# THE ECONOMICS OF SMALLHOLDER RICE PRODUCERS IN BILENE-MACIA DISTRICT, SOUTHERN MOZAMBIQUE

**By**

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**DEDICATION**

To my wife Isabel and my children Hellio and Yola Mucavele.

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# THE ECONOMICS OF SMALLHOLDER RICE PRODUCERS IN BILENE-MACIA DISTRICT, SOUTHERN MOZAMBIQUE

**DEGREE**: M INST AGRAR

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## ABSTRACT

Research carried out in several countries has concluded that high yielding varieties (HYV) of rice have tremendous potential compared to traditional rice varieties in alleviating poverty. On the other hand, it is argued that despite increase in yields, high yielding varieties do not benefit the poor farmers because of high costs associated with input acquisition and other operational costs. To further understand the issues related to production and economics of HYV, this study was carried out with its primary objective to assess the profitability of smallholder rice production in Mangol, Bilene district in southern Mozambique. Out of a total population of eighty farmers, sixty farmers participated in this research. Two groups of farmers, one using traditional rice varieties and the other using high yielding varieties were surveyed. The study consisted of field observations; yield measurements and interviews of the farmers using a semi-structured questionnaire. Gross margins were calculated for both traditional input users (TIU) and modern input users (MIU). Results show that an average farmer using high yielding varieties produces 4.4 tons of rice per ha, corresponding to a gross margin of 4 238 000,00 MZM. The highest yield obtained with high yielding varieties was 7.3 tons of rice per ha, producing a gross margin of 10 038 000,00 MZM. On the other hand, an average TIU farmer produces 2.5 tons per ha, realising a gross margin of 3 483 125, 00 MZM. The maximum yield attainable using traditional inputs is 2.9 tons per ha, producing a gross margin of 4

283 125, 00 MZM. The results also show that the lowest yield obtained by farmers using modern inputs was 3.1 tons per ha, producing gross margins of 1 638 000,00 MZM while the lowest attainable when using traditional inputs is 1.7 tons producing gross margins of 1 913 125,00 MZM.

The main conclusion of this study was that HYV are more profitable than traditional varieties, both in financial terms, to individual farmer and in economic terms, to the society as a whole. However, due to high production costs, farmers producing HYV must attain yield levels not less than 3.4 tons per ha as yields below that level make little financial incentives and does not motivate farmers to shift from traditional varieties to modern varieties. In order to ensure high yields, farmers must be assisted to carefully implement the recommended agronomic practices because the adoption of high yielding varieties does not ensure profitable yields if the other agronomic and management practices are not observed during the production process. The study also assessed the contribution of agricultural support services such as input supply, credit and extension, on the adoption of new technologies and it was concluded that when agricultural support services are available, farmers can successfully adopt recommended technologies.

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## ACRONYMS

| | |
|---|---|
| MAP | Ministry of Agriculture and Fisheries |
| PROAGRI | National Investment Program for Agricultural Sector |
| SADC | Southern Africa Development Community |
| SEMOC | Seed Company of Mozambique |
| DDAP | District Directorate of Agriculture and Fisheries |
| INIA | National Agronomic Research Institute |
| SG 2000 | Sasakawa Global 2000 |
| DNER | National Directorate of Rural Extension |
| SAP | Structural Adjustment Program |
| EAM | Empresa Agricola da Macia |
| DES | District Extension Supervisor |
| FEW | Field Extension Worker |
| TIU | Traditional input users |
| MIU | Modern input users |
| ROSCAS | Rotating Credit and Savings Associations |
| SPSS | Statistical Package for Social Sciences |
| EA | Extension Agent |
| HYV | High Yielding Varieties |
| SSA | Sub Saharan Africa |
| LDC | Less Developed Countries |
| GDP | Gross Domestic Product |
| MZM | Metical, the Mozmbique's currency |

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# CHAPTER ONE
# INTRODUCTION

## 1.1 BACKGROUND

Rice (*Oriza sativa L.*,) ranks third after maize and sorghum in terms of area cultivated with cereals in Mozambique (Mabbayad and Jorge, 1991). It is an important source of carbohydrates, plays an important role as cash crop and it is a potentially exportable product to neighbouring countries (Fumo, 1993; Zandamela, 1998;). Rice was introduced in Mozambique 500 years ago. It is not well known how this cereal was introduced, but it is believed that the Portuguese, Arabs could have brought it from Egypt or Indo-Malays (Zandamela *et al*, 1994). Following its introduction, rice production in Mozambique went through four different phases. The first phase corresponded to the period prior to 1942 characterised by slow growth in production because of the use of traditional technology, poor infrastructure and poor support services. During this stage the total production was not sufficient to cover the domestic requirements (Muendane, 1999). The second phase spanned the period of 1942 to 1975, characterised by a mix of both modern and traditional technologies, but with good infrastructure and support services. During this phase, Mozambique was producing enough rice to meet the domestic requirements and became a net rice exporter. The third phase, corresponding to the period after independence was characterised by a rapid decline in production due to the massive departure of Portuguese farmers who had the agronomic and management skills, (Cuco, 1993), the adoption of agricultural policy favouring large state agricultural companies, and the sixteen years of civil war that have destroyed a large component of rural infrastructure. The fourth phase started from 1993. While rehabilitation of the infrastructure in the rural areas is still required and taking place slowly, during this period, rice production in Mozambique has remarkably recovered both in terms of harvested area and yield (Porto, 1999). The country has about 900 000 ha of potential land for rice cultivation. Of this, only 194 000 ha, or 22%, are currently being utilised (Zandamela, 1994). About 90% of the rice is produced within the family sector (also known by small scale farming or smallholder farming sector) and women play a significant role within this sector contributing to more than 60% of the total work force. The annual rice production is approximately 199 000 tons of milled rice (MAP, 1999). Most of this rice is produced in the central provinces where Zambezia province alone contributes with 54.8% of all rice produced in Mozambique and 50.6% of the cultivated area. Rice domestic requirements have been estimated at 250 000 tons a year. The deficit of about 50 000 tons is covered by imports which cost the country a total amount of US$ 40 million. The recent floods that occurred during February 2000 have destroyed a large portion of the rural infrastructure in Gaza province including the entire irrigation system of Chokwe. This will further aggravate the current deficit in the supply of rice by another 10 000 tons until the irrigation system of Chokwe is rehabilitated and becomes fully operational.

Rice yields in Mozambique vary considerably in the different rice ecosystems and across different sectors. For the commercial sector characterised by larger areas of production per individual farmer, with application of modern inputs such as seeds and fertilisers, the average yield is estimated at 4.5 tons/ha, while for the family sector using traditional inputs yields range between 0.5 to 1.8 tons/ha.

Production and marketing costs are not well documented for the family sector. This is because of poor record keeping, the use of family labour and poor levels of literacy among the smallholders. This makes it difficult to tabulate accurate crop budgets for this sector. A study conducted by Muendane (1999) has estimated the production costs at US$ 274/ha for rice farmers applying moderate levels of modern inputs.

In 1997, the government of Mozambique has initiated a reform of the agricultural sector and the National Program for Agricultural sector 1998 - 2003 (PROAGRI) was formulated (MAP, 1997). With regard to rice production, PROAGRI aims to attain annual increases of 6 790 tons during the life span of the program. This will save hard currency through replacement of imports (Porto, 1999). Furthermore, as part of the reform of the agricultural sector, it has been proposed to set up a Rice Board, which will co-ordinate research and development activities related to rice production. According to Zandamela (1999) the Rice Board would concentrate specifically on the intensification and expansion of rice production, develop supplemental irrigation systems, strengthen research and extension activities and improve harvest and post harvest operations.

Rice production in Mozambique is constrained by a number of factors namely, poor credit facilities, lack of water, lack of inputs, poor input delivery system, lack of infrastructures, lack of developed market mechanisms, especially between the rice mills and the producers and poor links between research and extension. Rats and birds are the major pests that affect the yield in the rain-fed areas, while in the southern region, where rice is mostly grown under irrigation, the main constraints are inadequate weed control, poor management of irrigation water and late harvesting. A common problem in the whole rice crop production system has been a lack of high quality seed in the market (Zandamela *et al,* 1994).

## 1.2 PROBLEM STATEMENT

In much of Sub Saharan Africa (SSA), there appears to be little immediate prospect of rural industrialisation or other non-farm engines of growth. Smallholder agriculture is likely to remain the major source of rural growth and livelihood improvement for some time (Poulton *et al,* 1998). The popularity of rice in SSA is manifested by the increase in consumption, notably in urban centres. Production in the region is low principally because of the limited planted areas and the low yields obtained from the predominantly rain-fed rice systems (Nguyen, 1995). The thriving with rice concept aims to increase not only rice yields but also farmers' income and employment opportunities in rural areas.

Mozambique has tremendous potential for rice production both in terms of land availability and agro ecological conditions. Between 1945 and 1975, the country was a net rice exporter. After independence in 1975, changes in government policy including agricultural policy, affected rice production negatively, bringing the country back to a net rice importer (Muendane, 1999). With new policy reforms, and a peaceful political environment, there is a potential to increase rice production in Mozambique. Rice plays a key role for human consumption both in urban and rural areas of the country. In addition, within the Southern African Region, because of its geographical location and potential strong agro-ecological conditions, Mozambique has a high comparative advantage to produce rice. This competitive advantage of the rice industry in Mozambique can be improved by improving the support services and infrastructure. This will allow Mozambique to produce and export to meet the growing demand in the other SADC countries.

The family sector constitutes more than 80% of the total population throughout the country, and produces 90% of the total rice output in Mozambique. Improving the efficiency at household level could make a significant contribution to the improvement of the country's rural economy and to the total economy as a whole. According to the World Bank, (1982), the continuing importance of agriculture in the economies of developing countries is reflected in the association between the growth of agriculture and the economy as a whole. The parallels between growth in agricultural and Gross Domestic Product (GDP) growth suggests that the factors which affect agricultural performance may be linked to economy-wide social and economic policies. At the same time, agricultural households are often the basic market for a wide range of consumer goods that loom large in the early stages of industrial developments. Related to the need to improve the farm household efficiency, reduce rural poverty and improve the living standards of both the rural and the urban population, this study was carried out. **The primary objective of this study is to assess the profitability of the smallholder rice production systems and the factors determining profitability in rice farming in Mangol (Bilene district), of southern Mozambique.** Mangol valley, is a large valley with constant water supply for irrigation, a key factor for rice production; is close to the main rice milling factors, and the main markets of Maputo, both for inputs and output markets. In Mangol, also there are farmers' associations benefiting from a credit program through SG2000 programme and there is a team of extension agents assigned to the district. In this study, the current situation is analysed in terms of its strengths, weaknesses, opportunities and threats in order to assist the practitioners in rural development, both government and private including non government organisations to plan and implement a problem oriented and research based sound measures. The specific objectives of this study are as follows:

- Assess the profitability of small scale rice production;
- Assess the effect of input access and availability on the adoption and use of improved technologies;
- Assess the contribution of a technology package, extension, credit, farmers age and gender on commercial rice production; and
- Identify some socio-economic factors affecting rice production.

## 1.3 OUTLINE OF THE CHAPTERS

Chapter two provides an overview of the rice industry worldwide. The objective of this chapter is to show the importance of rice as a staple crop for most of the population in the world particularly in developing countries including Mozambique. Chapter three gives a description of the study area. It starts with a brief background of Mozambique, the country of study, then briefly outlines the characteristics of Gaza province, the host province for this study and then makes a description of the Bilene district the study area were the survey was carried out. Chapter four is concerned with the research methodology and data requirements. It indicates how the site selection and the sample was made, the type of data that was required, the methods of data collection and data analysis that were used to respond to the objectives of this study. Chapter five tabulates the results obtained from the field, both during the interviews to the farmers and through observations on the farming systems. The main objective of this chapter is to tabulate the output from the field as a tool for the discussions in the next chapters. Chapter six uses the literature review and the data available from the field to undertake a (socio) economic analysis of the smallholder rice producers in Mangol. Using the available data, this chapter presents the gross margin calculations to both modern and traditional input user farmers and makes analysis both in financial and economic dimensions. Chapter seven discusses the constraints affecting smallholder rice producers in Mangol. It also uses the information available from the literature and the data obtained from the field interviews to show the limiting factors that affect the performance of the rice industry in the district. Finally chapter eight makes the conclusions and recommendations of this study.

# CHAPTER TWO
# OVERVIEW OF RICE PRODUCTION

## 2.1 INTRODUCTION

Rice (*Oriza sativa* L.,) is the most important cereal crop in the developing world and is the staple food of over half the world's population (Juliano, 1993; Chandler, 1979; IRRI, 1994). Rice belongs to genus *Oriza* and family *graminae*. The date and the place of its origin are not well defined. However, the available literature suggests that this cereal originated in Asia (Infeld and Silveira, 1985; Fumo, 1993), more specifically in India where rice is known for more than 3 000 years (Muendane, 1999). After India, rice production was expanded to China and then to Japan 2 900 years ago. In North Africa, the Arabs introduced rice before the VIII century. The Portuguese introduced rice into Brazil and the Spanish into Central and South America. France and Germany also introduced rice into many African countries. In the USA, rice was introduced in 1646, from Madagascar. Australia only began to grow rice by 1891 (Grist, 1983:7). According to Zandamela *et al,* (1994), rice was introduced into Mozambique 500 years ago. Since then, the importance of rice grew progressively and currently rice ranks among the first three priority crops grown in the country. This chapter provides a literature review on various aspects of the rice industry worldwide. This includes data on rice production, trade and prices, rice ecosystems, the importance of rice for human consumption, nutrition, the importance of rice in Mozambique and previous studies on the economics of smallholder rice production.

## 2.2 THE IMPORTANCE OF RICE WORLD-WIDE

Rice is now grown in over 100 countries (Juliano, 1993; Chandler, 1979), from latitude 50 degrees north to 40 degrees south and from sea level to an altitude of 3000 m. Because of its long history of cultivation and selection under diverse environments, rice has acquired a broad range of adaptability and tolerance so that it can be grown in a wide range of water/soil regimes. The major rice producing countries are China, India, Indonesia, Bangladesh, Thailand and Vietnam. These countries account for nearly 78% of world rice production. Asia as a whole contributes about 92% to the world's rice harvest (IRRI, 1994).

Due to increased population growth, rice demand increased and efforts were made to increase rice productivity. Major increases in rice production have occurred during the last 25 years because of large-scale adoption of high-yielding, modern semi-dwarf varieties and improved technology, including the intensive use of chemical fertilisers. As a result, world rice production doubled from 257 million tons in 1965 to 520 million tons in 1990 (Khush, 1995). In 1998 the world rice production was estimated at 566 million tons (MAP, 1999). Modern varieties are rice cultivars that are short, stiff strawed, fertiliser-responsive, photoperiod-insensitive, and have short to medium growth duration - 100-130 days (IRRI, 1994). The recognition and utilisation of the potential of the semi-dwarf plant type in the mid-sixties signalled a new chapter in rice varietal improvement. Currently, more than 60% of the world's rice area is now planted to semi-dwarf varieties. This made possible a dramatic yield increase from a level of one tonne to more than 5 tons/ha (Pandey *et al,* 1989). Farmers get two to three times higher yields from these varieties than from traditional cultivars. The world average rice yields also doubled from about 2 tons/ha in the 1960s to almost 4 tons/ha in the early 1990s. The yield potential of current high-yielding rice varieties in the tropics is 10 tons/ha during the dry season and 6.5 tons/ha during the wet season (Khush, 1995). The highest yield of 8.4 tons/ha was recorded in Australia in 1992 (IRRI, 1994).

Table 2.1 depicts the world rice production (in tons) for the period 1996-98. China is the biggest rice producing country, contributing about 30% to the total world production and India ranks second with 20% of the total rice produced in the world. During the same period, rice production in Mozambique was estimated at 145, 183 and 199 thousand tons respectively corresponding to 0.03%, 0.03% and 0.04% of the world production (MAP, 1999).

**Table 2.1: World rice production, 1996-1998 (million tons)**

| Country | 1996 | 1997 | 1998 |
|---|---|---|---|
| Bangladesh | 25 | 27 | 29 |
| China | 178 | 187 | 190 |
| European Community | 2 | 2 | 3 |
| India | 122 | 122 | 124 |
| Indonesia | 47 | 48 | 50 |
| Japan | 15 | 13 | 13 |
| Pakistan | 5 | 6 | 6 |
| Thailand | 21 | 21 | 21 |
| USA | 9 | 8 | 8 |
| Vietnam | 25 | 25 | 27 |
| Other | 90 | 95 | 95 |
| **Total** | **539** | **554** | **566** |

Source: MAP, 1999

The population of rice-consuming countries is increasing at a faster rate than that of the rest of the World, and the number of rice consumers will probably increase by 70 percent during the next 25 years. Consumption of processed rice products is probably highest in Japan, where it accounts for about 9.5 percent of total rice consumption (Juliano, 1993: 80). It is estimated that demand for rice will exceed production by the end of this century (IFPRI, 1977 as quoted by Khush, 1995:1). On the other hand, availability of new land for expansion is low, the area planted to rice world-wide has remained stable since 1980 and a decline is likely because of the pressure on good rice land from urbanisation and industrialisation. Therefore agricultural output has to depend more on increasing the productivity of the existing land.

## 2.3 RICE PRODUCTION IN AFRICA

A literature review of rice production in Africa shows that about 149 million ha are cultivated with rice, while total production of rice is 15 million tons. The average yield of paddy rice in Africa is 2 tons/ha. The highest yield of 8 tons/ha has been recorded in Egypt and the lowest yield of 0.7 tons/ha was recorded in Zaire (FAO, 1995). Egypt is by far the largest rice producer in Africa. According to IRRI, (1997) Egypt produced 4.15 million tons of rice, followed by Madagascar, Nigeria and Ivory Coast with 2.6, 2.5 and 1 (one) million tons respectively. The other rice producing countries in Africa are Burkina Faso, Ghana, Ginea Bissau, Mali, Senegal and Tanzania. Rice is grown in several African ecological zones but the highest percentage is upland rice. Upland rice in Africa grows in rain fed, naturally well-drained soils, where surface water does not accumulate. Part of the rain fed area is fragile and erosion-prone while other parts have low pH, high Iron and Aluminium toxicity. About 20 million ha are in hydromorphic ecology, i. e., valley bottoms with fluctuating water tables. The lower basins are swampy during the rainy season. The preferred ecology for higher rice yields is under irrigation with water control (John and Gunneweg, 1985). Table 2.2 shows a summary of areas, yields and total rice production in some selected African countries.

