CID Working Paper Series

Food Demand Changes in Mozambique: Assessing the Role of the Rice Sector

Alessandro Alasia
Jan Low
Claudio Soregaroli

WP-N. 7
May 2003

Centre for International Development
Via dei Bersaglieri 5/c
40125 Bologna, Italy.
tel. +39.051.5870085/87
fax +39.051.221882
e-mail: cid@cid-bo.it
Internet: www.cid-bo.it

Working Paper Series

The working papers publication series is intended to be a forum for discussion on recent and on-going research conducted by CID associates and scholars at large. The forum is open to external contributions concerning the broad field of interest to the CID. Authors are invited to submit their works on the social, economic, institutional and political dimensions of development and international cooperation.

The papers are assessed by a Scientific Committee but they are included in the series prior to a full peer review to stimulate feedback and provide an opportunity for discussion. The readers are encouraged to submit comments and suggestions to the CID or to the authors. Working papers are expected to be published in some other form and their contents may be revised.

Food Demand Changes in Mozambique: Assessing the Role of the Rice Sector

by

Alessandro Alasia
alasia@spbo.unibo.it

Jan Low
lowj@msu.edu

Claudio Soregaroli
claudio.soregaroli@unicatt.it

May 2003

This paper was prepared for the IV International Symposium "Perspectives of the Agri-food System in the new Millenium" of the *Association Internationale D'Economie Alimentaire et Agro-industrielle* - AIEA2, Bologna, September 5-8, 2001, and subsequently published in the proceedings of the Symposium.

Alessandro Alasia is Research Coordinator at the Centre for International Development, Bologna, Italy. Jan Low is Visiting Associate Professor at the Department of Agricultural Economics, Michigan State University, USA. Claudio Soregaroli is Researcher at the *Istituto di Economia Agroalimentare*, Catholic University, Piacenza. Italy.

ABSTRACT

Considerable potential exists for growth in rice production and consumption in Mozambique, which suggests that this sector may require greater attention in formulating national food policies and agricultural interventions. First, this paper presents an overview of the sector and related policy issues. Then, we use a food demand system to assess the effects of rice price changes on the food demand structure and trends. These results provide a quantitative assessment of the potential consumption growth of rice and other major food crops under different scenarios affecting the relative price of rice, pinpointing the significant substitution effect between rice and wheat and the resultant implications for the Mozambican trade balance.

Keywords: rice, food demand, Mozambique.

SOMMAIRE

Il a un considérable potentiel de croissance pour la production et consommation de riz au Mozambique, ce qui suggère que ce secteur requière une plus grande attention des responsables et des analystes des politiques alimentaires et des interventions agricoles. D'abord, cet article présente une vue d'ensemble du secteur et de ces politiques. Puis, nous employons un système de demande alimentaire pour évaluer les effets des variations de prix du riz sur la structure et les tendances de la demande alimentaire. Ces résultats fournissent une évaluation quantitative de la croissance potentielle de consommation du riz et d'autres produits alimentaires sous différents scénarios de variation du prix relatif du riz. Ceci indique un effet significatif de substitution entre le riz et le blé qui peut avoir des effets important pour la balance commerciale du pays.

Mot-clés: riz, demande alimentaire, Mozambique.

TABLE OF CONTENTS

LIST OF TABLES

1. INTRODUCTION

Rice has been grown in Mozambique for about 500 years. Its introduction into Southern Africa is attributed to the Arabs, Asian traders and immigrants, and the Portuguese. During the 1930s, the Portuguese colonial Government attempted to develop a viable commercial sector by investing in major irrigation schemes and supporting new settlers in these areas (Newitt, 1995). Most of the irrigated land was absorbed into State farms after independence in 1975, an experience that proved to be largely unsuccessful. Like the colonial regime, the post-independence Government neglected the family sector, which in the early 1970s was already dominating the national agricultural production and was contributing in a significant way to the marketed output (Newitt, 1995). Only in the second half of the 1980s, coincident with a major shift towards market-oriented production systems, did the attention of public policy turn to the family sector. However, throughout the 1980s and until the early 1990s, the devastating civil war set a wedge between growing food demand in urban areas, increasingly covered by imports, and a disrupted rural economy that was struggling for subsistence.

Today, rice contributes about 10-15% of cereal caloric supply at the national level. The family sector produces about 90% of the domestic supply of rice, primarily in the rainfed lowland ecosystem, but smallholder production remains to a large extent oriented to self-sufficiency. Although rice is not the major staple in the national diet, which in aggregate terms is dominated by maize and cassava, there are several reasons why this crop should be of interest to national agricultural and food policy makers.

First, recent research has indicated that the projected rates of economic growth and urbanisation over the next decade will result in a substantial increase of food demand and in a shift from domestically produced crops, such as maize and tubers, toward imported crops such as rice and wheat (Alasia and Soregaroli, 2002). Between the beginning and the end of the current decade, the aggregate expenditure for maize and tubers may be expected to grow between 1.4 and 2.3 times, in real terms, depending on the nature and speed of socio-economic changes. For rice and wheat, the expected growth is between 1.7 and 4.5. Even though expenditure growth may not translate directly in quantity growth, these results suggest that consumption will shift from traditional foods requiring considerable preparation time, such as maize and tubers, toward more convenient foods, such as rice and processed wheat-based products. This pattern replicates trends that have also been observed in other African countries (Teklu, 1996; Reardon, 1993).

Second, and related to the previous point, rice and wheat are major import crops in Mozambique. Wheat is almost entirely imported. For rice, the domestic production has covered on average about 50% of the national requirements since 1995, with an estimated import requirements of about 150,000 tons in 1999/2000 and 240,000 tons in 2000/2001 (DNCI/MICTUR, n. 11-12, 1999 and n. 21-23, 2000).

Third, while the potential for domestic expansion of wheat appears limited, due to the agro-climatic conditions, the potential for growth of the rice sector is considerable. Yields are currently low with national average estimated at 1.04 tons per hectare (MADER/DNER, 2000). There exists considerable potential for improvement, with an estimated 890,000 hectares considered suitable for rice production (MADER/DNER, 2000). Research on the structural linkages between sectors of the Mozambican economy also indicates that rice is the crop with the highest multiplicative effect for household income (Arndt *et al.*, 1998).

Finally, with increasing urbanisation and rising populations, demand for imported rice is expected to continue to rise in Sub-Saharan Africa, from 2.8 to 6.8 million metric tons between 1990 and 2020, representing a 4.8% annual increase in imports (Rosengrant *et al.*, 1995). The Southern Africa Development Community (SADC) countries imported 953,000

tons of rice in 1998 (DNCI/MICTUR, 2000). Thus, if Mozambique could begin to competitively produce rice, a regional demand exists to absorb any surplus production.

In this paper we present an overview of the rice sector, by looking at production, marketing, consumption patterns and policy issues. Then, we use a food demand system estimate developed for Mozambique (see Alasia and Soregaroli, 2002) to assess how changes in the price of rice would affect the demand of this cereal and of the other food crops that constitute the bulk of the national diet. The demand system includes the main food staples in the national diet, namely maize, millet and sorghum, rice, wheat, cassava, potatoes, sweet potatoes, beans, and groundnuts. The data used for the estimate come from the *Inquérito Nacional aos Agregados Familiares sobre as Condições de Vida* 1996-97 (National Household Living Conditions Survey, hereafter referred to as IAF).

The paper is organised in four major sections. The next section provides an overview of the rice economy by summarising production, marketing and consumption patterns, and the major policy issues for the sector. Section 3 outlines the characteristics of the model and estimation and simulation procedures, and then focuses on the results of simulations that show levels of consumption that would be induced by policies affecting the relative price of rice. Section 4 discusses the policy implications of the findings, and the directions of future research.

