Chapter 5

POSTHARVEST PROCESSING, MARKETING, AND COMPETITIVENESS OF DOMESTIC RICE

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The production of domestic rice does not end with the harvesting of rice on paddy fields. The paddy rice has to undergo various processing and cleaning tasks before reaching final consumers in retail markets. At harvest, the seed grains are first loosened and separated from the unwanted parts of the harvested cereal grain (or the chaff), soaked in water, and boiled before being milled to remove the outer layer (or the husk) of the grain seed. Typically, further milling occurs to convert the grain at this stage into white rice by removing the outer bran, which defines it as brown rice. All these critical steps constitute the process of adding value and thus the competitiveness of domestic rice production with rice imports.

The purpose of this chapter is to review the postharvest processing and marketing activities of domestic rice production in Nigeria in order to evaluate domestic production's ability to compete with imports. This is accomplished by assessing the structure, conduct, and performance of the domestic rice sector. In doing so, key challenges and opportunities facing the sector are highlighted and research questions raised to address them, such as these: Is there potential to improve the quality and competitiveness of the final local rice product in domestic markets? Are there differential abilities and efficiencies among existing mill types (small to large) that affect their capacity to supply the domestic market? Are there lessons that can be drawn from elsewhere in West Africa and Asia? The chapter has been organized with this logical sequence of evaluation in mind.

The chapter begins by examining the structure and conduct of postharvest processing and marketing channels of the rice sector in Nigeria. This is followed by an evaluation of the relative performance of the different channels identified, including a comparison of the economic efficiencies of small- versus large-scale mills. The evaluation illustrates why the large-scale milling channel has the greatest likelihood of competing with imports due to its economies of scale and the quality of rice it can produce. However, it is usually unable to do so because of the inadequate and infrequent supply of

high-quality local paddy. The small-to-medium-scale milling channels, on the other hand, still have room for improvement and therefore offer the potential to supply the growing demand for better-quality local rice in Nigeria.

A discussion of the challenges and constraints that emerge from this analysis follows, including the type of improvements that would be needed. Lessons are drawn from elsewhere in the region and Asia for overcoming some of these constraints. The final section concludes by summarizing the key findings and the extent to which they help answer the principal questions raised in this chapter.

Data used in the analysis are sourced from a survey of the literature, field observations, and semistructured author interviews with farmers, millers, and traders in four states: Niger, Kano, Benue, and Kwara (see map in Figure 1.1 in Chapter 1 for the locations of these states). The visits occurred in August 2012 and April 2013 and involved interviews with a group of eight to ten farmers in two states (Niger and Kwara), five large mills in Kano and Benue, four medium-scale mills (Kano, Benue, and Niger), three smaller mills (Kano, Niger, and Benue), and four retail markets (Kano, Niger, and Benue). The small mills and two of the medium-scale mills were located in milling clusters in Niger, Kano, and Benue. The information collected at each location included prices, production, input and output data, technology use and capacities, production costs (material, labor, and other inputs), and overall constraints and issues facing the dominant types of postharvest processing and marketing channels.

Based on the review and findings here, a spatial equilibrium model is adopted in the next chapter to further explore the potential for modernizing the rice milling sector, especially with regard to the appropriate mix and scale of modern technologies in order to compete effectively with imports.

Structure and Conduct of Rice Value Chain

To analyze the value chain of the Nigerian rice economy, a subsector analysis or structure-conduct-performance approach is adopted from the industrial organization literature (Holtzman 2002). Postharvest processing and marketing contributes to a large share of the rice value chain. This is because once the paddy rice has been harvested, it has to undergo various processing tasks to be converted into milled white rice before reaching consumer markets. At harvest, paddy or rough rice contains an outer layer (or husk) and a bran covering the grain seed. The removal of these outer layers constitutes the milling process. When only the husk is removed the result is brown rice, and when further milling occurs to remove the bran, this converts it into white rice. A

process of parboiling the paddy rice may also occur before the milling process, as is common in Nigeria. The entire parboiling process involves washing, boiling, soaking, and steaming the paddy before drying it, which can take up to three days (Lançon et al. 2003a).

In Nigeria, the parboiling task is necessary because most consumers prefer parboiled rice for its taste and texture in preparing local rice dishes (Bamidele, Abayomi, and Esther 2010). It is also for this reason that most Nigerian consumers prefer the Thai parboiled rice among rice imports (Ogunbiyi 2011). Parboiled rice also offers other advantages: a higher recovery rate during milling and higher preservation of its nutritious properties after milling (Tinsley 2011). Milling is typically done using a mechanized de-huller (or de-husker). While traditional hand-pounding methods are still practiced, these are becoming less common and are mostly for home consumption (Akpokodje, Lançon, and Erenstein 2001).

After milling, a cleaning stage involves separating small stones from the rice, either by hand or with the use of a mechanized de-stoner. Further processing may also be carried out, especially by larger modern mills, such as polishing (buffing the white rice with glucose or talcum powder) and sifting and grading to separate any remaining small impurities and broken grains from the head rice. For the rice destined for market, a final process involves weighing and bagging the milled rice for the wholesale or retail market.

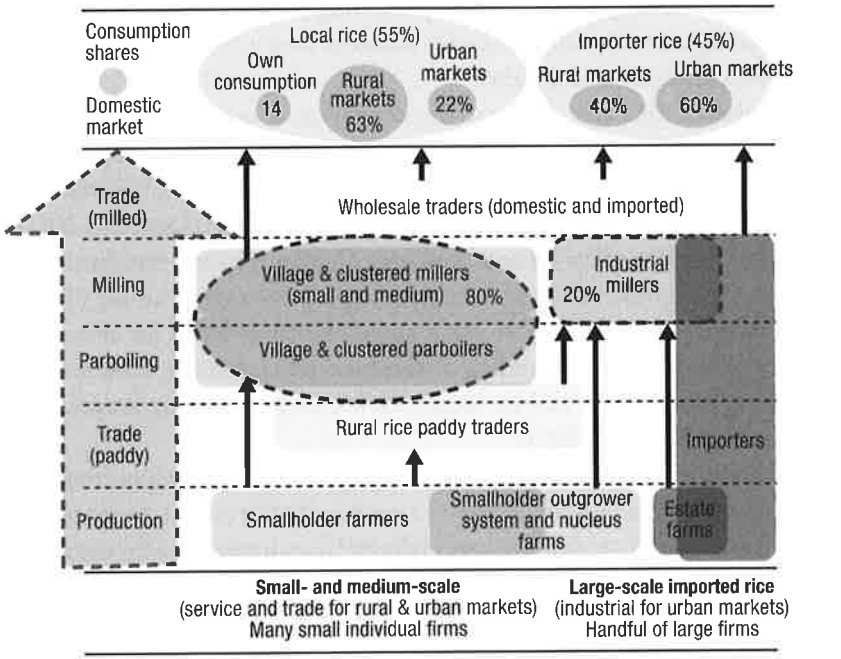
In Nigeria, the various processes described above involve many actors with varying degrees of skill and access to technologies, especially as the bulk of postharvest handling and processing is still very much a cottage industry made up of small-scale operators. Figure 5.1 describes the various channels along the entire value chain by which rice is produced, milled, and marketed in Nigeria.

The small- and medium-scale mills handle up to 80 percent of the total local rice processed.[1] Most of the operators along this channel mill paddy rice from smallholder farmers and traders for a fee, either for their own consumption or for rural markets. Based on the most recent data available, the share of rice milled for own-consumption is about 14 percent, while the rest enters the market, 63 percent going into rural and 22 percent into urban markets (LSMS–ISA 2011).

The economic activities along this chain involve many smallholder paddy farmers, small-to-medium-scale millers, middle traders, and wholesalers and

1 Borrowing from the study of Lançon et al. (2003b), we distinguish small-to-medium scale as having a milling capacity of less than 500 kg per hour. Lançon et al. define small scale as 50 to 149 kg per hour and medium scale from 150 to 500 kg per hour.