**Table 2.2: Areas, yields and total production of rice for some selected African countries during 1996/97 growing season**

| Country | Area (Ha) | Yield (Kg/ha) | Production (Tonnes) |
|---|---|---|---|
| Angola | 19 000 | 1000 | 19 000 |
| Benin | 9 000 | 1567 | 14 000 |
| Burkina Faso | 31 000 | 1958 | 61 000 |
| Burundi | 10 000 | 2682 | 27 000 |
| Cameron | 16 000 | 5000 | 80 000 |
| Chad | 52 000 | 1731 | 90 000 |
| Cote Devoir | 650 000 | 1608 | 1 045 000 |
| Egypt | 590 000 | 8173 | 4 822 000 |
| Gambia | 12 000 | 1597 | 20 000 |
| Ghana | 100 000 | 2017 | 202 000 |
| Guinea | 385 000 | 1381 | 532 000 |
| Guinea Bissau | 70 000 | 1907 | 133 000 |
| Kenya | 10 000 | 6000 | 60 000 |
| Liberia | 45 000 | 1111 | 50 000 |
| Madagascar | 1 218 000 | 2131 | 2 596 000 |
| Malawi | 36 000 | 1428 | 52 000 |
| Mali | 284 000 | 1652 | 469 000 |
| Mauritania | 23 000 | 3500 | 79 000 |
| Morocco | 6 000 | 5597 | 35 000 |
| **Mozambique** | **194 000** | **869** | **182 683** |
| Niger | 30 000 | 2333 | 70 000 |
| Nigeria | 1 875 000 | 1359 | 2 584 000 |
| Tanzania | 478 000 | 1512 | 723 000 |
| Togo | 40 000 | 875 | 35 000 |
| Uganda | 57 000 | 1404 | 80 000 |
| Zaire | 591 000 | 720 | 425 000 |
| Zambia | 10 000 | 1200 | 12 000 |

Source, IRRI, 1997

## 2.4 RICE ECOSYSTEMS

The ecosystems within which rice is grown, are characterised by elevation, rainfall pattern, depth of flooding and drainage, and by the adaptation of rice to these agro ecological factors. According to IRRI (1994) there are four rice ecosystems in the world. These are:

*Irrigated:* Rice is transplanted in to puddled soil on levelled, bounded fields with water control, in both dry and wet seasons in the lowlands, in the summer in high elevations, and during the dry season in flood-prone areas.

*Rain fed lowland:* Rice is transplanted or directly seeded in to paddled soil, on level to slightly sloping, bounded or diked fields with variable depth (up to 50 cm) and duration of flooding, depending on rainfall.

*Food-prone:* Rice is directly seeded or transplanted in the rainy season, on fields characterised by medium to very deep flooding (50 cm to more than 300 cm) from rivers and from tides in river mouth delts.

*Upland:* Rice is directly seeded in non-flooded well-drained soil on level to steeply sloping fields in plateau and hilly areas.

Worldwide, 53% of total rice area is irrigated, 27% is rain fed lowland, 8% is flood-prone, and 12% is upland. Most irrigated rice areas are found in Asia (55%) while the least irrigated areas are in Africa (17%).

## 2.5 RICE HARVEST

The chief consideration in harvesting is the degree of maturity of the grain, which is determined by measuring moisture content. The optimum moisture content of the rice grain at harvest time is 21 to 24 % (Chandler, 1979:66). Under tropical conditions this point is generally reached 28 to 32 days after flowering. De Carvalho (1983) argues that because the grain exhibits different moisture contents, harvesting must be conducted when the majority of the grain contains a moisture content of 17.5%. If the crop is allowed to stand in the field after it reaches maturity, large losses occur in both the field yield of the crop harvested and the percentage recovery of head rice after milling. Furthermore, cracking of the grain occurs and many of the grains break during milling. If the rice crop is left in the field until the moisture content of the grain is reduced to 15%, for instance, the reduction of the yield can be as high as 20% (De Carvalho 1983; Infeld and Silveira, 1985). The loss is due to a number of factors. A considerable amount of grain simply shatters and falls to the ground before it is harvested; birds and rodents take their share of the ripened grain; and additional losses come about during the harvesting process itself, because the grain is so loosely held on the panicles. Studies conducted in several countries reveal that 13 to 34 % of the crop is lost during harvest and post harvest operations with the following breakdown: 5 to 15 % during harvest and threshing; 2 to 3 % during cleaning and drying, 2 to 6 % during storage; in processing (parboiling and milling), 3 to 7 %, and during handling and transport, 1 to 3 %.

Early harvesting, besides reducing the risk of such losses, produces a high quality milled rice, but harvesting too early may also bring storage problems, especially in the tropical humid climate.

The harvest is done manually among very small farms and consists of picking every mature panicle. Rice is cut and placed in bundles in the field for drying. Later the dry plants are beaten on the ground with wooden sticks or hit against a metal drum (Mabbayad and Jorge, 1991).

## 2.6 CLEANING AND DRYING

When paddy is threshed it contains foreign matter, including sand and small stones, straw, and immature and unfilled grains. This extraneous material has to be removed - cleaned - to provide a high quality product (Infeld and Silveira, 1985; SEMOC, 1999). Hand sieving and winnowing is traditional farm methods of cleaning. These methods, however produce erratic results and often the paddy sold is of poor quality. Similarly, paddy coming from the field usually has a moisture content of between 20 and 24 percent. It should be dried to at least 14 % as soon as possible to prevent deterioration. Paddy with such a moisture content can be stored without much damage for up to 3 months (Chandler, 1976). For longer storage, paddy should be dried to 12.5 to 13 %. It is difficult to maintain moisture contents as low as these in the humid tropics especially in the wet season where the grain absorbs moisture from the atmosphere.

## 2.7 RICE YIELDS

Rice yields vary greatly from country to country, depending on the ecosystem where rice is produced. The type of farming systems and the type of production inputs used also contributes to the yield variations. Among the private sector, medium and large farmers, yields are generally much higher than the family sector. This is mainly because most of the medium and large farmers produce for profit maximisation, as they have to pay not only for inputs, but also for hired labour, capital and fixed costs associated with plant and equipment. Therefore, they follow more carefully the agronomic recommendations made by research and extension services, in terms of input application and management practices. They also have access to irrigation water, access to credit facilities and a large number of farmers also use a complete set of modern inputs. Yields among these farmers range between 4 to 7 tons per ha. In Mozambique within the family farm sector, the yields range between 0.5 to 1.8 tons/ha (Muendane, 1999). These low yields are due to the use of traditional varieties, low or no input use (especially fertilisers), poor weed control, and a lack of sufficient water for irrigation. Rice is the most demanding cereal crop for irrigation water. According to Mabbayad and Jorge (1991), some 8 500 cubic meters of water per hectare are necessary to meet the crop requirements.

Studies conducted by National Institute of Agronomic Research (INIA) suggest that within the family sector, the average yield of 2.5 tons/ha can be obtained using some modern inputs such as improved cultivars and fertiliser application; more recently experiences in Bilene-District have shown that yields of 4.5 tons can be obtained within this sector (DDAP-Bilene, 1998). This suggests that when small-scale farmers have access to modern technology, inputs and credit, they will produce yields as high as large-scale commercial farmers.

## 2.8 RICE IN HUMAN NUTRITION

Rice is the staple food in 39 countries of the world. It provides approximately 32 to 59 percent of the dietary energy and 25 to 44 percent of the dietary protein consumed by the people of South and Southeast Asia. It also makes a significant contribution to the dietary energy and dietary protein consumed by the rice eating population of Asia, Africa and Latin America. Rice is rich in energy and is a good source of protein with the highest protein digestibility among the staples (Juliano, 1993) probably in part because of its low dietary fibre and Tannin content. Rice also contains a reasonable amount of Thiamine, Riboflavin, Niacin and Vitamin E. In most developing countries, in particular Asian countries, because of the quantity consumed, rice is the principal source of those nutrients. Parboiled rice or rice powder gruel (Molla *et al,* 1985), rice water and extrusion-cooked rice (Tribelhorn *et al,*1986) have all been effectively used for the treatment of non-infectious diarrhoea. Bibby (1985) also pointed out that consumption of cereal foods including rice has been correlated with dental caries.

Processed rice products are derived from rough rice, brown rice, milled rice, cooked rice, broken, dry milled flour, wet milled flour or rice starch. These products include pre-cooked and quick-cooking rice, noodles, rice cakes, fermented rice cakes and puddings, expanded (puffed, popped) rice products, baked rice products, canned rice, fermented rice products, rice flour and starch, rice bran and rice bran oil (Juliano, 1993: 79).

## 2.9 RICE TRADE AND PRICES

Rice is traded on the world market through government-to-government contract and/or private trade. Only 4% of the total rice produced is traded internationally (IRRI, 1994). Because of the small market, rice prices are easily affected by small changes in supply and demand in the world market; therefore, rice price movements are often more volatile than those of other agricultural commodities. Prices also vary according to quality, type and grade of rice (IRRI, 1994). Domestically, rice prices are affected by the rice supply and demand situation in the individual countries and the price-related policy measures formulated by governments.

In Mozambique, the domestic price is set through negotiations between the producers and the rice milling factories. This negotiation is done under an oligopsony environment as there are several producers and only few buying mills that generally co-ordinate the price they can afford to pay to the producers. In 1998 the domestic price per kg of paddy rice was set at 2 500 MZM (US$ 214/tonne). Muendane (1999) taking the 1986 average price of paddy rice from some selected countries estimated the international price in 1999 at US$171/tonne. Thus, making the local price of paddy rice in Mozambique 25% higher than the world price.

## 2.10 THE IMPORTANCE OF RICE IN MOZAMBIQUE

Rice ranks third after maize and sorghum in terms of area cultivated with cereals in Mozambique (Zandamela *et al,* 1994: SEMOC, 1994). According to Fumo (1993), rice is a strategic cereal in the country due to the following reasons.

- It is an important source of carbohydrate consumed by both the rural and urban population;

- It is the most suitable crop to grow either in the light to heavy textured soils of the lower flood plains of the central and northern provinces. It is grown in the rich soils along the numerous rivers as well as in the dry and flat irrigated areas of the south;

- It is a potentially exportable product, which can be marketed in to neighbouring countries.

The crop is cultivated across the country. The most important areas are in the central and northern provinces accounting for about 75% of the total cultivated area, and along the Limpopo River in the south.

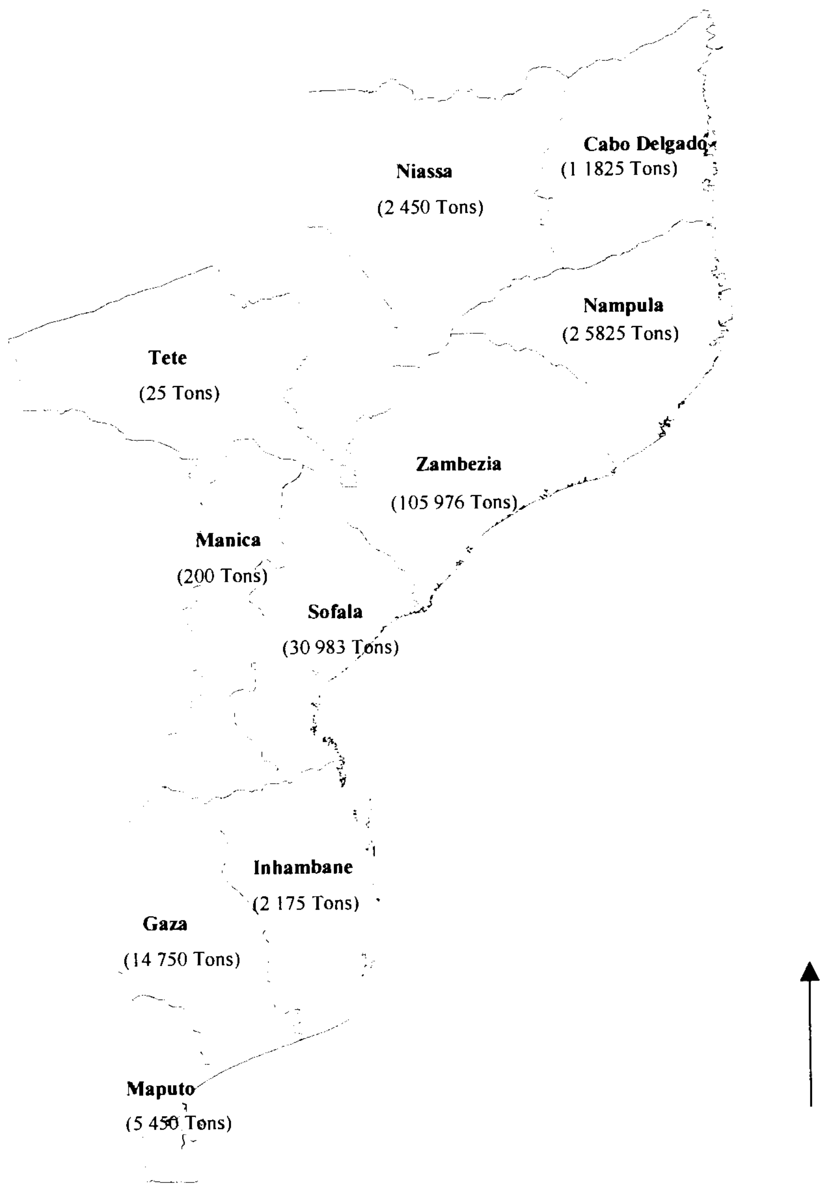



**Figure 2.1: Areas of Rice production in Mozambique**

From the 1930s, rice production in Mozambique grew progressively and from 1945 the country was a net rice exporter. Despite the long decline in production after independence, rice production is rapidly gaining more importance in Mozambique.

Demand is growing with rising incomes and greater urbanisation. Currently, rice in Mozambique is grown mainly by smallholder farmers with an average area of less than 0.5 ha per farm. It is estimated that at least 500 000 farm families (about 2.5 million people) are directly involved with rice production (Zandamela, 1998). Rice production takes place under rain fed lowlands of Zambezia, Sofala, Nampula and Maputo provinces; and rain fed uplands of Nampula and Cabo Delgado and under irrigation in Gaza province. Table 2.3 gives a summary of the current cultivated areas, the potential areas for rice production and the type of production ecosystems.

**Table 2.3: Estimated current cultivated area and the potential area for rice production in different zones and production systems in Mozambique.**

| Province | Present area (ha) | Potential area (ha) | Prod. Systems |
|---|---|---|---|
| Zambezia | 85 000 | 400 000 | Rain fed lowlands |
| Sofala | 55 000 | 200 000 | Rain fed lowlands |
| Nampula | 40 000 | 100 000 | Rain fed up/lowland |
| Gaza | 5 000 | 80 000 | Irrigated |
| Cabo Delgado | 5 000 | 40 000 | Rain fed up/lowland |
| Maputo | 3 000 | 60 000 | Rain fed lowlands |
| Inhambane | 1 000 | 10 000 | Rain fed lowlands |
| TOTAL | 194 000 | 890 000 | |

Source: Zandamela *et al*, (1994)

Rain fed lowland rice cultivation is normally practised on flat lands where water accumulates and no other food crops can be grown during the rainy season. Transplanting is the usual practice to establish the crop. Rain fed upland rice is planted by broadcasting seed at 80 kg/ha, in rotation with other food crops. Purchasable inputs such as fertiliser and pesticides are not used. Irrigated rice cultivation is practised in the south because of the existence of a regional irrigation system, which is managed by the government. Rice is directly seeded in dry soil, either by broadcasting as practised by smallholders, or by row seeding as practised by large farms. The sowing rate varies between 120 kg and 150 kg/ha (Mabbayad and Jorge , 1991).

Fertiliser is generally used in large and medium size farms: a basal application of Nitrogen and Phosphorous at sowing, and two applications of Nitrogen one at tillering stage and other at panicle initiation (Zandamela *et al,* 1985). Pre and post-emergent herbicides are used only by large and some medium size farms.

Two types of varieties are presently being grown: traditional and improved. Most of the traditional varieties are photoperiod sensitive, tall, leafy, susceptible to lodging and late maturing. However they do have some advantages such as drought resistance, disease tolerance, competitiveness against weeds, easy to hand thresh and tolerant to an extended planting and transplanting period. Most of these varieties are Indica type, with long grains and very good eating quality; a few have a flavour, which is very much appreciated by the local population. The most popularly grown local varieties include: Mamima, Chibiça, Chupa, Agulha, Ndeque, Faia, Oitava (Zandamela, 1994).

Modern rice cultivars bear characteristics that are not present in the local, traditional varieties namely: high tillering capacity, lodging resistance, photoperiod insensitive, fertiliser responsiveness, shorter plants, etc. The most important characteristics of improved varieties are their grain quality, that matches the requirement of urban consumers and their high productivity under controlled environment and appropriate management (irrigation, weed control, fertilization, etc.). The most important improved varieties grown mostly in the irrigated areas of Mozambique include IR 52 and C4 63, ITA 312 and IR 64 (World Vision, 1999).

The introduction of modern varieties has also been demonstrated to play a significant role in developing the relationship between technical innovation and institutional innovation. According to Stevens and Jabara (1988), in order to productively exploit the new opportunities stemming from changes in relative prices or from new technologies, increasing numbers of social rule (institutions) changes will be required. Examples of these include import rules, grades and standards, worker protection laws, product safety requirements, land tenure, etc. Government should provide a central social mechanism for such institutional change. Furthermore, much institutional change as resulting from technical change also takes place in the private sector as entrepreneurs develop more productive arrangements for input and product marketing.

In some countries where modern improved varieties have been introduced and adopted - *technical innovation* - there has been some changes not only in the wage structure of the farm labour but also in terms of land tenure arrangements. As new varieties were being introduced, the links between research, extension and farmers are also strengthened as well as links between input suppliers, local traders and, farmers organisations and the rural financial institutions - *institutional innovation.* In some cases, institutional innovations have involved the reorganisation of property rights in order to internalise the higher income streams resulting from the technical innovations (Ruttan and Hayami, 1990). A number of these identified links are already taking place in some areas as a result of technical innovation in Mozambique. Amongst others, the links between extension and research, input suppliers, and farmer's organisations are the most evident.

While at the macro level, the introduction of modern varieties made a significant contribution to meet the demand of rice as yields are higher than traditional varieties, at micro level, however individual farmers have to incur much more costs to produce modern varieties as they are more demanding in terms of soil quality, water regimes, inputs and crop management. This means that high yields resulting from the adoption of high yielding varieties and management practices may not necessarily imply profits for the individual farmers. Therefore, both financial and economic studies are required in order to analyse the profitability of the production systems using modern varieties, taking into consideration both the individual farmers benefits and the benefits to the society as whole.