2. THE RICE SECTOR IN MOZAMBIQUE

Production and consumption of rice has been growing during the 1990s. Estimates for 1999-2000 indicate that rice has become the second most important cereal in term of consumption, with almost 250 thousand tons required annually, maize being the first with about 1.1 million tons; rice is also the third most important cereal in term of production, with about 100,000 tons/milled equivalent produced annually, after maize (about 1.1 million) and sorghum and millet (about 350,000 tons) (DNCI/MICTUR, 1999, n. 11-12). Yet, before discussing the available evidence in detail, it should be stressed that the quality of agricultural statistics in Mozambique is still poor. Since the end of the civil war a major effort has been made to strengthen data collection by establishing national information systems and conducting a nationally representative household survey, but production and consumption data still remain weak and difficult to compare. As a consequence, data from different sources often presents sizeable discrepancies.[1]

The data used in this section are largely based on the preliminary results of estimates of consistent provincial level commodity balances. Table 1 shows the rice provincial balance for 1996, which is obtained by reconciling estimates of production, consumption and marketing using an optimisation model. This balance provides several insights on the structure of the sector, which are discussed in detail in the following sections together with other data on trends.

[1] An agricultural census interviewing heads of 21,146 smallholder farms (5 hectares or less), 1,885 medium size farms (5 to 10 hectares) and large farms (greater than 10 hectares) was conducted in 2000/2001. The last agricultural census was done in 1970. Initial results containing basic data on number of households producing specific crops and livestock, and area covered was released on August 28, 2001 (INE, 2001). Production data should become available by the end of March 2002. These data can be used to form a common base for monitoring change in national agricultural production

Table 1. Estimated provincial rice balance, 1996

	Moza.	Maputo	Gaza	In'bane	Sofala	Manica	Tete	Zambe.	Nampula	C.Delga.	Niassa
Provincial net balance (Tons)		-50,592	-7,420	-9,583	-3,070	-1,403	-1,133	445	636	-1,709	-1,104
Total food consumption (Tons)	142,921										
Export (Tons)	0										
Domestic consumption (T.)	142,921	53,740	12,314	11,087	11,196	1,487	1,192	31,190	10,274	8,262	2,178
Urban	79,194	51,697	5,138	6,315	7,917	1,150	978	2,279	2,203	1,057	459
Rural	63,728	2,043	7,176	4,772	3,279	337	214	28,911	8,071	7,205	1,719
Market purchase (Tons)	89,047	50,766	11,776	9,587	5,719	1,403	1,133	1,453	4,252	1,806	1,153
Urban	70,468	49,143	5,086	5,944	4,292	1,137	978	1,001	1,616	973	298
Rural	18,579	1,623	6,690	3,643	1,427	266	154	452	2,636	834	854
Auto-consumption (Tons)	53,874	2,974	538	1,500	5,477	84	60	29,737	6,022	6,456	1,025
Urban	8,726	2,554	52	371	3,625	13	0	1,278	588	84	161
Rural	45,149	420	486	1,129	1,853	72	60	28,459	5,435	6,372	865
Consumption per capita (kg)	9.6	31.0	11.9	10.1	8.9	1.6	1.1	11.0	3.5	6.6	2.9
Urban	18.2	35.9	20.0	29.3	15.2	4.3	5.9	6.0	3.0	5.0	2.7
Rural	6.0	7.0	9.2	5.4	4.4	0.5	0.2	11.8	3.7	6.9	3.0
Market purchase p.c. (kg)	6.0	29.3	11.3	8.7	4.5	1.5	1.0	0.5	1.5	1.4	1.6
Urban	16.2	34.1	19.8	27.6	8.3	4.2	5.9	2.6	2.2	4.6	1.8
Rural	1.8	5.5	8.6	4.1	1.9	0.4	0.2	0.2	1.2	0.8	1.5
Auto-consumption p.c. (kg)	3.6	1.7	0.5	1.4	4.3	0.1	0.1	10.5	2.1	5.1	1.4
Urban	2.0	1.8	0.2	1.7	7.0	0.1	0.0	3.4	0.8	0.4	0.9
Rural	4.3	1.4	0.6	1.3	2.5	0.1	0.1	11.6	2.5	6.1	1.5
Total food supply (Tons)	142,921										
Import (Tons)	74,932										
Domestic food supply (Tons)	67,989	3,148	4,895	1,504	8,127	84	60	31,635	10,910	6,553	1,074
Retained (Auto-consumpt.)	53,874	2,974	538	1,500	5,477	84	60	29,737	6,022	6,456	1,025
Commercialized	14,115	174	4,356	4	2,650	0	0	1,898	4,887	97	49
Commercialization shares	17.4%	5.0%	83.0%	0.0%	25.0%	0.0%	0.0%	5.0%	38.0%	1.0%	4.0%
Conversion to milled rice	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Seeds, losses, other uses (T.)	19,482	663	550	264	3,421	9	7	10,554	3,158	736	121
As share of production (%)	16.1%	12.4%	7.0%	10.5%	22.0%	7.0%	7.0%	18.3%	16.2%	7.0%	7.0%
Total production (Tons paddy)	120,959	5,362	7,855	2,508	15,550	136	96	57,770	19,441	10,517	1,724
Commercial sector	8,196	716	6,085	5	434	0	0	179	700	76	0
Family sector	112,763	4,645	1,770	2,503	15,116	136	96	57,591	18,740	10,441	1,724
Yields (Tons/ha)	0.97	0.88	1.34	0.60	0.83	0.48	0.40	1.13	0.80	0.94	0.53
Commercial sector	1.59	1.23	1.87	0.80	1.10	0.00	0.00	1.50	0.97	1.19	0.00
Family sector	0.94	0.84	0.68	0.60	0.82	0.48	0.40	1.13	0.79	0.94	0.53
Area at rice (ha)	125,260	6,093	5,862	4,180	18,735	283	240	51,124	24,301	11,188	3,254
Commercial sector (ha)	5,142	582	3,254	6	395	0	0	119	722	64	0
Family sector (ha)	120,311	5,530	2,603	4,172	18,434	283	240	50,966	23,722	11,108	3,254
Rice area share (%)	4.2%	5.6%	2.4%	1.5%	12.8%	0.2%	0.1%	8.6%	3.3%	3.7%	1.8%
Total area at food crops (ha)	2,963,856	108,917	242,493	285,839	146,835	166,318	198,540	596,856	736,269	305,063	176,724

Note: The figures are preliminary results of an estimate of consistent provincial-level commodity balances, with data from heterogeneous sources. The main data sources are: IAF 1996 for the demand side; National Early Warning System (SNAP 1996), and Agricultural Survey of the family sector (TIA 1996) for the supply side. The balance is estimated as constrained matrix problem. This implies estimating a posterior matrix (a consistent food balance) that lies at a minimum distance from a prior matrix (the original food balance which present discrepancies), and which satisfies a set of constraints defined by the relationships between entries of the balance. Quantity figures are in terms of milled rice, except for *Total production* and *Yields*, which are in terms of paddy rice. *Total area at food crops* includes area farmed at maize, sorghum and millet, rice, cassava, potatoes and sweet potatoes, beans, and groundnuts. *Export* and *Import* include variations in stocks. Maputo includes both Maputo City and Maputo Province.

2.1. Production

Aggregate production of paddy fluctuated around 150,000 tons during the 1990s, with an upward sloping trend. Table 1 shows that the family sector accounts for the great bulk of the supply in each province except Gaza, where the major irrigation scheme in the country is located. The recent agricultural census (1999/2000) estimates that there are 633,255 farms growing rice, i.e. which directly affects about 3.2 million people (INE, 2001). The average area per farm under rice is only 0.29 hectares.

Three provinces, Zambezia, Sofala, and Nampula, account for about three-quarter of the total production, with Zambézia alone accounting for about half. Of the three typical rice ecosystems, rainfed lowlands account for over 90% of the area planted under this crop. Upland rice accounts for only 7% of the national rice area and is found mainly in the northern provinces of Nampula and Cabo Delgado. Irrigated rice is grown mainly by commercial farmers in Gaza province, who use farm machinery, fertilisers, pesticides, and improved varieties developed in the early 1990s. The cultivated irrigated rice area was about 20,000 ha in the early 1980s but in recent years has declined to less than 5,000 ha. In 1994-95, less than 100 ha of rice were planted at Chókwè (Gaza Province), the country's largest irrigation scheme, as a result of periodic droughts, poor water management, and increasing soil salinity (MADER/DNER, 2000).

