Part III: Forces Driving the Competitiveness of West African Agriculture

Thanks to better technologies, infrastructure and policies, much of West African agriculture can compete with imports. But only if entire value chains are improved.

CHAPTER 8

Price Transmission and Trade Policy

Transmission des prix et politique commerciale

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Abstract

Throughout the period 2000-2008, and especially in 2007-2008 when world grain prices were rising precipitously, West African governments implemented several trade and non-trade measures to limit the degree to which the international price increases were transmitted to their domestic economies, in an attempt to stabilize consumer prices. This chapter analyzes the degree to which such measures were successful and the degree to which the changes in domestic consumer prices that did occur were transmitted back to farmers, influencing their production incentives. The analysis covers two coastal countries that were heavily dependent on grain imports from overseas (Côte d'Ivoire and Senegal) and two landlocked countries (Mali and Niger) that were had lower import-dependence.

Over the period 2000-2008, on average only about one-third of the percentage changes in the world price of rice was transmitted to the domestic price of imported rice in the four countries, with the rate of transmission higher in the two coastal countries than in the two landlocked countries. For maize, the rates of transmission were higher, ranging from 22% in Senegal to over 59% in Niger. These rates of transmission increased in the period 2007-2008, particularly for maize. The depreciation of the U.S. dollar relative to the CFA franc during 2000-2008 accounted for about a third of the reduction in transmission from international to domestic prices because as the dollar depreciated, international prices for these cereals, denominated in dollars, became cheaper in CFA francs. Other measures, such as reductions in import tariffs and subsidized sales to consumers, accounted for the rest of the reduction. Of the increases the domestic consumer prices of rice that did occur, a high share was transmitted back to farmers (ranging from 81% in Mali to over 100% in Niger), increasing production incentives. The ability of governments to buffer domestic consumers from future global price spikes to the degree that they did in 2007-2008, while still increasing production incentives is problematic, in part because of the recent appreciation of the U.S. dollar and in part because cuts in import taxes on imported cereals reduce government revenues that could otherwise be used to support expanded domestic production.

Résumé

Pendant la période allant de 2000 à 2008 et particulièrement de 2007 à 2008, lorsque les prix des céréales sont montés en flèche, les gouvernements ouest-africains ont appliqué plusieurs mesures commerciales et non commerciales afin de limiter le degré de répercussion des cours mondiaux sur les économies intérieures, dans tentative de stabilisation des prix à la consommation. Ce chapitre analyse le degré de réussite de ces initiatives et dans quelle mesure les fluctuations de prix à la consommation intérieure une ont été répercutées à leur tour sur les exploitants agricoles, affectant ainsi leurs incitations à produire. L'analyse couvre deux pays côtiers qui étaient fortement dépendants des importations céréalières d'outre-mer (Côte d'Ivoire et Sénégal) et deux pays enclavés (Mali et Niger), moins dépendants des importations.

Pendant la période de 2000 à 2008, en moyenne, seul un tiers des fluctuations en pourcentage du cours mondial du riz a été répercuté sur le prix du riz importé dans les quatre pays, le taux de transmission étant plus élevé dans les deux pays côtiers que dans les deux pays enclavés. Pour le maïs, les taux de transmission étaient plus élevés, allant de 22% au Sénégal à plus de 59% au Niger. Ces taux de transmission ont progressé pendant la période 2007-2008, particulièrement pour le maïs. La dépréciation du dollar des États-Unis par rapport au franc CFA pendant la période 2000-2008 a représenté environ un tiers de la réduction de la transmission des cours internationaux sur les prix intérieurs car, le dollar se dépréciant, les cours mondiaux de ces céréales, libellés en dollars, ont baissé en termes de francs CFA. D'autres mesures, telles que la réduction des tarifs sur les importations et les ventes subventionnées aux consommateurs, ont représenté le reste de la réduction. En ce qui concerne l'augmentation des prix à la consommation intérieure du riz, une grande partie a été répercutée en retour aux agriculteurs (allant de 81% au Mali à plus de 100% au Niger), ce qui a accru leurs incitations à la production. La volonté des gouvernements à protéger les consommateurs domestiques des futures hausses des cours mondiaux tout en continuant à augmenter les incitations à produire comme cela a été le cas de 2007 à 2008, est problématique, partiellement en raison de la récente appréciation du dollar, mais aussi parce que les réductions de taxes sur les importations de céréales contribueront à diminuer les recettes de l'État qui pourraient éventuellement servir à accroitre la production intérieure.

8.1. Introduction

The sharp increase in international food prices from late 2006 to late 2008 raised major concerns within West Africa. The consequences of this spike in international prices on West African food security were a function of the region's degree of dependence on imports from the international market and to the extent to which this rise was transmitted to domestic consumer and producer prices. Most of the countries in the region used trade and non-trade price stabilization measures to protect consumers and smallholders who are net buyers of food products. These measures involved, among other things, lower taxes, import subsidies, and duties and restrictions on exports. The non-trade measures consisted, above all, of social welfare, child nutrition, and food assistance programs. Meanwhile, food production stimulus programs focused on subsidies for fertilizer, seeds, agricultural equipment, and irrigation investments, as well as on strengthening extension services.

The biggest controversy brought to the forefront by the crisis was the doubt cast on the prevailing idea that expanding international trade and opening markets would make the food supply cheaper and more reliable, therefore creating a boon to importing countries, especially poor ones. Regrettably, the consequences of the crisis struck these poor countries head-on after the enactment of export restriction measures by some of the main rice-producing countries in Asia and the rest of the world. The West African countries quickly realized the need to reorient and bolster their investments in agricultural production (including rice) to lower their dependency on imports and increase food self-sufficiency, but also to take advantage of the promising prospects on the market. In doing so, most of the countries had to contend with the food price dilemma. On the one hand, they had to stimulate local production with incentive pricing. On the other hand, they had to forestall the risk of a disproportionate price increase that would upset consumers and lead to social unrest.

This chapter is based on the results of an in-depth study, *La transmission de la hausse des prix mondiaux sur les marchés agricoles ouest africains et l'analyse des prix de parité* (Transmission of Global Price Increases on West African Agricultural Markets and Analysis of Parity Prices) carried out in 2009 by a Michigan State University (MSU) team and its partners in West African research institutions and agricultural market information systems.[1] This study used the method of calculating cumulative price changes developed by the Food and Agriculture Organization of the United Nations (FAO) to test the hypothesis that international price increases were transmitted to Asian markets. The FAO analyzed price transmission and its implications in seven Asian countries (Dawe 2008). This chapter analyzes the impact of the rise in international prices on West African domestic prices for certain staples such as rice, maize, millet, and plantains in Côte d'Ivoire, Mali, Niger, and Senegal.

8.2. Literature Review and Knowledge Gap

The increase in food prices from 2007 to 2008 threatened food security around the world in general and in Sub-Saharan Africa in particular (HLPE 2011). Maize, wheat, and rice prices rose the most at the global level. According to FAOSTAT (2016), the price of wheat surged 130% in world markets between March 2007 and March 2008, while the price of rice rose 90% and that of maize by nearly one-third. The FAO Food Price Index, which had moved up 8% from 2005 to 2006, increased 24% in 2007. Between January and March 2008, these prices had gone up 53% compared to the same period of the previous year. In 2008, maize and rice prices in Côte d'Ivoire, Guinea, Mali, and Niger reached levels that had not been observed in the previous 10 years (Diallo et al. 2009).

The increase in food prices affected urban consumers and the survival of many individuals who live in the grips of poverty and who struggle each day to get enough food. Because it is domestic prices that affect food consumption, the bulk of the literature on the worldwide increase focused on the effects on consumers, especially urban consumers. In West Africa, urban consumers and net buyers of cereals in rural areas are the ones who were hardest hit by the food crisis. Because the cost of food usually gobbles up half or more of their income, many city dwellers and the poorest farming families had no choice but to consume cheaper foods or even skip meals. In some countries, consumers turned more to locally grown foods like cassava.

[1] A full set of the reports produced under this study are available at http://fsg.afre.msu.edu/srai/index.htm#rp.

Even these, however, became more expensive, in part because of rises in the price of the fuel needed to transport and process them (Dembélé, Cissé, and Blein 2008).

Still, few studies have looked at the output and income of rural producers who may have turned a profit as a result of the higher prices. The price increase appears to have been beneficial for rice farmers in many countries. Cotton-growing areas even saw renewed interest in rice farming. In Burkina Faso, for example, there was a trend among farmers to give up cotton in favor of rice production. In the rice-growing plains of Bagré and Sourou, rice purchase prices improved, helping farmers who now sold their output at over 175 CFA Francs (CFAF)/kg versus the previous rate of 90 CFAF/kg (Coulibaly 2009). In Mali, the average producer price of rice in real terms was 291 CFAF/kg in 2008 versus 195 CFAF/kg in 2003 (Diallo et al. 2009). The local price of rice in Senegal also benefited from the price increase on the international market. Between March 2006 and March 2008, the price of rice gained 38%, while the price of imported broken rice rose 27% (FARM and CIRAD 2008).

The FAO was amongst the first to highlight the degree to which international price fluctuations were transmitted to the consumer and producer levels between 2003 and 2007. Its interpretation of the results focused on the trade and non-trade policies adopted by various Asian countries and found that one-third of the increase in world food prices during this period was transmitted to domestic prices in real terms (Dawe 2008).

From 2009 to 2010, there were other analyses of the causes of the increase in world food prices, responses by private and institutional players, and policy implications (e.g., von Braun et al. 2008; FARM and CIRAD 2008; Dembélé, Cissé, and Blein 2008; Kelly, Dembélé, and Staatz 2008; Mousseau 2010). The Farm Foundation studied the rise in international prices in six African countries (Cameroon, Guinea, Madagascar, Mali, Niger, and Senegal). The results showed that the consumer prices of products imported to the respective capitals were more stable than international prices, whereas the prices of local rainfed cereals such as millet and maize were more variable and disconnected from international prices. The main factors that explain the supply-demand disequilibrium that, in the long term, resulted in an upward trend in prices were the following: the growth of the middle class in emerging markets, the scarcity of land owing to demographic pressure, and climate change. However, the short-term explanations for the surge in prices from 2007 to 2008 were, most significantly, the jump in oil prices and their impact on the cost of inputs and transportation, the downward trend in global cereals inventories, speculation by traders, limits on exports (because of the dip in supply), and financial speculation on commodities in the wake of the depreciation of the U.S. dollar (US$) (FARM and CIRAD 2008).

There has also been a lot of interest in the public sector's responses to the increase. Most government actions combined trade facilitation policies (e.g., lowering customs duties and negotiating with importers) with market regulations or restrictions (export bans, use of government grain stocks, price controls, and anti-speculative measures). In West Africa, certain countries—some more than others—managed to reduce the transmission of this inflation to their domestic markets thanks to the measures adopted, which are summarized in Table 8.1 (Diallo, Dembélé, and Staatz 2010).

Finally, according to Mousseau (2010), the 2007-2008 increase in food prices merely revealed and aggravated a food crisis that had already existed in many parts of the world. Overall, the number of people affected by chronic under-nutrition grew from 850 million in 2007 to over one billion in 2009. However, prior to 2007 many West African countries that were both poor and dependent on food imports were already affected by the instability of agricultural product prices. This suggests that high domestic price volatility is one of the main problems that must be tackled by correcting structural constraints in the market (poor transportation and storage infrastructure, an inadequate financing system, road harassment, information asymmetry, etc.).

Table 8.27. Measures Taken by Certain Countries and Their Impact

Country	Measures taken*	Impact	Results
Côte d'Ivoire	(5) (6) (7)	• Steep rise in prices despite measures	• Underperformance of emergency rice program
Mali	(3) (4) (7) (8) (9) (10)	• Upward price trend despite export bans • Production stimulated by input subsidies, but less than expected	• Import tax exemptions were of little benefit to the poorest • High cost in public spending
Niger	(1) (3) (4) (5) (6) (8) (10) (11) (12)	• Little protection for vulnerable groups • Upward price trend despite the measures	• High cost of safety nets • Limited effects on output and prices
Senegal	(2) (3) (5) (6) (8) (11) (12)	• Steep rise in prices despite production stimulus measures	• Suspension of customs duties not enough to curb the increase • High cost in public spending • Good cereal production

Source: Diallo, Dembélé, and Staatz (2010).
*Note: (1) Authorization to import rice and other food products; 2) Anti-speculation efforts and price controls; (3) Negotiations to reduce margins and prices; 4) Improved monitoring of food security indicators; 5) Price subsidies for fossil fuel and other energy sources; 6) Suspension of VAT and other indirect taxes; 7) Production support; 8) Suspension of customs duties on imports; 9) Suspension of exports of cereals and other products; 10) Sale of inventory from grain banks; 11) Subsidized sales of government inventory; 12) Free food distribution.

8.3. Methods and Data

The data used pertain to four West African countries: Côte d'Ivoire, Mali, Niger, and Senegal. The countries were chosen based on the size of the region's main production areas (northern Côte d'Ivoire, southern Mali for maize, Mali/Senegal/Niger for rice), on the role of cereal imports in these areas, and on the geographic aspects (coastal or landlocked) needed to get a firm grasp on the dynamics of the regional markets.

The choice of products considered the consumption profiles of urban areas, which are increasingly concentrated on rice, maize, and wheat and less on locally produced starchy staples such as millet, sorghum, and tubers. Amongst the data used are the Thailand rice Free on Board (FOB) and U.S. Gulf maize FOB international prices as proxies for the prevailing global market prices. They were extracted from the statistics database of the International Monetary Fund (IMF).[2]

At the regional level, the analysis used monthly data on consumer and producer prices taken from agricultural market information systems in the countries studied, as well as consumer price indices and exchange rate data.[3] The length of the price series varies by country. Most range from 1998 to 2009 for consumer prices and FOB prices, which makes it possible to analyze the transmission of the increase in food prices that began in 2003, with a peak period from 2007 to 2009. However, the producer price series are limited and difficult to use because of discontinuities. Therefore, an emphasis was placed on domestic urban prices, which are key interfaces for substitutions between imported and local products (Table 8.2).

Table 8.2. Summary of Price Series Used in the Study*

Country	PcPl [a]	PpPl [b]	PcPi [c]	Available Series
Côte d'Ivoire	Millet, maize, local rice, plantain[d]	None	Imported rice[e]	Jan. 2000-June 2009
Niger	Millet, maize, local rice	None	Imported rice	Jan. 1998-Dec 2008
Mali	Rice, millet	Rice	Imported rice	Jan. 1998-April 2009
Senegal	(Millet, maize)[f], local rice	None	Imported rice	Jan 2000 - July 2008

Source for this and the following tables: Diallo, Dembélé, and Staatz (2010).
* Unless otherwise noted, prices are for the capital cities of the countries indicated.
Note: [a] PcPl: Consumer price of local product; [b] PpPl: Producer price of local product; [c] PcPi: Consumer price of imported product; [d] In Daloa, Abengourou; [e] In Daloa, Abengourou; [f] In Dagana, Fatick, Kaolack, M'Pal, Passy, Porokhane, St. Louis, St. Maur, Tambacounda, Thiaroye.

Two of the countries studied are landlocked (Mali and Niger) and two are coastal (Côte d'Ivoire and Senegal). Although all four countries are supplied with extra-regional rice imports, it is mainly the coastal countries (Côte d'Ivoire and Senegal) that take in extra-regional maize imports. Similarly, two of the countries (Côte d'Ivoire and Mali) together produce more than

[2] http://www.imfstatistics.org/IMF/ImfBrowser.aspx
[3] Obtained from http://www.afristat.org/.

half the total maize output of the four countries combined and, along with Guinea, comprise the region's main maize production zone.[4]

This analysis mostly focused on the relationship between the international FOB prices for rice and maize and the import prices of these products and of local consumer substitutes in some markets.

The key measure of price change used in the study is the rate of cumulative change calculated as a percentage. This measure is defined as the sum of percentage changes in the monthly price compared to the previous price of a product or group of products in a given period. The analysis method used the international and domestic nominal prices and real prices adjusted for inflation and for the change in the US$-CFAF exchange rate to assess the transmission of fluctuations in rice and maize prices to the region's markets. It should be noted that during the analysis period, the U.S. dollar lost considerable value against the Euro and, consequently, against the CFA Franc, which is pegged to the Euro.

The transmission of the increase in international prices was assessed for the following periods and interfaces:

- Between the international price and the consumer price of imported rice and maize in nominal terms for the four countries (Niger, Mali, Côte d'Ivoire, and Senegal) over the periods January 2000 to July 2008 and January 2007 to July 2008.
- Between the consumer price of imported rice and the consumer price of local rice in nominal terms for three countries (Niger, Mali, and Côte d'Ivoire) over the periods January 2000 to July 2008 and January 2007 to July 2008.
- Between the consumer price of local rice and producer price in nominal terms for Mali over the periods January 2000 to July 2008 and January 2007 to July 2008.[5]
- Between the consumer price of local rice and the price of another locally produced starchy staple in nominal terms for three countries (millet for Niger and Mali and plantains for Côte d'Ivoire) over the periods January 2000 to July 2008 and January 2007 to July 2008.

8.4. Results

The results presented below examine two phenomena: (1) Changes in international prices over since 2000 and the transmission of their fluctuations to certain markets in the region. The analysis pays special attention to the period January 2007 to December 2008, when there was a sharp rise in global food prices; and (2) The degree of transmission between consumer and producer prices in the domestic market for various commodities (rice, maize, millet, and plantains produced and consumed locally). The results are presented as follows: analysis of the changes in rice and maize prices and their variability; followed by analysis of the transmission of international prices to domestic markets at different market interfaces.

[4] Excluding Nigeria and Ghana, which were not included in this study due to data limitations.
[5] Because Mali is the only country that provided producer rice prices, as seen in Table 8.2.

Price Changes and Variability

During the period 2000 to 2008, the low value of the coefficient of variation (CV) for international prices (CV = 6.0% for rice and 2.3% for maize) indicates that international prices were relatively stable (Table 8.3).[6] The FOB price for rice (Thailand 25% broken) of US$194 per ton in June 2000 held steady through January 2004, when it was US$197. Between 2004 and 2007, the price of rice followed a small upward trend, reaching US$317 per ton in December 2007. On the international maize market, prices moved much more slowly: prices held steady from US$92 per ton in January 2000 until September 2006, with a slight upward trend. Beginning in 2006, prices rose gradually to hit US$287 per ton in June 2008.