## 2.11 DOMESTIC RICE PRODUCTION AND CONSUMPTION

Table 2.4 depicts national rice production for the period 95/96 to 98/99. As indicated, during this period there has been an increase in the total production as a result of both increase in yields (tons/ha) and the cultivated area (ha).

**Table 2.4: Total area and Rice production in Mozambique for the period of 1995 to 1999**

| Year | 1995/6 | 1996/7 | 1997/8 | 1998/9 | Average |
|---|---|---|---|---|---|
| Area (ha) | 144 000 | 197 743 | 181 904 | 191 364 | 186 555 |
| Yield (tons/ha) | 1.01 | 0.92 | 0.92 | 1.06 | 1.04 |
| Prod (tons) | 145 440 | 182 683 | 199 659 | 202 042 | 193 251 |

Source: Zandamela (2000)

The highest production was of 202 042 tons was obtained during the 98/99 cropping season. This level of production however, will be reduced, by approximately 10 000 tons during the 99/00 growing season due to the massive destruction in the infrastructure caused by the recent floods in the southern and central parts of Mozambique.

**Table 2.5: Rice production and yield obtained per province for the 1997/98 growing season**

| Province | Production (Tons) | Average yield (Tons/ha) |
|---|---|---|
| Niassa | 2 450 | 0.67 |
| C.Delgado | 11 825 | 1.09 |
| Nampula | 25 825 | 0.74 |
| **Zambezia** | **105 976 (54.8%)** | **1.12** |
| Tete | 25 | 0.20 |
| Manica | 200 | 0.57 |
| Sofala | 30 983 | 0.91 |
| Inhambabe | 2 175 | 0.58 |
| Gaza | 14 750 | 2.17 |
| Maputo | 5 450 | 1.15 |
| **TOTAL** | **199 659** | **0.92** |

Source: Zandamela (2000)

The annual per capita consumption of milled rice in Mozambique is approximately 11 kgs. This is low compared to the major consumers, such as, Cambodia, Myanmar, Laos PDR, Vietnam and Bangladesh where the consumption ranges between 139 and 193 kgs of milled rice per capita, but higher than European countries where the average consumption is about 4 kgs of milled rice per capita per year (IRRI, 1994). Consumer preferences, and prejudices about the cooking and eating quality of rice vary considerably from region to region in the country, however, variations in the tendency of cooked rice to harden when it cools is among the primary factors influencing the cooking and eating qualities of rice.

## 2.12 RICE AS SOURCE OF FOREIGN INCOME

Rice also has the potential to be an important export earner for Mozambique due to anticipated growth in the demand from eastern and southern Africa. There is a growing demand for rice in the southern and central African countries due to rapid population growth. Among these countries, Mozambique has a comparative advantage over the SADC countries because it posses extensive areas of production with good ecological conditions for rice production. Table 2.6 depicts the rice imports in tons for some selected countries of southern and central Africa. South Africa is the largest import country and represents a potential export opportunity for Mozambique.

**Table 2.6: Rice imports for some selected countries in southern, central and east Africa for the period 1994-98 (Tons)**

| Country | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|
| Angola | 50 000 | 31 000 | 42 500 | 24 000 | 38 500 |
| Botswana | 10 509 | 11 670 | 13 087 | 11 823 | 11 823 |
| Comoros | 28 518 | 41560 | 30 538 | 34 323 | 34 323 |
| Dem. Rep. of Congo | 174 700 | 124 142 | 26 702 | 172 312 | 172 312 |
| Kenya | 83 659 | 27 097 | 27 404 | 62 436 | 62 777 |
| Madagascar | 79 847 | 60 206 | 20 604 | 57 823 | 58 078 |
| Malawi | 4 450 | 2 500 | 2 000 | 2 000 | 2 000 |
| Mauritius | 79 542 | 56 922 | 88 558 | 65 445 | 62 392 |
| Mozambique | 60 800 | 90 000 | 31 000 | 26 000 | 35 000 |
| South Africa | 430 632 | 466 154 | 482 333 | 580 180 | 519 636 |
| Tanzania | 60 000 | 65 000 | 65 000 | 98 213 | 97 486 |
| Zambia | 5 827 | 3 901 | 3 901 | 7074 | 7 074 |
| Zimbabwe | 25 653 | 29 045 | 16 948 | 32 988 | 34 097 |

Source: FAO, 1999

## 2.13 ECONOMICS OF SMALLHOLDER RICE PRODUCTION: PREVIOUS STUDIES

Singh (1985) has shown that the expansion in irrigation has contributed to the increase in both area planted and yields of rice obtained by the smallholder. Assured water availability not only contributes directly to yields by eliminating the likelihood of drought stress, but also by synergising the use of other production inputs such as fertilisers and modern varieties (Zandamela, 1999). Fertilisers constitute the other vital input for increased and sustained rice production (Von Blanckenburg, 1985). Fertiliser use by the smallholder rice producers is also closely linked with fertiliser price and the ratio of fertiliser to rice prices. Fertilisers are generally expensive, therefore, timing of application and the rates must be carefully observed to reduce these looses. Fertiliser use by smallholders is also affected by its formulation. For example farmers in Chokwe (Gaza province), preferred more Urea than Amonium Sulphate because of high percentage of Nitrogen in Urea (INIA, 1989). Combined use of organic and inorganic fertilisers can sustain soil fertility and grain yields in rice (Gupta and Gupta, 1997), and help the farmers to reduce the production costs.

Data collected from selected villages in Asia show that there was no significant difference in the average paddy yield per hectare between large and small farmers adopting modern varieties. These data are consistent with the hypothesis of scale neutrality of modern varieties (Hayami, 1990). Ruttan (1990) also concluded that neither farm size nor tenure has been serious constraint to the adoption of new high yielding varieties. According to Posada and Scobie (1990), in 1966, 90 percent of the Colombian irrigated sector was sown to the traditional varieties; by 1974 virtually all the irrigated rice production came from dwarf varieties. The changes from consumer surpluses resulting from the introduction of modern varieties were positive because in the absence of modern varieties, the volume of rice entering the domestic market would have been much lower, with concomitant higher internal prices. Abdulai and Huffman (1998), examined the production efficiency among rice farmers in the Northern Region of Ghana. They have concluded that inputs are still important to profitability of rice farming in Ghana. Furthermore, efficiency measures indicated that rice farmers are not applying their inputs in an absolutely efficient way. The average inefficiency is 27% with a wide variation (maximum of 95.5% and minimum of 0.16%), suggesting that considerable amount of profit is lost due to inefficiency. Their findings from the inefficiency analysis suggests that higher education of the household head, access to credit and greater specialisation, as well as location in districts where extension services and better infrastructure are available, are significant variables for increasing profit efficiency. These findings have important policy implications in promoting efficiency among farmers in Africa. According to Von Blanckenburg (1985), in many developing countries changing government policies were needed to promote efficiency among the smallholder rice producers and overcome scarcities on rice supply. This included the adoption of special rice production programs, the review of price policies – change its traditional orientation that was much more consumer oriented and aimed more at stabilizing markets than at substituting imports with increased rice production. Other strategy elements to support small-scale rice producers include credit policy, supply of inputs, extension work and agricultural research.

The World Vision International, conducted studies in Nicoadala and Namacurra Districts (Zambezia province) both on research stations as well as on-farm. Rice varieties tested included improved varieties compared to so-called regional or traditional varieties. It was concluded that under certain circumstances, the yield increase of the improved varieties as a response to fertiliser application was not sufficient to recover the costs. It is important however to note that these returns on the rice improved technologies were analysed for a small field of 0.25 ha. This area is very small to produce enough rice for home consumption and still generate some marketable surplus. Thus, given the lack of marketable surplus, the results presented a negative cash flow due to higher expenditures on improved seeds and fertilisers (World Vision, 1999). Other on-farm trials were conducted in Gurue during the 1993/94 season to compare ITA 312 with Cabo Delgado, Chibica, Agulha, PR 106 and Oitava - the local farmers' varieties. The highest result yields were obtained from ITA 312. Whilst ITA 312 has a high yield under good growing conditions such as those in Gurue, preliminary indications are that this modern high yielding variety performs less well under conditions of poor soil fertility, moisture stress and higher weed competition (White and Stich, 1994)

Muendane (1999), compiled the average total production costs per ha of selected countries for the 1997/98 and 98/99 growing seasons. The Philippines has the highest costs (US$ 800 and US$ 928 per ha), which are due to high costs of land, labour and equipment. On the other hand, in Cambodia where land is cheap and farmers do not use modern inputs, the costs of production are lower (US$ 105 and US$ 122 per ha). China, the biggest producer in the world has a total production cost of US$ 463 and US$ 537 per ha for the season 1997/98 and 1998/99 respectively (IRRI, 1994). Although China uses modern inputs and the cost of land is relatively high, the total costs are lower compared to other countries and this may find explanation on a relatively high labour supply and therefore inexpensive. The production costs in Mozambique have been estimated at US$ 635 and US$ 274 per ha respectively for the commercial sector and for the family sector using moderate levels of inputs.

Using the estimates of 1998 paddy rice price from the domestic and international markets, of US$ 214/tonne and US$ 170/tonne respectively, Muendane (1999) calculated the critical yield for Mozambique. Also known as break-even point, it is the yield that farmers must attain in order to cover the production costs. The computation of the critical yield is obtained by dividing the production cost per ha by the price of a tonne of rice. Production costs were estimated at US$ 274 (from table 2.7). This therefore, sets the break-even point at 1.3 tons/ha (274/214) for the domestic market and 1.6 tons/ha (274/171) for international markets. This is a critical yield as farmers producing below this level will not be able to pay their production costs. This yield is attainable among smallholder rice producers in Mozambique, there is a tremendous potential in the country for a better performance of the rice industry. Recent demonstrations held in Mangol by the local extension services on the farmers fields in collaboration with Sazakawa Global 2000, have demonstrated that when modern varieties and improved technology are in place, yields can be substantially improved.

**Table 2.7: Standard Production costs per ha of rice in the family sector using some modern inputs in Mozambique**

| Input | Unit | Rate/ha | Unit cost (MZM) | Cost/ha (MZM) | Cost/ha (US$) | (%) |
|---|---|---|---|---|---|---|
| Seed | Kg | 120 | 2 500 | 300 000 | 26 | 9 |
| Urea | Kg | 100 | 3 600 | 360 000 | 31 | 11 |
| Rope | Un. | 1 | 60 000 | 60 000 | 5 | 2 |
| H/M | | | | 1 876 425 | 160 | 58 |
| Jornas | | | | 612 353 | 52 | 19 |
| **Total** | | | | **3 208 778** | **274** | **100** |

Source: INIA, 1998

Muendane (1999) also made a comparative analysis of different agro economic parameters between family sector and commercial sector. The analysis takes into consideration the costs of production, current yields and the potential yields as well as the critical yields required by both sectors to cover the production expenses.

**Table 2.8: Comparative analyse of agro-economic parameters between commercial and family sector**

| Parameter | Commercial sector | Family sector |
|---|---|---|
| Production cost (USD/ha) | 635 | 274 |
| Potential yield (t/ha) | 6 | 2,5 |
| Critical yield (t/ha) | 3,7 | 1,6 |
| Current yield (t/ha) | 3,5 | 1,5 |

Source: Modified from Muendane (1999)

The commercial sector showed higher values among all the parameters. Two main reasons can explain this difference among the two sectors: first the commercial sector has more costs because of plant and equipment, as well as wages for the farm operators compared to the family sector. Second, the commercial sector applies more production inputs than the family sector.

Negative views of economic impacts of modern varieties revolve around the direction of factor-saving bias in new technology. According to Grabowsky (1979) modern varieties have a labour saving bias, the income position of landless labourers and tenants will deteriorate. This view was also questioned by Hayami (1990) who argues that although more econometric investigations are required to confirm the direction of factor-saving bias in the modern varieties technology, available evidence shows that the green revolution resulted in a significant increase in labour demand. Indeed, data assembled for various parts of Asia show that labour input per ha for rice production was higher for modern varieties than for traditional varieties in the order of 10 to 15 percent. Typically, labour application for land preparation was reduced by use of tractors, but the reduction was more than compensated for by increase in labour use for weeding, other crop tending requirements and harvesting.

## 2.14 SUMMARY

This chapter revised the important role of rice as a staple crop for more than fifty percent of the world population both in developing and developed countries. The importance of rice for Mozambique in particular was also emphasised throughout the chapter by stressing the comparative advantage both in terms of climate and geographic location that characterise the country in the region. This gives Mozambique a tremendous potential to become a strong rice producer to meet domestic demand and export to its neighbours in the region. Rice ecosystems were also revised and four types of ecosystems were described. Rice yields depend on a number of factors of which harvesting plays a significant role. This has also been discussed including the recommended moisture content in the grain for harvesting that has to be around 17% to avoid grain looses. Because this study has the objective of making an economic analysis of smallholder rice production, the chapter closes by reviewing some previous studies conducted worldwide in the field of rice production and economics of rice production.

# CHAPTER THREE
# STUDY AREA

## 3.1 INTRODUCTION

This chapter describes the area where this research was carried out. This description includes aspects of geography, climate, demographics, farming systems, agricultural support programs and services, infrastructures, cultural and socio- economics. The chapter starts by giving a general background of Mozambique. Because Bilene is within Gaza province, the chapter also provides a brief descriptive summary of Gaza. The bulk of the chapter is concentrated on the description of Bilene district, where most of the work was carried out with the district extension officers and the farmers producing rice at Mangol village.

## 3.2 MOZAMBIQUE'S BACKGROUND INFORMATION

Mozambique is located in south east Africa from latitude 11-12 degrees S to latitude 27 degrees S with the altitude varying from sea level to 1 800 m. It is bordered by Tanzania to the north, Zambia, Malawi, and Zimbabwe to the west; Swaziland and South Africa to the south; and by the Indian Ocean to the east. Mozambique has a total area of 801 509 $Km^2$ and a population estimated at about 17 million (Cuco, 1994). The climate of the country is classified as tropical with little variation in temperature but with a considerable variation in rainfall at different altitudes (FAO, 1981). The income per capita is estimated to be around US$ 145, making the country one of the poorest countries in the world (Word Bank, 1997). Economic decline in Mozambique began in the decade prior to independence and was aggravated by sudden and massive departure of about 90% of the Portuguese residents, who took with them essential managerial, operational, maintenance and administrative skills. Since 1987, Mozambique has been implementing a Structural Adjustment Program (SAP), which focuses on agricultural production and price liberalisation, industrial development and the promotion of exports to earn foreign exchange.

Administratively, Mozambique comprises 10 provinces: Maputo, Gaza and Inhambane provinces in the south; Sofala, Manica, Zambezia and Tete provinces in the central part of the country; and Nampula, Cabo Delgado and Niassa in the North. Maputo city, the capital of Mozambique has also been classified as a province. More than 80% of the population of the country live in rural areas and agriculture is their major source of subsistence (Dimande and Bay, 1989); maize, cassava, rice, groundnuts and varieties of beans are the most common crops grown and they play a significant role in the diet.

Mozambique's resource base is favourable for agricultural production. Cultivable land is plentiful in relation to population, and soils are reasonably fertile. According to the National Institute of Agronomic Research (INIA), Mozambique comprises ten different agro-ecological zones with different potential for farming. Rainfall is usually adequate, although there is a risk of draught in the south of the country. Annual average rainfall varies from 400 mm in the south to 2 200 mm in the northwestern highlands. Agricultural production in Mozambique is practised by several distinct groups of farmers, of which the smallholders (also called the family sector) are the most important both in terms of cultivated land and the total output. Comprehensive data on land use are difficult to obtain, however, tentative estimates indicate that of the total area of 78.6 million ha, some 36 million ha are classified as suitable for cultivation. Of these, some 3.4 million ha are estimated to be presently cultivated (that is approximately 10% of the suitable land).

The family sector consists of about 2.5 million families, accounts for over 90% of the cultivated area, and is the main supplier of food crops and cash crops. Other categories of farms consist of state/private joint ventures, state farms, co-operatives, and private individual farmers. Within the family sector, women play a central role accounting for as much as 60% of the total work force and contributing with 68% of the total output. This is even more pronounced in the southern part of the country where the work opportunities are available for men in the towns, including migration to South African mines (Muendane, 1999).

### 3.3 GAZA PROVINCE

Gaza is in the southeastern part of Mozambique. It is one of the seven provinces of Mozambique that are bordered by the Indian Ocean on the east. In the north it is bordered by the Save river which separates this province from the central province of Manica; in the south, the Incomati river separates Gaza from Maputo province. The Republic of South Africa and Zimbabwe border Gaza in the west, while Inhambane province forms the northeastern boundary. Figure 3.1 depicts the geographical position, boundaries and the administrative division of Gaza province.

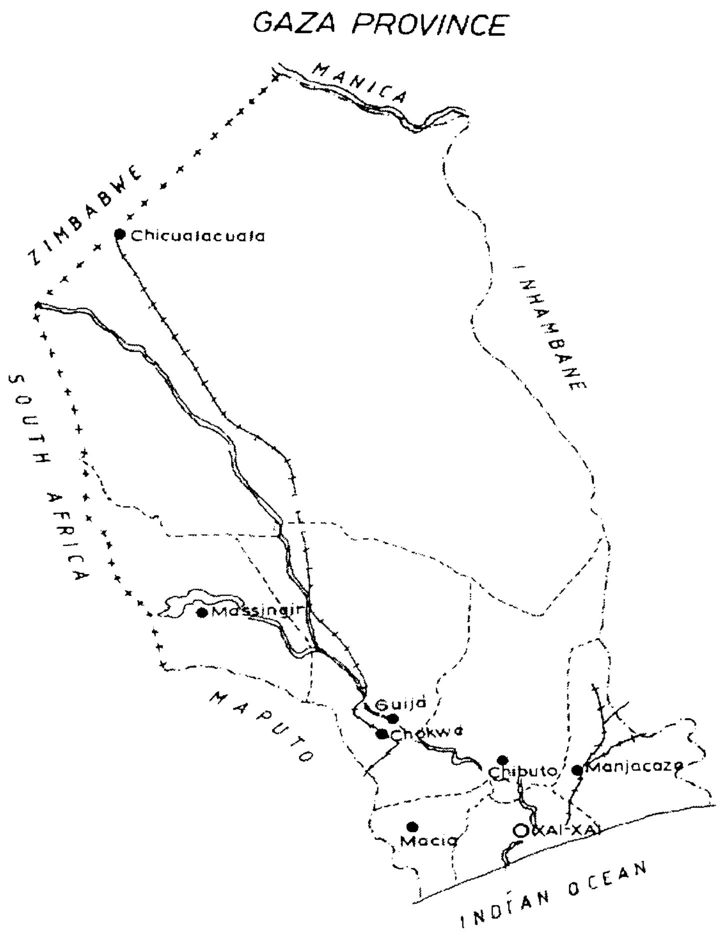



**Figure 3.1: Map of Gaza Province**

Gaza province covers a total area of 75 709 km$^2$ and its total population has been estimated at 1 300 000 inhabitants (DEA, 1991) of which 47% are male and 53% are female. The province comprises eleven districts, with Chicualacuala being the largest district (18 243 km$^2$), and Xai-Xai district the smallest (1 876 km$^2$).