Average rice yields in Mozambique are among the lowest in Africa. Rice varieties used by the family sector are mainly traditional, and as for all other food products, the use of inputs is virtually not existent. As indicated in table 1, the average provincial yields in 1996 varied from 0.4 to 0.9 tons/ha for the family sector. During the 1990s national averages ranged from 0.299 to 1.09 tons/ha, depending upon climatic conditions and rainfall, with irrigated rice yields achieving between 3 and 5 tons/ha (FAO, 2000).

Evidence from agricultural surveys (*Trabalho de Inquérito Agrícola* - TIA 1994, 1996 and the agricultural census) suggests that the production increases recorded in recent years are mainly due to the expansion of the area under cultivation. The estimated area planted to rice passed from 110,000 hectares in 1990 (FAOSTAT) to almost 190,000 hectares in 1999/2000 (INE/MADER, 2001), as many families displaced during the civil war returned to their land. Although the land that could be potentially farmed at rice is more than 4 times the current area, it is widely agreed that if Mozambique is going to become competitive, it must increase average yields. The potential for yield improvement is substantial. The top five rice varieties in 1999 World Vision research trials gave an average yield of 3.17 tons/ha under rainfed conditions with input use; while INIA obtained yields of 5.50 tons/ha in irrigated trials with input use in Gaza Province.

2.2. Markets, marketing, and prices

After the dissolution of the State agency for agricultural marketing and the liberalisation of trade and prices beginning in the late 1980s, the role of the State in food marketing was gradually eliminated, except under emergency situations. The abolition of public marketing monopoly has resulted in a mass entrance of new traders, most of which are small scale and not formally licensed. Today, these informal traders dominate the marketing system (Tschirley and Santos, 1998). Despite these changes, food markets outside major urban centers are still small and underdeveloped. Access to markets remains a major problem both for consumers and producers, particularly in rural areas.

One of the major impediments to increased commercialisation is the high transaction cost associated with marketing rice. Poor transportation networks and a lack of quality

storage facilities contribute to this situation. Transport infrastructures are particularly poor in the central provinces of Sofala and Zambézia, where in 1996 about 85% and 52%, respectively, of the road network was classified as poor or impassable (INE, 1997).

These conditions are reflected by the figures on market participation, for both producers and consumers. Some of this evidence is captured in Table 1. On the production side, it is estimated that less than 20% of the rice harvested by the family sector was commercialised in 1996, and the commercialisation share was particularly low in some of the major producing areas such as Zambézia (5%). Nationally, only about one-third of the rural households live in a community with a market (MPF *et al.*, 1998). Despite this, rice remains a major commercialised grain. In urban areas about 90% of rice is purchased on the market, but even in rural areas about 30% of the consumption is from market sources.

There are no clear estimates of trade flows of rice between areas. According to DNCI/MICTUR (various years) all three macro-regions – North (Niassa, Cabo Delgado, Nampula, Zambézia), Center (Tete, Manica, Sofala), and South (Inhambane, Gaza, Maputo) – present deficit balances. Only the northern region was indicated to have an overall surplus of rice in recent years. It is clear, however, that the major deficit areas are in the South, which is largely supplied by foreign imports. Table 1 indicates that in 1996, the deficit market of Maputo Province alone accounted for over half of the rice purchase on the market at the national level.

The provincial variation of prices provides further insights into marketing patterns across the country. Table 2 shows the evolution of the nominal price of rice between 1993 and 1999. Ratios between provincial prices and the national average are indicated in brackets. The southern provinces – Maputo, Gaza, Inhambane – have constantly recorded annual prices below the national average, as their markets are easily accessed by imports originating from Maputo City port. The price level in Maputo depends on the price at which rice is supplied from abroad. The highest prices are consistently recorded in the two non-coastal provinces where little rice is produced (Tete and Niassa), reflecting the high transport cost of rice imported into these provinces.

Table 2. Evolution of nominal retail prices of rice in Mozambique by province (Meticais per kilogram)

Year	Maputo	Gaza	In'bane	Sofala	Manica	Tete	Zambe.	Nampu.	C.Delg.	Niassa	Moza.
1993	1589	1618	1745	1631	1771	--	2050	1889	2445	--	1842
	(0.86)	(0.88)	(0.95)	(0.89)	(0.96)	--	(1.11)	(1.03)	(1.33)	--	
1994	2558	2554	2629	2601	2700	2785	2716	2799	3333	3180	2786
	(0.92)	(0.92)	(0.94)	(0.93)	(0.97)	(1.00)	(0.98)	(1.00)	(1.20)	(1.14)	
1995	4446	4221	4526	4460	5322	4978	5096	4958	5007	5999	4901
	(0.91)	(0.86)	(0.92)	(0.91)	(1.09)	(1.02)	(1.04)	(1.01)	(1.02)	(1.22)	
1996	5921	5865	6512	6936	8479	7890	7499	7619	8133	9972	7483
	(0.79)	(0.78)	(0.87)	(0.93)	(1.13)	(1.05)	(1.00)	(1.02)	(1.09)	(1.33)	
1997	5400	5531	5777	6716	8873	8388	7306	7507	8139	9751	7339
	(0.74)	(0.75)	(0.79)	(0.92)	(1.21)	(1.14)	(1.00)	(1.02)	(1.11)	(1.33)	
1998	5442	5285	5659	6748	8196	8370	7457	6522	7414	8816	6991
	(0.78)	(0.76)	(0.81)	(0.97)	(1.17)	(1.20)	(1.07)	(0.93)	(1.06)	(1.26)	
1999	5573	5633	--	6642	7702	8345	7657	6655	6131	8244	6954
	(0.80)	(0.81)	--	(0.96)	(1.11)	(1.20)	(1.10)	(0.96)	(0.88)	(1.19)	

Notes: The figures are annual averages of weekly prices recorded in provincial capitals. *Mozambique* is the simple average of all provincial prices. Ratios between provincial and average prices for the corresponding year are indicated in brackets.
Source: Authors' computation based on SIMA (National Integrated Market information System) database, Ministry of Agriculture and Rural Development.

Table 3. Retail price of rice relative to maize and wheat by province, 1993-1999

Year	Maputo	Gaza	In'bane	Sofala	Manica	Tete	Zambe.	Nampula	C.Delg.	Niassa
Rice to maize price ratio										
1993	1.63	1.77	1.86	3.53	5.50	--	3.23	3.30	1.78	--
1994	1.95	1.83	2.33	3.28	5.08	3.12	3.17	4.06	3.65	5.77
1995	2.00	1.70	1.86	2.40	3.10	3.41	6.89	3.48	3.25	6.14
1996	1.99	1.59	2.08	2.92	4.72	5.20	5.47	3.30	3.23	6.22
1997	1.93	1.92	2.19	3.55	5.92	5.56	4.19	5.67	4.76	7.36
1998	1.77	1.41	2.30	2.83	4.65	4.23	3.44	3.15	3.25	4.08
1999	2.52	2.33	--	3.49	5.67	3.95	8.22	2.44	2.01	2.42
Rice to wheat price ratio										
1993	0.90	0.90	0.91	0.94	0.96	--	0.82	0.93	0.89	--
1994	0.88	0.88	0.97	1.02	0.87	0.97	0.82	0.97	0.91	0.87
1995	1.05	0.95	1.04	0.95	0.91	1.08	0.86	1.03	0.99	1.06
1996	0.83	0.80	0.83	0.89	0.83	0.78	0.85	0.96	1.04	0.98
1997	0.77	0.77	0.90	0.89	0.93	0.98	0.84	0.91	1.02	1.04
1998	0.84	0.61	0.89	0.83	0.93	0.97	0.86	0.86	0.94	1.01
1999	0.86	0.61	--	0.89	0.96	0.92	0.85	0.97	0.64	0.94

Note: Ratio are computed on the average annual prices recorded in the provincial capital.
Source: Authors' computation based on SIMA database.

