWAIS (2004), there are three types of irrigation schemes in Tanzania. These are:

a) Traditional systems which consist of :

   i) Village irrigation based on the diversion of perennial or seasonal flows in hundreds of small schemes in upland areas, used mainly for the production of vegetables and other relatively high value crops.

   ii) Large areas of rainwater harvesting systems, such as those found in the semi-arid areas of much of central Tanzania, and the seasonally flooded *plais* found in the central and western parts, all used for rice cultivation.

The total combined area of these self-sustaining systems is thought to be of the order of 130 000 hectares. They are an important means of livelihood-generation for a large number of rural people; they have been initiated, financed and developed by the farmers themselves.

b) Improved traditional systems, which comprises of schemes that have received government or donor assisted interventions to improve the water control structures. The National Irrigation Master Planning (NIMP) estimates that there are about 25 500 hectares of land under this kind of schemes.

c) Modern schemes that comprises either parastatal estates under NAFCO or private commercial and large-scale farms. It is estimated that a total of 35 900 hectares of cultivated land are irrigated in this form.

### 2.3 Agriculture and Irrigation in Tanzania

During the base year, 1995, about 157 000 ha were under irrigation (URT, 1997). Eighty percent of the irrigated area was under traditional schemes; 20% were large centrally managed irrigation schemes owned by public and private organizations and individuals. Irrigation is not yet widespread in Tanzania, but where it is used, regulation of water consumption is a problem. Smallholder farmers account for 80% of water abstraction for irrigation and traditional furrows.

In theory a person or community must have a water right to be allowed to take water from a pump or irrigation furrow'. However, in general smallholder irrigators do not hold water rights. Currently efforts are being made to persuade communities to accept them, but there is understandably resistance. Tanzania has a very long history of indigenous irrigation, and people do not understand why they must now pay for a permit for something their ancestors have always seen as a right (Maganga, 2003).

### 2.4 Agriculture and Irrigation in Rufiji

Like in hydropower, significant potentials exist for both rainfed and irrigated agriculture in the Rufiji Basin. However, irrigation has not been widely practiced due

to large investment needed, especially in earthmoving equipment and expertise. The area suitable for irrigated agriculture is estimated at 622 400 ha (RUBADA, 2004).

**Table 1: Area suitable for irrigation in Tanzania**

| S/No | Area | Potential Area (ha) |
|---|---|---|
| 1 | Kilombero valley | 329 600 |
| 2 | Lower Rufiji Basin | 80 000 |
| 3 | Usangu plains | 208 000 |
| 4 | Little Ruaha | 4 800 |
| | Total | 622 400 |

Source: Irrigated Agricultural Development in the lower Rufiji Valley, 1982 as cited by RUBADA, (2004).

The lower Rufiji contains about 150 000 ha of potentially productive agricultural land in the flood plains of which 80 000 ha are irrigable. These areas have been studied in detail and they are ideal for crops like maize, rice, bananas and sugarcane. Citrus fruits and other numerous horticultural crops can easily be grown in these areas (RUBADA, 2004).

In terms of development planning, the Kilombero area takes the first priority, especially for near future development. The lower Rufiji valley is ranked second, with the Ikwiriri Block which occupies about 15 500 ha being earmarked for early development of irrigated agriculture (RUBADA, 2004).

## 2.5 Women and Agriculture

About ninety percent of third world women depend on land for their survival. They are the world's farmers. They grow the crops, gather the firewood, tend the animals, and fetch water. Their traditional farming methods created the necessity to ensurer future harvests, and passed down through generations. (Dankelman and Davidson, 1988 as cited by Natai, 2004).

Over the last several decades, considerable effort has been made throughout the world to provide women farmers and women on the farm with efficient, effective, and appropriate technology, training, and information. The positive effects are beginning to show in agricultural production statistics and in indices of family welfare. Yet these successes still fall far short of what is needed at a time when public sector investments in agricultural research and extension are under pressure, when ever-greater demands are being placed on rural women in the face of rapid social transformation (FAO, 1997).

## 2.6 Gender Perspective in Adoption of Irrigation Technology

The observations show a significant and negative influence on adoption of irrigation techniques to women. Suggestions that, the methods of irrigation like using buckets and treadle pump, are not gender neutral technologies. Similar observation was reported by Kay and Bradden (2000), as cited by Nassoro (2006), which explained about the treadle pump that, because an operator is elevated above the ground,

women do not feel comfortable standing on the pump for long period. They feel exposed and consider it undignified.

### 2.7 Rural Women and development programme

Rural women seldom have autonomous control over the opportunities that may come their way or the benefits, which flow from them. Many advantages won for rural women through development programmes are later lost, as illustrated in the following quotation: "When technological innovations do address women's tasks and make them more profitable, men often take them over. This was exactly what happened when pump irrigation was introduced for rice production in West Africa" (Gittinger *et al.*, 1990; FAO, 1997).

### 2.8 Constraints to rural Women and extension strategies

The constraints affecting rural women's ability to improve yield, profit, and efficiency in agriculture include: (1) women's legal and cultural status, which affects the degree of control women have over productive resources, inputs such as credit, and the benefits which flow from them (Olawoye, 1989 as cited by FAO, 1997); (2) property rights and inheritance laws, which govern access to and use of land and other natural resources (Jiggins, 1989a as cited by FAO, 1997); (3) the relationship among ecological factors such as the seasonality of rainfall and availability of fuelwood, economic factors such as product market failures, and gender-determined responsibilities such as feeding the family, which trade off basic household self-provisioning goals and care of the family against production for the market (Jiggins,

1989b; Horenstein, 1989 as cited by FAO, 1997); and (4) the way that agricultural services are staffed, managed, and designed (FAO, 1993; Saito & Weidemann, 1990; Gittinger *et al.*, 1990 as cited by FAO, 1997).

# CHAPTER THREE

## 3.0 RESEARCH METHODOLOGY

### 3.1 Overview

This chapter presents the methodology used in this study. It covers the sampling techniques, types of data used, data collection methods, data analysis techniques used in the study and last the limitations encountered during data collection period. First this section presents the description of the study area, which contains location, size, administration, human population, geographical climatic conditions and human activities in the study area. It finishes by statistical analysis used to test hypotheses and the limitation encountered in the data collection exercise.

### 3.2 Description of the study area

Rufiji District is located in the Coast Region and has its district headquarters at Utete. The District name comes from the Rufiji River, which runs through the district. The Rufiji River is flowing into the Indian Ocean intersecting the district into northern and southern parts.

#### 3.2.1 Location of the study area

The study was conducted in the Rufiji District. As shown in Fig.2 below, the Rufiji District is in the southern part of the Coast Region and adjacent to Kilwa and Liwale Districts of Lindi Region on the southern part and on the western part is adjacent to Morogoro Region. Kisarawe and Mkuranga districts are neighboring Rufiji on the

northern part while the Indian Ocean and Mafia District on the eastern side. Rufiji is one of the six Districts in this Region. The District lies between latitude 7.28 degrees and 8.23 degrees south of the equator and longitude between 37.47 degrees to 39.30 degrees east.

### 3.2.2 Size

The district covers an area of 13 339 square kilometers. It is estimated that about 7 914 square kilometers is covered by 20 registered forest reserves and Selous game reserves, which is equivalent to 59.3% of the district area.

### 3.2.3. Administration

The Rufiji District is administratively divided into 6 Divisions, 19 wards and 91 villages: The Wards are Bungu, Chumbi, Ikwiriri, Kibiti, Kiongoroni, Mahege, Maparoni, Mbuchi, Mbwara, Mchukwi, Mgomba, Mkongo, Mtunda, Mwaseni, Ngorongo, Ruaruke, Salale, Umwe and Utete.

### 3.2.4 Human population

The current data from 2002 population and housing census, Rufiji District was reported to have a total population of 203 102, showing the population growth rate of 2.4 per year since the 1988 census (URT, 2003). The following table gives population information.

Information on population size of a particular area is an important aspect, due to the fact that, the more people you have, more food, water, arable land and other essential materials from the natural resources pool you will need to make available (Kauzeni, 2003).

**Table 2: Total Human population in Rufiji District by Sex**

| | Number | Percentage |
|---|---|---|
| Female | 104 266 | 51.6 |
| Male | 97 735 | 48.4 |
| Total | 202 001 | 100.0 |

Source: URT (2005)

### 3.2.5 Climate, geography and soils

Geographically the district is divided into three main zones as follows: flood plain, coast and highland.

*The flood plain* is just next to Rufiji River, which usually floods during the rainy season. Its size is 130 square kilometers stretching from west to east. Its width is 7.35km consisting of more than 13 oxbow lakes. *Rufiji Delta and Coastal zone.* This area is characterized by sand alluvial soil as well as mangrove tree vegetation. *Highland.* This area extends from north and Kilwa/Liwale Districts in the southern part area. The average rainfall is 800-1200mm annually. The average weather is $18^0$C(lowest) – $35^0$C(highest). There are two rainfall seasons; the first starts in mid-November and ends up in mid-January. The second season starts in March and ends up in May. June to October is dry with hot sunshine in the daytime and cold at night.

