

## Rice Production Economics at the Local and National Levels: The Case of Usangu Plains in Tanzania

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## TABLE OF CONTENTS

<b>TABLE OF CONTENTS .....</b>	<b>i</b>
<b>LIST OF TABLES .....</b>	<b>i</b>
<b>LIST OF FIGURES .....</b>	<b>ii</b>
<b>LIST OF APPENDICES .....</b>	<b>ii</b>
<b>GLOSSARY OF ACRONYMS, SYMBOLS AND DEFINITIONS.....</b>	<b>iii</b>
<b>EXECUTIVE SUMMARY .....</b>	<b>vii</b>
<b>1.0 INTRODUCTION.....</b>	<b>1</b>
<b>2.0 AGRICULTURAL LAND RESOURCE AND PADDY PRODUCTION .....</b>	<b>2</b>
2.1 Land resource and paddy production at the national level .....	2
2.2 Land resource and paddy production at the local level.....	3
2.2.1 Usangu plains.....	3
2.2.2 Mbarali district.....	4
2.2.3 Regional level .....	6
2.2.4 Comparison of paddy yields .....	7
<b>3.0 PRODUCTION COSTS, MARKETING AND PROFIT MARGINS .....</b>	<b>9</b>
3.1 Production costs .....	9
3.2 Rice commodity chain .....	9
3.3 Prices, profit margins and productivity of irrigation water.....	10
3.3.1 Prices at the local level .....	10
3.3.2 Paddy prices at the national level.....	13
3.3.3 Returns to labour, profit margins and productivity of irrigation water.....	16
3.4 Rice imports, exports, consumption and food security .....	19
3.4.1 Rice imports and exports .....	19
3.4.2 Rice consumption.....	20
3.4.3 The national food balance sheet and food security .....	23
<b>4.0 IRRIGATED PADDY IN USANGU AND ITS IMPLICATIONS.....</b>	<b>24</b>
4.1 Local and national rice supplies.....	24
4.2 Opportunity cost.....	24
4.3 Irrigation water use and productivity .....	25
4.4 Balance of payments .....	26
<b>5.0 POLICY INSTRUMENTS IN TANZANIA AND THEIR IMPACTS ON PADDY PRODUCTION .....</b>	<b>27</b>
<b>5.0 SUMMARY AND CONCLUSIONS .....</b>	<b>28</b>
<b>References.....</b>	<b>30</b>

## LIST OF TABLES

Table 1: Production of paddy in major paddy surplus regions ('000 Tonnes).....	2
Table 2: Mbarali district: Paddy production trend and contribution to the regional production, 1992/93 - 2001/2002.....	4
Table 3: Regression results for paddy production ('000 tonnes) in Mbarali district, 1992/93 – 2001/02.....	6
Table 4: Mbarali district: Nominal paddy producer prices, 1993 – Mid December 2002.....	11
Table 5: Mbarali district: Average producer prices for paddy (Tsh per bag).....	12
Table 6: Mbarali district: Average producer prices for paddy (Tsh per kg).....	12
Table 7: Mbeya region: Wholesale prices for rice (Tsh per bag).....	12

Table 8: Average producer prices for paddy at the national level (Tsh/Kg), 1991/92 – 1997/98.....	13
Table 9: Average producer prices for rice at the national level (Tsh/Kg), 1991/92 – 1997/98.....	14
Table 10: Average prices for rice at the national level (Tsh/bag), December 1994 = 100.....	14
Table 11: Rice average wholesale prices in major regional markets (Tsh/bag).....	15
Table 12: Average wholesale prices for rice in major regional markets (Tsh per bag).....	15
Table 13: Comparison of profit margins, returns to labour and values of irrigation water in paddy production and rice trading, 2001/02.....	17
Table 14: Rice imports and exports before and after trade liberalization ('000 Tonnes).....	19
Table 15: Food trade (Imports and Exports), July – September 2002 (tonnes).....	20
Table 16: Paddy production, rice exports, imports and domestic consumption, 1972/73 - 2000/01 ('000 Tonnes).....	21
Table 17: Exponential regression results for rice consumption ('000 tonnes) versus time (years), 1972/73 – 2000/01.....	21
Table 18: Regression results for rice consumption ('000 tonnes) versus time (years), 1972/73 – 2000/01.....	22
Table 19: Consumption of rice in Tanzania 1972/73 – 2000/01 ('000 tonnes).....	22
Table 20: Usangu basin: Calculation of amount and value of water used in irrigated paddy.....	22

## LIST OF FIGURES

Figure 1: Trend of paddy production at the national level (1984/85 – 2000/01).....	3
Figure 2: Mbarali district: Paddy production trend, 1992/93 – 2001/02.....	5
Figure 3: Mbeya region: Time series paddy production, 1984/85 – 2000/01.....	7
Figure 4: Comparison of paddy yields, 1993/94 – 1999/00.....	8
Figure 5: Mbarali district: Average nominal prices for rice, 1993 – Mid Dec. 2002.....	11
Figure 6: Mbarali district: Values of paddy production.....	13
Figure 7: Average wholesale prices for rice in major regional markets, 1995/96 – 2000/01.....	14
Figure 8: Average prices for rice at the national level, 1994/95 – 1998/99.....	16

## LIST OF APPENDICES

Appendix 1: Mbarali District: Production trend for other crops, 1992/93 - 1999/2000.....	31
Appendix 2: Paddy production and marketing: Costs and margin/revenue structure, 2001/2002.....	32
Appendix 3: National food balance sheet, June 2002 – May 2003 ('000 tonnes) as of September, 2002.....	35
Appendix 4: Tanzania Food Supply Analysis and the Self Sufficiency Ratio for 2002/03 (Based on 2001/02 Final Food Crop Production Forecasts).....	36
Appendix 5: Trend Analyses for rice production, consumption and prices.....	37
Appendix 6: Correlation analysis.....	42

## GLOSSARY OF ACRONYMS, SYMBOLS AND DEFINITIONS

**Balance of payment:** The value of exports (goods and services) minus values of imports (goods and services). If this figure is positive then the country has favourable balance of trade, if negative (imports greater than exports) the country is said to have an unfavourable balance of payments.

**BoT:** Bank of Tanzania.

**CMEW:** Crop Monitoring and Early Warning Section.

**CMEWS:** Crop Monitoring and Early Warning System.

**Commercial imports received:** Quantities received by private traders for commercial distribution during the referred marketing year.

**Commercial imports expected:** Quantities ordered but not yet received by private traders for commercial distribution.

**Commodity cross-substitution:** Quantity of any surplus commodity item considered to offset similar quantity of the commodity deficit.

**Cumec:** Cubic meters per second.

**Current stocks:** Stocks held by private traders and Government reserves during the month under report.

**Deflator:** Ratio of the National Consumer Price Indices (NCPIs) in a given year to that of the base year.

**DF:** Degree of freedom.

**Domestic shortfall:** Total domestic availability less total annual requirements.

**EXP:** Exponential.

**Exports:** Products and services sold to foreign countries.

**FCBT (Formal Cross Border Trade):** Recorded exchange of goods undertaken by traders, both small and large.

**Food aid expected:** Quantities of food aid pledged for delivery in the current marketing year, but not yet received.

**Food aid received:** Quantities of food received to be distributed as food aid to vulnerable population.

**Food security:** An access by all people at all times to food sufficient for a healthy and active life. At the household level it implies access to adequate food by all members of the household.

**Forecasted Closing Stocks:** Projected end of marketing year national stocks available as on farm retentions or held by traders.

**Formal Opening Stocks:** Carry over stocks held by marketing agencies, private traders at the beginning of the marketing year (June 1<sup>st</sup>).

**Gross Consumption Requirements:** Aggregate domestic consumption requirements (food and non-food) over the full marketing year.

**GDP (Gross Domestic Product):** The total market value of all finished goods and services produced within the domestic economy whether by foreign or domestic resources in a given period of time.

**GNP (Gross National Product):** The total market value of all final goods and services produced in an economy, which is equal to gross domestic product adjusted to include the net income earned overseas.

**Gross Harvest Production:** Estimated or forecasted food crop production in the current crop season.

**Gross margin:** The difference between gross income earned and variable costs incurred.

**Ha or ha:** Hectare

**Imports:** Goods and services purchased from foreign countries.

**ICBT (Informal Cross-Border Trade):** Unrecorded exchange of goods undertaken by traders, both small and large. It does not necessarily mean illegal trade even though aspects of smuggling cannot be ruled out entirely.

**kg:** Kilogram.

**LN:** Natural logarithm.

**MAFS:** Ministry of Agriculture and Food Security.

**Microeconomics:** The area of economics that deals with output, employment, incomes, or other activities in the aggregate.

**m:** metre (s).

**m<sup>3</sup>:** cubic metres

**mm:** millimetres

**Mm<sup>3</sup>**: Million cubic metres.

**MS**: Mean Sum of Square.

**MT**: Metric tonnes

**NA**: Not available.

**NAFCO**: National Agriculture and Food Corporation.

**National Food Balance Sheet**: An aggregate national account for food production, food stocks, food imports/exports, and food available for human consumption after deduction of losses. It indicates the per capita availability of food at national level.

**National Income Accounts**: Dollar-term measures of the nation's economic performance.

**NCPI (National Consumer Price Index)**: The average price of a country's market basket of goods and services in index form to permit comparisons of the prices of goods and services over a period of time.

**Nominal prices**: Prices or values of goods and services at their current market prices.

**NMC**: National Milling Corporation.

**Opportunity cost**: The value of other opportunities given up in order to produce or consume any good.

**%C**: Percentage change.

**Productivity**: A rate of output, such as, the ratio of output to input service.

**Profit**: A surplus over all opportunity costs.

**Real prices**: Prices or economic values expressed in terms of a base year index that eliminates the effects of inflation or price changes.

**Returns to labour**: Revenue earned per time (e.g., hour or day) of labour used.

**s**: Second

**SAP**: Structural Adjustment Program.

**SGR (Strategic Grain Reserve)**: Closing Stock Requirement or recommended Government emergency reserve of grains.

**SMUWC**: Sustainable Management of the Usangu Wetland and its Catchment.

**SS**: Sum of square.

**SSR (Self Sufficiency Ratio):** A ratio of total food produced to total food requirements measured in percentage terms. A measure of the ability of food produced to meet demand for food and other food related requirement in a particular area.

**StDev:** Standard Deviation.

**TFNC:** Tanzania Food and Nutrition Centre.

**Total domestic food availability:** Formal Opening food stocks plus harvested production.

**Total Food Requirement:** Gross consumption requirements plus closing stock requirement plus non-food use (seed, post harvest losses, cross-border requirement).

**TRA:** Tanzania Revenue Authority.

**Tsh:** Tanzanian Shilling.

**US \$:** United States' Dollar.

**Vijaruba:** Small banded rice fields common among the indigenous farmers, with sizes ranging from 20m<sup>2</sup> to 400m<sup>2</sup>.

## EXECUTIVE SUMMARY

This report explores the production economics of paddy at the basin (Usangu), district (Mbarali), regional (Mbeya) and national (Tanzania) levels. The important features of the report are summarized below:

### Basin level (Usangu)

- The maximum irrigated land under paddy amounts to about 42000 ha.
- The core-irrigated area found in a dry year is 24500 ha.
- Land for rain-fed agriculture varies between 50,000 ha and 65,000 ha depending on the amount and distribution of rainfall in the area.
- The Mbarali and Kapunga rice farms cover a total area of 3200 ha.
- Annual paddy production is estimated to average at 105,000 tonnes (equivalent to about 70% of the average annual paddy production for Mbeya region).
- The use of fertilizers, pesticides, herbicides or manure is rare. Of the interviewed farmers, only 3.3% reported as applying fertilizers.
- Land renting is common and its cost varies with location of the irrigation system and relative location along the furrow (top-end or tail-end).
- The costs of renting land have ranged from Tsh 10,000 to 20,000 per acre.
- The nominal producer prices for paddy have ranged from the minimum of Tsh 4,800 to the maximum of Tsh 27,000 per bag for the period from 1992/93 to 2001/02.<sup>1</sup>
- Productivity of irrigation water is estimated at 0.18 per m<sup>3</sup> or Tsh 28.13 per m<sup>3</sup> (equivalent to US \$ 0.027 per m<sup>3</sup> of irrigation water).

### District level (Mbarali)

- Paddy production for the period from 1992/93 to 2001/02 has been increasing over time while real prices have declined with time (correlation coefficient for paddy production and real prices = -0.584, P < 0.10).
- On average, paddy production in the district has amounted to 59,990 tonnes for the period from 1992/93 to 2001/02. The highest production was recorded in 2001/02 (85,200 tonnes) and the lowest in 1998/99 (30,510 tonnes).
- The share of Mbarali district to the regional (Mbeya) paddy production is estimated at 60%. The remainder is considered to be coming from Kyela (about 20%), Ileje and Mbozi (mainly from the Naming'ong'o Irrigation Scheme) (about 15%) and other areas in the region (5%).
- Producer and wholesale prices for paddy and rice have increased only in nominal terms, but decreased in real terms resulting into falling trends for real values of paddy production.
- Average real producer prices for paddy have declined by 22% from Tsh 10,000 in 1994 to Tsh 7,789.29 in 1995. The prices have also decreased by 32% from Tsh 7,742.49 in 2000 to Tsh 5,279.40 in 2001.

<sup>1</sup> Prices from 1992/93 to 1996/97 were controlled prices (Cooperative prices), 1bag = 85 Kgs; after which period (1997/98 – 2001/02) prices have largely depended on the market forces and bags are currently modified to carry more weight (1bag = 96 Kgs).

**Regional level (Mbeya)**

- As for the district level, paddy production at the regional level has generally been increasing over time (correlation coefficient = 0.93,  $P < 0.01$ ).
- Paddy production has increased from 51,000 tonnes in 1991/92 to 112,000 tonnes in 1992/93 and 211,400 tonnes in 2000/01.
- Paddy production in 2000/01 had almost doubled that of the nearest rival region in the country (Mwanza). During that particular year, paddy production in Mbeya region has amounted to 121,500 tonnes.
- Mbeya region is therefore a major contributor to the national rice production.
- Producer and wholesale prices for paddy and rice have increased only in nominal terms, but decreased in real terms, resulting into falling trends for real values of paddy production.

**National level**

- In Tanzania, paddy production for the period from 1984/85 to 2000/01 has generally increased over time.
- The bulk of national paddy (about 70 to 80%) is produced from five regions: Shinyanga, Mwanza, Morogoro, Mbeya and Tabora. The regions are also the major sources of surplus rice in the country.
- Producer and wholesale prices for paddy and rice have increased only in nominal terms but decreased in real terms, resulting into falling trends for real values of paddy production.
- Average real producer prices for paddy have declined by 4% from Tsh 134.14 per kg in 1992/93 to Tsh 128.62 per kg in 1993/94. The prices have also declined by 28% from Tsh 102.03 per kg in 1996/97 to Tsh 72.38 per kg in 1997/98.
- Average wholesale real prices for rice have declined by 20% from Tsh 17,191.09 per bag in 1997/98 to Tsh 13,698.18 per bag in 1998/99. The prices have also declined by about 1% from Tsh 15,137.00 per bag in 1999/00 to Tsh 14,999.23 per bag in 2000/01.
- The Official Exchange Rates (mean selling rates) for the period from 1997 to 2001 have averaged at Tsh 764.4922 per US Dollar.
- Rice consumption for the period from 1972/73 to 2000/01 has generally shown an increasing trend ( $R^2 = 80.2\%$ ,  $P < 0.01$  and growth rate = 4.52%).
- The national rice consumption for the same period (1972/73 to 2000/01) is estimated to average at 350,460 tonnes per annum. This is relatively higher than the average quantity of rice, which has been domestically supplied (302,600 tonnes per annum).
- According to the 2001/02 final forecasts, the national food balance sheet shows a total domestic food availability of about 9.21 million tonnes, composing of about 8.57 million tonnes of food crop harvests, and about 634,000 tonnes of opening stocks grossly estimated as public stocks (SGR) 48,000 tonnes, private stocks amounting to 289,000 tonnes and farm level retentions of about 297,000 tonnes.
- Public and private stocks together stood at 186,000 tonnes of food, which comprised of about 9,000 tonnes of rice, 144,000 tonnes of maize and 33,000 tonnes of wheat.
- Compared to last year, yields have increased for all crops, except for sorghum and wheat.