Table 3 indicates the ratio between rice and maize prices (top part) and rice and wheat prices (bottom part), in each provincial Capital between 1993 and 1999. The figures indicate that rice is relatively cheaper than maize in the southern provinces where markets are more developed and imports are cheap. On the contrary, the relative price of rice in term of maize is particularly high for the non-coastal provinces of Manica, Tete and Niassa, where domestically produced maize is the major staple.

As might be expected, the retail price of rice relative to wheat is more uniform across provinces, and it is generally more stable over time than the rice-maize price. Since a large proportion of the marketed quantity of rice and wheat comes from imports, these figures confirm that the price of the two crops moved in the same direction across space and time. As a result, the relative price is not affected by the conditions of local food supply. The greater instability of rice-maize price ratios than rice-wheat ratios also reflects significant annual variations in domestic maize supply.

2.3. Consumption

The upper part of table 1 shows the average annual rice consumption in each province in 1996, both in per capita (kilograms) and in aggregate terms (tons). Aggregate consumption of milled rice was about 140,000 tons in 1996, which corresponds to an estimated annual per capita consumption of 9.6 kg. The estimated national requirement has grown to about 250,000 tons in 1999 (DNCI/MICTUR, n.11-12, 1999), reflecting a rapid increase in demand for this crop in recent years.

The total consumption figures in table 1 are decomposed into acquisition through the market and acquisition through own production (own-consumption), and each of these is

further decomposed into rural and urban components. The predominance of urban and market purchased consumption emerges clearly from this decomposition. Except for two of the major producing provinces, Nampula and Zambézia, per capita consumption is greater in urban areas, and is particularly high in the southern urban markets. Overall, urban annual consumption is 18.2 kg per capita, of which about 90% acquired on the market, while rural consumption is 6 kg per capita. The IAF data also indicate that participation rates, i.e. the percentage of households reporting any consumption, are low for both rice and wheat. For the whole IAF sample, only 40% of the households report consuming rice and 32% consume wheat. Moreover, a large proportion of households that do not report any consumption are concentrated in rural areas of the North.

The analysis of household expenditure shares for rice confirms these patterns of consumption. Table 4 reports expenditure shares for the major food products in Mozambique, by province and area of residence, highlighting the role of rice in the average food budget.[2] In terms of expenditure, rice is the second cereal in the average household budget,[3] which is dominated by maize and cassava (respectively 21.76% and 14.56% of the average household budget). Regional differences in consumption are particularly marked for tubers, but the sharpest contrasts are again between rural and urban consumption patterns. Wheat presents consumption patterns that are similar to rice. The average urban and rural shares for wheat are 8.46% and 0.88%, respectively. On the contrary, tubers are consumed mainly in rural areas, with a national share of 7.83% in urban areas and 16.12% in rural areas.

Alasia and Soregaroli (2002) assessed the potential evolution of food expenditures under alternative development scenarios defined by various growth rates of income, poverty reduction, urbanisation, employment in agriculture, and adult literacy. Their analysis indicates that household expenditure on food could be expected to rise substantially with economic growth. However, contrasting trends are observed for expenditure shares of maize, tubers and beans, on one hand, and rice and wheat, on the other. The first group of crops exhibits decreasing expenditure shares, while the latter shows increasing shares. The extent of the adjustment of the consumption patterns varies, but the results suggest that, over time, Mozambican households will shift from crops primarily produced domestically toward crops that currently are entirely or to a large extent imported, if current policies and preference trends remain unchanged.

[2] Note that the expenditure shares for the food categories reported in table 4 are those used in the demand system estimate that will be discussed in subsequent sections.

[3] Although in table 1 millet and sorghum expenditure shares are aggregated with maize, their total contribution of to the average household food budget is less than 3% (Alasia and Soregaroli, 2002).

Table 4. Average household expenditure shares for major food products, by province and area of residence, 1996

Province	Area	Maize[1]	Rice	Wheat	Tubers[2]	Beans[3]	Other food[4]
Niassa		35.05	3.28	0.82	8.16	13.2	39.49
	Urban	33.39	4.24	1.55	7.08	16.48	37.25
	Rural	35.55	2.99	0.60	8.48	12.22	40.16
C. Delgado		29.94	5.79	0.54	14.37	14.54	34.83
	Urban	27.29	6.05	2.56	10.62	12.46	41.03
	Rural	30.23	5.76	0.32	14.78	14.76	34.15
Nampula		18.53	3.35	1.29	24.22	9.52	43.09
	Urban	23.71	4.64	4.32	18.76	6.53	42.05
	Rural	17.35	3.06	0.60	25.46	10.19	43.33
Zambezia		24.81	6.98	0.52	18.10	6.16	43.44
	Urban	19.53	13.29	7.36	5.76	5.59	48.47
	Rural	25.04	6.70	0.21	18.65	6.18	43.22
Tete		27.1	1.06	0.77	4.05	13.81	53.22
	Urban	22.8	5.94	4.74	2.45	12.01	52.06
	Rural	27.68	0.39	0.22	4.26	14.05	53.38
Manica		43.36	1.30	1.49	4.10	4.66	45.10
	Urban	36.66	3.42	4.77	4.16	4.89	46.11
	Rural	44.87	0.83	0.74	4.08	4.6	44.87
Sofala		24.56	4.78	2.25	10.37	6.5	51.54
	Urban	24.65	7.02	6.45	4.32	4.99	52.58
	Rural	24.52	4.04	0.88	12.34	6.99	51.21
Inhambane		20.88	5.02	4.71	12.28	13.1	44.02
	Urban	13.48	12.83	13.10	6.84	11.23	42.51
	Rural	22.39	3.42	2.99	13.39	13.48	44.33
Gaza		32.02	5.40	2.56	15.06	13.68	31.28
	Urban	26.4	10.55	8.16	8.27	10.24	36.37
	Rural	32.41	5.04	2.18	15.53	13.92	30.93
Maputo		10.29	13.92	11.41	6.62	10.43	47.35
	Urban	6.43	16.92	14.10	3.64	10.2	48.71
	Rural	19.37	6.83	5.06	13.65	10.94	44.15
Mozambique		24.52	5.44	2.30	14.56	9.83	43.35
	Urban	18.47	10.24	8.46	7.83	9.05	45.95
	Rural	25.92	4.33	0.88	16.12	9.99	42.75

Note: all the figures are expressed as percentage of total food expenditure. Estimated means are adjusted for sample design. (1) *Maize* includes also millet and sorghum. (2) *Tubers* includes cassava, potato and sweet potatoes. (3) *Beans* includes both beans and groundnuts. (4) *Other food* includes all other food items not included in the previous categories, except beverages and tobacco.
Source: Authors' computation based on IAF data.

2.4. Policy context

There are three overriding factors that influence the policy framework affecting the development of the rice sector in Mozambique. First, Mozambique is signatory to both regional (the SADC protocol) and international (World Trade Organization) agreements which commit it to eliminating or substantially reducing import tariffs over the next fifteen years. As of 1999, 31% of the value of imported rice came from South Africa, the dominant SADC partner, with the remainder is imported mostly from Asian countries (table 5). These agreements set potential limits on the extent to which Mozambique can protect its domestic rice sector from imported rice through high import duties. At the current time, imported blanched and/or polished rice face a 7.5% tariff, which will be eliminated during the next 8 years for SADC partners. Therefore, a key question is what will be the impact of the potential tariff changes.