FIGURE 5.1 Domestic rice value chain in Nigeria



Source: Authors. Data on consumption shares are from authors' calculations based on Nigeria, NBS and World Bank (2011). The schema has been adapted from Figure 3 in DAI (2009).

retailers. It is a highly disaggregated and fragmented channel, with rice changing hands several times at points of sale from farmgate to end market. As a result, there is naturally a wide variation in the quality of the final product, which can reach consumers with unfavorable properties, such as discoloration and the presence of foreign matter (especially stones).

Most small- and medium-scale mill operators are either located in a village or small town market or within a cluster near paddy production areas. Consequently, areas with higher volumes of production usually have larger clusters of mills with higher operational capacities (medium-scale mills) and are more organized in procuring, milling, and selling of the final product, whether through the market or to middle traders (Lançon et al. 2003b). Some notable examples are the clusters found in Lafia, Otukpo, and Abakaliki, with 100 or more millers. Capacity utilization is usually highest during the months after harvest, between October and December each year. At other times of the year, paddy is procured from further afield.

Middlemen traders play a critical role in bringing paddy from farmers to rice millers and milled rice to wholesalers and retail markets. Only a few trade in both paddy and milled rice, using the services of small- and medium-scale millers for a fee to mill the paddy they purchase from farmers before resale. Others are millers themselves, usually medium-scale operators or smaller operators in the large clusters, who buy paddy from farmers or paddy traders to process and sell on the market. Though few in number, these two types of traders serve an important intermediate role in the collection and bulking of paddy. The dual role they play enables them to be selective about the type of paddy they buy, mill, and resell to the market, and in the process to help ensure homogeneity in the final product (Lançon et al. 2003a). The majority of middlemen traders serve either as paddy or milled rice traders and invest very little to improve the quality of the product itself (DAI 2009; Lançon et al. 2003a).

Despite differences in milling capacities between small- and medium-scale operators, the two compete and overlap. The main difference between the two is that medium-scale operators typically handle larger volumes, and among these are some who serve the dual role of miller and trader, wherein they buy their own paddy to mill and sell to traders downstream rather than simply milling for a fee. Although not common everywhere, such miller-traders may provide farmers with credit for inputs and even store their paddy. However, when they do store paddy, at least according to the findings of Lançon et al. (2003b), this is mostly to help smooth their milling activities during the peak and off seasons rather than to speculate against future expected prices. In their capacity as miller-traders, they do have the advantage of being more selective in the paddy variety they wish to mill, even handling the parboiling task itself before milling and in the process ensuring a better-quality product.

For the bulk of domestic rice, milling is done by smaller millers who provide the service for a fee. Many of these have varied skills and degrees of access to technologies, services, and information along the entire supply chain, and they do not engage in upgrading to better paddy varieties and processing technologies. Little vertical market integration is present in this sector, as evident from the surveys of Lançon et al. (2003b) and the authors' own field visits in Niger and Benue States, implying a weak link downstream between millers and retail markets. This is because the millers rarely deal directly with retail markets in their capacity of providing milling services and in selling to traders on-site. Consequently, there are significant inconsistencies between rice variety names and the final milled product that make it virtually impossible to

link production directly with consumer preferences (Lançon et al. 2003b). It is therefore not surprising that the quality of domestic rice in market outlets varies substantially or that the product is considered inferior to imported rice, which can be relied on for consistent quality, taste, and texture.

The branding of a higher-quality grade of domestic rice varieties is limited in Nigeria. It occurs only where there is a well-established vertical link in the value chain, from a unique paddy variety to the final processed product in the marketplace, a condition that is typical among larger industrial-type milling sectors (for example, the export industries in Asia). However, this sector in Nigeria is limited to a handful of firms that mostly produce to meet demand in high-end urban markets while simultaneously importing rice for the same purpose. This is, after all, a premium product, like imported rice, that is not easily substitutable with the more standard and lower-quality rice produced in higher volumes in Nigeria. Referring to Figure 5.1, this segment of the Nigerian rice market is represented by the two channels involving industrial millers and importers.

There are only a few company brands that exist in Nigeria among the large and industrial-scale millers. These include Olam, Veetee, Stallion, Dana Foods, Isyaku Rabiu Group, and Ebony Agro (Lodestar International 2010). For these firms, the dual role of serving as an importer and a larger miller helps guard against uncertainties related to global price volatility and domestic policies that restrict rice imports (Demont and Rizzotto 2012). As a result, the sector has not always been consistent in its milling activities, producing very little or nothing at all in some years whenever it was less profitable to handle domestically produced rice relative to imports.[2] At the end of 2008, for example, one source identified only two large industrial mills in operation that year: Olam and Veetee (DAI 2009).

Although large-scale operators can potentially handle a larger share of milled rice in the country, they are usually forced to operate well below capacity due to inadequate supplies of paddy rice from year to year; this explains their limited scope to date. In 2002, for example, a survey by Lançon et al. (2003b) estimated that only 32 percent of total milling capacity of the larger millers was being utilized, compared with more than half for small- and medium-scale operators. Aside from the risks of underutilizing existing capacity, the high up-front capital investment required to set up a large industrial mill makes it prohibitive for most investors.

2 Quite a few of the large operators import parboiled brown rice directly from Asia to then mill into rice locally. This can ensure a steady supply for the millers, subject to global price trends and any import barriers.

Rice Value-Chain Performance: Cross-Country Comparisons

To measure the performance of the rice value chain after harvest, information was gathered to generate estimates of the cost and price structure associated with the different activities along the chain in order to determine margins and price competitiveness with imports. Combining data from the literature and field trips to a few of the large rice-producing states in Nigeria (Niger, Kano, and Benue), we compared these costs and prices with those reported for two Asian countries: Thailand and Bangladesh.[3]

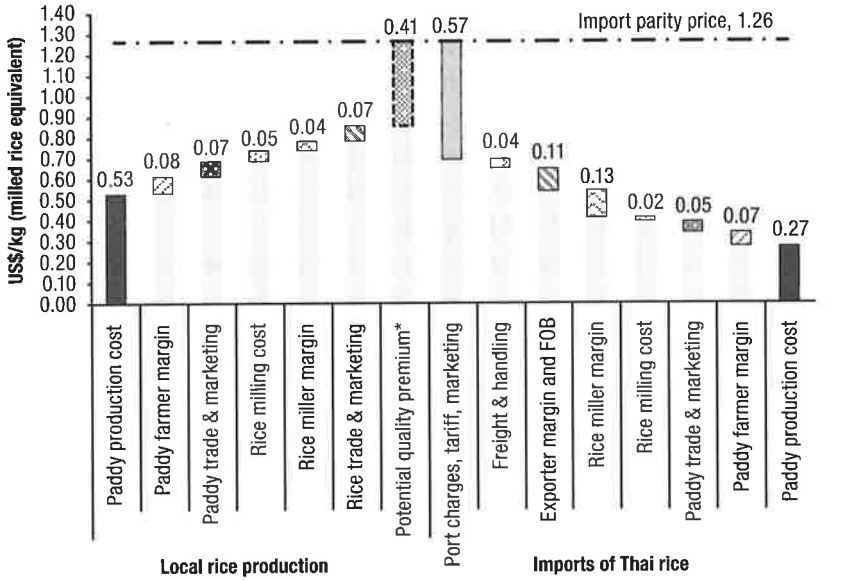
The estimates for all three countries are mostly representative of costs and profit margins associated with smallholder paddy producers, small-to-medium-scale processors (including millers), and traders. These add up to their respective domestic market prices for paddy and milled rice. The trader and retailer's shares of the final price represent both operating costs and profit margins and therefore the differential between a buying and selling price. Paddy traders, for example, will buy from farmers and sell to millers, while milled rice traders buy from mills and sell to retail markets. Although they incur their own operating costs, this is not reported here as such information was not available.

Thailand offers a useful benchmark because the bulk of Nigeria's imports come from this country. Additionally, Thailand is considered to have one of the more efficient rice value chains in the developing world, even though average milling costs could be even lower if existing large rice mills could operate at full capacity every year (Titapiwatanakun 2012). By comparing Thailand's costs and marketing margins, we can point out parts of the value chain in Nigeria that are inefficient and need improvements. However, because we expect the rice export industry in Thailand to have a greater comparative advantage as a major supplier of rice exports in global markets, another benchmark is needed. Bangladesh serves as such a benchmark, providing an example of a net importer (like Nigeria) among major rice-producing countries in Asia.

