Part II: Changing Food Consumption Patterns: Implications for Policy

West Africans are diversifying their diets rapidly. They want more convenient foods and a broader range of products, including more perishables. Food policies need to adapt to reflect these changes.

CHAPTER 4

Changing Patterns of Food Consumption in West Africa: Food Balance Sheet Analysis

Évolution des tendances de consommation alimentaire en Afrique de l'Ouest : Analyse du bilan alimentaire

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Abstract

Food balance sheets calculate the average per capita availability for human consumption of various foods in a country and the resulting per capita availability of different nutrients. Analysis of annual food-balance-sheet data for each of the 15 Economic Community of West African States (ECOWAS) countries over a 30-year period reveals striking changes in per capita food availability between 1980 and 2009. Per capita calorie and protein availability increased in all but two countries—Liberia and Côte d'Ivoire, which both suffered civil conflicts during the period—with the increases particularly striking in Ghana, Nigeria and the landlocked Sahelian countries. The data indicate that average diets also diversified strongly over the period, both among the range of starchy staples consumed and with respect to per capita availabilities of fruits, vegetables, animal-based products and pulses. Red meats, milk and pulses are the main sources of animal protein in the landlocked Sahelian countries, while fish remains the dominant source in the coastal countries. In recent years, however, poultry supplies, much of it from imports, have also increased sharply along the coast. The improvements in diet quality were most striking in the countries that experienced the most robust economic growth, such as Ghana and Cape Verde. Despite these changes, the proportion of total calories in the diets derived from carbohydrates is still high relative to the World Health Organization's recommended dietary standards, while the proportion of calories derived from proteins remains close to the lower bound.

Résumé

Les bilans alimentaires calculent la disponibilité moyenne par habitant de divers aliments destinés à la consommation humaine dans un pays et la disponibilité par habitant de divers nutriments. L'analyse des données du bilan alimentaire annuel de chacun des 15 pays de la CEDEAO sur une période de 30 ans révèle des modifications frappantes de la disponibilité de nourriture par habitant entre 1980 et 2009. La disponibilité des calories et des protéines par habitant s'est accrue dans tous les pays sauf deux—le Liberia et la Côte d'Ivoire qui ont tous deux connu des conflits civils pendant cette période—les augmentations ont été

particulièrement remarquables au Ghana, au Nigeria et dans les pays enclavés du Sahel. Les données indiquent que les régimes alimentaires moyens se sont aussi beaucoup diversifiés pendant cette période, à la fois par rapport à la gamme des féculents consommés et à la disponibilité par habitant de fruits, de légumes, de produits animaux et de légumineuses. La viande rouge, le lait et les légumineuses constituent la principale source de protéines dans les pays enclavés du Sahel, tandis que le poisson reste la source dominante de protéine dans les pays côtiers. Toutefois, ces dernières années, les approvisionnements de poulet (pour la plupart importé) ont aussi beaucoup augmenté le long de la côte. La qualité accrue du régime alimentaire a été remarquable dans les pays qui ont connu un essor économique plus fort, tels que le Ghana et le Cap Vert. En dépit de cette évolution, la proportion de calories dérivées des glucides est encore relativement élevée comparé aux normes diététiques recommandées par l'Organisation mondiale de la santé, tandis que la proportion de calories dérivées des protéines reste proche de la limite inférieure.

4.1. Introduction

Changes in food consumption patterns have important implications for food security. They can indicate, for example, whether a country's food production is diverging, in composition and quantity, from what consumers are demanding. As a result, policies to deal with issues of food security require knowledge about these consumption changes and the factors influencing them. Changing food consumption patterns also have implications for agricultural market development, for example, what sorts of marketing infrastructure will be needed in the future. Given West Africa's rapid urbanization and its growing urban middle class, understanding how these consumption patterns have changed will help identify opportunities and challenges for the development of agricultural value chains to meet the growing effective demand.

Rapid changes in the social and economic environment in West Africa (WA) are resulting in shifts in food consumption patterns.[1] These changes include growing total and urban population, increases in per capita incomes, demographic transition towards smaller family sizes in a few countries, migration within the zone towards the coastal states, and the adoption of more western lifestyles (Lopriore and Muehlhof 2003; Hollinger and Staatz 2015). During the period 1980-2010, the population of most ECOWAS nations grew rapidly. The regional average annual population growth rate was about 3%, with an overwhelming importance of the coastal countries (Nigeria alone accounting for three-fifths of the region's total population). The size of the consumer population obviously has an effect on aggregate food demand.

Not only is the population of WA growing rapidly, but it is also becoming more urban. The urban population is projected to continue to grow at a rate of 3.8% per year between 2015 and 2030 (UNDESA 2014). West Africa is the most urbanized part of Sub-Saharan Africa. Figures for 2005-2010 reveal urban population shares of over 40% for nine out of the 15 ECOWAS countries, and 3 of the 9 countries had a share above 50%. Urban population shares are generally higher in the coastal countries than in the inland countries. In the future, it is likely that the WA population will be more concentrated along the coast due to substantial out-

[1] In this chapter, West Africa refers to the 15 member countries of the Economic Community of West African States (ECOWAS), categorized into three groups: i) the Inland Sahel – Mali, Burkina Faso and Niger; ii) the Coastal Sahel – Cape Verde, Gambia, Guinea Bissau, Senegal; and iii) the Coastal Non-Sahel – Benin, Côte d'Ivoire, Ghana, Guinea, Liberia, Nigeria, Sierra Leone, and Togo.

migration from the inland countries of the Sudano-Sahelian belt (e.g., Burkina Faso and Mali) to the coastal countries (UNEP 2002).

Real per capita gross domestic product (GDP), an indicator of purchasing power, also grew sharply over the period 1980-2010. Increases in average annual real per capita GDP growth rates were particularly large in the 2000s. With the exception of a few countries (Côte d'Ivoire, Guinea Bissau, Liberia, Guinea and Togo), per capita GDP has been growing since 2000, and the growth rates have been largest for Cape Verde, Ghana, Nigeria, Burkina Faso, Mali and Sierra Leone. Figure 4.1 shows trends in the total population growth rate, urban population shares and growth of per capita incomes in selected ECOWAS nations for the period 1980-2010.

Rapid urbanization, when accompanied by growth in per capita incomes, has important consequences for how consumption patterns evolve. Regmi and Dyck (2001) note that the specific effects of urbanization on consumption differ depending on the economic conditions—when accompanied by increases in per capita income, urbanization may result in an overall increase in per capita consumption, improvement in diet quality (such as an increase in animal protein consumption), and increases in the demand for processed or easy-to-prepare food. In West Africa, Diagana et al. (1999) observed growth in the demand for easy-to-prepare foods such as rice and bread (wheat), starting in the 1970s, which they argued was favored by the rising demand for convenience in urban areas.

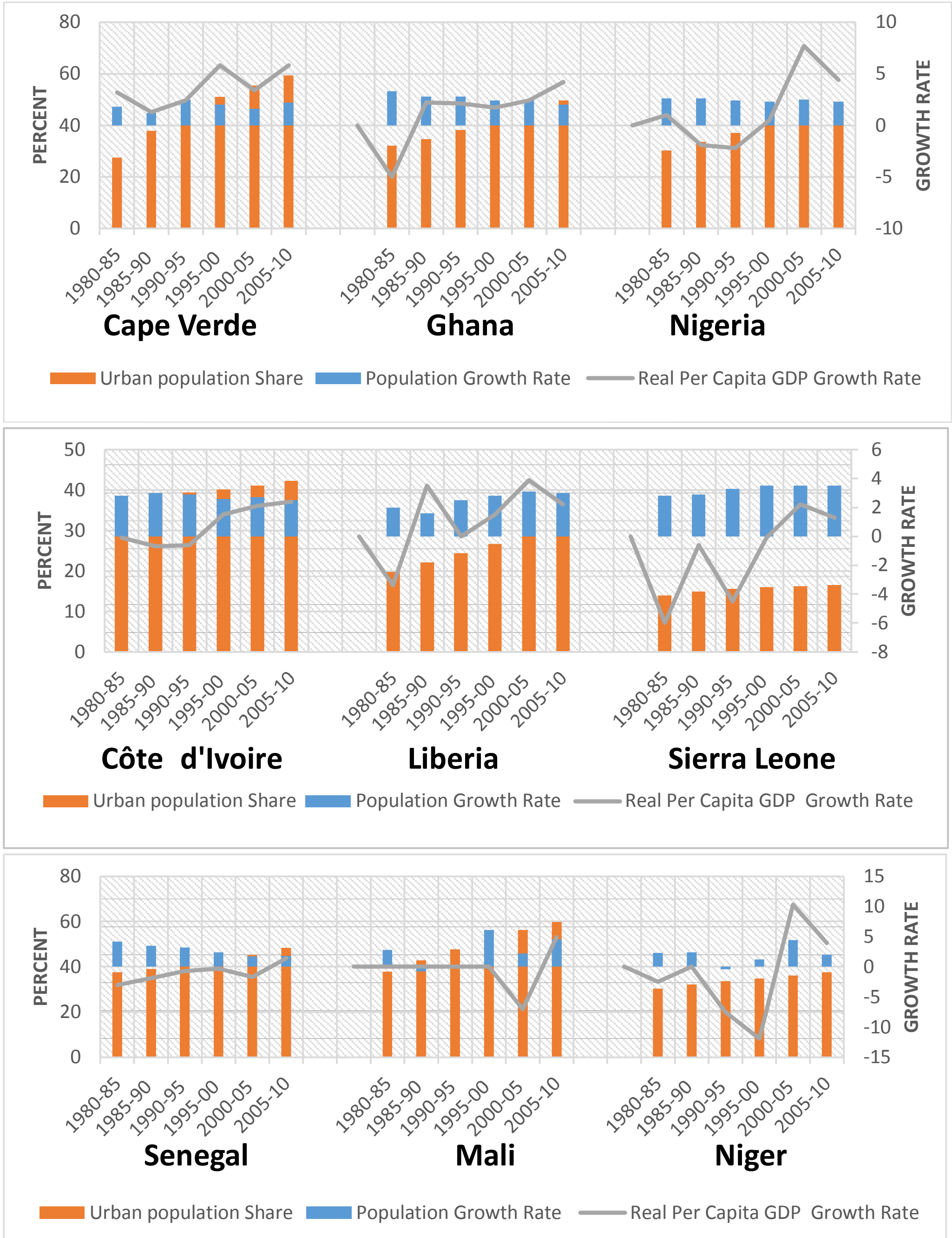
In addition to the structural changes that are influencing food consumption patterns in the region, West Africa has also experienced a series of policy shifts that have constituted major changes in the conditions that determine demand. Examples include the Structural Adjustment Programs of the 1990s, the 1994 CFA franc devaluation, and the 2008 global spike in food prices, all of which led to changes in relative prices, which in turn induced consumers to modify their diets.

The remainder of this chapter explores these issues, based on analysis of food-balance-sheet (FBS) data for each of the 15 ECOWAS countries over the period 1980-2009.

4.2. Literature Review and Knowledge Gap

Previous analyses of aggregate-level trends in food consumption in West Africa have been narrow, often focusing on specific commodities or commodity groups or on a specific country. Most previous analyses are also more than a decade old. Very few have examined aggregate-level trends in food availability with a focus on what is happening in each country, across food commodity groups, and in the context of specific sub-regions in West Africa. Lopriore and Muehlhoff (2003), for example, analyzed trends in dietary energy supply and in diet quality and diversity for the region of WA using national-level data from the Food and Agriculture Organization of the United Nation's (FAO's) FBS. Their analysis, however, extends only to 2001. Me-Nsope and Staatz (2013) and Me-Nsope (2014) expand and update evidence of aggregate-level trends in food availability for the region by providing a more comprehensive picture of the trends in per capita food availability in WA.

Figure 4.1. Population Growth Rates, Urban Population Shares, and Real Per Capita GDP Growth Rates for Selected ECOWAS Countries, 1980-2010



Sources: Population growth rates up to 2005 were calculated from Food and Agriculture Organization's (FAO) Population Statistics, while the growth rates for 2005-2010 were taken from the United Nation's population statistics. Urban population shares were compiled using World Bank, 2013 data. Average annual real per capita GDP growth rates were computed using per capita GDP (constant prices), in national currencies, from the International Monetary Fund, World Economic Outlook Database, April 2008.

Specifically, these latter two studies use national official statistics (as reported through FAO's FBS) to analyze aggregate (national) trends in per capita food availability over the period 1980-2009 for each of the 15 ECOWAS countries, in the context of the social, economic and political changes that have occurred in the region. The studies analyzed aggregate food availability data to identify the commodities that make major contributions to the national food supply as well as new food groups emerging as important contributors to the diet.

More specifically, these studies use aggregate-level food supply data to examine the following questions: i) Have rising per capita incomes in the region been accompanied by increases in the level of per capita calorie availability in the past 30 years? ii) Has the composition of the food supply diversified, with new food groups (e.g., roots and tubers in the inland Sahelian West African countries and maize in the landlocked countries) emerging as important contributors to the daily caloric supply? iii) Has the contribution of animal protein to total daily protein supply increased over time as per capita incomes have increased? and iv) Has the per capita food supply become more balanced in terms of its macronutrient composition?

In this chapter, we summarize the results of Me-Nsope and Staatz (2013) and Me-Nsope (2014) to highlight important regional trends in per capita food availability, as well as show what is happening in the big movers in the region, such as Nigeria, Ghana, and Côte d'Ivoire, which account for a large proportion of the region's population and GDP. These findings can help inform policy dialogue at the regional and national levels on key policy issues concerning the evolution of agrifood systems.[2]

4.3. Methods and Data

National-level official food availability data for the period 1980-2009 for each country in the region obtained from FAO's Statistical Database **(**FAOSTAT) food balance sheets (FBS) serve as the basis for the following analysis. The FBS calculate the domestic food supply as equal to domestic production plus imports, minus imports, plus stocks. Not all domestic supply is available as food for human consumption due to other uses**—**feed, seeds, processing and other modes of utilization. The FBS therefore deducts these quantities from the total food supply and converts the remaining supply (dubbed *supply for food use*) into estimated per capita availability by dividing it by the country's estimated population. The FBS then expresses the physical amounts of food available per person in terms of per capita availability of calories, protein, and fat, based on a food composition table.

Farnsworth (1961) was among the first to question the reliability of the FBS as a source of national food supply estimates. She noted the statistical shortcomings in the construction of food balances and argued that the FBS figures on per capita availability depend on the accuracy of the production, stocks, and population figures (major elements of the food balance equation), all of which are subject to varying degrees of error across countries. According to Farnsworth, these inaccuracies in food production estimates may stem from difficulties and the heavy costs of obtaining data on minor crops, minor producing areas, and/or home gardens; and incomplete coverage of the production of certain crops and livestock. Farnsworth further observed that

[2] For example, the findings summarized here were a major input into a 2015 FAO-African Development Bank-ECOWAS study on agricultural development challenges and opportunities in West Africa (Hollinger and Staatz (2015)).

stocks data are either nonexistent or limited to government holdings of a few export products, while population estimates frequently have a margin of error of 10%, sometimes much more. She noted further that agricultural production appears to be more frequently underestimated rather than overestimated in official statistics, and the underestimation could be from incomplete coverage of crop areas or crops—a characteristic of the agricultural statistics of practically all countries.

Although agricultural statistical systems around the world have improved substantially in the 55 years since Farnsworth wrote her seminal article, many of her caveats still are valid, particularly when comparing FBS data over a long period of time. For example, the recording of production data for non-cereal crops such as cassava, fruits, and vegetables has improved over the past half-century, so one needs to be cautious regarding apparent diet diversification over time as revealed by the FBS. The figures may just reflect an improvement in the ability of national agricultural statistics to capture previously under-recorded production rather than a real diversification of the diet.

On the consumption side, FBS data provide information the average quantity of food per person reaching the consumer in a given country. The figures do not represent the amount of food actually consumed, and if interpreted as actual food intake, they will almost invariably result in an overestimation in food consumption compared with results from dietary surveys at the individual level (Serra-Majem et al. 2003). Furthermore, national average food availability figures reported in FBS represent a composite of what may be distinctly different types of diets consumed by various subgroups of the total population.

Even with these limitations, however, Farnsworth acknowledged that the FBS figures do not obscure the broad pattern of total food supplies in a country—the estimates indicate important calorie contributors to the diet. Petrovici, Ritson, and Ness (2005) argue that the FBS data represent a valuable database for the aim of classifying countries according to the structure of their nutrient intake. Similarly, Timmer, Falcon, and Pearson (1983) argue that the analysis of FBS data is still the starting point for most food policy analysis at the country level.

FAO compiles food balance sheets annually for most countries around the world, including all 15 ECOWAS member states, and makes them available on the FAOSTAT website.[3] The analysis described in this chapter used data from FBS for each of the ECOWAS countries for every year over the 30-year period from 1980 through 2009 (a total of 450 FBS).[4] The analysis calculates trends in apparent food consumption patterns for each country.[5] The FBS show per capita quantities of food available for human consumption for almost all food commodities and all countries. They also show data on per capita food energy availability, as well as the availability of individual macronutrient groups (proteins and fats) in grams per capita/day. The analysis also classifies macronutrient availability by source (animal and plant). The analysis of protein availability by source provides some insight into diet quality. The analysis of fat availability also helps to understand important changes in the diets, as most West African diets, at least in the Sahelian countries, have historically been deficient in essential fatty acids. Using

[3] http://faostat3.fao.org/download/FB/FBS/E

[4] 15 countries x 30 FBS per country = 450 FBS.

[5] In this chapter, the term apparent per capita consumption is used synonymously with the per capita food or nutrient availability at the retail level as measured by the FBS.

information on per capita availability of individual macronutrients, the analysis calculates the energy contribution of proteins, fats, and carbohydrates.

In order to focus on longer-term trends rather than year-to-year fluctuations, the analysis calculates three-year averages for each key variable. The country results are grouped below by three sub-zones of West Africa, as diet composition and trends vary significantly across these groupings: Coastal Sahel, Inland Sahel, and Coastal Non-Sahel. Section 4.4 presents four major categories of results: 1) evolution of daily calorie supply per person; 2) diet diversification, which includes changes over time in the composition of food by major food group, as well as by major starchy staple types; 3) diet quality, which includes analysis of the contribution of proteins to daily food supply, a breakdown of protein supply by source (vegetal, animal, and pulses), and a breakdown of animal protein by source; and 4) trends in the share of macronutrients (carbohydrates, proteins, and fats) in daily food supply per capita.

4.4. Results

Evolution in Daily Calorie Availability per Person

The data reveal growing daily calorie supply (DCS) per capita over the period 1980-2009 for most ECOWAS countries. For many of these countries, the rate of growth in DCS per capita appears to have been strongly associated with the rate of economic growth and political stability. For example, countries experiencing rapid economic growth (e.g., Ghana and Cape Verde) have shown a pronounced and consistent growth in DCS per capita, while countries that have suffered civil strife (Côte d'Ivoire, Liberia, and Sierra Leone) showed disruptions in that growth (Figures 4.2A, 4.2B, and 4.2C). As a national average, DCS is an imperfect indicator of the state of individual food security. However, empirical evidence suggests a strong correlation between DCS per capita and more individual-based indicators of food security. For example, Smith and Haddad (2000) show that national caloric availability was responsible for more than a quarter of the reductions in child malnutrition in developing countries over the period 1970-95. Thus, the observed trend in DCS per capita in this study strongly suggests that there have been improvements in West Africa's state of food security over the last three decades.

Diet Diversification

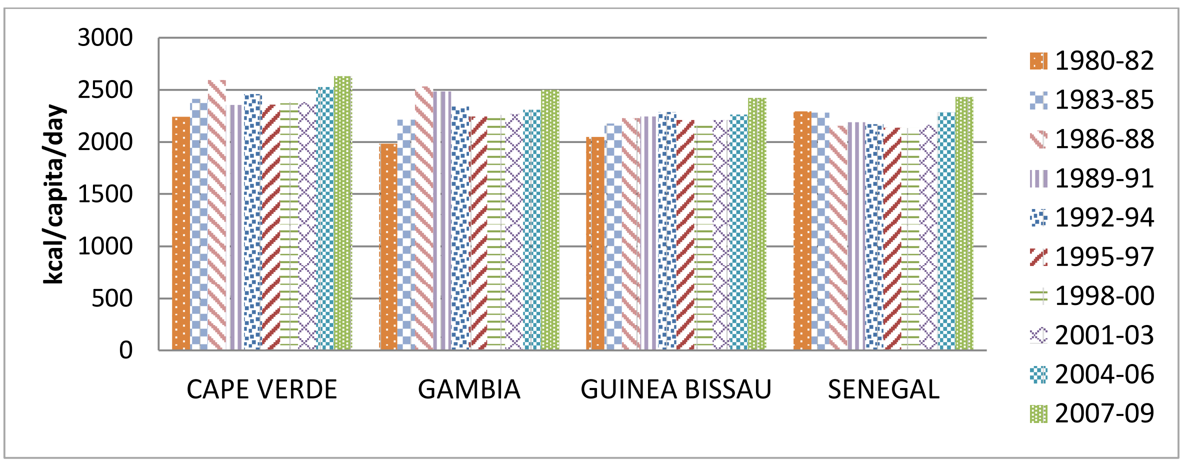
Trend in Availability by Major Food Group: The FBS data point to a diversification in the composition of the food supply over the period 1980-2009 (Table 4.1). The relative importance of starchy roots and tubers (R&T) in total food availability, particularly in the Sahel region, has grown over time.