The consumer prices of local and imported products and producer prices of local products fluctuated significantly compared to the international prices for both rice and maize across all four of the countries studied (Table 8.3). The variability of producer prices was higher than the variability of consumer prices for local and imported products. This is normal given the relative stability of marketing margins between the producer and consumer levels and given that demand at the producer level is determined by the consumer price. In Mali, the coefficient of variation was 14.3% for the producer price of rice, 11.0% for the consumer price of local rice, and 11.7% for the consumer price of imported rice.

The trends were almost identical for maize. The variability of rice and maize prices was in general more pronounced in the coastal countries than in the landlocked ones, despite expectations to the contrary because of the larger margin between the export parity price and the import parity price in the landlocked countries. However, the variability of consumer prices for imported rice was high in Niger compared to other countries.

Table 8.3. Coefficients of Variation in Nominal Prices of Rice and Maize (2000-2008) Expressed as a Percentage

Country	CV P.int*		CV PcPi*		CV PcPl*		CV PpPl*	
	Rice	Maize	Rice	Maize	Rice	Maize	Rice	Maize
Mali	6.3	2.3	11.7	-	11.0	11.1	14.3	20.3
Senegal	6.3	2.3	14.9	8.8	-	12.7	-	-
Niger	6.3	2.3	10.6	21.1	16.2	-	-	-
Côte d'Ivoire	6.3	2.3	14.7	15.1	20.6	-	-	-

*Note: P.int: International price in US$ (Thailand FOB [rice] and U.S.-Gulf FOB [maize]); PcPi: Consumer price of imported product in CFAF; PcPl: Consumer price of local product in CFAF; PpPl: Producer price of local product in CFAF.

Table 8.4 shows, for the period 2007 to 2008, a marked increase in the variability of the international price of rice (CV = 14%) and a slight increase in that of maize (CV = 2.5%)

[6] The coefficient of variation (CV) is defined as the ratio of standard deviation to the mean price in a given period, expressed as a percentage.

compared to the 2000-2008 period. Domestic consumer prices of imported rice also showed a sharp increase in their variability during this period (CV for imported rice = 15.2% for Mali, 28.2% for Senegal, 14.1% for Niger, and 21.5% for Côte d'Ivoire). Price volatility was also higher in the coastal countries than in the landlocked countries.

Table 8.4. Coefficients of Variation (CV) in Nominal Prices of Rice and Maize (2007-2008) Expressed as a Percentage

Country	CV P.int*		CV PcPi*		CV PcPl*		CV PpPl*	
	Rice	Maize	Rice	Maize	Rice	Maize	Rice	Maize
Mali	14.0	2.5	15.2	-	11.9	11.1	16.6	11.1
Senegal	14.0	2.5	28.2	5.6	-	7.0	-	-
Niger	14.0	2.5	14.1	23.6	19.0	-	-	-
Côte d'Ivoire	14.0	2.5	21.5	12.6	18.1	-	-	-

*Note: P.int: International price in US$ (Thailand FOB [rice] and U.S.-Gulf FOB [maize]); PcPi: Consumer price of imported product in CFAF; PcPl: Consumer price of local product in CFAF; PpPl: Producer price of local product in CFAF.

In the period 2000 to 2008, the consumer prices of the two imported cereals were relatively stable compared to the consumer prices of locally grown products. The situation was reversed during the period of soaring prices in Mali and Côte d'Ivoire, when the price of domestically produced rice was more stable than that of the imported product.

Overall, for the period 2000 to 2008 and for all four countries, the coefficients of variation given in Table 8.3 show relative stability in prices, except for the consumer price of local rice in Côte d'Ivoire and the price of imported maize in Niger. During the period 2007 to 2008, there was a clear uptick in the coefficients of variation for all four countries. It is important to note that, in reality, the period 2000 to 2008 can be divided into three distinct sub-periods:

(1) The sub-period prior to 2003, which saw prices fall in the international market. At the same time, there was a somewhat weaker decline in domestic prices, and markets were fairly stable;.

(2) The sub-period 2003 to 2007, which was characterized by a modest, but meaningful increase in international prices and during which prices for local and imported products rose significantly; and

(3) The sub-period 2007 to 2008, when international and domestic priced climbed to nearly unprecedented levels.

The Transmission of International Prices to Domestic Markets: January 2000 - December 2008 and January 2007-December 2008

Interface: International Prices and Consumer Prices of Imported Goods. A comparison of columns (1) and (2) in Table 8.5 shows that as the U.S. dollar depreciated against the CFA Franc, international prices expressed in CFA Francs did not rise as much as they did in dollar terms. For the two periods under consideration (see Tables 8.3 and 8.4), the rates of cumulative change in the international US$ FOB price of rice were 134.8% for the period 2000 to 2008 and 106.4% for the period 2007 to 2008, compared to the equivalent increases in CFA Francs of 96.8% and 88.5%. The same trend was observed for maize: the cumulative change rates were 110.3% and 41.5% for the US$ FOB price versus 75.4% and 25.7% for the equivalent international price in CFA Francs. Thus, the depreciation of the U.S. dollar muted, to a certain extent, the impact of the increase in food prices, which would have had even serious consequences (in terms of diminished buying power) for consumers and perhaps been even more favorable (in terms of incentives) to farmers if the full increase in US$ terms actually had been transmitted.

Table 8.5. Rate of Cumulative Change in Rice and Maize Prices (January 2000-December 2008) Expressed as a Percentage

Country	(1) P.int N-$*		(2) P.int N*		(3) PcNPi*		(4) PcRPl *		T (3)/(1)*	
	Rice	Maize	Rice	Maize	Rice	Maize	Rice	Maize	Rice	Maize
Mali	134.8	110.3	96.8	75.4	31.6	33.8	16.0	26.5	23.4	30.7
Senegal	134.7	110.2	96.7	75.4	43.7	24.3	68.6	1.7	32.4	22.0
Niger	134.7	110.2	96.7	75.4	30.4	64.9	22.5	94.6	22.5	58.9
Côte d'Ivoire	134.7	110.2	96.7	75.4	53.5	45.9	33.4	119.3	39.7	41.6

*Note: P.int N-$: Nominal international price in US$-FOB; P.int N: Nominal international price in CFAF; Pc NPi: Nominal consumer price of imported product in CFAF; Pc RPl: Real consumer price of local product in CFAF; T: Degree of transmission.

For the period 2000 to 2008 across the four countries, the cumulative change rate shows, for both rice and maize, a greater increase in international prices than in the consumer prices of imported products (Table 8.5). This increase was 134.8% in Senegal for the FOB international rice price versus 43.7% for the consumer price of imported rice. The cumulative increase for the consumer price of imported rice was greater in Côte d'Ivoire (53.5%) and Senegal (43.7%) than in Mali (31.6%) and Niger (30.4%). During the same period, only 23.4% of the changes in the international price of rice in dollar terms were passed through to the consumer price of imported rice in Bamako. In Senegal, 32.5% of the changes in the international price of rice in dollars were transmitted to the consumer price of imported rice in Dakar. Analysis in real terms reveals much lower cumulative changes, which suggests that the transmissions were weaker than suspected. This situation is more obvious during the period 2007 to 2008, which corresponds to the widespread surge in prices, during which the prices of non-food goods (e.g., energy) often rose as quickly as food prices. Thus, the price of these foods relative to other prices (this is the relationship captured by real prices) did not really change during the crisis. However, this does not signify that West African consumers did not see food prices rise relative to their purchasing power.

Furthermore, the transmissions for maize were larger than for rice across three of the four countries, the exception being Senegal (Table 8.5). The rate of transmission reached 59% in

Niger between 2000 and 2008. Niger imports three-fourths of the maize it consumes, a good portion of which is imported from Benin, Nigeria, and Burkina Faso.

During the period 2007 to 2008, the rate of price transmission from international prices to the consumer price of imported products increased in all four countries except for rice in Niger and Côte d'Ivoire (Table 8.6). The cumulative increase of the variations in the international rice price in a single year (2007-2008) accounted for approximately 79% of the cumulative increase observed over nine years (2000-2009). The cumulative increase for the consumer price of imported rice was also greater in Côte d'Ivoire (36.8%) and Senegal (39.8%) than in Mali (27.4%) and Niger (19.9%). During the same period, transmission in nominal terms of the changes between rice on the international market and the consumer price of imported rice ranged from 19% to 26% for Mali and Niger versus 35% to 38% for Côte d'Ivoire and Senegal. Over the same period, these transmissions in nominal terms across the four countries were stronger for imported maize than for imported rice, except for in Senegal.

Table 8.6. Rate of Cumulative Change in Rice and Maize Prices (January 2007-December 2008) Expressed as a Percentage

Country	(1) P.int N-$*		(2) P.int N*		(3) PcNPi*		(4) PcRPl *		T (3)/(1)*	
	Rice	Maize	Rice	Maize	Rice	Maize	Rice	Maize	Rice	Maize
Mali	106.3	41.4	88.4	25.7	27.4	22.3	-8.2	23.5	25.8	53.9
Senegal	106.3	41.4	88.4	25.7	39.8	10.3	79.0	-3.0	37.4	24.9
Niger	106.3	41.4	88.4	25.7	19.9	49.2	17.9	54.7	18.7	118.6
Côte d'Ivoire	106.3	41.4	88.4	25.7	36.8	22.7	36.6	51.6	34.6	54.9

*Note: P.int N-$: Nominal international price (US$-FOB); P.int N: Nominal international price converted to CFAF; Pc NPi: Nominal consumer price of imported product; Pc RPl: Real consumer price of local product; T: Degree of transmission.

Overall, the extent of transmission to the consumer price of imported rice was greater in the coastal countries than in the landlocked countries. Similarly, rice price volatility was more pronounced in the coastal countries, whereas the situation was reversed for maize.

Interface: Consumer Prices of Imported Rice and Local Rice. During the period 2000 to 2008, the consumer prices of imported rice and local rice were on the rise. The rate of cumulative change was higher in nominal terms for imported rice than for the consumer price of local price in Mali and Côte d'Ivoire (Table 8.7).

Table 8.7. Rate of Cumulative Change in Rice Prices (January 2000-December 2008) Expressed as a Percentage

Country	(1) Pc NPi*	(2) Pc RPl *	(3) Pp NPl *	(4) Pc RPl*	T (3)/(1)*
Mali	31.5	15.9	26.2	37.6	83.2
Niger	30.4	22.2	45.2	47.3	148.7
Côte d’Ivoire	53.5	61.0	32.8	48.6	61.4

*Note: Pc NPi: Nominal consumer price of imported product in CFAF; Pc RPl: Real consumer price of imported product in CFAF; Pp NPl: Nominal producer price of local product in CFAF; Pc RPl: Real producer price of local product in CFAF; T: Degree of transmission.

During the period 2007 to 2008, the trend stayed the same for the three countries, but transmission was much more pronounced compared to the period 2000 to 2008. Similarly, in 2007-2008, the cumulative changes in the consumer price of imported rice were higher than those in the consumer price of local rice in Mali and Côte d'Ivoire (Table 8.8). This was in part attributable to the successful 2007-2008 crop year in Mali and Côte d’Ivoire, which saw Côte d’Ivoire’s rice production rise by 12% relative to the previous year and Mali’s increase by 50% (FAOSTAT 2016).

Interface: Consumer Price and Producer Price of Local Rice: During the period 2000 to 2009, the cumulative price changes in nominal terms were roughly equivalent between consumer prices and producer prices in Mali. Producer prices, however, rose a bit more. Table 8.9 shows 109.9% transmission from the consumer price to the producer price. The period 2007 to 2008 saw a 30.6% increase in the producer price of local rice compared to 22.5% for imported rice, or a transmission rate of approximately 134%.

Overall, these results indicate that the increase in consumer prices was transmitted to Malian farmers. The price of local rice in Bamako, which was 285 FCFA in September 2000, remained stable at about the same price until May 2005. Starting in 2007, the price of local rice rose from 300 FCFA/kilogram (kg) in May to 405 FCFA in September 2008, i.e., an increase of 105 FCFA/kg. During the same period, the producer price in Niono climbed from 237 FCFA to 363 FCFA/kg, i.e., an increase of 126 FCFA/kg. This implies a drop in the marketing margin per kilogram between Niono and Bamako during the period.

Interface: Consumer Prices of Local Rice and Millet/Plantains: The analysis also examined the relationship between changes in the consumer price of imported rice and those of locally produced nontraded staples—millet in Mali and Niger and plantains in Côte d’Ivoire. During the period 2000 to 2008, the cumulative changes were greater for the consumer price of millet than the consumer rice price in Mali (Table 8.10).

The trend was reversed in Niger (where the millet price rose 16.1% versus 45.2% for rice) and for plantains in Côte d’Ivoire (14.3% for plantains versus 32.9% for rice). However, during the period 2007 to 2008, the cumulative price changes for rice were much higher than for the nontraded staples, reflecting the surge in international rice prices (Table 8.11). In this latter period, there appears to have been significant transmission of the rice price increases to the domestic prices for millet in Mali and Niger (58.6% and 22.9% respectively). This transmission likely was the result of consumers switching some of their consumption from higher-priced rice to lower-priced millet, thereby, bidding up the price of millet. In Côte d'Ivoire, in contrast, there was practically no change in plantain prices in 2007-08, suggesting that the upswing in rice prices had little impact on plantain prices. Either consumers were not substituting plantains for more expensive rice during this period or there was an increase in the plantain supply that was large enough to offset any increased demand resulting from such substitution.[7]

Table 8.8. Rate of Cumulative Change in Rice Prices (January 2007-December 2008) Expressed as a Percentage

Country	(1) Pc NPi	(2) Pc RPl	(3) Pp NPl	(4) Pc RPl	T (3)/(1)
Mali	27.4	23.6	23.6	30.2	86.1
Niger	19.9	17.9	32.4	36.6	162.7
Côte d'Ivoire	36.8	36.6	29.7	33.3	80.8

Note: Pc NPi: Nominal consumer price of imported product in CFAF; Pc RPl: Real consumer price of imported product in CFAF; Pp NPl: Nominal producer price of local product in CFAF; Pc RPl: Real producer price of local product in CFAF; T: Degree of transmission.

Table 8.9. Rate of Cumulative Change in Rice Prices in Mali Expressed as a Percentage

Period	(1) Pc NPi*	(2) Pc RPl*	(3) Pp NPl*	(4) Pc RPl *	T (3)/(1)*
2000-2008	34.3	26.2	37.6	45.4	109.9
Jan. 2007-Dec. 2008	22.5	23.6	30.6	32.6	134.3

*Note: Pc NPi: Nominal consumer price of imported product in CFAF; Pc RPl: Real consumer price of imported product in CFAF; Pp NPl: Nominal producer price of local product in CFAF;
Pc RPl: Real producer price of local product in CFAF; T: Degree of transmission.

[7] FAOSTAT (2016) data indicate that between 2007 and 2008 plantain production in Côte d'Ivoire increased by 11%.

Table 8.10. Rate of Cumulative Change in Rice Prices and Local Starches Expressed as a Percentage (January 2000 - December 2008)

Country	(1) Pc NPi* Rice	(2) Pc RPl* Rice	(3) Pc NPl* Millet/plantain **	(4) Pc RPl* Millet/plantain **	T (3)/(1)
Mali	34.3	26.2	52.0	62.6	151.6
Niger	45.2	47.3	16.1	30.5	35.4
Côte d'Ivoire	32.8	48.6	14.3	40.6	43.4

*Note: Pc NPi: Nominal consumer price of imported product in CFAF; Pc RPl: Real consumer price of imported product in CFAF; Pc NPl: Nominal consumer price of local product in CFAF; Pc RPl: Real consumer price of local product in CFAF; T: Degree of transmission; **Millet in Mali and Niger, plantains in Côte d'Ivoire.

Table 8.11. Rate of Cumulative Change in Rice and Millet Prices (January 2007-December 2008) Expressed as a Percentage

Country	(1) Pc NPi* Rice	(2) Pc RPl* Rice	(3) Pp NPl* Millet/plantain	(4) Pc RPl* Millet/plantain	T (3)/(1)*
Mali	22.5	23.6	13.1	15.8	58.5
Niger	32.4	36.6	7.4	21.8	22.8
Côte d'Ivoire	29.2	33.3	-0.9	-18.0	-3.0

*Note: Pc NPi: Nominal consumer price of imported product in CFAF; Pc RPl: Real consumer price of imported product in CFAF; Pp NPl: Nominal consumer price of local product in CFAF; Pc RPl: Real consumer price of local product in CFAF; T: Degree of transmission.

8.5. Conclusions and Policy Implications

This chapter measured the transmission of the international increase in prices over the period 2007 to 2008 to prices in certain markets in four countries (Côte d'Ivoire, Mali, Niger, and Senegal). The results of this analysis show that this increase was indeed transmitted to markets in the West African region, but not entirely. In percentages, the transmission was more significant in coastal countries than in landlocked countries. Factors such as transportation, freight, and the cost of delivering products to distant points of consumption all tended to dampen the transmission, in percentage terms, of the international price increases to the landlocked countries. For all countries, the U.S. dollar's depreciation against the CFA Franc also reduced transmission of the international price increases to their domestic markets.

If the rise in international prices continues over the long term, coastal countries will likely need to turn increasingly to the region's main production areas for their rice and maize supplies. The lingering question will be the extent to which farmers and decision makers respond to meet this potential demand. Many landlocked, as well as coastal, countries (notably Senegal and Côte d'Ivoire) are already implementing investment programs to boost the amount of cropped land and the yields of import-substitution products such as rice and maize to meet the ever-growing regional demand. While production will likely continue to increase in these coastal countries, intra-regional trade will also need to grow more to meet the growing demand in both the inland and coastal countries, including Nigeria.

