2. The rice economy of Madagascar

Bart Minten, Marie-Hélène Dabat and Ziva Razafintsalama

2.1. Production

2.1.1. Historical context and trends

Madagascar is a rice economy par excellence as documented by different studies and datasets.[2] For example, a commune census that was conducted in 2001 shows that the rice crop is stated to be the most important crop in the majority of the communes of the country, in terms of both area and value of production (Graphs 1 and 2). The only region where the rice crop is stated to be less important is in the eastern part of the country – where cash crops are a more important source of incomes - and the south where maize and cassava are the main crops. The latter region is characterized by a drier climate that makes rice production more problematic than in the rest of the country.[3]

However, performance in the rice sector has been sluggish (World Bank, 2003a; Bockel, 2003). While the total production of rice increased from 1,9 million tons in 1970 to 3,0 million tons in 2004, the per capita production has fallen from 237 kg per year in 1970 to 179 kg per year in 2004 (FAO). Population growth, at an annual average of almost 3%, has thus mostly outpaced production growth (Graph 3). As the cultivated area in rice has increased on average by 0,6% per year and yields by 0,5% per year over the period as a whole, total production increased by 1,1%, i.e. significantly below population growth.

Rice productivity in Madagascar started off on the same, or even better, footing as other countries, such as Mali and Indonesia (Graph 4). While yields stayed relatively stable in Madagascar, they increased significantly in these other two countries. Yields in Indonesia and Madagascar were similar in the beginning of the 1970s, but today yields in Indonesia exceed those in Madagascar by 2.5 tons per hectare. Yields in Mali were significantly lower than those in Madagascar in the beginning of the 1970s, but are now approximately the same as those in Madagascar.

The rice production technologies used in Madagascar are still largely traditional. The Green Revolution that increased rice yields in other rice economies has largely bypassed Madagascar. Local rice production is characterized by high labor intensity and few external inputs. The adoption of improved agricultural technologies is low. Nonetheless, there have been some changes over the years (Table 1). For example, using statements based on recall questions to focus groups in a nationally representative commune survey in 2004, it is

[2] See Bockel, 2002; Fraslin, 2002; IFPRI-FOFIFA, 1998; Le Bourdiec, 1974; Minten and Zeller, 2000; Pryor, 1990; Razafindravonona et al., 2001; Roubaud, 1997; UPDR-FAO, 2000; World Bank, 2003; Dorosh et al., 1990; Dorosh, 1994; Dorosh et al., 2003.

[3] Compared to ten years earlier, little change has been noted: the number of communes that reported rice as their main crop in value terms decreased by about 8%. However, this is partly explained by the high prices of cloves and vanilla in the year 2001.

estimated that the use of improved seeds, chemical fertilizer and in-line transplanting has slightly improved over the last fifteen years.

The lack of big changes in production and productivity is reflected in the trend of the real price levels (Graph 5). The real price of rice in the period 2000-2003 (as measured by the retail price of rice in Antananarivo divided by the non-rice consumer price index for Antananarivo) is similar to the level in the middle of the 1980s (i.e. just after the market liberalization measures that had been taken). This is in contrast with countries such as Bangladesh that saw a drop in the real price level of rice over time due a change in productivity driven by government investments in roads and irrigation infrastructure (Dorosh et al., 2004).

2.1.2. Current situation

85% of current agricultural producers, representing 60% of the total population, cultivate rice, illustrating the importance of rice in the agricultural sector. Rice productivity varies according to cropping system (Bockel, 2002; Keck et al., 1993; Minten et al., 2003; Le Bourdiec, 1974; UPDR-FAO, 2000). These include lowland rice, rainfed upland rice and tavy (or upland slash-and-burn) rice. Most of the rice in Madagascar is produced on lowlands: Based on the data of the national household survey of 2001 (the 'Enquête Permanente auprès des Ménages' or EPM), 89% of the rice plots are estimated to be situated in lowlands. Yields are highest on these lowlands, especially on plots with good water management (UPDR-FAO, 2000). Yields are significantly lower in upland rainfed cropping systems (4% of the plots) and are lowest under slash-and-burn conditions (7% of the plots).[4]