Historically, cereals have represented a large share of total household consumption in the Sahel. While cereals continue to remain the dominant starchy staples in the Sahel, the analysis shows an increase in the supply of starchy R&T, particularly in Mali, Senegal, and Cape Verde. In Mali, for example, R&T availability increased from 4 kg/capita/year in 1980-82 to 32 kg/capita/year in 2007-09 period. The specific composition of this trend is discussed below.

The FBS data also indicate that most countries in the region have experienced important increases in per capita supplies of fruits and vegetables (F&V). In the Inland Sahel, fruit and vegetable supplies per capita grew the most for Niger, with absolute increases of 30 kg/year for fruit and 8 kg/year for vegetables. In the Coastal Non-Sahel, Ghana experienced the largest growth in per capita availability of F&V, with an absolute increase of 14 kg/year for vegetables and 79 kg/year for fruit over the period 1980-2009. Nigeria, by far the largest country in the region, experienced an absolute increase in vegetable supply per capita of 21 kg/year in the study period. In the Coastal Sahel, absolute increases in fruit and vegetable supplies per capita in the study period were 43 kg/year and 56 kg/year, respectively, in Cape Verde; and 5 kg/year and 47 kg/year, respectively, in Senegal. While some of this apparent growth in per capita F&V supplies may reflect improvement in statistical coverage of these crops over time, the changes are so large (and consistent with data from budget-consumption studies discussed in Hollinger and Staatz 2015) as to suggest an important diversification in West African diets over the 30-year period.

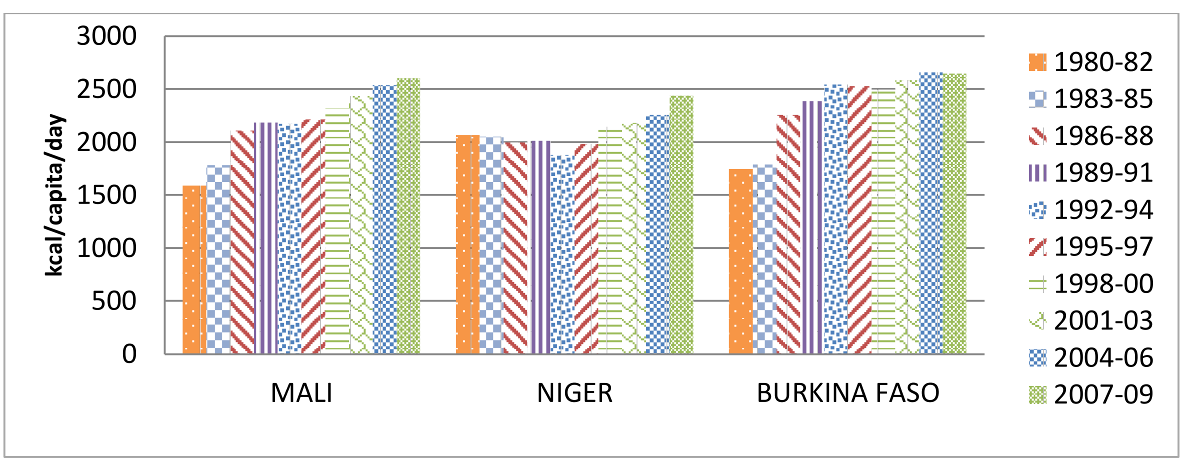
Changing Mix of Starchy Staples: Me-Nsope and Staatz (2013) and Me-Nsope (2014) further examined the contribution of individual starchy staple types to the diet (Figure 4.3). Data show increases in per capita rice availability for most countries over the period 1980-2009.

Figure 4.2A. Trends in Daily Calorie Supply per Capita, 1980-2009, in Coastal Sahel



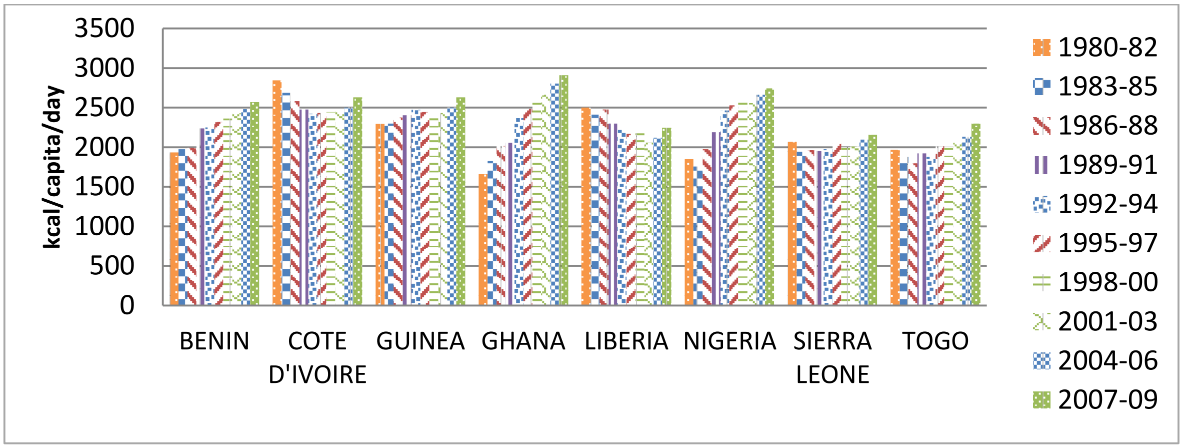
Source: Me-Nsope and Staatz (2013).

Figure 4.2B. Trends in Daily Calorie Supply per Capita, 1980-2009, in Inland Sahel



Source: Me-Nsope and Staatz (2013).

Figure 4.2C. Trends in Daily Calorie Supply per Capita, 1980-2009, in Coastal Non-Sahel



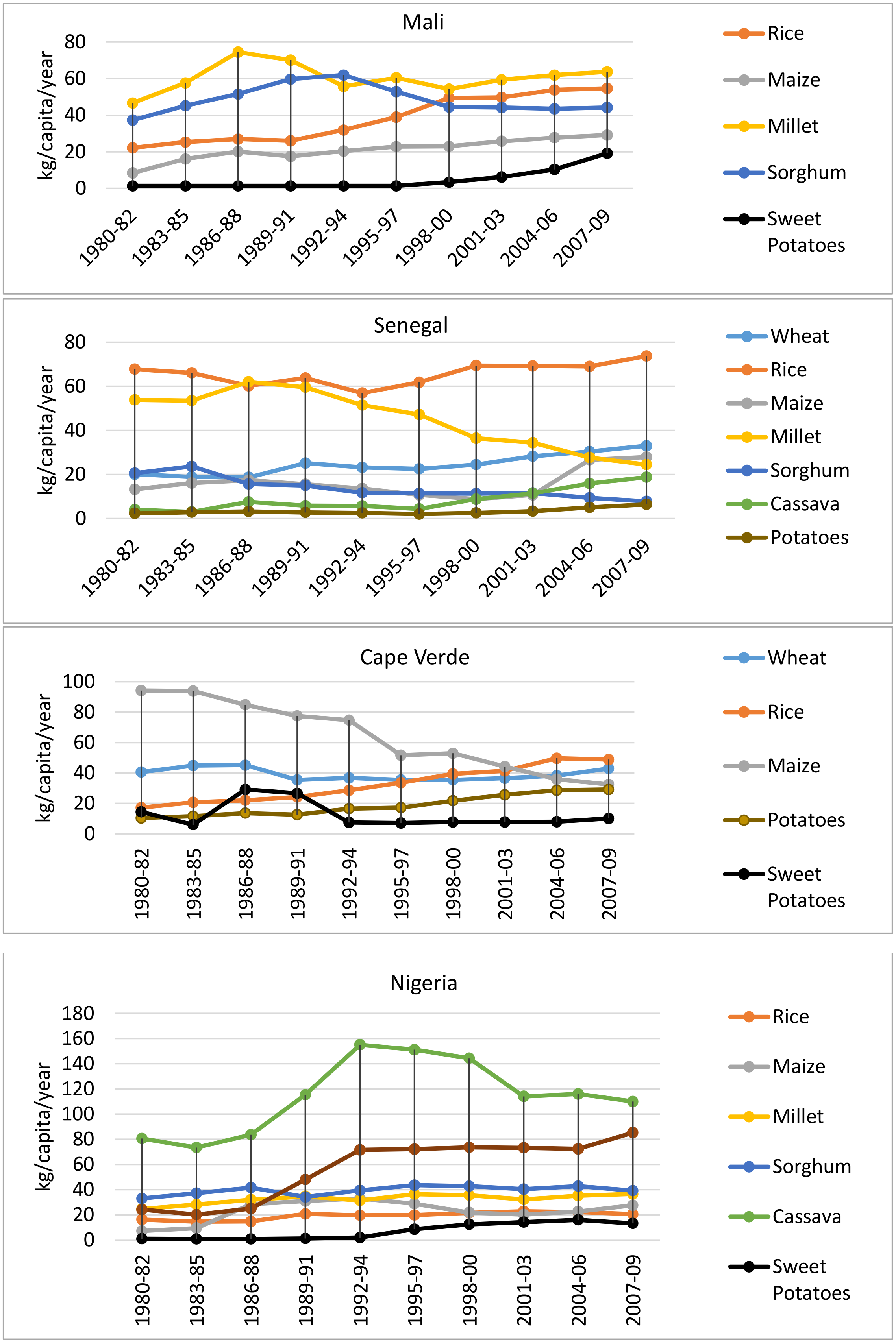
Source: Me-Nsope and Staatz (2013).

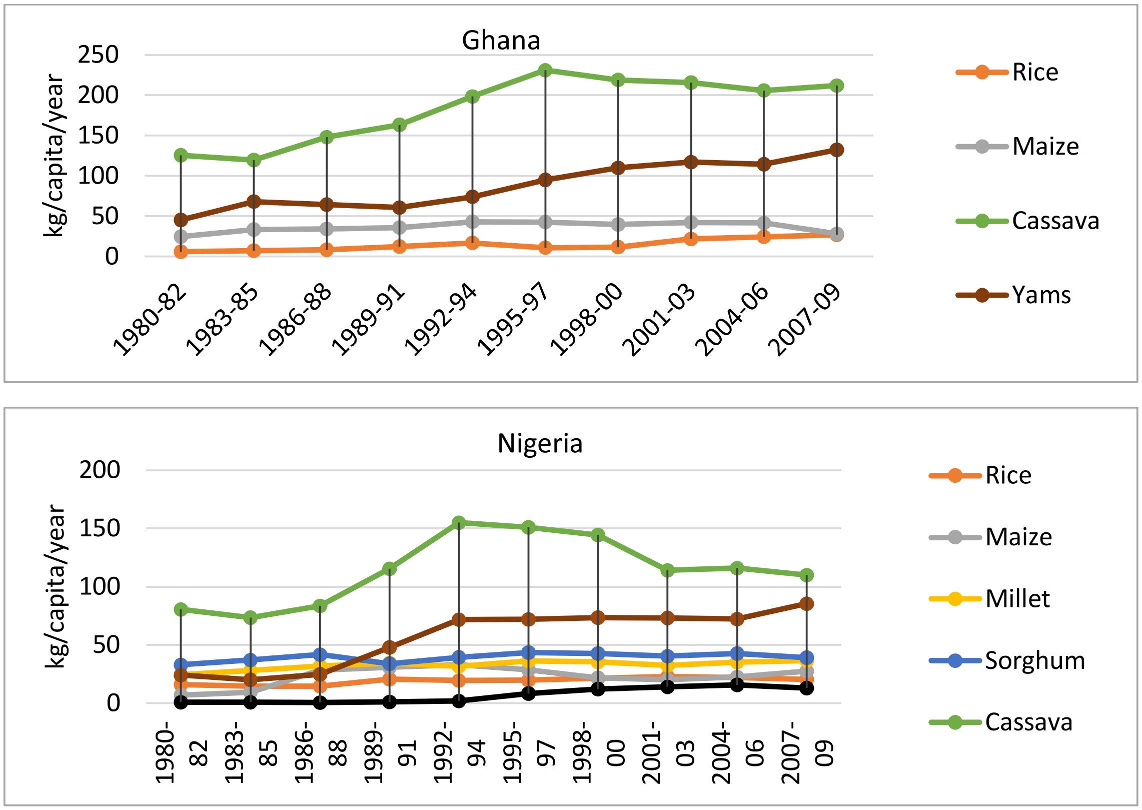
Table 4.4. Percentage Change in Food Availability by Major Food Group in the Period 1980-85 Compared to 2004-09, Selected Countries

Food Group	Inland Sahel		Coastal Sahel		Coastal Non-Sahel		
	Niger	Mali	Cape Verde	Senegal	Ghana	Nigeria	Côte d'Ivoire
Cereals Excl. Beer	3%	44%	-20%	-8%	57%	43%	-15%
Starchy R&T	-57%	729%	69%	247%	72%	117%	-2%
Sugar and Sweeteners	18%	213%	66%	-7%	425%	5%	-5%
Pulses	44%	113%	-27%	-39%	-33%	138%	-11%
Vegetable Oils	50%	45%	-56%	30%	55%	78%	15%
Fruits - Excl. Wine	93%	71%	21%	29%	72%	50%	-24%
Vegetables	170%	4%	106%	264%	79%	-2%	-9%
Meat and offal	12%	23%	777%	23%	22%	55%	-26%
Eggs	-100%	-100%	332%	100%	100%	-12%	0%
Fish and Seafood	218%	13%	300%	-24%	129%	34%	-62%
Milk Excl. Butter	-1%	0%	69%	16%	36%	-34%	-21%
Alcoholic Beverages	-67%	9%	-59%	-22%	26%	-10%	7%

Source: Me-Nsope and Staatz (2013). These figures were computed by comparing actual availability in kg/capita/year between the two periods and expressing the difference as a percentage of the base level. See Me-Nsope and Staatz (2013) and Me-Nsope (2014) for absolute quantities available (kg/cap/day).

Figure 4.3. Trends in Starchy Staples Availability, 1980-2009. Selected Countries





Source: Me-Nsope and Staatz (2013).

In Cape Verde, for example, there has been a replacement of maize with rice as the dominant type of cereal. Annual rice supply per capita increased by 60 kg over the period 1980-85 to 2004-09. In spite of the increase in rice availability, however, in key coastal countries (Nigeria, Ghana, and Sierra Leone), starchy R&T remain dominant. The increase in the availability of starchy R&T since the early 1980s has been due in part to the cassava revolution (Nweke, Spencer, and Lynam 2002). The growth in per capita availability of cassava (e.g., Senegal) and sweet potatoes (e.g., Mali) most likely reflects the lower-income population shifting towards cheaper calorie sources. Yam availability per capita also showed huge increases in some Coastal Non-Sahelian countries (e.g., Ghana and Nigeria) during the study period, although part of this increase may be due to better reporting over time on R&T production. Data also reveal positive growth in the supply of Irish potatoes in some countries (e.g., Cape Verde and Senegal). This growth likely reflects a westernization of diets among some segments of the population (increased consumption of potato chips/French fries). The FBS data also indicate a striking growth in per capita availability of maize in the Sahel (Burkina Faso, Mali, and Senegal).

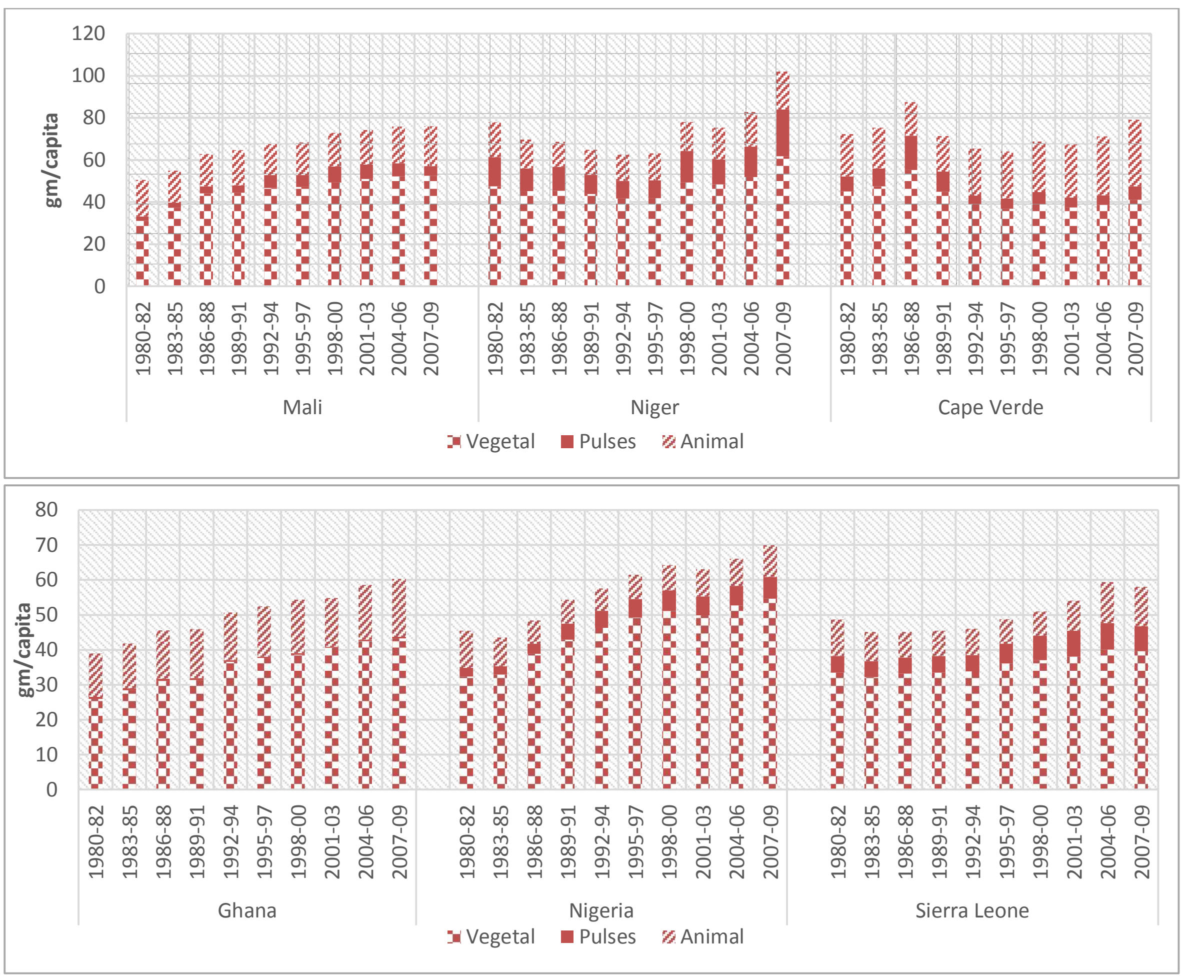
Although food availability is only one dimension of food security, rising starchy staple availability has likely had a positive impact for food security in the region. Overall, the data from the FBS reveal that shifts in apparent consumption among starchy staples in WA have been much more diverse than simply rice and wheat substituting for traditional staples, as policy debates would often lead one to believe. The *rice and wheat* story is really a rice, wheat, cassava, yams, and maize story, with important variations among countries.

Trend in Dietary Quality

The quality of a diet is measured by its nutrient composition. Me-Nsope and Staatz (2013) and Me-Nsope (2014) analyzed the macronutrient (fat and protein) composition of the diet to determine if there had been any improvements in the quality of the diet during the study period. They found that in addition to the increases in F&V availability discussed above, total daily fat and protein supplies per capita have been increasing for most countries since the early 2000s.

Figure 4.4 shows a breakdown of protein supply per capita, by source (animal, pulses, and other vegetal/plant), for selected countries in West Africa. Protein quality is measured by the balance of essential amino acids within the protein. Proteins from animal sources often have a better balance of these essential amino acids than do proteins from plant sources. There are, however, several exceptions to this generalization. Grain legumes, for instance, not only contain at least three times as much protein per gram as maize (the most commonly consumed staple in Sub-Saharan Africa), but unlike maize, they also contain most of the essential amino acids (de Jager 2013).