The outlook for the international food market is still uncertain, given the unsure impact of climate change and the variability of worldwide reserves. As incomes rise, Asians are diversifying their diets and increasing their consumption of animal products, which may reduce the area devoted to rice production in Asia and drive up the demand for feed grains like maize.[8] In recent years, India and China have experienced drastic fluctuations in their agricultural output and in their trade with the rest of the world. Policies in Africa must be deftly positioned with respect to these new challenges.

Overall, our analysis shows that only about one-third of the fluctuations in international prices for rice and maize (expressed in U.S. dollars) during the crisis from 2007 to 2008 were passed through to West African consumers. The U.S. dollar's depreciation against the CFA Franc and a series of emergency actions (exemptions from import duties, consumer subsidies, etc.) cushioned the impact of the crisis on consumers, but at a rather high opportunity cost for the countries in terms of resources, which were subsequently unavailable for investments elsewhere. Another increase in international prices could have similar short-term costs for these West African countries. That said, the analysis also showed that in Mali (the only country where the necessary data were available), as soon as the consumer rice price edged up, that increase was transmitted at a rate of over 100% to farmers, thus encouraging them to increase their production. This transmission of price increases from the consumer to the producer level is a potential positive factor for agricultural development in West Africa in the medium and long term, but will only take place if governments allow at least some of the increases in international prices to be transmitted to the domestic consumer level. In deciding how much of that transmission to allow, governments have to evaluate the net impact of the higher prices on food security in the region, which depends on the balance between the negative short-term effects on the consumer and the more positive medium- and long-term incentives for food producers.

The implications of the transmission of rising international prices to domestic prices are felt at several levels:

- For consumers, the effects will vary between urban and rural consumers. Among rural consumers, the impact is different depending on whether they are net sellers or net buyers of the goods involved. Urban consumers and net buyers in rural areas will experience a drop in their real income, at least in the short-run.[9] Their purchasing power will erode for consumption of both local rice and substitution products, such as millet and sorghum in the Sahel and roots, tubers and plantains in coastal countries, whose prices may edge up. The degree of consumer substitution between tradable and non-

[8] See Chapter 10 of this publication.

[9] In the medium and long run, they could gain if the growth in agricultural production generates new income-earning opportunities for them elsewhere in the economy through its growth linkages.

tradable products will depend on relative price increases in these two product categories.[10]

- If, as in the case of Mali rice markets, increases in consumer prices are transmitted back to farmers, farmers will face improved production incentives. For the higher global prices to induce greater production, however, two conditions must prevail. First, at least some of the rise in international prices need to be allowed to be transmitted to domestic consumer prices. Second, the food system as a whole needs the capacity to respond, in terms of technology, infrastructure, and farmer support services. If the production increase is to be environmentally sustainable, moreover, it must come primarily from increased yields and not simply extending the areas under cultivation.
- In the coastal countries, which will be the first to be exposed to surges in international prices, transmission of these international prices to domestic markets will force these countries to look to landlocked countries to help meet their supply needs, unless they make huge investments in infrastructure to stimulate their domestic production. It is clear that the rainfed rice production systems in these areas will not be enough to meet the challenge.

Finally, this analysis suggests that preventing price volatility at the local level is one of West Africa's first lines of defense against soaring world prices. There are still numerous, persistent imperfections in the domestic markets, such as inadequate transportation and storage infrastructure, a weak financing system, road harassment, and information asymmetry. These are all factors in the regional and local agricultural markets that must be tackled moving forward.

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[10] See Chapter 6 of this publication.

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CHAPTER 9

Options for Limiting and Managing Price Volatility

Limiter et gérer la volatilité des prix : Alternatives possibles

John M. Staatz and Nango Dembélé

Abstract

Price volatility refers to unanticipated price changes, either upward or downward, that are so large that agrifood system participants have difficulty managing the consequences. Since 2007-2008, unexpectedly higher food prices have been the main type of price volatility facing West Africans. Historically, however, downward price volatility, often the result of surges in the imports of cheap imported goods, have frequently created serious problems for West African farmers and agribusinesses. Price volatility has two sources. Imported volatility results from volatile international prices and exchange rates, while endogenous volatility occurs as a result of shocks in local domestic production and/or demand, compounded by structural problems such as thin markets and high transaction costs of trade. This chapter analyzes the relative importance of these two sources of volatility in West African agrifood markets, discusses their impacts, and analyzes policy measures to reduce each type of volatility. Not all price volatility can be eliminated, however, so the chapter concludes by reviewing tools to reduce and manage its impact. These range from weather-based crop insurance to financial reserves and expanded international lending facilities that could help countries cope with sudden increases in foreign-exchange demands for imports during periods of soaring prices and depressed export earnings during periods of deeply depressed prices.

Résumé

La volatilité des prix se réfère à des fluctuations de prix non anticipées, soit à la hausse ou à la baisse, suffisamment élevées de telles sortes que les acteurs du système agroalimentaire ont du mal à en gérer les conséquences. Depuis 2007-2008, c'est ce genre de volatilité inattendue des prix de denrées alimentaires à laquelle sont confrontés les agriculteurs ouest africains. Dans le passé, toutefois, la volatilité des prix à la baisse, souvent le résultat d'un afflux d'importations bon marché, a souvent créé de sérieux problèmes aux agriculteurs et aux entreprises agroalimentaires en Afrique de l'Ouest. Deux causes sont à l'origine de la volatilité des prix. *La volatilité importée* est le résultat de fluctuations de cours internationaux et de taux de change, tandis que *la volatilité endogène* se produit suite à des chocs dans la production et/ou la demande intérieure locale, auxquels s'ajoutent des problèmes structurels tels que l'étroitesse des marchés et les coûts élevés des transactions commerciales. Ce chapitre analyse l'importance relative de ces deux causes de volatilité sur le marché de l'agroalimentaire ouest-africain, explique leur impact et analyse les mesures visant à réduire chacune d'elles.

Cependant, puisqu'il n'est pas possible d'éliminer toute les formes de volatilité des prix, ce chapitre examine les outils d'atténuation et de gestion de son impact. Ces derniers passent des assurances agricoles basées sur la météorologie, aux réserves financières et facilités de prêts internationaux susceptibles d'aider les pays à faire face à des hausses soudaines de demande de devises pour les importations pendant des périodes d'envolée des prix et à l'occasion des chutes de recettes d'exportation pendant les périodes d'effondrement des prix.

9.1. Introduction

The 2007-2008 spike in world food prices raised concerns around the world about the harm that highly volatile food prices inflicted on poor consumers, farmers and the pace of economic growth. The Food and Agricultural Organization of the United Nations (FAO) (cited in HLPE 2011) estimated, for example, that the price spike increased the number of malnourished in the world by 173 million between 2007 and 2009. In West Africa, much of the debate about price volatility tended to equate price volatility with higher prices. In reality, price volatility refers to large, *unanticipated* price changes, which can be either upward or downward. Downward price volatility (collapsing farm prices) have historically been at least as frequent a problem in West Africa as soaring prices, often prompting charges by farm leaders that the low prices resulted from Organisation for Economic Co-operation and Development (OECD) countries dumping surplus agricultural products onto West African markets.

In order to develop effective policies to reduce and manage price volatility, decision-makers need a clear understanding of what price volatility is, what its impacts are, and what are its major causes. To help provide that understanding, beginning in 2009, the SRAI program began synthesizing information on price volatility in order to help inform policy debates about how best to address the problem in the context of the then-current high-price crisis. The syntheses fed into planning for the Economic Community of West African States (ECOWAS) regional agricultural policy (Economic Community of West African States' Agricultural Policy - ECOWAP), major publications by the UN's High Level Panel of Experts on price volatility and food security (HLPE 2011) and the FAO and African Development Bank (Hollinger and Staatz 2015), and discussions at the 2012 International Disaster and Risk Conference (IDRC 2012). This chapter summarizes key messages from the SRAI analysis, with an emphasis on policy options to reduce and manage the impacts of agricultural price volatility in West Africa.

9.2. Literature Review and Knowledge Gap

There is a long literature on the causes and impacts of agricultural price instability (see Demeke, Pangrazio, and Maetz 2011; Dawe and Timmer 2012; Anderson 2012; Galtier 2013; Hollinger and Staatz 2015 (Focus Section A) for reviews). The literature has stressed that participants in agricultural markets expect prices to vary, seasonally and year-to-year, for a variety of reasons. Some degree of price variation in response to shifts in supply and demand is essential to create incentives for spatial and temporal arbitrage and hence the efficient allocation of resources over time and space. Price variation becomes a concern only when its magnitude becomes so large and it occurs so unexpectedly that consumers and producers face serious problems in coping with the changes (Hollinger and Staatz 2015). Large and unpredictable price changes are referred to as price volatility. Previous literature has identified the major causes and types of price volatility, its impacts on various actors in the economy, and how government policies affect its magnitude.

Causes and Types of Price Volatility

In the simplest sense, price changes result from *expected* or *perceived* shifts in supply and demand. These price changes will be most severe and erratic when: (a) the shock to demand or supply is large; (b) there is little scope in the short-run of adjusting to the shocks through augmenting supply by drawing on or adding to carryover stocks, increasing production, or adjusting trade (inelastic supply); (c) little scope exists for adjusting consumption of the good (inelastic demand)—e.g., through shifting to substitutes; and (d) uncertainty prevails with respect to magnitude of the shocks, the size of carryover stocks and how government is likely to react.

The shocks to supply and demand can emanate from two sources. *Imported volatility* refers to volatility that occurs in international commodity and currency markets and is transmitted to domestic markets through trade. Imported volatility is generally more important in countries that trade heavily internationally, depend extensively on food imports, and adopt policies that allow fluctuations in world market prices to be transmitted into domestic markets (Hollinger and Staatz 2015). As agricultural markets have become more tightly integrated with markets for other commodities, particularly energy with the rise of modern biofuels, fluctuations in these related international markets can also redound onto global food markets, creating another source of imported food price volatility. Indeed, much of the debate about food price volatility in the late 2000s focused on the degree to which speculation in these non-food markets, particularly the energy market, helped to spur the price spikes of 2007/08 (HLPE 2011).

Price volatility can also be *endogenous* to a country or region, resulting from shocks to supply and demand in domestic markets. In West Africa, these shocks historically have been associated with major droughts on the supply side and civil disruption on the demand side. Endogenous volatility tends to be greater when markets are *thin*—i.e. when a relatively small proportion of total production enters the market, with the remainder being consumed on the farm. In these conditions, a relatively small variation in total production can result in a high variation in the amounts entering the market, thereby generating large price fluctuations. Thin markets are more typical in poor economies and in certain international markets, such as for rice, where a relatively small proportion of global production is traded internationally. *Endogenous* volatility also tends to be greater in landlocked countries, where high transport and transaction costs result in the band between import and export parity prices being large. This large band results in domestic prices varying widely before actors face an incentive either to import additional product (in the case of high prices) or export it (in the case of depressed prices) in order to stabilize prices through trade.

Impacts of Price Volatility

The literature identifies both short-run and long-run impacts of price volatility. In the short run, soaring prices (*upside volatility*) hurt consumers, particularly the poor, who devote a high proportion of their income to food (see Part II in this volume). Collapsing prices (*downside volatility*) hurt both farmers (particularly those who are large net sellers of agricultural products) and farm workers, as demand for hired agricultural labor often collapses along with farm prices. These collapses can redound into other parts of the economy, as demand for farm inputs and consumer goods sold in the rural areas also declines. Both upside and downside volatility also hurt other actors in the agrifood system (traders, input providers, agro-processors and retailers) by increasing their risks and disrupting their routine procedures. They also create problems for banks that are considering providing short- and medium-term credit to agriculture by increasing risks of repayment and the difficulty of valuing inventories of agricultural products pledged as collateral. This is one of the reasons why it is difficult to rely uniquely on private banks to finance agricultural mechanization.

The short-run impacts of price volatility can turn into long-run impacts as consumers, farmers and other agrifood-system actors attempt to cope with its effects. Consumers may be forced to cut back on their calorie consumption, reduce the quality of their diet, and shrink expenditures on child health and education, all of which can have long-run effects on the family's human capital and long-term earning capacity (Camara 2004). Similarly, farmers facing collapsing prices may have to sell off assets, which can trigger a downward spiral, leading families to fall into a poverty trap (Carter and Barrett 2006).

Agricultural price volatility can also slow economic growth over the long term because in a price-volatile environment, actors in the economy, knowing that prices can move erratically, tend to hold assets in more liquid forms rather than in forms that can have a larger impact on spurring productivity growth (Dawe and Timmer 2012). Farmers, for example, may hold higher levels of reserves in the form of grain stocks rather than selling more of the grain and investing in improved seeds and irrigation. Bankers, seeing how volatility affects the riskiness of agricultural investment, may invest in government bonds and other "safe assets" rather than lending to farmers and agribusinesses wanting to expand their operations. In addition, because governments and development partners are often the "insurers of last resort", they end up devoting more of their resources to relief efforts rather than to investment to spur economic growth.

There are also political-economy dimensions of how price volatility affects the pace and pattern of economic growth. As the food riots that swept several West African cities in 2008 testify, unexpected price spikes can lead to civil disruption that destroys infrastructure and discourages long-term investment. Similarly, farm protests during periods of abnormally low prices may lead to strongly protectionist policies that slow economic growth.

Price volatility can skew the path as well as the pace of economic growth, affecting who captures most of its benefits. Generally, the rich are better able to bear the risks that price volatility entails, allowing them to invest in higher return but riskier activities from which the poor are excluded (Hollinger and Staatz 2015). To the extent that domestic markets for agricultural products are more volatile (both in prices and in marketed volumes) than international ones, agro-processors are induced to turn towards imports for their raw materials rather than relying on local supplies, thus excluding local producers from West Africa's growing demand for processed food products (ibid.).

Impacts of Government Actions on Price Volatility

The literature on the impacts of government policies on volatility flows directly from the basic analytics of supply and demand. Actions that reduce the size of sudden shocks to supply and demand for agricultural products will reduce price volatility, as will actions that allow supply and demand to adjust to those shocks (increases in the price elasticities of supply and demand). Efforts to *drought-proof* domestic production through increased use of irrigation and increased use of carryover or reserve stocks have been widely promoted as means to stabilize supply, particularly in the Sahel, but the opportunity cost of the resources devoted to those options remain question marks given other options, such as more reliance on regional and international trade. The 2008 world food crisis demonstrated, however, that when regional and international trade are disrupted, many governments feel forced to promote policies to promote greater self-sufficiency, given the high political costs of supply shortages that result in lower consumption and concomitant nutritional stress. The literature on buffer stock operations (e.g., Gilbert 2012) stresses that while in principle such buy-sell operations by government agencies can reduce price volatility, such actions require large financial reserves, particularly when the price band that the government tries to defend is narrow. They can also crowd out private storage, shifting more of the financial burden of storage onto government budgets. In the absence of sufficient financial resources to effectively defend the price band, buffer-stock operations can actually be destabilizing rather than stabilizing (Minot 2012; Hollinger and Staatz 2015: 123).

Although the literature (e.g., Anderson and Masters 2009) generally argues that trade helps to stabilize supply, concerns about how reliance on trade can lead to high levels of imported price volatility from international markets were at the center of policy debates in West Africa in the late 2000s. The degree to which price volatility on international markets redounds onto domestic markets depends on government trade, tax and subsidy policies that affect the degree of price transmission from international to domestic markets (see Chapter 8 in this volume). Food-exporting countries often attempt to protect domestic consumers during periods of international price surges by restricting exports and to protect farmers during periods of low prices by subsidizing exports. Simultaneously, importing countries often try to limit domestic price volatility during global price surges by cutting import taxes or subsidizing imports, and protect domestic producers during periods of global price slumps by raising import barriers. Anderson (2012) has shown that these opposite actions of exporters and importers tend to be self-cancelling and actually increase global price volatility.

On the demand side, increasing the range of substitutes for goods subject to supply shocks lowers price volatility by allowing consumers to modify their consumption patterns more easily in response to shocks to the supply of a particular good.[1] Efforts to encourage more substitution between rice and coarse grains through promoting processed forms of the latter are an example of this phenomenon.[2]

Finally, the literature notes that transparency in government policy interventions is critical to reducing price volatility. In the absence of clear information about the conditions under which governments will intervene in markets, private actors may engage in either hoarding or panic selling, thus augmenting price volatility (Timmer, Falcon, and Pearson 1983). Similarly, in a regional context, clarity and coordination of policy actions across countries that are linked by trade is also critical to stabilizing rather than augmenting such volatility (Anderson 2012).

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[1] In economic jargon, such actions increase the price elasticity of demand of the good, making its price less responsive to shifts in demand.

[2] See Chapter 6 in this volume.

Knowledge Gap

The main knowledge contribution of the SRAI effort on price volatility was to illustrate how concepts from the literature on volatility applied in West Africa, particularly in the context of the 2007-2008 crisis. This contribution involved analyzing the main factors driving the price volatility in the West African context and how national and regional policies and programs were likely to affect it.

9.3. Methods and Data

The approach taken by the SRAI team was to synthesize existing data (including drawing on efforts that the FAO, World Bank, IFPRI, FEWSNET and other international agencies launched to monitor and analyze the high-price crisis as it unfolded) and to contextualize that information in terms of the situation in West Africa. This contextualization involved complementing the information from the literature and other ongoing monitoring efforts with data from West African market information systems and direct observation of policy processes and decisions made by key public- and private-sector actors in West Africa during the period following 2008.

9.4. Results

Key results from the analysis focused on: (a) the magnitude of price changes experienced in West Africa during the 2007-2012 period, placed in an historical perspective; (b) the relative magnitudes of imported and endogenous volatility in the region in the late 2000s; and (c) the driving forces behind both the imported and endogenous price volatility.