- Paddy yields have increased most at over 41% (from 1.39 to 1.96 tonnes/ha).
- Considering the 2002/03 annual national food requirement (estimated at 8.37 million tonnes) and desired SGR opening stock (150,000 tonnes), the domestic food balance shows a net domestic surplus of 683,00 tonnes of food having cross substituted about 154,000 tonnes cereal shortfall with about 836,000 of non-cereal (grain equivalent).
- When total food produced is compared to total requirements of 8,376,139 tonnes of food the country remains 102% self-sufficiency, which is substantially higher than the 94% reported in 2001/02. This leaves a marginal surplus of 196,149 tonnes of food over the 2002/03 marketing year.
- A flashback comparison shows that food security situation over the last two years has been improving overtime.
- Self Sufficiency Ratio (SSR) in 2000/01 marketing season was 92%
- The SSR in 2001/02 marketing season was 94%.

### Comparative analyses

- Average yields per hectare at the national, regional and district levels have averaged at 1.52, 2.93, and 2.11 tonnes respectively, from 1993/94 to 1999/2000.
- Paddy yields at both district and regional levels are therefore, higher than that of the national average.
- Returns to labour, profit margins and productivity of irrigation water were compared for four systems of paddy production and two types of rice traders (local and inter-regional traders).
- Return to labour for a smallholder farmer who irrigates his/her paddy field and uses tractor, fertilizer and hired labour was higher (Tsh 2,486.3 or US \$ 2.4 per manday) than any of the remaining paddy production systems. They also obtained the highest gross margin (Tsh 280,950 or US \$ 272.8) per ha.
- The smallest return to labour (Tsh 490.5 or US \$ 0.5 per manday) was obtained by an average smallholder farmer who cultivated rain-fed paddy using hand hoe and family labour.
- On average, the smallholder farmers who hired the National Agriculture and Food Corporation (NAFCO) farms/plots and cultivated irrigated paddy, using tractor, fertilizer and hired labour obtained the least gross margin (Tsh 77,600 or US \$ 75.3 per ha).
- Similarly, productivity of irrigation water (paddy produced per drop) was also relatively lower [0.12kg or Tsh 18.2 (US \$ 0.02) per cubic meter] for smallholder farmers within the NAFCO systems than for their counterpart smallholder farmers outside the NAFCO systems [0.22kg or Tsh 34.1 (US \$ 0.03) per cubic meter].
- Comparing the Usangu figure with that of the whole Sub-Saharan Africa (SSA) the former is ranked as average value for the region. Water productivity of rice in this region ranges from 0.10 to 0.25 kg per m<sup>3</sup>, with average yield of 1.4 metric tonnes per ha and water consumption per ha close to 9,500 m<sup>3</sup>.
- Among developing countries, China and some Southeast Asian countries have higher water productivity for rice, ranging from 0.4 to 0.6 kg per m<sup>3</sup>; however, the average for the developed world (0.47 kg/m<sup>3</sup>), is higher than that for the developing world (0.39 kg/m<sup>3</sup>).
- Between the two categories of traders compared in this study, the local trader buying paddy and selling rice within Usangu - along the Mbeya to Dar es Salaam

main road received a higher margin per kilogram in 2001/02 (Tsh 15.00 per kg) against Tsh 12.75 per kg for an inter-regional trader buying paddy in Usangu and selling rice in Dar es Salaam.

**What are the implications if farmers in Usangu stop producing irrigated paddy?**

- There will be a shrinkage in the annual paddy supply (both at the local and national levels) of about 105,000 tonnes (70% or 14.4% of the annual paddy production in Mbeya region or in Tanzania respectively).
- An opportunity cost of about Tsh 16.4 billion or US \$ 15.9 million (foregone gross revenue from irrigated paddy in Usangu) will be incurred annually. This is equivalent to gross revenue of Tsh 546,875 or US \$ 531 per annum for an average household practicing irrigated paddy in Usangu.
- Assuming a cultivable season of work spanning 170 days including land preparation and harvest, this revenue amounts to an average daily household of more than \$ 3.12 per day, which implies that irrigated paddy plays a crucial part in lifting the Usangu households out of poverty.
- The country's Gross National Product (GNP) or current account of the balance of payments will be affected by an average of 66,000 tonnes of rice (valued at US \$ 15.9 million). The effect will either be in form of annual drop in rice exports or increase in imports of rice depending on the national supply and demand for rice.
- About 576 Mm<sup>3</sup> of water, which is currently annually consumed in irrigated paddy would be utilized in alternative ways, either as evaporation from seasonal swamps within the Usangu basin or made available for other intersectoral uses.

## **1.0 INTRODUCTION**

Rice is one of the most important food grains widely produced and consumed in Tanzania. It falls under the category of ‘preferred staples,’ which also comprises of maize and wheat. Other categories include ‘drought staples’ (sorghum, millet and cassava), ‘pulses’ (beans and pigeon peas) and ‘oil seeds’ (sunflower, groundnuts, sesame and copra).

In Usangu, the major food crops grown include rice, maize, sorghum, and beans. The major cash crops are cotton, sunflower and groundnuts. Other minor crops include onions, tomatoes, sugarcane, vegetables and fruits (mainly citrus, mangoes and pawpaw). Irrigated crops include paddy, maize, beans, cassava, sweet potato, sugar cane, onions, and vegetables. Paddy is grown on the lower alluvial fans having clay soils, while maize and dry season crops are grown on the upper alluvial fans and foothills where the soils are sandy loams containing less clay.

Irrigated agriculture (in Usangu) dates back to the early 19th century, during the era of German missionaries. The missionaries built small furrows to provide domestic water to the missions and to irrigate vegetable gardens. Thereafter, the Baluchis (from Baluchistan) arrived in Usangu in 1920s and introduced paddy irrigation in 1940s (SMUWC 2001). The practice spread rapidly among local farmers. The Baluchis are currently operating several large, family paddy farms, with their own furrows and applying relatively more improved management practices. They are also well known as important traders and merchants in the area.

The most momentous expansion of irrigated paddy probably took place in the late 1980s after trade liberalization when a number of private traders began to operate in food grains. During this period, the producer prices for paddy increased rapidly encouraging farmers to increase production and extend the area under paddy cultivation. The establishment of irrigation schemes, like the large-scale Mbarali and Kapunga Irrigation Schemes and smallholder schemes (e.g. the Majengo, Kimani and Motombaya schemes) has also led to a further expansion of the area under paddy production.

This report explores the production economics of rice, both in Mbarali district (Usangu) and at the national level. It draws on both secondary and primary data collected between September 2002 and March 2003. The bulk of secondary data was gathered from the Mbarali District Agricultural Office; SMUWC database, Statistics unit and Crop Monitoring and Early Warning Section (CMEW), National Food Security Division of the Ministry of Agriculture and Food Security, Bank of Tanzania (BoT); Marketing Department of the Ministry of Cooperatives and Marketing. Primary data was gathered using semi-structured questionnaires encompassing questions of rice production and marketing. The questionnaires were administered in three villages namely; Uturo, Ihahi and Ukwavila and a total number of 120 respondents were interviewed. In addition, 20 rice traders and transporters were also interviewed so as to get a greater picture of rice marketing both at the local and interregional or national levels.

## 2.0 AGRICULTURAL LAND RESOURCE AND PADDY PRODUCTION

### 2.1 Land resource and paddy production at the national level

According to the Ministry of Agriculture and Food Security (2001), cultivated land in Tanzania Mainland amounts to 10,003,000 ha. The area under paddy cultivation was estimated at 516,900 ha in the 1999/2000 cropping season. The amount of paddy produced and yield per ha during the same season amounted to 782,300 tonnes and 1600 kilograms per hectare respectively. As of September 2002, the national food balance sheet for June 2002 - May 2003 shows a gross harvest of 640,000 tonnes of rice (appendix 3) recording a decrease of about 18% when compared with that of the 1999/2000 year.

In the country, paddy is produced mainly by small-scale farmers. There are however, few large-scale paddy farms in the country, most of which have been under the ownership of the National Agriculture and Food Corporation (NAFCO). The large-scale paddy farming is largely done with irrigation water using more “improved” irrigation facilities, whereas small-scale paddy farming is largely dependent on rainfall.

The bulk of national paddy is produced from five regions: Shinyanga, Mwanza, Morogoro, Mbeya and Tabora. As shown in table 1, these together account for about 70 to 80% of the national paddy production. The regions are also the major sources of surplus rice in the country.

Table 1: Production of paddy in major paddy surplus regions ('000 Tonnes)

Year	Mwanza	Morogoro	Mbeya	Shinyanga	Tabora	Total five regions (a)	Total national (b)	(a) % of (b)
1984/85	38	80	48	61	45	272	425	64
1985/86	86	149	37	81	38	391	551	71
1986/87	107	122	59	131	40	459	646	71
1987/88	181	80	45	103	56	465	612	76
1988/89	141	101	65	186	50	543	714	76
1989/90	145	104	67	191	51	558	744	75
1990/91	100	129	59	95	45	428	620	69
1991/92	66	67	51	64	22	270	391	69
1992/93	113	109	112	117	47	498	638	78
1993/94	112.7	118.5	119.8	111.9	45.7	508.6	654.5	83
1994/95*	121.8	78.1	102.2	75.8	57.3	435.2	622.6	70
1995/96	95.5	122.6	162.2	82.8	78.3	541.4	806.8	67
1996/97	58.3	121.4	113.9	54.8	31.3	379.7	549.7	69
1997/98	164.2	126.3	169.2	21.4	50.2	531.3	849.1	63
1998/99	113.0	129.5	175.5	39.5	64.2	521.7	778.4	67
1999/00	109.2	103.2	189.8	44.6	44.5	491.3	782.3	63
2000/01**	121.5	114.9	211.4	49.7	49.5	547.0	870.7	63

Source: CMEW, Ministry of Agriculture and Food Security (MAFS) and own calculation

\* National Sample Census of Agriculture 1994/95

\*\* Projections

Figure 1 presents the trend of paddy production from 1984/85 to 2000/01 at the national level. Paddy production has generally increased from 425,000 tonnes in 1984/85 to 744,000 tonnes in 1989/90. It has thereafter declined to 391,000 tonnes in

1991/93 and then started to increase to 806,800 tonnes in 1995/96. The largest figure was recorded in 2000/01 when 870,700 tonnes of paddy were produced.

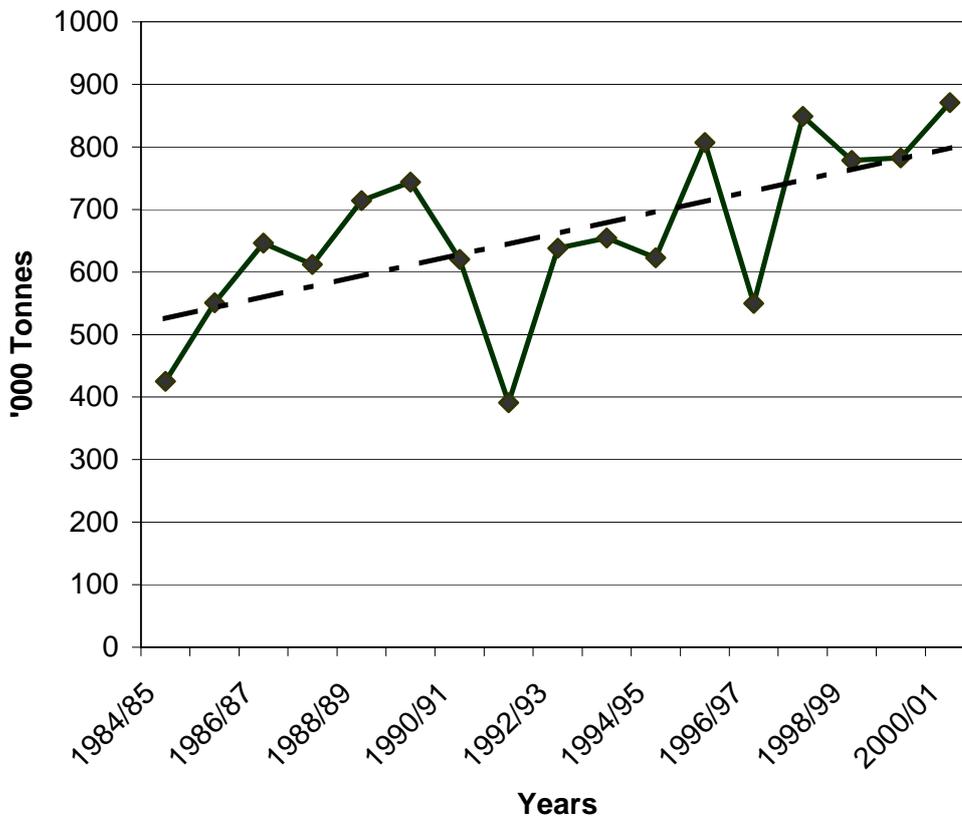


Figure 1: Trend of paddy production at the national level (1984/85 – 2000/01)

## 2.2 Land resource and paddy production at the local level

### 2.2.1 Usangu plains

The maximum irrigated land under paddy in Usangu plains, amounts to about 42 000 ha (SMUWC 2001). This is grown during a normal-to-wet year when average weather conditions are favorable, and when irrigation is essentially supplemental to the water provided by rainfall. The core irrigated area found in a dry year is 24 500 ha. This area includes a rice crop of 22 000 ha and a non-rice crop of 2 500 ha. Both rice and non-rice crops are irrigated using mostly river flows with little reliance on rainfall. The area planted in such a year depends on the river flows and rainfall in each sub-catchment.

The non-rice cropped area is 2500 ha. This mixed cropping includes maize, beans, vegetables and fruits, and extends throughout the year, mainly in the Chimala and Mkoji subcatchments. The maximum irrigated area in a normal to wet year is therefore 42 000 ha plus 2500 ha (44 500 ha). Dry season irrigation plots are usually very small (about 0.1 - 0.2 ha). Land for rain-fed agriculture varies between 50,000 ha and 65,000 ha depending on the amount and distribution of rainfall in the district. The Mbarali and Kapunga rice farms cover a total area of 3200 ha.

### 2.2.2 Mbarali district

Summarized in table 2 are the areas under paddy production in Mbarali district (part of Usangu basin) and the respective production figures as from 1992/93 to 2001/2002. During this period, paddy production has been increasing and decreasing depending on the area under cultivation and rainfall variability. In general, paddy production has been increasing in wet years and declining in dry years (figure 2). On average, paddy production in the district has amounted to 59,990 tonnes for the period from 1992/93 to 2001/02. The highest production was recorded in 2001/02 (85,200 tonnes) and the lowest in 1998/99 (30,510 tonnes). Production for other food crops are as given in appendix 1.