Figure 4.4. Trends in Per Capita Supplies of Protein from Various Sources (GM/Capita/Day)

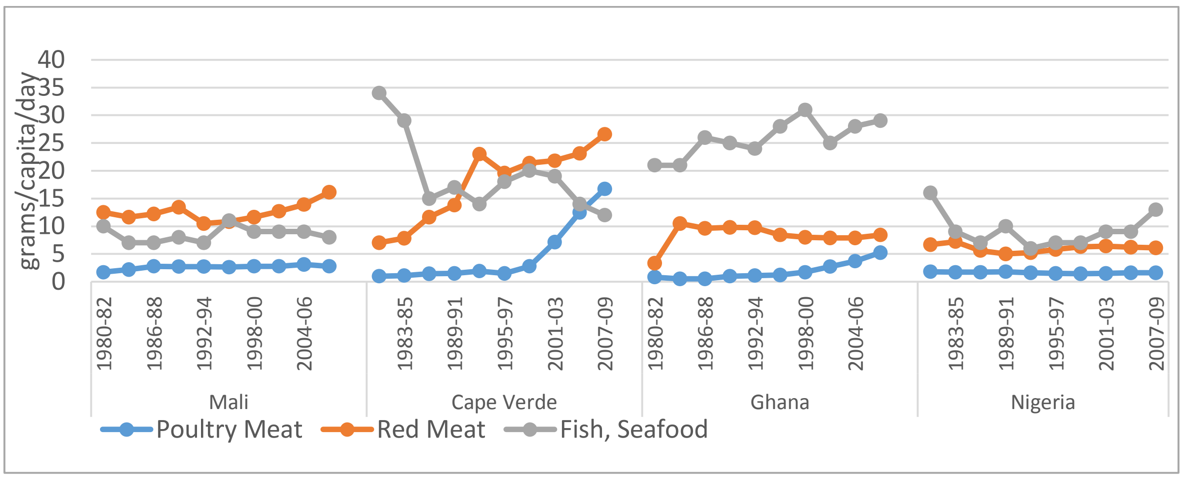


Source: Me-Nsope and Staatz (2013)

Protein from plant sources clearly dominates the total protein supply in the entire region. Some countries in the region (e.g., Niger, Sierra Leone, Nigeria, and Cape Verde) derive an important share of vegetable protein from pulses, a source of high-quality protein. Nonetheless, the animal protein supply increased for most countries between 1980 and 2009. The growth in the supply of animal protein was particularly striking in countries that experienced rapid economic growth, such as Ghana and Cape Verde. Countries with modest economic growth, such as Mali, showed modest changes in the supply of animal protein over time. Countries that have been through civil disruption, such as Liberia and Sierra Leone, showed significant declines in total protein and animal protein supply during periods of war.

The distribution of animal protein by source in selected countries in WA (Figure 4.5) shows that red meat remains an important source for the inland Sahelian countries, such as Mali. Red meat has also become increasingly important in Cape Verde, which experienced rapid economic growth over the 1980-2009 period and seen a substitution of red meat for fish in the diet. Fish and seafood remain the dominant source of animal protein for most of the other coastal countries. The rate of growth in poultry supply per capita was also quite large for most countries in the region—from 45% in Togo to 1246% in Cape Verde, between 1980-85 and 2004-09. Most of the increase in poultry meat supply came from imports.

Figure 4.5. Composition of Animal Protein by Source in Selected ECOWAS Countries



Source: Me-Nsope and Staatz (2013).

Trend in the Macronutrient Composition

According to FAO (2000), the healthy range of macronutrient intake (a balanced diet), expressed as a percent of total energy, can be broad: 55-75% from carbohydrates, 15-35% from fats, and 10-15% from proteins. The FBS data reveal that the share of carbohydrates, fats, and proteins in total DCS did not change much for almost all the countries over the period 1980-85 to 2004-09.

While most countries meet and even exceed the World Health Organization (WHO) and FAO recommended daily allowance (measured as shares) for carbohydrates, the share of protein in daily energy continues to remain close to the lower bound of the recommended daily value.

This does not imply, however, that dietary quality has stagnated over time, as some countries have experienced both growth in the supply of protein in absolute terms and greater availability of animal protein and pulses.

4.5. Conclusions and Policy Implications

Food balance sheet data indicate growth and diversification of per capita availability of foods consistent with what one would expect as a result of the region's growing economies and rapid urbanization. These patterns include greater per capita daily availability of calories and of starchy staples, a diversification in starchy staples availability, and improvements in the quality of the diet in terms of animal protein, pulses, fruits, and vegetables over time.

Policies to develop agricultural markets should take into account the diversification in the composition of food consumption rather than focus, as they often have in the past, mainly on cereals and other starchy staples. Many of the products concerned—livestock products, fish, fruits, and vegetables—are perishable and therefore require more sophisticated and tightly coordinated marketing systems and key investments such as cold chains to link West African producers effectively to these growing demands. The good news is that if such systems can be developed, the production, processing and marketing of these products is much more labor-intensive than cereal production, offering the opportunity to create new job opportunities for West Africa's burgeoning labor force.

These trends need to be interpreted cautiously, as some of the apparent changes in per capita food availability (particularly for non-cereals) reflected in the FBS may be an artifact of improved coverage over time of national agricultural statistical systems that generate the production figures used in the FBS. Bearing this caveat in mind, the findings described above document a dramatic evolution in the levels and composition of per capita food availability that have accompanied changes in structural factors such as urbanization, increases in per capita incomes and civil strife.

It is important to note, however, that FAO's FBS data only report national average figures of per capita food availability. These national averages do not capture differences in consumption that are due to income inequalities or regional or location-specific differences in food availability. Chapter 5 of this publication analyzes household-level demand for cereals in Mali. Specifically, the chapter presents estimations of household-level cereals demand parameters by per capita income groups (low, middle and high) and by rural and urban residence. The results illuminate the importance of taking into consideration such differences in understanding food consumption behavior.

References

Diagana, B., F. Akindès, K. Savadogo, T. Reardon, and J.M. Staatz, 1999. Effects of the CFA Franc Devaluation on Urban Food Consumption in West Africa: Overview and Cross-Country Comparisons. *Food Policy* 24:5: 465-478.

De Jager, I. 2013. "Literature Study: Nutritional Benefits of Legume Consumption at Household Level in Rural Areas of Sub-Saharan Africa." *N2Africa.* On line publication accessed in 2016 at http://www.n2africa.org/sites/n2africa.org/files/images/images/N2Africa_Nutritional%20benefits%20of%20legume%20consumption%20at%20household%20level%20in%20rural%20areas%20of%20sub-Saharan%20Africa.pdf.

FAOSTAT. 2015. Food Balance Sheets. http://faostat3.fao.org/download/FB/FBS/E.

FAO. 2000. The State of Food Insecurity in the World 2000. Rome: FAO. http://www.fao.org/FOCUS/E/SOFI00/img/sofirep-e.pdf

Farnsworth, C. Helen. 1961. Defects, Uses, and Abuses of National Consumption Data. *Food Research Institute Studies* II.3: 179-201.

Hollinger, F. and J.M. Staatz. 2015. Agricultural Growth in West Africa: Market and Policy Drivers. Rome: FAO and the African Development Bank. http://www.fao.org/3/a-i4337e.pdf.

Lopriore, C. and E. Muehlhoff. 2003. Food Security and Nutrition Trends in West Africa - Challenges and the Way Forward. Paper prepared for the 2nd International Workshop on Food-Based Approaches for A Healthy Nutrition. 23-28 November, 2003. Ouagadougou, Burkina Faso.

Me-Nsope, N.M. 2014. Trends and Determinants of Food Consumption Patterns in West Africa. Chapter 2. Ph.D. Dissertation, Michigan State University.

Me-Nsope, N.M. and Staatz, J.M. 2013. *Trends and Determinants of Food Consumption Patterns in West Africa*. Michigan State University International Development Working Paper No 130. E. Lansing, MI: Michigan State University.

Nweke, F.I., D.S.C. Spencer, and J.K. Lynam. 2002. *The Cassava Transformation: Africa's Best Kept Secret.* East Lansing: Michigan State University Press.

Petrovici, D.A., C. Ritson, and M. Ness. 2005. Exploring Disparities and Similarities in European Food Consumption Patterns. *Cahiers d'économie et sociologie rurales* 75. http://www.inra.fr/esr/publications/cahiers/pdf/petrovic.pdf.

Regmi, A. and J. Dyck. 2001. Effects of Urbanization on Global Food Demand. In *Changing Structures of Global Food Consumption and Trade*, ed. A. Regmi. Washington, DC: USDA, ERS. https://www.webharvest.gov/peth04/20041030184909/http://www.ers.usda.gov/publications/wrs011/wrs011e.pdf.

Serra-Majem, L., D. MacLean, L. Ribas, D. Brulé, W. Sekula. R. Prattala, R. Garcia-Closas, A. Yngve, M. Lalonde, and A. Petrasovits. 2003. Comparative Analysis of Nutrition Data from National, Household, and Individual Levels: Results from a WHO-CINDI Collaborative Project in Canada, Finland, Poland, and Spain. *Journal of Epidemiology and Community Health* 57: 74–80 (doi:10.1136/jech.57.1.74).

Smith, L.C. and L. Haddad. 2000. *Explaining Child Malnutrition in Developing Countries: A Cross-Country Analysis*. International Food Policy Research Institute Research Report No. 111. Washington, DC: IFPRI.

Timmer, C.P., W.D. Falcon, and S.R. Pearson. 1983. *Food Policy Analysis*. Baltimore: Johns Hopkins University Press for the World Bank.

UNDESA (United Nations, Department of Economic and Social Affairs, Population Division). 2014. World Urbanization Prospects: The 2014 Revision, CD-ROM Edition.World Urbanization Prospects: The 2014 Revision, CD-ROM Edition. http://esa.un.org/unpd/wup/CD-ROM/.

UNEP (United Nations Environmental Programme). 2002. Western Africa. Chapter 5. In *Africa Environment Outlook: Past, Present and Future Perspectives,* ed. Geoffrey Bird, Jacquie Chenje, and Sarah Medina. Nairobi, Kenya: UNEP.

CHAPTER 5

Changing Food Consumption Patterns: Household Budget-Consumption Study Analysis

Évolution des habitudes de consommation alimentaire : Analyse des études budgets-consommation des ménages

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Abstract

This chapter summarizes evidence of changing food consumption patterns in West Africa from the perspective of household budget surveys (HBS). It presents results from two budget-consumption studies. The first was carried out jointly by the Regional Strategic Analysis and Knowledge Support System (ReSAKSS) and Michigan State University (MSU). This study used data from HBS conducted in eight West African countries to describe how food consumption patterns changed between the late 1980s/early 1990s and the 2000s as per capita incomes and the urban populations grew. The second study was an econometric analysis of demand in Mali for rice, millet, sorghum, and maize in rural and urban areas and by income groups, based on Mali's 2006 HBS. This study also measured the effects on consumers' welfare of the cereals price shocks of the late 2000s. The ReSAKSS/MSU analysis revealed a diversification of diets over time, whereby non-traditional staples are emerging as important contributors to the diet—e.g., growth in the consumption of roots and tubers in the Sahelian countries (where, nonetheless, cereals remain the dominant calorie source) and an increase in the share of the food budget allocated to animal products. Roots and tubers still account for major shares of the food budget in the coastal countries. The econometric analysis revealed some substitution between rice and coarse grains in both rural and urban areas and across income groups, suggesting a scope to encourage ongoing diversification of staple food sources to give consumers more opportunity for substitution and choice. Price transmission across cereals suggests a need for a cereals policy rather than just, for example, a rice policy. The results suggest strong future growth in demand for food products and a need to focus on driving down unit costs throughout the food system. The analysis of the effect on consumer welfare of the food price shocks of the late 2000s revealed that in both rural and urban areas, the relative income loss from observed price changes was greater for poorer than richer households, but the absolute income loss was greater for the higher income groups.

Résumé

Ce chapitre résume les changements sur l'évolution des habitudes alimentaires en Afrique de l'Ouest obtenus à partir de sondages sur les budgets des ménages. Il présente les résultats de deux études budget-consommation. La première a été menée par le Système régional d'analyse stratégique et de gestion des connaissances [Regional Strategic Analysis and Knowledge Support System, ReSAKSS] et l'Université d'État du Michigan [Michigan State University, MSU]. Cette étude a utilisé les données des sondages sur les budgets des ménages réalisés dans huit pays d'Afrique de l'Ouest pour décrire l'évolution des modèles de consommation alimentaire entre la fin des années 1980/début des années1990 et les années 2000 parallèlement à la progression du revenu par habitant et de la population urbaine. La seconde étude est une analyse économétrique de la demande de riz, de mil, de sorgho et de maïs au Mali, en zone rurale et urbaine et par catégorie de revenus, basée sur des sondages sur les budgets des ménages au Mali en 2006. Cette étude a mesuré aussi l'effet des chocs des prix céréaliers sur le bien-être des consommateurs à la fin des années 2000. L'analyse ReSAKSS/MSU a révélé une diversification des régimes alimentaires au fil du temps avec des produits alimentaires non traditionnels qui émergent comme importants contributeurs au régime alimentaire—par exemple, l'augmentation de la consommation de racines et de tubercules dans les pays du Sahel (où les céréales restent néanmoins la principale source de calories) et la hausse de la part du budget alimentaire allouée aux produits animaux. Les racines et les tubercules représentent encore des parts importantes du budget alimentaire dans les pays côtiers. L'analyse économétrique a constaté une substitution partielle du riz par des céréales secondaires dans les zones rurales et urbaines et pour toutes les catégories de revenus, ce qui semble indiquer une tendance à la promotion en cours de la diversification des sources de denrées alimentaires afin d'offrir aux consommateurs une plus grande facilité de substitution et de choix. Une transmission des variations de prix sur les céréales suggère le besoin d'une politique sur l'ensemble des céréales plutôt, par exemple, d'une politique spécifiquement sur le riz. Les résultats semblent indiquer une forte croissance de la demande de denrées alimentaires dans les années à venir et le besoin de se focaliser sur la baisse des coûts unitaires dans l'ensemble de la chaine alimentaire. L'analyse de l'effet des chocs alimentaires de la fin des années 2000 sur le bien-être des consommateurs a démontré qu'en zone rurale comme urbaine, la perte relative de revenu due à la fluctuation des prix constatée était plus grande dans les ménages défavorisés que dans les ménages plus aisés. Cependant, la perte de revenu en termes absolus était plus forte dans les catégories de revenus les plus élevées.

5.1. Introduction

Analyses of food balance sheets (FBS), such as those presented in Chapter 4, are often a good starting point for understanding shifts and major drivers of food consumption patterns, but they are based solely on changes in the average national per capita availability of different foods. The FBS data fail to disaggregate food supply by income class, nor do they provide information on the distribution of food availability geographically within a country. For a full understanding of food consumption shifts, and the factors driving such shifts, aggregate-level FBS analyses need to be complemented with an analysis of food demand using household-level data.

Food demand analysis using household-level data allows for the inclusion of household-level economic and socio-demographic characteristics that influence food demand. Further, the interest of this type of analysis lies in the estimation of income and price elasticities of demand. These *demand parameters* measure how differences in the distribution of income across households, price changes resulting from variations in food supply, and differences in taste and preferences across regions influence food demand. Knowledge of these elasticities, combined with information about different households' current levels of food availability, enables identification of those households that are most vulnerable to sharp drops in their food intake because of price spikes or reductions in their incomes (e.g., due to a drought or other economic crisis). Such information is needed for a much precise understanding of food security problems, in designing programs that target food assistance efficiently, and in evaluating the effect of various trade and food policies and other targeted programs to alleviate food insecurity.

In spite of these advantages of household-level demand analysis, data limitations and the paucity of household-level estimates of food demand parameters (income- and price-elasticities of demand) in West Africa (WA) have severely limited understanding of consumer responses to changes in the conditions that determine food demand in the region. The need for good estimates of household-level food demand parameters was highlighted by the 2007-2008 global food crisis. The main symptom of the crisis was an upsurge in international prices for staple foods such as maize, wheat, and rice. The spike in the prices of these cereals caused great concern in WA, where historically cereals have represented a large share of total household consumption in the Sahelian countries. Furthermore, approximately 20% of the domestic cereal supply in the region originates from imports, making changes in international grain prices major considerations in food security strategies (Hollinger and Staatz 2015). A key preoccupation for policy makers in times of crisis such as in 2007-2008 is to understand how different consumer groups are responding to price and income shocks. Reliable estimates of food demand parameters differentiated by consumer groups therefore become critical in designing policies and programs to reduce the effects of the shocks on consumer welfare.

5.2. Literature Review and Knowledge Gap

Economic theory predicts that the demand for goods will respond to changes in factors that are popularly referred to as *demand shifters*. At the household-level, common food demand shifters include relative prices, income, and taste and preferences. In addition to these factors, household demographic characteristics (such as household size and its age and sex composition) and place of residence may also influence food demand.

Households of different income levels typically devote different shares of their income to food. A widely observed phenomenon, which economists refer to as Engel's Law, is that the proportion of income spent on food declines as incomes increase, even if absolute expenditures on food rise. The demand for food also typically responds differently to changes in income depending on the household's level of income; it is widely, if not universally, acknowledged that richer households are likely to spend proportionally less of any increment to income on food than are poorer households (Alderman 1986). Thus, designing effective food policy requires demand parameters differentiated by income groups.

A household's demand for a particular food item also typically responds to changes in the price of the item. Over the years, West Africa has been through a series of policy shifts such as the Structural Adjustment Programs of the 1980s and 1990s, the 1994 CFA franc devaluation, and policy reactions to the 2008 global spike in food prices. Associated with all these policy shifts have been changes in relative prices, which in turn have resulted in concerns about how consumers' demand for different foods is affected by the changes.

Specifically, the 1980s and early 1990s were characterized by rapidly increasing imports to meet household food grain needs, a phenomenon that was often attributed to the declining competitiveness of WA food production relative to other producers in the world. A leading research agenda during this period focused on understanding whether rapid growth in the consumption of imported rice and wheat in the region resulted from low world rice and wheat prices relative to those of locally produced millet and sorghum. A key finding was that the rising consumption of imported grains was not driven primarily by changes in relative cereal prices but rather by the greater convenience in the preparation and consumption of the imported goods (Reardon, Thiombiano, and Delgado 1988; Delgado 1989; and Rogers and Lowdermilk 1991).

In 1994 came the devaluation of the CFA franc, the common currency of eight West African countries. An intended consequence of the devaluation was to raise the costs of imports relative to domestic goods and reverse the trend in cereal demand from imported to locally produced grains. Consumption studies conducted following the devaluation, therefore, sought to examine whether, as intended, the resulting higher price of imported rice relative to traditional coarse grains stimulated substitution away from the former. Evidence from studies conducted in urban Mali, Burkina Faso, Senegal, and Cote d'Ivoire suggested low rates of substitution of local coarse grains for imported rice and instead a reduction in total cereal intake (Diagana et al. 1999). The lack of such a shift was attributed to the lackluster supply response of the coarse grain sectors and the resilience of rice demand based on its convenience of processing and preparation for the urban consumer.

The 2007-2008 global food crisis brought renewed attention to food consumption patterns. Again, policy makers sought to understand the extent to which the grain price hikes in the international markets were transmitted to local markets (see Chapter 8 in this volume), the corresponding effect on food demand, and the food security status of West African households. A prompt analysis of the effect of the global price hikes on the food security status of West African households was initially limited by the lack of availability of consistent estimates of food demand parameters in the region. A few attempts (e.g., Joseph and Wodon 2008) were made to understand the effects of the price hikes, but the approaches employed were severely circumscribed by data availability.

To fill this knowledge information gap, in 2011, the Syngenta Foundation funded a joint study conducted by the West African Regional Strategic Analysis and Knowledge Support System (ReSAKSS) and Michigan State University (MSU). The main objective of this study was to use existing budget-consumption data for eight countries in West Africa to understand how food consumption patterns had changed over time with increased per capita incomes and the growth in urban population. Using two budget surveys for each of the countries (Mali, Senegal, Burkina Faso, Niger, Ghana, Togo, Ivory Coast, and Benin), one collected in the late 1980s or the early 1990s and the other in the 2000s, the study examined the following for each country: (i) the evolution in the share of food in total expenditure; (ii) the evolution in food expenditure share by product type, income, and place of residence; and (iii) how food demand prospects were likely to change as a result of changes in per capita income and by place of residence—

the marginal propensity to consume (MPC) in response to a marginal increase in per capita income. The findings from the Regional Strategic Analysis and Knowledge Support System/Michigan State University (ReSAKSS/MSU) study are reported in Taondyandé and Yade (2011, 2012).

Coming a decade after the Diagana et al. (1999) study, the ReSAKSS/MSU study was very useful in providing up-to-date evidence of changing food consumption patterns for several West African countries. Nevertheless, the ReSAKSS/MSU study was limited in the sense that the study did not control for price variation across the sample, and hence, failed to examine the impact of food prices on food demand, information that is essential in times of crisis.