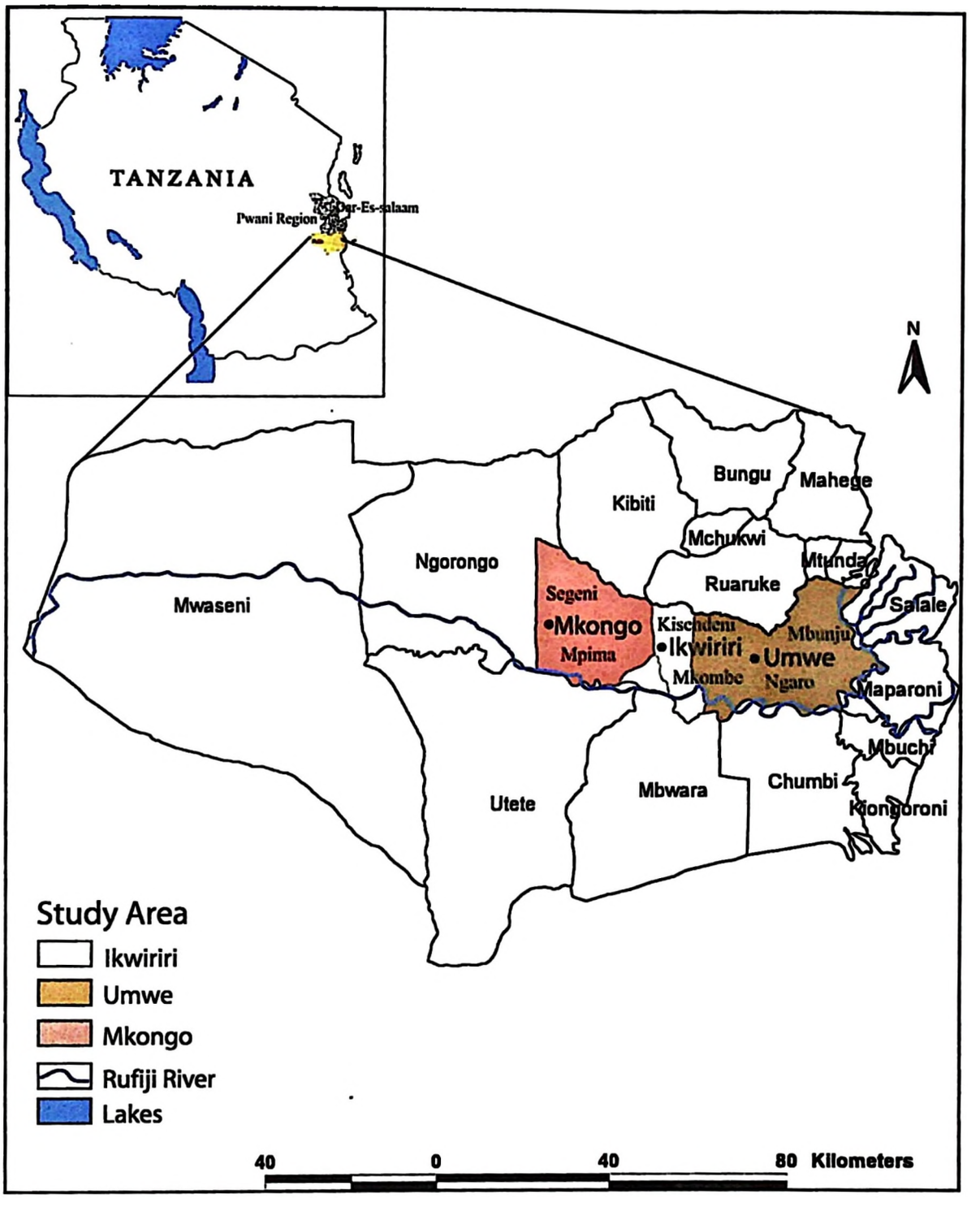


**Figure 2: Map of Rufiji District**

### 3.2.6 Human activities in the study area.

The major economic activities of Rufiji District are farming, livestock keeping, fishing and forest production. Food crops, which are grown, are cassava, paddy, maize and sorghum. Cash crops are coconuts, cashew nuts, cotton, fruits, rice and vegetables.

### 3.3 Justification of the selected area

Rufiji District has been chosen based on the fact that, it has been among the areas mentioned to be potential for irrigation farming, that is, more than 80 000 hectares in the lower Rufiji River which are suitable for irrigation. In 1986 the Iranian government through its Ministry known as "*Jihad e-sazandegi*" decided to finance for the establishments of rice paddy irrigation project at Segeni ward. They invested so heavily on irrigation infrastructures, three heavy-duty water pump machines, a lot of agriculture inputs together with improved rice seeds. The aim was to use the available water from Rufiji River to stimulate agriculture production and therefore improving lives of the people. Farmers were to provide labor force in facilitating all casual labor from cultivating, seeding, weeding and harvesting. After harvesting, they had the condition that every farmer had to provide to the Project 10 bags of rice so as to make the fund revolving in the next period. At the time when they were present, the project had wonderful performance, but when they left the project in the hands of the village government in 1996, the irrigation activities ceased. Apart from that project, no other paddy irrigation is undertaken in the lower Rufiji River. Despite the fact that irrigation tends to improve household income through increased

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crop production, there are very few farmers who are doing irrigation farming in the area; the plots are very small. Since the Rufiji River is flowing to the Indian Ocean via the area, and the area is just near to the Dar es salaam City where the market is readily available, then irrigation farming is thought to be the best practiced which will ensure that the productivity of water can be improved by utilizing this resource for the benefit of the nation through improving food security and the household income to the farmers.

### 3.4 Research design

A cross-sectional research design was used in this study. According to Bernard (1994), as cited by Franco (2005), the design allows data to be collected at a single point in time since it employs a survey method and can be used for descriptive study as well as determinations of relationship between variables. The limited time for fieldwork justifies the use of the selected design.

### 3.5 Field survey

Preliminary survey was done with a view of getting key information which were incorporated to the questionnaire used during the main survey. During the field survey farmers who are farming close to the Rufiji River were visited. Also Key informants were interviewed so as to get more information.

### 3.6 Key Informants

One of the important diagnostic features of good qualitative enquiry is its full exploitation of insights from key informants. Key informants were interviewed so as

to add more information and make the results more accurately. During the survey, the key informants who were interviewed includes the District Agricultural Officer, Three Wards' Extension officers, Representative of Rufiji Basin Development Association (RUBADA) available in Rufiji District, and representative of Rufiji District Development Association known as RUDIDEA. Also women and men farmers who were known to have more information were identified and interviewed.

### 3.7 The sampling procedure

#### 3.7.1 Population

The population of the study was farmers who were farming close to the Rufiji River, and those who were either practicing irrigation farming or not. The sampling frame was obtained from the office of (RUBADA) at Ikwiriri, Rufiji.

#### 3.7.2 Sampling

A purposive sampling technique was adopted to select three wards, and then six villages were chosen, two villages from each ward. The advantage of purposive sampling is that the researcher used his or her skill and prior knowledge to choose respondents. The selection criteria for these villages were to be close to the river and presence of active agriculture activities.

#### 3.7.3 The Sample size calculation

The sampling unit on which measurement of variables were undertaken included farmers, both women and men head of households. The sample size for the research

was supposed to be 235 households, but due to shortage of funds only 60% of the expected sample size was taken, 117.5~ 120 households. The sample size for the research was determined by using the following formula recommended by Kothari (2004).

$N = Z^2 pq/e^2$ where

N= sample size when population is greater than 10 000 (which is the case for the Population for the research)

Z= standard normal deviate which is about 2.0 corresponding to 95% confidence level.

p= proportion in the target population estimated to have a particular characteristic (in this case the population growth rate of Rufiji District i.e. 2.4 per year was used).

q= 1.0-p

e= 0.02(since estimate should be within 2% of the true value).

Therefore, the sample size was

$N = Z^2 pq/e^2 = (2.00)^2 . (0.024). (1-0.024)/ (0.02)^2$

N= 0.093696/0.0004= 234.24 ~235

### 3.7.4 Sample size

The population from which the samples for this research were both women and men farmers. By purposive random sampling, the respondents were picked; the total sample sizes were 120. Such that 25 women respondents and 5 men were randomly

selected from each village, making a total of six villages. The selection criteria were farming close to the river. Since the discussion were to be centered on irrigation constraints facing women farmers, greater portion of women were included in the sample compared to men farmers.

### 3.8 Instrumentation

The study used both primary and secondary data. Primary data were collected from farmers while secondary data were collected from different sources.

#### 3.8.1 Primary data

Primary data for this study were collected using structured questionnaire with both close and open-ended questions. Variables such as age, education level, income, type of farming, distance from the river, were collected using questionnaire. Also questions and checklist to Key Informants, such that District Agricultural Officer, Three Wards' Extension officers, Representative of RUBADA available in Rufiji District, and representative of RUDIDEA. The questionnaire was pre-tested in the field to the target group and necessary corrections were made before the process of data collection.

The unit of study was a household, therefore appointment was done through the local leaders and visit was paid to respondents' residential area for interviewing. Since most of the farmers were busy with farm operations, then, in certain situations it was

obliged to interview farmers at business area or at the farm after they have performed agricultural activities.

### 3.8.2 Secondary data

Secondary data were obtained from published and unpublished documents, Rufiji Basin Development Association (RUBADA), SUA National Agricultural Library (SNAL), Internet facilities and other sources.

### 3.9 Data Processing and Analysis

The data after being collected were edited, coded and then summarized; then the process of data entry into a computer was undertaken. Both qualitative and quantitative data were analyzed using the Statistical Package for Social Science (SPSS) computer software in line with the study objectives. In this statistical package descriptive statistics such as, frequencies, percentages and means were determined. Cross tabulation was done to establish relationship between variables. Hypothesis testing was undertaken at 5 percent level of significance. The decision rule was based on the fact that " Reject the Null Hypothesis ($H_0$) when P value $\geq$ 0.05.

Logistic regression model were used for determine the adoption of women farmers' to new irrigation technologies. The model was estimated using Limped computer software, where adoption of new irrigation technology was assigned 1 while non-adopters it was 0. Quantitative independent variables were, size of land suitable for irrigation measured in hectare, dummy of primary occupation of the respondent

(i.e.=1 if irrigation farmer; $X_2 = 0$ otherwise), dummy of irrigation extension training ($X_3$ =1 if received training; $X_3 = 0$ otherwise), household income in TZS, education measured in number of years in school and dummy of location of the farm ($X_6 = 1$ for close to the river; $X_6 = 0$ elsewhere).

The logistic regression model used in this study is given by:

$$\text{Ln}\ \frac{P}{1-P} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \mu$$

Where:

$\alpha$ = intercept

$\beta_i$ = parameters to be estimated

P = binary dependent variable (P =1 if adopt new irrigation technology; P= 0 otherwise)

$X_1$ = size of land suitable for irrigation

$X_2$ = dummy of primary occupation ($X_2$ =1 if irrigation farmer; $X_2 = 0$ otherwise)

$X_3$ = dummy of extension irrigation training ($X_3$ =1 if received training; $X_3 = 0$ otherwise)

$X_4$ = household income in TZS

$X_5$ = education measured in number of years in school

$X_6$ = dummy of location of the farm ($X_6 = 1$ for close to the river; $X_6 = 0$ elsewhere)

*Ln* = Natural logarithm $\mu_i$ = disturbance term $\mu \sim N(0, P_i(1-P_i))$

### 3.10 Limitation of the Study

During data collection, the researcher encountered a number of limitations which in one way or another have affected the accomplishment of tasks as schedules; the following are some of the problems encountered:

(i) Difficult to get the number of women farmers as previous proposed, 15 from each village while men were only 5. The Researcher solved this problem by compensating through interviewed more in some villages, believing that they were homogenous.

(ii) Due to socio-cultural aspect of the area, it is not usual to see a rural woman talking the issues concerning her job with a man who is not her husband. Some women were scared and not comfortable when approached by a researcher for the interview. The researcher managed to collect the required information after being accompanied by woman extension Officer.

(iii) Some respondents were interviewed while working; this were considered as a problem to a research due to the fact that, reduced the possibility of getting more clarification from respondents especially about the constraints hindering women from effective utilization of water from Rufiji River to improve small-scale irrigation farming. To avoid that a more detailed interviewing had to be conducted, though it was time consuming. Also use of secondary information to complement primary

data was done. Therefore findings represent, what was actually happening in Rufiji District.