Table 2: Mbarali district: Paddy production trend and contribution to the regional production, 1992/93 - 2001/2002

Year	Mbarali (Ha)	Mbarali ('000T)	Mbarali (T/Ha)	%Change Mbarali (Ha)	%Change Mbarali (T)	Regional production ('000T)	Mbarali % of regional production (Mbeya)
1992/93	24,444	46.44	1.9			112	41.5%
1993/94	24,900	54.78	2.2	18.0	15.8	119.8	45.7%
1994/95	26,777	48.20	1.8	-12.0	-18.2	102.2	47.2%
1995/96	36,000	78.00	2.2	61.8	20.4	162.2	48.1%
1996/97	35,000	61.25	1.8	-21.5	-19.2	113.9	53.8%
1997/98	23,834	78.65	3.3	28.4	88.6	169.2	46.5%
1998/99	20,342	30.51	1.5	-61.2	-54.5	175.5	17.4%
1999/00	17,600	35.20	2.0	15.4	33.3	189.8	18.5%
2000/01	28,800	81.64	2.8	131.9	41.7	211.4	38.6%
2001/02	28,400	85.20	3.0	4.4	5.8	NA	NA
Average	26,610	59.99	2.2			150.7	39.7
StDev	5,796	20.03	0.589			39.5	13.03

Source: Mbarali District Agriculture Office and own calculation

StDev = Standard Deviation

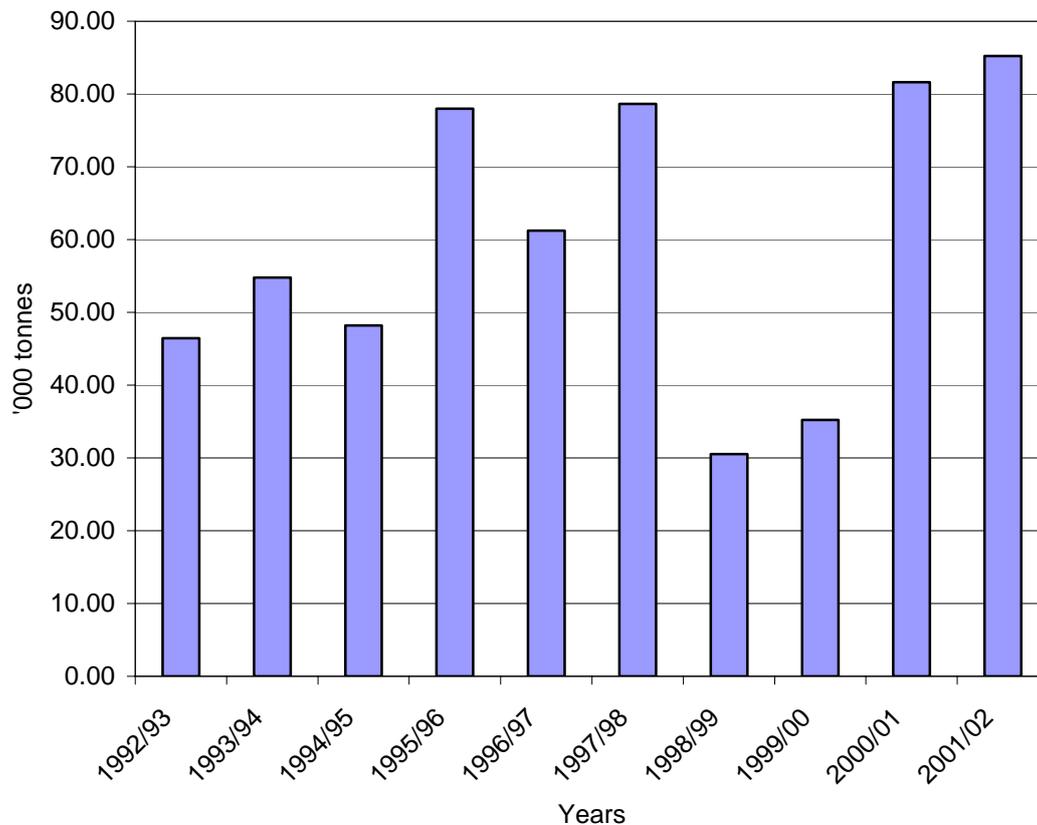


Figure 2: Mbarali district: Paddy production trend, 1992/93 – 2001/02

According to the statistics given in table 2, the contribution of Mbarali district to the regional (Mbeya) paddy production is about 40%. However, findings from informal discussions with several people in the district have revealed that the actual annual contributions might be higher than the figures shown in table 2. According to these latter findings, the overall contribution is estimated to range from 55% to 65%. Taking these findings into consideration the current study estimates the contribution of Mbarali district to the regional (Mbeya) paddy production at 60%. The remainder is considered to be coming from Kyela (about 20%), Ileje and Mbozi (mainly from the Naming'ong'o Irrigation Scheme) (about 15%) and other areas in the region (5%).

As per the regression results summarized in table 3, paddy production in Mbarali district is negatively affected by producer prices. Conversely, productivity and area under cultivation, as often expected, have shown a positive impact on paddy production ( $P < 0.01$  and  $R^2 = 99.1\%$ ). This is also supported by the trend and correlation analyses in appendices 5(h), 5(i), and 6, which show that paddy production has increased over time while real prices have declined with time (correlation coefficient = -0.584,  $P < 0.10$ ).

Table 3: Regression results for paddy production ('000 tonnes) in Mbarali district, 1992/93 – 2001/02

**Regression equation:** *Paddy production (000 tonnes) = - 48.9 – 0.000146 Paddy producer price (nominal) + 24.9 Productivity (T/ha) + 0.00194 Land under paddy (ha) + 0.534 Time*

Predictor	Coefficient	StDev	T	P
Constant	-48.87	12.38	-3.95	0.011*
Paddy producer prices (nominal)	-0.0001456	0.0007487	-0.19	0.853
Productivity (T/ha)	24.908	2.203	11.31	0.000***
Land under paddy cultivation (ha)	0.0019389	0.0002060	9.41	0.000***
Time	0.5336	0.8632	0.62	0.564
S = 2.610		R <sup>2</sup> = 99.1%		R <sup>2</sup> (adj) = 98.3%

### Analysis of Variance

Source	DF	SS	MS	F	P
Regression	4	3577.71	894.43	131.30	0.000***
Residual Error	5	34.06	6.81		
Total	9	3611.78			

\* Significant at 0.10 per cent level

\*\*\* Significant at 0.01 per cent level

### 2.2.3 Regional level

As for Mbarali district, paddy production at the regional level (Mbeya region) has generally been increasing over time (correlation coefficient = 0.93,  $P < 0.01$ ). It has increased from 51,000 tonnes in 1991/92 to 112,000 tonnes in 1992/93 and 211,400 tonnes in 2000/01 (table 2 and figure 3). The regional paddy production in the latter year (2000/01), had almost doubled that of the nearest rival (Mwanza region), which recorded 121,500 tonnes of paddy during that particular year. Mbeya region is therefore a major contributor to the national rice production.

The above increases in paddy production in the region can be attributed to various developments in the agricultural sector that have taken place during the early 1990s, particularly in Usangu plains. Of these developments, the most important one is perhaps the establishment of the Kapunga rice farm. Total area under paddy cultivation in this farm had amounted to 3,015 ha in 1992/93, which resulted to production of 5,831.5 tonnes of paddy for that particular year. This development has therefore contributed to rising paddy production at the district, Usangu and regional levels.<sup>2</sup>

<sup>2</sup> Annual paddy production in Usangu is estimated to average at 105,000 tonnes, which is about 70% of the average annual paddy production for Mbeya region.

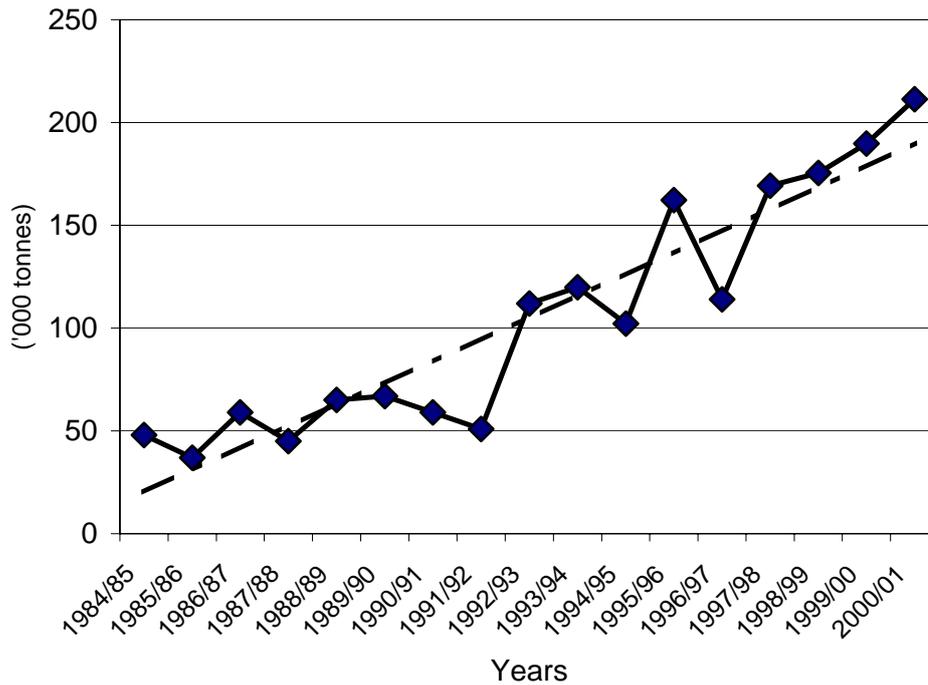


Figure 3: Mbeya region: Time series paddy production, 1984/85 – 2000/01

#### 2.2.4 Comparison of paddy yields

When the overall paddy yields at the national, regional (Mbeya) and district (Mbarali) levels are compared (figure 4), those at both the regional and district levels are generally higher than that of the whole country. For the period from 1993/94 to 1999/2000, the average yields per hectare have averaged at 1.52, 2.93, and 2.11 tonnes per hectare at the national, regional and district levels respectively. Paddy yields at both district and regional levels are therefore, higher than that of the national average.

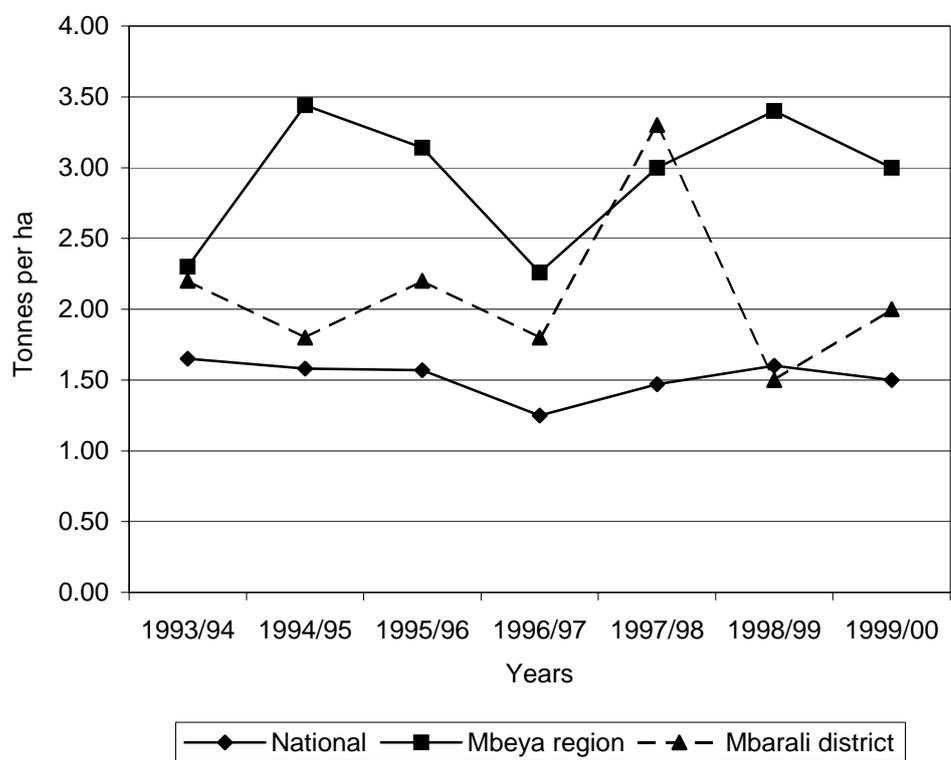


Figure 4: Comparison of paddy yields, 1993/94 – 1999/00

### **3.0 PRODUCTION COSTS, MARKETING AND PROFIT MARGINS**

#### **3.1 Production costs**

Paddy production may involve the use of a number of inputs including seeds, tools/equipment, labour, fertilizers/manure and water to mention a few. In Usangu, however, very few inputs are used apart from labour and irrigation water. Some farmers use improved seed varieties but these are relatively expensive, and new seeds need to be purchased at the beginning of each season, by which time farmers have little capital remaining. Most farmers keep a small proportion of each year's harvest as next years' seed, so that new seeds do not need to be purchased at the beginning of the season.

The use of fertilizers, pesticides, herbicides or manure is rare. Of the interviewed farmers, only 3.3% reported as applying fertilizers. Artificial inputs are commonly not used because they are too expensive. Even if many farmers can afford to purchase them, the extra financial investment involved may expose them to greater economic risk should the rains, and therefore their paddy crop, fail. Use of manure is also uncommon because it is difficult to carry sufficient quantities to the distant paddy fields.

Land renting is common and its cost varies with location of the irrigation system and relative location along the furrow (top-end or tail-end). For example, a top-end plot in villages close to the urban settlements like Rujewa can cost up to Tsh 30,000 per acre, while a tail-end plot costs Tsh 20,000. A top-end plot in the Kapunga Smallholder Scheme, which is about 26 km from the main settlement of Chimala, can be hired for Tsh 20,000 per acre at the top-end, and for Tsh 10,000 per acre at the tail-end. Many farmers in the upper alluvial fans rent these plots as they only have paddy plots, and do not own land that is in a suitable location for dry season crops. Dry season plots are rented for between Tsh 10,000 - 15,000 per acre (Tsh 25,000 - Tsh 37,500 per ha).

Farmers who have the capital will also hire cattle to undertake ploughing work, and labor for puddling, transplanting and harvesting. Farmers who do not have the money use their own labor and plough their fields by hand. It costs approximately Tsh 12,000 per acre (Tsh 30,000 per ha) to hire cattle and/or labour for ploughing or transplanting work. Hiring labour for harvesting costs less at around Tsh 8,000 per acre (Tsh 20,000 per ha).

#### **3.2 Rice commodity chain**

During the mid 1960s to early 1980s, the rice marketing system in Tanzania was characterized by a single-marketing channel. The government created government institutions/agencies for procurement, importation, storage and distribution of food grains. The National Milling Corporation (NMC) and Regional Cooperative Unions are just two of the organisations established to undertake the above tasks. The monopoly role of these government agencies (in procurement, importation and distribution of food grains) has seized since the country's decision to liberalise marketing of food and other crops in the mid-1980s.

The rice commodity chain has, therefore, changed into a two-channels marketing system with the dominant channel characterized by a large number of small traders operating between the farmer and the rice mills. The local traders buy small quantities directly from farmers and transport to mills where it is milled and the rice sold to inter-regional traders or local retailers or directly to consumers. The inter-regional traders ferry the rice to large consumer markets, particularly in Dar es Salaam and Zanzibar.

The alternative channel is very common in Usangu: inter-regional traders are buying paddy directly from farmers, bringing the paddy to mills and sending the rice to main consumption centres, particularly in Dar es Salaam and Mbeya.<sup>3</sup> Once harvested, paddy is sold by the sack-load to independent traders, who come to buy the crop directly from the field.<sup>4</sup>

### **3.3 Prices, profit margins and productivity of irrigation water**

#### **3.3.1 Prices at the local level**

Farmers in Usangu plains like to plant their nursery fields and transplant paddy as soon as the available water supplies allow them since an early harvest means good producer prices for paddy. Although yields are lower, a farmer who harvests in late April or early May, may be able to obtain up to about Tsh. 27,000 per sack of paddy compared to Tsh 6,000 to 12,000 later in the season (July and August). At the beginning of the harvesting season, the producer price for one sack can be as high as Tsh 27,000. By the end of the harvesting season, this can fall as low as Tsh 4,800 (table 3).<sup>5</sup>

In nominal terms, the average producer prices for paddy in Mbarali district have generally shown an increasing trend (figure 5). The prices have increased from Tsh 10,500 per bag in 1998 to Tsh 18,000 per bag in 2000 (table 4). The highest average price was recorded in 2000 (Tsh 18,000 per bag). The price decreased by 28.3% in 2001 and increased by 16.3% in 2002 to record Tsh 12,900 and Tsh 15,000 per bag respectively.

According to the price data given in table 4, the minimum nominal price for paddy was recorded in 2001 (Tsh 4,800 per bag) and a maximum price in 2002 (Tsh 24,000 per bag). However, a current study by Magayane (2002) has reported a maximum price of up to 27,000 in March 2000. Magayane has gone further into establishing a price he has dubbed a “normal price” or average price of paddy when both tail-end and top-end farmers have harvested their paddy crops. According to Magayane (2002), the monthly fluctuations in paddy prices (measured as proportions or percentages of market prices to “normal prices”) have ranged from 67% (in August, 2000 and July 2001) to 180% (in March 2000).

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<sup>3</sup> About 60% of the paddy, which is produced within Mbarali district (in Usangu) is sold outside the district.

<sup>4</sup> Some of the traders are local people while others come from Mbeya and Dar es Salaam.

<sup>5</sup> However, very few farmers are able to store their paddy until the beginning of the harvesting season or at the end of the dry season when prices are high.