Magnitude of Price Changes in Historical Perspective

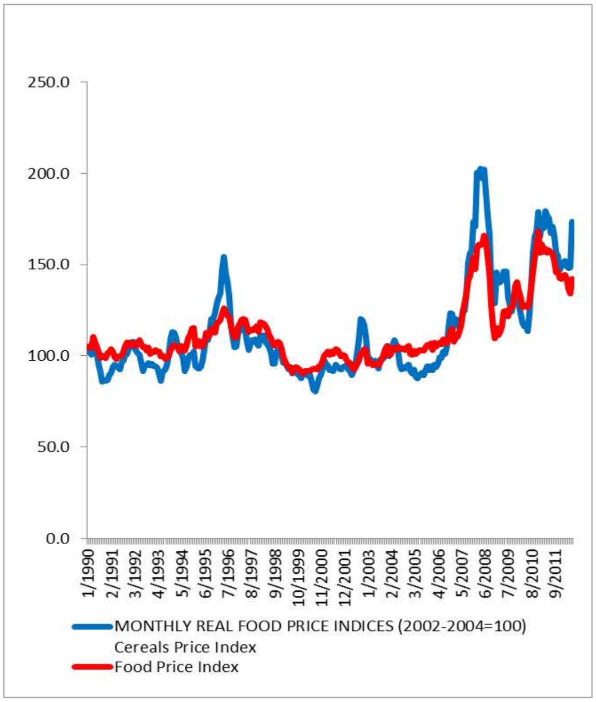
Data from FAO and the World Bank indicate that while real world food prices, and cereal prices, in the period 2008-2012 were the highest they had been since 1990, they were still markedly below the peaks attained during the world food crisis of 1975 (Figure 9.1, panels a and b). Indeed, from the peak in global grain prices in 1975, real world food prices had declined sharply through 2002. What was worrying was the indication that since 2002, real prices appeared to be trending upward, suggesting that the world was entering a new era of higher, and perhaps more volatile prices.

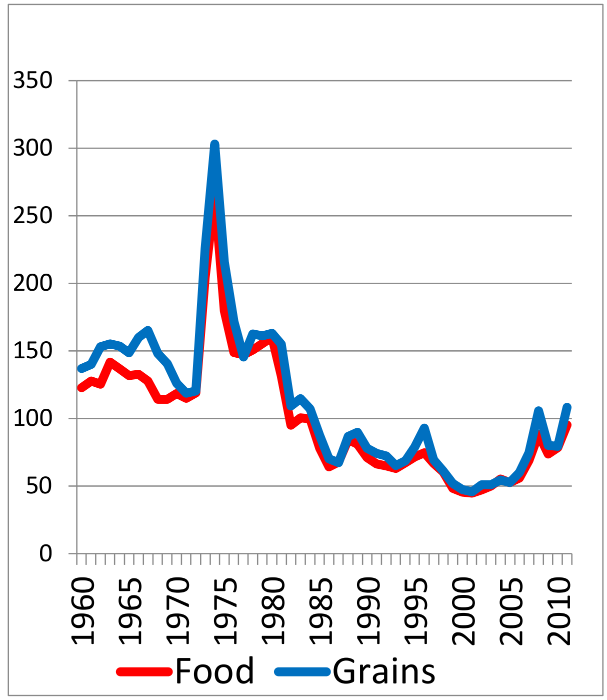
In West Africa, cereal prices, particularly for rice, reached levels in 2008 that had not been seen in the previous 10 years. For example, between July 2007 and July 2008, rice prices rose by 43% in Mali, 50% in Niger, 64% in Burkina Faso and 112% in Senegal (Demeke, Pangrazio, and Maetz 2011.) Yet government efforts to ease import restrictions and provide subsidized sales to consumers kept these price fluctuations below levels experienced in international markets (see Chapter 8 for details).[3]

[3] Minot (2012) showed that while world prices of internationally traded cereals became more volatile in the period 2007-10 compared to 2003-06, in 11 African countries for which time-series data were available, prices for these goods generally did not become more volatile, although they did increase in absolute magnitude. Minot measured volatility as the standard deviation of the proportional change in food prices from one month to the next.

Figure 9.6. International Food and Cereal Price Indexes

(a) 1990-2012 **(b) 1960-2012**





Source: FAOSTAT (2012); World Bank (2012).

While the late 2000s were characterized by soaring food prices in West Africa, historically the opposite has often been the case. Periods of low international prices for poultry (between 1995 and 2003), dairy products (1999-2003) and rice (1983-2003) led to import surges that undermined prices for West African producers and led to calls from them for higher import barriers.[4] FAO studies of these surges indicated that while policies of the exporting countries, such as export subsidies, in some cases were important causes of the large increases in imports, domestic causes such as low productivity, trade and market reform policies, and weak institutions also contributed to the surges (Hollinger and Staatz 2015, Focus Section A).

The Relative Magnitudes of Imported and Endogenous Price Volatility

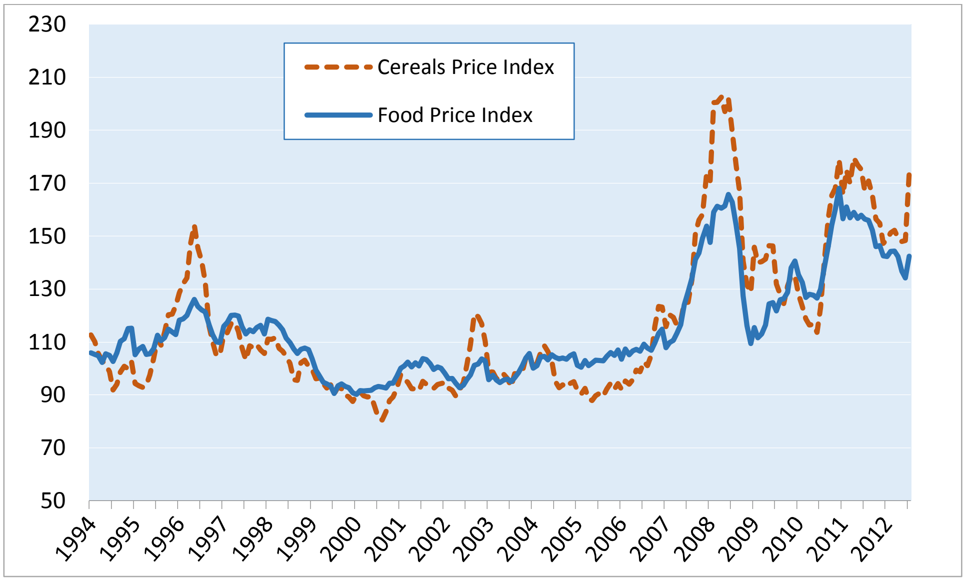
Figure 9.2 illustrates the magnitude of the endogenous and potential imported price volatility that West Africans faced over the period 1994 through 2012. Panel (a) shows the volatility of international food prices as measured by the FAO food and cereal price indices, while panel (b) illustrates the volatility of farm- and retail-level maize prices in Mali over the same period. While international prices varied by a factor of two, farm-level prices in Mali varied by a factor of up to five, and consumer prices varied by nearly a factor of four, suggesting that endogenous factors are at least as important as imported factors in influencing the price volatility facing Malian farmers and consumers. As discussed below, a combination of structural factors in West African cereal markets contributed to the endogenous price volatility, which is particularly a problem for landlocked countries like Niger, Mali, and Burkina Faso, where there is less scope to use international trade to help stabilize local production shortfalls. At the same time, West

[4] There is no universally accepted definition of import surges in the literature; they are generally described as sudden and often relatively short-lived increases in imports (Rakotoarisoa et al. 2011).

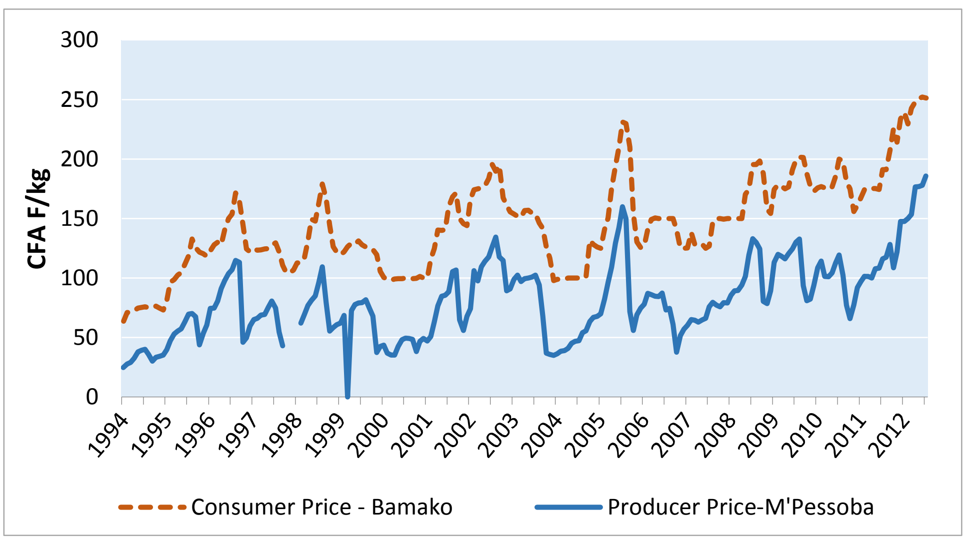
African governments implemented policies that limited the transmission of the imported price volatility to domestic markets, albeit at substantial financial cost to these countries (see Chapter 8 in this volume).

Figure 9.2. Relative Sizes of Endogenous and Potential Imported Price Volatility Facing West Africans, 1994-2012

(a) Global Food and Cereal Price Indices, 1994-2012[a]



(b) Producer and Consumer Retail Maize Prices in Mali



Sources: (a) FAOSTAT (2017); (b) Observatoire du Marché Agricole 2014.
[a] 2002-2004 = 100.

The Sources of Imported and Endogenous Price Volatility

Imported Volatility. Numerous studies examined the causes of the price spikes and higher variability of international staple food prices during the late 2000s and concluded that an unusual confluence of factors contributed to these phenomena (e.g., Kelly, Dembele, and Staatz 2008; Demeke, Pangrazio, and Maetz 2011; HLPE 2011; Anderson 2012; Konandreas 2012; Minot 2012; Hollinger and Staatz 2015). Among the key contributory factors identified by these studies were the following:

- Increasing price-inelasticity of demand for staple foods resulting from growing per capita incomes in much of the world and strong biofuel mandates from several OECD countries. The latter require a certain percentage of fuels come from non-traditional sources (such as maize-based ethanol) regardless of the staple-food prices. As demand becomes less sensitive (more inelastic) to changes in price, supply shocks—e.g., the shortfall in 2007/08 in Australian wheat production due to drought—generate larger price fluctuations, as it takes a large change in price to get consumers to adjust their consumption to the changed level of supply.
- The thinness of international rice markets, with only about 7% of world rice production entering international trade. Thus, a relatively small change in global rice production can result in a large change in the volume traded internationally, and hence, world prices.
- Changes in agricultural support policies in the OECD countries that led to a reduction in year-to-year carryover stocks of major grains, meaning that it became more difficulty to offset fluctuations in production by drawing on reserve stocks.
- A slow-down in investment in agriculture worldwide during the 1990s and early 2000s, leading to a tightening of global food supplies.
- Growing integration of agricultural markets with other commodity markets, particularly energy markets, with the result that speculative bubbles in those other markets—as occurred in the energy markets in 2007-08—spilled over into agricultural markets.
- Growing currency fluctuations. Since most international cereal transactions are priced in U.S. dollars, fluctuations in the value of the dollar relative to other currencies led to variations in cereal prices.
- Increasingly *defensive* measures by both grain-exporting and grain-importing countries to try to protect consumers in the face of rising prices. These measures included export-restrictions by food-surplus countries and subsidies and tax-exemptions to cheapen food imports by food-deficit countries. Collectively, these actions tended to encourage panic buying and hoarding and increase volatility in global markets (Anderson 2012).

*Endogenous volatility***.** The causes of endogenous agricultural price volatility in West Africa are related to structural constraints in local and regional markets, government policies, and poor information available to various actors in the market.

Structural issues include:

- The thinness of markets for locally produced cereals, particularly millet and sorghum. Typically less than half of West African production of these crops enters markets (the rest being consumed on the farm), and the crops are not widely traded internationally. Thus, relatively small changes in production can have large impacts on their prices.
- The heavy dependence of the region on rainfed agriculture, coupled with erratic rainfall. Only 10% of arable land in West Africa, and just 2% in the Sahel, is irrigated, compared with nearly a third of such area in Southeast Asia (FAOSTAT 2017).

- The poor transport infrastructure and high transaction costs of operating in West African markets. These costs, which can fluctuate widely due to disruptions in transport infrastructure (such as the deterioration of rural roads during the rainy season) and civil disruption, contribute to the volatility of prices faced by all agrifood system actors.
- The limited access of consumers to processed staple foods, which in turn constrains substitution among staples (e.g., substitution of maize grits for rice), thereby making the demand for the different staples more price-inelastic (see Chapter 6 in this volume).

Highly variable government policies (termed "policy volatility" by Hollinger and Staatz 2015) include:

- Ad hoc changes in government trade policies, such as export restrictions imposed by countries such as Burkina Faso and Mali during periods of high international prices and import bans imposed by Nigeria;
- Changing rules regarding import and export licensing; and
- Impromptu purchases and releases of grain from national reserve stocks.

The impact of these previously mentioned factors is compounded by frequently poor information by both public and private actors about evolving market conditions, particularly the levels of inventories held by private actors and planned government actions. In the absence of reliable information about the level of private stocks of grains, governments often fear that too much grain is being shipped out of the country and impose export restrictions. Uncertainty about planned government actions can provoke speculative buying and selling, including both panic buying by consumers and panic selling by traders, adding to increased market volatility.

9.5. Conclusions and Policy Implications

Policy measures and investments to deal with price volatility need to be of two sorts: those that aim to reduce volatility and those that give actors improved tools to manage its effects. For each type, it is important to distinguish whether the source of the volatility is imported or endogenous. When designing policies to deal with price volatility, it is also important to recall that it can involve abnormally low prices as well as abnormally high ones.

Measures to Reduce Imported Price Volatility[5]

Both during the food price spike of 2007/08 and during earlier periods of abnormally low prices, each West African country attempted to moderate and manage imported price volatility largely by itself. The measures deployed typically included trade policies (for example, exoneration of import taxes during periods of high prices, and increased tariffs and other trade barriers during low prices) and targeted sales of subsidized foods to vulnerable populations during periods of price spikes. Because neighboring countries frequently did not coordinate their actions with each other, such measures sometimes induced unintended trade flows within West Africa such as the re-export of subsidized goods to neighboring countries, thereby weakening the impact of the measures. Since 2015, however, trade of the ECOWAS countries with the outside world is, in principle, regulated within the context of the ECOWAS Common External Tariff (CET) and associated safeguard measures (Hollinger and Staatz 2015, ch. 12).

[5] The following sections draw heavily on Hollinger and Staatz (2015).

As a result, measures to reduce imported price volatility will increasingly fall under the mandate of ECOWAS, both in the application of the CET-associated safeguard measures and in the role of ECOWAS as an advocate for West Africa in international forums such as the World Trade Organization (WTO) negotiations.[6]

*Trade safeguard measures***.** The CET regime includes several trade safeguard measures – rules that trigger tariff increases in the presence of large import surges, tariff reductions in the presence of precipitous drops in imports, and compensatory taxes if imports are shown to be the result of large subsidies from the exporting country. These measures have, in principle, two advantages over the previous measures that were implemented by individual West African governments. First, the safeguard measures are designed to be triggered by specific formulas (taking into account changes in import volumes and prices) and hence, in principle, are a welcome shift from the ad hoc and often unpredictable implementation of previous trade measures. Second, they are meant to apply across the entire ECOWAS zone, thereby eliminating the incentive to re-export imported goods to neighboring countries in response to differences in external tariffs. Implementation of the safeguard measures, however, face at least two major difficulties: (i) how to implement the triggering mechanisms that depend on prices in an economic community that does not have a single currency (and hence, where price fluctuations that trigger the measures could vary from country to country depending on the exchange rate); and (ii) deciding on the level at which to set the triggers. For example, as originally designed, the trigger for the compensatory taxes were set so low that the taxes would be invoked almost constantly, essentially converting this safeguard measure into an additional ad valorem tax. Such an additional tax would provide added protection to domestic producers, but it would do nothing to reduce price volatility, as it would simply raise the level of domestic prices while not reducing their variability (Hollinger and Staatz 2015). Thus, while the concept of safeguard measures is very important in dealing with imported price volatility (both soaring prices and collapsing prices), ECOWAS needs to focus on how to implement those measures effectively. It also needs to put pressure on its member states to abide by the CET regime and not add additional ad hoc measures on top of the common tax schedule.

Lobbying for strengthened WTO disciplines on export restrictions. Current WTO rules have very strong rules limiting the degree to which a WTO member country can erect import trade barriers, but very weak restrictions on export restrictions. The 2007-2008 crisis illustrated how damaging export barriers by major food exporters (such as Thailand, Vietnam, and India) can be to international markets. ECOWAS has a role to play in encouraging its member states to argue for stricter rules limiting these types of export restrictions. However, to be credible in these arguments, the ECOWAS member states themselves need to pledge to limit such barriers among themselves, as export bans within West Africa were a major contributor to the region's endogenous price volatility during the 2007-2008 period.

Lobbying for more flexible biofuel standards. A number of OECD countries have passed legislation mandating that an increasing proportion of their domestic fuels come from renewable bio-sources. In the first phase of these programs, particularly in the United States, the feedstock for many of these fuels has been maize (for ethanol) and soybeans (for bio-diesel).

[6] ECOWAS only has observer status at the WTO, while its individual member states are WTO members. In its current status, therefore, ECOWAS can serve mainly as a tool to help its member states develop common positions on issues of critical importance to West Africa in the WTO negotiations and voting, as it cannot vote on those issues itself.

These mandates generally set required volumes of biofuels to be produced, but make no provision for the volumes to vary depending on the price of the feedstock. In other words, the mandates add a totally price-inelastic demand to the market, serving to drive prices even higher during periods of production shortfalls. Another lobbying role for ECOWAS, therefore, is to argue in various international forums for more flexibility in these mandates, allowing the mandated volumes to fall when prices of the underlying feedstocks rise precipitously.