### 3.11 Summary

This chapter described the study area and presented the methodology used for collecting and analyzing the Data. The geo-physical characteristics of the study location were highlighted. Then, the survey design and the technique used in sampling the households were presented. The chapter ended up with the limitation of the study.

# CHAPTER FOUR

## 4.0 RESULTS AND DISCUSSION

### 4.1 Overview

In this chapter results of the study are presented and discussed. The discussion starts with the characteristics of respondents, size of the households of respondents, irrigation agriculture in the study area, decision making on various resources, irrigation behavior, factors hindering women's effective utilization of water for irrigation purposes, and the factors determining the adoption of irrigation farming.

### 4.2 Characteristics of respondents

This study was conducted in six randomly selected villages in the rural area of Rufiji district namely: Kisendeni, Segeni, Mkombe, Mbunju, Mpima and Ngaro as indicated in Table 3. In those villages 120 randomly selected respondents were interviewed. The portions of the respondents in respect of gender were 83.33% and 16.67% female and male respectively. The number of males taken was very small because most of men are busy with other non-farm business.

**Table 3: Distribution of respondents in surveyed areas**

| Village | Number of Respondents | | | Percent of respondents |
|---|---|---|---|---|
| | Total | Male | Female | (N=120) |
| Kisendeni | 25 | 4 | 21 | 20.83 |
| Segeni | 18 | 8 | 10 | 15.00 |
| Mkombe | 22 | 3 | 19 | 18.33 |
| Mbunju | 17 | 7 | 10 | 14.17 |
| Mpima | 22 | 5 | 17 | 18.33 |
| Ngaro | 16 | 3 | 13 | 13.33 |
| Total | 120 | 30 | 90 | 100 |

Agriculture as any other economic activity involves people of different background. This is due to the fact that irrigation farming is an industry within agricultural sector. This study also investigated the respondents in order to know their background information as it is shown in Table 4.

In Rufiji District the age class boundaries, which are the most active in agriculture (farming) are 15-34 years, which makes 45.9% among the surveyed irrigation farmers. This age group is followed by 35-44, which makes 28.3%. The reason here is the nature of activity itself which needs a lot of energy and commitment. For example, irrigation farming involves watering of crops by using watering cans is the toughest job because irrigated crops need water twice per day. Therefore it is very difficult for older people to engage themselves in irrigation activities.

As far as education is concerned, the study revealed that 36.7% of farmers have no formal education; 25% are standard seven leavers, while 25.8% have formal

education of less than standard seven. Furthermore, in the surveyed areas the large number of farmers (71.6%) were indigenous, 26.9% settled immigrants and only 4.2 % were work immigrants.

Agriculture needs high degree of specialization because in most cases people who are engaged in this business have no time of doing other economic activities. This is because agriculture farming are very demanding and time consuming. In Rufiji District, the survey indicates that only 26.7% of respondents were involved in other activities such as employment work and commercial businesses.

**Table 4: Characteristics of respondents in surveyed areas**

| Characteristics of respondents | Male | | Female | | Both | |
|---|---|---|---|---|---|---|
| | No | % | No | % | No | % |
| **Age:** | | | | | | |
| 15-24 | 6 | 20.0 | 20 | 22.2 | 26 | 21.7 |
| 25-34 | 11 | 36.7 | 18 | 20.0 | 29 | 24.2 |
| 35-44 | 8 | 26.7 | 26 | 28.9 | 34 | 28.3 |
| 45-54 | 3 | 10.0 | 19 | 21.1 | 22 | 18.3 |
| 55-64 | 2 | 6.6 | 7 | 7.8 | 9 | 7.5 |
| Total | 30 | 100 | 90 | 100 | 120 | 100 |
| **Years attended school:** | | | | | | |
| No formal school | 1 | 3.3 | 43 | 47.8 | 44 | 36.7 |
| < Standard 7 | 6 | 20 | 25 | 27.8 | 31 | 25.8 |
| Standard 7 | 12 | 40 | 18 | 20.0 | 30 | 25.0 |
| Form IV | 8 | 26.7 | 3 | 3.3 | 11 | 9.1 |
| Certificate | 2 | 6.7 | 0 | 0 | 2 | 1.7 |
| Other | 1 | 3.3 | 1 | 1.1 | 2 | 1.7 |
| Total | 30 | 100 | 90 | 100 | 120 | 100 |
| **Occupation:** | | | | | | |
| Agriculture | 7 | 23.3 | 81 | 90 | 88 | 73.3 |
| Agriculture and business | 19 | 63.4 | 8 | 8.9 | 27 | 22.5 |
| Agriculture and employed | 4 | 13.3 | 1 | 1.1 | 5 | 4.2 |
| Total | 30 | 100 | 90 | 100 | 120 | 100 |
| **Marital status:** | | | | | | |
| Married | 19 | 63.3 | 69 | 76.6 | 88 | 73.4 |
| Single | 7 | 23.4 | 6 | 6.7 | 13 | 10.8 |
| Widowed | 1 | 3.3 | 8 | 8.9 | 9 | 7.5 |
| Divorced | 3 | 10.0 | 7 | 7.8 | 10 | 8.3 |
| Total | 30 | 100 | 90 | 100 | 120 | 100 |

As far as marital status is concerned, the table above shows that 73.1% of respondents are married. 7.5% of respondents are widowed, 10.4% are single and 8.9% are divorced; in this time whereby the rate of HIV/AIDS transmission is very high the percentage of people who are not married is also very high, therefore more awareness and protection techniques should be directed for those who live far from their partners and unmarried ones.

**4.3 Size of household of respondents**

From Table 5, the distribution of the respondents from the study area indicates that households have unevenly distributed sizes. In the surveyed area of Rufiji District, 43.3% of the households had a family size of 4 to 6 followed by families with size of 7 to 9 (26.7%) and 1 to 3 (20%); few households (10%) had a family size of 10 and above. Observation done by the researcher showed that in families with large population there were many dependants (orphans and adults) while those ranging with 1 to 3 were young married couples. Also information from the table indicates that many households fall at 6 per household. Meaning that many households had average of 5 to 6 members. And, this family size per household agreed with the national standard of an average of 5.6 persons per household (URT, 1997 as cited by Elias, 2003).

Findings in Table 5 from Chi-square show that there are close relationship of the household size, meaning that there was no great difference between one household and another at significant level $P < 0.05$.

**Table 5: Distribution of respondents according to the size of households (N = 120)**

| Ward | Household size of respondents | | | | |
|---|---|---|---|---|---|
| | 1-3 | 4-6 | 7-9 | 10 and above | Total |
| Ikwiriri | 9 | 12 | 8 | 2 | 31 |
| Mkongo | 8 | 17 | 11 | 10 | 46 |
| Umwe | 7 | 23 | 13 | - | 43 |
| Total : | | | | | |
| N | 24 | 52 | 32 | 12 | 120 |
| Percent | 20 | 43.3 | 26.7 | 10.0 | 100.0 |
| Chi-squared statistics 14.7 | | df=6 | 0.023 | | |

## 4.4 Irrigation Agriculture in the study area

### 4.4.1 Farmers using irrigation farming

All farmers interviewed were involved in agricultural activities just near to the River Rufiji; but data were collected to get the number of farmers using irrigation agriculture in their farms. In the study area, land close to the river is very scarce and the majority of irrigating farmers interviewed have hired land to the land lords; the results about the number of farmers interviewed who were practicing irrigation farming are summarized in Table 6 below.

**Table 6: Farmers using irrigation farming**

| | Male | | Female | | Both | |
|---|---|---|---|---|---|---|
| | No | % | No | % | No | % |
| Irrigating | 19 | 63.3 | 32 | 35.6 | 51 | 42.5 |
| Not irrigating | 11 | 36.7 | 58 | 64.4 | 69 | 57.5 |
| Total | 30 | 100.0 | 90 | 100.0 | 120 | 100 |

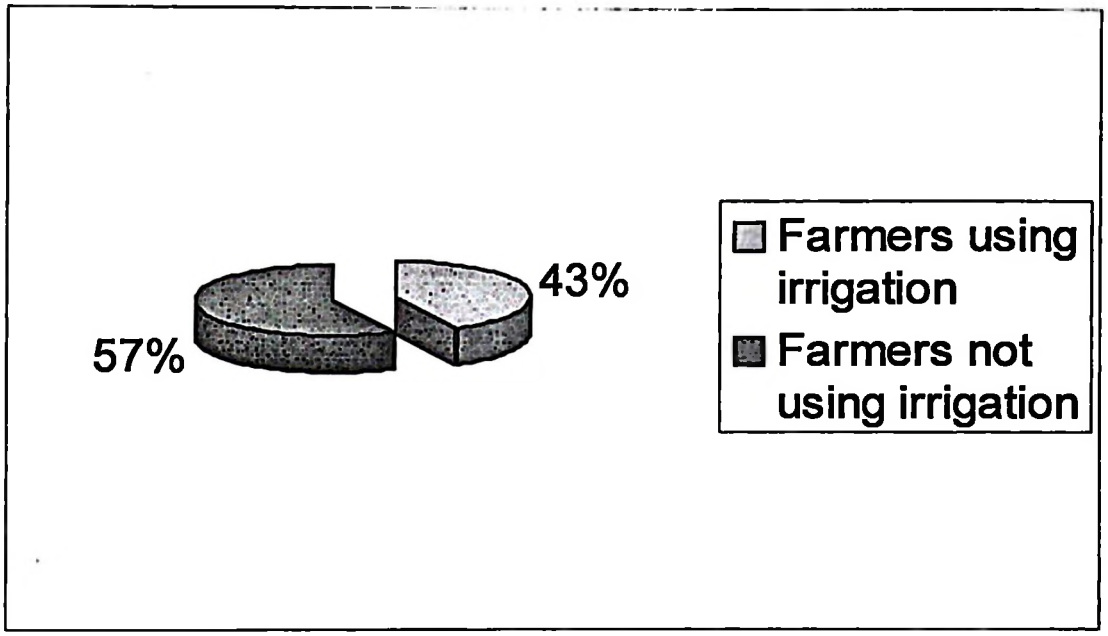


**Figure 3: Pie Chart for types of Farmers interviewed regardless of gender**

Out of 120 respondents interviewed only 43% were using irrigation farming while 57% of respondents are not using irrigation farming in their farms.

Out of 30 men interviewed, 63.3% were using irrigation practices in their farms while only 35.6% of women interviewed who were farming just near to the river, were using irrigation farming. This finding has revealed that men were at least much active in irrigation farming compared to women, in Rufiji District.