Table 4: Mbarali district: Nominal paddy producer prices, 1993 – Mid December 2002

Year	Minimum		Maximum		Average*	
	Tsh/bag	Tsh/Kg	Tsh/bag	Tsh/Kg	Tsh/bag	Tsh/Kg
1993	NA	NA	NA	NA	6,200.00	72.94
1994	NA	NA	NA	NA	10,000.00	117.65
1995	NA	NA	NA	NA	10,000.00	117.65
1996	NA	NA	NA	NA	10,000.00	117.65
1997	NA	NA	NA	NA	10,000.00	117.65
1998	9,000.00	93.75	12,000.00	125.00	10,500.00	109.38
1999	9,600.00	100.00	21,000.00	218.75	15,300.00	159.38
2000	12,000.00	125.00	24,000.00	250.00	18,000.00	187.50
2001	4,800.00	50.00	21,000.00	218.75	12,900.00	134.38
2002	6,000.00	62.50	24,000.00	250.00	15,000.00	156.25

Source: Mbarali District Agricultural Office and own calculation

\*Prices from 1993 to 1997 were controlled prices (Cooperative prices), 1bag = 85 Kgs; after which period (1998 – 2002) prices have largely depended on the market forces and bags are currently modified to carry more weight (1bag = 96 Kgs). Average prices for the period from 1998 – 2002 have been calculated as (minimum price + maximum price) / 2

NA = Not available

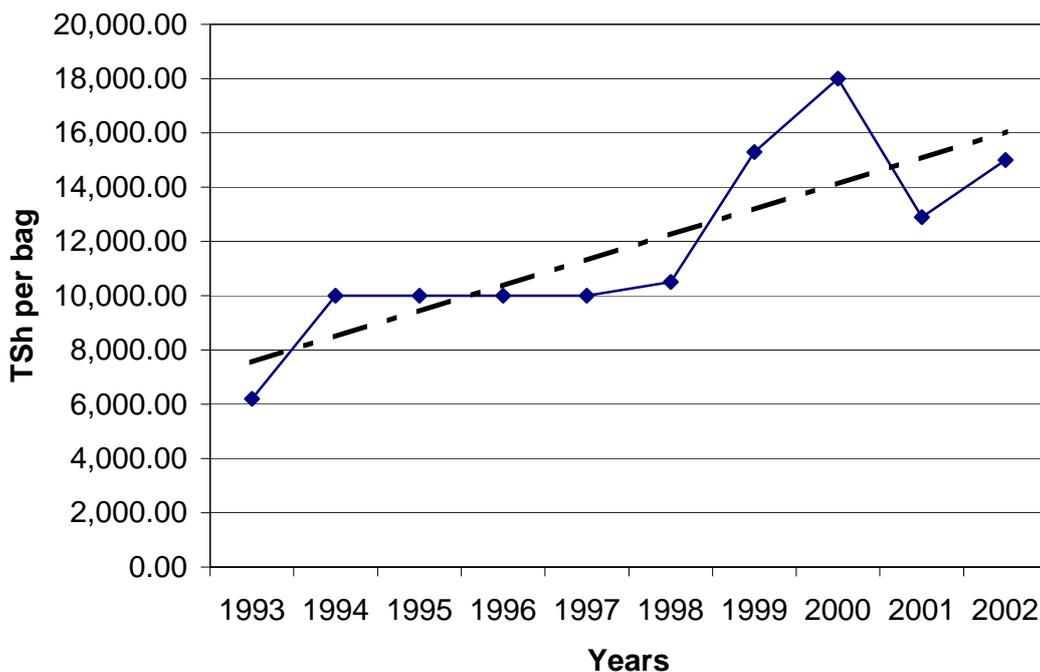


Figure 5: Mbarali district: Average nominal prices for rice, 1993 – Mid Dec. 2002

In real terms however, producer and wholesale prices for paddy and rice have declined over time, both at the district and regional levels [tables 5, 6, and 7; appendices 5 (h) and 5 (i)]. This has resulted into falling trends for real values of paddy production (e.g., figure 6).<sup>6</sup> In other words, the upsurges in nominal prices have generally lagged behind the inflation rates.

<sup>6</sup> In Mbarali district the average real producer prices for paddy (from 1993 to 2001) are negatively correlated with paddy production (correlation coefficient = -0.584,  $P < 0.10$ ).

For Mbarali district, the average real producer prices for paddy declined by 22% from Tsh 10,000 in 1994 to Tsh 7,789.29 in 1995. The prices have also decreased by 32% from Tsh 7,742.49 in 2000 to Tsh 5,279.40 in 2001 (table 5).

Table 5: Mbarali district: Average producer prices for paddy (Tsh per bag)

Year	Nominal prices	%C nominal prices	NCPI	NCPI %C	Real prices*	%C real prices
1993	6,200.00	NA	67.8	25.2	8,248.38	NA
1994	10,000.00	61.3	90.2	33.1	10,000.00	21.2
1995	10,000.00	0.0	115.8	28.4	7,789.29	-22.1
1996	10,000.00	0.0	140.1	21	6,438.26	-17.3
1997	10,000.00	0.0	162.6	16.1	5,547.36	-13.8
1998	10,500.00	5.0	183.5	12.8	5,161.31	-7.0
1999	15,300.00	45.7	197.9	7.9	6,973.52	35.1
2000	18,000.00	17.6	209.7	5.9	7,742.49	11.0
2001	12,900.00	-28.3	220.4	5.1	5,279.40	-31.8
<b>Average</b>	<b>11,433.33</b>				<b>7,020.00</b>	

\*Real price = Nominal price ÷ Deflator; Deflator =  $NCPI_t \div NCPI_0$

Table 6: Mbarali district: Average producer prices for paddy (Tsh per kg)

Year	Nominal prices	%C nominal prices	NCPI	NCPI %C	Real prices*	%C real prices
1993	72.94	NA	67.8	25.2	97.04	NA
1994	117.65	61.3	90.2	33.1	117.65	21.2
1995	117.65	0.0	115.8	28.4	91.64	-22.1
1996	117.65	0.0	140.1	21	75.75	-17.3
1997	117.65	0.0	162.6	16.1	65.26	-13.8
1998	109.38	-7.0	183.5	12.8	53.77	-17.6
1999	159.38	45.7	197.9	7.9	72.64	35.1
2000	187.50	17.6	209.7	5.9	80.65	11.0
2001	134.38	-28.3	220.4	5.1	55.00	-31.8
<b>Average</b>	<b>126.02</b>				<b>78.82</b>	

\*Real price = Nominal price ÷ Deflator; Deflator =  $NCPI_t \div NCPI_0$

Table 7: Mbeya region: Wholesale prices for rice (Tsh per bag)

Year	Nominal prices	%C nominal prices	NCPI	NCPI %C	Real prices*	%C real prices
1995/96	30,283.00	NA	140.1	21	19,497.00	NA
1996/97	30,329.00	0.2	162.6	16.1	16,824.60	-13.7
1997/98	35,740.00	17.8	183.5	12.8	17,568.10	4.4
1998/99	30,254.00	-15.3	197.9	7.9	13,789.30	-21.5
1999/00	32,486.00	7.4	209.7	5.9	13,973.50	1.3
<b>Average</b>	<b>31,818.40</b>				<b>16,330.50</b>	

\*Real price = Nominal price ÷ Deflator; Deflator =  $NCPI_t \div NCPI_0$

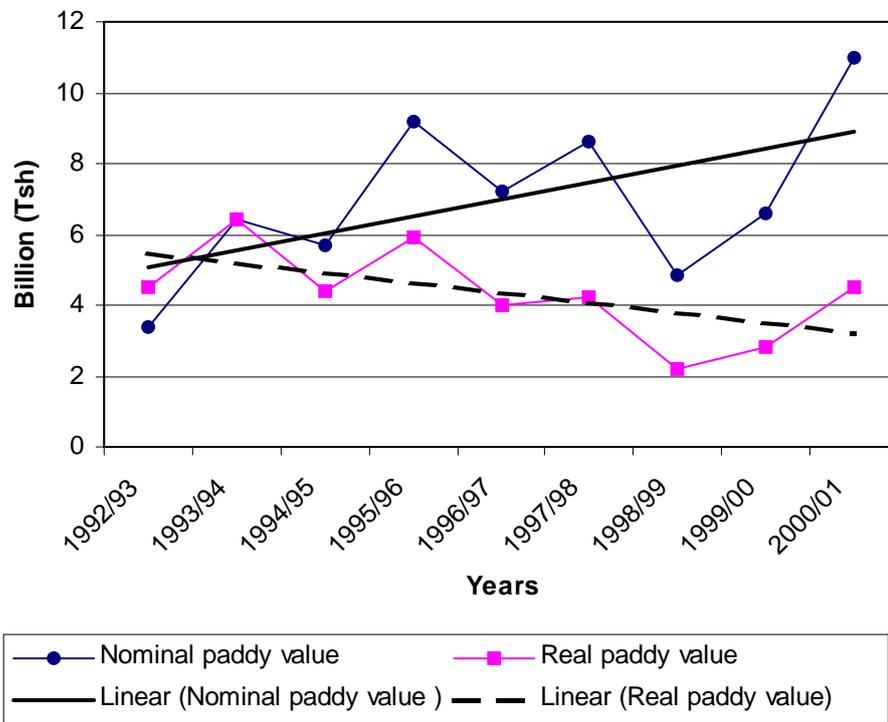


Figure 6: Mbarali district: Values of paddy production

### 3.3.2 Paddy prices at the national level

As for the district and regional levels, real prices for paddy and rice at the national level have shown a declining trend (appendices 5 (e - f) and figure 7). Average real producer prices for paddy have declined by 4% from Tsh 134.14 per kg in 1992/93 to Tsh 128.62 per kg in 1993/94. The prices have also declined by 28% from Tsh 102.03 per kg in 1996/97 to Tsh 72.38 per kg in 1997/98 (table 8).

Table 8: Average producer prices for paddy at the national level (Tsh/Kg), 1991/92 – 1997/98

Year	Nominal prices (paddy)	%C nominal prices	NCPI	NCPI %C	Real prices (paddy)*	%C real prices
1991/92	76.13	NA	54.1	21.9	126.93	NA
1992/93	100.83	32.4	67.8	25.2	134.14	5.7
1993/94	128.62	27.6	90.2	33.1	128.62	-4.1
1994/95	NA	NA	115.8	28.4	NA	NA
1995/96	126.33	NA	140.1	21	81.33	NA
1996/97	183.93	45.6	162.6	16.1	102.03	25.5
1997/98	147.25	-19.9	183.5	12.8	72.38	-29.1
<b>Average</b>	<b>127.18</b>				<b>107.57</b>	

\*Real price = Nominal price ÷ Deflator; Deflator =  $NCPI_t \div NCPI_0$

Table 9: Average producer prices for rice at the national level (Tsh/Kg), 1991/92 – 1997/98

Year	Nominal prices (rice)	%C nominal price	NCPI		Real prices (rice)*	
			NCPI	%C		%C real price
1991/92	141.10	NA	54.1	21.9	235.25	NA
1992/93	178.40	26.4	67.8	25.2	237.34	0.9
1993/94	217.50	21.9	90.2	33.1	217.50	-8.4
1994/95	273.90	25.9	115.8	28.4	213.35	-1.9
1995/96	308.20	12.5	140.1	21	198.43	-7.0
1996/97	350.40	13.7	162.6	16.1	194.38	-2.0
<b>Average</b>	<b>244.92</b>				<b>216.04</b>	

\*Real price = Nominal price ÷ Deflator; Deflator = NCPI<sub>t</sub> ÷ NCPI<sub>0</sub>

Table 10: Average prices for rice at the national level (Tsh/bag), December 1994 = 100

Year	Paddy		Nominal Prices	%C		Real prices*	%C real prices
	Pdn '000 tonnes	Rice equiv '000 tonnes		Nominal prices	NCPI		
1994/95	622.6	390.69	31,140.00	NA	115.8	24,255.85	NA
1995/96	806.8	506.28	28,362.00	-8.9	140.1	18,260.19	-24.7
1996/97	549.7	344.95	36,264.00	27.9	162.6	20,116.93	10.2
1997/98	849.1	532.83	33,079.00	-8.8	183.5	16,260.09	-19.2
1998/99	778.4	488.46	33,722.00	1.9	197.9	15,370.01	-5.5
<b>Average</b>	<b>721.32</b>	<b>452.64</b>	<b>32,513.40</b>			<b>18,852.61</b>	

\*Real price = Nominal price ÷ Deflator; Deflator = NCPI<sub>t</sub> ÷ NCPI<sub>0</sub>

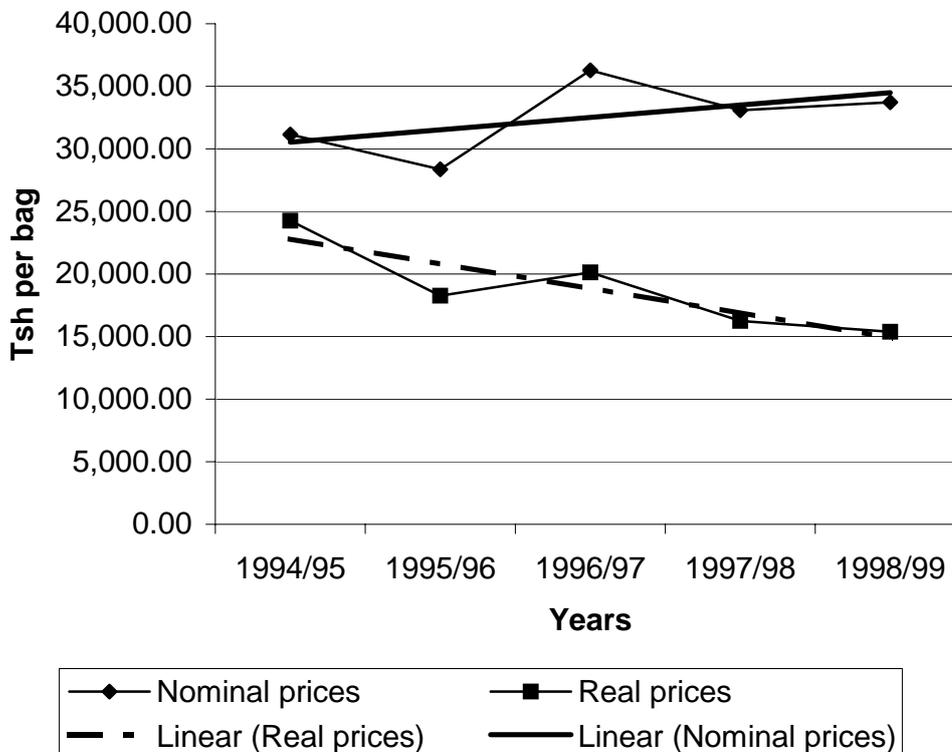


Figure 7: Average prices for rice at the national level, 1994/95 – 1998/99

Shown in table 11 are the average nominal wholesale prices for rice in the major regions in Tanzania. In nominal terms, the prices have increased from Tsh 27,072 in 1995/96 to Tsh 36,650 per bag of rice in 2000/01. In real terms however, the prices have generally declined with time (figure 8). The average wholesale real prices for rice declined by 20% from Tsh 17,191.09 per bag in 1997/98 to Tsh 13,698.18 per bag in 1998/99. They also declined by about 1% from Tsh 15,137.00 per bag in 1999/00 to Tsh 14,999.23 per bag in 2000/01 (table 12).