Measures to Reduce Endogenous Price Volatility

Reducing endogenous price volatility requires addressing the structural issues discussed above that help generate it. Measures that would help reduce this volatility include:

- Efforts to reduce fluctuations in production of basic staples through more weather-proofing of production systems through increased irrigation, better soil and water management, and varietal improvement.
- Improving the fluidity of regional and international trade to allow trade flows to help offset fluctuations in local supplies. Needed actions include, for example, improving roads and other transport infrastructure, reducing transaction costs of trade through diminution of West Africa's numerous roadblocks, and reforming trucking regulations to promote greater competition in the transport industry.
- Improving the collection and diffusion of information about market conditions to both public and private actors. This information needs to include monitoring of international trade volumes, production, and inventories held at both the farm and trader level. Such information is critical not only for private decision making but also to provide early warning of problems that could require special actions, such as the triggering of the CET safeguard mechanisms, and to prevent panicked imposition of intraregional trade barriers by governments fearing excessive outflow of food staples from their countries.
- Promoting expanded private stock holding, for example, through subsidizing construction of private storage facilities, coupled with improved reporting on inventory levels held in these facilities. The proposed establishment, under the ECOWAS Regional Agricultural Investment Plan (RAIP), of certified regional warehouses, where traders could store grain and be free to export it to any country in the region, is a move in this direction.
- Mutualizing some proportion of national grain reserve stocks into a regional reserve, as proposed under the ECOWAS RAIP, which would lead to greater flexibility in the management of such reserves and potential economies of scale. The RAIP plan also calls for holding two-thirds of the regional reserve in monetary form rather than physical stocks, which should reduce costs of managing the reserve, assuming that the financial reserves are well managed.

Measures to Manage the Effects of Price Volatility

Not all price volatility can be eliminated, so measures are needed to help various actors in the agrifood system deal with the volatility that remains. Key among the potential tools to achieve better management are:

- weather-based insurance for farmers and grain aggregators (much less developed in West Africa than East and Southern Africa)[7];
- financial reserves and expanded international lending facilities that would help countries cope with sudden increases in foreign-exchange demands for imports during periods of soaring prices and depressed export earnings during periods of deeply depressed prices[8]; and
- more targeted, market-compatible social safety nets to help consumers deal with the consequences of high food prices.

Governments throughout the region have implemented some targeted social safety nets, such as school feeding and food-for-work programs, in addition to less targeted programs, such as free food-aid distribution and subsidized food sales within geographic areas judged to be food insecure (e.g., because of drought). During the 2000s, lower-income grain-exporting countries within West Africa also imposed export bans in an attempt to hold down domestic staple-food prices in order to protect their consumers. Government leaders in these countries feared, with some justification, that their richer neighboring countries would bid away food supplies from the exporting countries' poor.[9] As discussed above, however, in aggregate such actions, taken together with countervailing actions by the importing countries, tend to increase rather than decrease regional and international price volatility and discourage long-term agricultural growth by depressing farmer incentives. Discussions by SRAI researchers with high-level government decision makers during the 2007-2008 crisis revealed that most of them understood many of the negative long-term consequences of such trade bans. They felt, however, that lacking any other proven and financially affordable ways of protecting consumers from spiraling food prices, they had no alternative but to rely on the trade bans. The ECOWAS regional food policy (ECOWAP) calls for experimentation on innovative models of social protection in the face of high food prices. Such an initiative is welcome, as the 2007-2008 experience showed graphically that West African governments are unlikely to move towards fluid regional trade without a simultaneous solution to protecting vulnerable populations from soaring prices.

Conclusions

Policies used in recent past to deal with volatility in West Africa, such as trade restrictions, increasing government physical stocks, and consumer subsidies (e.g., via tax exemptions on imported food) have had mixed effects and are likely to be financially unsustainable. Given ecological complementarities in West Africa, regional trade appears as a less costly price volatility mitigation and management tool. However, to be effective, such a trade-based approach requires strong regional leadership of ECOWAS to impose consequences on member-states that violate provisions of the ECOWAS Treaty calling for the free movement of goods and people throughout the region. It will likely also require some regional support of social safety nets in the inland countries that have the lowest per capita incomes (such as Burkina Faso, Mali, and Niger) in order to avoid political pressures in those countries for export bans during periods of high food prices. Thus, policies to reduce regional price volatility and

[7] For information on such insurance, see, for example, https://www.syngentafoundation.org/agricultural-insurance-east-africa

[8] For a discussion of international funding facilities to deal with price volatility, see Hollinger and Staatz (2015).

[9] See the discussion of bidding wars between poor and rich consumers in Chapter 6 in this volume.

promote agricultural growth through more fluid regional trade cannot be designed independently of a strategy to develop sustainable social safety nets.

Better information on production, trade, and inventory levels, as well as more transparent, predictable rules under which governments will undertake actions (such as release of grain reserves) are also critically important in reducing hoarding and panic selling, which aggravate endogenous price volatility. Allowing grain traders from neighboring West African countries to bid for contracts to help supply national grain reserves would also help drive down costs of such reserves (since neighboring countries may have greater marketable surpluses) and help expand and stabilize regional grain markets. In addition, efforts to promote weather-based crop insurance, better water control, and development of resilient crop/livestock varieties to reduce the risk of investment at the farm level will also play a key role in helping actors manage the remaining price volatility that the earlier-mentioned actions cannot entirely eliminate.

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CHAPTER 10

Implications of Asia's Changing Rice Economy for the Development of Rice Value Chains in West Africa

Implications de l'évolution de l'économie rizicole en Asie pour le développement des chaines de valeur du riz en Afrique de l'Ouest

Ramziath T. Adjao and John M. Staatz

Abstract

Following the 2007-2008 world food crisis, efforts to expand West Africa's rice production intensified in an attempt to reduce the region's dependence on imports, most of which come from Asia. The heaviest investments were in irrigated systems with full water control, where yields are highest and least variable. Using production budget data and domestic resource cost analysis, this chapter compares the financial and economic profitability of rice production in such systems in Côte d'Ivoire, Mali and Senegal with those of three major Asian rice exporters (India, Thailand and Vietnam) in 2011. Using data from three long-term rice market outlook studies, the chapter then conducts scenario analysis to identify the major factors that will influence the relative profitability of the West African and Asian systems through 2022. The financial profitability of the three West African value chains exceeded that in the three Asian countries. In all the scenarios analyzed, the financial and economic profitability of rice production was highest in Mali of the three West African countries analyzed.Sensitivity analysis reveals that the future profitability of the West African systems relative to their Asian counterparts is most sensitive to changes in world rice prices, the U.S. dollar/French Franc (US$/CFAF) exchange rate, increases in milling efficiency, and costs of irrigation infrastructure investments. Improving the quality of locally milled rice will also be an important factor in improving the profitability of local rice compared with imports.

Résumé

Suite à la crise alimentaire mondiale de 2007-2008, les initiatives d'expansion de la production rizicole en Afrique de l'Ouest se sont intensifiées pour tenter de réduire la dépendance de la région à l'égard des importations, pour la plupart provenant d'Asie. Les investissements les plus importants ont porté sur les systèmes irrigués avec maitrise totale de l'eau, dont les rendements sont plus élevés et moins variables. À l'aide de données sur les budgets de production et la méthode d'analyse du coût des ressources intérieures, ce chapitre compare la rentabilité financière et économique de la production rizicole des systèmes de riz en Côte d'Ivoire, au Mali et au Sénégal, avec ceux de trois grands pays exportateurs de riz (Inde,

Thaïlande et Vietnam) en 2011. À partir des données provenant de trois études sur les perspectives à long terme du marché mondial du riz, ce chapitre analyse ensuite des scénarios en vue de dégager les facteurs-clés qui affecteront la rentabilité relative des systèmes ouest-africains et asiatiques jusqu'à 2022. La rentabilité financière des trois chaines de valeur ouest-africaines est supérieure à celle des trois pays asiatiques. Lorsque l'analyse est réalisée sur la base des prix économiques et non des prix financiers, les systèmes malien et sénégalais restent rentables, mais le système ivoirien ne l'est que marginalement et demeure très sensible aux faibles fluctuations de prix des intrants et de la production. Dans l'ensemble des scénarios analysés et au niveau des trois pays ouest-africains étudiés, c'est au Mali que la rentabilité financière et économique de la production de riz était la plus élevée. L'analyse de sensibilité révèle que la rentabilité future des systèmes ouest-africains par rapport à celle de leurs homologues asiatiques est plus sensible aux fluctuations des cours mondiaux du riz, au cours du change dollar US/FCFA, à l'efficacité accrue des systèmes d'usinage et aux coûts des investissements dans les infrastructures d'irrigation. L'amélioration de la qualité du riz usiné localement sera aussi un facteur important de renforcement de la rentabilité du riz local face au riz importé.

10.1. Introduction

Rice is at the center of food policy debates in West Africa (WA).[1] Driven by its convenience in preparation and consumption and higher consumer incomes, per capita consumption grew from just under 15 kg/year in 1970 to 40 kg/year in 2011 while population tripled during the same period. As a result, imports have soared, from 464,000 metric tons (mt) in 1970 to 6.4 million mt, 44% of West Africa's total rice supplies, in 2011. The bulk of these imports comes from Asia, which accounts for about 90% of the world rice production and consumption and is the home of many of the world's top rice exporters and importers.

In 2007-2008, world rice prices spiked, with the free on board (FOB) price of the benchmark Thai 25% broken rice nearly tripling in one year and several key Asian exporters imposing export bans. This crisis laid bare West Africa's vulnerability to outside supply disruptions and stimulated massive actions by individual countries and the region as a whole, through regional organizations such as Economic Community of West African States (ECOWAS) and West African Economic and Monetary Union (WAEMU), to expand rice production in order to reduce import dependence and create new markets for West African farmers. These production initiatives expanded rice production in the ECOWAS zone from 6.9 million mt in 2008 to 11 million mt in 2013, but have relied heavily on input subsidies as well as investment in new irrigation infrastructure.

Over the long term, such production will only be economically sustainable if it can deliver local rice to West African consumers in the qualities and quantities desired and at a price that is competitive with Asian imports. Previous analyses by the authors (Adjao and Staatz 2015; Adjao 2016) have identified several factors that are likely to affect the relative competitiveness of West African and Asian rice systems. This chapter draws on those findings to estimate the

[1] In this chapter, West Africa (WA) refers to the 15 member countries of the Economic Community of West African States (ECOWAS): Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. Unless otherwise noted, all production, trade and consumption figures cited in this chapter are from FAOSTAT (2016).

relative competitiveness of the Asian and West African systems under various scenarios. The analysis highlights critical factors that West Africans must address to ensure that their efforts to substitute local production for imported rice remains economically sustainable in the future.

10.2. Literature Review and Knowledge Gap

This chapter draws together two disparate streams of literature on the competitiveness of Asian and West African rice value chains. On the one hand, the Food and Agriculture Organization of the United Nations (FAO) production and trade data (FAOSTAT 2016) and a number of recent studies (e.g., Hazell 2008; Pandey et al. 2010; Reardon et al. 2014; Chen et al. 2013) highlight the dominance of Asia in the global rice economy and key structural characteristics of the Asian and world rice markets. On the other hand, since the 1980s many studies have assessed the comparative advantage of rice value chains in West Africa (Pearson, Stryker, and Humphreys 1981; Barry 1994; Lançon and Erenstein 2002; USAID 2009; Seck et al. 2010; Diallo, Dembélé, and Staatz 2012; Diagne et al. 2013). Previous studies of comparative advantage in West Africa have compared (i) rice production with other commodities, (ii) different rice production systems within a given country, and (iii) similar rice production systems across West African countries. Very few studies, however, have explicitly compared profitability of rice production West Africa with that other regions of the world. A rare exception is a study carried out by the World Bank (Byerlee et al. (2013), which compared rice value chains in Thailand, Senegal, and Ghana.

None of the studies, moreover, have examined how future changes in Asia, the dominant region in the world rice economy, are likely to affect the future competitiveness of West African rice value chains. These changes include: (i) increased diversification of the Asian diet as a result of changing age structures and rapid economic growth; (ii) modifications in production patterns across Asia, as land moves out of rice and into more high-value products; and (iii) evolving costs of production in response to higher energy and water costs, technological change, changing marketing strategies of rice producers, and climate change (Reardon et al. 2014; Adjao and Staatz 2015; Adjao 2016). This chapter draws on world rice market outlook studies and other analyses of these changes to develop scenarios aimed at analyzing how these changes are likely to affect the future competitiveness of irrigated rice production in key West African countries.

10.3. Methods and Data

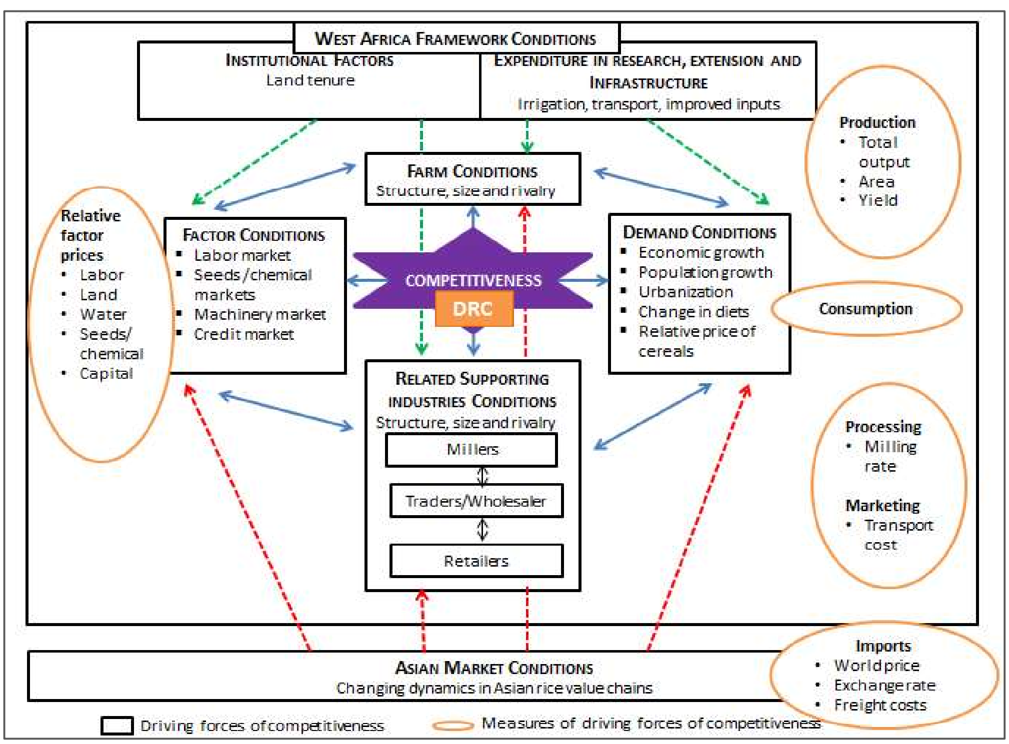
The analysis combines three elements: the development of an analytic framework to identify parameters that drive rice value-chain competitiveness, a review of major rice market outlook studies to identify likely ranges of values for those parameters in the coming 5 to 10 years; and the incorporation of those parameter values into the calculation of domestic resource cost ratios to measure future competitiveness of major rice value chains in selected West African countries.

Development of an Analytic Framework

In this chapter, competitiveness is be defined as "the ability to face competition and to be successful when facing competition, i.e., the ability to sell products that meet the requirements (price, quantity, quality) and, at the same time, ensure profits over time that enable the firm to thrive (…) within domestic or international markets" (Latruffe 2010). Thus, an increase in competitiveness or financial profitability occurs when a firm or country is able to lower its costs relative to those incurred by its rivals.

Building on the work of Porter (1998) and Reardon and Timmer (2014), Figure 10.1 presents a conceptual framework that identifies the main driving forces of competitiveness of West African and Asian rice systems and explains the changing structures of these systems as their economies evolve. The framework models changes in competitiveness as the outcome of changes in four interlinked factors, including (1) demand conditions; (2) farm-level conditions; (3) the conditions of related supporting industries; and (4) specialized factor markets, including for labor and capital, resulting from substantial, sustained investments in technology and know-how. These interlinked factors are complemented by both national framework conditions and global framework conditions of international markets, especially Asian markets, which influence the development of local value chains in WA. Each of these factors is linked by transactions (within firms or across markets), and the analysis of the coordination of these transactions is central to the model. The conceptual framework identifies key factors that are likely to drive competitiveness of West African irrigated rice er systems in the future. Sensitivity analysis on these factors, in Section 10.4 below, identifies which of them will be most influential in shaping WA's rice competitiveness in the future.

Figure 10.1. The Determinants of West African Rice Competitiveness



Source: Adjao (2016).

Summary of Key Outlook Studies

While Figure 10.1 presents the conceptual framework guiding the analysis, a review of major rice outlook studies provided likely parameter values for major driving factors identified in the framework. Three major organizations have developed outlook reports on probable trends over the coming decade in world rice markets, which are mainly driven by the major Asian rice economies: the USDA (Westcott and Trostle 2013)─covering the period 2011-2022; the University of Arkansas (Wailes and Chavez 2012)─covering 2010-2021; and the OECD-FAO (2013)─covering 2013-2022. These projections were developed assuming that no major domestic or external shocks would affect global agricultural markets in the next decade (e.g., normal weather with, in general, continuation of current trends in crop yields). The projections also assume: (i) an overall increase in economic growth in developing countries at around 3.8-4.2% per year, with strongest growth expected in Asia and Africa; (ii) population growth at around 1% per year, with the fastest growth occurring in Africa, while rates decline in the major Asian rice-exporting countries; (iii) subdued inflation in most parts of the world, at around 2%, with higher rates in the range of 4-8% for high-growth emerging countries; (iv) continued depreciation of the U.S. dollar, which would further decrease rice import prices (quoted in U.S. dollars) to countries whose currencies are not linked to the U.S. dollar; (v) further increases in crude oil prices, which were expected to increase faster than the general inflation rate; and (vi) continuation of domestic agricultural and trade policies, including long-term economic and trade reforms in many developing countries.