Thus, to build on the ReSAKSS/MSU study, a multivariate econometric analysis of cereals demand in Mali was conducted with funding from the Syngenta Foundation to investigate the combined effects of prices, income and household characteristics on food demand in that country. The parameters of the multivariate food demand analysis (own- and cross-price elasticities and income elasticities of demand) were expected to be useful for characterizing the nature of the demand for different food items, computing the effects on consumers' welfare of price shocks, classifying households per their level of vulnerability to food price shocks, and making enlightened suggestions for food security policy. The findings from the multivariate analysis are reported in detail in Me-Nsope (2014) and Me-Nsope and Staatz (2016).

The choice of Mali for the multivariate analysis was first motivated by the paucity of a complete set of food demand parameters for Mali. Prior to the ReSAKSS/MSU study, only two other studies provided statistical evidence of food demand parameters in Mali based on household-level data. Rogers and Lowdermilk (1991), using household-level data from the 1980s and a single equation model, investigated food consumption patterns of different income classes in urban areas of Mali. Camara (2004) used an Almost Ideal Demand Systems (AIDS) model to investigate the impact of seasonal changes in real incomes and relative prices on households' consumption patterns in Bamako. She found that Bamako households' consumption patterns were responsive to changes in real incomes and relative prices in any given season and that there were seasonal changes in income- and price-responsiveness for all commodities.

The second factor that motivated the choice of Mali for the multivariate econometric analysis was the availability of good quality price data for the basic food commodities identified in the household-level budget consumption survey (HBS) data. The HBS data were collected in 2006 through a survey known as the *Enquête Légère Intégrée auprès des Ménages (ELIM)-2006*. While the ELIM-2006 dataset by itself does not contain information on the prices paid by individual households for most goods, price data for cereals for the regions surveyed by the ELIM-2006 were available from Mali's *Observatoire du Marche Agricole* (OMA), the office responsible for collecting agricultural price data. Cereals prices from OMA were therefore integrated into the ELIM-2006 database.

The demand parameters estimated from the ELIM-2006 data served as the basis for calculating the impacts on consumers' welfare of food price changes. In West Africa, the approaches used in measuring the effects on consumer welfare of food price shocks in the past have been circumscribed by the availability of good demand parameters. In Mali, for example, Joseph and Wodon (2008), using food consumption expenditures data for Mali (ELIM-2006), assessed the short-term impact on poverty of the increase in the price of cereals. To overcome the limitations in data and the availability of good demand estimates, they made the following assumptions: i) an increase in the price of a food translates into an equivalent reduction of its consumption in real terms, meaning that they do not take into account the own-price or cross-price elasticities of demand that may lead to substitution effects; ii) relative prices remain constant and there is low substitution of millet, sorghum, and maize for rice and wheat on the grounds that these products are important in the Malian diet, and, therefore, their prices will increase in parallel at least in the medium term; and iii) changes in prices do not affect households when food is home-produced and consumed. Nouve and Wodon (2008) extended the work done by Joseph and Wodon (2008) and in a dynamic general equilibrium framework estimated the medium-term impact of higher rice prices in Mali on poverty. They compared a base scenario to six different scenarios that combine rice price changes and policy responses (import tax cuts on rice and measures to increase productivity of domestic rice production). They found that considering either an 80% or a 110% increase in international rice prices from the level in 2006, a 15% increase in productivity of domestic rice production would have a larger impact than a 100% reduction in rice import taxes.

Me-Nsope (2014) and Me-Nsope and Staatz (2016) made three important contributions to the existing evidence of food demand in Mali. First, the studies used a large nationwide dataset to provide first-time estimates of price and income elasticities of demand for cereals for rural Malian households in addition to urban estimates. Previous estimates of food demand parameters in Mali covered only the urban areas (Rogers and Lowdermilk 1991; Camara 2004). Second, the studies specified a Quadratic Almost Ideal Demand System (QUAIDS) model for cereals in Mali. The choice of a QUAIDS model was prompted by the results of a test for model specification. Unlike its popular predecessor, the AIDS model, the QUAIDS model allows for non-linearity in household expenditure shares (Banks, Blundell, and Lewbel 1997). Third, using the demand elasticities estimated from the QUAIDS model, the authors measured the welfare effects of cereals price changes observed in the period 2008-2011 by means of an indicator, the proportional compensating variation (CV)—defined in section 5.3 below—that allows for second-order demand responses (direct and substitution effects).

This chapter summarizes household-level evidence of changing food demand patterns in the region of WA, drawing on the results of the joint ReSAKSS-MSU study (Taondyandé and Yade (2011, 2012) and the econometric analysis carried out by Me-Nsope (2014) and Me-Nsope and Staatz (2016).

5.3. Data and Methods

Data

The ReSAKSS/MSU study used a descriptive approach and data from two household budget surveys (HBS) each for Mali, Senegal, Burkina Faso, Niger, Ghana, and Côte d'Ivoire–one collected in the 1980/90s and the other in the 2000s–and one each for Benin and Togo.[1] Each HBS reported expenditure for major household consumption items and categories. The study examined for each country: (i) the share of food in total expenditure; (ii) the evolution in food

[1] The dates of the HBS were as follows: Benin (2007), Togo (2006), Burkina Faso (1994, 2009), Côte d'Ivoire (1993, 2008), Ghana (1992 and 2006), Mali (1989, 2006), Niger (2005, 2008), and Senegal (1994, 2002).

expenditure share by product type, income and place of residence; and (iii) how food demand prospects would likely change as a result of changes in per capita income and place of residence (rural vs urban). Specifically, the study estimated, for both rural and urban residents, the additional demand for food (MPC) created by a small increase in per capita income.

Me-Nsope (2014) and Me-Nsope and Staatz (2016) used one of the two HBS datasets for Mali that was also used in the ReSAKSS/MSU study, the ELIM-2006. The ELIM-2006 data covered a total of 4,494 Malian households (of which 1,566 were urban and 2,888 were rural) in all nine regions of the country (Koulikoro, Segou, Sikasso, Gao, Kayes, Kidal, Mopti, Tombouctou, and the district of Bamako). ELIM-2006 collected data on household socio-demographic characteristics and food and non-food expenditures. The study measured total consumption expenditure on each food type as the sum of the value of consumption from own-production, purchases, and net gifts received. Total household expenditure on all items was used as a proxy for household income. The ELIM-2006 survey did not collect data on commodity prices. Me-Nsope (2014) therefore imported price data from an external source (OMA) to allow for the estimation of price elasticities of demand.[2]

Table 5.1 presents summary statistics of the data used in this econometric analysis. Average total consumption expenditures were higher for the urban than for the rural sub-sample. Irrespective of the place of residence, the data reveal a declining share of total expenditures going to food as one moves from the low-income to the high-income group (Engel's law). The share of cereals in the food budget also decreased from the low- to the high-income group within each place of residence. This suggests that the lower-income groups were more focused on ensuring adequate calorie intake from these carbohydrate sources, while higher-income groups, which likely had sufficient calorie intake, focused more on diet diversification. An examination of shares by cereal types, by income group and place of residence reveals that in both rural and urban areas, the share of the cereal expenditures going to rice increased with income level while that going to millet and sorghum fell.

Empirical Formulation and Estimation of the Cereals Demand Model

To simplify the modeling of consumption decisions, Me-Nsope and Staatz (2016) made the following assumptions in the specification of the cereals demand model. First, they assumed weak separability of consumer preferences, whereby the consumer's decision-making process is viewed as involving three stages. In Stage I, households allocate their total budget between food and non-food items. Conditional on the first stage allocations, in Stage II, households allocate food expenditure between cereals and non-cereal items. In Stage III, conditional on the second stage allocations, households allocate cereal expenditures to rice, maize, millet, and sorghum. Only the results of the third stage estimation are presented in this chapter.

[2] A question that often emerges in the analyses of household food demand using cross-sectional survey data is whether cross-sectional variations in prices can be used to derive a complete system of own- and cross- price elasticities. For a discussion of this issue and the justification for approached used here, see Me-Nsope (2014) and Me-Nsope and Staatz (2016).

Table 5.5. Summary Statistics of the ELIM-2006 Data

Variable	Urban			Rural		
	Income Tercile#			Income Tercile#		
	Low	Middle	High	Low	Middle	High
Annual Average Total Consumption Expenditure CFAF						
Per household	1,375,659 (41,759)	2,624,424 (72,556)	5,119,698 (160,300)	803,385 (16,050)	1,235,347 (23,403)	1,948,274 (53,820)
Per Adult Equivalent	197,931 (66,633)	423,478 (91,306)	1,089,084 (647,004)	99,421 (28,915)	177,400 (28,529)	362,015 (235,838)
Average Annual Expenditure Per Household CFAF						
Food	723,552	1,039,077	1,218,093	480,024	729,176	906,493
Non food	652,107	1,585,347	3,901,605	323,361	506,172	1,041,782
Food shares	0.53	0.41	0.26	0.60	0.59	0.47
Average Annual Expenditure CFAF Per Household						
Cereals	286,519	368,221	306,188	221,952	341,857	377,647
Non-cereals	437,032	670,856	911,905	258,073	387,319	528,845
Average Annual Expenditure CFAF Per Adult Equivalent##						
Cereals	42,209	59,842	63,021	27,997	49,809	70,574
Non-cereals	64,643	113,756	192,009	32,455	58,405	101,147
Cereals share	0.4	0.35	0.25	0.47	0.48	0.43
Average Annual* Expenditures CFAF Per Adult Equivalent (AE)						
Rice	24,491	39,866	42,734	7,890	18,134	32,166
Millet	10,255	11,858	12,705	11,557	17,321	20,580
Sorghum	4,325	4,778	4,202	5,523	8,751	10,958
Maize	3,137	3,339	3,380	3,027	5,603	6,870
Shares in Cereal Budget						
Rice	0.57	0.64	0.65	0.27	0.36	0.46
Millet	0.24	0.19	0.19	0.43	0.35	0.29
Sorghum	0.11	0.1	0.08	0.18	0.17	0.16
Maize	0.09	0.07	0.08	0.11	0.12	0.1
Average Household size	8.2			9.6		
Average HH AE	6.2			7.0		
Household Head						
Percent Male-	88.8			95.5		
Percent Female	11.2			4.5		

Source: Me-Nsope and Staatz (2016).

Notes: # Income terciles are calculated based on total per capita expenditures and are calculated separately for urban and rural areas. Exchange rate: 540.5 CFAF = US$1.00; ## Adult equivalents (AE) were calculated using the following scale: male > 14 years = 1.0; female > 14 = 0.8; children = 0.5 (Boughton 1994).

* includes the value of consumption from own-production; and figures in parenthesis are the standard errors of the mean.

Second, given data limitations, it was not possible to classify households as net buyers or net sellers of specific cereals, only of all cereals as an aggregate. It was therefore impossible to measure the impact on rural households of increases in their purchasing power arising from price increases of specific cereals, such as rice, which could offset the impact of such higher prices on the household's cereal consumption. The impact of this omission is likely small, as most rural households in the sample were net buyers of cereals.

Third, the analysis also assumes that a household's consumption of a specific cereal from its own-production is responsive to changes in market prices. While cereals are major staples in Mali, it is not uncommon for a cereal-producing household to sell one type of cereal, e.g., rice, and buy back a cheaper cereal, such as maize, in the event of a price hike.

Fourth, unlike most existing models of food demand in Mali, which assume linearity in the expenditure function and therefore specify the food demand function using the AIDS model, Me-Nsope (2014) conducted a formal test for model specification to determine the appropriate shape of the Engel Curve.3 Using the parametric quadratic expenditure specification test developed by Bopape (2006), she found evidence supporting the use of the QUAIDS model proposed by Banks, Blundell, and Lewbel (1997).4 As a complete demand system, the QUAIDS specification allows for non-linearity in the budget shares, thereby permitting an estimation that consistently accounts for the interdependence in the choices made by households among different cereals. In addition, this specification allows more flexibility—expenditure elasticities differ with expenditure levels, which could be a significant advantage in welfare analysis (Bopape 2006).

Fifth, to obtain unbiased and efficient price elasticities, the final QUAIDS model was specified to handle two most common econometric issues that arise when cross-sectional data are used to estimate elasticities–expenditure endogeneity and zero-expenditure.[5]

In order to measure the welfare effects on households of changes in cereal prices, Me-Nsope and Staatz (2016) computed a measured called the proportional compensating variation, or CV. The CV is adapted from de Janvry and Sadoulet (2008). The idea is that using a set of reference prices, one can compute how better-off or worse-off households are as a result of the price changes, moving from their initial utility level to a new utility level in response to the changes in cereals prices. The CV is the difference between the minimum expenditure required to achieve the original utility level at the new prices and the expenditure made at the old (initial) price level–i.e., the amount of money the household would need to be given at the new set of (higher) prices in order to maintain its original level of utility. Initial values for prices, expenditures, and budget shares were derived from the survey data collected in 2006 (the ELIM-2006).[6]

[3] The Engel curve measures how food expenditures change as income changes. The AIDS model assumes a linear Engel curve–i.e., that rate of change of demand for different foods is a fixed proportion of the rate of change of income across all income groups. This is unlikely to be true in reality; the QUAIDS model used here allows the demand for different foods to vary as incomes grow–i.e., for the Engel curve to be nonlinear.

[4] For detailed results of the tests, see Me-Nsope 2014.

[5] For details, see Me-Nsope 2014.

[6] See Me-Nsope and Staatz 2016 for details on the calculation of this welfare measure.

5.4. Results

We begin this section by presenting the major findings from the ReSAKSS/MSU study of the evolution in food consumption patterns between the late 1980s and the 2000s as presented in Taondyandé and Yade (2011, 2012). This is followed by a summary of the results from the econometric analysis of cereals demand in Mali presented in Me-Nsope (2014) and Me-Nsope and Staatz (2016).

Descriptive Analysis of Household Expenditure Patterns in West Africa

The analysis of the share of total household expenditures going to food reveals that food expenditures continue to represent an important share of the total consumption budget across all countries included in the analysis and across time. Based on HBS data collected in the late 1980s and early 1990s, the share of food in total household consumption expenditure ranged from 42% (in Côte d'Ivoire) to 50% (in Mali and Burkina Faso). HBS data collected in the 2000s from these same countries revealed that the food share in total consumption expenditures ranged from 39% in Côte d'Ivoire (2008) to 62% in Benin (2007). Still based on HBS collected in the 2000s, in five of the eight countries studied, the share of food in total household budget was greater than 50%. Comparing food budget shares from HBS collected in the late 1980s and early 1990s to those collected in the 2000s, the study found that the share of food in the total consumption budget had increased in some countries (Burkina Faso and Senegal) but decreased in others (Côte d'Ivoire and Mali). The changes in food share observed in some of these countries may be due to changes in the methods of the surveys over time and the timing of the particular surveys. Niger, Togo, and Benin each only had HBS available for the 2000s; the share of food in total household consumption was 60% for the poorest country in the sample, Niger (in 2005), 52% for Togo in 2006, and 62% for Benin in 2007. The high proportion, on average, of households' budgets going to food across all these countries means that increases in food prices hit West Africans' pocketbooks very hard. Consequently, the issue of food prices is politically sensitive across the entire region.

The analysis of the share of total household expenditures going to food by place of residence revealed that rural households devote a larger share of their total budgets to food than do their urban counterparts. Data from the late 1980s and early 1990s showed that rural food shares ranged from 53% in Mali to 63% in Senegal, while urban food shares ranged from 32% in Côte d'Ivoire to 45% in Mali. The difference reflects, in part, lower average incomes in rural areas than in urban areas and higher lodging costs in urban areas than in rural areas. The study, however, found that the gap in food shares between the rural and urban areas declined over the two decades in most countries. For example, in Côte d'Ivoire the gap dropped from 27 percentage points in 1993 to 12 percentage points in the 2008; in Senegal, the gap dropped from 27 percentage points in 1994 to 11 percentage points in 2002. In Mali, however, the gap in the share of total budgets devoted to food between the rural and the urban area increased by 10 percentage points between 1989 and 2006; while in Burkina Faso, the gap in food share was stable between 1994 and 2009. The finding for Mali suggests that income growth in that country during the 1990s and early 2000s may have been more concentrated in urban areas than was the case in the other countries in the region. The finding that rural households across the region devote a larger share of their total budget to food indicates that rural households are more vulnerable to food price shocks than are urban households.

The analysis of food shares by income level using HBS collected in the 2000s supports Engel's law—the share of food in total expenditures decreased from the low-income to high-income quintiles (Table 5.2). The results reveal high levels of vulnerability for Burkina Faso and Niger households; the data indicate that 80% of households in each of these countries devoted at least 60% of total household consumption expenditures to food. In Burkina Faso, households in the poorest two quintiles (Q1 and Q2) devoted almost 70% of total household consumption expenditures to food in 2009. In Togo, 60% of the population in 2006 allocated at least 60% of total consumption expenditures to food. Households in this group are therefore very vulnerable to food price shocks.

Table 5.6. Food Share (%) in Total Consumption Expenditure by Income Quintile

Country (Year HBS was collected)	Income Quintile (Q1 = poorest; Q5 = richest)					National Share
	Q1	Q2	Q3	Q4	Q5	All
Benin (2007)						62
Burkina Faso (2009)	70	68	65	60	42	54
Côte d'Ivoire (2008)	51	50	47	43	30	39
Ghana (2009)	61	59	57	54	45	51
Mali (2006)	58	59	58	52	31	43
Niger (2005)	61	63	65	64	56	60
Senegal (2002)	55	53	53	53	47	45
Togo (2006)	66	64	61	55	44	52

Source: Taondyandé and Yade (2012).

A decomposition of the food budget by major food groups, using HBS data collected in the 2000s revealed that starchy staples (cereals plus roots and tubers) constitute the largest share in the food budget in all eight countries. The composition of these shares by specific staple types are shown in Table 5.3, with cereals dominating in the inland countries and roots and tubers, especially yams and cassava, being very important in Côte d'Ivoire and Ghana. With respect to non-starchy staple food groups, animal products (meat, fish, and dairy products) take up an important share of the food budget, with shares ranging from 12% in Niger to 30% in Benin. In Benin and Ghana, animal products and fish dominate in food shares, 30% and 29% respectively.

The high share of animal protein in the food budget reflects the expensive nature of these products relative to other food items. A breakdown by place of residence revealed higher shares of animal products in the food budget in the urban areas compared to rural areas. Fruits and vegetables come in third place in terms of shares in the food budget, with shares greater than 10% in all five of the coastal countries. The shares are lower in the inland Sahelian countries (Mali, Burkina Faso, and Niger). Other important food groups in terms of expenditure shares are vegetable oils and oilseeds.

Table 5.7. Shares (%) in Food Budget by Major Food Groups in HBS Collected in the 2000s

Food Group	Benin	Burkina	Côte d'Ivoire	Ghana	Mali	Niger	Senegal	Togo
	2007	2009	2008	2006	2006	2005	2002	2006
Cereals	23	55	26	23	45	61	31	21
Roots, Tubers and Plantains	10	1	17	15	2	1	2	8
Grain Legumes	4	4			2	2	1	3
Oilseeds and Vegetable Oils	9	5	7	5	7	3	13	6
Fruits and Vegetables	12	6	16	14	10	5	13	15
Animal Products and Fish	30	10	23	29	22	12	26	18
Alcoholic Beverages and Stimulants	7	8	2	7	7	4		6
Other Food Products	7	12	10	7	6	12	14	23

Source: Taondyandé and Yade (2012).

The analysis of shares of the food budget by specific food types, based on HBS collected in the 2000s (Table 5.3), revealed some differences between the Sahelian and the coastal countries. The share of staple foods in the food budget is 64% for Niger (2005), 49% for Mali (2006), 60% for Burkina Faso (2009), 43% for Côte d'Ivoire (2008), 32% for Togo (2006) and 34% for Senegal (2002)[7]. Millet and sorghum contribute the most to the total staple food share in Burkina Faso (27% of the total food budget) and Niger (43%)[8]. In Mali and Senegal, rice is the leading starchy staple in terms of share of total food expenditures, accounting for 19% of the total food budget for Mali (in 2006) and 17% for Senegal (in 2002). The second most important starchy staple for these countries, in terms of food budget share, are millet and sorghum for Mali (18%) and wheat products for Senegal (9%). In the coastal non-Sahelian countries like Côte d'Ivoire, Ghana, and Togo, in addition to cereals, roots and tubers are also important staple foods. Rice is the dominant starchy staple item in terms of share in the food budget in Côte d'Ivoire (19% in 2008) and Ghana (11% in 2006). The second starchy staple in terms of shares in the food budget is cassava, with a share of 7% in both Ghana and Côte d'Ivoire. In Togo, the share of the food budget allocated to maize and rice are 11% and 7% respectively, while cassava and yams each represent 5% of the food budget.

The analysis on the evolution in expenditure shares between 1980/90s and 2000s (Table 5.4) showed that the combined share of starchy staples (cereals, roots and tubers and grain legumes) in the food budget increased in Burkina Faso (by +8 points) and Mali (by +3 points), remained

[7] Staple foods include cereals (maize, rice, millet and sorghum, wheat products) roots and tubers, plantains and grain legumes (e.g., cowpeas/beans).