### 4.4.2 Irrigation Crops

The purpose of one of the specific objectives was to determine the types of irrigated crops grown in Rufiji District. This section will attempt to examine type of irrigation crops and to study if there are land scarcity problem. In order to know that, the

respondents were asked to give details on the main crops grown, size of land used for irrigation farming, irrigation technology used, pests and diseases control and irrigation decision-making at the family level.

### 4.4.2.1 Main types of irrigated crops grown

**Table 7: Types of irrigated crops in the study area**

| Crops | Males (N=19) | | Females (N=32) | | Total (N=51) | |
|---|---|---|---|---|---|---|
| | No | % | No | % | No | % |
| Tomato | 15 | 78.9 | 21 | 65.6 | 36 | 70.6 |
| Paddy | 11 | 57.9 | 26 | 81.25 | 37 | 72.5 |
| Water melon | 6 | 31.6 | 17 | 53.1 | 23 | 45.1 |
| Green vegetables | 3 | 15.8 | 28 | 87.5 | 31 | 60.8 |
| Cucumber | 14 | 73.7 | 16 | 50.0 | 30 | 58.8 |
| Okra | 9 | 47.4 | 19 | 59.4 | 28 | 54.9 |
| Maize | 4 | 21.1 | 3 | 9.4 | 7 | 13.7 |

*Total N=51 respondents since out of 120 interviewed only 51 are irrigating farmers*

In the survey, 70.6% of irrigation farmers, used their plots for cultivating tomatoes, and 72.5% used for growing paddy whereby 81.25% of women practicing irrigation farming are growing paddy (see Table 7). About 13.7% of farmers grew maize while 60.8% of farmers were growing green vegetables such as amaranthus, eggplants and hot pepper. In Rufiji District, the farmers grow tomatoes, watermelon and paddy because these have got higher demand at the market. That is why when Iranian Project at Segeni started, the project encouraged farmers to improve the production of rice so as to generate income and also food security purposes. During the survey,

the respondents stated that growing tomato is more expensive because it needs big capital in comparison with other crops.

As far as the production of fruits is concerned, 45.1% were growing watermelon whereby 53.1% of irrigating women farmers are growing water melon. In Rufiji District most families have several fruit trees such as mango, coconut, cashew nut and paw paws. Farmers felt that it was economical to grow fruits like watermelon because it takes only few months to give its fruits compared to mango trees that take more than eight years to get the first fruits.

#### 4.4.2.2 Size of land used for irrigation farming

In the study areas land ownership is based on private small plots. Reliable land for irrigation farming is very limited. This is due to the fact that irrigation farming requires a plot to be just near by the river or to be in location whereby if the canals are established water can move free to the crops according to the gravitation forces. The question of land is very sensitive because the majority of the land suitable for irrigation belongs to landlords who have clan ownership rights. In order to determine land use pattern the respondents were asked to state the size of their land used for irrigation farming. The summary of the distribution is presented in Table 8. For easy analysis the land size are respectively treated as less than quarter hector, between quarter and half hector; between half and three quarters hector, and between 1 and 2 hectors.

Out of the 51 respondents who practiced irrigation farming, 25.78% of the respondents doing the irrigation farming in the farm plots whose size is less than quarter hector. 37% of the surveyed irrigation farmers used land size between quarter and half hectors, 21.74% used land size between half and three quarters. Only 15.5% of respondents used between 1 and 2 hectares of the land for irrigation farming.

**Table 8: Land size used for irrigation farming**

| Land size (in ha) | Percentage (N=51) |
|---|---|
| Less than ¼ | 25.78 |
| ¼- ½ | 37.0 |
| ½ - ¾ | 21.74 |
| 1-2 ha | 15.5 |
| Total | 100.0 |

*N=51 respondents since out of 120 interviewed only 51 are irrigating farmers*

In terms of proportion of the land used for irrigation farming, among 51 respondents, only 13.1% used over ¾ of their land/plots for irrigation farming of which only 5% used all their land. This is small proportion of population and the reality might be the immigrants to the areas. They normally hired the plots from landlords and therefore used all their areas for irrigation farming. Due to the fact that many irrigation farmers are small-scale producers, the survey revealed that 46.3% of the irrigation farmers use less than half of their area suitable for irrigation. This coincides with the findings from 2002 population and housing census as reported by URT (2005) "there is very small planted area with irrigation in the Coast region".

#### 4.4.2.3 Examination of land scarcity problem in the irrigated area

**Table 9: Responses about the question asked "is the land you have enough for your agricultural activities?" N=120**

| | Frequencies | Percentage |
|---|---|---|
| Yes | 44 | 36.6 |
| No | 76 | 63.4 |
| Total | 120 | 100 |

The Table 9 above represent the findings when the respondents were asked about the land they have if is enough for their farming activities; out of 120 respondents farming close to the river, 63.4% they said that the need more land than they have, the remaining 36.6% said that they are satisfied by the pieces of land they have. The major reason for this big demand for land near to the river is that these plots have very high economic values, and the greater portion is owned by land Lords. This is an indication that there is land scarcity problem along the Rufiji River.

#### 4.4.2.4 Pests and diseases control

The study revealed that pests and diseases are the key problems, which affect the production of irrigated crops in the areas as it has been indicated in Table 10. In order to overcome the pests problem farmers have been using pesticides. The farmers stated that in most cases if they don't apply the pesticides they get poor yields and sometimes no yields at all. According to Table 10, the most common pesticide in the area is thionex as 71.2% of irrigation farmers do apply. The reason behind is that Thionex is cheaper compared to other pesticides.

**Table 10: Pesticides commonly used in irrigated crops (N=51)**

| Pesticides type | Percent of farmers |
|---|---|
| Thionex | 71.2 |
| Karete | 58.2 |
| Thiodan | 42.5 |
| Corbox | 32.9 |
| Brovo | 17.4 |

*N=51 respondents since out of 120 interviewed only 51 are irrigating farmers*

#### 4.4.2.5 Irrigation decision making at the family level

Sustainability of irrigation farming activities at the household level depends on the participatory decision-making as well as ownership of irrigation farming activities by members of the household. Majority of the respondents, 52%, stated that, in the household, father had the final say on the irrigation decision. But 46% of the respondents said both husbands and wives do the decision together. However, fathers have an upper hand than mothers. A small number, 2% said that the whole family or other family members make decisions. The respondents explained that, they have been able to achieve the women involvement through the current equal opportunity move, which is advocated by different organs in the media.

#### 4.4.2.6 Methods of obtaining water for irrigation

Farmers in Rufiji District are facing difficulties as far as the methods used to obtain water for irrigation is concerned. Table 11 below shows that, within the sample size taken, 49.01% of farmers are using motorized (overhead) pump irrigation of which women are 37.21% and men are 11.8%; this method is very expensive as it requires a

big start up capital to purchase water pump and also need fuel whenever used. 9.82% irrigate using treadle pump (all are men), 37.25% used bucket for irrigation and 3.92% used surface irrigation.

**Table 11: Distribution of farmers in respect to irrigation technologies, N=51**

| Irrigation method | Men | | Women | | Total | |
|---|---|---|---|---|---|---|
| | No | % | No | % | No | % |
| Motorized pump | 6 | 11.8 | 19 | 37.21 | 25 | 49.01 |
| Bucket | 7 | 13.72 | 12 | 23.55 | 19 | 37.25 |
| Treadle pump | 5 | 9.82 | 0 | 0 | 5 | 9.82 |
| Surface irrigation | 1 | 1.96 | 1 | 1.96 | 2 | 3.92 |
| Total | 19 | 37.3 | 32 | 62.7 | 51 | 100.00 |

*N=51 respondents since out of 120 interviewed only 51 are irrigating farmers*

Most of the farmers who irrigate currently using overhead pump were previously using bucket for irrigation, which is so tedious. Surface irrigation is not common in Rufiji due to the fact that level of water is down compared to the edge of the land, to the extent water cannot flow to the farms using gravity. According to URT (2005) "Gravity is the most common means of getting water for irrigation with 58% of households with irrigation using this method (in Tanzania). This is closely followed by hand bucket with 39% of households. The remaining methods (hand pump, motor pump and other) are of minor importance".

In the surveyed area, irrigation is mainly practiced for vegetables productions, and fruits like tomatoes, watermelon, and eggplants; also crop rotation is normally practiced to maintain the fertility of the soil and also improve the productions.

Rice paddy production were produced under mechanized irrigation farming at Segeni irrigation project which were financed by the Iranian Government, the project had to support small farmers by providing them with improved rice seeds, fertilizers, and fuel for pumping water to the plot. The farmer had to do field work of planting, weeding, and harvesting. Therefore from the harvests the Iranian were to take ten bags to compensate for the costs incurred. The project had very good performance, but when the project phased out and left in the hand of *"Ushirika wa Umwagiliaji Maji Segeni"*, it collapsed; although the farm is available of more than 150 hectares, water pump machines are there, and well developed irrigation infrastructures, but the farmers do not have enough fund to support the agricultural irrigation activities.

#### 4.4.2.7 The cost of establishing irrigation technology

**Table 12: The cost of establishing irrigation farming using motorized pump**

| Money range in TZS | Frequency | Percentage |
|---|---|---|
| 100 000- 500 000 | 11 | 9.2 |
| 500 000-1 000 000 | 87 | 72.5 |
| 1 000 000-2 000 000 | 22 | 18.3 |
| Total | 120 | 100.0 |

The research reveals that the most common method of irrigation in rufiji District is motorized pump; this method is used due to the fact that water can not flow to the farms using gravity. So there are high cost, which is associated with purchasing the water pump, pipes and also fuel. The respondents were asked about the cost for establishing motorized pump irrigation in their plots, the table below summarizing the results. It has been revealed that majority of respondents, 90.8%, have suggest that the cost is more than TZS 500 000; this is huge amount of money for a rural people to be able to pay. The findings are summarized in the Table 12 above.

## 4.5 Women's affordability and sources of fund for irrigation infrastructure

### 4.5.1 Women's affordability to irrigation infrastructure

**Table 13: Responses of women farmers on affordability of irrigation infrastructures (N=58)**

| | Frequencies | Percentage |
|---|---|---|
| Can afford | 4 | 6.9 |
| Cannot afford | 52 | 89.7 |
| No comment | 2 | 3.4 |
| Total | 58 | 100.0 |

*N=58 women respondents since out of 90 interviewed 58 do not practice irrigation*

One among the specific objective was to assess the women's affordability to irrigation infrastructures; the women respondents were asked if they can afford to buy/ establish irrigation infrastructures in their farms. The results are summarized in Table 13 above, out of the 58 women who are farming close to the river without practice irrigation farming, 89.7% said that they do not have financial capacity to

purchase the water pumps, 6.9% pointed out that through their hardworking they are capable to purchase the irrigation infrastructures, while 3.4% did not mention their views about if they can or not.