Figures 5.2 and 5.3 present initial comparisons of the price structure of the domestic rice value chains in Nigeria and the exporter value chain in Thailand. Figure 5.2 exhibits costs and profit margins associated with the small miller rice value chain in Nigeria, which produces a standard or

3 The Nigerian data are mostly based on cost estimates in one of the major rice-producing states, Niger, Kano, and Benue. Some adjustments were made based on secondary data sources, cited under each graph or table. Data for Thailand and Bangladesh are secondary, with the source cited. These are meant only to be indicative of average performance.

FIGURE 5.2 Comparison of rice value chains between Nigeria's small milling sector and Thailand's rice export sector



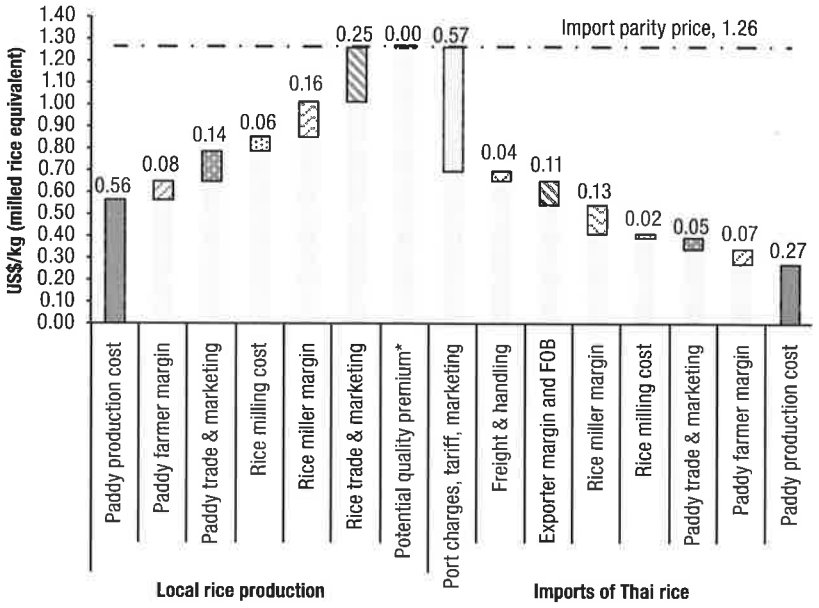
Source: For Nigeria, based on authors' own field visits in Niger State and compared with estimates by Chemonics (2009); for Thailand, based on Maneechansook (2011) and FOB data from the Thai Rice Exporters Association for the rice type known as Thai parboiled rice 100% (www.thairiceexporters.or.th).

Note: FOB = free on board. Dollar values are in constant real 2012 US dollars. Numbers may not add up exactly to 1.26 because of rounding off to two decimals. *This defines an amount consumers may be willing to pay or producers may be willing to absorb in order to bring the quality of standard local rice closer to that of premium-quality rice (from local large mills or imports).

inferior rice type. Figure 5.3 shows related values associated with the large miller value chain, which produces premium-quality rice that is more substitutable with imports. Both domestic value chains are compared with the same average rice exporter value chain in Thailand, which produces premium-quality rice. All values are measured in terms of US$ per kilogram of milled rice equivalent and in constant real 2012 US dollars to allow for a more accurate comparison.[4] The left side of each figure represents the Nigerian rice sector, while the right side represents the Thai rice sector. For

4 Rice equivalent weight accounts for the loss in paddy weight during processing (e.g., from removal of the chaff). On average, this is about 60 percent of paddy weight, although it varies with postharvest and milling technologies (see conversion factors for each miller type in Table 5.2 later in this chapter). Therefore, milled rice equivalent values for activities prior to the final milled rice output will be higher than their paddy equivalent by a factor of (1/0.6). All values in Figures 5.2, 5.3, and 5.4 were converted to constant real 2012 US dollars and in milled rice weight equivalent to allow for a more accurate comparison.

FIGURE 5.3 Comparison of rice value chains between Nigeria's large milling sector and Thailand's rice export sector



Source: For Nigeria, based on authors' own field visits in Niger, Kano, and Benue States and compared with estimates by Chemonics (2009); for Thailand, based on Maneechansook (2011) and FOB data from the Thai Rice Exporters Association for the rice type known as Thai parboiled rice 100% (www.thairiceexporters.or.th).

Note: FOB = free on board. Dollar values are in constant real 2012 US dollars. Numbers may not add up exactly to 1.26 because of rounding off to two decimals. *This defines an amount consumers may be willing to pay or producers may be willing to absorb in order to bring the quality of standard local rice closer to that of premium-quality rice (from local large mills or imports).

the latter, only the export sector is considered, as we are interested in the rice destined for Nigerian markets.

In both figures, paddy is procured from the same source—smallholder paddy farmers—but with different paddy production costs between the two figures due to the type of paddy variety sold. Improved superior (or premium) paddy is typically sold to the medium- and large-scale milling sectors; in the case of the large milling sector, as Figure 5.3 shows, this paddy fetches a price premium at farmgate of about 5 percent over more common (or standard) varieties milled by the small sector (0.64 versus 0.61 naira per kg, respectively). "Paddy production cost" refers to costs associated with growing paddy rice on the farm. The difference between the price of paddy at the farmgate and production cost is referred to as the "paddy farmer margin," while the "paddy trade & marketing" margin is the difference between a wholesale market price for paddy and the farmgate price and therefore includes traders' unknown marketing costs and profit margins.

"Rice milling costs" are associated with the costs of milling paddy procured from paddy traders. We do not include annualized fixed costs that large mills have to absorb to remain operational throughout the year, as we did not have similar estimates to benchmark against in Thailand's milling industry. However, these can be quite high in Nigeria for the large modern mills, especially given the scarcity and higher cost of capital relative to Thailand. We estimate these to be more than double the direct milling costs of the mill at maximum capacity, based on the sample of large mills visited in Kano and Benue States ($0.10 per kg in fixed costs versus $0.06 per kg for milling). We will come back to this later when comparing the relative efficiencies between small- and large-scale miller types.

For each country, the "rice miller margin" is calculated as the difference between the price received for the milled rice by the miller and the price of paddy combined with the cost of milling operations. It is therefore a miller's profit margin. The difference between the miller gate price and domestic retail price in Nigeria is referred to as the "rice trade & marketing margin." Here again, the margin represents the sum of the trader's unknown marketing costs and profit margins.

For Thailand, because we are only interested in the rice that enters Nigeria's retail markets, additional components associated with moving the rice from Thailand to final retail markets in Nigeria are introduced. First, an "exporter margin and FOB" measures the difference between the free on board (FOB) price for rice leaving the Bangkok port and the miller gate price in the country. Second, the "freight & handling" refers to the shipping costs for moving a ton of rice from Bangkok to the port of Lagos, Nigeria. Adding this to the FOB price results in the cost and freight (C&F) price recorded at the Lagos port. The freight and handling costs from Bangkok to Lagos was computed to be $44.30 per ton.[5]

The "port charges, tariff, marketing" component of Thai rice determines the final cost of the imported rice in Nigerian markets, which includes any tariff charged at the port of Lagos, plus transportation and retail marketing costs of bringing it to market. In Figures 5.2 and 5.3, given a C&F price of US$0.69 per kg for Thai parboiled rice 100 percent at the port of Lagos, plus port handling charges of $20 per ton, an exchange rate of 158 naira per US dollar, an import tariff of 50 percent, and domestic marketing costs of 20 percent of the C&F price, the final import parity price of 1 kg of Thai rice

5 From Anderson (2009) data files (also used later in Chapter 7).

in Nigerian markets is estimated at US$1.26.[6] All unit costs are in US dollars per milled rice weight equivalents.