**Table 3.1: Gaza Province; Areas and inhabitants per district**

| District | Area (km$^2$) | Inhabitants | Density (Inh/km$^2$) |
|---|---|---|---|
| Bilene | 3 200 | 135 117 | 42.2 |
| Chibuto | 5 878 | 224 873 | 38.3 |
| Chicualacuala | 18 243 | 26 841 | 1.5 |
| Chigubo | 13 952 | 33 033 | 2.4 |
| Chokwe | 1 955 | 100 986 | 51.7 |
| Guija | 3 589 | 63 914 | 17.8 |
| Mabalane | 9 580 | 22 774 | 2.4 |
| Mandlakaze | 3 748 | 180 632 | 48.2 |
| Massangena | 10 351 | 11 033 | 1.1 |
| Massingir | 5 858 | 29 810 | 5.1 |
| Xai-Xai | 1 876 | 167 001 | 89.0 |
| TOTAL | 78 230 | 996 014 | |

Source: DEA, 1991

The economy of this province is based on agriculture. It is estimated that 90% of Gaza population have their livelihoods based on farming. The major crops for small scale subsistence farming are: rice, maize, beans, cassava, and groundnuts, while cotton, cashew, sugar cane, pineapple and bananas are grown for cash purposes.

## 3.4 BILENE DISTRICT

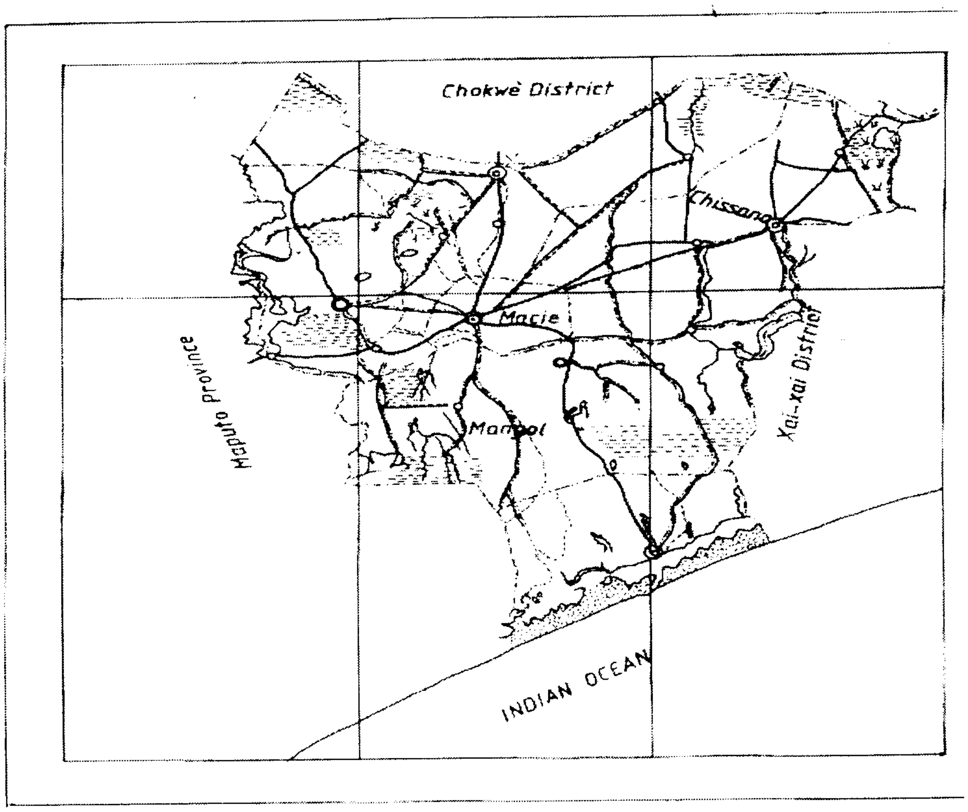
Bilene is located in the southern province of Gaza, 145 km north of Maputo[1] and 60 km south from Xai-Xai, the capital of Gaza province. The total area of the district

[1] Maputo is the Capital of Mozambique and is the largest city both in terms of inhabitants and infrastructures

estimated in 3 200 km$^2$ and its population estimated in 135 117 inhabitants. Bilene district comprises 14 administrative zones.

People of Bilene belong to Shangane tribe. This is one of the largest tribes in the southern part of Mozambique. The levels of literacy in the district are very low, both for male and female. The family sizes are generally high in numbers as it includes extended family of different generations leaving together as a single family. Traditionally they practice agriculture for subsistence. While women tend to work in the field, producing staples, men tend to migrate to find jobs in towns like Maputo, Xai-Xai, Chokwe and on sugar cane plantations of Xinavane and Maragra on Manhica district 20 and 70 Km south from Bilene respectively. Furthermore, a significant number of males from Bilene district are working in the South African mine industry.

BILENE-MACIA DISTRICT




Mangol ⟶ Study Area

**Figure 3.2: Map of Bilene District**

Bilene is geographically close to Maputo, which gives the district relative advantages in terms of access to markets both for input supply and for commercialisation of the agricultural output plus other support services. Roads linking Bilene with other districts are also quite well developed. This level of development of infrastructure, allows to lower the transaction costs and makes a good incentive to private investors to work in the district.

Bilene's altitude is between 60 - 90 meters, the climate is classified as tropical humid with mean annual temperature of about $22.4^{oC}$. The annual rainfall ranges between 800 to 1000 mm with most of it occurring in summer. A summary of long-term climatic data for Bilene district is shown in Table 3.2 below.

**Tabie 3.2: Summary of the long term climatic data for Bilene**

| | **Average maximum** | **Month** | **Average minimum** | **Month** | **Average per annum** |
|---|---|---|---|---|---|
| Temp. (C) | 31.5 | D/J/F | 11.3 | J/J/A | 22.4 |
| Rain (mm) | 146.9 | J/F/M | 27.3 | J/A/S | 932 |

Source: INIA/DTA, 1999

Agriculture and fishing are the main determinants of the economy in Bilene. Crops produced includes maize, beans, cassava, rice, sweat potatoes, groundnuts, vegetables and a range of fruits. Farmers usually have more than one parcel of land and they produce different crops as a strategy for risk minimisation. Further, intercropping is a common practice among the agricultural sector in the district where as part of risk reduction strategy, farmers grow more than one crop in the same parcel of land.

Bilene has a higher potential for producing cashew nuts. The public extension program in Bilene was established in early 1990s, through World Bank supported projects. The main objective of the extension programs was to assist farmers producing cashew nuts only. However, because it was early realised that cashew in the district is produced by small-scale farmers in intercropping with food crops, a decision was taken so that extension programs for Bilene district disseminate messages for both cashew nuts and food crops grown in the district. The extension system used in Bilene is the Participatory Training and Visit System, which is an institution - directed pedagogical training program (Chamala and Martwanna, 1991), comprising the following features: a) unified extension services, b) extension exclusivity, c) systematic training and visit, d) concentration of effort, e) imitable contact farmers, f) best use of available resources, g) recommendations according to the farming systems and farmers' ability, h) linkages with research and continuous improvement (Benor and Baxter, 1984).

The farmer support program to assist small-scale rice production in Mangol was first introduced in 1996/97 season through the National Extension Services (DNER) in collaboration with Sasakawa Global 2000 after consultations with the local farmers. It was identified the need to improve rice production, as part of the strategy to attain food security and improve peasants income. SG2000 is a non-governmental organisation that has an accumulated experience of assisting farmers to improve their yields through adoption of high yielding varieties and modern technologies. The program aims not only to improve the rice production through introduction of modern technologies but also it has the objective of strengthening the links among other services such as research, extension, credit, and input supply, that are required to intervene collectively in the process of technology dissemination. The program consists of allowing farmers to borrow production inputs such as seeds of high yielding varieties, fertilisers and herbicides at the beginning of the season and pay the loan after the harvest and sale of surplus rice at an interest rate of 25% per annum. The program works with the local traders who own shops close to the production areas. Those are the local input suppliers and also they work as buyers for the farm produce during the commercialisation period. Farmers get their seeds, fertilisers and other required inputs from these local shops. This is useful for the sustainability of the program and also helps to create a good relationship between extension agents, farmers and input suppliers. During the period of this study, the farmer support program was working directly with 80 farmers in Mangol. All produced rice but they had other farms outside the valley.

The area for rice production comprises some 6 000 ha of irrigated land in Mangol valley. During the period of Portuguese occupation, this area belonged to private farmers who received incentives to produce rice on a commercial scale. After independence, with nationalisation and introduction of state companies, this area and its infrastructures became a state farm called "Empresa Agricola de Macia" (EAM) and the company produced both rice and Maize using highly modernised equipment such as powerful tractors, combines and modern inputs. Like other state firms, EAM survived through heavy government subsidies. Furthermore, they usually received loans from the state bank (BPD). The management skills were poor within most of the state firms and there were no incentives to improve efficiency. As a result, by the early 1980's the decline in production was evident. The EAM went bankrupt, no more money was available through the state bank because the bank itself did not have money to keep up with a loan portfolio for a non-paying agricultural sector. Several problems arose, as the EAM could not meet the high fixed expenses of plant, equipment and staff, nor its operational costs. This affected the entire economy in the district due to the linkage effect between the agricultural sector and the other sectors in the economy.

From 1987 the government of Mozambique started to implement a structural adjustment program (SAP). Because of its important role not only in the production process but also for income distribution, land reforms became an important component of the SAP. Land reform aims to give access to productive land to the poor. According to Binswanger (1990) land reform only makes economic sense if small efficient farmers replace the large inefficient enterprises. Following this view, land from the EAM was made available to the smallholder producers and currently more than 100 small-scale farmers have benefited from the program.

With water coming from a natural catchment, Mangol gives an opportunity to rural peasants to produce rice under constant water supply at low costs. The role of the farmers with respect to water management is to ensure the maintenance of the canals (both intake canals and drainage canals) to allow good water flow among the rice fields. The following features also give the strengths of this region for the purpose of rice production.

*a) Alternative to Chokwe*

Traditionally, Chokwe has been the most important rice-producing district in Gaza. It has some 20 000 ha of irrigated land and for several years this district has been known for its strengths on rice production. After independence of Mozambique, because of poor water management and fertiliser use, more than 50 percent of this available land was no longer useful for farming. In addition, the Limpopo River also started to undergo some shortage in water during some growing seasons and those factors combined have weakened the production potential of Chokwe. Very recently, during February 2000, the situation were aggravated by an occurrence of heavy floods that have never been recorded for the last 50 years, which destroyed all the infrastructures in Chokwe including the irrigation system. The average annual rainfall in Chokwe is below 500 mm, which suggests that rice cannot be produced in Chokwe without irrigation. The combined effect of decline in soil fertility and a destroyed irrigation system has weakened completely the potential contribution of Chokwe valley for rice production. Therefore, Mangol in Bilene district will play a significant role producing rice for the southern region of the country where demand is high.

*b) Land Reform program*

Mozambique's nationalisation experience soon after independence in 1976, created large firms and cooperative farms that gave few direct incentives to produce. Since 1987, in recognition of this failure the government dismantled the state farms and gave the land to the farmers associations and individual households. Land reform gives poor people ownership rights or permanent cultivation rights to specific parcel of land. It makes sense when it increases their income, consumption or wealth, however, it fails if their consumption does not increase or is reduced (Binswanger and Elgin, 1990). At Mangol valley a **land reform** program is being implemented through the replacement of the large state enterprise with smallholder production. This study could also contribute to the future analysis of land size and productivity relationships in the region, because if small farmers can show efficiency, there will be a benefit resulting from the land reform program.

*c) Agricultural Support programs*

An increase in agricultural productivity is a complex business, including a range of factors, many of them interdependent. Among these factors, credit, extension, research, agricultural inputs, markets and policies play a crucial role (Pickering, 1989). In the Bilene district agricultural support services, such as **extension, agricultural inputs, markets** and **credit** are available, assisting the local farmers in rice production. Although the credit program does not benefit all the farmers, the small number of farmers that currently get access to it to purchase production inputs, can be used to illustrate the role of interdependence between agricultural support programs for the benefits of rural communities.

*d) Water availability*

Water, is among the three main factors contributing to the increase in rice production; the other two are fertiliser and modern varieties (Singh, 1985). Water contributes directly to yields not only by eliminating the likelihood of drought stress on rice crops, but also by allowing a more efficient use of other production inputs such as fertilisers. Water availability also makes possible the cultivation of more than one crop in the same field each year. In Mangol, irrigation water is available throughout the year, therefore rice is grown under irrigation.

*e) Farmers' Associations*

Farmers in Mangol are organised in associations. In the farmers' associations, each farmer has his own plot of rice to cultivate his own crop. The farmer's plots are located in the same area. During the period of land preparation, organised farmers in the association have the possibility to hire machinery to work in individual plots. This in theory gives farmers a better bargaining power but on the other hand facilitates the work of machinery owners who find several clients organised as a group. This also facilitates the task of both extension services by reducing the distances required to meet clients and the financial institutions by lowering the transaction costs and the risks associated to credit (working with a group is less expensive than working with small farmers individually).

*f) Proximity to Rice Mills*

There are three rice-milling factories close to Mangol, two in Gaza Province (Xai-Xai and Chokwe) and one in Maputo Province (Palmeira). All those milling factories are located at about 60 km away from Mangol, providing an important incentive to produce rice.

*g) Relative Proximity to the markets*

Last but not least, Mangol is 150 km away from Maputo town. Maputo is not only the highest populated town in the country, but is also the capital of Mozambique, both politically and economically, with potentially strong markets both for input supply and for rice consumption.

## 3.5 SUMMARY

This chapter provides a description of the area where this study was carried out. Starting from the background of Mozambique, the chapter brings us to Bilene district were the interviews to the farmers and field measurements were conducted. Description is made in terms of administrative division, demographics, geography, farming systems, the economy, social and cultural aspects of the district. This chapter also introduces the period when agricultural support services were introduced in the district and the rationale for allocating those services in the district. Then the chapter closes by pointing out the main reasons that makes Mangol an important area for rice production in the region namely: a) an alternative to Chokwe, b) the implementation of Land Reform program, c) the availability of Agricultural Support programs such as credit and extension, d) water availability, e) the existence of farmers associations, f) close to Rice Milling factories, both in Gaza and Maputo province and g) the relative Proximity to the markets both for input supply and output commercialisation.

# CHAPTER FOUR

# RESEARCH METHODOLOGY AND DATA REQUIREMENTS

## 4.1 INTRODUCTION

This research is part of a series studies initiated in 1996/97 by the Food Security Project and the National Extension Services (DNER), aimed at analysing the economics of small scale producers assisted by the DNER/Sazakawa Global 2000 program to produce high yielding varieties with modern inputs. The first study of this type was conducted for small-scale maize producers in Manica and Nampula Provinces, central and northern Mozambique respectively.

The farmer support program in Mangol, which aimed at assisting local small farmers to have access to modern rice varieties with improved technology, was initiated in 1996/97 growing season. Twenty farmers organised to form an association benefited from the project support during the first year of the project implementation. During the following seasons the number of farmers assisted by the project grew progressively and by the 1998/99 growing season 80 farmers benefited from the project support. This is the first study aimed to analyse the economics and the constraints of rice production systems in the region.

After several visits to the field and consultations with district extension supervisor (DES), field extension workers (FEW), local traders, traditional leaders, extension managers both at National and Provincial levels and the SG2000 country director, and my academic supervisor, the need for this study was recognised and the objectives were commonly agreed as follows:

- Assess the profitability of small scale rice production;
- Assess the effect of input access and availability on the adoption and use of improved technologies;
- Assess the contribution of extension, credit, farmers age and gender on rice production, and
- Identify some socio economic constraints affecting rice production;

To respond to the above specific objectives, the survey methodology was proposed, mainly comprising two different but complementary components: the farmers' yield measurement and the interviews of the farmers using a semi-structured questionnaire. Sixty farmers were interviewed 40 from the population of modern input users, and 20 from the traditional input users. Random sampling was used to select the sample of 40 farmers using high yielding varieties. Similarly, a sample of 20 farmers within traditional input users was obtained. The initial sample size was 80 farmers - 40 from the population of modern input users and other 40 from the traditional input users. Because of the low number and the geographical dispersion of the traditional input users, it was not possible to get the initial proposed number, limiting the yield measurements to 20 farmers among the traditional input users. The survey was carried out from January 1999 to July 1999 and using the following calendar:

**Table 4.1: Calendar of field activities for data collection**

| | J | F | M | A | M | J | J |
|---|---|---|---|---|---|---|---|
| Visits to the fields | X | X | | | | | |
| Training to extension agents | | | X | | | | |
| Yield measurements | | | | | X | X | |
| Interviews of farmers | | | | | | X | X |

The objective of this chapter is to provide a detailed discussion of the various aspects of survey that was taken into consideration to gather the necessary data for the study.

## 4.2 YIELD MEASUREMENTS

The yield measurements among both modern input and traditional input users were conducted to compile budgets which later was used to make a comparative financial and economic analysis between the traditional input users (TIU) and modern input user (MIU) farmers. According to Mabbayad and Jorge (1991) and Eicher and Staatz, (1990), one of the drawbacks associated with the use of high yielding varieties is the high production costs as they require more inputs and more field operations compared to traditional varieties. Therefore, yields, costs and revenues of both modern and traditional input users were compiled and financial comparisons were made. Furthermore, using the available data, an economic analysis is also carried out in order to understand the economic implications of both modern and traditional inputs in rural communities. Financial and economic analysis are important as they help to clarify several aspects of the technology, project or program performance.