[8] Millet alone is about 36% of the food budget in Niger.

the same for Ghana, and declined in Senegal (-6%) and Côte d'Ivoire (-13%). The diversity of results across countries likely was the result, in part, of the differing years in which the various surveys took place and the price levels prevailing in those years. For example, the second survey in Senegal took place in 2002, when staple food prices were fairly low, while that in Burkina Faso occurred in 2009, when the effects of the spike in world food prices were still being felt. Similarly, the two HBS in Mali spanned the period 1989, when cereal prices were relatively low, and 2006, when they were relatively high. The increases in staple food shares in Burkina Faso and Mali were mostly driven by the increases in the share of the cereals food group in the food budget—the share of cereals alone in the food budget increased in Burkina Faso by 9% and in Mali by 3%. The increase in the share of cereals in the food budget in Burkina Faso was driven by increases in expenditures on rice (+3%) and maize (+6%). A breakdown by urban/rural residence reveals that most of the growth in maize shares in the food budget in Burkina Faso was from the urban areas, suggesting that urbanites may have been substituting processed maize for rice to cope with the soaring rice prices. At the same time, the share of food expenditures on animal products in Burkina fell by 2%, as consumers likely cut back on those products to defend their consumption of the now more costly starchy staples. Meanwhile in Mali, shares in the food budget increased by 7% for rice between 1989 and 2006, 3% for wheat products and 1% grain legumes.

Table 5.8. Evolution in Food Budget Shares Based on Data from Two Household Budget Surveys

Product and Product Groups	Burkina Faso		Côte d'Ivoire		Ghana		Mali		Senegal	
	1994	2009	1993	2008	1992	2006	1989	2006	1994	2002
Cereals	46	55	34	26	20	23	42	45	38	31
Rice	10	13	14	19	7	11	12	19	19	17
Maize	6	12	5	4	7	6	4	4	1	1
Millet and sorghum	28	27	1	0	1	1	25	18	10	4
Wheat products	2	2	15	3	4	5	1	4	8	9
Other cereals	0	1	0	0	0	0	1	0	0	0
Roots, Tubers, Plantains	1	1	21	17	18	15	1	2	2	2
Cassava and derivatives			7	7	9	7				
Yams and derivatives			8	6	5	5				
Other roots and tubers			1	1	1	0				
Banana plantains			5	3	3	3				
Grain Legumes	4	4					1	2	1	1
Oils and Oilseeds	7	5	6	7	7	5	10	7	14	13
Fruits and Vegetables	6	6	10	16	10	14	14	10	12	13
Animal Products and Fish	12	10	12	23	30	29	20	22	24	26
Meat/poultry	7	4	8	7	8	7	11	12	10	9
Dairy products	2	2	2	1	2	2	4	4	5	6
Eggs and products from eggs			1	1	1	1			1	0
Fish and Seafood	4	4	2	14	20	19	6	6	9	11
Beverages and stimulants	13	8	4	2	8	7	7	7		
Other Food Products	11	12	12	10	8	7	4	6	10	14

Source: Taondyandé and Yade (2012).

Animal products (meat, fish and dairy products) increased in share in food budget by 2% in Mali, 11% in Côte d'Ivoire (in 2008, the year of record food prices), 2% in Senegal (in 2002, a year of moderate prices), but decreased by 1% in Ghana. The evidence in this chapter, just like the analysis of food balance sheet data seen in Chapter 4, suggests some diversification in food consumption, whereby new products or non-traditional staples are emerging as important contributors to the diet (e.g., maize in Burkina Faso and wheat in Mali). However, to the extent that prices have also changed over time, these increases in budget consumption shares are likely partially due to changes in prices and not just increases in the actual quantities consumed.

The analysis of staple food expenditures by place of residence reveals that staple food shares are higher in the rural areas than in the urban areas for most countries in the sub-region; rural staple food shares in the food budget exceeded 50% in all countries except Ghana, Senegal, and Togo. This high share of the total food budget devoted to starchy staples explains why these products, particularly cereals, have been at the center of food policy debates in West Africa.[9] Rice is the dominant staple in food shares in urban areas across all the countries, with an average expenditure share of about 15%; country-level shares range from 7% in Togo to 20% in Mali. In urban areas of coastal countries such as Côte d'Ivoire and Senegal, wheat products are also important in the food share (4% and 9% respectively). Millet retains an important share in the urban food budget in Burkina Faso, Niger, and Mali; although the share is lower than in the rural areas. In Cote d'Ivoire and Togo, cassava and yams occupy second and third place, respectively in the urban food budget share. Traditional staples occupy an important share in the food budget in rural Burkina Faso, Mali and Togo.[10] In Burkina and Mali, millet and sorghum had 37% and 24% respectively of the food budget in the rural areas. In rural Togo, maize, and roots and tubers had a share of 14% and 12%, respectively, in food expenditures. Meanwhile in rural areas, rice had a 19% share of the food budget in Côte d'Ivoire, 17% in Mali, and 20% in Senegal. Unlike the other countries in the sub-region, wheat expenditures were important among rural households in Senegal; rural households allocated at least 5% of their food budget to wheat related products (mostly bread). The importance of rice and wheat in the Senegalese food budget allocation and the country's heavy reliance on imports for these cereals highlight the country's vulnerability to price shocks in the global food market (Table 5.5).

The analysis of expenditure by income level reveals that the poorest 40% of the population in Niger spend 56% of their food budget on millet and sorghum, while the corresponding figures are 43% for Burkina Faso and 26% for Mali. The high share of millet and sorghum in the food budget of poorer households suggests greater vulnerability amongst these households to millet and sorghum price shocks, such as those that emanate from droughts.[11] The finding also suggests that millet and sorghum are potential candidates for the design of food safety nets targeting the poor in times of crisis. In Côte d'Ivoire, the food budget of the poorest 40% of households is dominated by rice (22%), cassava (9%), and yams (9%); meanwhile in Senegal, rice and wheat products dominate the food budget of the poorest 40%. Maize represents 17% of the staple food budget for the poorest 40% of households in Togo.

[9] Demand, however, is changing in the region as incomes increase, implying a need to broaden food policy beyond just starchy staples. See Chapter 7 in this volume.
[10] Traditional staples include coarse grains and roots and tubers.
[11] See Chapter 6 in this volume.

By income quintile in the urban areas, the analysis reveals that animal products occupy an important share in the budget of the richest 20% of urban households across all countries (with the exception of Burkina Faso), with shares ranging from 19% in Niger to 37% in Mali (Table 5.6).

Table 5.9. Shares (%) in Food Budgets by Place of Residence Based on Household Budget Survey Data Collected in the 2000s

Product	Burkina Faso (2003)		Côte d'Ivoire (2008)		Ghana (2006)		Mali (2006)		Niger (2005)		Senegal (2002)		Togo (2006)	
	R	U	R	U	R	U	R	U	R	U	R	U	R	U
Banana Plantain	-	-	3	3	3	3	-	-			-	-		
Beans/Cowpeas	-	-	-	-	-	-	-	-	2	2	-	-	5	2
Yams	-	-	10	3	4	6	-	-	-	-	-	-	6	4
Legume	-	-	-	-	-	-	4	8	-	-	-	-	-	-
Maize	6	10	5	2	6	5	5	3	5	11	-	-	14	7
Cassava	-	-	10	7	8	7	-	-	-	-	-	-	6	4
Millet	-	-	-	-	-	-	16	7	41	15	5	1	2	0
Millet /Sorghum	37	7	0	0	1	0	-	-	-	-	-	-	-	-
Wheat Products	1	3	2	4	4	6	0	0	1	4	5	9	1	3
Roots and Tubers	0	1	19	10	-	-	1	3	1	1	2	3	-	-
Rice	7	14	19	18	11	12	17	20	7	19	22	13	7	7
Sorghum	-	-	-	-	-	-	8	3	9	2	2	1	3	0
Total Staple Food Share	51	34	49	37	37	39	51	45	66	53	32	24	43	27

Source: Compiled from Taondyandé and Yade (2011, 2012).

R=Rural and U=urban.

The share of animal products in the food budget also increased from the poorest to the richest 20% of the urban population across all countries. Fruits and vegetables also occupy an important share in the food budget for these richest 20% of urban households in the coastal countries (Ghana, Senegal, Togo, and Côte d'Ivoire), with shares ranging from 13% in Ghana to 17% in Côte d'Ivoire. The share of fruits and vegetables in these coastal countries is greater than the share of rice, the most important starchy staple in terms of shares across all urban income groups and across all eight countries. The exception is Niger, where millet and sorghum dominate the food budget of the poorest 40% of urban households, with an average share of 25%. In Burkina Faso, rice has the largest share in the budget of the top 20% of urban households, followed by maize, with a share in food budget of 17%. The analysis shows the importance of rice in the food budget of all urban income groups across countries and, therefore, highlights the vulnerability of these households to hikes in the world market price of rice, given that most of these countries rely on imports for a significant portion of their rice consumption needs. The results also illustrate a shift away from starchy staples to better quality foods like animal proteins and fruits and vegetables as urban households get richer.

Table 5.10. Food Shares by Income Quintile in Urban Areas

Country	Quintile	Rice	Maize	Millet/ Sorghum	Wheat	Roots and Tubers	Fruits and Vegetables	Animal Products
Burkina Faso (2009)	U1	16	17	15	2	1	9	7
	U2	19	18	15	2	0	8	8
	U3	22	16	9	4	1	9	9
	U4	22	15	6	4	1	9	12
	U5	25	17	3	5	1	8	16
Côte d'Ivoire (2008)	U1	25	6	0	2	12	16	18
	U2	24	4	1	3	11	17	21
	U3	21	2	0	4	10	17	24
	U4	17	2	0	4	10	17	26
	U5	14	1	0	5	8	17	30
Ghana (2006)	U1	14	8	1	5	13	15	26
	U2	13	7	0	6	14	14	27
	U3	12	6	0	6	12	14	28
	U4	12	5	0	6	13	14	29
	U5	11	4	0	6	13	13	27
Mali (2006)	U1	21	6	15	4	1	11	16
	U2	25	3	14	5	1	11	18
	U3	23	3	12	4	2	12	21
	U4	22	2	8	5	3	12	22
	U5	14	2	6	5	4	12	37
Niger (2005)	U1	19	11	30	1	1	7	8
	U2	21	11	22	2	1	7	10
	U3	20	12	19	2	1	8	13
	U4	19	11	15	4	1	8	14
	U5	16	10	10	6	2	10	19
Senegal (2002)	U1	19	0	3	11	2	12	9
	U2	15	0	3	13	3	13	13
	U3	14	0	2	13	3	13	16
	U4	11	0	2	12	3	14	20
	U5	13	0	1	9	3	15	28
Togo (2006)	U1	8	11	1	1	9	16	13
	U2	8	9	1	3	8	16	16
	U3	7	7	1	3	9	16	18
	U4	7	6	0	4	8	16	19
	U5	6	4	0	4	8	16	22

Source: Taondyandé and Yade (2012).

U1 to U5 are the urban income quintiles, with U1 being the lowest-income and U5 the highest.

Table 5.11. Food Shares by Income Quintile in Rural Areas

Country	Quintile	Rice	Maize	Millet/ Sorghum	Wheat	Roots and Tubers	Fruits and Vegetables	Animal Products
Burkina Faso (2009)	R1	5	7	35	1	0	7	7
	R2	6	9	39	1	0	7	7
	R3	7	11	36	1	1	6	7
	R4	9	10	34	2	1	5	9
	R5	10	10	36	2	1	4	10
Cote d'Ivoire (2008)	R1	22	10	1	1	17	14	15
	R2	21	7	1	1	22	13	16
	R3	20	5	0	1	20	15	17
	R4	20	5	0	2	21	15	19
	R5	17	4	0	2	16	14	22
Ghana (2006)	R1	9	9	6	3	5	16	25
	R2	10	8	2	4	8	15	32
	R3	12	7	1	4	10	14	33
	R4	11	6	1	4	12	15	31
	R5	11	5	1	5	13	13	31
Mali (2006)	R1	11	6	29	2	1	9	13
	R2	14	5	28	2	1	8	15
	R3	18	5	25	2	1	8	15
	R4	17	6	24	2	1	7	17
	R5	20	4	17	3	1	8	23
Niger (2005)	R1	4	4	58	0	1	3	10
	R2	5	4	57	1	1	3	10
	R3	6	4	54	1	1	3	11
	R4	7	4	50	1	1	4	11
	R5	9	6	44	2	1	5	12
Senegal (2002)	R1	26	1	10	5	1	10	4
	R2	22	1	9	7	2	11	5
	R3	22	1	8	8	2	11	5
	R4	21	1	8	7	2	11	6
	R5	23	1	6	8	2	10	8
Togo (2006)	R1	7	11	2	1	5	11	13
	R2	7	8	1	1	7	12	13
	R3	8	8	1	1	7	14	15
	R4	8	8	1	2	8	13	15
	R5	8	6	1	2	8	14	19

Source: Taondyandé and Yade (2012).

R1 to R5 are the rural income quintiles, with R1 being the lowest-income and R5 the highest.

Disaggregating across rural income groups, the analysis reveals that across all rural income groups (with the exception of Ghana, which has the highest per capita income of all of the sample countries), starchy staples represent the largest shares of the food budgets (Table 5.7). Millet and sorghum take up the largest share in the food budget in Sahelian countries across all income groups, except in Mali, where the share of rice in the food budget exceeds that of millet and sorghum for the richest 20% of rural households. Rural households in Senegal have the largest share of wheat products in the food budget of all the countries, and the wheat share increases with increases in income. In Ghana, in rural areas, just like in the urban areas, animal products, fruits, and vegetables take up the most important share of the food budget.

Food Demand Prospects—Marginal Propensity to Consume (MPC)

Estimates of the MPC of different food products indicate that demand for most foods will grow rapidly as per capita incomes rise in West Africa. Results suggest that a 100 CFAF increase in per capita income will result in additional spending on food amongst urban households ranging from 23 CFAF in Mali to 47 CFAF in Togo. For rural households, this amount will range from 42 CFAF in Côte d'Ivoire to 67 CFAF in Niger.

A decomposition of this additional demand shows a clear preference for rice, fruit and vegetables and animal products in the urban areas. Rice is expected to take up about 15% of this additional total spending in Burkina Faso, Niger, and Mali, about 8% in Senegal and Côte d'Ivoire, and about 5% in Togo. About 10% of the additional spending would be devoted to fruits and vegetables in Burkina Faso and Niger, 15% in Côte d'Ivoire and Togo, and 13% in Senegal. The share of increased spending devoted to meat ranges from 8% in Togo to 25% in Senegal. For fish, the additional expenditure lies between 5% in Mali and 11% in Senegal. The share of increased spending going towards dairy products ranges from 2% in Burkina Faso to 7% in Mali.

Millet and sorghum not only dominate the cereal basket of rural households in Burkina Faso and Niger, but also increments to spending in these areas. The MPC analysis indicates that 24% of increments to income of rural residents of Burkina Faso, at the margin, would go to these cereals, while in rural Niger the corresponding figure is 42%. Only 10% of the increment in per capita income will be spent on rice in the rural areas of these countries.

This finding suggest that (a) demand in the rural areas will likely remain robust in the short to medium term and (b) consumers in the rural areas are probably still calorie-short since they are spending such a high percentage of increments to income on basic, low-cost staples. In Mali, Senegal, and Côte d'Ivoire, rice is the most preferred in rural areas, with MPCs of 24%, 16% and 15%, respectively. While Mali is nearly self-sufficient in rice, Senegal and Côte d'Ivoire rely heavily on rice imports. This heavy reliance on imports exposes these countries to shocks in world rice prices, thereby increasing their vulnerability to food insecurity. This finding therefore suggests a need to explore ways to expand domestic rice production at lower per-unit costs.

Econometric Analysis of Cereals Demand in Mali

While MPCs indicate the proportion of an increment to income that would go to expenditure on a given product (all other things held equal), price and income elasticities of demand address somewhat different questions. Income elasticities of demand measure the percentage change in the expenditure on a given item (e.g., rice), given a 1% change in the consumer's income. This elasticity thus measures whether demand will grow faster or slower than the growth of per capita income. Own-price elasticities of demand measure the percentage change in the expenditure for a good given a 1% change in its price, while cross-price elasticities measure the percentage change in expenditure for the good given a 1% change in the price of a related good (a substitute or a complement). Collectively, these various elasticities, which measure how sensitive the demand for a product is to changes in income and prices, are referred to as demand parameters. Me-Nsope (2014) estimates a complete set of cereals demand parameters for urban and rural Mali and by income group within each place of residence. In the sections that follow, we present key results from those estimations.

Expenditure Elasticities of Cereals Demand. All estimated expenditure elasticities were found to be positive and statistically significant at the 1% level (Table 5.8).[12] Rice and sorghum expenditure elasticities were higher in the urban areas than in the rural areas, meaning that the demand for rice and sorghum in the urban area is more responsive to changes in income than the demand for rice and sorghum in the rural areas.

Millet and maize expenditure elasticities were higher in the rural areas than in the urban areas. The estimated expenditure elasticities in the urban areas suggest an increasing preference for rice, sorghum, and maize at higher per capita income levels, while the preference for millet tends to decrease as incomes rise in the urban areas. The high average expenditure elasticities of sorghum and millet in the urban area and the increase in sorghum expenditure elasticity as income increases are intriguing findings because past studies argued that coarse grains are generally less preferred than rice in the urban areas for reasons such as the high opportunity cost of the time required for their processing and preparation. One possible reason for the present findings is that the ELIM 2006 data did not distinguish between expenditures on processed and unprocessed millet and sorghum, and the demand for processed products, which are becoming more widely available in urban areas, is likely to be much stronger among high-income groups. If the higher-income groups buy more of these processed products (as well as eat more of these cereals in prepared meals away from home), these findings would likely result. This suggests a need for future budget-consumption studies to differentiate expenditures for processed versus unprocessed forms of these cereals and by place of consumption (for example, home and away from home).

[12] Except for millet in the low-income urban households, which is only significant at a 10% level.

Table 5.12. Cereals Expenditure Elasticities by Place of Residence and Income Group[a]

	Rice	Millet	Maize	Sorghum
URBAN				
All	0.964*	1.038*	0.668*	1.502*
By Income Group				
Low	1.248*	0.758***	0.702*	0.673*
Middle	0.880*	1.079*	1.070*	1.454*
High	1.239*	0.415*	1.032*	1.247*
RURAL				
All	0.728*	1.200*	1.099*	1.109*
By Income Group				
Low	0.654*	1.248*	1.030*	1.054*
Middle	1.006*	0.980*	0.867*	1.069*
High	1.001*	1.025*	1.014*	0.974*

Source: Me-Nsope and Staatz (2016).
Notes: [a] The per-capita consumption expenditure terciles for both rural and urban areas are referred to, for simplicity of exposition, as low-income, middle-income, and high-income. These appellations refer to the relative incomes of the three groups and not to any standards for low-, middle- or high-income status used by international agencies such as the World Bank.
* means significant at a 1% level and ** means significant at 5% and *** means significant at 10%.

In rural areas, rice continues to be the most preferred cereal as per capita income increases. The expenditure elasticities for millet, sorghum, and to a lesser extent maize tend to decline with increases in income in the rural areas. In the urban areas, a similar pattern was observed only for millet.