Finally, a last term is introduced in measuring the relative price differences between local Nigerian rice and imported Thai rice, referred to in the figures as the "potential quality premium." This can be viewed as the price premium imported Thai rice enjoys over domestic rice due to its higher quality and preference among consumers. Alternatively, it can be similarly viewed as an amount that represents the additional costs that could be absorbed by domestic rice producers in order to improve the quality of local rice and compete with imported Thai rice, hence the term "potential quality premium." For the large milling sector, this is assumed to be zero, as the rice is comparable in quality to imported Thai rice.

To compare the cost of Thai rice in Nigerian markets to local rice, we need to include all costs associated with importing the rice into the country and bringing it to market, which we estimated to be $1.26 per kg (2012 US dollars), based initially on 2009 data from Titapiwatanakun (2012). Because the 2009 price in current 2012 dollars corresponded well with current prices, we compared this with field data collected by the authors in Nigeria in 2012.

Beginning with Figure 5.2 for the small milling channel, the data reveal that average paddy production cost per unit of output in Nigeria is almost double that in Thailand ($0.53 per kg versus $0.27 per kg in their milled rice weight equivalent). Nevertheless, farmers seem to be earning the same in absolute terms. Paddy trader costs are slightly higher in Nigeria. Overall, the final price for domestic rice at the mill, that is, before adding the "rice trade & marketing" component for Nigerian rice and the "exporter margin and FOB" for Thai rice, is well above the comparable price in Thailand ($0.77 per kg versus $0.54 per kg, respectively). Clearly, even after milling, the Nigerian rice industry remains less competitive. Direct milling costs in Thailand are very small—about a third of what Nigeria's small millers experience. This is not only a sign of their efficiencies and volume of operations but their large-scale nature.

Under zero tariffs, evidently, rice produced in Nigeria cannot compete with imports on price, let alone quality, because after freight and handling at the port in Lagos, the price of imported Thai rice (which is considered to be of higher quality) is still lower than the domestic rice at the small miller's gate (after the rice miller margin). Only if we include an import tariff of about

6 The C&F price is based on an FOB price at the port of Bangkok of $0.65 per kg (or $649 per ton) for Thai parboiled rice 100 percent in 2009, the year for which sufficient information on the Thai rice value chain was readily available (see Titapiwatanakun 2012), plus freight, insurance, and handling of $0.04.

50 percent and add domestic transportation and marketing costs (say about 30 percent of C&F price) does the final import parity price at the retail level rise to $1.26 per kg (199 naira per kg) and above an average retail price for domestic rice of $0.85 (135 naira per kg, respectively).[7]

For consumers, such a price differential makes sense, considering the perceived inferior quality of the bulk of domestic rice coming from the small sector in Figure 5.2 (that is, a 33 percent premium for quality alone).[8] Similar conclusions were drawn in the earlier study by Lançon et al. (2003b), who estimated the gap to be about 25 percent. The differential of $0.41 in Figure 5.2 can be viewed as an amount that the smaller domestic producers (small- and medium-scale millers) could potentially absorb as additional costs in processing higher-quality rice, therefore increasing their chances of competing with rice imports (hence the term "potential quality premium" for this element in the figure).

Turning to Figure 5.3, we compare the performance of the large milling sector in Nigeria with Thailand's milling export sector, as it provides a fairer assessment given their similarities in technology use, scale, and demand for quality seed varieties for milling. For our purposes, therefore, we can assume the milled rice by either country to be of similar quality, and thus that it can compete well when selling at the same price.

As Figure 5.3 illustrates, the large sector in Nigeria experiences much higher per-unit operating costs all along the value chain for paddy production, paddy trade and marketing, rice milling, and rice trade and marketing. The "paddy trade & marketing" component of the value chain, in particular, is significantly higher than the same component in the small milling sector in Figure 5.2. This is partially because of higher search costs and a price premium for the superior paddy variety sought after by large millers. Profit margins are still reasonable, nevertheless: about 16 percent as a proportion of the price received at the mill gate. In contrast, the smaller millers fetch only 5.6 percent. Oguntade (2011) also reports small profit margins for medium-scale millers (about 7 percent).

Beyond the mill gate, trade and marketing costs for the large millers are again larger than those of the small milling channel, probably because large millers typically target the bigger urban markets scattered throughout the country. Therefore, while the large milling sector is better able to compete

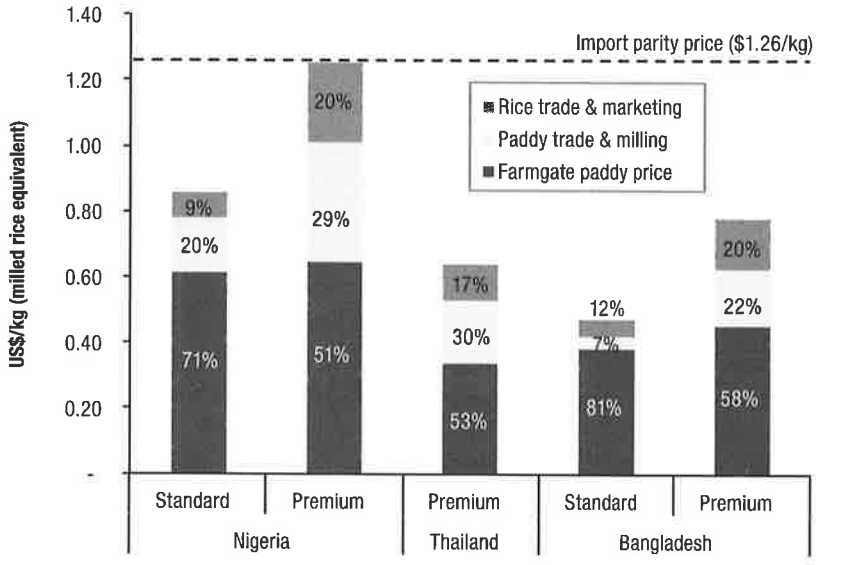
7 Retail and wholesale prices of domestic rice are based on monthly averages in 2011 collected by FEWS NET (the Famine Early Warning Systems Network) in one of the major rice marketing centers in Nigeria, in Bodija (Ibadan). The prices for imported rice in 2012 are easily around 200 naira per kg, so these figures are quite reasonable.

8 An exception is *ofada* rice, which is considered to have high-quality premium characteristics—but has only a small niche market relative to total rice demand.

with imports on quality, they cannot do so on price unless import tariffs are sufficiently high. In this case, the 50 percent levy existing at the time when the data were collected results in a comparable import parity price of $1.26 per kg, which offers positive profit margins for millers and, just as likely, wholesale and retail traders (as illustrated in Figure 5.3 by the rice trade and marketing component valued at $0.25, about 20 percent of the import parity price).

In comparing the price structure only between Nigeria, Thailand, and Bangladesh, we can gain further insight into the share of the price captured by the farmer, by paddy traders and millers, and finally, by wholesale traders and retailers. Figure 5.4 presents this price structure for all three countries and by type of rice. For Nigeria, as before, we distinguish between rice produced by the small and large miller marketing channels, which produce a standard and premium quality product, respectively. For Bangladesh, "standard" refers to the more common coarse rice brand, while "premium" refers to the fine brand targeted to higher-end urban markets and based on the work by Minten, Murshid, and Reardon (2013). For each country, the price has been broken up

FIGURE 5.4 Comparison of the rice price structures in Nigeria, Thailand, and Bangladesh



Source: For Nigeria, authors' calculations based on authors' own field visits in Niger, Kano, and Benue States and compared with estimates by others such as Oguntade (2011); for Thailand, based on Maneechansook (2011) and FOB data from the Thai Rice Exporters Association for the rice type known as Thai parboiled rice 100 percent (www.thairiceexporters.or.th); for Bangladesh, based on Minten, Murshid, and Reardon (2013) and referring to fine-quality rice grain.

Note: FOB = free on board. Prices are in 2012 US dollars and have been converted to their milled rice weight equivalents.

into three components: farmgate paddy price, paddy trade and milling, and rice trade and marketing. These capture the combined costs and profit margins among the actors involved under each component, such as farmers, millers, and traders.