Based on these assumptions, the three studies all project global rice consumption to grow at an average rate of 1% annually, with higher rates in Africa and in the Middle East. For instance, Wailes and Chavez (2012) estimate total rice consumption in Africa to rise particularly fast (about 3% per year over the next decade) while the opposite is expected in China (0.3% per year). Moreover, all three studies project global rice production to increase by about 1% annually, mainly as a result of improvements in yields, although new investments in the sector in Africa are expected to contribute significantly to area expansion. Most of the expected growth in production is likely to come from India and Asian Least Developing Countries, including Cambodia and Myanmar, but also African countries, especially Nigeria, Mali, Sierra Leone and Ghana. However, China, currently the world's largest producer, is projected to cut output significantly in response to declining per capita domestic consumption and strong competition for land. As a result, Wailes and Chavez (2012) expect Asia's share of world production to decline slightly from 89.9% to 89.3% over 2010-2021 while Africa's share will increase from 3.4% to 4.2% over the same period.

Moreover, world prices, on average, are projected to remain on a high plateau compared to the previous decade in both nominal and real terms, although they are likely to be lower than the 2007-2008 levels. In fact, the Organisation for Economic Co-operation and Development (OECD)-FAO projections foresee the world rice/coarse-grain price ratio falling from 2.5 in recent years to 1.9 by 2022 and the rice/wheat price ratio falling from 1.8 to 1.7 (OECD-FAO 2013), suggesting some shift in consumption away from rice toward coarse grain and wheat-based products, such as noodles, especially among lower income consumers in WA.

The three studies also expect international trade in rice to continue to grow within a range of 2.0–2.5% per year, likely fueled by increased import demand by countries in West Africa, especially Nigeria and Côte d'Ivoire, and in the Middle East, especially Iran and Iraq, as well as traditional rice-deficit Southeast Asian countries, such as the Philippines and Bangladesh. However, new trade patterns are expected to emerge. While China and India are projected to remain the largest rice economies, still accounting for nearly half of global rice production and consumption in the next decade, China will significantly reduce its rice exports while India's exports will increase. Although Thailand, Vietnam, India, Pakistan, and the U.S are projected to remain the top five rice exporters, accounting for over fourth-fifths of global net trade, Vietnam may surpass Thailand as the leading exporter by 2020 depending on whether Thailand continues to pursue its high producer price policies, which have eroded its competitive edge in recent years. Myanmar and Cambodia are also expected to increase exports by about 10% per year to 2020.

Financial and Economic Analysis

In order to assess the current competitiveness of West African irrigated rice systems compared with those of major Asian rice exporters, the analysis examined a wide range of production and marketing data for rice produced in full water-control irrigation systems in Mali, Côte d'Ivoire and Senegal. Mali is the second-largest rice producer in West Africa (after Nigeria), and Côte d'Ivoire and Senegal are the region's second and third-largest rice importers (after Nigeria). Lack of comparable farm-level budget data precluded including Nigeria in the analysis. The analysis focused on full water-control irrigation systems because these systems account for the bulk of the marketed surplus of rice in West Africa and they are the systems that have received most public investment to date.

The analysis was conducted in terms of market and production conditions existing in 2011. It compared the competitiveness of rice produced from these systems with imports of Asian rice from two different perspectives. The first perspective is financial analysis, which calculates the cost of production and net value added using prevailing market prices, including any taxes paid and subsidies received by value-chain actors. The financial analysis thus measures the profitability to private actors of rice production and marketing under existing market conditions. The second perspective is economic analysis, which nets out the value of any taxes and subsidies, including the effects of over- or under-valued exchange rates. The economic analysis thus measures the profitability to the economy as a whole of the activity, i.e., whether the country has a comparative advantage in rice production and marketing.[2]

The indicator used here to assess economic profitability is the Domestic Resource Cost (DRC) ratio. This ratio measures the cost to the country, in terms of the domestic resources it uses, of producing a kilogram (kg) of rice and delivering it to consumers, in a given location, compared to importing it. It does so as follows. The numerator of the ratio is the value (expressed in terms of foreign exchange) of domestic (nontradeable) resources (land, labor, capital) used in the production and delivery of a given amount of rice to the country's capital city. The denominator is the net value of foreign exchange that would be needed to replace the same amount of rice

[2] Economic analysis takes the prevailing world prices as given and does not take into account any taxes paid or subsidies received by actors in the exporting country. The justification is that the importing country cannot affect these taxes and subsidies, and therefore, the world price represents the opportunity cost to the importing country of producing the good rather than importing it.

with imports. If this ratio is less than one, it indicates that it is cheaper to produce and deliver the rice using domestic resources than to import it, and hence the country has a comparative advantage in providing the good. If the ratio is above one, the opposite is true (Adjao 2016). The lower the value of the DRC ratio (the closer it is to zero), the higher is the comparative advantage of the country in rice production.

Data

The data used for this analysis were compiled based on recent rice value chains studies conducted by the Asian Development Bank and the Regional-Research and Development Technical Assistance (R-RDTA) for several Asian countries, including India, and Vietnam (Chen et al. 2013); the Asian Development Bank and its Institute (ADBI) in Vietnam (Reardon et al. 2014); the World Bank in Thailand and Senegal (Byerlee et al. 2013); USAID/Mali in Mali (Stryker and Coulibaly 2011), and AfricaRice and its national partners (NARS) in collaboration with Michigan State University (MSU) for several countries in WA, including Côte d'Ivoire, Mali, and Senegal (Diagne et al. 2013; Diallo, Dembélé, and Staatz 2012; Dieng et al. 2011; Ouattara 2011). The year 2011 is taken as the base year of this analysis. Where necessary, the data, especially per-unit costs figures and average producer and consumer prices for WA, were updated to 2011 using data obtained from national Market Information Systems (MIS) and Famine Early Warning Systems (FEWSNET). The cost data are mostly representative of those facing small- to medium-scale paddy producers and processors. World prices and exchange rates were obtained from international statistical databases, including the World Bank and FAOSTAT. However, it is important to note that rice is not a homogeneous product and quality differences are not always accurately reflected in the data, making some of the cross-country comparisons subject to error. Therefore, cost numbers need to be interpreted with caution.

10.4. Results

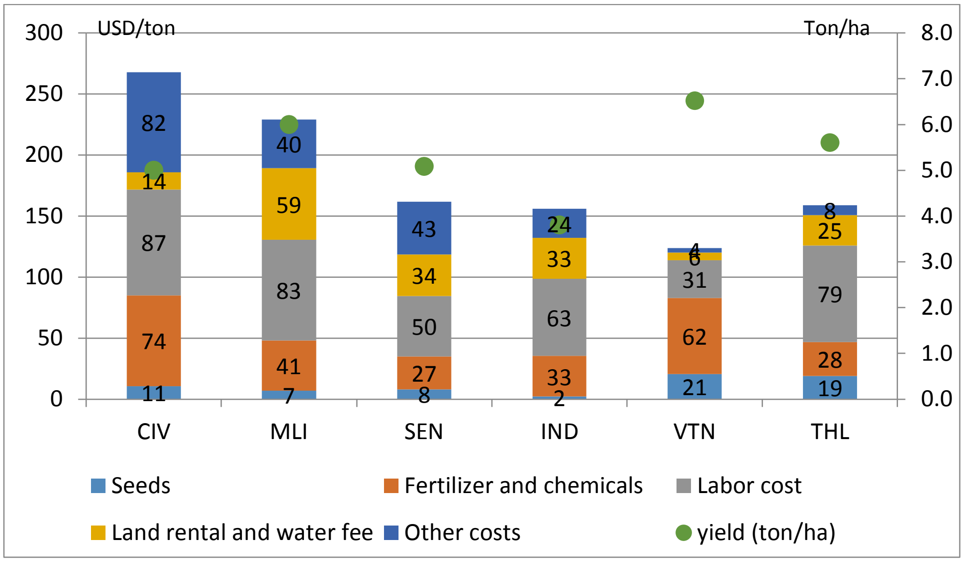
Financial Analysis

Figure 10.2 compares financial costs of production, at the farm level, of paddy rice in Côte d'Ivoire, Mali, Senegal, India, Vietnam, and Thailand. Senegal's cost, at slightly over US$150/metric ton, is comparable to that of India and Thailand, but above that of Vietnam. The financial costs for Côte d'Ivoire and Mali exceed those India and Thailand by between 50% and 80%, and by an even higher amount for Vietnam.

Because consumer rice prices are higher in West Africa than in the Asian exporting countries, however, the financial profitability of the entire value chain, as measured by the cumulative net margin (value added) by all actors involved in producing and delivering rice to each country's respective capital city, is positive in West Africa and even higher than that of the three Asian countries (Table 10.1). The high financial profitability in the three West African countries is consistent with the rapid expansion of rice production in these countries since the rice crisis of 2008.

Figure 10.3 presents a comparison of the price structure along the retail (or export) value chains in the selected countries, highlighting the principal activities in the chain that capture the highest share of the final retail price. The price structure in WA contrasts strongly with the structure in Asia. Overall, the performance of downstream segments of Asian rice value chains (i.e., traders, millers, and wholesalers) has become nearly as important as the farm segment, with about 40% of the total value added of the rice value chain (reflected in the final retail price) deriving from the downstream segments and the remaining 60% from the farm segment. However, in WA the share of the off-farm components in the final retail price is only half of those estimated for Asia, except in Senegal.

Figure 10.2. Level and Distribution of Production Costs for Irrigated Rice in Côte d'Ivoire, Mali and Senegal Compared to India, Vietnam and Thailand (US$/ton paddy)



Source: Adjao (2016).

Note: Other costs include machine rental, equipment maintenance and depreciation, interest on capital, gas and fuel, sacks; depreciation of irrigated infrastructure is excluded.

Table 10.1. Net Financial Value Added in Irrigated Rice Value Chains, 2011 (US$ per Metric Ton of Milled Rice)

Country	Net Value Added
Côte d'Ivoire	263
Mali	250
Senegal	258
India	201
Vietnam	189
Thailand	148

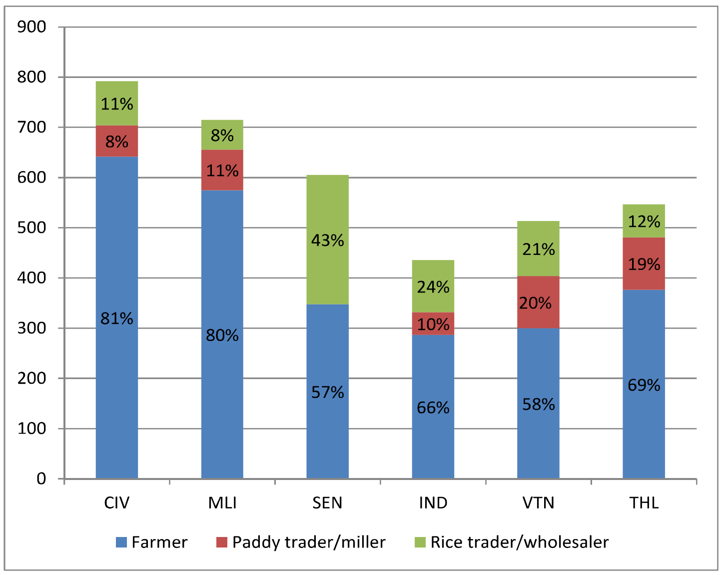
Source: Adjao (2016).

Economic Analysis

When competitiveness is measured using economic analysis, a slightly different picture emerges. The DRC ratios for Mali (0.68) and Senegal (0.78) are both below 1.0, indicating that under conditions prevailing in 2011 these countries had a comparative advantage in rice production. In Côte d'Ivoire, however, the DRC was 1.0, indicating that, from an economic standpoint, irrigated rice production in that country was just at a break-even point, and hence was highly vulnerable to shocks that could make it unprofitable from the perspective of the country as a whole. The divergence between Côte d'Ivoire's break-even position in economic terms and the financial profitability shown in Table 10.1 implies that the financial profitability in Côte d'Ivoire was driven by explicit and implicit subsidies to the rice sector.

It is not surprising that Mali has the strongest the comparative advantage in producing and marketing rice to its capital city, as Mali's landlocked position offers the country some natural protection from imports. In contrast, the major rice-consuming cities of Senegal and Côte d'Ivoire are close to ports, making access to imports cheaper.

Figure 10.3. Price Structures of the Rice Value Chain in RCI, Mali, and Senegal Benchmarked to India, Vietnam, and Thailand (% of Wholesale or FOB Price)*



Source: Adjao (2016).
*Note: In the Delta region in Senegal, paddy is processed either by the farmer or the wholesaler. In the above scenario, paddy is processed by the wholesaler who pays for custom milling and transportation fees from farm to wholesale markets.

These DRC results differ from those of a 2013 study by AfricaRice (Diagne et al. 2013), which found that Côte d'Ivoire had a comparative advantage in rice production (DRC = 0.57). That study, however, assumed that the major irrigation infrastructure was already paid for and thus did not have to be included in the analysis. The AfricaRice approach is only appropriate if one is analyzing the economics of expanding production within an existing irrigation facility that requires no new major infrastructure. Since most rice production initiatives in West Africa involve bringing new areas under irrigation, it is preferable to include the investment costs of the new infrastructure in the analysis. The fact that excluding such costs makes a marginally unprofitable activity look highly profitable probably explains why many private promotors of expanded large-scale irrigation in Côte d'Ivoire (and elsewhere) have sought to have the infrastructure costs covered by government within a public-private partnership framework.

Sensitivity Analysis: Key Factors Influencing Future Competitiveness

Figure 10.1 illustrates the driving forces affecting future competitiveness of West African rice systems vis à vis their Asian counterparts. These range from institutional issues, such as land-tenure conditions, to exchange rates, access to new technologies, conditions in factor markets, and costs of both ocean and inland freight. This section presents sensitivity analysis of the DRC calculations presented above with respect to several of these driving forces (shown as the circled items in Figure 10.1). They include the world rice price, the CFAF/US$ exchange rate, ocean and inland transport costs, rice yields, costs of chemical inputs, milling rates, irrigation costs, capital costs, land costs and the cost of labor. The level of changes in these key variables relative to the base period (2011) were taken from the outlook studies discussed earlier for the medium run (i.e., the period 2011-2016) and the long run (i.e., 2011-2021).

Table 10.2 summarizes the results for changes in the individual levels of these major drivers of competitiveness. Key results for the most important drivers were the following (for details, see Adjao 2016):

Changes in World Rice Prices and Exchange Rates: Competitiveness was most sensitive to projected declines in the world prices (a function of production costs in Asia) and a depreciation of the U.S. dollar relative to the Euro (and hence the CFAF).[3] For example, a 12% decline in world prices from 2011 levels would increase the DRC to 1.49 in Côte d'Ivoire and 1.07 in Senegal, making rice production in those countries economically unprofitable, and reduce Mali's competitiveness (DRC increasing to 0.87). In reality, world prices in dollar terms for Thai 25% broken rice fell by 27% between 2011 and 2015 (FAO 2016), but this was largely offset by a 20% appreciation of the US$ relative to the CFAF, resulting in a net decline in world prices, in CFAF terms, of 7%. The net effects of these actual price and exchange rate changes were to increase Senegal's DRC to 0.94 (still marginally profitable in economic terms) but to turn Côte d'Ivoire's production unprofitable (DRC = 1.27). Mali's competitiveness declined but remained economically profitable (DRC = 0.79). Both the world price and the exchange rate are entirely outside the control of these three West African countries, so in order to strengthen their competitiveness, they need to concentrate on factors that are within their control, such as investment costs in irrigation infrastructure and operational efficiency throughout the value chain.

Increases in Milling Efficiency and Farm-Level Yields: Increases in milling rates (rates of conversion of paddy into milled rice) and paddy yields were strong factors in increasing competitiveness, with increases in milling rates having a somewhat stronger impact than growth in farm-level yields. For example, a 5% increase in milling rates would decrease the DRC in Senegal from 0.78 to 0.73, while a 5% yield increase would reduce the figure to 0.75. This finding underlines the importance of looking to improve efficiency throughout the entire value chain and not just at the farm level.

[3] The CFA franc (CFAF) has a fixed parity with the Euro (1 Euro = 656 CFAF). All three West African countries analyzed here share the CFAF as a common currency.

Table 10.2. Impact of Changes in Key Variables on Competitiveness

	Scenario	% change MR	% change LR	DRC MR	DRC LR
	CÔTE D'IVOIRE			DRC (1.00)*	
1	World rice price	-5%	-12%	1.09	1.24
2	Dollar exchange rate	-5%	-10%	1.09	1.18
3	Ocean freight costs	10%	20%	0.97	0.95
4	Inland transport costs	10%	20%	1.01	1.02
5	Yield	-6%	3%	1.11	0.96
6	Chemical costs	10%	20%	1.03	1.06
7	Milling rate	5%	8%	0.93	0.89
8	Irrigation costs	-20%	-50%	0.91	0.77
9	Capital costs	-5%	-10%	0.97	0.95
10	Land costs	50%	100%	1.03	1.06
11	Labor costs	20%	50%	1.07	1.17
	MALI			DRC (0.68)*	
1	World rice price	-5%	-12%	0.72	0.78
2	Dollar exchange rate	-5%	-10%	0.72	0.76
3	Ocean freight costs	10%	20%	0.67	0.65
4	Inland transport costs	10%	20%	0.68	0.69
5	Yield	11%	22%	0.61	0.55
6	Chemical costs	10%	20%	0.69	0.7
7	Milling rate	5%	8%	0.64	0.62
8	Irrigation costs	-20%	-50%	0.63	0.56
9	Capital costs	-5%	-10%	0.67	0.65
10	Land costs	10%	20%	0.69	0.7
11	Labor costs	20%	50%	0.72	0.78
	SENEGAL			DRC (0.78)*	
1	World rice price	-5%	-12%	0.83	0.93
2	Dollar exchange rate	-5%	-10%	0.83	0.89
3	Ocean freight costs	10%	20%	0.76	0.74
4	Inland transport costs	10%	20%	0.78	0.78
5	Yield	3%	5%	0.75	0.74
6	Chemical costs	10%	20%	0.79	0.8
7	Milling rate	5%	8%	0.73	0.7
8	Irrigation costs	-20%	-50%	0.72	0.62
9	Capital costs	-5%	-10%	0.76	0.74
10	Land costs	50%	100%	0.79	0.8
11	Labor costs	20%	50%	0.81	0.86

Notes: * Base scenario, MR = medium-run; LR = long-run

Source: Adjao (2016).