### 4.5.2 Women irrigation farmers sources of fund for irrigation infrastructure

**Table 14: Women irrigation farmers sources of fund for established irrigation farming (N=32)**

| | Frequencies | Percentage |
|---|---|---|
| Long saving period | 21 | 65.6 |
| Assisted by relatives | 10 | 31.3 |
| Credit from Saccos | 1 | 3.1 |
| Total | 32 | 100.0 |

*N=32 women respondents since out of 90 interviewed 32 are using irrigation farming*

Those women farmers who are using irrigation farming in their plots were asked about the source of fund for their irrigation technology. As shown in Table 14 above, out of 32 women, 65.6% said that they managed to buy the irrigation infrastructures after a long period of saving from their income, such that monthly salary, sales of commodities and also agricultural wages; 31.3% they did after being supported by their relatives and 3.1% received a credit from established smallholders farmers Saccos.

## 4.6 Women's access, control and decision making over various resources

**Table 15: Access, control and decision making over various resources (%) (N=120)**

| Items | Access | | | Control | | | Decision making | | |
|---|---|---|---|---|---|---|---|---|---|
| | MA | FA | B | MA | FA | B | MA | FA | B |
| Labor | 12.7 | 35.5 | 51.8 | 12.7 | 36.4 | 50.9 | 9.1 | 35.5 | 55.5 |
| Education | 37.3 | 21.8 | 40.9 | 38.2 | 19.1 | 42.7 | 31.8 | 20.9 | 47.3 |
| Non-farm Activities | 16.4 | 28.2 | 55.5 | 55.5 | 29.1 | 57.3 | 13.6 | 29.1 | 57.3 |

MA = Male adult

FA= Female adult

B= Male and Female adult

### 4.6.1 Women's access, control and decision making over Agricultural labour and education

Due to male out-migration to urban and semi-urban areas to look for non-farm employment such as road construction and timber business, the number of women household heads are increasing and this enables them to have access, control and decision to agricultural labour. Results in Table 15 indicate that 35.5% of females have access to agricultural labour, while 55.5% of both male and female adults have decision-making power to agricultural labour. However in households where husbands are present, they have shown cooperation to labor such as cultivating land, weeding, irrigation and also crop harvesting. Opportunity to children's education has shown no difference between males and females as it is presented in Table 15.

The households visited where husbands are away, still women take seriously the future of their children. The most encouraging thing is the income contribution of

some men who are away, where they are completely involved in the shaping the future of their children by financing their education. However, 19.1% and 20.9% of households it was found that women have control and decision-making power respectively on their children.

### 4.6.2 Women's access, control and decision making over Non farm activities

The results reveal that most women prefer to do non-farm activities compared to men. Females have access and control on non-farm activities for 28.2% and 29.1% respectively as shown in Table 15. Men have great control on non-farm activities by 55.5% while 57.3% of males and females have shown to have great control over non-farm activities.

### 4.7 Factors that hinders Women's utilization of water for irrigation purposes

Rufiji District is well blessed with fertile soil and also plentiful availability of water, which economically has a big role to play in ensuring all season continuation of farming activities. The results revealed that farming in Rufiji does not involve much of irrigation practices. Out of 120 respondents interviewed who were farming just near the river, only 42.5% were practicing irrigation farming; looking on the gender perspective, out of 30 men interviewed 19 (63.3%) were practicing irrigation farming, but out of 90 women interviewed, only 32 (35.5%) women were practicing irrigation farming. This means that greater portion of men who are farming near the river are used to irrigation farming compared to women. The results revealed that there are several problems that hinder women from effectively utilizing water from

Rufiji River for improving their farming activities; the factors observed from the study area when respondents were asked to indicate constraints which limit them from effectively utilizing water from the River for improving farming activities are presented below:

**Table 16: The factors hindering women effective utilization of water from the Rufiji River**

| Factors | Percent |
|---|---|
| Lack of start up capital | 87 |
| Low household income | 73 |
| Weak attitudes towards irrigation farming | 72.5 |
| Heavy household chores on the part of women | 54.4 |
| Lack of concerted effort by extension agents | 69 |
| Long Distance from the water source | 48 |
| Low-level education | 42 |

### 4.7.1 Low household income

Form Table 17 below, it was revealed that majority of women farmers who are not using irrigation farming, 79.3%, are earning on average below TZS. 1 000 per day, whereby only 20.7% of them are earning between TZS. 1 000-5 000 per day. While the 87.5% of women farmers using irrigation farming are earning on average between TZS. 1 000-5 000 per day, whereby 9.4% of them are earning on average above TZS. 5 000 per day. This is an indication of improvements in the purchasing power and standard of living of people who are using water for irrigation purpose.

**Table 17: Household income per day in the sampled households in % (N=90)**

| Income | Irrigation farmers | | Non irrigation farmers | | Total | | |
|---|---|---|---|---|---|---|---|
| (TZS) | N | % | N | % | N | % | $X^2$ |
| Below 1 000 | 1 | 3.1 | 46 | 79.3 | 47 | 52.2 | 5.9914* |
| 1 000- 5 000 | 28 | 87.5 | 12 | 20.7 | 40 | 44.5 | |
| Above 5 000 | 3 | 9.4 | - | - | 3 | 3.3 | |
| Total | 32 | 100 | 58 | 100 | 90 | 100.0 | |

*statistically significant at ($p<0.05$)

There is connection between the level of household income and irrigation farming in the Rufiji District. Farmers who are using irrigation farming are the ones who are having other sources of income, most of them are immigrants. This is an indication that low-income women are constrained from using water for irrigation due to their poor capacity of financing the purchases of irrigation infrastructures and also buying fuel to run the machines. This is a major factor that has resulted into a collapse of the well-established *"Iranian's Irrigation project"* at Segeni Village. Although the irrigation infrastructures and machines are there in a very good condition, people are not able to utilize the opportunity available due to low income which makes them not to be able to purchase fuel needed to pump water into their plots.

The major reason which constraints many women in Rufiji District to utilize water available in Rufiji River for improving farming activities is due to extreme poverty that exists in their households. Results of the chi-square showed that there is

significant relationship ($p<0.05$) between irrigation farming and household income of the respondents; hence the null hypothesis is rejected and the alternative is accepted: that is, household income has a significant effect on the possibility of the family to practice irrigation farming.

### 4.7.2 Limited resources available to women

The main constraint faced by women not to be able to utilize effectively water from Rufiji River for small-scale irrigation is the limited amount of resources available to them. Such that with little access to cash income, less access to land and credit.

#### 4.7.2.1 Lack of start up capital

Lack of enough start up capital was ranked the first, by 87% of respondents as the highest limiting factor that hinders women to utilize effectively water from Rufiji River for improving their farming activities. Amount of capital they have access and control over is not enough for purchasing irrigation implements including overhead water pumps, water pipes, and hiring people to carry water from the river to the plot using water cans. The influence of the lack of enough capital on respondents' information is presented in the Table 16 above. Credit is a good source of start up capital for women but the majority of respondents have never received the credit. In this study access to credit was measured in terms of who have the knowledge on the availability of credit. Some of the respondents had reported to receive credit in kind in the form of fertilizers, pesticides and other agricultural inputs. These loans are repaid upon selling the farm products e.g. rice and maize.

**Table 18: Distribution of respondents by access to Agricultural credit**

| | Men (N=30) | | | | Women (N=90) | | | |
|---|---|---|---|---|---|---|---|---|
| | Yes | | No | | Yes | | No | |
| | N | % | N | % | N | % | N | % |
| Access to Agric. credit | 19 | 633 | 11 | 36.7 | 7 | 7.7 | 83 | 92.3 |

Table 18 above shows that, majority of male respondents in the study area had access to credit, such that 63.3% of male respondents, while only 7.7% of women respondents. This accessibility was mainly due to knowledge respondents have about the availability of credit. They acquire this knowledge through their participation in various irrigation project, village organizations and extension activities. Therefore males have greater access to credit than women. Greater accessibility to credit for men has also been reported by FAO (1984), as cited Mbago (1997).

#### 4.7.2.2 Constraints to land resource

##### 4.7.2.2.1 Limited access to land resource suitable for irrigation

There is a consensus in literature that women are farmers of Africa. Their ability to fulfill their role as agricultural producers especially in small-scale irrigation is based on rights in access to and control over land suitable for irrigation and other productive resources. Access to land resource is defined as the right to use them. The study results (Table 19), women have a little access to land suitable for irrigation (land plots close to the river) compared to men. Out of 120 households studied,

21.7% show that women have access to land suitable for irrigation, while 52.5% show that men have access to land. 25.8% of respondents suggest that both men and women have access to land resource. As it discussed in URT (2006) that this is a direct consequence of low socio-economic status of women in society.

These findings are the same as reported by FAO (1997) "one among the constraints affecting rural women's ability to improve yield; profit, and efficiency in agriculture include property rights and inheritance laws, which govern access to and use of land".

**Table 19: Access to land resource**

| Village | Male | Female | Both | Total |
|---|---|---|---|---|
| Kisendeni | 13(20.6) | 5(19.2) | 7(22.6) | 25(20.8) |
| Segeni | 9(14.3) | 4(15.4) | 5(16.1) | 18(15) |
| Mkombe | 11(17.5) | 5(19.2) | 6(19.4) | 22(18.3) |
| Mbunju | 11(17.5) | 4(15.4) | 2(6.5) | 17(14.2) |
| Mpima | 10(15.9) | 5(19.2) | 7(22.6) | 22(18.3) |
| Ngaro | 9(14.3) | 3(11.5) | 4(12.9) | 16(13.3) |
| Total | 63(52.5) | 26(21.7) | 31(25.8) | 120 (100) |

Note: Figures in parenthesis are percentages.

#### 4.7.2.2.2 Lack of control and decision making over land resources by women

**Table 20: Control and decision making to land resource**

| Village | Control to land resource | | | | Decision making to land resource | | | |
|---|---|---|---|---|---|---|---|---|
| | Male | Female | Both | Total | Male | Female | Both | Total |
| Kisendeni | 12 (24.0) | 9 (25.7) | 4 (11.40) | 25 (20.8) | 18 (24.0) | 2 (9.5) | 5 (20.8) | 25 (20.8) |
| Segeni | 7 (14.0) | 4 (11.40) | 7 (20.0) | 18 (15.0) | 10 (13.3) | 5 (23.8) | 3 (12.5) | 18 (15.0) |
| Mkombe | 9 (18.0) | 8 (22.8) | 5 (14.28) | 22 (18.5) | 16 (21.3) | 2 (9.5) | 4 (16.7) | 22 (18.5) |
| Mbunju | 5 (10.0) | 2 (5.7) | 10 (28.6) | 17 (14.2) | 9 (12.0) | 4 (19.0) | 4 (16.7) | 17 (14.2) |
| Mpima | 8 (16.0) | 8 (22.8) | 6 (17.1) | 22 (18.3) | 13 (17.3) | 4 (19.0) | 5 (20.8) | 22 (18.3) |
| Ngaro | 9 (18.0) | 4 (11.40) | 3 (8.5) | 16 (13.3) | 9 (12.0) | 4 (19.0) | 3 (12.5) | 16 (13.3) |
| Total | 50 (41.7) | 35 (29.2) | 35 (29.2) | 120 (100.0) | 75 (62.5) | 21 (17.5) | 24 (20.0) | 120 (100.0) |

Note: Figures in parenthesis are percentages.