As shown in Figure 5.4, the overall price structure in Asia contrasts sharply with Nigeria's. To begin with, the most striking difference is the higher farmgate paddy price and milled rice price in Nigeria compared to the two Asian countries for both standard and premium rice types. At the same time, the farmgate prices' share of the final retail prices indicates that Nigerian farmers seem to capture lower shares of the final price than farmers in Asia: 71 percent versus 81 percent for standard and 51 percent versus 53 and 58 percent for premium.

Paddy trade and milling cost is also significant in Nigeria for both types of rice: for standard rice, this cost is about five times that for standard rice in Bangladesh, and for premium rice it is more than double that for premium rice in Bangladesh and Thailand. As already pointed out earlier, one explanation is the higher trader and marketing costs in Nigeria, especially for large millers who often have to resort to procuring paddy over long distances when facing limited supplies of their preferred superior-quality paddy. For the large millers in particular, the insufficient access to paddy throughout the year implies that they are often operating well below full capacity (Oguntade 2011). If we had considered annualized fixed costs, the paddy trade and milling cost would be even greater.

As a result, the share of the Nigerian final retail price accounted for by paddy trade and milling cost is comparable with the same cost's share in Thailand's final retail price, but it is much lower than paddy trade and milling cost's share of this price in Bangladesh. This is not surprising, as large exporter mills in particular have been shown to capture large shares of Thailand's rice prices (Maneechansook 2011; Agrifood Consulting International 2005).

After milling, the share of rice trade and marketing margin is about the same across all three countries. In Bangladesh, about 20 percent of the final retail price for premium rice goes to retail traders (Minten, Murshid, and Reardon 2013). For Nigeria, this is possible given the presence of the 50 percent tariff. For the standard type of rice, these margins are much smaller in both Nigeria and Bangladesh (about 9 to 12 percent). Evidently, a key area for improving the competitiveness of domestic rice is going to be not only ensuring better product quality but lowering processing, trader, and marketing costs to increase incentives to upgrade.

Despite higher production costs, Nigerian paddy farmers seem to share the same profit margins as their Asian counterparts. Using national averages for

TABLE 5.1 Comparison of production costs, yields, and profit margins

	Nigeria		Thailand	Bangladesh
Measurement	Standard[a]	Premium	Premium	Premium
Input costs				
Production costs ($/MT)	531.0	563.0	254.0	312.0
Milling costs ($/MT)	51.0	160.0	17.0	NA
Paddy yield and returns				
Paddy yield (MT/ha)	1.9	3.0	2.9	4.2
Farmer return ($/ha)	151.0	253.0	191.0	207.0
Profit margins				
Farmer profit margin (%)	13.0	13.0	19.5	13.6
Miller profit margin (%)	5.6	16.0	24.2	NA

Source: Data sources for Nigeria are authors' calculations based on field visits in Niger, Kano, and Benue States and compared with estimates by others such as Oguntade (2011); for Thailand, based on Maneechansook (2011) and FOB data from the Thai Rice Exporters Association for the rice type known as Thai parboiled rice 100 percent (www.thairiceexporters.or.th); for Bangladesh, based on Minten, Murshid, and Reardon (2013) and referring to fine-quality rice grain. For farmer returns, the data are value-added agriculture per hectare from the World Bank (2012); for yields, FAOSTAT (FAO 2014).

Note: FAOSTAT = statistical database of the Food and Agriculture Organization of the United Nations; NA = not available; MT = metric tons. Per-unit values are in 2012 US dollars. Input costs are in milled rice weight equivalents. [a]Here, "Standard" refers both to inferior paddy varieties and lower-quality milled rice, while "Premium" refers both to superior paddy varieties and higher-quality milled rice. Trade and marketing margins were not included because of insufficient information to distinguish between operating costs and profit margins.

yields, production costs, and prices, Table 5.1 shows Nigerian farm-level profits as reasonably close to those of both Thailand and Bangladesh. Thailand's higher margins may actually be partially due to a government support program. In absolute terms, however, Nigerian farmers earn lower margins per hectare for the common varieties due to lower yields, about $151 per year compared with $253 for the local superior (and higher-yield) varieties, and with $191 and $207 for Thailand and Bangladesh, respectively (all in 2012 US dollars). With regard to production costs, both Bangladesh and Thailand enjoy much lower costs per ton for both paddy production and milling relative to Nigeria, a sign of the higher yields and efficiencies in the technology inputs being used.

The poor performance of the entire Nigerian rice value chain relative to that of Asian countries leaves a lot of room for improvement. Per-unit costs for paddy production, milling, trading, and marketing are all on average higher than those in Asia—Table 5.1 illustrates these higher costs for paddy production and milling (trading and marketing was not included because of insufficient information to distinguish between operating costs and profit). The share of paddy trader/miller activities and profit margins in the final price is

especially high for the large mills (the premium rice type in Figure 5.4): three times those of smaller mills that produce the more inferior standard rice variety. As a start, simply raising the productivity of paddy production by promoting the adoption of superior varieties, as argued for in Chapter 4, can have a significant effect.

Efficiency of Small versus Large Millers

In assessing the performance of the postharvest rice value chain in Nigeria, a key question that arises is the relative economic efficiency of the small versus large milling channels that were illustrated earlier in Figure 5.1. To measure the economic efficiency of both channels, we draw on the arguments used by Timmer (1998). In his seminal study for Indonesia, he showed that small mills were more efficient than larger milling operations because of the combination of lower paddy-to-milled conversion ratios, higher capital-to-labor price ratios, higher economic discount rates, and higher price ratios of the final milled rice to paddy rice (or milled-to-paddy price ratio) that are typical in a developing-country setting.

The paddy-to-milled conversion ratio defines how much weight of milled rice is converted from a single unit weight of paddy rice (milled rice weight is always lower than paddy rice weight, because the husk and bran of the seed are removed during milling). The capital-to-labor price ratio helps determine the degree to which a mill can minimize costs—and thus compete more efficiently—by drawing on additional capital or labor, depending on which input is cheaper (for cost minimization, the marginal rate of technical substitution between capital and labor equals this price ratio).

An economic discount rate here represents the cost of a capital investment over time. An economic discount rate is the interest rate used either (1) to discount any future cash returns from a current investment or (2) to calculate the present value of any future investment. The higher the rate, the lower the present value of any future cash flows or the higher the future value of a current investment. The price ratio of final milled rice to that of paddy at the farmgate measures the price gap between the two that captures how much cost can be absorbed in processing and moving the rice to market. A small gap (hence a smaller price ratio) implies that milling costs have to be small enough for millers to remain profitable.

The paddy-to-milled conversion ratio measures the technical efficiency of the mill and can affect the ability of a mill to compete; for example, if the milled-to-paddy price ratio is small due to cheaper imports. This situation can

be especially challenging for large-scale millers, who typically have added costs associated with procuring quality paddy and further processing unless they are able to capture a price premium on the quality of their brand.

Because larger mills are capital-intensive enterprises that rely more on capital inputs than labor, the capital-to-labor price ratio and discount rate are just as important in determining their economic efficiency and competitiveness. Naturally, they are more competitive when they operate under conditions of lower per-unit capital costs relative to wages. A key factor that can lower this ratio is the rate at which capacity is being fully utilized, given the scale economies of this heavily capitalized industry. As pointed out earlier, the underutilization of large mills is a common problem in Nigeria and other developing countries where the supply of sufficient quantities of paddy is not always guaranteed.

Another key factor is the economic discount rate, which simply measures the rate at which future costs and benefits are discounted relative to the present. Since large mills have higher up-front investment costs and larger benefits accruing in the future than smaller mills, a high discount rate makes the large mills less attractive than their smaller counterparts, because the present value of all future benefits is far outweighed by the total costs, translating into a negative return on investment. Under the same conditions, on the other hand, the smaller mills are more attractive as they are less capital intensive and incur only higher wage costs in the future.

Finally, higher milled-to-paddy price ratios typically imply that, relative to the price of paddy, there are higher milling and marketing costs (and/or profit margins) being captured in the final price of the milled rice entering retail markets. Conversely, a lower ratio implies higher efficiencies of these postharvest activities.

Table 5.2 provides estimated values of each of these four indicators across Nigeria, Thailand, and Bangladesh. Derived mostly from anecdotal evidence, it is meant to be indicative and form the basis for discussion. The comparison with Thailand and Bangladesh allows for consistency with the previous assessment of value-chain performance.