Price Elasticities of Cereals Demand: Own-Price Elasticities of Cereals Demand. Aggregating across income groups, all estimated uncompensated and compensated own-price elasticities were not only negative as expected for normal goods, but were also statistically significant at a 5% level (Table 5.9).[13,14]

Economic theory predicts that poorer households are generally more sensitive to price changes than are richer households. In the urban sub-sample, this expectation proved true only for maize and sorghum. Rice demand response to changes in its own price in the urban areas turns out to be higher for high-income households than low-income households. This finding reinforces the

[13] A change in the price of a good affects the demand for it in two ways. First, there is a *substitution effect*, whereby consumers shift their consumption pattern in reaction to the good becoming more or less expensive relative to other goods. For example, if it becomes more expensive, consumers typically substitute consumption of something else for at least part of their consumption of the original good. Second, there is an *income effect*, as the change in price of the good also changes the consumer's real income. For example, if the price of the good increases and the consumer continues to buy the same amount of the product, s/he has less income left over to spend on other goods. An *uncompensated elasticity* captures both the substitution effect and the income effect, while a *compensated elasticity* measures only the substitution effect (by measuring how consumption would change if the consumer were compensated for the income effect of the price change).
[14] Economists refer to goods whose demand fall as their prices increase as *normal good*s.

argument made by Diagana et al. (1999) that rice has become a key fast food eaten at noon by low-income urban laborers who have few alternatives to substitute other staples for a quick

Table 5.13. Own-Price Elasticities of Cereal Demand–Urban and Rural Mali

	Rice	Millet	Maize	Sorghum
URBAN				
Uncompensated				
All	-0.955*	-0.904*	-1.046*	-1.156*
Low	-0.997*	-0.243	-0.996*	-1.014*
Middle	-0.915*	-1.035*	-1.026*	-0.948*
High	-1.065*	-0.514*	-0.946*	-0.658*
Compensated				
All	-0.341*	-0.714*	-0.986*	-1.021*
Low	-0.277*	-0.089	-0.914*	-0.944*
Middle	-0.318*	-0.860*	-0.945*	-0.828
High	-0.241*	-0.439*	-0.870*	-0.557**
RURAL				
Uncompensated				
All	-0.938*	-1.135*	-1.024*	-0.994*
Low	-0.781*	-1.010*	-1.041*	-0.894*
Middle	-0.973*	-0.963*	-0.940*	-0.945
High	-0.991*	-0.993*	-0.996*	-0.988*
Compensated				
All	-0.660*	-0.723*	-0.896*	-0.819*
Low	-0.585*	-0.513*	-0.907*	-0.713*
Middle	-0.607*	-0.622*	-0.834*	-0.768*
High	-0.516*	-0.696*	-0.897*	-0.853*

Source: Me-Nsope (2014); Me-Nsope and Staatz (2016).
Note: * = significant at 1%, ** = significant at 5% and *** = significant at 10%.

lunch. Among the rural households, rice is the least sensitive of all cereals included in the analysis to changes in its own price. The uncompensated own-price elasticities show that low-income rural households are more sensitive to millet and maize price changes than are high-income households, but these findings appear to be driven by the income-effects of the price change, as the compensated elasticities are not uniformly higher in magnitude for the bottom income tercile than for the top one.

Price Elasticities of Cereals Demand: Cross-Price Elasticities of Cereals Demand. Positive cross-price elasticities indicate that two goods are substitutes, while negative cross-price elasticities indicate that the goods are complements. With one exception, all the estimated urban cross-elasticities among cereals that are statistically significant are also positive, suggesting some substitution between these starchy staples (Table 5.10). Rice is a substitute for millet and sorghum across all urban income groups. Millet is a substitute for rice across all urban income groups, while sorghum is a substitute for rice only in the low- and middle-income urban groups. Rice is a complement for maize in the high-income urban group. Maize is a substitute for rice across all urban income groups. The substitution between these major starchy staple types suggests some flexibility in consumer demand choices and signals that a potential option for reducing the effect on consumer welfare (particularly the poor) of a food price shock will be to expand the scope of substitution between the different starchy staples.[15]

In the rural sample, with one exception, all compensated cross-price elasticities are statistically significant and positive (Table 5.11). The sensitivity of rice demand to changes in the price of millet, maize, and sorghum increases from the low- to the middle-income rural group but drops from the middle- to the high-income rural group. Also noticeable is the increase in the sensitivity of millet, maize, and sorghum demand to changes in the price of rice as per capita income increases.

This means that richer rural households are more likely to substitute coarse grains for rice when the price of rice increases. With agriculture being the mainstay of rural Malian households, one would expect that richer households would own larger farms than poorer households and produce more food than poorer households. This finding suggests that richer households have more options than poorer households, such that an increase in the price of one type of cereals (for example rice) would cause these households to substitute coarse grains from their own production for rice to satisfy household food needs.

Table 5.14. Compensated Cross-Price Elasticities of Cereal Demand–Urban Mali

Demand For:	Elasticity with Respect to Changes in the Price of: Rice	Millet	Maize	Sorghum
		Low-Income		
Rice	-0.277*	0.129**	0.098*	0.130*
Millet	0.192	-0.089	0.124***	-0.077
Maize	0.567*	0.145	-0.914*	0.215**
Sorghum	0.460*	-0.304	0.300*	-0.944*
		Middle-Income		
Rice	-0.318*	0.146*	0.096*	0.067*
Millet	0.674*	-0.860*	0.063*	0.128*
Maize	0.580*	0.191*	-0.945*	0.111*
Sorghum	0.437*	0.356*	0.000*	-0.828*
		High-Income		
Rice	-0.241*	0.128*	-0.097**	0.089*
Millet	0.305	-0.439*	0.651*	-0.034
Maize	1.299*	0.570***	-0.870*	0.245
Sorghum	0.167	0.089	-0.005	-0.557**

Source: Me-Nsope and Staatz (2016).

Note: * = significant at a 1%; ** = significant at 5%, and *** = significant at 10%.

[15] See Chapter 6 for an analysis of the role of staple food substitution in softening the effects of price shocks on consumers.

Table 5.15. Compensated Cross-Price Elasticities of Cereal Demand–Rural Mali

Demand For:	Elasticity with Respect to Changes in the Price of: Rice	Millet	Maize	Sorghum
		Low-Income		
Rice	-0.585*	0.291*	0.058*	0.148*
Millet	0.215*	-0.513*	0.202*	0.176*
Maize	0.326*	0.469*	-0.907*	0.117*
Sorghum	0.369*	0.298*	0.103*	-0.713*
		Middle-Income		
Rice	-0.607*	0.335*	0.119*	0.167*
Millet	0.347*	-0.622*	0.122*	0.171*
Maize	0.338*	0.363*	-0.834*	0.048
Sorghum	0.369*	0.367*	0.064	-0.768*
		High-Income		
Rice	-0.516*	0.286*	0.096*	0.141*
Millet	0.457*	-0.696*	0.104*	0.136*
Maize	0.451*	0.308*	-0.897*	0.136*
Sorghum	0.495*	0.266*	0.092*	-0.853*

Source: Me-Nsope and Staatz (2016).
Note: * = significant at a 1%; ** = significant at 5%, and *** = significant at 10%.

The compensated cross-price elasticities computed by income group suggest that across all urban income groups, households were more likely to replace millet with rice than they were to replace sorghum with rice, and the magnitude of the substitution of rice for sorghum declines from the low to the high-income urban groups. This finding suggests some preference for sorghum in urban Mali. Conversely, the cross-price elasticities did not reflect a uniform pattern in the substitution of millet and sorghum for rice across income groups in both urban and rural areas. The results also suggest that substitution of maize for rice increases as incomes increase in urban areas. In rural areas, maize substitution for rice is lower than in urban areas. A possible reason for the higher tendency to substitute maize for rice in urban areas is that the larger number of milling facilities in urban areas increases the availability of processed maize products, which are attractive to time-poor urban consumers because these products require shorter time to prepare and are more easily substituted for rice. The substitution between rice and coarse grains across income groups in both the rural and the urban groups implies some scope for dealing with price spikes for one cereal by increasing the availability of substitutes—a possibility that the earlier findings of low cross-elasticities seemed to discount.[16]

Welfare Effects of Cereals Price Changes

Me-Nsope (2014) and Me-Nsope and Staatz (2016) used the estimated demand elasticities to compute the welfare effects associated with the price changes observed at the district level in each of the years 2008, 2009, 2010 and 2011 compared to the 2006 baseline.[17] Specifically, a CV was computed jointly for rice, millet, sorghum, and maize. A summary of average price changes for all locations covered by ELIM-2006 is presented in Table 5.12.

[16] See Chapter 6 for more analysis of this point.
[17] Price data at the administrative unit level for 2006 to 2011 were obtained from the OMA.

The analysis isolates the first-order effect of the price change on households' welfare, which implicitly assumes that households are unable to change their consumption patterns when prices change, from the second-order effect, which includes substitution effects through cross-price elasticities, but no income effects through production or other linkages (e.g., wages).

Table 5.16. Average Consumer Price Changes Compared to 2006 (%)

Period	Rice	Millet	Maize	Sorghum	Average
2008	21	9	17	10	14
2009	21	21	28	21	23
2010	16	15	20	14	16
2011	23	19	30	23	24

Source: Me-Nsope (2014).

Friedman and Levinsohn (2002) have argued that ignoring substitution effects in consumption in the computation of welfare measures may lead to significant biases and inappropriate inferences.

The results obtained suggest that the first-order estimates capture almost all the impact of the price changes on welfare in both urban and rural areas (Tables 5.13 and 5.14). This finding reflects the fact that during the 2008-2011 period all cereals prices were rising sharply, thus limiting the scope for substitution to cheaper cereals.

Table 5.17. Magnitude of Welfare Losses Implied by the Cereals Price Changes over the Period 2008-2011, by Urban Per Capita Income Group

Year	CV (Full impact) in %	Value of compensation based on 2006 average cereals expenditure (CFAF)	Percent of average total household consumption expenditure in 2006
		Low-Income	
2008	17.8	51,000 (95)	3.7%
2009	22.6	64,753 (120)	4.7%
2010	16.2	46,416 (86)	3.4%
2011	22.7	65,040 (121)	4.7%
		Middle- Income	
2008	18.0	66,280 (123)	2.5%
2009	21.9	80,640 (150)	3.1%
2010	16.7	61,493 (114)	2.3%
2011	22.8	83,954 (156)	3.2%
		High-Income	
2008	17.5	53,583 (99)	1.0%
2009	21.8	66,749 (124)	1.3%
2010	17.0	52,052 (97)	1.0%
2011	23.1	70,729 (125)	1.4%

Source: Me-Nsope and Staatz (2016). Note: The figures in parenthesis are U.S. dollar equivalents.

Across all the years, the first-order impact was larger than the full impact by less than 1%. Thus, consistent with a priori expectations, the first-order effect overstates, but only marginally, the welfare losses for urban and rural households. In this chapter, we present the results from the full or second-order effect only. Interested readers should see Me-Nsope and Staatz (2016) for the first-order values.

Although the CVs of cereals price changes do not show much difference across per capita income groups when measured in terms of percentage of total cereals expenditures in 2006, in absolute terms, the impacts differ widely. The actual magnitude of the welfare losses from cereals price changes were substantial and differed by place of residence and income groups (Tables 5.13 and 5.14). In 2008, for instance, on average low-income urban households would have had to be compensated by 17.8% of their cereal budget in 2006, equivalent to 51,000 CFAF = US$95, to be as well off after the price increases as they were before them (Table 5.13). For low-income rural households, the corresponding figure was 15.0% of their total cereals expenditures in 2006, equivalent to 33,293 CFAF = US$62 (Table 5.14).

This is equivalent to saying that the observed price changes in 2008 would have required a compensation of low-income urban households of about 3.7% of their 2006 total household consumption expenditures (proxy for income) to avoid a fall in their welfare. For low-income rural households, the figure was 4.1%.

Table 5.18. Magnitude of Welfare Losses Implied by the Cereals Price Changes over the Period 2008-2011, by Rural Per Capita Income Group

Year	CV (Full impact) in %	Value of compensation based on 2006 average cereals expenditure (CFAF)	Percent of average total household consumption expenditure in 2006
		Low-Income	
2008	15.0	33,293 (62)	4.1%
2009	23.4	51,937 (96)	6.5%
2010	16.7	37,066 (69)	4.6%
2011	23.3	51,715 (96)	6.4%
		Middle- Income	
2008	15.4	52,646 (98)	4.3%
2009	22.7	77,602 (144)	6.3%
2010	16.3	55,723 (103)	4.5%
2011	23.6	80,678 (150)	6.5%
		High-Income	
2008	16.2	61,179 (114)	3.1%
2009	21.7	81,949 (152)	4.2%
2010	15.6	58,913 (109)	3.0%
2011	23.3	87,992 (163)	4.5%

Source: Me-Nsope and Staatz (2016). Note: The figures in parenthesis are U.S. dollar equivalents.

The adverse effect of the higher prices on the Malian population as shown in Tables 5.13 and 5.14 supports the view that essentially every group experienced an income reduction because of the higher cereals prices. However, the percentage reduction in total household consumption declined from the low- to the high-income groups in both the urban and the rural sub-samples. This means that in both locations, the welfare loss from observed price changes in the period 2008 to 2011, as a proportion of total household consumption expenditures, was greater for poorer households than for richer households. Furthermore, the percentage reduction in total household expenditures was higher for rural groups than for urban ones. These findings are consistent with findings presented in Chapter 6 on the results of bidding wars for staple foods that break out between low-income and high-income groups in times of price spikes.

Me-Nsope (2014) also showed that rice accounted for a substantial part of the overall welfare effect implied by the higher cereals prices. Across all income groups, the full welfare effects of the increase in rice prices were higher in the urban area than in the rural area across all years. This result was not surprising given that the share of rice in cereals budget was much larger in urban areas than in rural areas.

5.5. Conclusions and Policy Implications

The analysis in this chapter points to five major conclusions and related policy implications. First, the descriptive analysis conducted by ReSAKSS/MSU suggests that cereals continue to take up an important share of the food budget in the Sahel region of West Africa, and roots and tubers continue to account for an important share of the food budget in coastal West African countries like Côte d'Ivoire and Togo. The study finds evidence of a diversification in the diet characterized by a growing demand for maize and to some extent roots and tubers in the Sahelian countries. These findings imply that changes in staple food prices have a strong effect on consumers' budgets and hence are likely to be politically very sensitive.

Second, the estimated marginal propensities to consume various food products imply that food demand will grow strongly in West Africa as per capita incomes increase, including demand for basic starchy staples. The results from the econometric analysis of cereals demand in Mali also found high expenditure elasticities for cereals in both urban and rural areas of Mali, reinforcing the message that demand for these staples will be robust if per capita incomes continue to grow. This implies that prices are likely to rise if supply is not increased substantially. Therefore, there is a need to expand production while driving down unit costs throughout the food system.

Third, the compensated cross-price elasticities derived from the estimation of cereals demand in Mali point to a relationship of substitution among the different cereals in both the urban and rural sub-samples. This finding suggests not only a scope for dealing with price spikes for one cereal by increasing the availability of substitutes—a possibility that the earlier findings of low cross-price elasticities seemed to discount—but also a scope for price transmission across cereals. Efforts geared towards expanding production and driving down the unit cost of production could encourage consumption of these grains, and private sector involvement in the processing of coarse grains to reduce preparation time would give consumers more opportunity for substitution and choice. Overall, this finding points to a need for a cereals policy rather than just, for example, a rice policy.

Fourth, the findings further suggest that demand patterns for cereals may be changing over time. For example, while past findings suggested that coarse grains were generally less preferred in the urban areas for various reasons such as the high opportunity cost of the time required for their preparation, Me-Nsope and Staatz (2016) found a high expenditure elasticity for sorghum in the urban sub-sample. This finding could be explained by the greater availability of mechanical processing of coarse grains in urban areas, which reduces preparation time and makes the grains more attractive for consumption to urban dwellers.

Fifth, the welfare analysis of cereals price shocks in Mali over the period 2008-2011, considering the first order (direct) and the second-order (substitution) responses, revealed a very limited substitution effect during this period because all the prices of all cereals rose together. If supply of some of the cereals could have been increased, e.g., through greater regional trade, the scope for substitution would have been greater. Estimates of the full impact revealed that all households were adversely affected by cereals price changes and the adverse effect of the higher cereals prices on Malian population ranged from a 1% to 7% income reduction, without considering the possibility of producer supply response. The findings suggest that, as expected, in both the urban and rural population, low-income households are hardest hit by cereals price increases–i.e., the percentage increase in total household expenditure required to compensate for the higher prices was lowest for the high-income group and largest for the low-income group. The willingness to substitute one cereal type for another implies that expanding the availability of these cereals could help reduce some of the welfare losses from cereals price shocks, especially those emanating from the world market for rice. Overall, the estimated welfare losses from the recent price hikes suggest a need to address supply (including marketing, international, and regional trade, and processing) issues in order to improve consumers' welfare and food security.

References

Alderman, H. 1986. *The Effect of Food Price and Income Changes on the Acquisition of Food by Low-Income Households.* Washington, DC: IFPRI.

Banks, J., R. Blundell, and A. Lewbel. 1997. Quadratic Engel Curves and Consumer Demand. *Review of Economics and Statistics* 79.4: 527-539.

Bopape, L.E. 2006. The Influence of Demand Model Selection on Household Welfare Estimates: An Application to South African Food Expenditures. Ph.D. Dissertation, Michigan State University.

Boughton, D.H. 1994. A Commodity Subsector Approach to the Design of Agricultural Research: The Case of Maize in Mali. Ph.D. Dissertation, Michigan State University.

Camara, O. 2004. The Impact of Seasonal Changes in Real Incomes and Relative Prices on Households' Consumption Patterns in Bamako, Mali. Ph.D. Dissertation. Michigan State University.

de Janvry, A. and E. Sadoulet. 2008. Methodological Note: Estimating the Effects of the Food Price Surge on the Welfare of the Poor. Assessed on March 23, 2016 at http://are.berkeley.edu/~esadoulet/papers/FoodPriceMethodologyDec08.pdf.

Delgado, C. 1989. Why Is Rice and Wheat Consumption Increasing in West Africa? Paper Presented to the European Seminar of Agricultural Economists, May 29-June 2. Montpellier, France.

Diagana, B., F. Akindès, K. Savadogo, T. Reardon, and J.M. Staatz. 1999. Effects of the CFA Franc Devaluation on Urban Food Consumption in West Africa: Overview and Cross-Country Comparisons. *Food Policy* 24.5: 465-478.

ELIM-2006. 2006. Enquête Légère Intégrée auprès des Ménages. http://www.instat-mali.org/nada/index.php/catalog/4.

Friedman, J. and J.A. Levinsohn. 2002. The Distributional Impact of Indonesia's Financial Crisis on Household Welfare: A 'Rapid Response' Methodology. *World Bank Economic Review* 16.3: 397-423.

Hollinger, F. and J.M. Staatz. 2015. *Agricultural Growth in West Africa: Market and Policy Drivers*. Rome: FAO and African Development Bank.

Joseph, G. and Q. Wodon. 2008. *Assessing the Potential Impact on Poverty of Rising Cereals Prices: The Case of Mali*. World Bank Policy Research Working Paper Series No. 4744. Washington, DC: The World Bank. Assessed March 23, 2016 at SSRN: http://ssrn.com/abstract=1277063.

Me-Nsope, N. M. 2014. Trends and Determinants of Food Consumption Patterns in West Africa. Ph.D. dissertation, Michigan State University. http://web2.msue.msu.edu/afreTheses/fulltext/Me_Nsope_Dissertation_Final.pdf

Me-Nsope, N. M. and J.M. Staatz. 2016. *Household-Level Evidence of Cereals Demand and the Welfare Implications of Cereals Price Shocks in Rural and Urban Mali.* PRESAO/SRAI 2 Component Working Paper No. 2016.01. East Lansing and Bamako: Michigan State University. . http://fsg.afre.msu.edu/srai2/WP2016_01_MeNsope_Staatz_Household_paper_AAAE_RESUBMISSION.pdf

Nouve, K. and Q. Wodon. 2008. Impact of Rising Rice Prices and Policy Response in Mali: Simulations with Dynamic CGE Model. Washington, DC: World Bank. Mimeo.

Reardon, T., T. Thiombiano, and C. Delgado. 1988. La substitution des céréales locales par les céréales importées : la consommation alimentaire des ménages à Ougadougou, Burkina Faso. Paper presented at the CEDRES/IFPRI Colloque sur la Consommation Alimentaire au Burkina Faso, 6-7 June, 1988, in Ouagadougou, Burkina Faso. Washington: International Food Policy Research Institute.

Rogers, B.L. and M. Lowdermilk. 1991. Price Policy and Food Consumption in Urban Mali. *Food Policy* 16.6: 461-473.

Taondyandé, M. and M. Yade. 2011. Etude sur la Consommation Alimentaire en Afrique de l'Ouest: Rapport de synthèse. Draft Report. Ibadan, Nigeria: ReSAKSS West Africa.

Taondyandé, M. and M. Yade. 2012. Etude sur la Consommation Alimentaire en Afrique de l'Ouest. AGWA Background Paper. Ibadan, Nigeria: ReSAKSS West Africa.

CHAPTER 6

The Role of Staple Food Substitution and Trade in Moderating Major Food Shocks in Sahelian West Africa

Le rôle de la substitution des denrées de base et du commerce dans l'atténuation des chocs alimentaires dans le Sahel en Afrique de l'Ouest

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Abstract

This chapter reports results from a multi-market simulation model to evaluate the impact of common production and world-price shocks on food consumption of vulnerable groups in Sahelian West Africa. The analysis confirms that poor households bear the brunt of such consumption risks, particularly in closed markets, where trade barriers restrict imports and the poor find themselves in a bidding war with richer consumers for limited food supplies. In the absence of expanded trade, a drought that reduces domestic rainfed cereal production by 20% would compress already low calorie consumption of the rural poor by as much as 15%, four times as much as other household groups. Conversely, a 50% spike in world rice prices would hit the urban poor hardest, reducing their calorie consumption by up to 8%.