To get at the current problems in Malagasy rice productivity, rural focus groups were asked at the end of 2004 to evaluate the importance of different constraints to improve rice productivity (Table 2). For each constraint, they were given the choice between four categories, ranking from 'not important' to 'very important'. 85% of the population stated that inadequate irrigation was the most important constraint to increasing rice productivity. The two other most important constraints as reported by these focus groups were access to cattle to work the land and access to better equipment. Thus, lack of capital and investments are among the major perceived problems for improved rice productivity.[5]

The low adoption of improved technologies and low productivity is explained by a multitude of reasons and is difficult to link to one specific cause (Bernier and Dorosh, 1993;

[4] The highland plots might be larger in size as UPDR-FAO (2000) estimates that about 10% of the rice area is in rainfed uplands.

[5] It is also interesting to note the constraints that are *not* considered to be that important. They include more secure property rights and silt in the rice fields. While security in property rights is in general an important determinant for soil investment and thus higher productivity (Feder and Feeny, 1991), it seems that the overall land tenure situation is such that little land conflicts exist that would make such investments risky. An alternative explanation might be that credit markets, that might allow for such investments, are imperfect or missing and might not be linked with improved property rights as farmers currently know them. Silting of ricefields is often linked to deforestation but this might cause less production problem than is commonly assumed, especially in the highlands (Brand *et al.*, 2002; Larson, 1993).

De Laulanié, 2003; Bockel, 2002; Droy, 1997; Freudenberger, 1998; Goletti et al., 1997; Robbiliard, 1999; UPDR-FAO, 2000; Moser and Barrett, 2003). Chief among them are the lack of road and irrigation infrastructure (Stifel and Minten, 2003). Table 3 shows to what extent roads make a difference in the productivity of major agricultural products. However, other factors matter as well (Minten and Barrett, 2005). They include a badly functioning and under-funded research and extension system, lack of credit, the lack of a local seed industry, the high climatic risks, an unclearly defined role of the state and insecurity problems.

Increased use of chemical fertilizer was a major component of increased yields achieved through the green revolution in other countries. However, chemical fertilizer use in Madagascar is one of the lowest in the world and has changed little over time. Only 6% of the plots are reported to receive any chemical fertilizer and the average application is only 3 kg of nutrients per hectare during a typical year. The spatial distribution shows further that fertilizer use is heavily concentrated along roads (Graph 6 and Table 3). The low fertilizer use is largely explained by economic reasons. The ratio of the price of one kg of fertilizer over the price of a kg of paddy in rural areas hovers over time above 2. This is significantly above the ratio in Asian economies (in the case of India, the ratio of urea prices over paddy prices in 2004 was estimated at around 0.8). As paddy prices are similar to Asian rice economies, this unfavorable ratio is due to the high price of fertilizer in Madagascar due to the type of fertilizer that is being used[6], the thin market, the high transport costs to bring fertilizer from abroad into the country, and government interventions in this market (Bockel, 2002, 2003).

2.2. Consumption

Table 4 shows average calorie consumption in Madagascar over time. It illustrates the low overall calorie intake and the worsening trend over time: it is estimated that average per capita calorie consumption declined by 16% over a thirty year period. Rice is the most important plant product in Madagascar. It is estimated that it counted for about 48% of the total calorie consumption in 2002 (Table 5), with consumption per capita at about 95 kg per year (in 2002).[7] The importance of rice in consumption is relatively and absolutely on the decline, however. Rice accounted for 51% of total calorie consumption in 1970, compared to 48% in 2002/2003. Over the same period, cassava, the second most important crop, has become more important because of increasing poverty and its lower cost per calorie. It also serves as a buffer crop in the off-season. As a result, cassava's share in the supply of calories increased from 12% in 1970 to 20%(16%) in 2002 (2003). Meat consumption has declined relatively most over this 30-year period, i.e. by almost 30%, given declining incomes and the high income elasticities for meat products (Ravelosoa et al., 2000).