As seen in Table 5.1, Nigeria is evidently less efficient in milling technologies and practices, considering its lower paddy-to-milled conversion ratio and higher milled-to-paddy ratios. A large wedge between paddy and milled rice prices is an indication of higher operating costs and margins for processing and marketing, which was shown to be the case for Nigeria in Figure 5.4. It can also have the effect of introducing greater profit risks for millers and middle traders, as larger price swings are possible within this price band. This is

TABLE 5.2 Key indicators of efficiency and profitability of small- versus large-scale rice milling

Indicator	Nigeria	Thailand	Bangladesh
Paddy-to-milled conversion[a]	0.58	0.66	0.63
Milled-to-paddy price ratio[b]	1.4/2.1	1.9	1.2/1.7
Capital-to-labor price ratio[c]	2.7	1.6	2.1
Economic discount rate[d]	10.1	6.7	13.1

Source: Authors' calculations based on various sources of data.

Note: [a]For Thailand, data source is Titapiwatanakun (2012); for Nigeria, Lançon et al. (2003b); and for Bangladesh, Minten, Murshid, and Reardon (2013). [b]The two numbers represent a distinction between the quality levels of paddy and milled rice varieties: common or traditional paddy rice versus standard milled rice for the first number and superior paddy rice versus premium milled rice for the second number. Data sources for Nigeria are authors' calculations based on the author's own field visits in Niger, Kano, and Benue States and compared with estimates by others such as Oguntade (2011); for Thailand, based on Maneechansook (2011) and FOB data from the Thai Rice Exporters Association for the rice type known as Thai parboiled rice 100 percent (www.thairiceexporters.or.th); for Bangladesh, based on Minten, Murshid, and Reardon (2013) and referring to fine-quality rice grain. [c]This is the ratio of total value of agricultural capital stock per agricultural population (US dollars/person) over the agriculture gross domestic product per agricultural population (US dollars/person). Data are from World Bank (2012). [d]This is an annual average interest rate between 2010 and 2012 from the International Monetary Fund statistical database (IMF 2012). Because some banking discount rates were higher than lending rates, we chose to use the former in Nigeria. For Thailand and Bangladesh, in order to be as conservative as possible, we chose the lending rate. The four indicators here are those highlighted by Timmer (1998). All values use constant 2005 US dollars and are averaged across three years, 2005 to 2007.

possibly one reason why many small millers in Nigeria operate only on a fee basis. Even among those who buy paddy to resell as milled rice, according to Lançon et al. (2003b), the probability of making a profit is only 40 percent.

A comparison of the two price ratios and average discount rate for each country in Table 5.2 reveals that Nigeria and Bangladesh face higher investment risks from introducing capital-intensive modern rice mills (MRMs) relative to Thailand. Nigeria shows a higher milled-to-paddy price ratio for the higher-quality premium rice, indicating the higher share of milling, trade, and marketing costs captured in the final price of milled rice. This seems to be true also for the lower-quality standard rice when compared with Bangladesh (1.4 versus 1.2, respectively). The capital-to-labor price ratio is also higher in Nigeria, indicating higher per-unit capital costs relative to labor. Additionally, for Nigeria, the fact that large mills typically have to operate at well below capacity due to an insufficient paddy supply implies much higher per-unit operating costs.

The logistical costs and uncertainty associated with procuring the paddy from year to year presents an even bigger challenge in keeping operating costs down. Other operating costs stem from the heavy reliance on diesel-operated electric generators in the absence of a dependable supply of electricity throughout the year. In contrast, the dominant smaller-scale milling sector faces lower capital investment requirements and operating costs and thus has the potential

to realize quick positive returns from simply upgrading post-milling activities for de-stoning, polishing, and packaging. The potential to do so exists, considering the current large price band between the standard and premium varieties of domestic rice.

Key Constraints, Opportunities, and Challenges for Rice Millers

In analyzing and comparing the two distinctive value-chain sectors for domestic rice in Nigeria—the small-to-medium- and the large-scale milling sectors—a number of constraints and opportunities associated with each emerged. To begin with, because the large industrial sector enjoys the advantage of having a higher milling capacity and modern technologies for supplying the premium-grade rice, it has greater potential to compete with imports. However, the sector is usually unable to take full advantage of its greater economies of scale, as it is often forced to operate well below maximum capacity due to insufficient access to quality paddy. Because much of the paddy is produced by smallholder farmers, this is a major challenge.

As the dominant supplier of paddy, the smallholder rice farming sector in Nigeria varies widely with regard to paddy yield and varieties of seeds grown, in addition to the type of production system and inputs used as well as distance to major processing centers and markets. All of this introduces a major logistical challenge in procuring the right quality and quantity of paddy in a timely and well-coordinated fashion.

In the past, large millers have had to resort to traveling great distances or establishing outgrower systems to procure sufficient quantities of quality paddy. However, these tactics did not always guarantee a sufficient supply and in the end proved too costly to sustain business due to both the higher per-unit operating costs of not utilizing the full capacity of the mills and the added search and administrative costs to secure paddy. To circumvent these problems, some millers have chosen to start growing their paddy on large-scale irrigated lands (Box 5.1 presents the Olam story as an example). Alternatively, the government is also proposing to set up a number of smallholder nucleus farms that will cultivate paddy on large irrigated lands in close proximity to the large modern mills (Adesina 2012).

Adding to the higher operating costs for accessing paddy, one challenge faced by large-scale operators is a periodic breakdown in utility services (such as electricity and water) and machinery parts (which have to be imported from the mill manufacturer overseas). A second challenge is the risk associated

BOX 5.1 The story of Olam in Nigeria

As a major importer in Nigeria that holds one of the largest market shares, Olam has in the past invested to process local rice using large modern rice mills. In 2006, the firm entered into a partnership with USAID (the US Agency for International Development) to establish an outgrower system with smallholder rice producers in order to promote local Nigerian rice production. The program allowed farmers to access technologies, credit, and technical assistance to produce superior paddy varieties and have assured markets and prices.

Productivity and incomes reportedly more than doubled in the first years, encouraging a Nigerian commercial bank (First Bank) to become a major stakeholder in a smallholder farmer commercial credit program. Unfortunately, the program was discontinued after 2008, when Olam failed to procure sufficient paddy after its price guarantee offering fell below other offerings of competitors in the area as world prices (and thus price of imported rice) were increasing. At the same time, credit repayment problems among many of the participating rice paddy farmers had also started to emerge.

Evidently, Olam's initial effort at procuring paddy from outgrower systems proved too risky given global price uncertainties and the logistical costs associated with maintaining varietal quality, input delivery, credit repayments, and sufficient volumes of rice each season. By 2012, Olam had started venturing into rice production (its first in Nigeria), putting 49.2 million dollars (7.675 billion Naira) into rice farming and a milling facility in Nasarawa State.

Olam intends to irrigate up to 6,000 ha of rice to supply up to 60,000 tons of paddy annually for the company's processing facility. The paddy is expected to be converted into about 36,000 tons of milled rice annually. Olam expects to focus attention on milling two superior paddy varieties in Nigeria (FARO 44 and FARO 52) and expects to get about 65 percent of paddy needed from its own farm and the rest from outgrower cooperative agreements with smallholder farmers. How it will successfully manage the latter scheme based on its past experience is not certain.

Source: Based on Olam (2011); USAID (2010); Chemonics (2009); and authors' own interviews with staff at Olam Mills, extensionists, and farmers involved in the outgrower system.

with declining domestic rice prices if the government chooses to lower the import tariff. Therefore, while the large milling sector has greater potential to compete with imports on quality, it may not be able to do so on price.

The dominant small-to-medium-scale milling sector, on the other hand, has remained quite vibrant in its ability to procure, process, and market the bulk of the paddy being produced by thousands of smallholder farmers

scattered all over Nigeria. Although still very much a cottage industry, the sector employs the most within the Nigerian rice industry. Therefore, any increases in the productivity and product quality of this sector have the potential to result in larger and broader effects on overall rural employment and welfare.