Control of resources is the ability to dictate their uses, and men controlled and owned land resource (Table 20 above). Traditionally, land in the study area belongs to men and they have control over land and not women. Women can be involved in land decision-making, such as types of crops to be grown and the likes. However 29.2% of respondents declared that both males and females have control over land. About 41.7% of households visited, men have control over land, although they cannot sell land without consent of members of family, which include the wife.

Lack of decision-making authority by women is one among the constraints to cropping, irrigation and harvesting. Where both husband and wife are present, control and decision making in the household remain the sole responsibility of the husband, although married women were less likely to make decision than widowed or single women. The results reveal that only 17.5% indicate that women have decision on land. This implies that women do not have big decision on the type of farming, types of crops and also whether to irrigate their land or not. In the present study area there is an indication that women do not have power on land, therefore men decision making over land seem to have a upper end. (Table 20 above).

#### 4.7.2.3 Lack of capital assets

During interview, the women farmers were asked about the assets owned by the household so as to measure the poverty in the household level. It includes variables such as assets with household, house and livestock. These assets are easily to be convertible into cash.

**Table 21: The assets owned by Women (N=90)**

| Assets owned | percent |
|---|---|
| Bicycle | 13.5 |
| Radio | 35.2 |
| Table/chair set | 17.8 |
| Mattress | 18.9 |
| House | 36 |
| Farm | 60 |
| Livestock | 43.5 |

Women have very few assets, which they owned by themselves and the family. As shown in the Table 21 above, few percentages of women are owning capital assets which can be easily converted into cash, 13.5% own bicycle, 36% own houses but these are the local houses, 60% are owning plots of farms and 43.5% are owning livestock with majority of them are keeping goats, which were introduced by Iranians.

### 4.7.3 Women's behaviour and attitudes towards irrigation farming

#### 4.7.3.1 Low irrigation behaviour of women in the Rufiji District

In order to determine the perception and attitude of women farmers on irrigation farming, an index was developed using a list of behaviour variables. Five variables

were used to form this index. These variables were: Irrigating the farm in the past 12 months, planting the crops which need water regularly, attending in the meeting discussing irrigation farming, purchasing a water pump, purchasing a land which is near to the river. For each of the above mentioned variable, the response was given the value ranging from 1 to 5, in which 1 means never happen, 2 uncertain, 3 agreed, 4 strongly agreed 5 very strongly agreed, such that indicated "No" response. The list of these variables and their values are presented in Table 22 below. Scores of 1 to 2 were considered as low irrigation behaviour and perception, 3 medium and 4 to 5 high irrigation behaviour.

According to Table 22 below, the majority of the respondents were in the low irrigation behaviour, 51.1%; medium irrigation behaviour had 10.54% of respondents, while the high irrigation behaviour occupied only 38.36% of the respondents.

**Table 22: Index scale for measurement women's irrigation behavior (%)**

| Statement on Irrigation Behavior | Score (N=90) | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Irrigating the farm in past 12 months | 64.4 | | | | 35.6 |
| Planting the crops which need water regularly | | 31.0 | 7 | 37.8 | 24.2 |
| Attending in the meeting discussing | 60 | 18.3 | 10 | 11.7 | |
| Purchasing a water pump | 75 | | | | 25 |
| Purchasing a land which is near to the river | 6.8 | | 35.7 | 11.8 | 45.7 |
| **Level of irrigation behavior** | | | | | |
| Low | 51.1 | | | | |
| Medium | 10.54 | | | | |
| High | 38.36 | | | | |

The estimated index of knowledge and perception among respondents was further used to examine the relationship between respondents' knowledge and perception on irrigation farming and demographic and socio-economic factors. *Chi-squared test* was used to determine the significance between these variables and farmers' knowledge and perception on irrigation farming.

### 4.7.3.2 Weak attitudes towards irrigation farming

Irrigation is normally carried out for the purpose of increasing crops productivity, income generation, ensuring stable flow of food into the household and also creation of employment opportunities.

**Table 22: Perceptions of rural women on the irrigation farming (N=90)**

| | Agree | | Undecided | | Disagree | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Irrigation is best for high Crop yield | 49 | 54.5 | 17 | 18.8 | 24 | 26.7 |
| Irrigation contributes much to the improvements of household Income | 35 | 38.9 | 46 | 51.1 | 9 | 10.0 |

During interview the respondents were asked to give their views on irrigation farming so as to predict their attitudes towards irrigation. The results reveal that women in the Rufiji District have weak attitude towards irrigation. From Table 23 above, 54.5% of respondents agree that irrigation farming is the best for high crops yield while some women farmers have negative attitudes, i.e., 26.7%, felt that productivity is uniform whether they irrigate their land or not, believing that since

their farms are close to the river, the soil has enough moisture contents therefore no need to irrigate their farms. Also the majority (51.1%) had no option on the idea that, irrigation farming contributes much to the improvements in the household income; they had the feelings that irrigation farming is also associated with high costs, i.e., of fuel, and inputs so the profit expected is to be directed into inputs. This misconception has been influenced by their poor level of education and also lack of concerted effort by extension agents. Therefore women in Rufiji district have constraints, which limit their accessibility to irrigation technical information. During interview, respondents were asked about if they had any formal schooling and about their highest level of education. Out of 90 women interviewed 47.8% had no formal schooling, only 52.2% had formal schooling, while 27.8% had the education level of less than standard seven. This is very high level of illiteracy level compared to men where by only 3.3% of men interviewed were having no formal schooling while 20% had education level of less than standard seven.

### 4.7.4 Lack of concerted effort by extension agents to contact rural women

The extension workers are the leading repositories of knowledge regarding improved irrigation farming practices in the rural areas. They are the most usual sources of information for farmers. Although extension agents are instrumental in teaching peasants improved farming practices, rural women do not benefit from these agents as much as men. Evidence shows that rural women are not included in irrigation extension programmes to their full potential in proportion to their contributions to agriculture and rural life. Studies indicate further that extension agents, whether male

or female, do not provide rural women the information, assistance and status commensurate with their contributions to farm work. This has resulted into rural women farmers in Rufiji District not to practice active irrigation farming.

**Table 24: Frequency of irrigation advice received from extension agents (N=120)**

| Received advice | Frequency | Percentage |
|---|---|---|
| Once per month | 5 | 4.2 |
| Once in every two months | 9 | 7.5 |
| Once in every five months | 12 | 10 |
| Once in every seven months | 10 | 8.3 |
| Once per year | 12 | 10 |
| None | 72 | 60 |
| Total | 120 | 100 |

When women farmers were asked to indicate the frequency with which they had been contacted with extension agents and received the irrigation messages, the results in the Table 24 show that 4.2% of the respondents indicated that they had been in contact with extension agents about once in a month; 7.5% reported to have contacted them about once in every two months while 28.3% indicated that they had communicated with extension agents about once in 5-12 months. 60% indicated that they had no contact at all with extension agents. In short, less than quarter of the rural women in the sample (4.2%) had sustained contact with extension agents.

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FAO (1997) when looking on women's access to extension services in Sub-Saharan Africa pointed out that "Agricultural extension services still do not attach much importance to reaching women farmers or women on the farm".

### 4.7.5 Location of Farms away from the River

The location of the farms is one among the constraints, which make most women not to be able to utilize water for irrigation purposes. Farms which are close to the river, which are suitable to be used for irrigation are owned by landlords, and even if you want to hire, rental charges are around Tshs. 15 000 per month per hector; this is very expensive for a normal poor women to manage. This is also a constraints because to practice irrigation in the plots which are very far from the water source requires a lot of capital due to heavy irrigation equipments needed, heavy duty water pumps and long water pipes.

**Table 25: Location of the Women's Farmers**

| | Frequency | Percentage |
|---|---|---|
| | N | % |
| Close to the River | 75 | 83.3 |
| At a long distance | 15 | 16.7 |
| Total | 90 | 100 |

From Table 25, out of 90 women interviewed, 57.7% were farming close to the river but hired the plots from the landlords, 25.6% had their own plots and 17% are at long distance from the water source.

### 4.7.6 Heavy household chores on the part of women

With regard to this aspect, the majority of women respondents agreed that one among the biggest constraints that hinder women from effectively utilizing water from the Rufiji river is their heavy work load at the family level, which makes them to feel that by adding another extra duty of irrigation, they will put their lives into deep tension of works.

**Table 26: Is heavy household chores on the part of the women constraints them from small-sc ale irrigation farming? (N=90)**

| | Frequency | Percentage |
|---|---|---|
| | N | % |
| Agree | 49 | 54.4 |
| Undecided | 9 | 10.0 |
| Disagree | 32 | 35.6 |

As shown in Table 26, during the interview out of 90 women respondents, 54.4% of respondents agreed that heavy household chores is among the constraints for them to be active in irrigation farming, 10.0% were undecided, while 35.6% disagreed that the household chores were limiting them from effective by utilizing water from the river for improving farming activities. URT (2006) suggested that " men who generally consider that it is quite normal for women to do so much work and for that workload to increase, there are formidable barriers to women being able to take matters into their own hands and invest in better production technology".

Mbago (1997) found that women spend much time in domestic activities, adding up with the time spent on agricultural activities it will be that women have very little time for resting as they are overburden by domestic as well as agricultural activities.

### 4.7.7 Low-level education

Education aiming to developing a person's mind and character through teaching especially through formal instruction at a school or college. Education of the farmers enhances their ability to acquire information, evaluate new farming practices, and be able to use new agricultural technology efficiently. Therefore, education is considered to be an important factor which enables farmers to gather reliable information through media such as magazines, radio and field demonstrations by extension officer. The study reveals that women farmers with high levels of illiteracy cannot make use of such media. Such farmers tend to rely on neighbors and friends as sources of information.

As shown in Table 27 below, out of 90 women interviewed, 47.8% had no formal schooling, 52.2% had formal schooling, while 27.8% had the education level of less than standard seven. This is very high level of illiteracy level compared to men whereby only 3.3% of men interviewed were having no formal schooling while 20% had education level of less than standard seven.