The budget shares of rice in total (food and non-food) expenditures differ significantly by type of household. While the average weight is estimated at 26%, based on the household survey of 1993, this varies from 34% for the rural poor to 11% for the richest urban group (Ravelosoa et al., 1999). Rice consumption is shown to be more price and income elastic for

[6] The most common type of fertilizer used in Madagascar is NPK 11:22:16.

[7] This compares to 164 kg per year in Bangladesh, 103 kg/year in Thailand and 75 kg/year in Senegal. Madagascar has the highest rice consumption per head in Africa.

poorer socio-economic groups.[8] Most of rice consumption is from own production. Based on the national household survey data of 2001, it is estimated that about two thirds of the production of rice is auto-consumed. About 22% is purchased by the rural population and 13% is bought by the urban areas. These numbers reflect the lower importance of urban markets in total local rice consumption. This is partly due to the large share of the population that lives in rural areas.

Imported rice makes up the difference between local production and consumption. It is important to note that imported rice is not only consumed in urban areas: based on the numbers of the national household survey of 2001, it is estimated that about 60% of the consumption of imported rice was in rural areas. This compares to 40% in urban areas. However, urban areas depend relatively more on imported rice. Graph 7 shows geographically the presence of imported rice in rural areas. As expected, it shows that the presence is highly influenced by distances to a port and to good roads.

Overall consumption, and rice consumption in particular, is further characterized by significant seasonality. Dostie et al. (2000) estimate that caloric intake declines by more than 10% in the lean period compared to the harvest period (Table 5). The drop is highest for the poorest households. The composition of caloric intake also changes. The part of rice drops between 6% and 13% in rural areas and by a little over 1% in urban areas. This drop in the importance of rice is made up by a relative increase in consumption of cassava, other tubers and maize (Dostie et al., 2000). This seasonality in consumption is confirmed by other studies and shows up in welfare indicators. Based on a national survey, Unicef estimated for example that malnutrition rates were 15% higher during the lean period than during the harvest period (Seecaline, 1996). Mortality rates are also found to be higher in the lean period (Waltisberger et al., 1998).[9]

2.3. The rice value chain

2.3.1. Households

Sales of rice are concentrated in the hands of a minority of agricultural producers (Table 6). Based on the national household survey of 2001, it is estimated that only a quarter of the agricultural households report sales of more than 250 kg of rice a year. Their sales represent 90% of all the local rice that is marketed in Madagascar. Almost half of the agricultural producers report no rice sales at all. They however are still producing more than a quarter of total Malagasy rice production. The households that report larger sales are also richer: their consumption level is almost a quarter higher than the average consumption level of agricultural producers.

[8] Ravelosoa et al. (1999) show that the overall income elasticity for rice consumption is about 0.47 and that this increases to 0.75 for the poorest group (based on an AIDS – Almost Ideal Demand System – estimation). The same trends are seen in own price elasticities which vary from -0.48 for the richest rural group to -0.62 for the rural poor. We see thus high sensitivity in consumption with respect to prices and income. Similar results are found by Minten and Zeller (2000) based on a smaller survey.

[9] This is also partly due to the more humid conditions and the higher disease incidence during the lean period.

Net buyers of rice make up a large part of the population in Madagascar, also in rural areas (Barrett and Dorosh, 1996; Minten and Zeller, 2000; Minten et al., 2003). Estimates based on annual production and consumption data from the EPM 2001 indicate that 19% of the households in Madagascar are net sellers of rice, 11% are self-sufficient and 46% are net buyers (Table 7). 23% of the households are urban households and most of them can be considered net buyers (there is about 3% in the 24% that is a net seller). Almost 60% of the purchased rice in Madagascar is estimated to be consumed by the net buyers in rural areas.