The sector not only employs many processors and traders, including women, but also provides a cheaper rice alternative for millions of poorer consumers in the country, as shown by a number of research studies (see, for example, Akighir, Ngutsav, and Asom 2007; Basorun 2008; Agwu and Ibeabuchi 2011; and Ayoola et al. 2011). This is, after all, a distinctive sector of the domestic rice market relative to the higher-end markets for imported rice, as shown previously in Chapter 2. Nevertheless, for the sector to improve, many of the challenges it faces along its value chain will need to be addressed.

The principal challenge for the small milling sector in Nigeria is the many obstacles it faces for improving productivity and product quality. As still very much a cottage industry, one obvious challenge is the necessity of dealing with many producers, traders, and processors who have variable skill levels, access to technologies, and credit, and who interact only at the point of sale or for servicing. As a fragmented processing and marketing system, it has limited abilities or incentives to upgrade to better technologies, marketing, and branding, especially in the downstream part of the value chain. Relatedly, the existing marketing system has no consistent grades and standards, exhibits poor record keeping, and has poor organizational capacities. Because most of the millers mill paddy for a fee, they simply leave it up to the traders or consumers who seek their service to worry about quality. While they may wish to invest in modern equipment, many of the smaller-scale operators have poor access to credit to pay for the investment.

Simply providing credit to small-scale operators can hardly be a solution, however. Even among the medium- and larger-scale operators, access to credit has not necessarily led to investments in modern equipment. Based on their surveys in Nigeria, Lançon et al. (2003a) found that many of the larger-scale operators were not investing in upgrading their equipment because of uncertainties about paddy supply. Instead, promoting access to shared infrastructure, markets, and technologies, such as for further processing (de-stoning and polishing) within small town or village-level clusters, may be more promising.

Based on field visits by the authors to two such milling clusters in Benue and Kano States, cluster members appear to benefit from both economies of scale and location. The cluster not only enables shared access to infrastructure, technologies, and know-how but offers lower costs for accessing paddy among

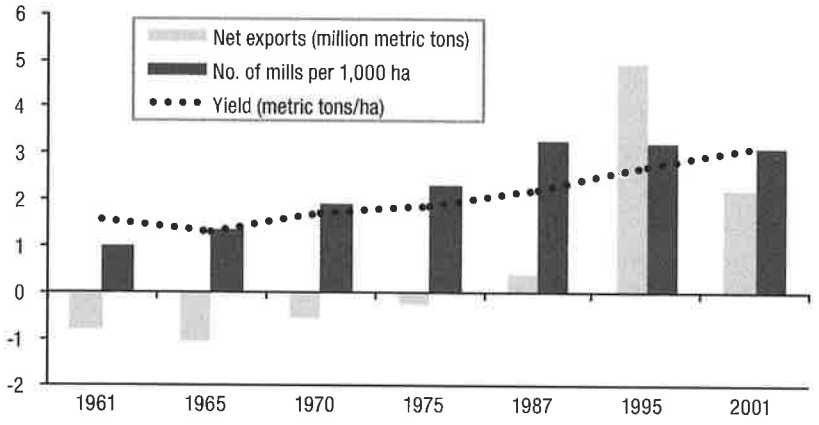
suppliers who prefer to deal in bulk. This is also the case for accessing buyers among rice traders who are willing to travel long distances if the cluster's reputation for quality, price, and timely delivery is perceived as good. This advantage alone seems to also attract medium-scale operators who set up shop nearby. Aside from the proximity to input and output markets, the clusters also provide members with the opportunity to adopt other technologies for further processing if such a technology already exists in the cluster. This can be of particular value to small-scale operators who are unable to afford owning the technology on their own.

Improved performance of the entire rice value chain of the Nigeria rice milling industry will require distinguishing these unique challenges faced by the small and larger milling sectors. For the larger milling sector, lowering operating and input costs, including access to adequate utility services, will be important. But even more essential is ensuring access to sufficient quantities of quality throughout the year in order to compete more effectively with imports. For the smaller sector, it is not only about improving productivity and quality but about considering the promotion of miller clusters to take advantage of economies of scale and location. Finally, for both sectors, increasing the productivity of paddy production to expand output and lower prices more generally, as well as insisting on a higher quality and standardized rice seed variety, would be beneficial.

Drawing Lessons from Elsewhere

Given the numerous challenges facing the rice economy in Nigeria, successful upgrading and improving of the milling industry will be key and will require significant investments and policy interventions, as the government was attempting to do under the Agricultural Transformation Agenda (ATA) launched in 2011. ATA was the main agricultural policy agenda under the administration of President Goodluck Jonathan and was led by the Federal Ministry of Agriculture and Rural Development. Because this has been tried elsewhere in the region and beyond, it is useful to draw on lessons from other experiences. In much of developing Asia where rice is a food staple, for example, the rice milling industry transformed itself over time in tandem with the rapid growth in paddy production during the Green Revolution. Figure 5.5 illustrates this growth for India, showing that as yields grew over time, the number of mills (whether small or large) also expanded per unit area. It is also interesting to note how the growth in rice production in India eventually led the country to switch from being a net importer to a net exporter—which

FIGURE 5.5 Evolution of modern rice mills, yields, and net exports in India



Source: For number of mills, Nayak (1996) and Harriss-White (2005); for yields and net exports, FAOSTAT (FAO 2012).

was only made possible by an expansion of the country's milling capacity for premium-quality rice destined for export markets (for example, basmati rice). Indeed, the country experienced a phenomenal growth in the utilization of large, modern rice mills (MRMs) in the 1980s and 1990s, reaching a total of about 35,000 by 2001 (Harriss-White 2005). However, MRMs never completely displaced traditional practices of parboiling, sun-drying, and using rice hullers, which continued to exist alongside the MRMs. MRMs were instead the preferred choice in both India and Thailand for milling higher-quality rice destined for export markets in both India and Thailand.

Large industrial MRMs easily handle large volumes of paddy for supplying export markets. A disadvantage of their use for domestic markets is that they often face the risk of operating below maximum capacity as they seek to procure sufficient supplies of paddy destined for domestic markets each year from thousands of smallholder farmers. Therefore, public-sector interventions are often needed to ensure that MRMs can continue to operate profitably by assisting with the procurement of paddy, guaranteeing rice purchases directly from mills (for example, for government-managed stocks), or both. In fact, much of the growth in MRMs in India could not have occurred without government support in the form of credit subsidies to promote investments in building large mills and in procuring the paddy (Harriss-White 2005). Other incentives were also introduced, such as imposing an outright ban on the use of existing small-scale mills based on the traditional huller, establishing rice procurement agencies, instituting quality-standardization agencies at the state

level, and maintaining a minimum price guarantee for paddy (Shwetha 2009). Today, the Indian government continues to provide both logistical (warehousing and procurement) and price-support mechanisms for technology upgrading. Over time, these practices have introduced high fiscal and economic costs, as paddy farmers and the MRM industry have grown to rely heavily on such support. At the same time, the small and traditional millers have continued to flourish despite efforts to ban them. In fact, they still contribute a significant share of total milled rice in India (Harriss-White 2005).[9]

In contrast to India, the public sector in Thailand has not been involved in subsidizing MRMs directly, many of which are in the export sector and privately owned. Instead, the government has typically intervened by introducing price-support mechanisms for paddy to ensure a steady supply to the milling sector and, ultimately, for exports. The program is popular among politicians because it helps to garner votes among farmers and millers, who represent a large part of the population and benefit the most from the policy (Forssell 2009). Referred to either as the "rice mortgage scheme" or the "pledging program," the policy enables farmers to sell their paddy to the government via millers participating in the program at more favorable prices should market prices fall below a guaranteed price—thus benefiting both farmers and millers (Titapiwatanakun 2012). A key challenge to the policy happens whenever the guaranteed price is set higher than the market price, leading to higher domestic prices and higher holdings of government rice stocks, something that occurred in 2010, when government-owned stocks reached 5 million tons (Thongrattana 2012). Because the policy of accumulating stocks is fiscally costly and can threaten Thailand's ability to compete in international markets over time, the government has since discontinued the program and slowly begun to release the accumulated stock. In its place, a new price-guarantee program has been introduced, but this time it does not involve the direct purchase of paddy from farmers (Thongrattana 2012).