Second, while policymakers are in agreement with the shift away from state control of the agriculture sector towards a market system, the extent of public sector involvement in stimulating production and commercialization of various sub-sectors is still under debate. While the public sector is seen to have a clear role in research, market information systems, and provision of basic infrastructure, its role in directly providing extension and marketing services or subsidizing the private sector to provide those services is not well-defined.

Third, with approximately 70% of their population living in absolute poverty, the government is committed to pursuing strategies which will maximize poverty reduction, particularly in rural areas where the majority of the poor live. This means that any proposed policies and programs to develop the rice sector must be evaluated from the standpoint of their potential contribution to policy reduction. What are the trade-offs in investing in large-scale, highly mechanized irrigation schemes serving a few highly skilled farmers versus more labor-intensive, smaller-scale schemes where average plot size is smaller, but the number of farmers is greater? Should the large-scale rice processing factories active in colonial times be rehabilitated, or are greater reductions in poverty more likely through investment in smaller-scale, village-based processing equipment? Employment generating effects from both types of investments need to be taken into account.

Table 5. Value and country of origin of rice imports into Mozambique, 1999

Origin of import	Value in Meticais (1,000,000 MT)	Value in US Dollars ($1000)	Percent of total imports of rice
South Africa	176,325	13,757	30.1
Pakistan	124,138	9,949	21.8
Vietnam	70,065	5,513	12.1
China	68,186	5,316	11.6
United States	32,514	2,574	5.6
Other Countries	108,594	8,568	18.8
Total	579,822	45,677	100

Source: Ministry of Industry and Commerce (2001).

Needless to say, the challenge of creating an internationally competitive rice sector in Mozambique is daunting. A comparative analysis of the average wholesale value of imported rice (mixed varieties with up to 25% of broken grains) compared to what it would cost to produce and process rice nationally in Mozambique found that nationally produced rice was quite uncompetitive in 1999: with an approximate value of $322 USD/ton for imported, processed rice versus 454 USD/ton for locally produced and processed rice (DNIC/MICTUR, 2000). This 41% difference reflects the lower yields, the higher costs of production and transport, as well as the more inefficient processing and marketing facilities in Mozambique compared to its major Asian competitors.

The government is cognizant of the need to develop a comprehensive rice strategy, but faces severe resource constraints in designing and implementing such a strategy. A draft National Strategy for Rice was prepared in February 2000. However, its final adoption and implementation by the Ministry of Agriculture is contingent on conducting a feasibility study of the interventions the proposed strategy contemplates. To date, no detailed study has been made to assess where investment in the rice sector could potentially provide its greatest return.

The lack so far of a coherent, coordinated approach to the rice sector is reflected in the discrepancies found in documents and the reality of actual investments. For example, the National Agronomic Research Institute (INIA) in its Medium-Term Strategy and Plan (1995) identified rice as a high priority crop for research investment. However, fiscal and human resource constraints have prevented INIA from significantly improving research output related to production constraints or varietal testing over the past five years.

The severity of these constraints is evident in the recent history of rice seed production in the country (Rorhbach *et al.*, 2000). Prior to 1999, the formal parastatal seed company, SEMOC, maintained responsibility for rice breeding and seed production. Mozambique relied on seed produced within its boundaries; imports of rice seed were discouraged. Despite the fact that there is no competition from imported sources of rice seed, rice seed production was not very profitable, leading the company to abandon breeding efforts. Responsibility of the nation's supply of pre-basic rice seed and testing program was transferred back to INIA. Yet the national research institute had no financial or staffing capacity to pick up this responsibility. The research service does not even have a rice breeder. To make matter worse, SEMOC's stocks of certified rice seed were then lost in the 1999/2000 season floods. INIA is slowly rebuilding the country's seed stock from approximately 60 kg of breeder seed.

The lack of a comprehensive assessment has also resulted in the tendency to revert to past models and emphasize rehabilitating old structures, such as large-scale rice processing plants and the Chókwè irrigation scheme. For example, in 1999 $425,000 USD worth of credit was extended to rehabilitate the Factory for Rice Dehulling in Beira (Sofala Province). The factory has a capacity to process 9 tons/hour, yet in 1999 only managed to purchase and process 45 tons of rice before ceasing operation (Benfica and Sambo, personal communication). According to the owner, the price he had to offer producers in order to be competitive with imported rice was so low that producers preferred to retain their production for home consumption. Lack of competitiveness is in part due to current fiscal policies, which are biased against domestic rice processors. Unhulled rice bought on the local market is subject to a 17% value added tax, whereas imported polished rice faces a 7.5% import duty, but is not subject to a value added tax.

On the production side, emphasis has been placed on rehabilitating old irrigation schemes. At the present time, an assessment is underway to decide whether to rehabilitate 22,000 hectares in the Chókwè irrigation scheme, where rice would be the predominant crop. In Zambézia, the rehabilitation of the 150-250 hectares of the Mucelo irrigation scheme began in June of 2001. The profitability of these schemes will depend significantly on the

extent to which farmers will be able to obtain access to high quality extension services and inputs. In the past, productivity at Chókwè was severely hampered by poor water system management.

It is of interest to note that a significant percentage of the productivity increases seen in countries such as Vietnam has been due to increased cropping intensity (two to three harvests per year instead of one) on irrigated plots (Minot and Goleti, 2000). The ability to double crop has been possible due to national research programs producing shorter duration varieties. However, in Mozambique, only one new variety of rice has been released during the last five years, Limpopo – which is of medium duration (125 days) – and as of yet, no Limpopo seed is commercially available. Most traditional varieties still used in rainfed lowlands have longer maturity periods (150 days). Varieties released in the early 1990s have shorter maturity periods, from 140-145 days. However, no early (108 days average) or very early varieties (103 days average) are available to farmers. The capacity to increase cropping intensity may be critical for assuring the profitability of irrigation scheme investments. However, at the present time, the rehabilitation of Chókwè can only be evaluated with one rice crop per year because of existing varietal constraints.

3. ASSESSING THE EFFECT OF RICE PRICE CHANGES

The previous section outlines some of the key policy issues that will affect the sector in the coming years. Some of these, and in particular tariff and fiscal policies, will have a direct impact on the price of rice. Others, such as research and extension policies, will have an indirect impact through changes in domestic supply over the medium term. In both cases, it is relevant to assess the potential effects of rice price changes induced by these policies on aggregate food demand. In this section we use a food demand system to address these questions. The model used is an enhanced version of a food demand system estimated for Mozambique (Alasia and Soregaroli, 2002). The characteristics of the model, the estimation procedure, and the estimate results are briefly outlined before presenting the results of the price change simulations.

3.1. Food demand system specification

The model is based on the *Almost Ideal* (AI) demand system of Deaton and Muellbauer (1980) and extended to include demographic characteristics and to correct for estimation inconsistencies. Defining as $z_h = [z_{1h},...,z_{kh}]$ the vector of demographic characteristics of households the model can be defined as:

$$w_{ih} = \alpha_i(z_h) + \sum_{j=1}^{n} \gamma_{ij}(z_h) \log p_j + \beta_i(z_h) \log \frac{m_h}{P^S} \qquad (i = 1,...,\ \mathrm{N};\ h = 1,...,\ \mathrm{H}) \qquad (1)$$

where w_{ih} is the expenditure share of household *h* for the *i*th good; p_j is the price of good *j*; α_i , γ_{ij} , and β_i are parameters with values depending on the demographic characteristics; m_h in the total food expenditure of the family; *n* is the number of food groups in the system, and P^S is a price index.