The location of net buyers and sellers differ. The most populated province of Antananarivo has the largest number of net buyers of rice (more than 800,000 households), partly due to the presence of the capital city of Antananarivo, while only a little over 100,000 households in the province are net sellers (Table 8). This province thus depends significantly on other provinces (and countries) for their rice supply. The province of Mahajanga has relatively and absolutely the largest number of net rice sellers, and is a net exporter of rice in most years.[10] Almost a quarter of the net rice sellers in Madagascar are located in this province. This compares to only 8% of all the net buyers. The Lac Alaotra area in the province of Toamasina contains the largest rice plain in Madagascar (with about 84,000 ha rice fields connected to a modern irrigation system (UPDR-FAO, 2000)). Its rice production counts for almost 15% of the national production but its commercial surplus is relatively much more important. UPDR-FAO (2000) estimates that about 220,000 tonnes of paddy are marketed in this area. It is thus a large provider of rice for the capital Antananarivo.

The selling and buying activities in rice markets show strong links with poverty (Table 9). For the population as a whole it is estimated that 66% is a net buyer of rice, 13% is self-sufficient and 21% is a net seller. Self-sufficiency in rice decreases significantly with an increase in poverty. While a quarter of the poorest quintile does not participate in rice markets, this is only the case for 7% for the richest quintile. The percentage of net buyers increases systematically from the poorest (54%) to the richest households (81%). Even though the number of net buyers in the poorest quintile is the lowest of all, the percentage of net buyers in this category is still 2,5 times higher than the percentage of net sellers. Richer households purchase significantly more rice on the market (Table 9): the average quantity of rice bought varies from 132 kg per household for the poorest quintile to three times as much, i.e. 391 kg per household for the richest quintile. These differences are partly driven by the difference in activities as 44% of the richest quintile lives in urban areas compared to only 8% for the poorest quintile.

The poverty – purchase linkage still holds when we calculate the purchase statistics only for agricultural producers. The richest quintile of agricultural producers produces, sells, purchases and uses significantly more rice than the poorest quintile (Table 9). Almost one third of the poorest quintile sold and bought rice, often at significantly higher prices, during the same year. 20% did so for the richest quintile. This illustrates to what extent liquidity constraints might lead some of the poorer farmers to participate in rice markets.

2.3.2. Seasonality

[10] This explains why rice price decreased in this province (and increased in the province of Antananarivo) during the political crisis of 2002 when transport and trade between the two provinces was almost impossible.

The annual figures presented above ignore important seasonality. Even more households will buy rice in the lean period but this number will drop significantly during rice harvests. In the commune survey of 2004 a question was asked on the percentage of people that are net buyers or net sellers of rice during the four quarters of the year. The numbers illustrate the large seasonal swings. About half of the rural households were reported to be sellers of rice in the harvest period. During the lean period, 70% of the rural population is estimated to be a buyer of rice while only 8% of the rural households sell rice.

Malagasy communes also often show a pattern of seasonal flow reversals in rice. While 66% of the communal focus groups state to have exported rice after the main harvest in April-June, 51% of the communes imported rice at the end of the year (Graph 9). As is the case in many developing countries, the rice flow occurs primarily during the harvest period and may actually reverse in the pre-harvest season (Barrett, 1996; Moser et al., 2005). Even if the flow itself does not reverse, interseasonal price variability might still be higher in rural areas than in urban ones. Some of the reasons cited for this include inadequate storage, market thinness, and intermediary market power in rural areas (Barrett 1996; Moser et al., 2005). When rural areas experience significantly higher price variability, rural households are much more vulnerable to seasonal undernutrition. These statistics further illustrate that also rural areas are suffering from the high price of rice and other agricultural products in the lean period as they are often net buyers in this period.