Table 11: Rice average wholesale prices in major regional markets (Tsh/bag)

Region/Year	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Arusha	27,804	33,648	38,940	35,736	37,891	12,894
Dar es Salaam	31,476	36,154	37,894	37,268	38,707	38,904
Dodoma	24,725	31,313	33,461	31,506	37,757	40,142
Iringa	27,227	31,607	36,007	33,201	32,771	36,810
Songea	31,140	28,362	36,264	33,079	33,722	34,177
Mbeya	30,283	30,329	35,740	30,254	32,486	36,704
Morogoro	29,208	31,914	33,046	31,966	31,767	34,636
Moshi	27,144	31,341	30,347	29,686	32,271	33,202
Mwanza	22,524	29,336	33,541	22,410	35,851	34,816
Shinyanga	19,736	25,932	26,572	20,335	31,131	39,055
Singida	23,649	27,607	34,340	26,743	35,438	36,504
Sumbawanga	23,532	29,147	28,670	26,495	31,200	40,681
Tanga	29,886	33,318	33,132		35,918	33,605
Tabora	23,100	29,148	36,071	24,969	34,617	35,390
Mtwara	37,681	38,121	36,139	38,684	38,900	35,766
Lindi	34,593	37,168	40,059	35,948	38,469	43,112
Musoma	24,738	32,402	38,805	28,188	36,217	41,658
Bukoba	20,055	39,533	35,761	25,706	36,317	47,212
Kigoma	25,869	33,636	39,695	28,790	37,200	41,076
<b>AVERAGE</b>	<b>27,072</b>	<b>32,106</b>	<b>34,973</b>	<b>30,054</b>	<b>35,191</b>	<b>36,650</b>

Source: Marketing Development Division, Ministry of Co-operatives and Marketing

Table 12: Average wholesale prices for rice in major regional markets (Tsh per bag)

Year	Nominal prices	%C nominal prices	NCPI	NCPI %C	Real prices*	%C real prices
1995/96	27,072.00	NA	140.1	21	17,429.65	NA
1996/97	32,106.00	18.6	162.6	16.1	17,810.34	2.2
1997/98	34,973.00	8.9	183.5	12.8	17,191.09	-3.5
1998/99	30,054.00	-14.1	197.9	7.9	13,698.18	-20.3
1999/00	35,191.00	17.1	209.7	5.9	15,137.00	10.5
2000/01	36,650.00	4.1	220.4	5.1	14,999.23	-0.9
<b>Average</b>	<b>32,650.00</b>				<b>16,044.25</b>	

\*Real price = Nominal price ÷ Deflator; Deflator =  $NCPI_t \div NCPI_0$

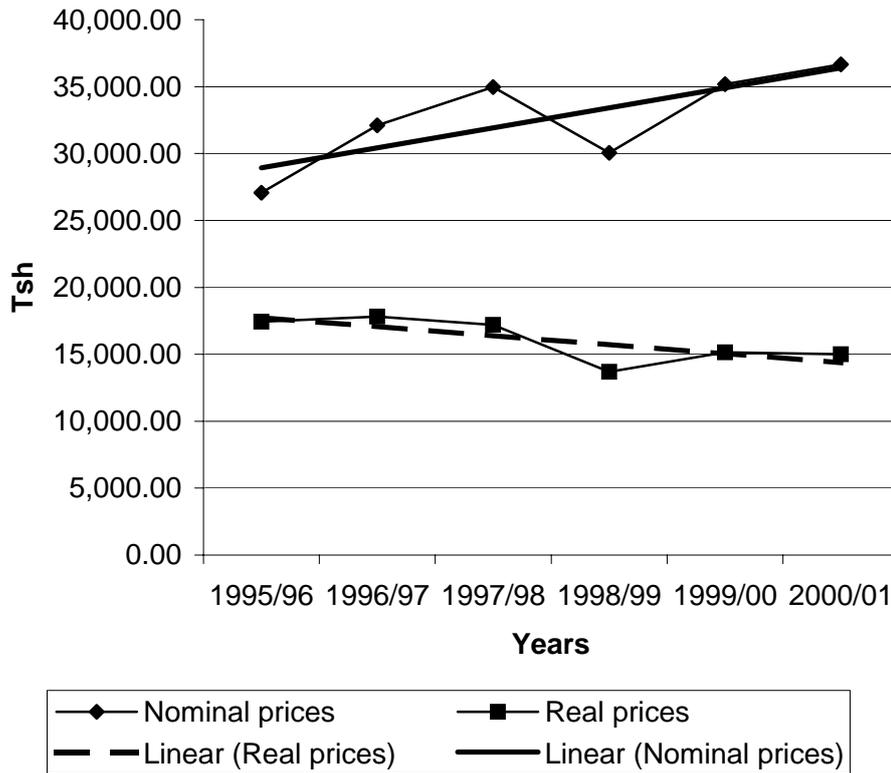


Figure 8: Average wholesale prices for rice in major regional markets, 1995/96 – 2000/01

### 3.3.3 Returns to labour, profit margins and productivity of irrigation water

In this section, returns to labour, profit margins and productivity of irrigation water are compared for four systems of paddy production in Usangu and two types of rice traders (local and inter-regional traders) using both primary and secondary data collected during the study. The results are as depicted in appendix 2 and summarized in table 13.

Table 13: Comparison of profit margins, returns to labour and values of irrigation water in paddy production and rice trading, 2001/02

Type	Farm size (Ha)	Paddy Yields* (Kg/ha)	Gross margins			Return to Labour (Tsh/Manday)	Irrigation Water Productivity** (Kg/m <sup>3</sup> )	Irrigation Water Value (Tsh/m <sup>3</sup> )
			Tsh/ha (paddy)	Tsh/kg (paddy)	Tsh/kg (rice)			
I	0.3	788	101,525 (98.57)	128.84 (0.13)	257.68 (0.25)	490.46 (0.48)	NA	NA
II	0.5	1500	94,075 (91.33)	62.72 (0.06)	125.44 (0.12)	514.07 (0.50)	NA	NA
III***	6	1600	77,600 (75.34)	48.5 (0.05)	97 (0.09)	760.78 (0.74)	0.12	18.21 (0.02)
IV	1.25	3000	280,950 (272.77)	93.65 (0.09)	187.30 (0.18)	2,486.28 (2.41)	0.22	34.14 (0.03)
V				7.5 (0.01)	15 (0.02)			
VI				6.38 (0.01)	12.75 (0.01)			

Type I = Smallholder farmer cultivating rain-fed paddy, using hand hoe and family labour

Type II = Smallholder farmer cultivating rain-fed paddy, using tractor, fertilizer and hired labour

Type III = Smallholder farmer hiring NAFCO farms/plots, cultivating irrigated paddy using tractor, fertilizer and hired labour

Type IV = Smallholder farmer cultivating irrigated paddy, using tractor, fertilizer and hired labour. Type V = Local trader buying paddy and selling rice within Usangu - along the Mbeya-Dar es Salaam main road

Type VI = Inter-regional trader buying paddy in Usangu and selling rice in Dar es Salaam

\*Average paddy yield for the whole of the Usangu basin is 2500 kg/ha (SMUWC, 2001)

\*\* Average productivity of irrigation water (in paddy production) for the Usangu basin is estimated at 0.18 kg/m<sup>3</sup>

\*\*\* Hired plots in the NAFCO (Kapunga) system are normally 6 ha in size

Numbers in bracket represent equivalent values in US \$, calculated using April 2003 Exchange Rate of 1 US \$ = Tsh 1,030.

Variations in returns to labour and profit margins are noted. On average, the return to labour in paddy production for smallholder farmers who irrigated their paddy fields and used tractor, fertilizer and hired labour during the 2001/02 season was higher (Tsh 2,486.3 or US \$ 2.4 per manday) than any of the remaining paddy production systems. They also obtained the highest gross margin (Tsh 280,950 or US \$ 272.8) per ha. The smallest return to labour (Tsh 490.5 or US \$ 0.5 per manday) was obtained by an average smallholder farmer who cultivated rain-fed paddy using hand hoe and family labour. On average, the smallholder farmers who hired the NAFCO farms/plots and cultivated irrigated paddy, using tractor, fertilizer and hired labour obtained the least gross margin (Tsh 77,600 or US \$ 75.3 per ha). When gross margins per hectare are compared, the differences among the above four production systems are determined more by the extent to which commercial inputs were used and less by the differences in economies of scale. As the evidences in this study indicate, commercial inputs were relatively very expensive and their use might have eroded a large share of profit margins.

Productivity of irrigation water (paddy produced per drop) was also relatively lower for smallholder farmers within the NAFCO systems than for their counterpart smallholder farmers outside the NAFCO systems [compare productivity of 0.12kg or Tsh 18.2 (US \$ 0.02) per cubic meter versus 0.22kg or Tsh 34.1 (US \$ 0.03) per cubic meter in Table 13].

The above findings support the argument given in SMUWC (2001) that ‘average yields on the NAFCO systems are lower than those on the traditional smallholders’ (compare also the returns per manday of Tsh 826.99 versus Tsh 760.78 in table 13). While it is difficult to specify the main cause of low yields in the NAFCO systems, weed infestation and poor water level control seem to be some of the major causative factors. Water level control on the NAFCO systems is in essence variable as fields are large, the soil surface is uneven and farmers do not use smaller plots (*vijaruba*) to control water level and movement. On the traditional smallholders irrigation system, plots are smaller enabling greater care over water levels.

Comparing the Usangu figure with that of the whole Sub-Saharan Africa (SSA) the former can be rated as an average value for the region. Water productivity of rice in this region ranges from 0.10 to 0.25 kg per m<sup>3</sup>, with average yield of 1.4 metric tonnes per ha and water consumption per ha close to 9,500 m<sup>3</sup> (Rosegrant, *et al*, 2002). Among developing countries, China and some Southeast Asian countries have higher water productivity for rice, ranging from 0.4 to 0.6 kg per m<sup>3</sup>; however, the average for the developed world (0.47 kg/m<sup>3</sup>), is higher than that for the developing world (0.39 kg/m<sup>3</sup>) (*ibid.*).

Between the two categories of traders compared in this study (local trader buying paddy and selling rice within Usangu - along the Mbeya to Dar es Salaam main road and an inter-regional trader buying paddy in Usangu and selling rice in Dar es Salaam), the former received a higher margin per kilogram in 2001/02 (Tsh 15.00 per kg against Tsh 12.75 per kg for the latter trader).

Much of the profit margin for an inter-regional trader is eroded by excessive marketing costs. The more complex and lengthy the market chain is, the higher are the marketing costs (preparation, packing, taxes, handling, transport, storage, processing etc). Most of the interviewed traders (80%) maintained the assertion that the number of taxes and the amount taxed on rice and other agricultural produces are on the increase. They also do not see how the tax money they pay is used. While assenting that taxes are a necessary component of the society, many still consider taxes as ‘a necessary evil.’ They suggest that the number of taxes be reduced and simplified and the taxes to be levied be correlated with profitability of an activity. This implies that, the Treasury, through Tanzania Revenue Authority (TRA) and the Local Authorities should sit together and decide on the means to harmonize the different taxes. This is particularly imperative because high taxation for traders may imply passing on the taxes to the rural poor (farmers) by way of lower farm prices unless there is increasing competition among crop buyers to offset this trend and the traders are bearing part of the burden.

### 3.4 Rice imports, exports, consumption and food security

#### 3.4.1 Rice imports and exports

Prior to trade liberalization in the late 1980s, the National Milling Corporation (NMC) used to handle all external trade of crops. The NMC imported and exported food crops with the approval of the government, whenever considered it necessary to do so. The NMC was thus, a reliable source of information concerning external food trade. With liberalization of the food trade in late 1980s and the consequential participation of the private traders, reliable data on the actual imports and exports is extremely difficult to obtain. This is partly because the private traders are reluctant to release trade information and partly because the Customs Department of the Ministry of Finance (which publishes the actual data on this trade) takes long time to process the information. Shown in table 14 are the volumes of rice imports and exports before and after trade liberalization.

Table 14: Rice imports and exports before and after trade liberalization ('000 Tonnes)

Before trade liberalization*			After trade liberalization**		
Year	Imports	Exports	Year	Imports	Exports
1972/73	-	7.6	1988	19.5	-
1973/74	72.6	7.0	1989	0.04	-
1974/75	14.3	-	1990	2.59	5.01
1975/76	21.0	-	1991	3.52	0.45
1976/77	5.0	-	1992	65.5	0.51
1977/78	49.0	-	1993	69.8	0.80
1978/79	41.0	-	1994	48.2	6.2
1979/80	55.0	-	1995	8.0	-
1980/81	63.2	-	1996	119.2	-
1981/82	70.2	-	1997	110.1	-
1982/83	29.4	-	1998	42.2	-
1983/84	57.1	-	1999	115.5	-
1984/85	36.1	-	2000	129.3	-
1985/86	32.9	-	2001	66.8	-
1986/87	83.5	-			
1987/88	52.3	-			

Sources: \* NMC; \*\* CMEWS, Ministry of Agriculture and Food Security and Statistics Section – Customs Department.

NA = Not available

As depicted in table 14 above, Tanzania has heavily depended on rice imports to satisfy local consumption requirements during most of the period before and after food trade liberalization making the country to be a net importer of the commodity. As it will be shown in section 3.4.2, domestic annual rice supplies for the period from 1972/73 to 2000/01 have only averaged at 302,600 tonnes against the average national consumption of 350,460 tonnes per annum, implying an average deficit of about 47,860 tonnes per annum for the same commodity. The deficit had to be covered either through increased rice imports or through commodity cross-substitution (offsetting the deficit by increased consumption of other commodities e.g., maize, wheat, sorghum and millet).

Import and export data for food crops was also obtained for the period from July to September 2002 from the Plant Protection Section of the Ministry of Agriculture and

Food Security (table 15). The cumulative imports of grains from July 2002 to September 2002 stood at 149,160 tonnes, which was mainly composed of wheat. Rice imports accounted for only 163 tonnes for the same period. During September 2002, a total of 79,923 tonnes of the grains were imported. At the same time cumulative export trade from July 2002 to September 2002 reached 34,770 tonnes, of which rice accounted for 1,099 tonnes, maize accounted for 15,570 and wheat accounted for 15,007 tonnes. The other food items exported include pulses (3,092 tonnes) and sorghum (2 tonnes).

Table 15: Food trade (Imports and Exports), July – September 2002 (tonnes)

Crop	Imports		Exports	
	July 2002 - Sept 2002	Sept, 2002	July 2002 - Sept 2002	Sept, 2002
Rice	163	163	1099	39
Maize	5001	5000	15570	447
Wheat	143996	74760	15007	140
Sorghum	0	0	2	2
Pulses	0	0	3092	465
Total	149160	79923	34770	1093

Source: MAFS, Plant Protection Section – Office records.

### 3.4.2 Rice consumption

While there is paucity of published data on time series aggregate consumption of food crops in Tanzania (including rice), attempts have been done in this study so as to obtain crude estimates of aggregate consumption of rice using the available annual data on domestic production, imports and exports (table 16). Other assumptions made based on the Tanzania Food and Nutrition Centre (TFNC) are: a) about 5% of total production is used for seed and b) wastes account for about 1% of total production. The annual consumption figures were therefore calculated as:

$$R_C = R_P - R_E + R_I$$

Where  $R_C$  = rice consumption;  $R_P$  = Rice produced;  $R_E$  = Rice exported;  $R_I$  = Rice imported, and

$$R_P = [P_P - P_S - P_W] * r_e$$

Where  $P_P$  = Paddy produced;  $P_S$  = Paddy used for seeds;  $P_W$  = Paddy wasted, and  $r_e$  = extraction factor (paddy to rice = 0.6275).

The annual growth rate for rice consumption ( $r_g$ ) was calculated using the consumption figures (in table 16) and the “Exponential Regression Method” (tables 17 and 19) as:

$$LN(X_t) = \alpha + \beta T = 5.11 + 0.0417 * Time$$

$$r_g = (EXP(\beta) - 1) * 100\%$$

Table 16: Paddy production, rice exports, imports and domestic consumption, 1972/73 - 2000/01 ('000 Tonnes)

Crop Year	Paddy Produced	Paddy used for seeds	Paddy wasted	Rice Produced*	Rice Exported	Rice Imported	Rice Consumption
1972/73	301.0	15.05	3.01	177.55	7.60	-	169.95
1973/74	223.0	11.15	2.23	131.54	7.00	72.60	197.14
1974/75	265.0	13.25	2.65	156.31	-	14.30	170.61
1975/76	346.0	17.30	3.46	204.09	-	21.00	225.09
1976/77	314.0	15.70	3.14	185.22	-	5.00	190.22
1977/78	387.0	19.35	3.87	228.28	-	49.00	277.28
1978/79	262.0	13.10	2.62	154.55	-	41.00	195.55
1979/80	291.0	14.55	2.91	171.65	-	55.00	226.65
1980/81	200.0	10.00	2.00	117.97	-	63.20	181.17
1981/82	326.0	16.30	3.26	192.30	-	70.20	262.50
1982/83	350.0	17.50	3.50	206.45	-	29.40	235.85
1983/84	356.0	17.80	3.56	209.99	-	57.10	267.09
1984/85	425.0	21.25	4.25	250.69	-	36.10	286.79
1985/86	551.0	27.55	5.51	325.02	-	32.90	357.92
1986/87	646.0	32.30	6.46	381.05	-	83.50	464.55
1987/88	612.0	30.60	6.12	361.00	-	52.30	413.30
1988/89	714.0	35.70	7.14	421.17	-	19.50	440.67
1989/90	744.0	37.20	7.44	438.86	-	0.04	438.90
1990/91	620.0	31.00	6.20	365.72	5.01	2.59	363.30
1991/92	391.0	19.55	3.91	230.64	0.45	3.52	233.71
1992/93	638.0	31.90	6.38	376.34	0.51	65.50	441.33
1993/94	654.5	32.73	6.55	386.07	0.80	69.80	455.07
1994/95	622.6	31.13	6.23	367.25	6.20	48.20	409.25
1995/96	806.8	40.34	8.07	475.90	-	8.00	483.90
1996/97	549.7	27.49	5.50	324.25	-	119.20	443.45
1997/98	849.1	42.46	8.49	500.86	-	110.10	610.96
1998/99	778.4	38.92	7.78	459.15	-	42.20	501.35
1999/00	782.3	39.12	7.82	461.45	-	115.50	576.95
2000/01	870.7	43.54	8.71	513.60	-	129.30	642.90
<b>Average</b>	<b>513.0</b>	<b>25.6</b>	<b>5.1</b>	<b>302.6</b>		<b>48.8</b>	<b>350.46</b>

Source: CMEWS, Ministry of Agriculture and Food Security; NMC; Statistics Section – Customs Department, and own calculation

NA = Not available

\* Calculated using an extraction rate of 0.6275 (paddy to rice).