Given the high prevalence of zero consumption in the data, the above specification has been estimated adopting the procedure proposed by Shonkwiler and Yen (1999). The procedure involves two steps: 1) in the first step a probit model is estimated for each good in the system and the values of the probability of consumption $\Phi(.)$ and of the univariate standard normal distribution function $\phi(.)$ are computed for each good and observation; 2) the demand system (1) is estimated including the above variables as corrector factors. The resulting empirical model is:

$$w_{ih} = \Phi(\boldsymbol{s}_{ih}^{/}\boldsymbol{b}_i) f(\boldsymbol{x}_{ih}, \boldsymbol{a}_{ih}) + \delta_i \phi(\boldsymbol{s}_{ih}^{/}\boldsymbol{b}_i) + \xi_{ih} \quad (2)$$

where $\boldsymbol{x}_{ih}$ and $\boldsymbol{s}_{ih}$ are vectors of independent variables, $\boldsymbol{a}_{ih}$ and $\boldsymbol{b}_i$ are vectors of parameters, $\Phi(\boldsymbol{s}_{ih}^{/}\boldsymbol{b}_i)$ and $\phi(\boldsymbol{s}_{ih}^{/}\boldsymbol{b}_i)$ are, respectively, the cumulative distribution function and the univariate standard normal probability density function obtained from the probit model, $f(\boldsymbol{x}_{ih}, \boldsymbol{a}_{ih})$ is the demand model (1), and ξ_{ih} in the error term. All of the observations are included in both steps of the estimate.

Model (2) has implications on the way elasticities are usually computed since the probability to consume enters the derivation of the marginal price and income effects. Indeed, the derivative of the censored variable with respect to the price and total expenditure variables, generically defined as x_j, is:[4]

$$\partial w_{ih} / \partial x_i = a_{ih} \Phi(\boldsymbol{s}_{ih}^{/}\boldsymbol{b}_i) \quad (3).$$

The derived expenditure and price elasticities obtained from the estimated parameters (indicated in hat) are respectively:

$$e_{ih} = \frac{\Phi(\boldsymbol{s}_{ih}^{/}\hat{\boldsymbol{b}}_i)\hat{\beta}_i(\boldsymbol{z}_h)}{\hat{w}_{ih}} + 1 \quad (4)$$

$$e_{ijh} = \frac{\Phi(\boldsymbol{s}_{ih}^{/}\hat{\boldsymbol{b}}_i)}{\hat{w}_{ih}} (\hat{\gamma}_{ij}(\boldsymbol{z}_h) - \hat{\beta}_i(\boldsymbol{z}_h)\hat{w}_{jh}) - \delta_{ij} \quad (5)$$

where $\hat{w}_{ih} = \Phi(\boldsymbol{s}_{ih}^{/}\hat{\boldsymbol{b}}_i) f(\boldsymbol{x}_{ih}, \hat{\boldsymbol{a}}_{ih}) + \delta_i \phi(\boldsymbol{s}_{ih}^{/}\hat{\boldsymbol{b}}_i)$ is the estimated share for good *i* (the same is for good *j*).

3.2. The data and estimation methods

All the data used for the demand system estimation come from the National Household Survey on Living Conditions (IAF), conducted between February 1996 and March 1997. The sample includes a total of 8274 households.[5] The food items used in this analysis include all the food products except beverages and tobacco, but the focus is on a basket of five products, namely maize, rice, wheat, tubers and beans. A residual category, named "other food", includes all the other food items consumed by the household.[6] The value of total household consumption on food, which includes both market expenditures and the value of food

[4] The derivative is true when the price and total expenditure variables do not enter $\boldsymbol{s}_{ih}$.

[5] A detailed description of the characteristics of the IAF is available in MPF/UEM/IFPRI (1998).

[6] Each primary crop results from the aggregation of the basic crop and its derivatives as recorded by the IAF (for example, maize, maize flour and maize grain). It should be noted, however, that within each aggregate a restricted number of products represent the large majority of observations.

acquired through own production and other transfers, is used as the measure of the household food consumption to compute budget shares for each food product.

We estimated a system of five equations (maize, rice, wheat, tubers, and beans) using the two-step estimation procedure outlined in the previous section. The parameters for the sixth equation (Other food) are derived from the imposition on the regression parameters of the symmetry and homogeneity conditions.

The first stage of the estimation was performed with a probit model, where the household expenditure share on each staple was set as function of location and seasonal dummies, socio-demographic variables, poverty and own-consumption dummies. The computation of these variables, all of which were based on the IAF database, is summarised below.

Location and seasonal effects are accounted for by three sets of dummy variables. The first indicates the province of residence of the household. The second indicates the residence in urban areas. The third represents quarterly dummies to control for seasonal variation of consumption. The effect of the demographic structure of the household is accounted for by three variables, indicating the number of children below age 6, the number of young between age 6 and age 12, and the number of adults. Educational attainments are entered as dummies, which discriminate between households that have both chief and spouse illiterate; those with one of the two who is literate; and those with both of them able to read and write. Similarly, three dummies capture the employment structure of the household: the first identifies households with all members 15 years of age or over employed in agriculture; the second dummy includes households with all members employed outside agriculture; and the third households with a mixed agricultural and non-agricultural employment structure. Three dummies resulting from the national assessment on poverty conducted on the same sample are used to discriminate between non-poor, poor and ultra-poor households (see MPF/UEM/IFPRI, 1999). The last dummy introduced indicates own-consumption of any of the food staples.

In the second stage, the model includes a set of economic variables (price and expenditure) and relevant slope dummies for price and expenditure, in addition to all of the variables and dummies used in the probit. A price survey conducted at the community level, in conjunction with the household survey, provided the price data used in the demand system. Food prices were estimated at the district level.[7] This approach resulted in 128 price observations to be used in the estimate. The total value of household consumption was used as a proxy for expenditure. Slope dummies for the own-consumption of the family were introduced on prices and on total food expenditure variables. On the expenditure variables, slope dummies were also introduced for the other demographic characteristics. Finally, the cumulative distribution function and the standard normal distribution function, computed for each observation by the probit procedure, were included as variables in the second step estimate.

[7] The food prices were computed at the district level as weighted price index for the items included in the group, where the weights are the respective average budget shares at the district level. For a few districts where no price was recorded despite a positive consumption for some items of the food group, the unit values of the reported consumption (values of acquisition divided quantity of acquisition) were used with a similar procedure. The price index for the category *Other food* was computed on a basket of the 22 most commonly available food products at the district level.

3.3. Estimate results

The results of the estimates that are presented in this section focus on elasticities.[8] It is worth mentioning, however, that in the second step estimate 33 of the 60 parameters for the economic variables are significantly different from zero (significance level of 5%). Moreover, almost all parameters are of the expected sign. Also, the demographic variables contribute significantly to explaining variability, especially the location dummies. Finally, R-squares for the equation of the second step estimate are between 0.1 and 0.45. These values are acceptable considering that the data are at the household level.

Price and expenditure elasticities computed at the average of the sample are presented in table 6. All of the price elasticities are negative in sign and are different from zero at a significance level of 5%. The food categories are price elastic, even if some values are close to unity. Cross-price elasticities indicate significant effects of substitution, in particular, between rice and wheat and between maize and tubers. In contrast, beans have a significant complementary relation with maize, rice, and tubers.

Finally, all of food expenditure elasticities are positive and significantly different from zero. The three aggregates including cereals are luxuries, while beans, and other-foods are considered as necessities. The expenditure elasticity for tubers is close to unity.

Table 6. Uncompensated price and expenditure elasticities

	Maize	Rice	Wheat	Tubers	Beans	Other food	Expenditure
Maize	-1.057	0.008	0.002	0.044	-0.029	-0.116	1.149
	(0.016)	(0.016)	(0.012)	(0.011)	(0.010)	(0.026)	(0.024)
Rice	0.024	-1.042	0.134	0.028	-0.049	-0.136	1.041
	(0.029)	(0.046)	(0.030)	(0.026)	(0.022)	(0.059)	(0.053)
Wheat	-0.015	0.254	-1.185	0.218	-0.038	-0.374	1.141
	(0.046)	(0.060)	(0.086)	(0.038)	(0.029)	(0.097)	(0.105)
Tubers	0.12	0.036	0.134	-1.138	-0.114	-0.048	1.009
	(0.023)	(0.028)	(0.022)	(0.029)	(0.019)	(0.046)	(0.035)
Beans	0.021	-0.053	-0.013	-0.131	-1.075	0.501	0.749
	(0.027)	(0.036)	(0.023)	(0.027)	(0.036)	(0.052)	(0.044)
Other food	-0.013	-0.041	-0.062	-0.006	0.109	-0.892	0.905
	(0.016)	(0.021)	(0.019)	(0.015)	(0.012)	(0.041)	(0.031)

Note: For price elasticities the rows indicate the product being affected and the columns the product whose price is changing. The figures in brackets are standard errors. Elasticities are estimated at the sample mean.