### 4.2.1 Measurement techniques

The yields were measured using the $49m^2$ method. This method has been used in Mozambique for the yield measurements within the family sector as recommended by the Department of Early Warning. This technique of yield measurement, resulted from a number of studies and observations of the cultivated areas by the small-scale farmers of Mozambique. Assuming an idealised rectangular rice field of 100 m length and 70 m wide, this section attempts to demonstrate the steps of this technique as follows:

**Step 1:** measurement of the total area of the field

Area = 7 000 $m^2$

**Step 2:** Measurement of the perimeter of the field.

Perimeter = 70 + 100 + 70 + 100 = 340 m

**Step 3:** Calculation of the semi-perimeter of the field. In our example the Semi-perimeter =340/2 = 170 m

**Step 4:** Using the table of random numbers select four random numbers that are less than the semi-perimeter. These numbers are useful as they allow a random determination of two small plots of $49m^2$ each, in the field, that are required to conduct yield measurement. Again for the purpose of illustration we have selected the following numbers: 10, 50, 60 and 5. The first two random numbers (10 and 50) are used to determine the location of the first plot and the second numbers (60 and 5) are used to locate the second $49m^2$ plot.

**Step 5:** Determination of the point of reference. Any of the corners of the farm can be used for this purpose. This point is important as together with the four random numbers will allow the identification of points in the large field where to measure the two small randomly selected plots of 49m$^2$ each as shown bellow in Figure 4.1. In our practical illustration, point A is our reference point.

**Step 6:** From the reference point, using the first two random numbers now we can identify the first small plot. Using a tape, we measure 10 meters (clock wise), but along the borderline of the farm, then another 50 meters right. From this point we can measure the 7 x 7 m (49 m$^2$) plot using right, left, left and left as shown below. Similar procedure is used to measure the second of the two required parcels to determine the yield.

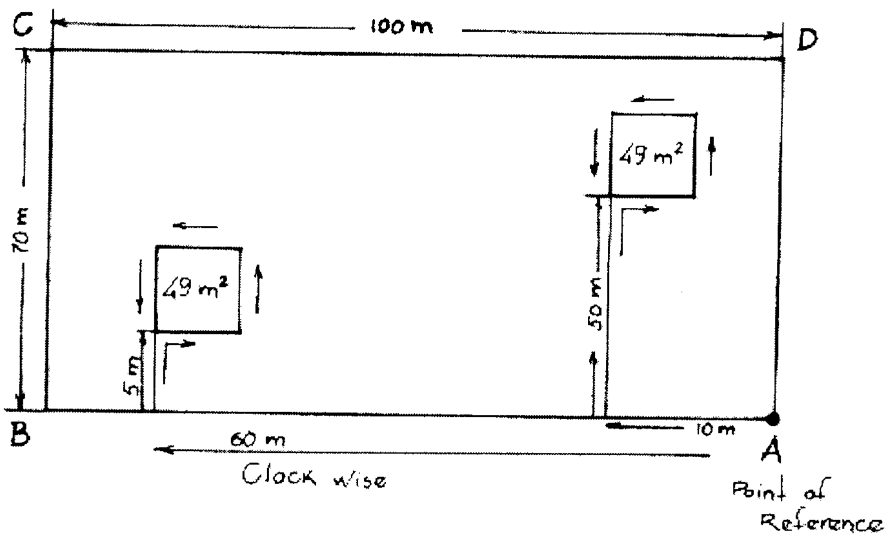



**Figure 4.1: Illustration of steps for yield measurement using 49m$^2$ method.**

**Step 7:** The yield of the crop within the two 49 m$^2$ parcels is harvested, then the average yield of the two parcels is determined. Using the proportions, the average yield is converted into a hectare basis. Again taking an example of one of the field data for illustration the yield was compiled as follows:

Yield obtained from the first plot...............................35.5 kgs

Yield obtained from the second plot..........................36.0 kgs

Average..........................................................................35.75 kgs

Yield (kg/ha) = 10 000 x 35.75/49 ..........................7295.9 kgs (7.3 tons/ha)

## 4.3 QUESTIONNAIRE

In addition to the yield measurements, a questionnaire was compiled for gathering data through interviews with the farmers. The questionnaire had a dual purpose: qualitative data was needed for a farming systems analysis and quantitative data for the financial analysis (Van Rooyen and D'Haese, 1999). The questionnaire comprised six sections: section one was aimed at gathering background **personal and demographic** information, section two attempted to gather data about **production and marketing costs**, section three was concerned with the **yields** obtained from the rice field while section four was aimed at understanding the **role of extension services**, section five was concerned with the **role of credit**, and section six the final section was concerned with production **constraints**.

Mostly closed ended questions were employed in order to bring the respondents to a range of options and thus facilitate the data analysis. A limited number of open-ended questions were also used to allow the respondents to make their contribution to the study. Quantitative data was analysed using Statistical Package for Social Sciences (SPSS).

## 4.4 TRAINING OF THE EXTENSION AGENTS

A short training session for the extension agents involved in the survey took place prior to conducting both yield measurements and interviews of farmers. This training, of which the author was the facilitator, aimed to revise the steps and procedures that have to be observed when conducting interviews with the farmers, including the preparation of the farmers and the methodology of asking questions. This training was also aimed to prepare the extension agents to conduct yield measurements on the rice fields. Although the $49m^2$ method of yield measurement has been well disseminated and is widely used within the country, mainly by the extension agents, a quick revision of the method was recommended in order to ensure a good performance of the extension agents and good data quality.

## 4.5 BUDGETS

Costs of production and total revenue were calculated for both modern input and traditional input users. This data is useful for the calculation of gross margins (GM) - *Gross income minus variable costs.* Total revenue and the costs incurred were obtained by valuing the outputs and inputs at prices using the data from the interviews. Costs are generally not easy to calculate accurately within smallholder production, and this is further complicated because the family labour is a major component of total labour use. Alternatives to value the family labour include the use of the opportunity cost principle. That is the wage rate for the farm operation: what the farmer or the family member could have earned by selling labour services to other farmers. This assumption however is not always valid because during slack agricultural seasons there is little or no off-farm work for farmers, even if they want work, and the alternative to working on the family farm (or own farm) may be not to work at all. On the other hand, during peak agricultural seasons, labour demand may be high, therefore complicating the estimation of the real value (Flynn *et al,* 1991).

Gittinger (1982:73) recommends that when compiling the budgets, family labour has to be treated differently from hired labour. It is not entered as a cost; instead, the wages for the family become a part of the net benefit. This is the approach used in this study. The rationale behind this view is that family members such as children and the farmer's wife (or husband) will be entitled to a share of the family income even if the family farm is too small to give them an opportunity to be productive.

To calculate the gross margins the following data were gathered:

- Total yield (Y) in tons/ha obtained by each farmer, obtained from the yield measurements
- The price (P) in MZM/tonne of the farm output, obtained from the farmers interviews

- The gross income (GI) was calculated as follows:

$$GI = Y \times Py$$

The cost of mechanical land preparation was obtained from the farmer's interviews. Farmers hire a tractor for land preparation and the rate paid is based on the size of the field. The amount the farmers paid for hiring a tractor for all land preparation operations were converted into a hectare basis as a requirement for the calculation of gross margins. The cost of manual labour was also obtained for each operation. The approach used was to determinate the labour requirements by operation per hectare, and then multiply it by the rate paid. For instance, to calculate the cost of labour for land preparation the procedure is as follows:

> **Cost of hired labour for land preparation** = number of people hired for land preparation **x** number of days with hired labour for land preparation **x** rate paid per person per day

The interest rate on production credit of 25% per annum was included in the calculation. The project management has set this figure. The value of interest rate was included for the computation of gross margins for both the modern input users and for the traditional input users. While traditional input users, informally they may get credit from the other peasants, the interest paid is not generally easy to calculate as sometimes is in kind and may vary from lender to lender and from different lender and borrower arrangements. However, according to Ouattara, (1999), interest rates tend to be higher under informal than to formal credit in most rural areas. Therefore, the 25% interest rate while seems conservative for the traditional input users, will be included in the computation of their gross margin because no other accurate and trustable figure was obtained.

Gross Margin (GM) was calculated by subtracting the total variable costs from the Gross income as follows:

$$GM = GI - VC$$

where

GM = Gross margin, GI = Gross income and VC = Variable costs

### 4.5.1 Net Farm income and Net Farm Profit

The net farm income is the total gross margin minus overhead and net farm profit is the net farm income minus return to hired management, rentals and interest on capital. Overhead costs consist of all non-directly allocable variable costs (fuel, oil, lubricants, repairs and spare parts for vehicles and implements) and fixed costs(depreciation, insurance on buildings and implements, licences, regular labour, bookkeepers' fees, bank charges, telephone and post office costs, etc.) Net farm income does not imply profit because return to management, interest on capital and rentals are not included. In reality the small scale rice producers of Mangol, do not keep fixed assets such as plant, equipment, labour, and nor fixed costs for land, therefore, gross margins are commonly used as indicators of net farm profitability.

## 4.6 SUMMARY

This chapter outlined the survey procedure starting from the preparation of the study which consisted of visits to the field, discussions held with the extension staff, district supervisors, management of the extension services at the high level and with the SG 2000 director. The chapter then describes the sampling methodology, which consisted of interviews of farmers and the extension officers and by yield measurements, using the 49 $m^2$ method, which the steps have also been described. The composition of the questionnaire was also outlined through the chapter. The chapter closes by describing how data obtained from the field, both production costs and farm revenues were used to calculate the gross margins.

# CHAPTER FIVE
# THE FARMING SYSTEMS AND SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS

## 5.1 INTRODUCTION

The essence of this chapter is to describe the socio-economic aspects that characterise the farmers in Mangol based on the results obtained from the field survey, interviews, observation and appointments with the extension agents. These aspects include demographics, farming systems, links between extension and farmers, including the messages disseminated by the extension agents to the farmers. This chapter describes what was observed in the field in order to support the discussion, analysis, conclusions and recommendations. It does not attempt to explain or to analyse these characteristics as this is the task of the next two chapters.

## 5.2 DEMOGRAPHICS

Among the modern input users (MIU), the average farmer's age is 47 years. The minimum and the maximum age recorded among this strata was 22 and 68 years respectively. More than 60% of the farmers are aged older than 40 years and 62.5 % are male. Similarly, the average age among the Traditional input users (TIU), was calculated at 50 years and the minimum and maximum age recorded under this group of farmers was 25 and 69 years respectively, with 65 % of them aged more than 40 years. As in the case of MIU, male farmers dominated this group, representing 90 % of the total respondents.

**Table 5.1: Farmers' Age**

| | MIUs | TIUs |
|---|---|---|
| Mean | 47 | 50 |
| Maximum | 68 | 69 |
| Minimum | 22 | 25 |
| Standard deviation | 12.8 | 12.8 |
| Variance | 164 | 164 |

**Table 5.2: Gender composition**

| | MIU (%) | TIU (%) |
|---|---|---|
| Male | 62.5 | 90 |
| Female | 37.5 | 10 |

Shangana is the most common language spoken among the farmers both MIU and TIU as part of their identity. Ronga is also spoken in Macia district although less commonly. Portuguese is the official language in Mozambique, but only 15 % of the MIU and 35 % of the TIU can understand/speak Portuguese.

**Table 5.3: Languages commonly spoken by the interviewed farmers in Mangol**

| | MIU | | TIU | |
|---|---|---|---|---|
| | % | Cummulat % | % | Cummulat % |
| Shangana | 67.5 | 67.5 | 55.0 | 55.0 |
| Ronga | 17.5 | 85.0 | 10.0 | 65.0 |
| Portuguese | 15.0 | 100 | 35.0 | 100 |

### 5.2.1 Family size and family members working in the family farm

The family size varies significantly from 2 to 34 people among MIU and from 3 to 11 among TIU, giving an average of 8 and 6 people respectively. The average number of family members in the whole country has been estimated at 5 people. Historically, most families in the rural areas are large; however with respect to Mangol, most of the large families consist of different generations - grandfather to grandchildren - living together as one family.

**Table 5.4: Family size**

| | MIU | TIU |
|---|---|---|
| Mean | 8 | 6 |
| Maximum | 34 | 11 |
| Minimum | 2 | 3 |
| Standard deviation | 6.78 | 1.95 |
| Variance | 45.97 | 3.8 |
| Average family members working in the farm | 4 | 4 |
| Range of family members working in the farm | 1 – 23 | 2 – 4 |

The average number of family members working in the family farm is 4 people for both MIU and TIU. However there are large variations in the range. For instance the minimum and the maximum members obtained for the MIU were 1 and 23 respectively while only 2 and 6 respectively were recorded for the TIU. According to the interviewed farmers, when modern varieties are cultivated and improved technologies are employed, more field operations need to be carried out in the field to ensure good quality crop and high output, therefore more labour is required.

## 5.3 FARMING SYSTEMS

### 5.3.1 Size of the rice fields

The average area of rice fields is 0.91 ha for the MIU and 0.90 ha for the TIU. The minimum size of the fields was 0.50 ha for both. While there is no difference in the average and the minimum, there is quite a large difference for the maximum area recorded. For the MIU it was 4 ha and for the TIU the maximum field size was 2 ha. The average total farm size per family however, is 2 ha, including the other fields outside the valley that all interviewed farmers used to produce other crops such as cassava, beans, maize and groundnuts.

**Table 5.5: Area of the rice fields in Mangol (ha)**

| | MIU | TIU |
|---|---|---|
| Mean | 0.91 | 0.90 |
| Maximum | 4.0 | 2.0 |
| Minimum | 0.5 | 0.5 |
| Standard deviation | 0.94 | 0.48 |
| Variance | 0.88 | 0.23 |

### 5.3.2 Rice yields in Mangol

The average rice yield recorded from the yield measurements among the MIU was 4.4 tons/ha, with minimum and maximum of 3.1 and 7.3 tons/ha respectively. On the other hand, among the TIU, the average yield recorded was 2.5 tons/ha, with minimum and maximum of 1.7 and 2.9 respectively.

**Table 5.6: Rice Yields (tons/ha)**

| | MIU | TIU |
|---|---|---|
| Mean | 4.4 | 2.5 |
| Maximum | 7.3 | 2.9 |
| Minimum | 3.1 | 1.7 |
| Standard deviation | 0.84 | 0.33 |
| Variance | 0.71 | 0.11 |

Among the MIU, 50 % of the farmers produced yields ranging between 4 to 5 tons/ha and 20 % produced yields ranging from 5 to 6 tons/ha while within the TIU 95 % of the farmers produced yields ranging from 2 to 2.9 tons per ha. The frequency distribution Tables 5.7 and 5.8 gives the picture of the levels of yields obtained by the farmers from either group.

**Table 5.7: Frequency distribution of yields among MIU**

| Yield Interval (tons) | % of farmers |
|---|---|
| 3 – 3.9 | 25 |
| 4 – 4.9 | 50 |
| 5 – 5.9 | 20 |
| 6 – 6.9 | 2.5 |
| 7 – 7.9 | 2.5 |

**Table 5.8: Frequency distribution of yields among TIU**

| Yield Interval (tons) | % of farmers |
|---|---|
| 1 – 1.9 | 5 |
| 2 – 2.9 | 95 |

### 5.3.3 Other crops grown by the farmers

All interviewed farmers both from MIU and TIU, apart from producing rice, they grew maize in intercropping with other crops. The second most grown crop is cassava with 92.5 % of the MIU and 45 % of the TIU farmers cultivating this crop. Other crops grown during the season included beans, vegetables, sweat potatoes, sugar cane, groundnuts and bananas.

**Table 5.9: Percentage of farmers that produced other crops besides rice**

| | MIU (%) | TIU (%) |
|---|---|---|
| Maize | 100 | 100 |
| Cassava | 92.5 | 45.0 |
| Beans | 67.5 | 30.0 |
| Vegetables | 37.5 | 55.0 |
| Sweat potatoes | 45.0 | 45.0 |
| Sugar cane | 35.0 | 45.0 |
| Groundnuts | 32.5 | - |
| Banana | 25.0 | - |

## 5.4 CONTACTS BETWEEN EXTENSION OFFICERS AND FARMERS

According to the MIU farmers, 47.4 % always received visits from the Extension agents (EAs), and 52.6 % received the visits from the EAs regularly. As for the TIU, 85 % seems to receive visits from the EAs regularly. Both groups of farmers have rated the role of the Extension agents as very important as they help to understand and implement many aspects of their production systems. Table 5.10 illustrates the contents of training offered by the EAs to the farmers as perceived by the farmers.

**Table 5.10: Messages disseminated by the extension agents as perceived by farmers**

| | MIU ( %) | TIU ( %) |
|---|---|---|
| Land preparation | 27.5 | 10.0 |
| Seeding | 47.5 | 90.0 |
| Weeding | 45.0 | 45.0 |
| Fertiliser application | 90.0 | - |
| Herbicide application | 92.5 | - |
| Water level control | 37.5 | 37.5 |
| Cleaning water canals | 10.0 | 30.0 |
| Harvesting time | 70.0 | 70.0 |

The application of herbicide ranks first among the MIU followed by contents related to fertiliser application and harvesting time. Comparatively, seeding ranked first among the TIU, followed by harvesting time.

Both MIU and TIU have ranked the messages related to harvesting time higher (70%). Weed control and water level control also received similar rankings of 45 and 37.5 % respectively from both MIU and TIU groups of farmers participating in the study.

As expected at the beginning of this research, farmers under TIU did not receive any contents related to herbicide and fertiliser application. However, MIU received more contents of land preparation, while TIU received more contents related to clearing the water canals.

## 5.5 COST OF INPUTS AND OUTPUT PRICE AS PERCEIVED BY THE FARMERS

Most MIU farmers (69 %) rates the cost of inputs (seeds, fertilisers and pesticides) as high. While for the price of rice, 59 % of MIU rated it low, 38 % rated it fairly good and only 2.6 % rated it good. The TIU did not rate the cost of inputs, first because most farmers within this group, retain part of their production to ensure seeds for the following season; indeed they do not buy fertilisers nor pesticides. As for the price of rice 95 percent of the TIU farmers rated it low and only 5 % rated it good.

## 5.6 PRODUCTION CONSTRAINTS AS PERCEIVED BY THE FARMERS

According to farmer's views, there are six production constraints affecting rice production in Mangol. These include credit, fertiliser acquisition, land tenure, land preparation, seed acquisition and seed quality. The extent to what these factors negatively affect the production systems are viewed differently by the farmers. Because of the important need to understand and overcome those production constraints in order to improve rice production, chapter seven, gives a more detailed analyse of those constraints. Each constraint is analysed separately, but looking to linkages with other constraints and always taking into account the farmers' view.