Table 17: Exponential regression results for rice consumption ('000 tonnes) versus time (years), 1972/73 – 2000/01

Regression equation: $LN \text{ Rice consumption} = 5.11 + 0.0442 \text{ Time}$				
Predictor	Coefficient	StDev	T	P
Constant	5.11445	0.06923	73.88	0.000***
Time	0.0044212	0.004031	10.97	0.000***
S = 0.1816		R <sup>2</sup> = 81.7%		R <sup>2</sup> (adj) = 81.0%

\*\*\* Significant at 0.01 per cent level

From the above calculations, regression results in table 18 and trend analysis presented in appendix 5(b), rice consumption in Tanzania (for the period from 1972/73 to 2000/01) has generally increased at the rate of 4.52% (R<sup>2</sup> = 80.2%, P < 0.01). It has increased from 169,170 tonnes per annum in 1972/73 to the highest of 642,900 tonnes in 2000/01 (table 16). The same is estimated to average at 350,460 tonnes per annum, which is 15.8% relatively higher than the average domestic supply

of rice (302,600 tonnes per annum). The deficit (averaging at 47,860 tonnes per annum) had to be covered either through increased rice imports or commodity cross-substitution (offsetting the deficit by increased consumption of other commodities e.g., maize, wheat, sorghum and millet).

Table 18: Regression results for rice consumption ('000 tonnes) versus time (years), 1972/73 – 2000/01

Regression equation: $Rice\ consumption = 127 + 14.9\ Time$				
Predictor	Coefficient	StDev	T	P
Constant	126.73	23.97	5.29	0.000***
Time	14.915	1.396	10.69	0.000***
S = 62.89		R <sup>2</sup> = 80.9%		R <sup>2</sup> (adj) = 80.2%

\*\*\* Significant at 0.01 per cent level

Table 19: Consumption of rice in Tanzania 1972/73 – 2000/01 ('000 tonnes)

Crop Year	Time	Rice consumption	Linear trend	[NL] Trend	EXP-Trend
1972/73	1	169.95	141.90	5.136	173.16
1973/74	2	197.14	156.80	5.284	180.98
1974/75	3	170.61	171.70	5.139	189.16
1975/76	4	225.09	186.60	5.417	197.71
1976/77	5	190.22	201.50	5.248	206.65
1977/78	6	277.28	216.40	5.625	215.98
1978/79	7	195.55	231.30	5.276	225.74
1979/80	8	226.65	246.20	5.423	235.95
1980/81	9	181.17	261.10	5.199	246.61
1981/82	10	262.50	276.00	5.570	257.75
1982/83	11	235.85	290.90	5.463	269.40
1983/84	12	267.09	305.80	5.588	281.58
1984/85	13	286.79	320.70	5.659	294.30
1985/86	14	357.92	335.60	5.880	307.60
1986/87	15	464.55	350.50	6.141	321.50
1987/88	16	413.30	365.40	6.024	336.03
1988/89	17	440.67	380.30	6.088	351.22
1989/90	18	438.90	395.20	6.084	367.09
1990/91	19	363.30	410.10	5.895	383.68
1991/92	20	233.71	425.00	5.454	401.02
1992/93	21	441.33	439.90	6.090	419.14
1993/94	22	455.07	454.80	6.120	438.08
1994/95	23	409.25	469.70	6.014	457.88
1995/96	24	483.90	484.60	6.182	478.57
1996/97	25	443.45	499.50	6.095	500.20
1997/98	26	610.96	514.40	6.415	522.80
1998/99	27	501.35	529.30	6.217	546.43
1999/00	28	576.95	544.20	6.358	571.12
2000/201	29	642.90	559.10	6.466	596.93
<b>Average</b>		<b>350.46</b>	<b>350.50</b>	<b>5.778</b>	<b>343.94</b>

### 3.4.3 The national food balance sheet and food security

As per the 2001/02 final forecasts by CMEWS, the national food balance sheet shows that the total domestic food availability in Tanzania approximates 9.21 million tonnes, composing of about 8.57 million tonnes of food crop harvests, and about 634,000 tonnes of opening stocks grossly estimated as public stocks (SGR) 48,000 tonnes, private stocks amounting to 289,000 tonnes and farm level retentions of about 297,000 tonnes.

In summary, the national food balance sheet during September 2002 showed that public and private stocks together stood at 186,000 tonnes of food, which comprised of about 9,000 tonnes of rice, 144,000 tonnes of maize and 33,000 tonnes of wheat (appendix 3). Compared to last year, yields are reported to increase for all crops, except for sorghum and wheat. Rice increased most at over 41% (from 1.39 to 1.96 tonnes/ha) and all non-cereal crops increased between 9% (for pulses) and 40% (for cassava) (CMEW, 2002).

Considering the 2002/03 annual national food requirement which is estimated to amount to 8.37 million tonnes and desired SGR opening stock of 150,000 tonnes, the domestic food balance shows a net domestic surplus of 683,00 tonnes of food after cross-substituting about 154,000 tonnes cereal shortfall with about 836,000 of non-cereal (grain equivalent) (CMEW, 2002).

Presented in appendix 4 is an analysis of the national food supply and self-sufficiency ratio (SSR) for 2002/03 as reported by CMEW (2002).<sup>7</sup> When total food produced is compared to total requirements of 8,376,139 tonnes of food the country remains 102% self-sufficiency, which is substantially higher than the 94% reported in 2001/02. This leaves a marginal surplus of 196,149 tonnes of food over the next marketing year (2002/03). A flashback comparison shows that food security situation over the last two years has been improving overtime (c.f. self sufficiency ratios of 92% in 2000/01 and 94% in 2001/02 marketing season). According to CMEW (2002), the SSRs vary among regions leading to three categories of regions namely:

- a) Deficit regions (SSR < 100%): 4 regions (Arusha,<sup>8</sup> Tabora, Kilimanjaro and Dar es Salaam)
- b) Self-sufficient regions (SSR > 100% and < 120%): 11 regions (Mbeya, Dodoma, Mwanza, Morogoro, Shinyanga, Singida, Tanga, Mara, Lindi, Kigoma and Coast),<sup>9</sup> and
- c) Surplus regions (SSR > 120%): 5 regions (Mtwara, Rukwa, Kagera, Iringa and Ruvuma)

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<sup>7</sup> The analysis was done by CMEWS of the Ministry of Agriculture and Food Security based on the 2001/02 final food crop production forecasts.

<sup>8</sup> Arusha includes the new region of Manyara

<sup>9</sup> Comparing the SSRs in 2001/02 to that of 2000/01, Dodoma, Singida, Morogoro and Coast regions have shifted to self sufficient status in the later season

## 4.0 IRRIGATED PADDY IN USANGU AND ITS IMPLICATIONS

As it is for any other production activity, paddy production in Usangu basin has its implications in terms of resource utilization, trade, commodity supplies, consumption, food security and livelihoods both at the local and national levels. This section presents a trade-off analysis of irrigated paddy farming in Usangu using the following two scenarios:

- a) Current situation: *with irrigated paddy production*, and
- b) Alternative situation: *without irrigated paddy production*.

The analysis attempts to answer the question of what will be the effects if farmers in Usangu shift from the current practice of producing irrigated paddy to an alternative situation of not producing irrigated paddy. The effects are as discussed in subsections 4.1 to 4.4 below.

### 4.1 Local and national rice supplies

Using the average paddy production figures at the regional (Mbeya region) and national levels for the period from 1992/93 to 2000/01 (table 1), average paddy yield in Usangu (2.5 tonnes per hectare), maximum irrigated land under paddy in Usangu (about 42 000ha) and extraction rate (paddy to rice) of 0.6275, the quantity of paddy, which is produced in Usangu is estimated to amount to about 105,000 tonnes (equivalent to 66,000 tonnes of rice). This quantity is about 70% and 14.4% of the total quantity of paddy and rice produced at the regional (Mbeya) and national levels respectively. These proportions explain as to why Mbeya region should be considered as the major contributor to the national rice production.

Thus, if farmers in Usangu basin stop producing irrigated paddy, there will be a shrinkage in annual production (both at the local and national levels) of about 105,000 tonnes of paddy or 66,000 tonnes of rice.

### 4.2 Opportunity cost

By converting the annual production figure for Usangu basin (105,000 tonnes of paddy) into monetary value using an average producer price of Tsh 156.25 per kg of paddy (the Mbarali's average producer price for the year 2002, as also shown in table 4), the value of the Usangu paddy can be estimated at Tsh 16.4 billion or US \$ 15.9 million per annum.<sup>10</sup>

The above revenue supports about 30,000 agrarian families in Usangu. The average revenue per family is therefore, estimated at Tsh 546,875 or US \$ 530.95 per annum. This implies that if farmers in Usangu stop practicing irrigated paddy the opportunity cost for this decision is approximated to amount to Tsh 16.4 billion or US \$ 15.9 million per annum (average annual gross revenue from irrigated paddy). Assuming a cultivable season of work spanning 170 days including land preparation and harvest, this revenue amounts to an average daily household income of more than \$ 3.12 per day, which implies that irrigated paddy plays a crucial part in lifting the Usangu households out of poverty.

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<sup>10</sup> The value of paddy (in Tsh) is converted into US \$ using the current (April 2003) exchange rate of US \$ 1 = Tsh 1,030

The above revenues however, do not necessarily refer to net losses of income to farmers in the basin as they may shift their resources from producing irrigated paddy to production of rain-fed paddy or non-paddy crops or other income generating activities.

### 4.3 Irrigation water use and productivity

Summarized in table 20 are the parameters and procedure applied to estimate the amount and productivity of irrigation water in paddy production and hence the amount of water, which can be saved under the second scenario of *without irrigated paddy in Usangu basin*. The amount of water, which is currently utilized in irrigated paddy under the *business as usual (BAU)* scenario is estimated at about 576 Mm<sup>3</sup> per annum.<sup>11</sup> Out of this 60% (345.6 Mm<sup>3</sup>) is inter-regionally traded outside the basin as “virtual water”<sup>12</sup> to main consumption centres, particularly in Dar es Salaam, Mbeya and Morogoro. Under the *without irrigated paddy* scenario this water would be utilized in alternative ways, either as evaporation from seasonal swamps within the Usangu basin or made available for other intersectoral uses.

Under the alternative scenario of *with irrigated paddy in Usangu basin*, the productivity of irrigation water is estimated at 0.18 per m<sup>3</sup> or Tsh 28.13 per m<sup>3</sup> (equivalent to US \$ 0.027 per m<sup>3</sup> of irrigation water). In other words this is an estimate of the opportunity cost of irrigation water if the *without irrigated paddy* option is chosen.

Table 20: Usangu basin: Calculation of amount and value of water used in irrigated paddy

Estimated water abstraction for paddy irrigation	= 46 cumecs
Average annual depth of water applied in paddy field	= 1850 mm
Mean annual rainfall	= 669 mm
Effective annual rainfall	= 479 mm
Irrigation annual demand	= (1850 – 479)
	= 1371 mm
	= 1.371 m
Mean wet season irrigated area (paddy)	= 42,000ha
Annual volumetric demand (water use) for 42,000ha	= 42,000 x 10 <sup>4</sup> m <sup>2</sup> x 1.371 m
	= 576 x 10 <sup>6</sup> m <sup>3</sup>
	= 576 Mm <sup>3</sup>
Annual volumetric demand (water use) per hectare	= 0.013731 Mm <sup>3</sup>
	= 13731.43 m <sup>3</sup>
Average yield per hectare	= 2.5 tonnes
Estimated irrigation paddy productivity	= 0.18 Kg per m <sup>3</sup>
	= Tsh 28.45 (\$ 0.03) per m <sup>3</sup>
Estimated volume of “virtual water trade” per annum	= 60% x 576 Mm <sup>3</sup>
	= 345.6 Mm <sup>3</sup>

Source: Own calculation and SMUWC (2001) data

<sup>11</sup> The estimate considers only the wet season abstractions, if dry season irrigation is taken into account (August to November), then the figure might be higher, but the contribution of dry season flow downstream is considered as insignificant because dry season irrigated paddy is uncommon in Usangu Basin.

<sup>12</sup> “Virtual water” is defined as the water needed to produce a commodity or service (Allan, 2003).

#### 4.4 Balance of payments

In a macroeconomics context, the quantity of rice which is produced in Usangu should be accounted for in the Gross National Product (GNP) or National Income and Product Accounts, which also records income from sales of commodities abroad (exports) and payments for foreign-produced goods and services (imports). The net exports term (total exports minus total imports) in the GNP identity is the current account balance of the balance of payments. This is measured by the net receipts from the sale of currently produced goods and services abroad less payment for purchases of foreign-produced goods and services (including rice and other commodities).

Based on the above argument and the estimates given in the preceding subsections, the trade-offs between the above two scenarios can also be expressed in terms of the share of Usangu paddy in the country's GNP and hence the current account of the balance of payments. Using this criterion, one may argue that the country's GNP or current account balance of the balance of payments will be affected by an average of 66,000 tonnes of rice (valued at US \$ 15.9 million) if the second scenario (*without irrigated paddy production in Usangu*) will be adopted. The effect can either be in form of annual drop in rice exports or increase in imports of rice depending on the national supply and demand for rice.

## **5.0 POLICY INSTRUMENTS IN TANZANIA AND THEIR IMPACTS ON PADDY PRODUCTION**

The Government has used several policy instruments in order to achieve its development objectives. Some of the objectives have related to overall economic efficiency and economic growth, others have reflected a concern for the distribution of consumption and production resources while others have derived from the fact that the government cannot spend limitlessly and it needs to be supported by taxes and other sources of revenues. This section provides a brief discussion of some policy instruments, which have influenced production of paddy and other agricultural products in Tanzania prior to, and after, the 1974/75 cropping season.

Prior to 1974/75 the concern of the government has been that of maintaining price stability. The Government intervention in pricing agricultural products was in fixing into-store price. Producer price was determined as a residual after deducting estimated marketing costs of cooperatives.

Following two consecutive crop failures in 1973/74 and 1974/75 seasons, there was a change in priority to food self-sufficiency. A large increase in producer prices was instituted to both food and export crops but with a shift in the terms of trade in favour of food crops.

The period 1976/77 and 1983/84 was characterized by a general decline in producer prices for food grains in constant terms despite the price increases in nominal terms. This coincided with the dissolution of cooperatives in 1976. After the dissolution of cooperatives, state intervention in pricing changed from fixing into-store prices to fixing producer prices. A pan-territorial pricing system was therefore introduced. The move to pan-territorial pricing, which based on the desire to equalize regional incomes, had a detrimental effect on efficiency in resource allocation. The upward adjustment of real producer prices ended in 1976/77.

In order to boost food grain production, the pan-territorial pricing system was then replaced by regional pricing in 1982. The regional pricing system gave a premium price to areas with high production potential and marginal areas were awarded a lower price. The increase in producer prices in constant terms between 1983 and 1984 might have possibly been a result of this policy measure. Producer prices in constant terms declined between 1984/85 and 1989/90 despite the policy changes which included devaluation of the Tanzania shilling by 26% in dollar terms and a substantial increase in nominal producer prices of major food and export crops. These policy measures were re-enforced following the adoption of Structural Adjustment Programme (SAP) in June 1986, and the monopolistic role of the state marketing institutions was reduced and state control in marketing and pricing was relaxed. A number of private traders began to operate in food grains. Consequently producer prices for grains (including paddy) increased and encouraged farmers to increase production and extend the area under both rain-fed and irrigated paddy. However, the increases in producer prices have been only in nominal terms. In real terms the prices have been declining over time (section 3.3).

## 5.0 SUMMARY AND CONCLUSIONS

In Tanzania, the bulk of paddy (70 – 80%) is produced from five regions namely Mbeya, Shinyanga, Mwanza, Morogoro and Tabora. As for the district level, paddy production at the national level has shown an increasing trend with oscillations from one year to another. It has, for example, increased from 425,000 tonnes in 1984/85 to 744,000 tonnes in 1989/90. It has thereafter declined to 391,000 tonnes in 1991/93 and then increased to 806,800 tonnes in 1995/96. The largest figure was recorded in 2000/01 (870,700 tonnes). At the district level (Mbarali), paddy production for the past ten years has averaged at 59,990 tonnes. The highest figure was recorded in 2001/02 (85,200 Metric tonnes) and the lowest in 1998/99 (30,510 tonnes).

The available official statistics show that, Tanzania has heavily depended on rice imports to satisfy local consumption requirements during most of the period before and after food trade liberalization making the country to be a net importer of the commodity. The domestic annual rice supplies for the period from 1972/73 to 2000/01 have averaged at 302,600 tonnes against the average national consumption of 350,460 tonnes per annum, recording an average deficit of about 47,860 tonnes per annum for the same commodity.