3.4. Simulating consumption trends and price changes

The estimate of a demand system enables the assessment of the effect of a change of one or more of the explanatory variables on food consumption. Various consumption scenarios can be generated by altering independent variables to reflect different trends or the impact of specific policies. We define the *trend scenario* for consumption in which per capita income, urbanisation, poverty, agricultural employment, and literacy levels change according

[8] The values of parameters of the two-step estimates are available from the authors upon request.

to Government targets, projections, and/or long term trends. The prime source used for Government projections was the national plan for poverty reduction, *Plano de Acção para a Redução da Pobreza Absoluta 2000-2004*, (GoM, 2000 - hereafter referred as the PARPA).[9] For this reason, the time frame under considered is from 1996, the year of data collection, to 2004, the final year of the reference PARPA.

In brief, the rates of change of the determinants of consumption in the trend scenario are as follows:

1. Annual growth rate in population is 2.39% (GoM, 2000);
2. PARPA projections of GDP in real terms, combined with the population growth, are used to derive the annual growth rate of per capita income (total expenditure) of 5.3%. However, for the period 1996-1999 we used the estimated annual growth rate of per capita income of 8.4%;[10]
3. The target of poverty reduction set by the PARPA corresponds to a decline of absolute poverty of about 3.5% per year. This percentage is used for the period 2000-2004, while it is assumed that the reduction of poverty prior to the introduction of a national plan, i.e. between 1996 and 1999, is 2.5% per year;
4. The annual growth rate of urban households is 4.7%, based on projections by INE (2000);
5. The decline of agricultural employment is assumed to be 1% per year; and
6. The rate of growth of adult literacy is computed on long term trends, and is 6.3% (UNDP, 1998).

These rates of change were applied to the corresponding variables in the model (or set of dummy variables) and, after converting the food expenditure elasticities estimated by the model into total expenditure elasticities,[11] the new values of the explanatory variables for the year 2004 were computed.

Once the trend scenario was defined, we assumed the existence of a set of policies that affect the relative price of rice. Four possible scenarios were considered: (1) an increase of 25% of the price of rice relative to other food products (2) an increase of 15% of the relative price of rice; (3) a decrease of 25% of the price of rice relative to the other food products; (4) and a decrease of 15% of the price of rice relative to the other food products. It is assumed that these variations would occur in the year 2004. As noted earlier, price variations can be the outcome of alternative policies, and in particular these can be easily induced by some of the tariff and fiscal policies that Government may consider over the next few years.

3.5. Simulation results

The results of the simulation are presented in table 7. The first column indicates the base scenario for 1996. This was established by running the model at the mean values of the explanatory variables, and it is used as the base scenario to compare with the four hypothesized scenarios. The results for the year 2004, with no change in the relative price of rice, are reported in the column named *Trend*. The two columns on the left of *Trend* report

[9] For the period 1996-1999 we used the recorded or estimated mean rate of growth, while for 2000-2004 growth rates are based primarily on projections adopted in policy documents of the Government of Mozambique.

[10] Available figures refer to income growth, while the demand system is restricted to food expenditure. Hence, to measure the consumption response to changes in total income (expenditure) an appropriate adjustment had to be made, which allowed to approximate total expenditure elasticities from the available food expenditure elasticities (see Alasia and Soregaroli, 2002 for details).

[11] This is done by estimating a first step demand function, which is consistent with the two-stage budgeting procedure assumed in this study. The total expenditure elasticity of the food aggregate is then used to compute the total expenditure elasticity of each crop.

the results for trend changes and a relative decrease of rice price of 25% and 15%, while the results for relative price increases are reported in the two columns on the right.

The household expenditure shares for each scenario appear in the upper part of the table. The changes in the structure of household expenditure are contained for most products. It should be kept in mind, however, that budget shares are for national averages; hence decimal variations imply substantial changes in aggregate terms. The results resemble those observed in previous research. Compared to 1996, the expenditure shares are increasing for rice and wheat in 2004 (after adjusting for prevailing socio-economic conditions). In contrast, expenditure shares are decreasing for maize, tubers and beans. Hence, rice and wheat will become more important in the average household budget. The price changes alter the magnitude of the changes between 1996 and 2004, but the sign of the trend is not reversed for any of the crops, except for the aggregated category *other food*.

The central part of the table 7 shows the evolution of household consumption. The values for 1996 are set equal to 100 to focus attention on relative rather than absolute changes. For the commodities whose relative price is held constant over the period considered, the change in expenditure is assumed to be equal to changes in quantity. For rice, expenditure changes are divided by the new price to evaluate consumption in quantity terms. In addition, it is assumed that expenditure changes correspond to quantity changes. Given these strong assumptions, the results should be interpreted with caution. Nevertheless, they provide upper and lower bounds to the potential range of values of consumption due to changes in the relative price of rice.

Declining expenditure shares do not necessarily imply declining household consumption for the food product. Income expansion results in a sizeable growth of consumption for all the crops. Due to the trends in budget shares, however, the growth is proportionally larger for wheat and rice than for maize, tubers, and beans. Trend changes imply that household consumption of rice and wheat would approximately double between 1996 and 2004, while for the other crops the growth of consumption would be in the order of 50%. Changes in the relative price of rice would substantially shift the consumption of rice and wheat, while, in relative terms, they would have a more limited impact on the consumption of all the other crops. A reduction of the relative price of rice by 25%, combined with trend changes in the other socio-economic variables, would result in an increase of approximately 150% of household consumption of rice between the two reference years. If the exact opposite occurred, that is, a 25% increase in the price of rice, consumption of rice would only increase by 50%, which is half of increase shown in the trend scenario.

Finally, the bottom part of table 7 indicates the aggregate consumption. Also in this case the value for 1996 is set equal to 100 in order to emphasise the relative changes. Aggregate consumption is computed by multiplying the household consumption in 2004 by the population growth factor between 1996 and 2004 (which is 1.21). Hence, patterns of changes are similar to those described for household consumption. The aggregate figures, however, allow an assessment of the magnitude substitution between rice and wheat, the two major urban, commercial, imported crops. In 1996, the estimated consumption of rice and wheat was about 140 and 150 thousand tons, respectively.[12] Maintaining the expenditure/quantity relationship constant, the trend scenario presented in table 7 would imply an aggregate consumption of about 320 and 400 thousand tons of rice and wheat respectively, in 2004. A 15% increase of relative price of rice would reduce its consumption

[12] For wheat the value of 150,000 is obtained from the estimate of a consistent provincial-level commodity balance, as those presented for rice in table 1. For 1996, FAO reports estimates of wheat consumption ranging form 198,000 to 230,000 tons (FAOSTAT). These figures appear inconsistent with estimates of consumption obtained from the IAF, even allowing for generous conversion factors to wheat primary equivalent for all the wheat derived products recorded by the survey.

of about 44,000 tons below the trend level, while a 25% increase would results in a reduction of about 67,000 tons. Part of this reduced consumption would be substituted by an increasing consumption of wheat, which can be quantified in the order of and additional 14,000 (15% price change) to 22,000 tons (25% price change) above the trend scenario consumption. In contrast, a decrease in the relative price of rice by 15% would result in an additional consumption of this cereal of about 59,000 tons over the trend value. For a price decrease of 25%, rice consumption would increase of about 113,000 tons above the trend value. The same price changes would lead to a decrease of wheat consumption of about 16,000 and 29,000 tons, respectively.