## 5.7 SUMMARY

This chapter presented the results from the survey. The chapter started by describing the demographic characteristics which consisted of the age of the farmers, gender of the farmers, common languages, family size and number of family members working on the farm, the respective farming systems as well as the farm sizes were described throughout the chapter. Other crops grown by farmers were also identified. Maize and cassava are the most important food crops as perceived by the farmers. Other aspects outlined in this chapter included the messages disseminated by the extension agents, cost of inputs which the farmers generally considered them high, the price of rice and the production constraints. All these findings are used as inputs for the next chapters.

# CHAPTER SIX

# THE ECONOMICS OF SMALLHOLDER RICE PRODUCTION IN MANGOL

## 6.1 INTRODUCTION

Profitability of the smallholder rice production in Mangol is the central objective of this study. To do so, however, it is crucial to transform data from field surveys into budgets. Budgets are a formalised way to compare production process benefits and costs. Budgets are the key elements for the process of financial and economic analysis. For the smallholder production systems, however, the compilation of budgets is usually not easy due to the following reasons:

- Poor record keeping system of the farm input levels, farm operations and farm outputs;
- Sometimes distortions of the current levels of outputs are used by the farmers during interviews as a strategy to avoid liabilities;

The main objective of this chapter is to use the data available both from literature and from the field survey to analyse the rice production systems and to determine the profitability of smallholder rice production in Mangol.

## 6.2 GROSS MARGINS

Gross margin is the difference between gross returns and variable costs (Woodford, 1991). Also referred to as returns above variable costs, gross margin measures the contribution of an enterprise to farm profitability. Input quantities and values used in production process and output quantities and values are the basic data required to construct gross margins.

Using data from the field, through yield measurements and farmers interviews, gross margins were compiled for both MIU and TIU smallholder rice producers in Mangol. Three different levels of yield – lowest, average and maximum – were used to allow us to analyse separately the effects of different yields for the final farm profit. Under both MIU and TIU there is not much variation on the amount of inputs used among different farmers, which suggests that the variation in yields is a result of other factors such as timing and quality of land preparation, planting time depth and density, timing of field operations such as weeding, fertiliser application and harvesting. Transport cost was the only cost that varied among different farm levels of output, and this is because farmers producing more had also to transport more rice to the market and vice-versa. However, the total revenue had significant variation between the different outputs and so is the gross margin.

**Table 6.1: Gross margin for the Traditional Input Users**

| | **Average** | **Maximum** | **Minimum** |
|---|---|---|---|
| Yield (tons/ha) | 2.5 | 2.9 | 1.7 |
| Price (MZM/tonne) | 2 150 000 | 2 150 000 | 2 150 000 |
| **Total revenue** | **5 375 000** | **6 235 000** | **3 655 000** |
| Variable Costs (MZM) | | | |
| *Manual land prep* | *225 000* | *225 000* | *225 000* |
| *Labour for weeding* | *240 000* | *240 000* | *240 000* |
| *Labour for harvest* | *360 000* | *360 000* | *360 000* |
| *Labour for threshing* | *450 000* | *450 000* | *450 000* |
| *Transport* | *375 000* | *435 000* | *225 000* |
| *Inputs (seeds)* | *215 000* | *215 000* | *215 000* |
| *Interest*[2] | *26 875* | *26 875* | *26 875* |
| **Total cost** | **1 891 875** | **1 951 875** | **1 741 875** |
| **Gross Margin** | **3 483 125** | **4 283 125** | **1 913 125** |
| **Break-even point (tons/ha)** | **0.88** | **0.91** | **0.81** |

*(During the period of survey, the exchange rate was US$1: MZM 12 000)*

Farmers using traditional inputs do not have access to formal credit. This study did not attempt to find out if the farmers get loans from the other farmers informally;

[2] This value corresponds to six months interest at 25% per annum. The reason is that the majority of farmers payback the credit soon after harvesting, therefore, they use the credit for a period of six months. In the case of TIU, seed was the only production input, thus, interest was included only on the cost of seed.

however, for both financial and economic analysis, an interest rate of 25% per annum, similar to the interest paid by the MIU, were included in the calculation of gross margins by assuming that even when farmers used own funds to purchase production inputs, an interest rate is still there because of the opportunity cost of not investing elsewhere.

The gross margins for the MIU farmers have been compiled and are presented in table 6.2. As in the case of TIU, three levels of production were considered.

**Table 6.2: Gross margins for the Modern Input Users**

| | **Average** | **Maximum** | **Minimum** |
|---|---|---|---|
| Yield (tons/ha) | 4.4 | 7.3 | 3.1 |
| Price (MZM/tonne) | 2 150 000 | 2 150 000 | 2 150 000 |
| **Total revenue** | **9 460 000** | **15 695 000** | **6 665 000** |
| *Variable Costs (MZM)* | | | |
| *Mechan land prep* | *1 100 000* | *1 100 000* | *1 100 000* |
| *Labour for weeding* | *240 000* | *240 000* | *240 000* |
| *Labour for harvest* | *432 000* | *432 000* | *432 000* |
| *Labour for threshing* | *540 000* | *540 000* | *540 000* |
| *Transport* | *660 000* | *1 095 000* | *465 000* |
| *Inputs* | | | |
| ➢ *Seeds* | *850 000* | *850 000* | *850 000* |
| ➢ *NPK* | *370 000* | *370 000* | *370 000* |
| ➢ *Urea* | *780 000* | *780 000* | *780 000* |
| *Interest*[3] | *250 000* | *250 000* | *250 000* |
| **Total cost** | **5 222 000** | **5 675 000** | **5 027 000** |
| **Gross Margin** | **4 238 000** | **10 038 000** | **1 638 000** |
| **Break-even point (tons/ha)** | **2.4** | **2.6** | **2.3** |

[3] This value corresponds to six months interest at 25% per annum. The reason is that the majority of farmers payback the credit soon after harvesting, therefore, they use the credit for a period of six months. For the MIU, it was calculated for the following inputs: Seeds, fertilisers and pesticides

When farmers apply modern technologies and follow carefully other agronomic and management practices such as land preparation, planting time and depth, weed control, insect and pest monitoring and control, water control, and harvesting time, they can obtain gross margin of about 2.3 times higher than the highest gross margin obtained under use of traditional technologies. Similarly, at the average yield, MIU can produce a gross margin 1.2 times higher that the gross margin obtained by the average TIU. At the lowest levels of production, however, the gross margin obtained by farmers producing traditional varieties is 1 913 125,00 MZM, corresponding to 1.2 times higher than those producing modern varieties. Although the lowest yield obtained by MIU is higher than the lowest obtained by the TIU, because of high costs of production inputs associated to modern varieties, the gross margins for the TIU is higher. Under the current scenario of costs of production inputs and the price of rice, farmers producing HYV in Mangol should never produce below 3.4 tons per ha, and farmers should be encouraged to produce from 4.5 tons per ha as this yield not only ensures the payment of all production and market expenses but also producing above that level farmers make more income than any farmer producing TIU.

According research carried out by DDA-Bilene (1998), Rice contributes 17% to the total annual smallholder income in Bilene district. Therefore, if the contribution made by the gross margin of 10 038 000 MZM obtained by the best farmer represents seventeen percent of his/her total income, we can estimate the annual income of the best farmer to be around 59 047 059,00 MZM. The average farmer with a gross margin of 4 238 000,00 MZM would therefore typically earn an annual income of 24 929 412,00 MZM, while the weakest farmer producing gross margin of 1 638 000,00 MZM would earn an annual income of 9 635 294,00 MZM. Similarly, for the TIU the annual income earned would be 25 194 853,00; 20 488 971,00 and 11 253 676,00 MZM respectively for the best, average and the weakest farmer.

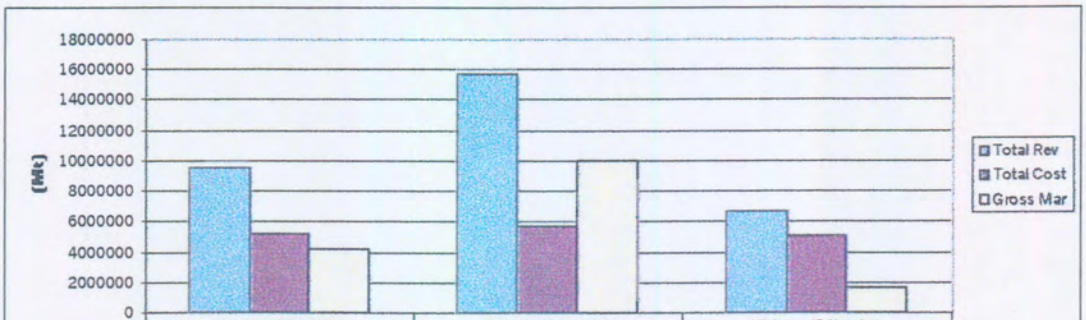
All the farmers involved in this study, both TIU and MIU, besides the rice farms received recently through land reform, they have other plots outside the valley where they produce other crops such as cassava, Maize, beans, vegetables and other food crops. One assumption made to undertake these annual income estimations is that the best rice producing farmers are also the best in the production of the other crops, and so is the average and the weakest farmer. Because this may not be necessarily true, further studies are required to allow a better understanding of the level of output obtained by crop by farmer. However, since rice makes the highest contribution to the total household income in Bilene, than the other crops, these calculations can be used to foresee the rice contribution to the total farm income, and help us to understand the important role of enhancing household efficiency. This is important as also may help to shift from the traditional view that smallholder producers are the weakest income earners in the economy, and can motivate more people to participate productively in the agricultural sector.

According to the data obtained from the interviews, MIU farmers used mechanical land preparation while the TIU farmers used manual land preparation. Therefore the gross margins on tables 6.1 and 6.2 were compiled based on these premises. Table 6.3 summarises the yield, total revenue and the gross margins obtained by both MIU and TIU farmers. Graphically, the comparative gross margins between the two groups of farmers is shown in figures 6.1 and 6.2.

**Table 6.3: Comparative gross margins between modern and traditional input users**

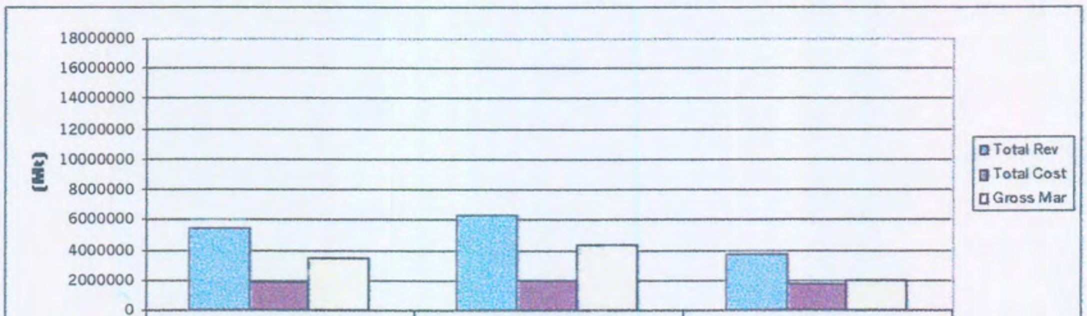
| | **Average MIU** | Average TIU | **Maxim MIU** | Maxim TIU | **Minim MIU** | Minim TIU |
|---|---|---|---|---|---|---|
| Yield (tons/ha) | **4.4** | 2.5 | **7.3** | 2.9 | **3.1** | 1.7 |
| Total Rev (MZM) | **9460000** | 5375000 | **15695000** | 6235000 | **6665000** | 3655000 |
| Total cost (MZM) | **5222000** | 1891875 | **5657000** | 1951875 | **5027000** | 1741875 |
| Gross mar (MZM) | **4238000** | 3483125 | **10038000** | 4283125 | **1638000** | 1913125 |

It is important however to note that as the yield decreases, the difference between the gross margins of MIUs and TIUs becomes smaller. This is because of the higher costs of input acquisition and the production expenses in farm operations that MIU farmers have to meet during the production cycle, which are higher compared to the TIU.




| | Average (4.4ton/ha) | Maximum(7.3ton/ha) | Minimum(3.1ton/ha) |
|---|---|---|---|
| Total Rev | 9460000 | 15695000 | 6665000 |
| Total Cost | 5222000 | 5657000 | 5027000 |
| Gross Mar | 4238000 | 10038000 | 1638000 |

**Figure 6.1: Total Cost, Revenue and Gross Margins for the MIU.**




| | Average (2.5ton/ha) | Maximum(2.9ton/ha) | Minimum(1.7ton/ha) |
|---|---|---|---|
| Total Rev | 5375000 | 6235000 | 3655000 |
| Total Cost | 1891875 | 1951875 | 1741875 |
| Gross Mar | 3483125 | 4283125 | 1913125 |

**Figure 6.2: Total Cost, Revenue and Gross Margins for the TIU.**

## 6.3 THE ECONOMIC IMPORTANCE OF HIGH YIELDING VARIETIES

The adoption and production of modern high yielding varieties produce a number of benefits to the society as a whole. These benefits are closely related to the overall role of agriculture in the economy namely the increase in the supply of food for domestic consumption, release labour for industrial employment, enlargement of the size of the market for industrial output, increase the size of domestic savings and earn foreign exchange (Timmer, 1990). In Bilene district and within the neighbouring districts, the production of HYV in Mangol has the following potential benefits:

### 6.3.1 Food provision

When farmers adopt high producing modern varieties there will be an increase in the total rice output produced. The increase in production will contribute to meet the demand of rice first within the district, because Bilene district is vast and only Mangol valley has appropriate agro ecological conditions to produce rice in the district. This will also make a substantial contribution to meet the demand at provincial level, especially under the current problems caused by floods. Mangol valley comprises some 6 000 ha of good soils with available water to produce rice. Only small part of this area is currently under production by small-scale farmers using HYV. If more farmers are encouraged to use the available land through incentives such as credit, prices, technical assistance and input availability, the overall rice production will be boosted and will contribute to reduce the current deficit of about 50 000 tons that annually have to be imported to meet the country's domestic requirement for food. As the production increases, the rice prices will become more competitive as there will be no shortage, and this will benefit the people not only in Bilene district, but countrywide. This will also save some hard currency from importing large quantities of rice that can be produced locally, and will allow some reallocation of the resources to import other products that cannot be efficiently produced in the country.

### 6.3.2 Earning foreign currency

In the southern African region Mozambique has a strong comparative advantage in producing rice. The country has a potential area of about 900 000 ha for rice cultivation of which only 20% is currently being utilised. In the past, before 1975, Mozambique used to be a net rice exporter. Because of easy access to the Bilene district by road and its relative proximity to the port in Maputo, including the easy access to Maputo corridor, rice produced in Mangol can easily be targeted also to neighbouring countries of low agricultural potential to produce rice, therefore, contributing to meet the rice growing demand in the region and thus earn foreign currency.

### 6.3.3 Contribution to reduce unemployment

Because of the linkage effect of the agricultural sector with the other sectors, the use of modern technologies usually brings benefits the other sectors in the economy. The adoption of HYV in Mangol, will create an effective demand on inputs such as improved seeds, fertilisers and crop protection chemicals. Input producers such as seed companies, fertiliser and pesticides industries have a role to play and they get share of the benefits. In this marketing chain more people will be employed both in rural and urban areas with more emphasis to rural areas where local shops (commonly known by cantinas) that have not been operating for long time due to the lack of demand on agricultural inputs, will play a key role in the distribution process. Milling factories will also come into operation as more rice is produced and this will also contribute to the reduction of unemployment in Mozambique, currently estimated in 70% as more people will be hired to work. All the above reasons fall under the five roles of agricultural sector to the economy as described by Johnston and Mellor (1961)

### 6.3.4 Promoting linkages between institutions

Any individual farmer, regardless of the size of operation and the type of production systems is a multidisciplinary complex comprising natural resources, inputs, crops, markets, research, extension, credit and so forth. Therefore, any extension program aimed to assist rural farmers can only be effective if the other support services are reaching the farmers effectively. By using modern technologies farmers will make an effective demand to many institutions to perform their role. This role of technology to induce institutional innovation has long been recognised as playing a significant role in the process of rural development (Stevens and Jabara, 1988).

Despite those positive contributions to the society, yields below 3.4 tons/ha should be discouraged when modern inputs are used for rice production, because farmers as individual actors in the economy are more concerned about improving their financial status and the aspects of economic contribution are beyond their scope. Therefore, both farmers and agricultural support services such as extension and research must combine their efforts to attain much better yields so that farmers can see the benefits of applying modern technologies.

## 6.4 ENTERPRISE DIVERSIFICATION

Crop diversification is a common practice within the smallholder production systems and to a large extent is related to food security reasons. Because rice is mostly produced for cash purposes, farmers have adopted the strategy to have other plots of land to produce staples in order to attain food availability for home consumption. All interviewed farmers both from MIU and TIU, apart from producing rice, they grew maize in intercropping with other crops. The second most grown crop by the farmers is cassava with 92.5 percent of the MIU and 45 percent of the TIU farmers cultivating this crop. Other grown crops in diversification with rice during the season included beans, vegetables, sweat potatoes, sugar cane, groundnuts and bananas.

Crop diversification (also known as enterprise diversification) plays a significant role on risk management in agriculture. It is premised on the condition that low or negative correlation of returns among some enterprises will stabilise total returns over time. When the income of one enterprise is low, the income from another is high; therefore it may be possible through diversification to reduce the total variability of returns, and thus the investment's risk, without reducing the expected levels of returns. Hence, the diversified investment would be preferred over investing in only one unit (Barry, *et al*,1995:216). Under enterprise diversification, the potential for risk reduction is determined by (1) the number of investments held, (2) correlation (or covariance) between the expected returns of the individual investments, and (3) possible changes in the levels of costs and returns per unit of investment as a result of diversifying.

Enterprise diversification in farm business however, should be carefully considered as both prices and yields of most crops grown in a given area tend to be positively correlated. This correlation occurs because in roughly the same location, most crops experience similar weather patterns, use similar resources, and experience similar market forces. Combining livestock and crops is likely the most promising approach. This study did not investigate the number of farm animals kept by the farmers, however it is suffice to say that the task of the extension officers in this regard should be to stress the need to combine both livestock and cropping production systems when producing recommendations to the farmers, based on the principle of covariance.