With respect to attending farm demonstrations the results show that 57.4% of the respondents who had formal schooling attended such demonstrations as compared to only 24.1% of those respondents who had never been to school (illiterates).

On attendance of extension meetings, the results show that 50.0% of respondents who completed primary education attended extension meetings as compared to 30.0% of those who had not completed primary education and 20.0% of those who were illiterate.

With regard to contacts with extension agents, the results show that 50.6% of respondents who completed primary education contacted extension agents as compared with 33.7% of the respondents who had not completed primary education and 15.7% of the illiterate group who did so.

With regard to irrigation, the results reveal that there is significant relationship between level of education of the respondents and irrigation farming. Out of 120 respondents interviewed, all 51 irrigation farmers had formal schooling, out of which 75% have education level of greater than standard seven.

**Table 27: Influence of education on respondents behavior (N=120)**

| | Level of Education (in %) | | |
|---|---|---|---|
| | Completed Primary school Education | Not completed Primary school Education | Illiterate |
| Farm demonstration | 57.4 | 24.1 | 18.5 |
| Extension meeting | 50.0 | 30.0 | 20.0 |
| Extension contact | 50.6 | 33.7 | 15.7 |
| Practice irrigation | 75.0 | 25.0 | |

This results is the same as findings by Nabbumba and Bahiigwa (2004), the higher the number of years spent at school, the higher the level of profits realized from growing maize and that is perhaps associated with the ability to appreciate and take up improved technology. Another report by Sserunkuuma *et al.*, (2004) from Uganda, suggested that educated farmers may have other non-agricultural income sources that make it easier for them to pay the irrigation users fees. Therefore education enables one to engage in non-agricultural activities as well.

### 4.7.8 Age group of Women

Analytical results show that, age is significant and influence adoption of irrigation farming negatively. Meaning that increase in age of the women reduce the chances for her to adopt the method of irrigation in farming. This is consistent with Steel (1995), as cited by Nassoro (2006) that older women have more experience but receptivity to new ideas and technologies typically decreases with age. From the survey, respondents aged above 54 years, reported that, they could not operate irrigation farming.

### 4.7.9 Findings suggested by the Key Informants

The key informants were interviewed so as to supplement the findings collected from the respondents; the aim was to add the missing factors and also to make the results more accurately. The key informants who were interviewed include the District Agricultural Officer, Three Wards' Extension officers, Representative of RUBADA available in Rufiji District, and representative of RUDIDEA.

The following are the factors suggested by the key informants as constraints to women's from using water from Rufiji River in small-scale irrigation farming:

(i) Poor understanding on the benefits of irrigation farming. Many women have observed reactions to the adoption of new agricultural technologies; they like to continue with their traditional way of farming of relying on rains and floods. This is mainly contributed by their low level of education and low socio-economic status in the society.

(ii) Methods to be used for irrigation farming in Rufiji District differs with other places in the River Rufiji basin. In other places water flow to the plots using traditional irrigation method were by water flow free by gravity. This is a constraint to women farmers because it is forcing them to have no option rather than using the irrigation technologies that are demanding much capital, which they cannot manage.

(iii) Lack of accessibility of rural women to agricultural credit. Irrigation farming in Rufiji District needs heavy investments to finance for irrigation equipments and fuel. This is due to the fact that in Rufiji District water cannot flow to the farms using gravity. In Rufiji District there are no credit organizations, which offer agricultural credit to women farmers.

(iv) Rufiji River is a home of many crocodiles. If women farmers want to use irrigation farming while water cannot flow to the plots using gravity and most women in Rufiji District have poor financial position, the simplest way is to use bucket irrigation; this require women enter into the River so as to collect water and this brings them into a risk of being damaged by

the crocodiles. So many women constrained from using water from Rufiji River for small-scale irrigation by fearing the crocodiles.

(v) Socio-cultural factors also affect the women from using water from Rufiji River for small-scale irrigation, this is due to the truth that it is difficult to provide irrigation extension messages to them. The traditional culture of people in Rufiji District is that women are forbidden to stand for a long time with a man who is not the husband. Many irrigation extension messages and projects are reaching the men and not women.

### 4.8 Size of irrigated land versus attitudes towards irrigation

During interview the respondents were asked about the size of their land used for irrigation farming and also their attitudes towards irrigation. The aim was to get the data to be used in cross-tabulations, then by using the chi-squared distribution to test the null hypothesis: "Size of land irrigated does not differ significantly between women having unfavorable attitudes and those having favorable attitude towards irrigation". The results are summarized in the Table 28 below.

**Table 28: Perception on irrigation compared to percentage of land used for irrigation farming (N=51)**

| Land proportion | Attitude on irrigation (in %) | | | | |
|---|---|---|---|---|---|
| | Low | Medium | High | Total | $X^2$ |
| Less than ¼ | 4.36 | 9.40 | 12.0 | 25.76 | 15.47 |
| ¼- ½ | 5.20 | 13.20 | 18.6 | 37.0 | |
| ½ - ¾ | | 8.04 | 13.7 | 21.74 | |
| Over ¾ | | | 15.5 | 15.5 | |
| Total | 9.56 | 30.64 | 59.8 | 100.0 | |

The critical $X^2_{(3-1)(4-1)\ 0.05} = X^2_{(6)\ 0.05}$ was 12.5916; But the decision rule is that " reject the null hypothesis when $X^2$ calculated is greater than $X^2$ critical". From the above findings, 15.47 is greater than 12.5916. Therefore reject the null hypothesis and accept the alternative hypothesis. The results indicate that there is significant relationship between the size of land irrigated and the attitudes of women on irrigation; this result is the same as previous expectations; it was expected that the farmers with positive attitudes towards irrigation, to have a big size of land irrigated. Most farmers with positive attitudes towards irrigation they are farming between ½ and ½ hectares, this is an indication that irrigation farming in Rufiji district is mostly undertaken to vegetables and fruits which requires a lot of time in watering crops, so in order for farmers not to spend the whole day irrigating, they decide to take the plots which they can easily manage.

**4.9 Factors determining the women's adoption of new irrigation technologies**

Logistic regression analysis was performed to analyze the factors influencing the women's adoption to new irrigation technologies. Table 29 below suggests that, land size suitable for irrigation, primary occupation, extension irrigation training, household income, education of a woman and location of the farm have a positive influence on adoption of new irrigation technology.

**Table 29: Results of the regression analysis**

| Variables | Coefficients | Std. error | T-values | Significance |
|---|---|---|---|---|
| Constant | -7.340 | 0.345 | -18.547 | 0.000 |
| Land size suitable for irrig | 0.650 | 0.059 | 7.828 | 0.000 |
| Primary occupation | 0.097 | 0.037 | 2.653 | 0.015 |
| Irrigation training | 2.053 | 0.159 | 12.908 | 0.000 |
| Household income | 1.854 | 0.152 | 12.224 | 0.000 |
| Education | 0.138 | 0.032 | 4.369 | 0.002 |
| Location | 2.700 | 0.254 | 10.632 | 0.000 |
| -2Log likelihood = 16.411 | Adjusted $R^2$ = 0.927 | | | |
| F-value = 60.37** | | | | |

Note: ** = significant at $p < 0.01$, SG = significant at $P<0.05$ and
NS = Not significant at $P<0.05$

Increase in land size suitable for irrigation, increase the chance of adoption of new irrigation technology. Perhaps explained by the fact that, women farmers owning a relatively small piece of land prefer to use bucket for irrigation, however with increased farm size, new irrigation technology is more convenient to use.

Primary occupation had a positive effect on adoption of new irrigation technology, this is because majority of the small-scale irrigation farmers who adopt the new irrigation technology were small-scale farmers who operated small-scale irrigation enterprises.

Extension training on irrigation had a positive effect on adoption of new irrigation technology, implying that those women farmers who received training on irrigation have a higher possibility of adopting new irrigation technology.

Household income had a positive influence on the adoption of new irrigation technology, this is due to the fact that irrigation farming is capital intensive, so the higher the household income the higher the chance to adopt the new irrigation technology.

Education level of women farmers is a positive statistical significant, suggesting that increase in education, increases the chance for a woman farmer to adopt new irrigation technology.

Location of the farm plot close to the river had a positive effect on the possibility of adopting new irrigation technology. This implies that women farmers found in close to the Rufiji River have a higher possibility of adopting new irrigation technologies than those located in far from the river.

Significance of the F-value ($P < 0.01$) indicate that the model was significant, moreover adjusted $R^2$ value of 0.927 indicate that the model explained about 92.7% of the variation in the odd ratios. This high $R^2$ value suggest that the model fitted well to the data.

# CHAPTER FIVE

## 5.0 CONCLUSIONS AND RECOMMENDATIONS

### 5.1 Overview

This chapter brings forward a summary of the major findings; conclusion and recommendations based on the research findings.

### 5.2 Conclusion

The major objective of this study was to identify gender constraints to effective utilization of water from Rufiji River for improving small-scale irrigation. Specifically the study aimed at: (i) determining the types of irrigated crops in Rufiji District, (ii) examining the women's affordability of irrigation infrastructure, (iii) assessing women's knowledge and perception on irrigation farming, (iv) identifying constraints to women's effective utilization of water for small scale farming.

It was hypothesized that (i) size of land irrigated does not differ significantly between women having unfavorable attitudes and those having favorable attitude towards irrigation; and (ii) there is no significant relationship between irrigation farming and the household income. Chi-square was employed to check whether there was any relationship between the above variables.

### 5.3 Summary of the Major Findings

#### 5.3.1 Types of irrigated crops

In attempt to identify types of irrigated crops, the respondents were asked to mention the main types of irrigation crops. The study reveals that in the Rufiji District, the

main types of irrigation crops are tomato, paddy, watermelon, green vegetables, cucumber, okra and maize. These crops are mainly grown for generating income and also for subsistence. The study also reveals that, growing tomato is more expensive because it needs big capital especially for buying pesticides in comparison with other crops.

### 5.3.2 Women's affordability of irrigation infrastructure

The study found that majority of women in Rufiji District cannot afford to purchase irrigation infrastructure. This has been contributed much by low household income, lacking access to land suitable for irrigation, low level of education and lacking extension irrigation advices. Majority of those managed to establish irrigation farming have managed to purchase the irrigation infrastructures after a long period of savings from the earnings, such that monthly salary, sales of commodities and also wages in the agricultural labour.

### 5.3.3 Women's knowledge and perception on irrigation farming

In the findings, it was revealed that majority of the respondents were having the low irrigation behaviour, this were characterized by not found to Irrigate their farm in past 12 months, not found planting the crops which need water regularly, failure to attend in the meeting discussing irrigation farming, never purchase a water pump, and never purchase a land which is near to the river. In terms of the attitudes towards irrigation farming, the majority had no option on the idea that, irrigation farming contributes much to the improvements in the household income; they had the

feelings that irrigation farming is also associated with high costs, i.e., of fuel, and inputs so the profit expected is to be directed into inputs. This misconception has been influenced by their poor level of education and also lack of concerted effort by extension agents.