An important lesson from both India and Thailand is the failure to displace completely small- and medium-scale milling operations with large MRMs. This seems to be a general pattern elsewhere in developing Asia. Timmer's (1998) example for Indonesia provides a good explanation for this phenomenon by showing how small mills are both socially and privately profitable compared with larger mills in supplying domestic markets. Not only do they have lower per-unit operating costs, but they also do not displace rural employment, especially female labor. Although Timmer's original study was

9 The ban was finally lifted in 1996 (Harriss-White 2005).

carried out more than three decades ago, his findings continue to be relevant today. Both India and Thailand have witnessed the maintenance of a vibrant small milling sector that supplies domestic markets alongside larger MRMs that have emerged to serve high-end urban and export markets.

The experience in West Africa in general has not been very different from Asia's, except in the context of being exclusively a net importing region. Large MRMs were initially introduced with heavy state intervention as part of the import substitution strategies in the 1970s and 1980s. But these collapsed in due course as governments withdrew their support under a broad sweep of structural adjustment and market reform efforts in the 1990s. The experience in Mali is a particularly good example. After the government sold off several large mills in Office du Niger in Mali to private operators and lifted a ban on small-scale milling, the large operators suddenly found themselves unable to compete effectively with the small milling sector in procuring paddy. The latter was well positioned to operate more efficiently and flexibly with smallholder suppliers. At the time, according to Diarra et al. (1999), per-unit costs for large millers turned out to be about four times those of smaller mills (17.6 versus 4.3 West African CFA francs) because the large mills typically operated at well below capacity. This is not too different from the experience in Nigeria.

The conditions Timmer (1998) analyzed for Indonesia in the 1970s remain partially relevant in Nigeria today, as they have been in Asia in the past. However, conditions have changed as urban populations and incomes continue to grow in both Asia and Africa. Research shows demand shifting toward higher-quality and premium milled rice in Asia's emerging sophisticated urban markets (Minten, Murshid, and Reardon 2011 and 2013; Murshid 2011; and Chapter 2 in this book). In response, the postharvest rice sector has been transforming itself by adopting larger MRMs. While past adoption of higher-yield paddy varieties has certainly helped to meet the growing demand, the increased adoption of MRMs is proving more critical in meeting the demand of these new domestic markets. In some locations in Bangladesh, for example, MRMs now generate more than 90 percent of the rice marketed from the local area, according to observations by Murshid (2011). Their presence is increasing not only the milling capacity but also the quality of rice produced in the area. This shift has also led to more sophisticated institutional and marketing arrangements that involve middlemen brokers who link paddy traders with millers and the latter with rice traders and wholesalers. These actors capture a larger share of the price premium for the higher-quality rice, while farmers benefit the least (Minten, Murshid, and Reardon 2013). Evidently the added quality from improvements in processing

has provided a positive return for investors as demand for premium-quality rice continues to expand in developing Asian countries. Overall, these changes are having a profound effect on local rice economies. Greater employment opportunities are appearing on the scene—such as subagents for paddy producers and other new trader entrants, medium-scale parboiling and milling firms, mini-drying yards, and new post-milling operations (for example, for puffing)—and the changes are also leading to the commodification of rice with a system of quality grades and standards (Harriss-White 2005).

For Nigeria, similar trends are poised to occur with rapid urban population growth—as is already evident in the dramatic increase of premium rice imports during the last few decades. Unlike in the Asian countries, however, the local rice sector in Nigeria has been ill prepared to respond and adapt to these changing demands. Meeting the demand for higher-quality premium rice with domestic rice, therefore, is feasible in the short run only through the promotion and use of the larger MRMs, as the government is already doing. However, the heavy government support that the larger MRMs require to achieve this goal will potentially introduce economic distortions that will undermine the health of the rice sector as a whole. As pointed out earlier, it is unlikely that the large MRMs can be economically efficient in supplying the domestic market so long as they continue to face limited access to quality paddy. Their higher up-front capital investments and overheads will lead to higher per-unit operating costs if they are forced to operate below capacity, as experiences elsewhere in West Africa and in Asia have illustrated. In fact, it is more likely that imports will not be totally displaced, while the small milling sector continues to fill the void in supplying the domestic market with a more inferior product.

Therefore, while popular attention has been on the establishment of large industrial mills, serious attention should be given to revitalizing the dominant small and medium milling sector, especially from a public policy perspective. The small sector has the potential to improve, given the current cost and price structure it faces along its entire value chain—with the potential to absorb increased costs (such as for de-stoning and colorization) to further process better-quality milled rice. The potential is even greater if there is a significant improvement in paddy production costs and yields, varieties (such as long grain), access to improved milling technologies, and lowered trader and marketing cost margins. Some of these can be addressed through the promotion of miller clusters to take advantage of agglomeration effects from economies of scale and location. Field observations showed very poor conditions of basic infrastructure such as access to electric power, water, and good

feeder-road networks. Addressing these basic infrastructural problems, along with improving access to technologies, credit, and storage, will also be critical to upgrading the sector and providing options to smooth out operations outside the typical harvest season. Finally, although it is unlikely that the small milling sector can produce a premium-quality brand comparable to that of the larger and more capital-intensive milling sector, it has the potential to produce rice of sufficient quality and at a low enough cost to be able to meet the demand and price preferences of the average consumer.

Conclusion

Several key messages arise from this chapter. First, while the production of higher-quality premium rice is feasible in the short run and only through the promotion and use of the larger MRMs as the government is already doing, this strategy will likely require continued government support via an import tariff so long as Nigerian rice cannot compete with imports on price alone. It will also require an expansion in the production of superior-quality paddy if MRMs are going to access sufficient quantities to mill and the Nigerian rice sector is going to improve its productivity and competitiveness with imports over time. Otherwise, there is always the danger that in years to come the sector will still have to rely on the government to remain competitive, as experiences elsewhere in West Africa and in Asia have shown. If this dependence has to be maintained over a long period, such interventions can quickly become a fiscal burden for the government, in addition to the economic costs associated with higher consumer prices induced by import tariffs. As shown in Chapter 2, higher consumer prices will only hurt the welfare of low-income groups, as a large component of a poor household's rice expenditures is for subsistence. This could change, of course, but only if there are significant reductions in operating costs and the logistical challenge of guaranteeing a constant supply of quality paddy is removed.

Second, investments to expand the large milling sector should not come at the cost of ignoring the smaller milling sector. Serious attention should be given to revitalizing this sector as well, especially considering it has the potential to absorb 25 to 33 percent in increased costs (such as for de-stoning and polishing). Placing more emphasis on improving the productivity of small- and medium-scale milling channels, such as from the greater use of labor-saving and quality-improving technologies, will help meet a broader demand base for cheaper rice, while maintaining rural employment and income opportunities for this dominant group of millers and paddy traders in the country.

Meanwhile, trader and miller costs could also be lowered further if economies of scale and location are taken advantage of by a greater number of small-to-medium-scale millers choosing to locate within or in proximity to milling clusters. However, more research is needed to substantiate the degree to which there are potential gains to be had from such agglomeration effects.

Finally, the presence of varying qualities of domestic rice that emerge from the three different types of milling channels described in this chapter implies a more complex story about their relative competitive advantages. While the simple comparisons of production efficiencies and costs with respect to the paddy-to-milled conversion rate, milled-to-paddy and capital-to-labor price ratios, and the economic discount rate are useful for this purpose, they do not account for other policy, environmental, and economic factors that can affect their competitiveness. For example, import restrictions can help protect and thus explain the presence of large-scale operators when they would otherwise be unprofitable without the policy. High transportation and marketing costs can also affect the presence of larger-scale millers in high-production areas if they are situated too far from lucrative markets. By considering these other factors, we can test for whether they help explain the current mix of milling types in the Nigerian rice economy, as well as answer the important question posed at the beginning of this chapter: Are there differential abilities and efficiencies among existing mill types (small to large) to supply the domestic market? This is accomplished in the next chapter by using a Nigeria Rice Milling Model specifically developed for this purpose.