## 6.5 SUMMARY

This chapter started by drawing the attention towards the primary objective of this study, which is an assessment of the profitability of smallholder production in Mangol. Then it introduces the concept of budgets, which are the formalised way to compare production process costs and benefits, they are also the key elements in the process of financial and economic analysis. Gross margins, also known as the returns above the variable costs have been compiled for both MIU and TIU smallholder rice producers in Mangol. The analysis show that when farmers use improved technologies and follow the recommended agronomic practices can obtain gross margins three times higher than the highest gross margin produced by farmers using traditional inputs. At the average levels of production also the MIU have produced one and a quarter much higher gross margins than TIU. However, as for the lowest level of output, there was a slight advantage to the TIU, which suggests that when producing HYV, farmers must be efficient in order to obtain acceptable levels of profitability. Attempts to estimate the household farm income are also made in this chapter, based on the contribution of rice to the total farm income, which according to government survey was estimated in seventeen percent. The contribution of modern technologies to the rest of the economy such as food provision, employment generation, linkages between institutions and earning foreign currency are also discussed throughout the chapter. Then, this chapter closes with a small component of enterprise diversification, which characterise the farming systems of the peasants as a strategy to attain food security and risk minimisation.

# CHAPTER SEVEN

# SOCIO ECONOMIC CONSTRAINTS AFFECTING RICE PRODUCTION IN MANGOL

## 7.1 INTRODUCTION

Rice production in Mozambique is constrained by a number of factors from technical, biological, and socio-economic nature. Some constraints such as pests and diseases, lack of credit facilities, lack of effective input supply system, lack of effective research and poor linkages between research and extension have been identified earlier and are country wide constraints affecting rice production. To better understand the factors affecting rice production in Mangol, in particular, farmers were asked to identify a number of constraints, listed on chapter five, and summarized on table 7.1 bellow.

This chapter aims to analyse each of these identified constraints perceived by farmers including their potential linkages, it also gives the rationale behind each constraint in order to assist both policy makers and rural development practitioners to improve the programs that are directed to the farmers. This chapter also discusses the role of agricultural support services such as extension, input supply and credit to minimise the negative effects caused by these constraints.

**Table 7.1: Rice Production constraints perceived by the farmers**

| | MIU | | TIU | |
|---|---|---|---|---|
| | yes (%) | No (%) | Yes (%) | No (%) |
| Credit | | 100 | 55 | 45 |
| Fertiliser acquisition | 65 | 35 | 8 | 92 |
| Land tenure | 12.8 | 87.2 | 50 | 50 |
| Land preparation | 46.2 | 53.8 | 75 | 25 |
| Seed acquisition | 5.1 | 94.9 | 15 | 85 |
| Seed quality | 15.4 | 84.6 | 21.1 | 78.9 |

## 7.2 LAND PREPARATION

Land preparation is an important determinant of yields. It creates the necessary soil conditions for seed germination and emergency by enabling good water and air circulation and by facilitating the root system to develop and capture the plant nutrients required during the growing season. Land preparation can be done manually, mechanically or using animal traction. Data from table 7.1 shows that 46% of MIU and 75% of TIU perceived land preparation as the main constraint for their rice production systems. MIU consider this operation as the main constraint because of high costs of hiring the tractor for land preparation. The cost of mechanical land preparation is 1 100 000 MZM corresponding to 18% of the total variable production costs. In the other hand, TIU using manual land preparation, see this operation as a limiting factor affecting rice production because of the labour requirements, indeed, the manual land preparation is also difficult under both wet and dry soil conditions in Mangol. Furthermore, the timing and quality of land preparation are crucial determinants of the total yield produced as they can affect in different ways seed germination and emergency.

## 7.3 CREDIT AVAILABILITY

Credit is an important support service that when available to the farmers makes an important incentive towards adoption of new technologies disseminated to the farmers. One of the reasons behind little implementation of some adopted technologies disseminated by the extension services lies on the farmers' inability to pay for the technologies in advance. Credit is not available for the majority of small-scale farmers in Mozambique. Even when credit facilities are available, credit may not be accessible to the farmers due to a number of factors including asymmetric information, lack of collateral, not well defined property rights, lack of institutions, high transaction costs and shortage of money itself. In the case of Mozambique, the situation is aggravated because financial institutions are not designed to service smallholder farmers.

All the MIU farmers had access to credit through the project, therefore only TIU (55%) have perceived lack of credit as a limiting factor within their rice production systems. A percentage that seems small taking into account that formal credit through the project is targeted to MIU farmers. In the other hand, however, th the other half of TIU farmers may not see access to credit as a major constraint due to the following reasons: (1) Farmers may have other informal forms of access to credit such as money lenders and ROSCAS, (2) they may buy inputs (seeds) from their neighbours in the form of credit to pay in kind, (3) farmers may simply not be interested for credit because their rice fields are very small, (4) farmers may be unaware of the role of credit and (5) last but not least, farmers may be risk averse and this is true in the rural communities therefore not willing to engage on credit.

The production of HYV requires a set of production inputs such as improved seeds, fertilisers and pesticides that their cost are beyond the farmers capability. Therefore, credit programmes should always be included with other support services required to motivate farmers' participation on agricultural intensification schemes. It is important however that when credit programs are planned and implemented, beneficiary farmers must be prepared and clarifications must be done in advance taking into consideration country specific situations. Mozambique was during many years under emergency because of the war. During that period, farmers received granted production inputs. Now the environment both politically and economically has changed, therefore, farmers are required to shar the costs of production inputs, including the costs of borrowing money. This sometimes is not easily understood and must be clarified to the farm communities.

## 7.4 INPUTS OF PRODUCTION

The availability and access of production inputs to the farmers has early been recognised as an important engine for growth of the agricultural sector. In many rural areas of Mozambique, the input supply system is very weak or non-existent at all. Several reasons contributed to this; the long period of civil war has aggravated the problem by destroying many infrastructures in the rural areas, such as roads, production facilities, stores, and so forth.

Although Bilene district is located within an area of relatively good infrastructures, such as roads, milling factories and other facilities, the use of production inputs by smallholder rice farmers has been limited. This to some extent was due to the fact that before the independence in 1975, the rice producing areas belonged to the Portuguese large farmers, and soon after independence those farms belonged to the state as a result of the nationalisation. Only very recently, after a failure of the large state firms there was a new approach of allowing the small farmers get access to those areas for rice production.

The role of both Research and Extension Services is only useful if the technology is being adopted and implemented by the farmers, the end users. To do so however, inputs must be available and accessible to the farmers.

### 7.4.1 Seed and fertiliser acquisition

Among the farmers involved in the study, 65% of MIU perceived fertiliser acquisition as a problem and only 5.1% perceived seed acquisition as a limiting factor (Table 7.1). Contrary to the expectation at the beginning of this study, fertiliser acquisition was not seen as a problem among the TIU. Regarding seed acquisition only a small percentage of MIU farmers (5%) and TIU (15%) have considered it a constraint for their rice production systems.

The following points explain why farmers have different perceptions with regard to input acquisition. As for the MIU while they have access to fertilisers through the project, the cost of fertilisers is high. Both Urea and NPK (12-24-12) required during the growing season costs the farmers a total of 1 150 000 MZM per ha and this is viewed by the farmers as very expensive. The seed acquisition is not seen as a problem not only because they get seeds through the project, but also because some of the farmers among MIU use their own seeds, which allow them to reduce the costs of production.

In the other hand, although TIU do not have access to fertilisers throughout the growing season, they do not see this as a constraint because of lack of awareness of the potential benefits of using fertilisers to enhance rice production. Indeed, TIU do not see seed acquisition as a problem because they keep own seed for the next growing season.

### 7.4.1 SEED QUALITY

The quality of seed available to the farmers is another important determinant of the total yield obtained from the rice field. Contrarily to what was found throughout the literature review on chapters one and two, where seed quality appears as a major constraint for rice production systems, 84.6% of the MIU did not see seed quality as a major limiting factor, so was the view of 78.9% within the TIU (Table 7.1). As for the MIU, the seed company operating in Mozambique through a careful selection and purification process that ensures good uniformity and high yields has produced seed available to them. Therefore this may explain this sharing view of good seed quality. As for TIU seed comes from the farmer production. Farmer have for years built some experience of seed selection starting from the field to ensure a good seed quality. This also helps to explain why TIU did not perceive seed quality as a major constraint.

## 7.5 LAND TENURE

There are different views in the literature with regard to land tenure. For example Ruthan (1990) concluded that land tenure is not a serious constraint to the adoption of new HYV nor has been an important source of differential growth in productivity. Eighty seven percent of the MIU did not see land tenure as a limiting factor for rice production. Within the TIU, however, 50% considered land tenure as a limiting factor. This also could be explained by the way land was made available to the farmers. MIU farmers had access to land for rice production through a land reform program promoted by the government, where land that belonged to state companies was redistributed to the smallholder rice producers. Whereas, for TIU land is still acquired through the traditional mechanisms, which requires negotiations with traditional leaders including some form of payment either by cash or in kind.

## 7.6 LOW OUTPUT PRICES

Both MIU and TIU farmers sold their rice at 2 150 MZM/kg (2 150 000 MZM/tonne) corresponding to US$ 162/tonne. This price is close to the international prices, however, fifty nine percent of the MIU considered this as very low to cover their production expenses while 38.5% considered this price fairly good. Among TIU, 95% considered this price as very low. Farmers pay 150 000 MZM to transport a tonne of rice to the market and tend to associate this with the price they receive. About 97.4% of modern input users sell rice in their field and 90% of the TIU transport their rice to the market. In both scenarios, transport cost seems to be similar because traders and milling firms deducted transport costs when they travel to the farmer's field to buy rice. Another dimension affecting the price of rice is the moisture content of the grain at harvesting. If the moisture contact in the grain is too high. The millers are reluctant to pay good price because of the difficulty associated with rice storage; indeed, after further drying, rice will reduce its weight measured at harvesting time.

## 7.7 FARM SIZE

The farmers also identified farm size as a constraint limiting rice production in Mangol. The average farm size for both MIU and TIU is 0.90 ha (Table 5.5). Seventy five percent of MIU have an area of 0.5 ha while farmers can see the power of modern technology by boosting the yields, they consider this farm size too small to generate enough yields for home consumption and allow some marketable surplus to cover the costs of production including interest on credit.

Considering that most of 6 000 ha of land available for rice production in Mangol is not being currently being used, and the fact that farmers in Mangol have access to credit, they are producing high yielding varieties, more labour demanding for field operations, it seems legitimate that a study should be recommended to determine the optimum size of the rice field to produce using high yielding varieties in order to generate enough marketable surplus to meet their cost obligations.

## 7.8 THE ROLE OF EXTENSION

Extension consists of all activities that help rural families improve agricultural production, find solutions to daily problems of home making, and deal with various other aspects of rural living by the application of science and technology to daily needs (Okigbo, 1989). The overall role of extension is assisting farm people through educational procedures to improve farming methods and increase production efficiency to lift the standard of rural living (Van den Ben and Hawkins, 1988). Extension is aimed at assisting farm people to improve their state of knowledge, skills, attitudes and values, so as to raise the quality of their living and thus help them to become more self-reliant. It combines the best knowledge and skills, both traditional and modern. It uses adult education techniques, and acts as a multi-way communication between government planners, researchers and the farming people (Mucavele, 1993). All interviewed farmers both MIU and TIU, perceived extension service as playing an important role for the improvement of their production systems. It seems clear to the farmers that much of the high yields was obtained partly due to a good resource management through a learning process made possible by the extension services. However, in order to be effective, extension needs that other support services such as credit, research, and inputs reach the rural communities effectively. Figure 7.1 depicts those linkages that are required to support the family farm in order to increase the efficiency of smallholder farming systems.

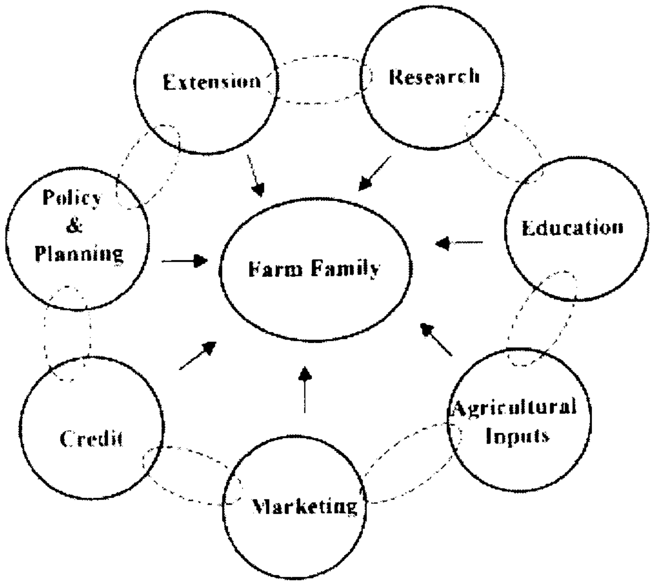



**Figure 7.1: Linkages supporting the farm family (From Watts, L.H.,1984)**

Another determinant of an effective extension service is the willingness of farmers to change, which arises upon careful identification of the benefits associated with change. Change agents are required to be able to create the need for change among the farmers, but always taking into account that farmers are rational, and therefore before they engage in a change process they will always make a careful analysis of the resulting implications. Extension agents need also to work as facilitators, assisting the farmers not only during the production process through demonstration of appropriate practices, but also by helping farmers to identify more reliable input suppliers and post harvest measures such as better storage facilities, and better markets for their products.

## 7.9 SUMMARY

This chapter discussed the social and economic constraints that affect rice production in Mangol. The chapter revised how farmers perceived the constraints, and also used the secondary data and available experience to explain the farmer's perceptions. The most important constraints as pointed by the farmers, included land preparation, credit availability, input acquisition, seed quality, land tenure, low output prices, and farm size. These constraints have been classified differently by the farmers according to whether they belong to the MIU or TIU, however, constraints such as land preparation, and low output prices seems to affect in similar ways both groups of farmers. The chapter have also discussed the role of agricultural support services such as extension, credit and input suppliers in the process of technology dissemination and adoption among the rural communities.

# CHAPTER EIGHT
# CONCLUSIONS AND RECOMMENDATIONS

## 8.1 CONCLUSIONS

Smallholder farmers are rational decision makers and respond to economic incentives (Stevens and Jabara, 1988). However, farmers to be efficient in resource allocation, they must have access to information, access to markets, access to inputs and all support services (Delgado, 1998). This study was primarily designed to analyse how efficiently small scale farmers can produce rice in Mangol, looking at two different production systems: one using traditional inputs with some support services from extension and the other with a complete set of support services including modern varieties, credit and extension services. After a careful analysis, both financial and economic, the main conclusions were reached as follows:

### 8.1.1 Profitability of smallholder rice production

Gross margins for the smallholder rice producers in Mangol have been compiled. Results from the tables indicate that farmers using modern inputs, have much higher yield (tons/ha) than those using traditional technology. The results also indicate that farmers using modern technology incurred much higher production costs because of the costs of buying inputs. Furthermore, because high yielding modern varieties are more demanding with regard to the management of agronomic practices, such as good soil quality, land preparation, planting time and density, and weeding, compared to traditional varieties, additional expenses are incurred by the users of modern technology to ensure good crop management. Therefore although high yielding varieties are highly fertiliser responsive, they are more expensive to produce.

This study also concluded that the difference between the gross margins among the farmers operating at minimum yield for both modern and traditional input users is very small giving advantage for the TIU. **However, comparing the farmers operating at the average and the maximum output, the modern input users have a much higher gross margin comparing to the traditional input users.** This suggests that farmers when operating with high yielding varieties, they must follow a set of agronomic recommendations in order to ensure higher yields.

When farmers use modern inputs, more rice is produced, and the society as a whole benefit in the following aspects:

- Increase in the total rice produced to meet the market requirements;
- The more likely outcome of increase in production is to make the rice prices more competitive as there will be no shortage, and this will benefits the society as a whole;
- The use of high yielding varieties and modern technology provides employment to the input suppliers such as seed producers, fertilisers and pesticide suppliers, etc;
- As more rice is produced, the milling factors (processing) will have raw material and this will make another contribution to the employment in the country;
- As modern technologies are adopted, and more rice is produced, there will be an inducement of institutional innovation;
- Producing high yielding varieties and therefore more rice, will also improve the linkages between producers, input suppliers, marketing institutions, rural financial institutions;
- Export to the regional markets to earn foreign exchange, can only be assured if more quantity of rice is being produced; and
- Research and Extension staff will have more work to do as modern rice varieties are continuously adopted

Contrary to Grabowsky (1979) belief, the danger of growing inequalities in rural communities is not because of the modern varieties, but because of insufficient progress in the technology under the strong population pressures on land.

Rural economies in developing countries have been experiencing a rapid deterioration in the man/land ratio, with the average number of workers per hectare of arable land doubling within a fifty-year period. If technological progress of the land saving type is not sufficient rapid, the increase in labour demand will fail to keep up with the increase in labour supply arising from population growth.

Moreover, concern is periodically voiced for the distributional implications of technological change in developing agriculture. One is often led to feel that introduction of new technology has been only a qualified success because of its apparent failure to solve a broad spectrum of social ills. But frequently, because of not capturing all the factors, to undertake a complete economic analysis, it is only the well being of the rural poor that is the focus of attention. The presence of large concentrations of urban poor who are potential beneficiaries of expanded production of basic foodstuffs is sometimes neglected when castigating the green revolution.

### 8.1.2 The effect of input availability on the adoption of new technologies

Input availability and easy access to the farmers has long been recognised as an engine for technology adoption. When technologies are disseminated in rural areas, it is of crucial importance that farmers have access to these inputs that come along with the technology. Inputs must be available to farmer without requiring neither too much extra work nor costs. To do this, rural infrastructures such as roads and communication systems play a significant role, because when they are developed, allow rural merchants and input suppliers to deliver the inputs close to the farmers and lower the transaction costs. Mangol is within easy access, roads are good, and therefore inputs can easily made available to the farmers at competitive prices. There are also shops close to rice production areas selling production inputs to the local farmers. This made a significant contribution to the massive adoption of the new rice production technologies by farmers.

### 8.1.3 The contribution of extension and credit on rice production

Extension and Credit play a key role in technology dissemination and to overall development in the rural areas. Extension component is aimed to assist farm people to improve their state of knowledge, skills, attitudes and values, so as to raise the quality of their living. Most farmers in rural areas of Mozambique are poor, so are the farmers in Mangol, therefore they cannot afford to pay fully in advance for the new technologies that are disseminated by the extension service. Credit component is crucial, it allow people to borrow funds to pay for inputs. The availability of credit program in Mangol, made a significant contribution to the adoption of HYV of rice, showing that farmers are responsive to economic incentives.