### 5.3.4 Constraints to women's effective utilization of water for small-scale farming

The study found that there are a number of constraints that limit women from effective utilization of water from Rufiji River for improving small-scale farming; these are: Low household income, limited resources available to women (i.e., lacking of start up capital, lacking access, control and decision making over land suitable for irrigation), lack of concerted effort by extension agents, heavy household chores, low level of education, and socio-cultural factors. It is generally said that there is an abundance of land in Tanzania, however the analysis contained in this report suggests that smallholders farmers do not have access to sufficient land to meet their needs not only in terms of non-subsistence but also subsistence needs.

### 5.3.5 Results from testing the hypothesis

The results indicate that there is significant relationship between the size of land irrigated and the attitudes of women on irrigation farming. Also the study found that household income has a significant effect on the possibility of the family to practice irrigation farming. Therefore both null hypotheses were rejected and the alternative accepted.

### 5.3.6 Results from analysis by logistic regression model

The study also examined factors determining the women's adoption of new irrigation technologies. Results show that land size suitable for irrigation, primary occupation, irrigation extension training, household income, education of a woman and location of the farm have a positive influence on adoption of new irrigation technology. A test for overall significance of the model, F-value ($P < 0.01$) indicated that the model was explained by 92.7%.

## 5.4 Recommendations

Based on the findings of the study the following recommendations that geared toward improving utilization of water from Rufiji River for small-scale irrigation have been put forward.

### 5.4.1 Promoting irrigation farming by providing start up capital

The study found that majority of smallholders farmers although are farming close to the river they do not use irrigation practices and depends much on rains and floods. URT (2006) reported "there was zero growth in the number of households with access to irrigation over the last intercensal period (1994-2003)". Therefore the major recommendation is that efforts must be made to ensure that irrigation schemes become a reality and they should be supported with start up capital to ensure rapid expansion in these areas suitable for irrigation development.

### 5.4.2 Improving women's access to resources

The study recommends that in the mean time, government and development agencies and Non-Governmental Organizations (NGOs) should focus more attention on women's access to resources in their development programmes. They should study the socio-economic and technical environment for responding to demand-led interventions for credit, agricultural land and improved agricultural technology like irrigation tools and implements.

### 5.4.3 Institutional support

The study found that institutional support such as provision of training and extension services on irrigation farming were not adequate in most of the study areas. Also farmers' organizations were missing in most places. The study thus recommends increase in provision of training and extension services and re-establishment of smallholder farmers organization and cooperatives that would empower small-scale irrigation farmers and enable them to improve their household income and also their food status.

### 5.4.4 Communication activities to change attitudes and behaviour toward irrigation

The study found that women farmers have weak attitudes and behaviour towards irrigation farming, this is due to the fact that the present situation is noted in the culture and traditions of the people in the study area. The attitudes and behaviour can be improved by providing the society with formal education especially primary

education even for post schooling age group, because the study reveal that there is direct relationship between irrigation farming and the education level of respondents, such that all farmers using irrigation farming were found to have formal schooling.

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# APPENDICES

## Appendix 1: Questionnaire survey instrument

GENDER PERSPECTIVE IN EFFECTIVE UTILIZATION OF WATER FROM RUFIJI RIVER FOR SMALL-SCALE IRRIGATION

Please, you are kindly asked to provide sincerely information on the following questions. All information provided will strictly be confidential livelihood

Respondents name _____

Village_____

Ward_____

Date_____

**A: Background information (demographic)**

Please tick (√) or fill where appropriate

1. 1 How old are you? _____

1.2 Sex of the household head

1= Male [ ]

2= Female [ ]

1.3 Marital status

1= Single [ ], 2= Married [ ], 3= Divorced [ ], 4= Widowed [ ]

5= others (specify) [ ]

1.4 Have you had formal schooling?

1= Yes [ ], 2= No [ ]

1.5 If Yes

1.5a What is your highest level of education?

1= Less than standard seven [ ]

2= Standard seven level [ ]

3= Form four [ ]

4= Certificate

5= Others (specify)_____

1.5b How many years you have spent for schooling? _____

1.6 What is the total number of family members in the household? _____

1.7 Household composition

| Family members | Sex type | Age (yrs) | Education level |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |

Note/include male and female children, male and female adult, dependants and all relatives living in the house.

1.8 What is your major economic occupation?

1= Farming (specify) [ ], 2= Livestock keeping (specify) [ ]

3= Both 1 and 2 [ ]

4= Wage employee [ ] (specify)_____

5= Non farm business [ ] (specify)_____

1.9 Which properties among the following do you own?

| Property | acquired | hired | allocated | size |
|---|---|---|---|---|
| Land | [ ] | [ ] | _____ | [ ] |
| House | [ ] | [ ] | _____ | [ ] |
| Farm | [ ] | [ ] | | |
| Radio | [ ] | [ ] | | |
| Bicycle | [ ] | [ ] | | |
| Livestock | [ ] | [ ] | | |
| Any other | [ ] | [ ] | | |

**B: Access, control and decision making over resources and cropping preference.**

2.1 Do you own land which can be used for agricultural activities?

1= Yes [ ], 2= No [ ]

If YES, is it enough for your agricultural activities? 1. Yes.....[ ] 2. No[ ]

2.2 What indicates ownership of land by a farmer in your villages?

1= Village government letter/certificate of ownership [ ]

2= Local government letter/ certificate of ownership [ ]

3= Title deed [ ]

4= Nothing [

2.3 (a) Who in the household have access to land resource?

1= males [ ] 2= females [ ] 3= both [ ]

(b) Who in the household have control over land resource?

1= males [ ] 2= females [ ] 3= both [ ]

( c) Who in the household have decision making over land resource?

1= males [ ] 2= females [ ] 3= both [ ]

2.4 (a) Who in the household have access to Agricultural labour?

1= males 2= females 3= both

(b) Who in the household have control over Agricultural labour?

1= males [ ] 2= females [ ] 3= both [ ]

( c) Who in the household have decision making over Agricultural labour?

1= males [ ] 2= females [ ] 3= both [ ]

2.5 (a) Who in the household have access to Education?

1= males [ ] 2= females [ ] 3= both [ ]

(b) Who in the household have control over Education?

1= males [ ] 2= females [ ] 3= both [ ]

( c) Who in the household have decision making over Education?

1= males [ ] 2= females [ ] 3= both [ ]

2.6 (a) Who in the household have access to Non-farm activities?

1= males [ ] 2= females [ ] 3= both [ ]

(b) Who in the household have control over Non-farm activities?

1= males [ ] 2= females [ ] 3= both [ ]

( c) Who in the household have decision making over Non-farm activities?

1= males [ ] 2= females [ ] 3= both [ ]

2.7 What are three most important crops grown for income generation in your household: i) _____ ii) _____

iii)_____

2.8 Which other important crops are grown for food availability within household?

1= maize [ ], 2= wheat [ ], 3= beans [ ], 4= sweet potatoes [ ],

5= cabbages [ ] 6= paddy [ ], 7= others specify

**C: Irrigation agricultural**

3.1 Do you know about irrigation farming? 1= Yes [ ], 2= No [ ]

3.2 If yes, where did you learn about irrigation?

1= Parents [ ]
2= Radio and television [ ]
3= friends and relatives [ ]
4=seminar/workshop attended [ ]
5= reading magazines [ ]
6= extension services [ ]
7= other (specify) [ ]

3.3 Have you ever received the irrigation advice from extension Agents?

1= Yes [ ], 2= No [ ]

If YES, in what frequency?

1. Once per month.....[ ]
2. Once in every two months.....[ ]
3. Once after about five months.....[ ]
4. Once after seven months.....[ ]
5. 
6. Once per year.....[ ]

3.4 What are the requirements for somebody to establish irrigation farming?

---

3.5 Do you practice irrigation farming? 1= Yes [ ], 2= No [ ]

3.6 If "YES"

(a) Which method/ technology of irrigation are using?

1= Motorized pump.....[ ]

2= Bucket irrigation.....[ ]

3= Treadle pump.....[ ]

4= Surface irrigation.....[ ]

5= Other? .....[ ], mention _____

(b) Where did you get the fund for establishing irrigation farming in your plot? _____

(c). What is the size of your plot? _____hectares

(d) What proportion of your land is used for irrigation farming? _____

(e). What are the types of irrigated crops? 1. _____

2. _____ 3. _____

(f) Do you use pesticides? 1= Yes [ ], 2= No [ ]

(g) What pesticides are commonly used in your irrigated crops?

1. _____

2. _____ 3. _____

(h) Who makes the irrigation decision in your household?

1= males 2= females 3= both

3.7 If "NO" give reasons, what do you see as constraints?

_____

3.8 (a) what constraints are affecting women farmers from using water for irrigation purposes? 1. _____

2. _____

3. _____

(b) is heavy household chores among the constraints to women farmers from using water for irrigation purposes? 1. Yes.....[ ] 2. No.....[ ]

(c) Do you know about credits? 1. Yes.....[ ] 2. No.....[ ]

If YES, what kind of credits have you ever received?

_____

3.9 How long from your farm to the river? _____

3.10 (a) How much does it cost for someone to establish irrigation farming?

Tshs._____

(b) Is there any support from Government in establishing irrigation? 1= Yes [ ],2= No [ ]

3.11 (a). Do you afford to use water for irrigation?

1= Yes [ ], 2= No [ ]

(b). If "NO" give reasons? _____

3.12 Mention any constraints that hinder people from using water for irrigation farming? _____

3.13 What do you think should be done to improve water uses for farming activities?

_____

**THANK YOU VERY MUCH FOR YOUR COOPERATION**

**Appendix 2: Checklist for key informants**

1. How long have you been in this District/Ward?
2. To what extent smallholder farming is practiced?
3. Are there any irrigation activities in your area?
4. What are the requirements for somebody to establish irrigation farming?
5. Are there any limiting factors to irrigation farming by women in Rufiji District?
6. What are your comments about irrigation farming in Rufiji District?
7. What is the role of the government in supporting the irrigation farming?

**Appendix 3: Index scale for measurement women's knowledge and perception on irrigation**

| **Statements implying Women's knowledge and perception on irrigation** | **Maximum scores** | **Scores by respondents** |
|---|---|---|
| Irrigating the farm in past 12 months | 5 | |
| Planting the crops which need water regularly | 5 | |
| Attending in the meeting discussing irrigation farming | 2 | |
| Purchasing a water pump and pipes | 2 | |
| Purchasing a land which is near by the River | 1 | |
| **TOTAL** | 15 | |