Policy responses need to focus on two basic mechanisms that can help to moderate this pressure—trade and consumer substitution among staple foods. Immediately south of the Sahel, coastal West African countries enjoy higher rainfall, dual rainy seasons, more stable staple food production based on root crops (cassava and yams) as well as frequent double cropping of maize. The model simulation results indicate that regional trade in maize, yams, and cassava-based prepared foods like gari and attieké could fill over one-third of the consumption shortfall resulting from a major drought in the Sahel. Increasing substitutability across starchy staples, for example through expansion of maize, cassava, and sorghum-based convenience foods, would further moderate consumption pressure by expanding the array of food alternatives and hence supply responses available during periods of stress.

Résumé

Ce chapitre délivre les résultats d'un modèle de simulation multi-marchés visant à évaluer l'impact de la production courante et des chocs des cours mondiaux sur la consommation de denrées alimentaires au niveau des groupes vulnérables des pays sahéliens en Afrique de l'Ouest. L'analyse confirme que les ménages les plus pauvres font les frais de tels risques de consommation, notamment dans les marchés fermés où les barrières commerciales réduisent

les importations et où les pauvres se trouvent dans une guerre de surenchère avec les consommateurs les plus riches dans un contexte d'approvisionnements limités de denrées alimentaires. En l'absence d'un commerce intense, un épisode de sécheresse qui diminuerait la production pluviale de céréales de 20%, réduirait de 15 % la consommation déjà faible en calories des pauvres des zones rurales, soit quatre fois plus que les autres catégories de ménages. Inversement, une hausse de 50% du cours mondial du riz affecterait les populations urbaines les plus défavorisées, réduisant ainsi leur consommation en calorie d'un pourcentage pouvant atteindre jusqu'à 8%.

Les réponses politiques doivent se focaliser sur deux mécanismes de base susceptibles de contribuer à modérer cette pression—le commerce et la substitution des denrées de base au niveau du consommateur. Situé immédiatement au Sud du Sahel, les pays côtiers d'Afrique de l'Ouest ont une pluviosité plus importante, deux saisons des pluies, une production plus stable de denrées à base de racines (manioc et ignames) ainsi que de grandes possibilités de doubles récoltes de maïs. Les résultats de ce modèle de simulation indiquent que le commerce régional de maïs, d'ignames et d'aliments préparés à base de manioc (comme le gari et l'attiéké) pourrait combler pour plus d'un tiers les baisses de consommation résultant d'une forte sécheresse au Sahel. Les importantes possibilités de substitution parmi les féculents, par exemple à travers une augmentation d'aliments à base de maïs, de manioc ou de sorgho prêts à consommer, réduirait significativement les conséquences de la baisse de consommation en élargissant la gamme de choix alimentaires et de ce fait les réponses de l'offre pendant les périodes de stress.

6.1. Introduction

Increasingly erratic weather patterns, together with recent world food crises in 2008 and 2011, have convinced West African policy makers of the growing need to understand the effects of major food shocks on the food security of poor households. In particular, two common shocks impose significant pressure on vulnerable households in the Sahel region of West Africa: (a) production shocks—commonly caused by droughts that result in reduction of the region's supply of rain-fed staples (sorghum, millet, and maize); and (b) world price shocks, especially for imported staple food in the region, such as rice. These production and price shocks limit the poor's access to food and trigger concerns among policymakers about how to reduce the effects of the shocks on poor, vulnerable households.

Developing adequate policy responses to these shocks requires a better understanding of the pathways through which they affect the food consumption of different groups in the population. In order to provide such an understanding, researchers under the SRAI 2 program developed a simulation model to estimate the effects of such shocks on the calorie consumption levels of four different population groups in a typical Sahelian economy: the rural poor, the rural nonpoor, the urban poor, and the urban nonpoor. The full structure of the model and its results are available in Haggblade, Me-Nsope, and Staatz (2016). This chapter summarizes the main findings from the analysis, highlighting the effects on the food consumption levels of the different population groups of: (a) their willingness to substitute between different staple food groups depending on relative prices and (b) regional and international commodity trade in softening the deterioration in food consumption that results from major supply shocks. By highlighting critical factors influencing consumption outcomes, the results help draw implications for food and trade policies, including efforts to develop new technologies and markets for processed products that can help to broaden the ability of poor families to deal with major supply shocks.

6.2. Methods and Data

The study developed a multi-market simulation model, following the tradition of Braverman and Hammer (1986), to evaluate the impact of common production and world-price shocks on food consumption of vulnerable groups in the West African Sahel. The model simulates staple food consumption responses to price and income shocks of differing household groups using available estimates of key consumption parameters. To account for differences in consumption patterns, income sources and therefore vulnerability to key shocks, the model distinguishes between two categories of food-insecure households (the rural poor and the urban poor) as well as two nonpoor groups, urban and rural. The model includes five commodity groups─three staple foods (sorghum and millet, rice, and other starchy staples), high-value foods, and non-foods. Other starchy staples (OSS) for the Sahelian countries include maize, wheat, sweet potatoes, Irish potatoes, fonio, and small amounts of yams and cassava. High-value foods (HVF) include fresh fruits and vegetables, fats and oils, dairy products, poultry, fish, red meat and high-protein legumes such as cowpeas and groundnuts. Nonfood goods and services account for the remainder of household consumption expenditures.

More specifically:

- The model constructs as its baseline an archetype Sahelian food economy using detailed consumption, price, production, and trade data from 2010. A baseline household population, consumption, and expenditure profile is constructed for each of the four household groups using 2010 consumption survey data from Mali along with official poverty line estimates from 2010.[1] Table 6.1 summarizes the baseline population data as well as per capita food consumption and total expenditure for the four household groups.
- Initial consumption data reveal that within the staples, sorghum and millet provide the largest source of calories in most Sahelian countries (Table 6.1 and Me-Nsope 2014). Rice is the region's second most important single source of calories. Other starchy staples for the Sahelian countries contribute calories per capita roughly comparable to rice.
- Rural nonpoor (RN) households produce more food than they consume, making them large net sellers of food. In contrast, the rural poor (RP) and urban households remain net buyers of staple foods.
- While poor rural households rely on sorghum and millet for over 40% of total calorie intake, urban households rely more heavily on rice, consuming three times as much rice per capita as the rural poor, 66 kg per capita annually compared to 19 kg (Table 6.1). Because of these differences in consumption patterns, specific shocks affect these two

[1] The consumption data are drawn from the 2010 Enquête Legère Intégrée auprès des Ménages (ELIM) study in Mali (République du Mali 2011), while the Malian national poverty line from 2010 is used to define poor and nonpoor household groups (Republic of Mali 2011).

groups very differently. To capture these differences in consumption patterns, the initial consumption basket for each household group was obtained from ELIM 2010, République du Mali (2011) and Bricas, Tchamda, and Thirion (2013). In aggregate, the baseline food consumption quantities respect the per capita calorie availability of 2,833 kcal/person/day as well as the commodity composition of those calories as outlined in the Mali food balance sheet for 2010 (FAOSTAT 2016).

- Differences in consumption patterns affect the vulnerability of the urban and rural poor to various types of price shocks. An examination of detailed consumption data revealed significant differences in the composition of OSS and HVF consumed by different household groups. Within OSS, urban and nonpoor groups consume more wheat products and Irish potatoes than do rural and poor groups, while maize and sweet potatoes claim a larger share of OSS consumption among the rural groups. Even more striking differences emerge in the high-value foods, where wealthy and urban groups typically consume more beef, dairy products, fish, horticultural, and processed foods than do the rural and nonpoor households. In contrast, the rural households and urban poor consume a greater proportion of HVF in the form of oils and legumes (particularly cowpeas and groundnuts). As a result, the calorie density of HVF and OSS differs markedly across household groups. Among HVF, poor households purchase foods with a calorie density more than double that of HVF consumed by nonpoor groups (see Table 6.1).
- Aggregate food supply data were generated from FAO food balance sheets (FAOSTAT 2016). Because Mali's large irrigated rice infrastructure makes it far more rice self-sufficient than its neighbors, the baseline import shares adopt the Sahel-wide average of 40% domestic production and 60% rice imports (Table 6.2).

Price formation and supply responses differ across these five commodity groups. Given a single annual cropping season for most agricultural commodities, the model sets the short-run supply elasticity of domestic production at zero for all commodities. Weather-induced shocks to domestic production shift domestic supplies, leading to endogenous price determination for sorghum and millet (SM), other starchy staples (OSS) and high-value foods (HVF). Because imports account for over half of Sahelian West Africa's rice supplies, the model fixes the nominal rice price at import parity. Nonfoods similarly take prices as fixed, with imports balancing supply and demand. Other starchy staples (OSS) include a mix of internationally traded wheat products and regionally traded staple food substitutes, most notably maize, roots, and tubers, which traders bring north into the Sahel from coastal production zones. Given two rainy seasons across most of coastal West Africa, maize farmers in particular can respond rapidly to price hikes in regional markets, enabling higher imports during drought years. For this reason, the model includes an upward-sloping supply of OSS imports. In sum, endogenous prices equilibrate sorghum/millet, OSS and high-value food markets, while imports balance supply and demand for the model's two fixed-price commodities, rice, and nonfoods.

Table 6.3 summarizes these alternative supply responses and price formations embodied in this stylized model of Sahelian West Africa.

- Income for each household group varies in response to production and price shocks, which alter the quantity and value of the group's output. The model takes baseline production shares for each household group as fixed and allocates production shocks proportionally across producing groups.

- Consumption likewise varies in response to price changes and shifting nominal income of each household group. For the four food commodities, the model estimates consumption responses using a log-linear demand function with constant elasticities of demand with respect to total expenditure, own price and cross prices. Demand for nonfoods becomes a residual, computed as total expenditure minus expenditure on foods, with changes in total expenditure set equal to changes in nominal income.

Table 6.1. Household Consumption and Expenditure Baseline

	Household groups				Total
	Rural		Urban		
	Poor	Nonpoor	Poor	Nonpoor	
Population share (%)	37%	25%	8%	30%	100%
Total expenditure ($/capita/year)	207	558	384	1,449	683
Consumption (kg/capita/year)					
sorghum/millet	125	158	55	61	109
rice	19	42	66	117	58
other starchy staples	56	103	45	110	83
high-value foods	39	102	138	278	134
nonfoods*	83	310	133	958	406
Net sales (production minus consumption: kg/capita/year)					
sorghum/millet	-28	133	-55	-61	0
rice	-1	24	-66	-117	-35
other starchy staples	-12	116	-45	-110	-12
high-value foods	89	153	54	-278	-8
Calorie density (kcal/kg)					
sorghum/millet	2,893	2,893	2,893	2,893	2,893
rice	3,618	3,618	3,618	3,618	3,618
other starchy staples	2,725	2,699	2,697	2,560	2,752
high-value foods	6,247	2,482	2,233	1,308	3,224
Caloric intake (kcal/person/day)					
sorghum/millet	990	1,252	436	483	860
rice	189	418	657	1,155	571
other starchy staples	420	764	334	774	510
high-value foods	671	691	843	994	892
total calories	2,270	3,125	2,270	3,406	2,833

Source: Haggblade, Me-Nsope, and Staatz (2016), compiled from République du Mali (2011); FAOSTAT (2016); Observatoire du Marché Agricole (2015); and Bricas, Tchamda, and Thirion (2013).
*Nonfoods valued in 2010 US$.

Table 6.2. Commodity Supplies Baseline Data

	Sorghum/ Millet SM	Rice R	Other Starchy OSS	High-Value Foods HVF	Nonfoods NF
Production (kg/capita)*	109	23	71	126	414
Exports (kg/capita)*	0	0	0	5	108
Import share of domestic consumption	0%	60%	15%	10%	25%
Price ($/kg)	0.30	0.56	0.45	1.29	1.00
Value added/value of gross output	0.90	0.75	0.90	0.75	0.80
GDP share	0.06	0.02	0.06	0.22	0.63

Source: Haggblade, Me-Nsope, and Staatz (2016) compiled from République du Mali (2011); Observatoire du Marché Agricole (2015); Miller, Adjao, and Staatz (2011); and World Bank (2016).
*Nonfoods valued in 2010 US$.

The model simulates the impacts of two different types of shocks:

- A production shock caused by a serious drought that reduces domestic production of sorghum, millet, and other starchy staples by 20%.
- A price shock in the world rice market resulting in a 50% increase in the world rice price, which in turn affects domestic rice prices.

Table 6.3. Price Determination in the Multi-Market Model

	Supply responsiveness		
Commodity	Domestic Production (Q)	Imports (M)	Price Determination
1. Sorghum/millet	Fixed	Fixed at zero	Endogenous (S=D)
2. Rice	fixed	Perfectly elastic	Exogenous world price sets domestic price
3. Other starchy staples	Fixed	Imperfectly elastic	Endogenous (S=D)
4. High-value foods	Fixed	Fixed	Endogenous (S=D)
5. Nonfoods	Fixed	Perfectly elastic	Fixed at base level; imports balance supply and demand

Source: Haggblade, Me-Nsope, and Staatz (2016).

In order to evaluate the impact of these shocks on the calorie consumption of the four different population groups, the analysis involved a series of simulations, using the General Algebraic Modeling System (GAMS). The first simulation provided a baseline projection that included no substitutions in consumption (all cross-price elasticities of demand set to zero) and only the rice supply (via imports) responsive to changes in prices and incomes. A second set of simulations introduced consumption substitution across staple food groups using cross-price elasticities of demand along with varying assumptions about the degree to which regional imports of other starchy staples (maize, roots, and tubers) respond to changes in demand. Further sensitivity analysis explored the impact of varying degrees of consumer substitution among staple food products and making income exogenous (as opposed to endogenous). See Haggblade, Me-Nsope, and Staatz (2016) for a full set of model equations used in simulating the impact of these shocks on income, prices and food consumption of vulnerable groups.

Critical to the results are the values of the parameters (income- , price- and cross-price elasticities of demand) included in the model. These were chosen following a thorough compilation of existing estimates for the Sahel region of West Africa (see Haggblade, Me-Nsope, and Staatz 2016, Annex B for details). Few of the existing estimates are disaggregated by place of residence (urban/rural) or by income group. In one welcome exception, Camara (2004) examined the effects of seasonality on the cross-price elasticities of different starchy staples in Bamako, Mali. Specifically, Camara's study reports substitution effects among different starchy staples across four different seasons—lean, harvest, post-harvest and planting seasons. Camara's findings reveal that: (a) substitution among different starchy staples was strongest during the lean season; and (b) pooling data across seasons dampens the annual average estimated substitution among the different starchy staples. The present study derived its cross-price elasticities from Camara's uncompensated lean-season parameters, based on their recognition that the lean-season parameters better reflect the behavior of poor households during periods of duress. Table 6.4 presents a summary of empirical estimates of demand parameters in the Sahel region used in this analysis.

6.3. Results

This section summarizes key results from the analysis of the two shocks simulated by the model: the drought-induced production shock that reduces domestic production of sorghum, millet, and other starchy staples by 20%; and the world market rice price shock that raises world rice prices by 50%.

Impact of a Major Drought

Table 6.5 summarizes the impacts of a major drought, defined as a 20% fall in the domestic production of sorghum and millet (SM) and other starchy staples (OSS), on the calorie consumption of the different population groups under various scenarios. The scenarios differ by the assumptions they make about: (a) the degree of substitution in demand between the different food groups and (b) the responsiveness of regional imports of other starchy staples during a major drought. Under all scenarios, the rural poor (RP) faced the greatest consumption pressure of all household groups. For example, under scenarios that allow rice imports but no increase in regional trade in OSS (Simulations a and b in Table 6.5), the RP faced severe compression in caloric intake, with per capita caloric intake falling by 15%, two to four times more than other household groups. The severity of the impact on rural poor households reflects the group's high initial level of sorghum/millet consumption and their sensitivity to changes in the sorghum/millet price (own-price elasticity of demand of -0.8, as shown in Table 6.4). The results further indicate that in the absence of any increase in regional imports of OSS (Simulations a and b in Table 6.5), increases in the prices of sorghum and millet and of other starchy staples will result in falling real incomes for the rural poor and both urban household groups, who are net buyers of products.

Allowing a moderate increase in regional trade in OSS, however, causes a significant reduction in the consumption pressure. Specifically, the results indicate that under the scenario with moderate regional imports of other starchy staples (Table 6.5, Simulation c), regionally sourced imports of 164,000 tons from unaffected coastal countries moderate the domestic OSS price, as well as other foods prices.[2]

Table 6.4. Demand Parameters

Elasticity of Demand	With Respect to Commodity i			
	Sorghum/ Millet SM	Rice R	Starchy Staples OSS	High-Value Foods HVF
Expenditure elasticity of demand				
Rural poor (RP)	0.90	1.40	0.70	1.50
Rural nonpoor (RN)	0.40	0.90	0.50	1.20
Urban poor (UP)	0.80	0.90	0.60	1.00
Urban nonpoor (UN)	-0.20	0.50	0.40	0.80
Price elasticity of demand, Rural Poor				
sorghum/millet (SM)	-0.8	0.1	0.15	
rice '(R)	0.1	-0.4	0.05	
other starchy staples (OSS)	0.2	0.05	-0.9	
high-value foods (HVF)				-0.6
Price elasticity of demand, Rural Nonpoor				
sorghum/millet (SM)	-0.6	0.05	0.15	
rice '(R)	0.2	-0.2	0.1	
other starchy staples (OSS)	0.1	0.05	-0.6	
high-value foods (HVF)				-0.4
Price elasticity of demand, Urban Poor				
sorghum/millet (SM)	-0.4	0.1	0.1	
rice '(R)	0.1	-0.8	0.15	
other starchy staples (OSS)	0.15	0.15	-0.8	
high-value foods (HVF)				-0.9
Price elasticity of demand, Urban Nonpoor				
sorghum/millet (SM)	-0.2	0.05	0.1	
rice '(R)	0.05	-0.4	0.2	
other starchy staples (OSS)	0.1	0.2	-0.5	
high-value foods (HVF)				-0.7

Source: Haggblade, Me-Nsope, and Staatz (2016), Annex B.

[2] The figure for imports of 164,000 tons under the drought scenario with moderate OSS trade (Simulation c) is calculated as the difference between the change in the OSS supply in Simulation b relative to the non-drought situation (-189,000 mt) and that under Simulation c (-25,000 mt). Equivalently, it is equal to the sum of the net change in imports shown in Table 6.5 under Simulation c (98,700 mt) plus the original level of imports in normal years (65,300 mt, or 15% of normal supplies).

Table 6.5. Impact of a Major Drought*

				Simulations					
				a	b	**c****	d	e	f
		Demand substitution		None	Moderate	**Moderate**	Moderate	High	Hi-urban
		Import responsiveness							
		Rice		Infinite	Infinite	**Infinite**	Infinite	Infinite	Infinite
		Other Starchy Staples		Zero	Zero	**Medium**	Infinite	Medium	Medium
Simulation Results									
% Δ	Q	Domestic Production							
		SM		-20	-20	**-20**	0	-20	-20
		Rice							
		OSS		-20	-20	**-20**	0	-20	-20
		HVF							
% Δ	P	Price							
		SM		49.4	67.1	**53**	0	60.9	54.5
		Rice							
		OSS		37.1	53.2	**14.7**	0	18.3	15.9
		HVF		3.5	4.9	**2.6**	0	3	2.7
% Δ	M	Imports							
		SM							
		Rice		2.9	24.5	**12.5**	0.0	27.7	19.7
		OSS				**98.7**	0.0	131.7	108.8
		HVF							
Δ	S	Total Supply Change ('000 tons) =							
Δ	D	Change in Demand ('000 tons)							
		SM		-289	-289	**-289**	0	-289	-289
		Rice		13	113	**58**	0	127	91
		OSS		-189	-189	**-25**	0	30	-8
		HVF							
% Δ	Cal/cap/day								
		RP	rural poor	-15.4	-15.0	**-11.3**	0	-9.4	-11.5
		RN	rural nonpoor	-8.1	-4.4	**-4.3**	0	-0.7	-4.4
		UP	urban poor	-6.7	-3.6	**-2.0**	0	1.4	1.2
		UN	urban nonpoor	-5.1	-1.2	**-0.4**	0	2.9	2.6

Source: Haggblade, Me-Nsope, and Staatz (2016).
* Shock = 20% reduction in domestic production of sorghum, millet (SM) and other starchy staples (OSS).
** Best-guess baseline scenario.

Compared to a 53% increase when no increase in regional trade is allowed (Simulation b), the OSS price rises only 15% in Simulation c. This smaller price increase relative to the no-increase-in-trade scenario in turn triggers substitution between different foods, thereby driving calorie improvements among all household groups. For rural poor households, calorie compression drops from -15% when there is no increase in regional trade to -11% with moderate regional imports of OSS. The urban poor also benefit from the increased regional imports in OSS, with their calorie shortfalls dipping from -3.6% to -2.0%. Further increases in trade responsiveness (Simulation d) raise the total supply of OSS from imports even more, further moderating the OSS price increase, and consequently reducing calorie compression among all household groups.