### 8.1.4 The role of gender and farmers' age on rice production

In Mozambique, rural farmers are generally old and women are the majority of workforce in the family sector. This study came also to similar conclusion. Farmers in Mangol are relatively old, with an average age of 50 year. The percentage of women however was lower in Mangol both for TIU and for MIU. Two arguments may help to explain this relative low percentage of women on the total farm workforce; the first one is that studies in LDCs show that generally women dominate dominate in the staple crop production while male farmers tend to dominate in the cash crops. Rice in Mozambique can be grown as staple or as cash crop. In the particular case of Mangol, there is a high pressure of growing rice for cash purposes because of the high demand from towns nearby including Maputo city. The second reason to explain this high percentage of male farmers, may be simply an indication that men holds most of the family power, including authority to make interviews to outsiders, and not necessarily a true indication of the males being the majority of workforce in the family farm.

### 8.1.5 Social and economic constraints

According to farmers perception, the most significant constraints that are hampering rice production among the MIU in Mangol are land preparation, input acquisition, output prices and farm size, while the TIU have identified land preparation, land tenure, credit availability as the major limiting factors. Land preparation seems to be a common problem. Other common constraints affecting rice production in the region are the weak links between research and extension.

## 8.2 RECOMMENDATIONS

### 8.2.1 For both extension and farmers to ensure superior yields when producing HYV

Modern varieties have demonstrated high yield potential compared to traditional varieties, but to attain good yields and make profits with HYV it is vital to ensure good crop management. Poor and late land preparation, late planting, reluctance to apply the recommended levels of fertilisers, poor timing of fertiliser application, poor weed and insect control, late harvesting have negative implications for the production of HYV as they contribute to lower the yields. Farmers and Extension agents are required to work close together to ensure yields above 3.4 tons/ha, and this can be easily attainable as demonstrated by farmers in Mangol.

### 8.2.2 More studies are required to recommend the optimal area of rice fields

The average farm size is 0.90 ha for both MIU and TIU and most farmers have only 0.5 ha. This study did not aim to study the optimal farm size, however, the view that the farm size is too small to generate marketable surplus and allow farmers to repay their loan seems to be common for the farmers in Mangol. Therefore, additional studies should be conducted in order to recommend the optimal farm size for these farmers under the credit program to allow them to produce acceptable outputs for home consumption and get some marketable surplus to meet their loan obligations.

### 8.2.3 Adoption of modern varieties have a potential contribution to the economy as a whole

Modern rice varieties have demonstrated their superiority in both yields and gross margins obtained in Mangol. Farmers must be recommended to adopt these varieties as their use brings benefits not only for the producing farmers because of higher incomes, but also for the economy as a whole. They increase the provision of food, make contribution to the employment market, and allow earning foreign currency and promoting linkages between institutions. The adoption of HYV also contributes to the process of institutional innovation because more challenges to institutional reforms are created.

### 8.2.4 Enterprise diversification must be further emphasised

Enterprise diversification is a common practice among the smallholder production systems and to a large extent is related to food security reasons. Farmers in Mangol implement enterprise diversification with crops. This is important, however, careful measures should be taken into account as both prices and yields of most crops grown in a given area tend to be positively correlated. Combining crops and livestock is likely the most promising approach. This should be emphasised by the extension agents to the farmers.

### 8.2.5 Adoption of reduced or minimum tillage to reduce problems associated with land preparation

Both MIU and TIUs perceived land preparation as a constraint of their rice production systems. For the MIUs, it is due to high costs of renting tractors for land preparation while for the TIUs is because of hard work and labour requirements for land preparation. The application of herbicide followed by use of a disk harrow can substitute for ploughing and harrowing or manual land preparation and has the following advantages:

- Cost reduction;
- Farmers can perform all operations and is not dependent on tractor services;
- Less time required for land preparation,ss allowing for timely planting;
- Clean field of terrible levels of perennial weed infestation;
- Facilitate and reduced cost of post planting weed control.

### 8.2.6 For the extension agents to use more practical methods, with application of adult education techniques

The farmers' level of education is poor and also extension people are dealing with much older farmers. Therefore, extension agents need to use adult education concepts such as involving the farmers in planning and stimulating learning by participation and action. Moreover, extension agents need to use more practical work such as demonstrations and pictures rather than writing and talking alone, also, extension agents need to be able to speak the local languages to communicate with farmers because the majority of farmers cannot speak Portuguese the official language. Careful attention however need to be placed with respect to translating messages to ensure that the key information is not lost while changing it from Portuguese or other languages to Shangana.

### 8.2.7 Important to ensure complementarities among agricultural support services

The role of both extension and credit is crucial to rice production systems and the farmers in Mangol also perceive this. However in order to have an efficient service, other support services must be in place. An increase in agricultural productivity is a complex business, including a range of factors, many of them interdependent such as extension, research, education, agricultural inputs, credit, marketing and policy and planning.

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# APPENDICES

UNIVERSITEIT VAN PRETORIA
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# APPENDIX I
# QUESTIONNAIRE FOR THE FARMERS AT MANGOL

## A: Background Information

| | |
|---|---|
| 1. Name of farmer | |
| 2. Age | |
| 3. Sex | |
| 4. Family size | |
| 5. Number of family members working in the farm | |

6. How many languages do you speak

| | | | |
|---|---|---|---|
| Shangana | Ronga | Portuguese | Other (specify) |

**7.** How many years have you been growing rice

| | | | | | |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | >5 |

8. Size of the rice field

| | | | | | |
|---|---|---|---|---|---|
| <0.25 ha | 0.25ha | 0.5ha | 1.0 ha | 1.5ha | >1.5ha |

9. How many days per week do you spend on farm work

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

10.How many hours per day do you work on the farm

| | | | |
|---|---|---|---|
| Morning only | Afternoon only | All day | Depend on the work load |

11.What other crops do you grow

| | | | | |
|---|---|---|---|---|
| Maize | Beans | Cassava | Vegetables | Other (specify) |

## B: Production and Marketing costs

12.How do you do the land preparation

| | | | |
|---|---|---|---|
| Manualy | Animal traction | Mechanically | Other(specify) |

12.1 When using animal traction how much money do you pay per ha.......................MZM

12.2 When using the tractor, how much money do you pay per ha..........................MZM

13.Do you hire people for land preparation? YES.....NO......*(If no go to question 17)*

14.If YES how many people do you hire?

| | | | | | |
|---|---|---|---|---|---|
| 1 person | 2 persons | 3 persons | 4 persons | 5 persons | 6 persons |

15.How much do you pay each hired person per day

| | | | | | |
|---|---|---|---|---|---|
| 10 000 mts | 20 000 mts | 40 000 mts | 60 000 mts | 80 000 mts | Other(specify) |

16.For how many days do you hire people for land preparation?

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 day | 2 days | 3 days | 4 days | 5 days | 6 days | 7 days | >7 days |

17.Do you hire people for weeding? YES.........NO...........*(If no go to question 21)*

18.If YES how many people do you hire?....................................................

19.How much do you pay each hired person..................................MZM/day

20.For how many days do you hire people for weeding?

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 day | 2 days | 3 days | 4 days | 5 days | 6 days | 7 days | >7 days |

21.Do you hire people for harvesting? YES..........NO.........*(If no go to question 25)*

22.If YES how many people do you hire..............................................

23.How much do you pay each hired person..................................MZM/day

24.For how many days do you hire people for harvesting?

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 day | 2 days | 3 days | 4 days | 5 days | 6 days | 7 days | >7 days |

25.Do you hire people for trashing rice? YES.........NO........*(If no go to question 29)*

26.If YES how many people do you hire..............................................

27.How much do you pay each hired person..................................MZM/day

28.For how many days do you hire people for trashing?

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 day | 2 days | 3 days | 4 days | 5 days | 6 days | 7 days | >7 days |

29.Do you buy seeds? YES............NO..................*(If no go to question 31)*

30.If YES how much do you pay for each **kg** of seeds................MZM

31.Do you buy fertilisers? YES..........NO................*(If no go to question 33)*

32.If yes how much money do you pay for each **kg** of fertilisers............MZM

33.How much do you pay for the entire package.................MZM
*(Seeds and fertilisers together)*

34.How do you rate the cost of inputs

| | | | |
|---|---|---|---|
| Very good | Good | Just fine | Low |

35.Do you hire transport to deliver inputs to your field? YES.........NO......***(If no go to question 39)***

36.If YES how is the rate you pay determined?

| | | |
|---|---|---|
| Number of bags | Distance | Other (specify |

37.If the rate is based the number of bags how much do you pay **per bug**..................MZM

38.If the rate is based on the distance how much do you pay **per Km**........................MZM

39.Do you hire transport to deliver your rice to the market? YES.......NO..... ***If no go to question 43)***

40.If YES how is the rate you pay determined?

| | | |
|---|---|---|
| Number of bags | Distance | Other (specify |

41.If the rate is based the number of bags how much do you pay **per bug**..................MZM

42.If the rate is based on the distance how much do you pay **per Km**......................MZM

## C: Yields/Income

43.How many bags of rice did you get in the rice field?......................

44.How many bags of rice did you sell?...............................................

45.How many bags or rice did you use for loan repayment?...................

46.How many bags of rice did you leave for home consumption?...........

47.For how much do you sell rice?....................MZM/kg

48.Where do you sell your rice

| | | | |
|---|---|---|---|
| At the farm | In the local market | Outside the village | Other (specify) |

49.How do you rate the price of rice

| | | | |
|---|---|---|---|
| Very good | Good | Just fine | low |

## D: The role of Extension services

50.How often do you see the Extension officer

| | | | |
|---|---|---|---|
| Very often | Often | Occasionally | Never |

51.How do you rate the role of Extension

| | | | |
|---|---|---|---|
| Very important | Important | fairly important | not important |

52.What kind of Extension messages did you learn from extension

| | **YES I learn with Extens.** | **NO I never learn with Ext.** |
|---|---|---|
| Land preparation | | |
| Sowing | | |
| Weeding | | |
| Fertiliser application | | |
| Pesticide application | | |
| Other (specify) | | |

## E: The role of Credit

53.How many years are you benefiting from credit?……………..

54.How did you know about this credit program?

| | | | |
|---|---|---|---|
| Extension officers | Neighbours | Local traders | Other(specify) |

55.How much money did you borrow this cropping season………………..MZM

56.Do you know how much interest do you pay? YES………NO…………

57.If yes how much?………………..

58.How do you rate this interest

| | | | |
|---|---|---|---|
| Very high | High | Just fine | Low |

## F: Constraints

59.Is obtaining land a problem for rice production? YES...............NO...............*(If no go to question 61).*

60.If YES how do you rate this problem

| | | | | |
|---|---|---|---|---|
| Major problem | Significant prob | Problem | Minor problem | not a problem |

61.Is land preparation a problem for rice production? YES..................NO.............. *(If no go to question 63).*

62.If YES how do you rate this problem

| | | | | |
|---|---|---|---|---|
| Major problem | Significant prob | Problem | Minor problem | not a problem |

63.Is seed acquisition a problem for rice production? YES................NO............... *(If no go to question 65).*

64.If YES how do you rate this problem

| | | | | |
|---|---|---|---|---|
| Major problem | Significant prob | Problem | Minor problem | not a problem |

65.Is seed quality a problem for rice production? YES......................NO............... *(If no go to question 67).*

66.If YES how do you rate this problem

| | | | | |
|---|---|---|---|---|
| Major problem | Significant prob | Problem | Minor problem | not a problem |

67.Is fertiliser availability a problem for rice production? YES.............NO............*(If no go to question 69).*

68.If YES how do you rate this problem

| | | | | |
|---|---|---|---|---|
| Major problem | Significant prob | Problem | Minor problem | not a problem |

69.Is access to credit a problem for rice production? YES......................NO............ *(If no is the end of questionnaire).*

70.If YES how do you rate this problem

| | | | | |
|---|---|---|---|---|
| Major problem | Significant prob | Problem | Minor problem | not a problem |

**Thank you**

# APPENDIX II
# YIELD OBTAINED BY MIU AND TIU UNDER DIFFERENT FARM SIZES

## YIELD OBTAINED BY MIU UNDER DIFFERENT FARM SIZES

| | Average yield (4.4 tons/ha) | Maximum yield (7.3 tons/ha) | Minimum yield (3.1 tons/ha) |
|---|---|---|---|
| Average farm size (0.91 ha) | 4.0 | 6.64 | 2.81 |
| Maximum farm size (4 ha) | 17.6 | 29.2 | 12.4 |
| Minimum farm size (0.5 ha) | 2.2 | 3.65 | 1.55 |

## YIELD OBTAINED BY TIU UNDER DIFFERENT FARM SIZES

| | Average yield (2.5 tons/ha) | Maximum yield (2.9 tons/ha) | Minimum yield (1.7 tons/ha) |
|---|---|---|---|
| Average farm size (0.9 ha) | 2.25 | 2.61 | 1.53 |
| Maximum farm size (2 ha) | 5.0 | 5.8 | 3.4 |
| Minimum farm size (0.5 ha) | 1.25 | 1.45 | 0.85 |

# APPENDIX III
# TOTAL COST INCURRED BY MIUAND TIU UNDER DIFFERENT FARM SIZES

## TOTAL COST INCURRED BY MIU UNDER DIFFERENT FARM SIZES

| | Average yield (4.4 tons/ha) | Maximum yield (7.3 tons/ha) | Minimum yield (3.1 tons/ha) |
|---|---|---|---|
| Average farm size (0.91 ha) | 4 752 020 | 5 164 250 | 4 574 570 |
| Maximum farm size (4 ha) | 20 888 000 | 22 700 000 | 20 108 000 |
| Minimum farm size (0.5 ha) | 2 611 000 | 2 837 500 | 2 513 500 |

## TOTAL COST INCURRED BY TIU UNDER DIFFERENT FARM SIZES

| | Average yield (2.5 tons/ha) | Maximum yield (2.9 tons/ha) | Minimum yield (1.7 tons/ha) |
|---|---|---|---|
| Average farm size (0.9 ha) | 1 702 687.5 | 1 756 687.5 | 1 567 687.5 |
| Maximum farm size (2 ha) | 3 783 750 | 3 903 750 | 3 483 750 |
| Minimum farm size (0.5 ha) | 945 937.5 | 975 937.5 | 870 937.5 |

# APPENDIX IV
# TOTAL REVENUE OBTAINED BY MIU AND TIU UNDER DIFFERENT FARM SIZES

## TOTAL REVENUE OBTAINED BY MIU UNDER DIFFERENT FARM SIZES

| | Average yield (4.4 tons/ha) | Maximum yield (7.3 tons/ha) | Minimum yield (3.1 tons/ha) |
|---|---|---|---|
| Average farm size (0.91 ha) | 8 554 000 | 14 282 450 | 6 065 000 |
| Maximum farm size (4 ha) | 37 600 000 | 62 780 000 | 5 998 500 |
| Minimum farm size (0.5 ha) | 4 700 000 | 7 847 500 | 3 332 500 |

## TOTAL REVENUE OBTAINED BY TIU UNDER DIFFERENT FARM SIZES

| | Average yield (2.5 tons/ha) | Maximum yield (2.9 tons/ha) | Minimum yield (1.7 tons/ha) |
|---|---|---|---|
| Average farm size (0.9 ha) | 4 837 500 | 5 611 500 | 3 289 500 |
| Maximum farm size (2 ha) | 10 750 000 | 12 470 000 | 7 310 000 |
| Minimum farm size (0.5 ha) | 2 687 500 | 3 117 500 | 1 827 500 |

# APPENDIX V
# GROSS MARGINS OBTAINED BY MIU AND TIU UNDER DIFFERENT FARM SIZES

## GROSS MARGINS OBTAINED BY TIU UNDER DIFFERENT FARM SIZES

| | Average yield (4.4 tons/ha) | Maximum yield (7.3 tons/ha) | Minimum yield (3.1 tons/ha) |
|---|---|---|---|
| Average farm size (0.91 ha) | 3 856 580 | 9 134 580 | 1 490 580 |
| Maximum farm size (4 ha) | 16 952 000 | 40 152 000 | 6 552 000 |
| Minimum farm size (0.5 ha) | 2 119 000 | 5 019 000 | 819 000 |

## GROSS MARGINS OBTAINED BY TIU UNDER DIFFERENT FARM SIZES

| | Average yield (2.5 tons/ha) | Maximum yield (2.9 tons/ha) | Minimum yield (1.7 tons/ha) |
|---|---|---|---|
| Average farm size (0.9 ha) | 3 134 812.5 | 3 854 812.5 | 1 721 812.5 |
| Maximum farm size (2 ha) | 6 966 250 | 8 566 250 | 3 826 250 |
| Minimum farm size (0.5 ha) | 1 741 562.5 | 2 141 562.5 | 956 562.5 |

# APPENDIX VI
# LIST OF INTERVIEWED FARMERS IN MANGOL

A: MODERN INPUT USERS

| | |
|---|---|
| Helena Maolele | Valente Langa |
| Isabel Matusse | Efremo Fidelis |
| Maria Mathe | Fabio Vombe |
| Elina Cossa | Armando Zucula |
| Mario Mula | Oscar Machava |
| Atalia Pelembe | Afonso Pelembe |
| Albertina Mathe | Andre Cossa |
| Adriano Cossa | Atalia Dzimba |
| Antonio Tcavane | Francisco Mucavel |
| Julieta Nhabanga | Castigo Macie |
| Julio Mimbire | Antonio Kane |
| Octavio Muhate | Cacilda Mucavele |
| Armando Mubetho | Sara Sigauque |
| Flugencio Chemo | Francisco Mabunda |
| Florencia Chemo | Francisco Ndeve |
| Jose Mazaiane | Clara Chirinza |
| Isabel Nhabanga | Elisa Mathe |
| Carlos Pelembe | Rosalina Balate |
| Paulo Maholele | Alice Sitoi |
| Agostinho Chavane | Teresa Sigauque |

B: TRADITIONAL INPUT USERS

| |
|---|
| Carlos Pelembe |
| Alberto Langane |
| Joana Machava |
| Lucas Cuna |
| Alfredo Zime |
| Afonso Pelembe |
| Fernando Maolele |
| Jose Cossa |
| Helena Matavele |
| Benedito Parruque |
| Manuel Chongo |
| Agostinho Ubisse |
| Mundau Mahacane |
| Simone Miliano |
| Jose Matusse |
| Antonio Mathe |
| Pedro Tembe |
| Samuel Parruque |
| Miguel Mahacane |
| Elias Novela |