Moser et al. (2005) found, based on a nation-wide commune survey in 2001, that communes experienced an 84 percent increase in the rice price over the year and urban communes experience statistically significantly lower price changes. Given that both the urban and rural price changes considerably exceed prevailing interest rates (even adjusted for stock loss due to spoilage, etc.)[11], there appears to be considerable foregone intertemporal arbitrage opportunities in Madagascar's rice markets (Moser et al., 2005). Part of the seasonal price movements stems from seasonality in production and storage costs (due mostly to opportunity costs of funds). It is estimated at the national level that almost three quarters of the Malagasy rice production happens in four months, i.e. between March and June (Graph 10). The number of lowlands where double rice harvests are possible is relatively limited, due to lack of irrigation and to water problems. The lowlands where two rice harvests are possible are mostly found in the west of the country. While most households store and auto-consume part of their harvest over the year, the rice sales seem to happen in a period shortly after harvest. Richer households sometimes postpone sales and might therefore profit of higher prices (Graph 11).

2.3.3. The trading sector

Since the liberalization of the trading sector and before 2004, government refrained from intervention in rice trade and rice storage and rice traders are currently subject to few government interventions (Berg, 1989; Barrett, 1997; IFPRI-FOFIFA, 1998; UPDR-FAO, 2000). Storage of rice by the government and the donors is limited to emergency stocks of

[11] Micro-finance institutions in rural areas typically charge 3% monthly interest rates.

about 10,000 tons that is held by the World Food Program. These stocks are used for distribution in case of natural disasters.

In the private rice trading sector, we see a myriad of traders, ranging from micro-retailers to large rice millers/traders. While Barrett (1996) finds higher profits and high entry costs for the more profitable segments of the rice markets, Fafchamps et al. (2004) do not find any economies of scale. Based on a nation-wide trader survey, UPDR-FAO (2000) and IFPRI/FOFIFA (1998) find rice margins to be reasonable and to reflect capital, transportation and entrepreneurial costs of trade. For example, UPDR-FAO (2000) estimates that a high proportion (85%) of benefits of the rice value chain is captured at the production level in the form of income and salaries of agricultural workers.

The liberalization of the rice market has also led to a restructuring of the trading sector. The importance of vertically integrated firms, that were previously widespread in the rice plains, has greatly diminished. They have been replaced by numerous small and highly specialized traders that work with their own capital and that show little sophisticated linkages (credit, orders) between layers (Dabat et al., 2004; Fafchamps and Minten, 1999).

While the trade of local rice is mostly in the hands of small traders, this is less so for imported rice given the important financial requirements. Madagascar imports substantial quantities of rice from international markets. Imports in 2003 were estimated at 250.000 tons, representing more than 10% of the total consumption of the country and about 1% of the world trade in rice. Rice is mostly imported from Asian countries, mainly from Pakistan, India, and Thailand. These imports arrive in lots of about 1,000 to 4,000 by boat mostly from Asia. Imports are exclusively done by private importers and the total number of importers in a regular year amounts to about a dozen. The rice trade was fairly concentrated in 2004, with the largest 5 importers of rice accounting for almost 60% of all imported rice in Madagascar (Table 10).[12]

The average annual imported quantity of rice over the last decade amounts to 120,000 tons (Table 11). However, an increase is noticed over time, going from less than 60,000 in 1996-1998 to 150,000 tons or more since 2000 (except for the crisis year 2002 when the political crisis disrupted regular trade). Imports are characterized by significant seasonality, arriving relatively more in the lean period and less during local harvests. The percentage of imports during the first six months of the year is usually higher than 50% of the total of the year. It was lowest in the year 2004 (except for the political crisis year 2002). We will discuss reasons for this later on.

[12] This relatively high concentration of the import trade does not suggest that a competitive import trade is not possible, but it does suggest why the government is concerned about the possibility of collusion. In contrast to the structure of the Madagascar market, over two hundred traders imported rice across land borders from India to Bangladesh following major production shortfalls in Bangladesh in 1997 and 1998 (Dorosh, 2001).