Changes in Energy Prices: The impact of changes in energy prices is ambiguous on the competitiveness of West African rice production. On the one hand, higher energy costs raise the cost of ocean transport, thereby raising the cost of imports and improving West African competitiveness. On the other hand, costs of inland transport and energy-intensive inputs like fertilizer also rise, hurting local competitiveness.

Rising Agricultural Labor Costs: Higher agricultural labor costs in West Africa reduce competitiveness, with the effect strongest in Côte d'Ivoire, where a 20% increase in labor costs per mt of output would raise the DRC from 1.0 to 1.07, making rice production uncompetitive with imports. This finding underlines the importance of promoting labor-saving technologies (such as herbicides and selective mechanization) in countries like Côte d'Ivoire and Ghana, where wage rates are rising due to robust economic growth.

Cost of Irrigation Infrastructure: The cost of developing irrigation infrastructure is a major determinant of competitiveness. If these costs per ha could be reduced by 20%, production in Côte d'Ivoire would become competitive (DRC = 0.91) and that in Senegal and Mali would be even more so (DRCs falling from 0.78 to 0.72 in Senegal and from 0.68 to 0.63 in Mali).

Relative Competitiveness across Countries: The sensitivity analysis shown in Table 10.2 indicates that Malian rice production for the domestic market would remain competitive under a wide range of scenarios. In contrast, the competitiveness of Ivorian production is very sensitive to the factors shown in the table. Senegal occupies an intermediate position, often remaining competitive, but with some combinations of factors, such as declines in the world price coupled with rising transport costs, eroding the sector's competitiveness.

10.5. Conclusions and Policy Implications

Recent changes in the Asian rice economy suggest a favorable environment for expansion of West African rice production, as area is shifting out of rice in Asia, productivity growth is slowing and labor costs are increasing. In West Africa, large-scale irrigated production was financially profitable in 2011 in Senegal, Mali and Côte d'Ivoire, but only economically profitable the former two. This suggests that net subsidies to the rice sector since the 2008 world food price crisis have been an important contributor to expansion of production, at least in Côte d'Ivoire. The fact that production is economically profitable in Senegal and Mali suggests that current levels of subsidies are not needed for the full-water-control component of the rice value chain to be competitive. Given its relatively high comparative advantage in producing and marketing rice to its capital city, Mali may even be in a position itself as a substantial exporter of rice to regional markets.

However, the future competitiveness of West African rice value chains will depend on factors both outside the countries' control, such as world prices and exchange rates, and those they can influence, such as efficiency in production, processing and transport. World rice prices in dollars have declined since 2011, potentially weakening the competitiveness of West Africa's rice sector vis à vis Asian imports. Within the CFAF zone, however, this effect has been largely offset by a weakening of the Euro, and hence the CFAF, relative to the dollar. Should economic conditions in the European Union strengthen or conditions in the US weaken, the Euro (and hence the CFAF) could strengthen relative to the dollar, putting West African rice systems under greater competitive pressure. Therefore, focusing on improving the efficiency of these systems is critical.

Increases in farm-level yields and milling rates, reductions in per ha investments in irrigation infrastructure, and reduced financing costs are among the most powerful factors that could offset the negative impacts of unfavorable changes in world prices and exchange rates. The ability to achieve these increases in system-wide efficiency requires adequate investment in agrifood system research and extension. This raises the question of whether shifting public resources to such efforts from the current heavy expenditures on input subsidies might have a larger and more sustainable impact on West Africa's rice competitiveness than current policies. Another action that could improve competitiveness is the reduction of inland transport costs through efforts to increase competition in the trucking industry and reduce non-tariff barriers such as roadblocks, which increase the already high marketing costs of local rice.

Quality improvement can also strengthen the competitiveness of West African rice. In most countries of the region, consumers perceive local rice to be of lower quality than imports, frequently with higher levels of impurities such as stones and chaff. Demand for higher quality food products is increasing throughout West Africa, particularly among the growing middle class (Hollinger and Staatz 2015). Therefore, increasing marketable volume of milled rice without addressing the quality issue may no longer be sufficient if West African rice value chains are to claim a bigger share of the booming West African rice market. Strengthening systems of contracting among farmers, their organizations, millers and marketers will be an important element in achieving such quality improvement.[4]

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[4] See Chapter 12 in this volume.

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CHAPTER 11

Competitiveness of Rainfed Rice and Maize Production in West Africa

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Abstract

This chapter analyzes the financial and economic profitability of rainfed rice and maize production systems in Benin, Burkina Faso, Côte d'Ivoire, and Senegal under prices prevailing in 2011. These systems have shown remarkable dynamism in West Africa since 2007-2008, when world grain prices increased sharply and NERICA rice varieties began to be introduced to the region. Using the Policy Analysis Matrix (PAM) and Domestic Resource Cost Analysis (DRC), the chapter shows that all six rainfed rice production systems and six of the eight rainfed maize systems analyzed were financially and economically profitable at the farm level and competitive with imported cereals. Government policies in the countries generally provided net subsidies to farmers, with the exception in Burkina Faso and for maize producers in Côte d'Ivoire, where policies implicitly taxed them. Given the strong competitiveness of these rainfed systems and their rapid expansion in recent years, they merit strong attention in future food policies for the region.

Résumé

Ce chapitre analyse la rentabilité financière et économique du riz et du maïs pluvial au Bénin, Burkina Faso, Côte d'Ivoire et au Sénégal. Ces systèmes ont connu un certain dynamisme en Afrique de l'Ouest depuis 2007/08, lorsque les prix alimentaires mondiaux se sont envolés et au moment où les variétés de riz NERICA ont commencé à être introduites dans la sous-région. Utilisant la Matrice d'Analyse des Politiques (MAP) et l'Analyse de Coût des Ressources Domestiques (CRD), ce chapitre montre que tous les six systèmes de production de riz pluvial et six des huit systèmes de production de maïs pluvial analysés sont financièrement et économiquement rentables au niveau de la ferme et compétitives par rapport aux céréales importées. Les politiques gouvernementales dans ces pays ont généralement alloué des subventions aux producteurs qui ont été protégés à l'exception de ceux au Burkina Faso et ceux du maïs en Côte d'Ivoire qui ont été plutôt taxés. Compte tenu de la forte compétitivité de ces systèmes pluviaux et leur rapide expansion durant ces dernières années, ceux-ci méritent dorénavant une attention particulière dans la sous-région.

[1] This chapter was written by Boubacar Diallo of Michigan State University, who assumes entire responsibility for all the statements herein. The underlying research, upon which the chapter is based, however, could not have taken place without the strong collaboration of researchers from AfricaRice (especially Ali Touré, Rose Edwge Fiamohe, Simon Codjo, and Jeanne Coulibaly) who supervised collection of data and analysis of the competitiveness of rainfed rice and maize by teams from national agricultural research systems (NARS) in West Africa. The author expresses his profound gratitude to the AfricaRice colleagues and the members of the NARS teams.

11.1. Introduction

Chapter 10 analyzed the profitability and competitiveness of irrigated rice production under full water control in West Africa compared to similar systems in Asia. This chapter complements that analysis by examining the private and social profitability of two types of rainfed cereals that have shown remarkable dynamism in West Africa in recent years: rainfed rice, whose production has been spurred since 2008 with the introduction of NERICA varieties, and rainfed maize, whose production expanded more than nine-fold between 1980 and 2014.[2] Specifically, the chapter explores the whether it is more profitable for small farmers in the region to produce rainfed rice and maize for their own families to consume (and sell in local markets) rather than procuring those cereals from imports. The chapter explores the profitability and competitiveness of these crops based on evidence from field surveys and includes recent developments in these sectors, including changes observed since 2008.

In West Africa, rice and maize are important staples for food security. They also play a significant role in supplying regional markets, increasing the income of farmers and creating jobs in rural areas. As described in Chapter 3, rice production in West Africa is mostly concentrated in the basins of Nigeria (40%), Guinea and Mali (30%), and Côte d'Ivoire and Liberia (10%-15%). Maize is a critical crop for the region because it serves as both human food (predominantly white maize) and animal feed (predominantly yellow maize). Maize production is concentrated in the basins formed by Nigeria, Benin, Togo, Côte d'Ivoire, and Ghana. Since the increase in world food prices that began in 2007-2008, these areas have been joined by an emerging basin comprising Burkina Faso, Mali, and Guinea (see Chapter 3). The rates of rice self-sufficiency for the three largest rice producers in West Africa were 96% for Mali, 80% for Guinea, and 56% for Nigeria during the period 2006 to 2010 (Hollinger and Staatz 2015). Over the same period, nearly all West African countries were self-sufficient in maize, or close to it. In more recent years, maize imports have grown in some countries, such as Ghana and Senegal, as demand for poultry feed has burgeoned (FAOSTAT 2017).

Over the last 20 years, West African agriculture has relied primarily on two types of production systems. The first type includes traditional systems, which range from rainfed to uncontrolled flooding, mainly for rice, sorghum, and maize. The second type relies on hydro-agricultural improvements, such as controlled flooding and full water control, for irrigated crops (African Development Bank 2016). The area sown to rice in West Africa rose from three million hectares (ha) in the 1980s to more than six million ha in 2013. The average yield of irrigated rice in Senegal and Mali is three tons per ha. The average yield per ha for the entire region of West Africa for all rice production systems combined has stagnated at around 1.6 tons. This low average yield is attributable in large part to the limited yields of rainfed rice farming (Boutsen and Aertsen 2013). Meanwhile, the land area sown to maize surged from 2.2 million ha in 1980 to 5.9 million in 2000, then to 11.1 million ha in 2014. Maize production has undergone a spectacular boom from 2.1 million tons in 1980 to 19.5 million tons in 2014 (FAOSTAT 2017).

[2] NERICA, or the New Rice for Africa, is a series of rice lines that resulted when AfricaRice researchers crossed the African species *Oryza glaberriama*, which withstands harsh environments, with the high-yield Asian species *Oryza sativa.* NERICA varieties have made remarkable inroads in upland ecological zones, but have made less of an impact on irrigated and seasonally flooded bottomland ecological zones.

Rainfed rice production is associated with traditional farms that require intensive family labor, especially that of women, and use very little capital. Yields from the traditional methods are low at around 0.5 to 1.5 tons (t)/ha. NERICA varieties have been adopted relatively quickly since 2008, enabling many farmers to boost their production in both upland rice and bottomland (*bas-fonds*) rice systems. The NERICA varieties, which by 2010 had been disseminated to over more than 300,000 ha, have shown that there is tremendous potential for upland rice production (Diagne 2010). These varieties have been particularly beneficial to women, whose rice production is concentrated in upland and bottomland areas. Fertilizers and pesticides are generally not used much in rainfed rice production systems and when they are, the technical guidelines are not closely followed. Rainfed rice is most often produced in combination with other crops (maize, tubers, etc.) and is subject to certain constraints, such as the variability of rainfall, erosion, extensive soil depletion, disease, and pest attacks. The harvests are intended mainly for home consumption, but sometimes a portion is sold on local markets.

Maize farming systems in West Africa are very heterogeneous. In most countries, maize production is rainfed, and the development of irrigated maize is recent. The maize farming areas cover land ranging from the semi-arid Sudano-Sahelian climate to the sub-humid, tropical climates of southern West Africa. Maize is usually very responsive to improvements in its growing conditions (water, fertilizer, sunlight, etc.). Experience in cotton-producing countries (Benin, Burkina Faso, Côte d'Ivoire, Mali, and Chad) has demonstrated that when inputs are used for cotton, they also benefit maize. For example, fertilizer applied to cotton has residual benefits for maize grown in rotation, and animal traction equipment financed through cotton production also benefits maize production. Cotton and maize grown in rotation in the region has brought many agronomic benefits and improved soil fertility (AFD, CIRAD, and FIDA 2011).

To respond to the 2007-2008 increase in food prices, West African governments focused much of their attention on rehabilitating and deploying new agricultural irrigation facilities—especially for rice—and providing subsidies to farmers for fertilizer and improved seed (see Chapter 13). However, the response to the crisis was also driven by farmers, who increased the area planted in dryland systems as well as in seasonally flooded bottomlands and upland areas where rainfed rice is produced. Rainfed rice now accounts for about 40% of the rice-growing farmland in West Africa and employs approximately 70% of rice farmers (Diagne et al. 2010; Grain 2009). Similarly, the area under rainfed maize expanded rapidly. This expansion raises the question of whether the growth in production of these rainfed cereals was driven primarily by subsidies or by more fundamental economic profitability. The analysis in this chapter addresses this question.

11.2. Literature Review and Knowledge Gap

Over the last two decades, profitability and competitiveness analyses in West Africa have focused on local rice production systems (irrigated, seasonally flooded bottomland and rainfed) because of the important role that rice plays in the domestic food basket and because of rice's strategic and economic importance in the policy agenda of decision makers, particularly since the 2007-2008 food crisis. These decision makers have come to understand that local rice may be able to compete with imported rice in terms of production potential, quality, and price. Most of these studies have used the Policy Analysis Matrix (PAM) and Domestic Resource Cost

(DRC) analyses to assess whether the use of domestic resources to produce rice locally is less costly than importing the cereal. As explained in section 11.3 below, the PAM is a tool that systematically compares private (financial) and social (economic) costs of producing and selling a good and measures the income transfers that occur among private actors and society as a whole as a result of the prevailing system of pricing, taxes, and subsidies.[3] DRC analysis uses the same concepts incorporated in the PAM to measure whether it is economically more efficient to produce a good locally or to import it. As explained in Chapter 10, a DRC ratio of less than 1.0 indicates that it is economically more efficient to produce the good domestically in order to supply a specified market than to import it, while a DRC ratio of above 1.0 indicates that the country does not have a comparative advantage in producing the good and would be economically better off importing the good and using its own domestic resources to produce something else.

AfricaRice, a pioneer in the field of PAM and DRC analysis, conducted a general review of issues relating to rice policy in West Africa and maintains a databank of West African rice-growing statistics (AfricaRice 2011). In this review, AfricaRice also examined the efficiency of the rice market and carried out an in-depth study on the competitiveness of the rice sector in select countries like Benin, Côte d'Ivoire, Guinea, Nigeria, and Senegal. The study concluded that the continent's rice production potential exceeds consumption levels and that local rice can be competitive. (See also Chapter 10). The AfricaRice (2011) study showed that although aggregate rice yields in Africa are lower than in Asia, a more precise analysis suggests that rice yields in Africa, when controlled for by ecological zone and season, are at least as high as those in Asia. That study, which looked at irrigated rice production as well as rainfed systems, assumed that most of the major infrastructure supporting the region's irrigated systems was built right after the countries gained their independence and, thus, could be considered a sunk cost. Consequently, AfricaRice did not take these infrastructure costs into account when carrying out its DRC analysis. This assumption explains why the DRC ratios in that study for irrigated rice are almost all less than 1.0 and why AfricaRice concluded that irrigated rice was competitive in most of the countries of West Africa.[4]

In contrast, a study by Stryker and Coulibaly (2011) estimated that when the cost of infrastructure is taken into account, the DRC ratio of local rice in Mali, in both irrigated and rainfed systems, is always greater than or equal to 1.0. This was true for systems with partial water control, such as in the Office du Riz Segou and the Office du Riz Mopti (DRC = 1.44), the small village irrigation projects (PIVs) in Timbuktu (DRC = 1.07), and the seasonally flooded bottomlands of Sikasso (DRC = 1.0). Thus, the question of whether irrigated rice under full water control is competitive with imports depends on whether one is analyzing its expanded production under existing infrastructure or whether it involves the creation of new irrigation

[3] In the following analysis, the terms *financial* or *private* costs, prices, and returns refer to the costs, prices, and returns that accrue to or are faced by private actors in the economy given the prevailing taxes, subsidies, and pricing structures that exist in the economy. For example, financial prices represent the prices that actors, such as farmers, actually face in the market. *Economic* or *social* costs, prices, and returns refer to those same items once all taxes, subsidies, and monopoly charges have been removed. Economic prices and costs thus represent the opportunity costs to society as a whole of undertaking a given activity.

[4] As explained in Chapter 10, the assumption that irrigation infrastructure costs are sunk costs means that AfricaRice's analysis pertains to expanding rice production on the existing irrigation systems, assuming no further investment or infrastructure rehabilitation costs are needed. In contrast, if one assumes that future expansion of irrigated rice production will require investment in new irrigation systems or rehabilitation of older ones, then those costs need to be taken into account in the analysis.

facilities and/or rehabilitated facilities, requiring additional new investments (see Chapter 10 in this volume). Given these results drawing into the question the economic efficiency of irrigated rice production, it seems prudent to examine the competitiveness of rainfed rice production as at least a complement to expanded irrigated production.

Barbier et al. (2011) attempted to provide an overview of the existing technical options across the range of rice production systems in the Sahel (rainfed, flood recession, improved bottomland, uncontrolled and controlled flooding, full water control, with or without pumping, large and small irrigation perimeters) using a typology developed by experts from five Sahel countries. The results show that the effectiveness of these systems varies widely and is constantly changing: large perimeters are seeing new developments with the rise in agribusiness; small private perimeters are expanding rapidly; partial water control irrigation is stagnating or regressing; and bottomland crops are growing at a quick rate, especially in savanna areas, both in the rainy season for flooded rice farming and in the dry season for market gardening (Barbier et al. 2011).

In contrast to rice systems, little attention has been given in the literature to the competitiveness of local production of rainfed cereals such as millet, sorghum, and maize, even though these crops also compete with food imports such as rice, maize, and wheat. A few authors have addressed this topic recently. Stryker and Coulibaly (2011) estimated the economic and financial profitability of a large range of agricultural value chains in Mali (millet, sorghum, maize, rice, beef, milk, poultry, and fish farming). The results show that investing in the intensification of maize and rice production in the Office du Niger is profitable, whereas the intensification of millet and sorghum production in their current state is premature unless better technologies are found for these crops.