Table 7. Simulation results

	1996	2004				
	Base	-25%	-15%	Trend	+15%	+25%
Budget share (%)						
Maize	26.11	25.17	25.24	25.32	25.39	25.44
Rice	7.25	8.64	8.59	8.54	8.49	8.46
Wheat	2.97	3.74	3.87	4.03	4.17	4.26
Tubers	10.57	9.64	9.69	9.76	9.81	9.85
Beans	8.97	8.26	8.18	8.07	7.97	7.91
Other food	44.14	44.55	44.44	44.29	44.16	44.09
Household consumption, 1996 = 100						
Maize	100	156.2	156.6	157.1	157.6	157.8
Rice	100	257.3	225.8	190.7	164.8	151.1
Wheat	100	204.2	211.1	220.1	227.8	232.5
Tubers	100	147.7	148.5	149.6	150.4	151.0
Beans	100	149.2	147.7	145.7	144.0	143.0
Other food	100	163.5	163.1	162.6	162.1	161.8
Aggregate consumption, 1996 = 100						
Maize	100	189.0	189.5	190.1	190.7	191.0
Rice	100	311.3	273.2	230.7	199.4	182.8
Wheat	100	247.1	255.5	266.3	275.7	281.3
Tubers	100	178.8	179.7	181.0	182.0	182.7
Beans	100	180.6	178.7	176.3	174.3	173.0
Other food	100	197.9	197.4	196.7	196.1	195.8

Note: Food expenditure growth between 1996 and 2004 is 1.62; population growth between 1996 and 2004 is 1.21.

4. CONCLUSIONS

There are several reasons that suggest that the expansion of the rice sector has appealing potentials for the Mozambican food policy. This crop presents an opportunity to increase incomes at the farm household level, generate surpluses for food deficit areas, alleviate the cereal deficit of the country, and substitute a major imported crop, with a potential for export in the longer term. Nevertheless, the underlying research to explore and assess these opportunities to date has been extremely limited in scope.

In this paper we outlined the major structural characteristics of the sector. Then, we focused on the demand side to evaluate how rice price changes could affect aggregate food demand in Mozambique. Despite the limits of the model, due in part to the limitations inherent in the use of cross-sectional data (see Alasia and Soregaroli, 2002), and to a focus limited to the demand side, the results provide an estimate of the potential changes in consumption that would be induced by changes in the relative price of rice.

The simulation results emphasise how any policies adopted which change the relative price of rice in relation to wheat, will have an impact on the quantities of those two foods consumed. A protectionist strategy, in which a tax was introduced on rice to encourage domestic rice production, would result in a substantial shifting of rice consumption towards wheat product consumption. Since all wheat is imported, the amount of reduced foreign reserves gained through decreased rice imports is significantly diminished. On the other hand, if the costs of producing rice domestically could be substantially reduced and output significantly expanded, with increased rice supply driving down the price of rice relative to wheat, rice consumption would increase while wheat imports would diminish.

The results of the analysis, therefore, argue in favour of policies that support the growth of domestic production through productivity increases. However, there are several other key questions that need to be addressed before significantly increasing investment in additional rice sector initiatives, and among these:

- Can substantial, sustainable yield gains be obtained from existing rice varieties or do significant investments need to be made in developing new materials? Should efforts to test internationally available germplasm be rapidly expanded?
- What should be done with the existing irrigation schemes? Should resources be used to rehabilitate them? Similarly, should investment be concentrated in introducing small-to-medium scale rice processing operations as opposed to rehabilitating old large-scale rice processing facilities?
- Can transport costs be sufficiently reduced so that Zambézia can meet rice demand north of the Zambezi river, with Sofala and Gaza supplying the needs south of the Zambezi? What would be the level of transport cost reduction and productivity increases needed for Zambézia to economically feed all major urban centers?

Following a comprehensive assessment, a longer term research and training agenda will need to be implemented, coupled with pilot initiatives to test the viability of the most promising approaches. The requisite investment in human resources will also need to be made to assure that the proposed rice sector strategy can be adequately implemented.

REFERENCES

Alasia A. and Soregaroli, C., 2002 "Economic Growth and Food Demand Changes: An Assessment of Scenarios and Implication for Policy", CID Working Paper Series N. 3. Centre for International Development. Bologna.

Arndt C., Tarp Jensen H., Tarp F., 2000. Structural Characteristics of the Economy of Mozambique: A SAM-Based Analysis. *Review of Development Economics* 4: 292-306.

Benfica R. and Sambo L., 2001. Personal communication based on field research on agro-processing, July 2001.

Deaton A., and Muellbauer, J., 1980. An Almost Ideal Demand System. *The American Economic Review* 70: 312-336.

DNCI/MICTUR, 2000. *Os Mercados de Arroz e de Trigo em Moçambique*. Nota de Pesquisa da DNCI, Número 14, Maputo.

DNCI/MICTUR/FAO, (Various years). *Boletim Mensal de Comércio de Cereais*, various numbers, Maputo, Ed. Ministry of Industry, Commerce and Tourism.

FAO, 2000. *FAO Rice Information*. Volume 2, Rome, Ed. FAO.

Government of Mozambique, 2000. *Plano de Acção para a Redução da Pobreza Absoluta (2000-2004)*. Maputo.

INE/MADER, 2001. *Censo agro-pecuário 1999-2000: Apresentação Sumária dos Resultados, Quadros e Gráficos*. Maputo, Ed. INE.

Instituto Nacional de Estatística (INE), 1997. *Anuario Estatistico 1996, Mocambique,* Maputo, Ed. INE.

Instituto Nacional de Estatística (INE), 1999. *Inquérido Nacional aos Agregados Familiares sobre Condições de Vida: Quadros Gerais*. Maputo: INE.

Instituto Nacional de Estatística (INE), 2000. *Projecções Anuais dos Agregados Familiares 1997-2000*. Estudos n. 8. Maputo: INE.

MADER/DNER, 2000. *Estratégia de Desenvolvimento da Cultura do Arroz*. Unpublished Memorandum, Maputo, Februry 2000.

Ministry of Planning and Finance, Universidade Eduardo Mondlane, and International Food Policy Research Institute (MPF/UEM/IFPRI), 1998. *Understanding Poverty and Well-Being in Mozambique: The First National Assessment (1996-97)*. Maputo: Ministry of Planning and Finance, Government of Mozambique.

Minot N. and Goletti F., 2000. *Rice Market Liberalization and Poverty in Viet Nam*. Research Report No. 114, Washington, D.C., Ed. International Food Policy Research Institute.

Newitt, M., 1995. *A History of Mozambique*. Bloomington, Ed. Indiana University Press.

Reardon T., 1993. Cereal Demand in the Sahel and Potential Impacts of Regional Cereal Production. *World Development* 21: 17-35.

Rohrbach D. D., Low J., Pitoro R., Cucu A., Massingue J., Boughton D., Rafael G., Paulo A., Jocene D., 2001. *Investment Priorities for the Development of the Seed System in*

Mozambique. Research Report 44, Department of Policy Analysis. Maputo. Ed. Ministry of Agriculture and Rural Development.

Rosegrant M. W., Agcaoili-Sombilla M., Perez N. D., 1995. *Global Food Projections to 2020: Implications for Investment*. Food, Agriculture, and the Environment Discussion Paper 5, Washington, D.C., Ed. International Food Policy Research Institute.

Shonkwiler, J.S. and Yen, S.T., 1999. Two-step estimation of a censored system of equations. *American Journal of Agricultural Economics* 81: 972-982.

Teklu, T., 1996. Food demand studies in Sub-Saharan Africa: a survey of empirical evidence. *Food Policy*. Vol.21, pp.479-496.

Tschirley, D.L. and Santos A.P., 1998. *Desafios para garantir a concorrência e reduzir os custos no sistema alimentar de moçambique*. Relatório No. 28. Maputo: Ministerio da Agricultura e Pescas.

UNDP, 1998. *Human Development Report 1998*. New York: United Nations.