2.3.4. Pricing

To a large extent, Madagascar has opted for a policy of market stabilization through private sector trade since a period of structural adjustment in the late 1980s.[13] Private sector imports have occurred almost every year, stabilizing rice prices in the months prior to the major rice harvest. Although structural adjustment policies in sub-Saharan Africa have often led to increased price variability, the private sector rice import trade generally has kept rice prices in Madagascar more stable than prices of major staples in other African countries, such as Ethiopia and Zambia (Table 12).

Since Madagascar is a net importer of rice, in the absence of trade and market restrictions, the price of imports in the local market is determined by the full cost of imports (including the c&f cost, tariffs, taxes, transport, handling and marketing costs). Table 13 shows the different costs required to bring imported rice into the Malagasy market in the beginning of 2004.[14] Two types of duties are levied on imported rice: an import duty that was about 20% in the beginning of 2004 and a VAT tax of 20%.[15] Combined with other duties, this raises the price level by 43%. Taking further transportation costs, wholesale and retail margins into account, it is estimated that retail prices in the Antananarivo market are almost 130% above the wholesale international FOB prices (World Bank, 2004).

Imported and local rice are close substitutes in Madagascar. Using the retail prices in Antananarivo, the ratio of the price of domestic rice to the price of imported rice averaged 1.00 from 2000 through 2003. However, we see consistent seasonality differences: the seasonal index of the price ratio (price of domestic rice over the price of imported rice) ranged from 0.93 in June-August to 1.09 in March-April. In rural areas, imported and local prices are also strongly related, i.e. if both types of rice are available. However, as in urban areas, imported rice prices are slightly higher in the harvest period. In communes where no imported rice is found, local prices are significantly lower (explaining why there is no imported rice as it is unable to compete).

While import parity prices and local prices in the city of Antananarivo are closely correlated, the setting of rural rice prices on the other hand suffers from the lack of market integration. Moser et al. (2005) estimate that that there is very little integration of markets at the national level, mostly due to prohibitively high transport costs. While they find that markets are fairly well integrated spatially at the sub-regional level, where nearly 70 percent of communes appear to be in competitive equilibrium, most of the evidence points to significant spatial and inter-temporal rural market fragmentation.

[13] The rice subsidy reached 25% of the government budget in the mid-1980s prior to market reforms (Dorosh and Bernier, 1994).

[14] In the past, Madagascar has regularly changed rice taxation levels. In 1996, the tariff on rice was 30%, going down to 10% in 1997 and to 5% in 1999, before increasing, on top of a new value added tax of 20%, to 15% in 2000 and to 20% in 2004. The current import tax on rice import is 15%. In 2005, the VAT was reduced to 18% and import duties to 10%.

[15] This VAT is in most cases not levied on locally produced rice and can thus be considered as a hidden import duty.

It has been shown that Malagasy rice production is highly competitive at the international level (Razafimandimby, 1999). The low production costs, due to low labor costs and the little use of inputs, make local rice production cheap. A domestic resource costs (DRC) analysis showed that DRCs are about 0.3, indicating that rice production is economically very profitable. However, competitiveness with international markets is lost in the value chain due to the large marketing costs involved due to remoteness, transport costs and the multiple actors involved in the value chain (Razafimandimby, 1999).

However, there is no evidence of the existence of excessive rents in rice marketing. UPDR-FAO (2000) did a large nationwide survey on the structure of the margins between producers and consumers for local as well as imported rice in 1999. For local rice, about 58% of the final retail consumer price went to the producers, 7% to millers, 27% to traders and 8% to retailers. For imported rice, CAF price levels represented about 61% of the final retail price. Import duties made up 22% of the final price and wholesalers/traders and retailers each had a margin of about 8%. The larger margins for traders in the case of local rice reflect partly the larges costs related to local transport and assembly.