The use of fertilizers, pesticides, herbicides or manure at the local level is rare. Of the interviewed farmers, only 3.3% apply fertilizers. Most farmers do not use artificial inputs because they see them as too expensive. Manure is also rarely used because it is difficult to carry sufficient quantities to the distant paddy fields. The analysis of costs and margins showed variations in returns to labour and profit margins.

Return to labour for a smallholder farmer who irrigates his/her paddy field and uses tractor, fertilizer and hired labour was higher (Tsh 2,486.3 or US \$ 2.4 per manday) than any of the remaining paddy production systems. They also obtained the highest gross margin (Tsh 280,950 or US \$ 272.8) per ha. The smallest return to labour (Tsh 490.5 or US \$ 0.5 per manday) was obtained by an average smallholder farmer who cultivated rain-fed paddy using hand hoe and family labour. On average, the smallholder farmers who hired the National Agriculture and Food Corporation (NAFCO) farms/plots and cultivated irrigated paddy, using tractor, fertilizer and hired labour obtained the least gross margin (Tsh 77,600 or US \$ 75.3 per ha). Similarly, productivity of irrigation water (paddy produced per drop) was also relatively lower [0.12kg or Tsh 18.2 (US \$ 0.02) per cubic meter] for smallholder farmers within the NAFCO systems than for their counterpart smallholder farmers outside the NAFCO systems [0.22kg or Tsh 34.1 (US \$ 0.03) per cubic meter].

For a local trader buying paddy and selling rice within Usangu the profit margin was higher than that of an inter-regional trader buying paddy in Usangu and selling rice in Dar es Salaam (Tsh 15.00 per kg versus Tsh 12.75 per kg). Much of the profit margin for the latter trader is eroded by excessive marketing costs. The number of taxes and the amount taxed on rice and other agricultural produces were reported to be on the increase. High taxation for traders implies passing on the taxes to the rural poor (farmers) by way of lower farm prices unless there is increasing competition among crop buyers to offset this trend and the traders are bearing part of the burden. The same also implies high consumer prices to residents living in places like Dar – es Salaam and Morogoro where the commodity is sold.

Irrigated paddy benefits about 30,000 households in Usangu by supporting them with food and cash from crop sales, which help them pay school and medical costs and buy other things to improve their lives. If all farmers in Usangu were to decide stop producing irrigated paddy there will be a shrinkage in the annual paddy supply (both at the local and national levels) of about 105,000 tonnes (70% or 14.4% of the annual paddy production in Mbeya region or in Tanzania respectively) and an opportunity cost of about Tsh 16.4 billion or US \$ 15.9 million (gross revenue from irrigated paddy in Usangu) will be incurred annually. This is equivalent to Tsh 546,875 or US \$ 531.0 per annum for an average household practicing irrigated paddy in Usangu or an average daily household income of more than \$ 3.1 per day, which implies that irrigated paddy plays a crucial part in lifting the Usangu households out of poverty.

In terms of water resource utilization, about 576 Mm<sup>3</sup> of water, which is currently consumed in irrigated paddy annually would be utilized in alternative ways, either as evaporation from seasonal swamps within the Usangu basin or made available for other intersectoral uses. It is however, worth noting that out of this water 60% (345.6 Mm<sup>3</sup>) is inter-regionally traded outside the basin as “virtual water” to main consumption centres, particularly in Dar es Salaam, Mbeya and Morogoro.

Although irrigated paddy in Usangu basin is seen as utilizing too much of the available water resources, the same sector plays an important role in enhancing food security, rural income and livelihoods of the local people. The area constitutes the single largest rice producer in Tanzania contributing the largest share of paddy to the national production. Based on these facts, one would suggest not abandoning the practice but striving to increase irrigation efficiency and improve its productivity.

The findings presented in this report show that, although irrigated paddy (in Usangu basin) is asserted as utilizing too much of the available water resources, the same is also playing an important role in enhancing food security, rural income and livelihoods of the local people in the area. It also contributes a large share of paddy to the national production (about 14%). Based on these facts, one would suggest not abandoning the practice but striving to increase irrigation efficiency and improve productivity (paddy produced per drop). The current average productivity figure for the basin (0.18 kg of paddy per m<sup>3</sup> of irrigation water) compares well with figures reported in many other developing countries (e.g., 0.19 - 0.22 kg/m<sup>3</sup> for India). The water productivity of rice in Sub-Saharan Africa ranges from 0.10 to 0.25 kg/m<sup>3</sup>. Elsewhere in the world, figures of up to 0.6 kg/m<sup>3</sup> are found but with intensive management, thus the Usangu figures are approximately 30 – 67% of attainable productivity and there is room for improvement, if “wise use” of water resources is achieved.

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**Appendix 1: Mbarali District: Production trend for other crops, 1992/93 - 1999/2000**

Year	Maize		Sorghum		Finger millet		Sweet potatoes		Cassava		Beans		Groundnuts	
	Ha	MT	Ha	MT	Ha	MT	Ha	MT	Ha	MT	Ha	MT	Ha	MT
1992/93	22,888	35,798	757	1,011	430	344	876	4,818	617	3,394	770	616	3,098	2,478
1993/94	21,300	51,120	578	1,072	397	397	956	8,891	534	4,806	786	786	3,338	4,173
1994/95	20,454	24,544	680	1,100	470	423	1,294	7,764	666	3,996	906	725	3,200	2,560
1995/96	22,346	67,035	730	660	506	500	1,000	6,700	701	6,300	834	800	2,940	1,470
1996/97	25,665	17,223	800	730	1,000	500	1,159	8,229	758	5,738	840	934	3,000	2,100
1997/98	28,771	74,805	992	1,248	336	336	1,660	16,600	617	6,170	5,897	6,060	8,364	10,037
1998/99	34,984	31,486	3,364	4,586	1,900	1,843	4,820	28,636	1,187	6,980	4,545	900	9,200	4,740
1999/00	10,000	15,000	1,000	1,000	350	280	550	2,750	1,000	6,000	360	2,124	2,700	1,080
2000/01	32,500	74,750	5,400	7,020	1,800	2,000	3,000	32,500	2,800	29,200	6,000	5,200	17,000	10,250
2001/02	33,000	66,000	9,000	7,200	1,200	840	3,200	25,600	2,200	15,400	11,000	8,800	12,000	10,800
Average	25,191	45,776	2,330	2,563	839	746	1,852	14,249	1,108	8,798	3,194	2,695	6,484	4,969
T/Ha		1.8		1.1		0.9		7.7		7.9		0.8		0.8

Source: Mbarali District Agricultural Office

## Appendix 2: Paddy production and marketing: Costs and margin/revenue structure, 2001/2002

### 1) Costs and margins for smallholder farmers in Usangu—rain-fed paddy cultivation using hand hoe and family labour

	Units	Price/unit	Total Value
<b>REVENUE:</b>			
Yield (Kg/Ha)	788	156.25	123,125.00
Total revenue			123,125.00
<b>COSTS:</b>			
Seeds (Kg/Ha)	33	200.00	6,600.00
Bags and twine	10	700.00	7,000.00
Transport			8,000.00
Total costs (Tsh/Ha)			21,600.00
GROSS MARGIN (Tsh/Ha)			101,525.00
Average farm size (Ha)	0.3		
Family labour (mandays/Ha)	207		
GROSS RETURN TO AN AVERAGE FARM (Tsh)			30,457.50
RETURNS PER MANDAY (Tsh/manday)			490.46
RETURNS PER MANDAY (US \$/manday)			0.48

### 2) Costs and margins for smallholder farmers in Usangu—rain-fed paddy cultivation using tractor, fertilizers and hired labour

	Units	Price/unit	Total Value
<b>REVENUE:</b>			
Yield (Kg/Ha)	1500	156.25	234,375.00
Total revenue			234,375.00
<b>COSTS:</b>			
Seeds (Kg/Ha)	34	200.00	6,800.00
Fertilizer (bags/Ha)	2	15,000.00	30,000.00
Tractor hiring charge (Tsh/Ha)			30,000.00
Hired labour (days/Ha)	39	1,500.00	58,500.00
Bags and twine	10	700.00	7,000.00
Transport			8,000.00
Total costs (Tsh/Ha)			140,300.00
GROSS MARGIN (Tsh/Ha)			94,075.00
Average farm size (Ha)	0.5		
Family labour (mandays/Ha)	183		
GROSS RETURN TO AN AVERAGE FARM (Tsh)			47,037.50
RETURNS PER MANDAY (Tsh/manday)			514.07
RETURNS PER MANDAY (US \$/manday)			0.50

**3) Costs and margins for smallholder renting a plot in NAFCO farms (Usangu) irrigated paddy cultivation using tractor, fertilizers and hired labour**

	Units	Price (Tsh/Unit)	Value (Tsh)
<b>REVENUE:</b>			
Yield (Kg/Ha)	1600	156.25	250,000.00
Total revenue			250,000.00
<b>COSTS:</b>			
Plot renting (Tsh/Ha)			30,000.00
Seeds (Kg/Ha)	22.00	200.00	4,400.00
Fertilizer (bags/Ha)	2.00	15,000.00	30,000.00
Tractor hiring charge (Tsh/Ha)			30,000.00
Hired labour (days/Ha)	42.00	1,500.00	63,000.00
Bags and twine	10.00	700.00	7,000.00
Transport			8,000.00
Total costs (Tsh/Ha)			172,400.00
GROSS MARGIN (Tsh/Ha)			77,600.00
Farm/plot size (Ha)	6.00		
Labour (mandays/Ha)	102.00		
GROSS RETURN TO AN AVERAGE PLOT (Tsh)			465,600.00
RETURNS PER MANDAY (Tsh/manday)			760.78
Estimated annual volumetric water demand (use) (m <sup>3</sup> per ha)	13,731.00		
Estimated annual volumetric water demand for the average plot size of 6 ha (m <sup>3</sup> )	82,386.00		
Productivity (value) of irrigation water (Kg/m <sup>3</sup> )	0.12		
Productivity (value) of irrigation water (Tsh/m <sup>3</sup> )		156.25	18.21
Productivity (value) of irrigation water (US \$/m <sup>3</sup> )		0.15	0.02

**4) Costs and margins for smallholder farmers in Usangu—irrigated paddy cultivation using tractor, fertilizers and hired labour**

	Units	Price (Tsh/Unit)	Value (Tsh)
<b>REVENUE:</b>			
Yield (Kg/Ha)	3000	156.25	468,750.00
Total revenue			468,750.00
<b>COSTS:</b>			
Plot renting (Tsh/Ha)			30,000.00
Seeds (Kg/Ha)	24.00	200.00	4,800.00
Fertilizer (bags/Ha)	2.00	15,000.00	30,000.00
Tractor hiring charge (Tsh/Ha)			30,000.00
Hired labour (days/Ha)	52.00	1,500.00	78,000.00
Bags and twine	10.00	700.00	7,000.00
Transport			8,000.00
Total costs (Tsh/Ha)			187,800.00
GROSS MARGIN (Tsh/Ha)			280,950.00
Average farm size (Ha)	1.25		
Labour (mandays/Ha)	113.00		
GROSS RETURN TO AN AVERAGE FARM (Tsh)			351,187.50
RETURNS PER MANDAY (Tsh/manday)			2,486.28
Estimated annual volumetric water demand (use) (m <sup>3</sup> per ha)	13,731.00		
Estimated annual volumetric water demand for the average farm size of 0.7 ha (m <sup>3</sup> )	17,163.75		
Productivity (value) of irrigation water (Kg/m <sup>3</sup> )	0.22		
Productivity (value) of irrigation water (Tsh/m <sup>3</sup> )		156.25	34.14
Productivity (value) of irrigation water (US \$/m <sup>3</sup> )		0.15	0.03

### 5) Costs and Revenue structure for local trader buying paddy and selling rice within Usangu/along the Mbeya-Dar main road

	Units	Price /unit	Total Value
<b>REVENUE:</b>			
Sale of rice (Kg/day)	144	320.00	46,080.00
Total revenue			46,080.00
<b>COSTS:</b>			
Paddy (Kg)	288	125.00	36,000.00
Bags and twine	3	700.00	2,100.00
Transport	3	600.00	1,800.00
Milling costs	144	17.50	2,520.00
Village levy	3	500.00	1,500.00
Total costs (Tsh/Ha)			43,920.00
Margin (Tsh/day)			2,160.00
Margin per Kg of paddy (Tsh/Kg)			7.50
Margin per Kg of rice (Tsh/Kg)			15.00

### 6) Costs and margins for an inter-regional trader buying paddy in Usangu and selling rice in Dar es Salaam

	Units	Price (Tsh/unit)	Value (Tsh)
<b>REVENUE:</b>			
Sale of rice (bags/trip @ 180 Kg)	40	72,000.00	2,880,000.00
Total revenue			2,880,000.00
<b>COSTS:</b>			
Purchasing paddy (Bags @ 96 Kg)	150	12,000.00	1,800,000.00
Bags and twine	150	700.00	105,000.00
Local taxes/levies at source	150	700.00	105,000.00
Loading at source and unloading at the mill	150	1,000.00	150,000.00
Transport from source to the mill	150	1,000.00	150,000.00
Drying and refilling in the bags	150	200.00	30,000.00
Feeding in the mill	150	100.00	15,000.00
Milling charges	40	3,150.00	126,000.00
Filling rice in the bags	40	350.00	14,000.00
Local taxes/levies after milling	40	1,200.00	48,000.00
Loading from the mill	40	700.00	28,000.00
Transport from the mill to Dar es Salaam	40	3,000.00	120,000.00
Unloading	40	550.00	22,000.00
Storage	40	30.00	1,200.00
Dalali fee	40	1,800.00	72,000.00
Market charges	40	50.00	2,000.00
Total costs (Tsh)			2,788,200.00
Margin per trip (Tsh)			91,800.00
Margin per bag of rice (Tsh/bag)			2,295.00
Margin per Kg of rice (Tsh/Kg)			12.75

\*Calculated using the average paddy yield for Usangu of 2500 kg/ha (SMUWC 2001), average producer price of Tsh 156.25 per kg of paddy and an annual volumetric demand (use) of irrigation water of 13731 m<sup>3</sup>. Productivity of irrigation water in paddy production is therefore equal to 0.18 kg of paddy per m<sup>3</sup> of water equivalent to 0.09 kg of rice per m<sup>3</sup> of water or Tsh 28.12 per m<sup>3</sup>.

### Appendix 3: National food balance sheet, June 2002 – May 2003 ('000 tonnes) as of September, 2002

	Rice	Maize	Sorghum & millet	Wheat	Total cereals	Non-cereals*	Total food
Domestic Availability	734	2927	1040	396	5096	4111	9207
Opening Stocks @ 1.6.2002	93	222	0	319	634	0	634
Public Stocks (SGR)	0	48	0	0	48	0	48
Private Stocks	16	7	0	267	289	0	289
Farm retention	77	167	0	52	297	0	297
Gross Harvest	640	2705	1040	77	4462	4111	8572
Crop Domestic Requirements	573	3089	1264	176	5102	3274	8376
Desired SGR Carryover Stocks	0	150	0	0	150	0	150
National Food Balance	161	-312	-224	219	-156	836	680
Commodity Cross Substitution	0	513	231	92	836	-836	0
Domestic Shortfall [-]/Surplus	161	201	7	312	681	0	681
Planned Imports	0	5	0	75	80	0	80
Received					0	0	0
Commercial**	0	5	0	75	80	0	80
Food Aid	0	0	0	0	0	0	0
Expected	4	2	0	42	48	0	48
Planned Exports	0	0	0		1	0	1
Commitments shipped	0	0	0		1	0	1
Commitments not yet shipped	0	0	0		0	0	0
Import Gap	0	0	0		0	0	0
Forecasted Closing Stocks	161	355	7	386	910	0	910
Current Stocks @ 30.9.2002	9	144		33	186	0	186

Source: CMEW, National Food Security Division, MAFS

\* Non-cereals include pulses, cassava, banana & potatoes

\*\* Commercial Sector importation of highly tradable food items like wheat is not only in response to demands in domestic market but also in neighbouring countries. Food is imported to Tanzania and then re-exported to such countries making use of the prevailing free trade opportunity.