Given the mixed results from previous studies, and the substantial work already done on the profitability of irrigated rice under full water control (see Chapter 10), the major knowledge gap addressed by the present research concerns the profitability of rainfed production of the two crops that appear to have the greatest production potential: rice and maize.

11.3. Methods and Data

This analysis is based on the results of studies conducted by Michigan State University (MSU) through the SRAI project and AfricaRice on the profitability and competitiveness of rice and maize. These were analyzed on the basis of data collected by teams from national agricultural research systems (NARS) in several West African countries in 2011 as part of a joint project conducted by AfricaRice and the NARS entitled the "Project to Reinforce the Availability of and Access to Rice-Growing Statistics in Sub-Saharan Africa".[5] The project identified 22 countries in Africa and collected data on crop budgets for different rice and maize production systems (irrigated, seasonally flooded bottomland, and rainfed). The MSU/SRAI project collaborated with the AfricaRice/NARS project in carrying out analyses on six countries in West Africa (Benin, Burkina Faso, Côte d'Ivoire, Guinea, Mali, and Senegal) to assess the

[5] The rice data system for Sub-Saharan Africa is supported by the Japan-AfricaRice Emergency Rice Initiative, which is funded by the government of Japan. The project was coordinated at the regional level by Africa Rice Center (AfricaRice).

profitability and competitiveness of rice and maize production systems.[6] This chapter focuses on the results concerning the profitability and competitiveness of rainfed rice and maize systems in the upland ecological zone (in Benin, Burkina Faso, and Senegal for rice; and in Benin, Burkina Faso, and Côte d'Ivoire for maize). The chapter also reviews the current production context for these crops, taking into account recent developments in West African and international markets.

The policy analysis matrix (PAM) method employed by the NARS drew on data from the different production systems and developed budgets for rice and maize farmers using both financial (private) prices and at economic (social) prices. The financial prices were the prices prevailing in the markets for the outputs and inputs updated to 2011. The economic prices for outputs (rice and maize) were import parity prices calculated at the farm level, taking into account the costs of transport along the supply chain to the port. The economic prices for tradeable inputs (fertilizer, seed, and pesticides) were the international prices for these inputs minus customs duties and adjusted for the costs of storage and transport to the area of use. To determine the economic prices for domestic inputs (land, labor, and capital), these resources were valued at their opportunity costs. Using the economic prices, DRCs were calculated for the rainfed rice and maize production systems.

Table 11.1 summarizes the main steps of the PAM model. For rainfed rice, the research conducted by the NARS focused on three countries in the region—Benin, Burkina Faso, and Côte d'Ivoire—as shown in Table 11.2. For maize, the research also focused on three countries—Benin, Burkina Faso, and Côte d'Ivoire (Table 11.3).

11.4. Results

Characterization of Rainfed Maize and Rice Production Areas

The 2007-2008 surge in world prices resulted in a renewed emphasis throughout West Africa on food self-sufficiency, and all production systems (irrigated, seasonally flooded bottomland, and rainfed) were seen as important means to boosting agricultural production (Barbier et al. 2011).

Table 11.28. Presentation of the Policy Analysis Matrix

	Revenues	Costs of factors		Profit
		Tradeable goods	Non-tradeable goods	
Private	A	B	C	D
Social	E	F	G	H
Divergences	I	J	K	L

Source: Monke and Pearson (1989).
D = A-B-C = Financial profit I = A-E = Output transfers K = C-G = Domestic input ransfers
H = E-F-G = Economic profit J = B-F = Tradeable input transfers L = D-H = Net transfers

[6] Data on all the rice and maize production systems by ecological zone were not available for all countries. Therefore, the results presented here cover only four countries (Benin, Burkina Faso, Côte d'Ivoire, and Senegal).

Table 11.29. Data Sources by Ecological Zone for Rainfed Rice Production

	Data source	Sample size	Ecological zone
Benin	• INSAE	1,255 rice farmers in 244 villages	Rainfed system in the North (Atakora, Borgou, Alibori, Donga) and Center (Collines, Zou)
Burkina	• Ongoing surveys (EPA) by the DPSAA	n.a.	Rainfed system in Center-East (Bagré), Hauts Bassins (Bobo) and Boucle du Mouhoun (Degougou and Sourou)
Senegal	• CSA surveys. SAED and AfricaRice databases in St. Louis.	n.a.	Rainfed system in the Middle Valley of the Senegal River

Source: Adegbola and Akoha (2011); Dieng et al. (2011); Ouédraogo, Ouédraogo, and Yelemou (2011b).

INSAE : I*nstitut National de la Statistique et de l'Analyse Economique* (National Institute of Statistics and Economic Analysis).
EPA: *Enquêtes Permanentes Agricoles* (Continuous agricultural surveys).
DPSAA: *Direction de la Prospective et des Statistiques Agricoles et Alimentaires* (Directorate for Agricultural and Food Statistics and Forecasting).
CSA: *Commissariat à la Sécurité Alimentaire* (Food Security Commission).
SAED: *Société Nationale d'Aménagement et d'Exploitation des Terres du Delta du fleuve Sénégal* (National Authority for Land Reclamation & Development in the Senegal River Basin).
n.a. = not available.

Table 11.30. Data Sources by Ecological Zone for Rainfed Maize Production

	Data source	Sample size	Ecological zone
Benin	• Primary data collected as part of the PAPA project in 2011	Random sample of 182 producers	• North (Borgou, Alibora, Atakora, Donga) • Center (Zou and Collines)
Burkina Faso	• Ongoing surveys (EPA) by the DPSAA	n/a	Southwest region, East region, Center-North region, Cascades and Sahel regions
Côte d'Ivoire	• Secondary data from government agencies • Primary data from lead farmers • CNRA and ONDR survey in 2009 • Further investigations in 2011	n/a	Savanna and forested areas

Source: Adegbola and Aloukoutou (2011); Ouédraogo, Ouédraogo, and M. Kabore. (2011a); Yeo (2011).

PAPA: *Programme d´Analyse des Politiques Alimentaires* (Food Policy Analysis Program) of the *Institut National des Recherches Agricoles du Bénin* (INRAB).
EPA: *Enquêtes Permanentes Agricoles* (Continuous agricultural surveys).
DPSAA: *Direction de la Prospective et des Statistiques Agricoles et Alimentaires* (Directorate for Agricultural and Food Statistics and Forecasting).
CNRA: *Centre national de recherche agricole* (National Agricultural Research Center).

In West Africa and in the Sahel in particular, the rainfed system is a significant contributor to rice and maize production. According to AfricaRice (2011), rainfed rice accounts for about 40% of total rice farmland in West Africa, while more than 80% of maize in the region is rainfed.

Characterizing these systems in their various forms (diversity of practices, costs, and performance) is an important step in any profitability analysis. The rainfed rice and maize production systems and areas are characterized in Table 11.4.

Table 11.31. Characterization of Rainfed Rice and Maize Production in Four Countries

Country	Area	System Characteristics
Benin	• North • Center	• Rice: Rainfed system that employs NERICA, little fertilizer, and manual and animal fieldwork. Yield is about 1.5 t/ha without fertilizer, 3.5 t/ha with fertilizer. • Maize: Rainfed system that employs improved seeds and manual fieldwork. Yield is about 1.5 t/ha.
Burkina Faso	• Southwest region • Center-East region • Center-North region • Cascades region • Hauts-Bassins region	• Rice: Rainfed system that employs improved seed (NERICA), little fertilizer, and manual and animal fieldwork. Yield is about 1.3 t/ha without fertilizer, 3 t/ha with fertilizer. • Maize: Rainfed system that employs improved seed and manual fieldwork. Yield is about 1.5 t/ha.
Côte d'Ivoire	• Forested area • Savanna area	• Rice: Rainfed system that employs improved seed (NERICA), little fertilizer, and manual and animal fieldwork. Accounts for approximately 90% of rice farmland and 80% of rice production. Yield (NERICA) is about 2 t/ha without fertilizer and 3 t/ha with fertilizer. • Maize: Rainfed system that employs improved seed, fertilizer and animal or manual fieldwork. Practiced in all regions. Yield is about 2 to 5 t/ha.
Senegal	• Middle Valley of the Senegal River	• Rice: Rainfed system that employs improved seed (NERICA), little fertilizer, and manual and animal fieldwork. Yield is about 1.5 t/ha without fertilizer and 2.5 t/ha with fertilizer.

Source: Adegbola and Akoha (2011); Adegbola and Aloukoutou (2011); Dieng et al. (2011); Ouédraogo, Ouédraogo, and M. Kabore (2011a); Ouédraogo, Ouédraogo, and C.P. Yelemou (2011b); Yeo (2011).

Profitability and Competitiveness of Rainfed Rice (Farm Level)

As shown in Table 11.5, the production of rainfed rice for local consumption in the three countries is financially and economically profitable in these upland ecological zones, as evidenced by the positive profit figures. The DRC ratios, which are all under 1.0, indicate that production systems, aimed at meeting local farm-level consumption needs, are economically profitable and can survive without government subsidies. Mechanized production using tractors in Burkina Faso appears to be more efficient economically (lower DRC ratio) than production based on manual production or use of animal traction.

The value added measured in financial prices in Benin and Senegal is higher than that measured in economic prices, which indicates that rainfed rice producers are supported and protected at the farm level by the input subsidies that were applied to all production systems, as well as by other government policies. In contrast, in Burkina Faso, the economic value added exceeds the financial value added, indicating that farmers in that country are implicitly taxed by a range of government policies.[7] Given the low levels of the DRC ratios, particularly for north and central

[7]One of those policies is monetary policy. The researchers from the Burkina NARS who conducted the DRC analysis estimated that the CFA franc was overvalued by 10% in Burkina Faso, which had the effect of making imports appear artificially cheap in local currency term.

Benin and the Middle Valley of Senegal, such production is likely to be competitive vis à vis imported rice in the rural markets surrounding the production zones.

Table 11.32. Results of the PAM Analysis, at the Farm Level, for Rainfed Rice in Three Countries (CFAF/kg)

Country	Systems	Value Added per kg in Financial Prices	Value Added per kg in Economic Prices	Net Transfers	DRC
Benin	N7	235	120	115	0.47
	N10	245	132	113	0.41
Burkina Faso	PT	88	104	-16	0.79
	PA	82	101	-19	0.84
	PM	105	125	-20	0.61
Senegal	SMV	106	95	11	0.50

Source: Calculated from data in Adegbola and Akoha (2011); Ouedraogo, Ouédraogo, and C.P. Yelemou (2011b); Dieng et al. (2011).

N7: Improved rainfed system in the North with use of fertilizer–Benin
N10: Improved rainfed system in the North without use of fertilizer–Benin
PT: Rainfed system with manual cultivation
PA: Rainfed system with animal traction
PM: Rainfed system using tractors
SMV: Rainfed system in the Senegal River Middle Valley

In contrast to the figures shown in Table 11.5, Easypol (2009), a project supported by the FAO, estimated that in 2005 the DRC ratio for rainfed rice production in Burkina Faso using animal traction equipment was 1.0, indicating that such production was only borderline efficient. The figures in Table 11.5 showing that the DRC ratio for this system had fallen to 0.84 by 2011 suggest that the higher prices that have occurred both globally and in West Africa since 2007-2008 have made rainfed rice production more economically competitive, at least in Burkina Faso.

Profitability and Competitiveness of Rainfed Maize (Farm Level)

In Benin, the maize production systems are classified into areas (North, Central, and South) located in Ouémé/Plateau, Borgou, Atlantique, Couffo, Zou, and Donga Departments, which together make up over 85% of national production. Depending on the system, farmers may use improved maize varieties, local yellow or local white cultivars; work the soil with tractors, animal traction equipment or hand hoes; and may or may not use fertilizer and pesticides. The specific systems for which our analysis applies are described in Table 11.6. Yields have improved markedly, from 600 kg/ha on average in 1970 to 1.4 t/ha in 2009. The national production volume reached 1,346,000 tons in 2013 (FAOSTAT 2017).

In Côte d'Ivoire, maize is cultivated in three main regions that combine to yield 68% of the country's total maize production: Savanes (50% of output), Haut Sassandra (9%), and Denguélé (9%). From 2000 to 2009, the average volume produced was 604,031 tons from an average land area of 291,852 ha, for a yield of about 2.3 t/ha (Yeo 2011). In these areas, manual maize farming is still far more widespread than use of animal traction. The latter, however, has been a marked success in northern Côte d'Ivoire, especially in the large cotton-growing basins. There are also two versions of motorized farming. The first form is intermediate motorization, which includes rotary tillers and small, low-power tractors (Yeo 2011). The other version is considered conventional and involves medium- to high-power tractors.

Table 11.33. Results of the PAM Analysis, at the Farm Level, for Rainfed Maize in Three Countries (CFAF/kg)

Country	Systems	Value Added per kg in Financial Prices	Value Added per kg in Economic Prices	Net transfers	DRC
Benin	N1	153	-229	382	3.00
	N2	130	-153	283	2.27
	C1	162	101	61	0.44
Burkina Faso	PT	93	105	-12	0.50
	PA	89	100	-11	0.50
	PM	81	92	-11	0.67
Côte d'Ivoire	ZF	56.6	67.9	-11.3	0.65
	ZS	50.6	62.6	-11.9	0.59

Source: Adegbola and Aloukoutou (2011); Ouédraogo, Ouédraogo, and M. Kabore (2011a); Yeo (2011).

N1: System used in North with improved varieties, fertilizer and animal traction tilling–Benin
N2: System used in North with local varieties, fertilizer and tractor tilling–Benin
C1: System used in Center with local varieties, no fertilizer and animal traction tilling–Benin
PT: Rainfed system with manual cultivation
PA: Rainfed system with animal traction
PM: Rainfed system using tractors
ZF: Forested area system with improved varieties and animal traction tilling in Côte d'Ivoire
ZS: Savanna system in Côte d'Ivoire with local varieties and animal traction tilling in Côte d'Ivoire
* In Burkina Faso, financial and economic profits are expressed in million CFAF per year for the entire rainfed maize sector.

In Burkina Faso, most maize is grown under rainfed systems, but irrigated maize production has recently emerged. Its share of total production, however, remains very small, and hence the profitability of the irrigated system is not analyzed here. The primary areas with high production in the rainy season are: (i) the Southwest, where the share of rainfed maize production in regional production is 93.3%; (ii) East (91.7%); Center-North (89.2%); and Cascades (89.2%) (Ouédraogo, Ouédraogo, and M. Kabore 2011a). There are three subsystems within the rainfed production systems: traditional rainfed, rainfed with animal traction, and motorized rainfed.

Maize yields from rainfed systems are fairly uniform in Burkina Faso, ranging from 1.1 t/ha to 1.5 t/ha. The yields are tripled in the irrigated system (Kaminski, Elbehri, and Zoma 2013).

Table 11.6 indicates that in Côte d'Ivoire rainfed maize production at the farm level is financially and economically profitable and competitive for local demand compared to imported maize, which comes mainly from Argentina. Financial value added is less than economic value added for farmers in the savanna and forested areas, indicating that these farmers are implicitly taxed by a combination of government policies.

In Burkina Faso, Table 11.6 indicates that rainfed maize is financially and economically profitable and competitive for domestic demand compared to imported maize for all three systems analyzed. In contrast to rainfed rice production, mechanized production of maize using tractors appears to be less economically efficient (higher DRC ratio) than production using animal traction and manual cultivation. In all three systems analyzed, however, value added measured in economic prices exceeds that measured in financial prices, indicating (as was the case for rainfed rice in the country) that farmers are implicitly taxed by a combination of government policies.

In Benin, the results of the analysis are more mixed. They show that the financial value added in maize growing at the farm level is positive in all three systems analyzed, but that production is not economically profitable in the two systems analyzed from the northern part of the country. The positive net transfers in both the north and the center of the country show that the government's policy measures (input subsidies) have benefited maize farmers and the magnitude of the figures suggest that these transfers are the main reason that maize production persists in the north. The DRC ratios (less than 1 in the Center but greater than 1 in the North) convey the same story: rainfed maize farming is competitive with imports for local consumption in the Center of the country, but not the North.

In summary, the figures in Table 11.6 show that with the relatively high maize prices that prevailed in 2011, rainfed maize farming was financially profitable in all the systems analyzed in the three countries. However, it was not economically profitable in the two systems analyzed for northern Benin. The competitiveness of maize in these northern Benin systems could be compromised by factors relating to agro-ecology and the adoption and use of inputs. The very low level of intensification in these systems affects productivity, as does the inefficient use of tradeable inputs, whose prices also soared in the period following 2007.

11.5. Conclusions and Policy Implications

While the rise in cereals prices that began in 2007-2008 has had a negative impact on consumers by lowering their purchasing power, it has provided positive incentives for rainfed rice and maize producers in the region. When measured at the farm level, the DRC ratios show that in 2011 the production of rainfed rice and maize was economically competitive for local consumption in the four countries studied with the exception of the ecological zones in northern Benin. Thanks to government subsidies, production was financially profitable in the systems analyzed, even though it was not economically profitable in northern Benin. Overall, a combination of government policies increased the profits of rainfed rice and maize farmers in all these systems except in Côte d'Ivoire for maize and in Burkina Faso for both rice and maize, where policies resulted in implicit net taxation of farmers.

It thus appears, at least for the systems analyzed here, that under the higher prices prevailing in the region in 2011, rainfed production of rice and maize holds promise of being an important component of West African countries' food strategies. The net government support provided to farmers, as documented by the MAP analysis, may have been important in inducing adoption of new technologies, particularly the NERICA rice varieties. These varieties for the upland ecological zone have made it possible to boost the production of rainfed rice significantly and improve food consumption for rural populations. They are currently being disseminated on a large scale and should be given special consideration because of the opportunities they afford to increase production and decrease the region's rice dependency. More research is also needed on seed varieties suited to seasonally flooded bottomlands, considering the potential of bottomland ecological zones in the region. In addition, demand for maize in West Africa, for both human consumption and use in animal feed, is growing sharply. This burgeoning demand, combined with the strong economic and financial profitability of production in the rainfed systems analyzed here, suggests that continued promotion of this crop in areas that are ecologically suited to its production is strongly warranted.

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