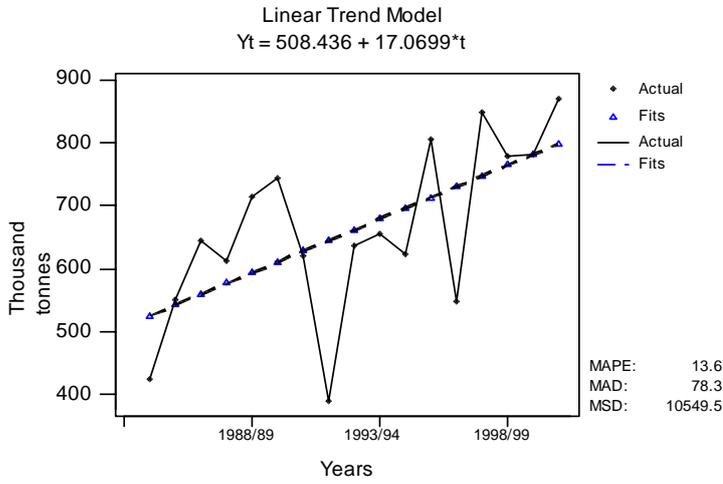
### Appendix 4: Tanzania Food Supply Analysis and the Self Sufficiency Ratio for 2002/03 (based on 2001/02 Final Food Crop Production Forecasts)

Region	Total Cereals				Total Non-cereals				Total Food				Deficit
	Product.	Requir.	Gap / Surplus	SSR (Cer.) (Cereals)	Product.	Requir.	Gap / Surplus	SSR (Non-cer.)	Product.	Requir.	Gap / Surplus	SSR (Total)	
Arusha	278,716	374,746	-96,030	74	173,810	225,983	-52,173	77	452,526	600,729	-148,203	75	*
Coast	75,502	188,996	-113,494	40	254,135	119,047	135,088	213	329,637	308,043	21,594	107	
DSM	7,774	387,922	-380,148	2	32,662	253,920	221,258	13	40,436	641,842	-601,406	6	*
Dodoma	262,952	268,635	-5,683	98	175,023	165,531	9,492	106	437,975	434,166	3,809	101	
Iringa	402,226	273,218	129,008	147	161,736	168,904	-7,168	96	563,962	442,122	121,840	128	
Kagera	126,817	277,064	-150,247	46	482,329	190,300	292,029	253	609,146	467,364	141,782	130	
Kigoma	162,123	173,587	-11,464	93	154,371	121,898	32,473	127	316,494	295,485	21,009	107	
Kilimanjaro	195,677	217,071	-21,394	90	152,508	141,869	10,639	107	348,185	358,940	-10,755	97	*
Lindi	100,892	176,740	-75,848	57	171,644	81,525	90,119	211	272,536	258,265	14,271	106	
Mara	190,571	222,625	-32,054	86	205,739	139,672	66,067	147	396,310	362,297	34,013	109	
Mbeya	405,707	333,602	72,105	122	229,774	218,631	11,143	105	635,481	552,233	83,248	115	
Morogoro	289,064	264,102	24,962	109	181,627	173,084	8,543	105	470,691	437,186	33,505	108	
Mtwara	98,829	156,645	-57,816	63	304,784	102,659	202,125	297	403,613	259,304	144,309	156	
Mwanza	325,577	394,740	-69,163	82	422,979	258,699	164,280	164	748,556	653,439	95,117	115	
Rukwa	318,548	192,272	126,276	166	95,388	126,009	-30,621	76	413,936	318,281	95,655	130	
Ruvuma	186,860	179,615	7,245	104	180,236	117,714	62,522	153	367,096	297,329	69,767	123	
Shinyanga	443,836	389,140	54,696	114	237,805	255,029	-17,224	93	681,641	644,169	37,472	106	
Singida	166,912	163,940	2,972	102	109,554	107,441	2,113	102	276,466	271,381	5,085	102	
Tabora	212,430	211,439	991	100	124,576	138,570	-13,994	90	337,006	350,009	-13,003	96	*
Tanga	210,771	255,867	-45,096	82	259,826	167,687	92,139	155	470,597	423,554	47,043	111	
Total	4,461,784	5,101,966	-640,182	87	4,110,506	3,274,172	836,334	126	8,572,290	8,376,138	196,152	102	

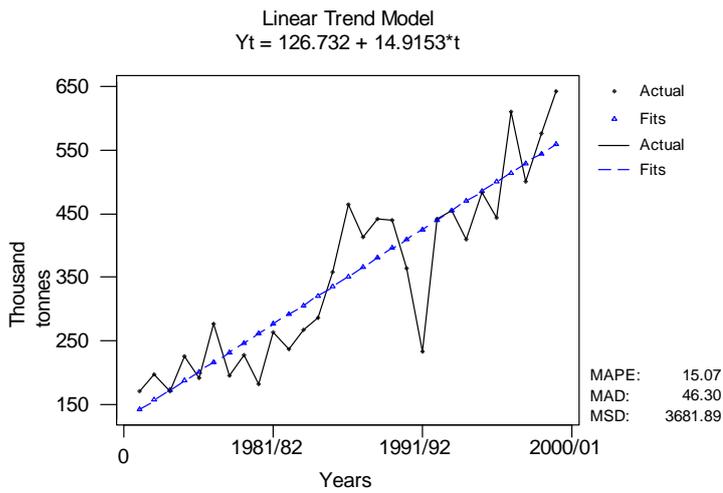
Source: CMEW, National Food Security Division MAFS

### Appendix 5: Trend analyses for rice production, consumption and prices

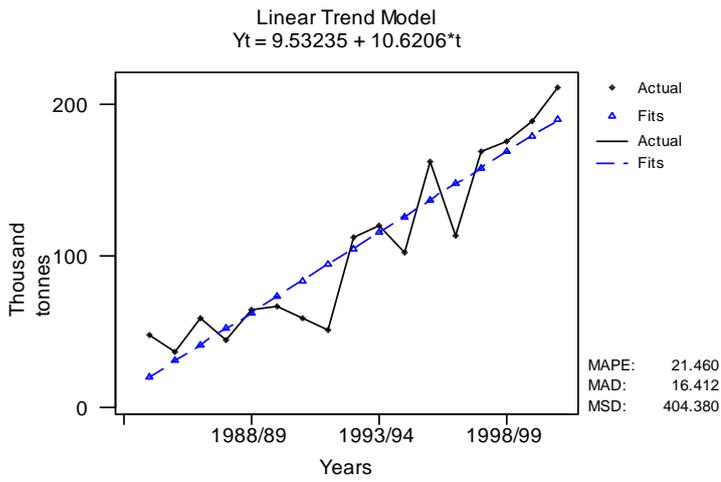
a) Paddy production at the national level, 1984/85 - 2000/01



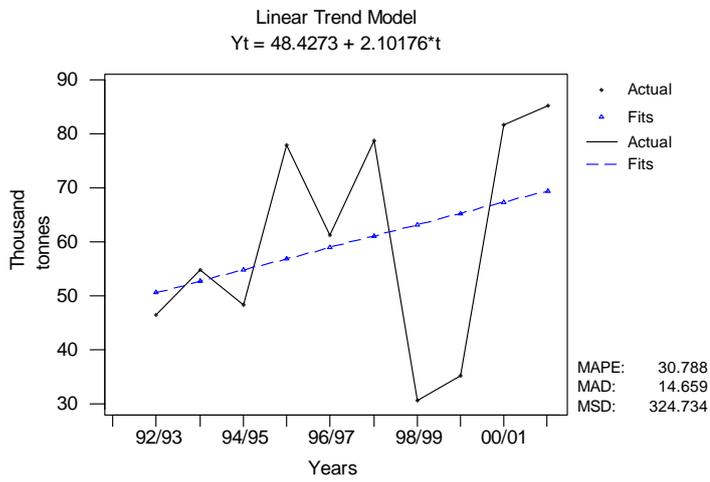
b) Rice consumption trend at the national level, 1972/73 - 2000/01



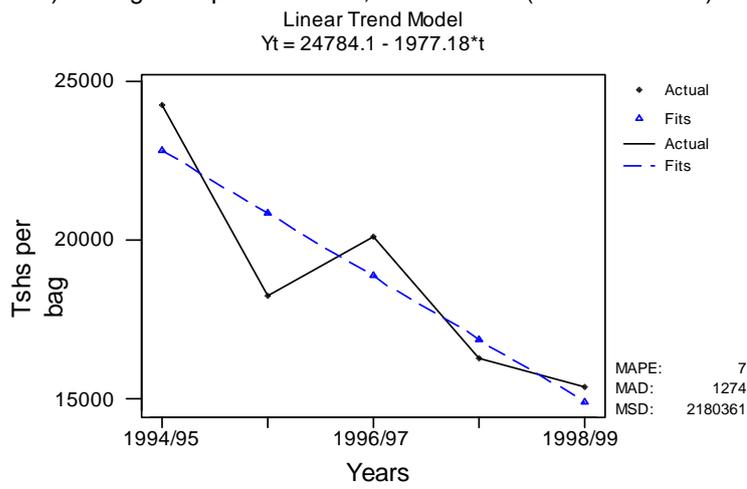
c) Paddy production at the regional level, 1984/85 - 2000/01



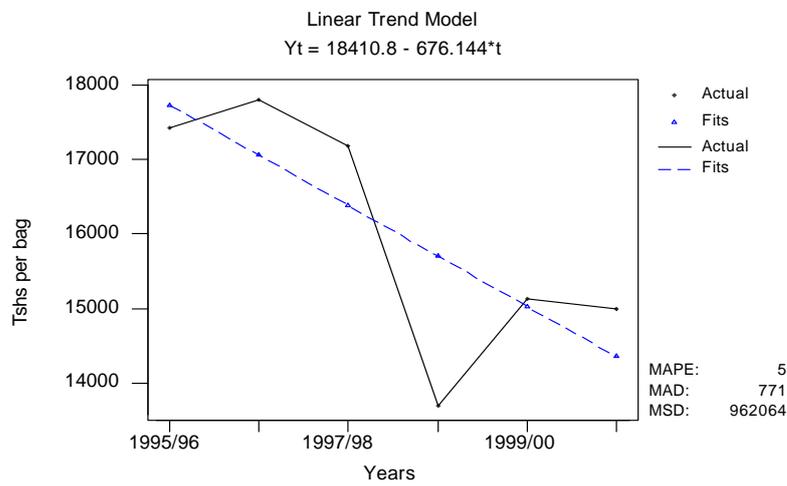
d) Paddy production at the district level, 1992/93 - 2001/02



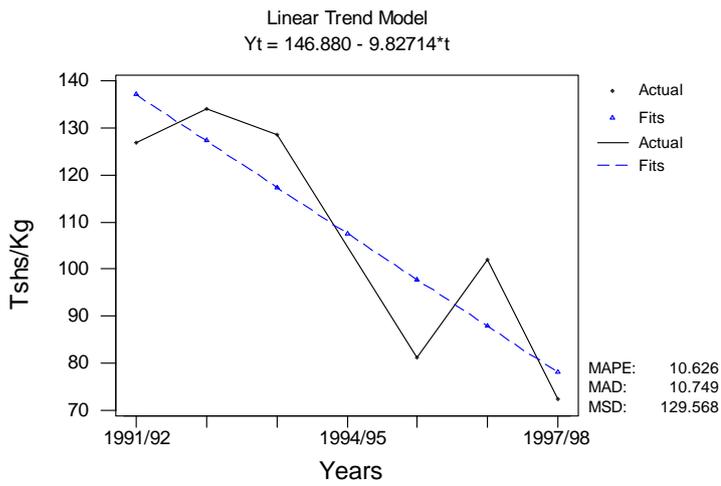
e) Average real prices for rice, national level (1994/95 - 98/99)



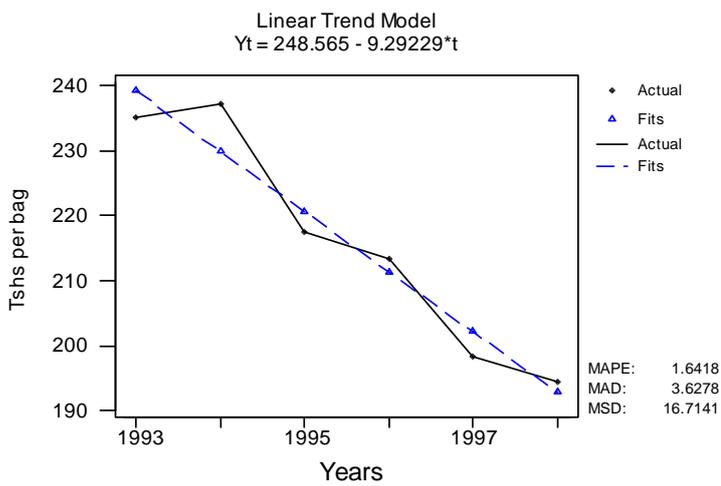
f) Average wholesale prices (real) for rice in major regional markets, 1995/96 - 2000/01



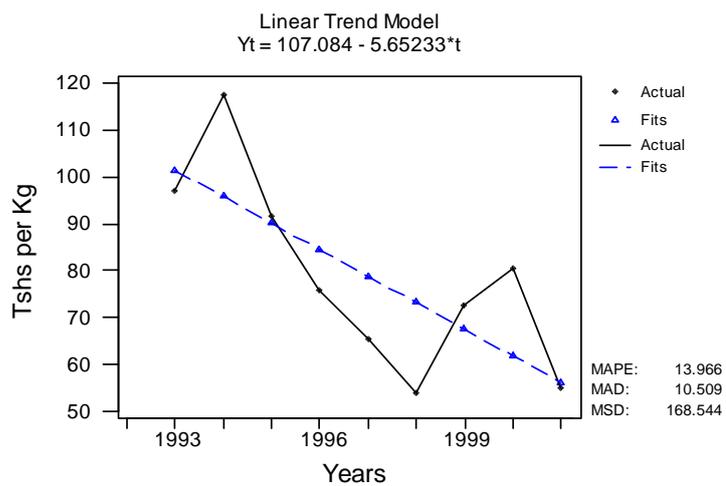
g) Average producer prices (real) for paddy, national level (1991/92 - 97/98)



h) Mbarali district: Average producer prices (real) for paddy (1993 - 2001)



i) Mbarali district: Average producer prices (real) for paddy (1993 - 2001)



## Appendix 6: Correlation analysis

	Correlation
Paddy production and time, Mbeya region (1984/85 – 2000/01)	0.933***
National and regional paddy production (1984/85 – 2000/01)	0.764***
Rice consumption and time, national level (1972/73 – 2000/01)	0.899***
Nominal prices for rice (Tsh/Kg) and time, national level (1991/92 – 1996/97)	0.998***
National and regional paddy production (1992/93 – 2000/01)	0.910***
Real prices for rice (Tsh/Kg) and time, national level (1991/92 – 1996/97)	-0.968***
Nominal paddy prices/bag and time, Mbarali district (1993 – 2001)	0.813***
Nominal prices (Tsh/Kg) and time, national level (1991/92 – 1997/98)	0.865**
Real prices for rice (Tsh/Kg) and time, Mbeya region (1995/96 – 1999/00)	-0.913**
Real prices for paddy (Tsh/Kg) and time, national level (1991/92 – 1997/98)	-0.843**
Average wholesale nominal prices (rice) in major regional markets and time (1995/96 – 2000/01)	0.768**
Average real prices in major regional markets and time (1995/96 – 2000/01)	-0.762**
Real paddy prices/bag and time, Mbarali district (1993 – 2001)	-0.615**
Real paddy prices/bag and paddy production, Mbarali district (1993 – 2001)	-0.584*
Real paddy prices (Tsh/Kg) and paddy production, national level (1991/92 – 1997/98)	-0.712
Paddy production and time, national level (1991/92 – 1997/98)	0.692
Paddy production and real prices for rice, national level (1994/95 - 1998/99)	-0.732
Rice production and time, Mbeya region (1995/96 – 1999/00)	0.641
National and district paddy production (1992/93 – 2000/01)	0.379
Nominal paddy prices/bag and paddy production (000 tonnes), district level (1993 – 2001))	-0.367
Nominal prices-rice (Tsh/Kg) and rice production, national level (1991/92 – 1996/97)	0.479
Real prices-rice (Tsh/Kg) and rice production, national level (1991/92 – 1996/97)	-0.468
Paddy production and nominal prices for rice, national level (1994/95 - 1998/99)	-0.475
Paddy production and time, national level (1994/95 - 1998/99)	0.435
Paddy production and nominal prices, national level (Tsh/Kg), 1991/92 – 1997/98	0.374
Real prices for rice (Tsh/Kg) and rice production, regional level (1995/96 – 1999/00)	-0.406
Regional and district paddy production (1992/93 – 2000/01)	0.229
Nominal prices-rice (Tsh/Kg) and rice production, regional level (1995/96 – 1999/00)	0.352
Nominal prices-rice (Tsh/Kg) and time, regional level (1995/96 – 1999/00)	0.287
National paddy production and time (1991/92 – 1997/98)	0.128
Paddy production (000 tonnes) and time, district level (1993 – 2001)	0.113
***	Significant at 0.01 per cent
**	Significant at 0.05 per cent
*	Significant at 0.10 per cent