The moderate regional trade scenario (simulation c) is more realistic than the other scenarios given likely aggregate supply constraints in the coastal countries, and hence is dubbed the best-guess baseline scenario in Tables 6.5 and 6.6.

In addition to regional trade, substitution among food staples also helps to moderate consumption pressure, though primarily among urban households and the rural nonpoor. To observe the effect of substitution in demand on consumption when there is a major drought, compare Simulations a (zero cross-price elasticities) to simulation b (non-zero, positive cross-price elasticities). The results indicate that allowing for substitutions leads to increased consumer demand for rice in response to sharply increased SM and OSS prices, an increase in demand that is met by increased rice imports, which benefit all rice consumers.

The results indicate, however, that urban nonpoor households benefit the most from the increased rice imports when substitution is allowed. This result is due to this group's greater initial consumption of rice and their stronger purchasing power than other groups. The effect on calorie consumption of the substitution in demand during a major drought is marginal for rural poor households (calorie compression dropped from -15.4% to -15.0%). The modest benefit to the rural poor is because food substitution in the absence of trade pushes up prices for local foods, and given the rural poor's weak purchasing power, these households get outbid for those foods by the nonpoor households (see more in section 6.4 below).

Impact of a World Rice Price Hike of 50%

Table 6.6 illustrates the impacts of a 50% spike in world rice prices. The findings indicate that urban households, particularly the urban poor, are hardest hit by higher rice prices. Under the most realistic conditions (moderate demand substitution and moderate trade in OSS – Simulation i), per capita calorie consumption would fall by 7.0% among the urban poor and by 3.2% for the urban nonpoor when rice prices rise by 50%. The results indicate that rural households face smaller losses due to their lower initial levels of rice consumption. The rural nonpoor would actually benefit slightly, with calorie consumption increasing by 0.2% when there is a spike in the price of rice of 50%. This result is due to the rural nonpoor being large net sellers of rice; hence, their incomes rise with the large increase in rice prices. This income effect more than offsets the impact of the higher price of the rice that they consume.

Allowing for moderate substitution between foods in the absence of an increase in regional trade in OSS (Table 6.6, Simulation h) increases the demand for substitute staple foods to make up for the reduced consumption of rice caused by the rice price spike, thus pushing up the prices of SM (+8.8%) and OSS (10.4%). Under this scenario, all household groups except the rural nonpoor see their consumption levels fall considerably. Meanwhile, the rural nonpoor, as net sellers of food, benefit from the increase in the prices of substitute staple foods (OSS and SM), allowing them to increase their calorie consumption.

As in the case of a major drought, regional trade in OSS helps to moderate the consumption pressure originating from the spike in the world rice price. Moderate responsiveness of regional OSS imports (Simulation i) increases the total supply of OSS by 38,000 tons relative to the pre-price-spike situation, an increase which fills about a third of the total supply gap created by the 101,000-ton reduction in rice imports.

This growth in the OSS supply enables greater substitution towards these starchy staples, thereby softening the impact of the rice price hike on per capita calorie consumption for all household groups.[3] The results show that the rural poor benefit the most from a moderate increase in trade in OSS, as their calorie loss per capita declines from -2.0% with no expansion of OSS trade to -1.1% with a moderate OSS trade increase.

Table 6.6. Impact of a 50% Increase in World Rice Price

				Simulations					
				g	h	**i***	j	k	l
		Demand substitution		None	Moderate	**Moderate**	Moderate	High	Hi-urban
		Import responsiveness							
			Rice	Infinite	Infinite	**Infinite**	Infinite	Infinite	Infinite
			Other Starchy Staples	Zero	Zero	**Medium**	Infinite	Medium	Medium
Simulation Results									
% Δ	Q	Domestic Production							
		SM							
		Rice							
		OSS							
		HVF							
% Δ	P	Price							
		SM		0.6	8.8	**7.0**	5.8	16.6	9.1
		Rice		50	50.0	**50.0**	50.0	50	50
		OSS		0.5	10.4	**4.2**	0	9.5	7.2
		HVF		0.6	1.4	**1.0**	0.8	1.6	1.2
% Δ	M	Imports							
		SM							
		Rice		-24.1	-20.2	**-22.1**	-23.3	-15.1	-19.2
		OSS				**22.8**	39.4	57.2	41.3
		HVF							
Δ	S	Total Supply Change ('000 tons) =							
Δ	D	Change in Demand ('000 tons)							
		SM							
		Rice		-111	-93	**-101**	-107	-70	-88
		OSS				**38**	65	95	69
		HVF							
% Δ	Cal/cap/day								
		RP	Rural Poor	-1.3	-2.0	**-1.1**	-0.5	-0.6	-1.9
		RN	Rural Nonpoor	-0.3	0.0	**0.2**	0.4	1.8	-0.1

Source: Haggblade, Me-Nsope, and Staatz (2016).
* Best-guess baseline scenario.

Sensitivity Analysis

Increasing the degree of substitution among staple foods: Tables 6.5 and 6.6 also analyze the impact of variations in the willingness of consumers to substitute among different food staples, as measured by cross-price elasticities of demand. The next-to-last column of each table shows how outcomes would differ if all cross-price elasticities of demand shown in Table 6.4 were doubled—for example, if expansion in the availability of processed forms of millet, sorghum and other starchy staples made them closer substitutes for each other and for rice. The last column in each table shows the impacts of doubling only the cross-price elasticities in the urban

[3] The increase in OSS price fell from 10.4% with no expansion of OSS trade to an increase of only 4.2% with a moderate increase in OSS trade.

areas—for example, if newly available processed products remain concentrated only in the cities.

In the case of a major drought, higher food substitution among all household groups (Table 6.5, Simulation e) leads to a major increase in rice imports (compared to the base Simulation c) and to a slight increase in OSS and SM prices, which, in turn, trigger increased OSS imports. In this scenario, the responsiveness of rice imports increases from 58,000 tons in the base scenario (Table 6.5, Simulation c) to 127,000 tons under higher food substitutability (Table 6.5, Simulation e). All income groups benefit. However, when higher substitutability occurs only in urban areas, only the urban households gain. While the urban poor see calorie consumption improve, from a 2% decline with a drought under moderate substitutability (Simulation c) to a 1.2% improvement under urban-only higher substitution (Simulation f), both rural household groups see exacerbated calorie losses.

A similar result occurs in the face of a world rice price spike (Table 6.6). All households benefit from increased substitutability when cross-price elasticities increase for all household groups (Simulation k). In response to higher substitutability, SM and OSS prices increase, triggering increases in OSS imports. These imports increase from 38,000 tons in the base scenario (Simulation i) to 95,000 tons under high substitution (Simulation k). As a result, all household groups see improved calorie consumption. However, when only urban households have access to higher substitutability foods (Simulation l), urban households improve calorie consumption at the expense of rural households. This outcome suggests that the geographic availability of more substitutable processed foods, which may trigger these changes in substitutability in the first place, will become an important determinant of differential consumption outcomes in rural and urban areas.

Endogenizing farm income: The simulations presented in Tables 6.5 and 6.6 all consider farm income to be endogenous—that is, they assume that as prices rise, incomes increase for those groups that are net sellers of the goods (the rural non-poor for major food staples). Income gains from these net sales help to moderate the consumption shock resulting from increases in staple food prices. In contrast, if income is held exogenous (unaffected by the staple food price increases), calorie losses accruing to the rural nonpoor (large net sellers of millet and sorghum) nearly double in the drought scenario to -7.6% compared to -4.3% under the assumption of endogenized farm income in the base scenario (simulation c in Table 6.5). A similar result occurs in the event of a 50% hike in world rice price; calorie consumption for the rural nonpoor would fall from roughly neutral (0.2% increase) in the base scenario (Simulation i in Table 6.6) to -1.1% without the income effect (see Haggblade, Me-Nsope, and Staatz 2016 for details).

6.4. Discussion

Bidding Wars

Any supply shock will trigger a bidding war among different groups in the population for the resulting reduced supply of staples. In the case of a major drought affecting the supply of SM, these bidding wars determine which groups will absorb the reduction in sorghum and millet supplies and which ones will capture the increase in OSS supplies resulting from the induced increase in regional imports. Table 6.7 illustrates the bidding war in the aftermath of a major drought. The results indicate that the rural poor would absorb a disproportionate share of the total reduction in SM and OSS compared to their share of total consumption of those goods in the baseline (pre-drought) situation. Although the rural poor account for 43% of baseline SM consumption, they absorb 57% of the total reduction in supplies. In contrast, the urban nonpoor account for 17% of total initial SM consumption, but absorb less than 6% of the reduction, as they bid supplies away from the rural poor. Although the reduction in total OSS supply amounts to only 2.2% due to increased regional OSS imports, the rural poor and all urban households lose the bidding war for OSS supplies to the rural nonpoor, who absorb only 14% of the reduced supply compared to their 31% baseline consumption share. As large net sellers of cereals, the rural nonpoor see their real income increase with rising commodity prices, enabling them to bid away food supplies from all other household groups. For the same reason, rice supplies, which increase by 7.5% due to imports, also go disproportionately to rural nonpoor households, a group that accounts for only 18% of the initial share of national rice consumption but absorbs 40% of the increased rice supplies.

Table 6.7. Bidding Wars Following a Major Drought

	SM - supply falls by 20%		OSS- Supply falls by 2.2%		Rice- Supply increases by 7.5%	
Household group	Initial share of total consumption	Share of reduction absorbed	Initial share of total consumption	Share of reduction absorbed	Initial share of total consumption	Share of increase absorbed
Rural poor	43%	57%	25%	32%	12%	12%
Rural nonpoor	36%	34%	31%	14%	18%	40%
Urban poor	4%	3%	4%	8%	9%	8%
Urban nonpoor	17%	6%	40%	46%	61%	40%
total	100%	100%	100%	100%	100%	100%

Legend: Losers (shaded: Rural poor SM 57%, OSS 32%; Urban poor OSS 8%; Urban nonpoor OSS 46%, Rice 40%); Winners (green: Rural nonpoor OSS 14%, Rice 40%; Urban nonpoor SM 6%)

Source: Compiled from Table 6.5, Simulation c.

Table 6.8 illustrates the outcome of these bidding wars following a rice price hike in the world market. In this case, the bidding wars revolve around which groups will absorb the reduction in rice supplies and which ones will capture the increase in OSS supplies resulting from the induced increase in regional imports. The results indicate that in the scramble for diminishing rice supplies, the rural nonpoor clearly win, as they account for 18% of initial rice consumption, but they absorb only 6% of the total reduction in supplies. In contrast, the urban poor emerge as the clear loser, accounting for only 9% of initial rice consumption but absorbing 17% of the shrinkage. The results also indicate that in the bidding war for increased OSS supplies, the rural poor lose out—they account for 25% of initial OSS consumption, but they capture only 1% of increased OSS supplies. In contrast, the urban nonpoor capture over 80% of increased OSS supplies.

Table 6.8. Bidding Wars Following a World Rice Price Hike

	SM - supply stable		OSS- Supply increase by 3.4%		Rice- Supply falls by 13.2%	
Household group	Initial share of total consumption	Share of final consumption	Initial share of total consumption	Share of increase absorbed	Initial share of total consumption	Share of decrease absorbed
Rural poor	43.2%	43.1%	25%	1%	12%	13%
Rural nonpoor	36.1%	35.9%	31%	13%	18%	6%
Urban poor	3.8%	3.9%	4%	5%	9%	17%
Urban nonpoor	16.9%	17.1%	40%	81%	61%	64%
total	100%	100%	100%	100%	100%	100%

Legend: Losers (shaded: Rural poor OSS 1%; Urban poor Rice 17%); Winners (green: Urban nonpoor OSS 81%; Rural nonpoor Rice 6%)

Source: Compiled from Table 6.6, Simulation i.

Trade

Trade serves as a potentially critical shock absorber in times of food insecurity. In particular, the simulations highlight the importance of rice imports during drought years and of OSS imports from coastal countries during times of drought in the Sahel as well in periods of world price spikes. Specifically, in the case of a major drought, regional imports of 164,000 tons of maize, cassava and other starchy staples (OSS) from unaffected coastal countries plus 58,000 tons of rice imports from Asia fill nearly 40% of the gap resulting from a 20% decline in domestic SM and OSS production (Table 6.5, Simulation c). Similarly, in the case of a world rice price hike, regional imports of OSS (especially maize) fill over 35% of the gap resulting from price-induced reductions in rice imports (Table 6.6, Simulation i). The findings in Tables 6.5 and 6.6 clearly show that increases in the supply responsiveness of regional OSS imports can help to moderate consumption pressure in the Sahel.

These findings reinforce the importance of repeated efforts by the Economic Community of West African States, West Africa Economic and Monetary Union, Comité Permanent Inter-Etats de Lutte contre la Sécheresse au le Sahel (ECOWAS, WAEMU, CILSS) , and other regional organizations to maintain open borders (see Chapter 13 in this volume). Such efforts will prove critical in building resilient regional food systems capable of coping with what would otherwise be extreme consumption compression by vulnerable groups during food crises.

Consumer Substitution

Substitution among staple foods serves to moderate supply-induced consumption shortfalls. The basic mechanism at work involves bidding up prices of unaffected substitute foods, which in turn helps to elicit a supply response. In Eastern and Southern Africa, multi-year storage of in-ground cassava stocks serves as a regional food buffer stock in drought years, when maize supplies fall (Haggblade et al. 2012). In West Africa, in contrast, maize supplies from the coastal countries, which are generally less affected by drought than their northern Sahelian neighbors and which have two rainy seasons (and hence the possibility of two maize crops per year), play a similar buffering role. In addition, yams and cassava-based convenience foods like gari and attieké are increasingly traded between the coastal states and the Sahel. The model simulation results highlight the importance of consumer substitution among food staples. In scenarios without short-term supply response through regional trade in OSS, consumer substitution benefits primarily nonpoor households, who have the purchasing power to outbid vulnerable groups for limited available food supplies.

6.5. Conclusions and Policy Implications

Four major policy implications emerge from the preceding analysis:

First, fluid trade benefits vulnerable groups. The results highlight the critical importance of trade in staple foods, both regionally and internationally. Tradeability of staple foods provides a vital shock absorber that protects both the urban and rural poor populations from shocks resulting from reductions in domestic staple food production and spikes in world prices. In the case of a major drought, policy makers have long recognized the importance of rice imports in helping protect the urban poor and nonpoor populations. Less widely recognized is how regional tradability of other starchy staples, coupled with the willingness of consumers to substitute these other starchy staples for rice to some degree, can mitigate the pain caused by a major drought or a spike in world rice prices. For example, compare a major drought scenario where only rice imports can increase and there is no inter-staple substitution by consumers to a scenario of moderate tradability of OSS and a degree of substitution consistent with our best estimates of cross-price elasticities of demand. In the latter scenario, the reduction in per capita calorie consumption among the urban poor falls by more than two-thirds compared to the former scenario and virtually disappears for the urban nonpoor. Among the rural poor, who absorb the hardest hits during a major drought, compression in per capita calorie consumption falls 27% relative to the no-increase-in-OSS-trade, no-substitution scenario.

Therefore, efforts by ECOWAS and other regional organizations to build a truly regional market for foodstuffs in West Africa will prove vital to the food security of the Sahelian countries. The challenge remains to convince policy makers that more open borders can only function effectively as a two-way street. The Sahelian countries cannot expect to be able to close their own borders to exports in periods of high prices (to protect domestic consumers) and simultaneously expect their neighbors to export to them during periods of stress. Yet, the need to protect low-income domestic consumers during periods of high prices remains a stark political reality. The Sahelian countries therefore need to find instruments other than trade barriers to offer that consumer protection. This leads directly to the second policy implication.

Second, the poor require special support. The urban and rural poor typically suffer the most acute calorie compression during food crises, particularly when policy makers place restrictions on regional trade. During rice price crises, the urban poor face the largest consumption pressure, while in drought years the rural poor emerge as most vulnerable. Therefore, in addition to improving trade flows, policy makers need to offer increased purchasing power through temporary, targeted income transfers to vulnerable groups. These could take various forms, from public works employment to direct cash transfers to in-kind distribution of food.

These efforts need to target the rural poor and not just the urban poor. The income impacts of higher food prices help to temper the adverse impacts on the rural nonpoor, but have little positive impact on the rural poor. Because the rural nonpoor are net sellers of starchy staples and high value foods, higher food prices increase their incomes, which helps offset the negative effects of higher prices on their consumption. The differential income effect on the rural nonpoor and the rural poor underlines the need in policy analysis to distinguish between rural net sellers and rural net buyers of staple foods rather than assuming that all farmers benefit from higher food prices.

Third, there is a need to increase substitutability through improved processing of traditional staple foods. The sensitivity analysis presented above demonstrates that increasing the degree of substitutability of sorghum/millet and other starchy staples for rice (e.g., through processing) could help reduce the adverse impacts of a world price shock on consumers, particularly when coupled with more open regional trade in these products. For many years, CILSS and other regional organizations have promoted the development of processed maize, millet, sorghum, and other local food products to substitute for imported rice (Ilboudou and Kambou 2009). The analysis suggests that these product-development efforts can significantly help the poor, but only when coupled with efforts to ensure the regional tradability of locally produced starchy staples. The analysis further suggests that increasing cross-product substitutability only in urban areas—for example, through making such processed products more available only in the cities—can actually make the rural population worse-off by exacerbating the bidding wars between rural and urban groups for available food supplies. This finding implies that policy makers need to include rural areas in their efforts to improve the availability of processed local staple foods.

Fourth, policy makers need to support efforts to get better information on cross-product substitution. Developing improved food policies requires solid information on how consumers will respond to changes in the relative prices of different foods. The results of the sensitivity analysis demonstrate the sensitivity of outcomes to the demand parameters used in the model. Despite their importance, available estimates of cross-price elasticities for different staple foods in the Sahel remain scarce (see Chapter 5 in this volume). Furthermore, those that exist from econometric studies vary considerably in terms of commodity disaggregation, times, location, and methods. There is therefore a need to support further research on consumer behavior, including use of non-econometric approaches (e.g., contingent valuation studies with consumers) to obtain more reliable and disaggregated estimates of expected consumer responses during periods of stress.

References

Braverman, A. and J.S. Hammer. 1986. Multimarket Analysis of Agricultural Pricing Policies in Senegal. In *Agricultural Household Models: Extensions, Applications, and Policy,* ed. Inderjit Singh, Lyn Squire, and John Strauss. Baltimore: Johns Hopkins University Press for the World Bank.

Bricas, N., C. Tchamda, and M.C. Thirion. 2013. Consommation alimentaire en Afrique de l'ouest et centrale : les productions locales tirées par la demande urbaine, mais les villes restent dépendantes des importations de riz et de blé. Déméter 2014. *économie et stratégies agricoles* 20: 125-42.

Camara, O. 2004. The Impact of Seasonal Changes in Real Incomes and Relative Prices on Households' Consumption Patterns in Bamako, Mali. Ph.D. dissertation. Michigan State University.

FAOSTAT. 2016. http://faostat3.fao.org/home/E.

Haggblade, S., A.A. Djurfeldt, D.B. Nyirenda, et. al. 2012. Cassava Commercialization in Southeastern Africa. 2012. *Journal of Agribusiness in Developing and Emerging Economies* 2.1: 4-40. doi: 10.1108/20440831211219219.

Haggblade, S., N.M. Me-Nsope, and J.M. Staatz. 2016. *Food Security Implications of Staple Food Substitution in Sahelian West Africa*. PRESAO/SRAI 2 Working Paper No. 2016-02. Bamako and East Lansing: Michigan State University. http://fsg.afre.msu.edu/srai2/WP2016_02_Full_length_Article_Food%20Security_Implications_13Oct_reformatted.pdf.

Ilboudou, S. and D. Kambou. 2009. Elaboration d'une stratégie opérationnelle de dévloppement de l'agro-industrie au Sahel et en Afrique de l'Ouest: rapport provisoire. Ouagadougou: CILSS Sécretariat, Exécutif Programme Régional d'Appui/Accès aux Marchés.

Me-Nsope, N.M. 2014. Trends and Determinants of Food Consumption Patterns in West Africa. Ph.D. dissertation, Michigan State University. https://etd.lib.msu.edu/islandora/object/etd%3A2830.

Miller, S., R. Adjao, and J. Staatz. 2011. Excel Spreadsheet Decision Support Tool to Assess the Impact of FTF Investments on Income Growth and Food Security. Report to USAID/Mali. East Lansing, MI: Michigan State University. http://fsg.afre.msu.edu/promisam_2/FTFMatrix_2011.xls.

Observatoire du Marché Agricole (Mali). 2015. Le Reflet, various issues. http://www.oma.gov.ml/.

Republic of Mali, Ministry of Economy and Finance, General Secretariat. 2011. Presentation of the Report on the 2010 Review of the Strategy Framework for Growth and Poverty Reduction. Bamako. https://www.imf.org/external/pubs/ft/scr/2011/cr11372.pdf.

République du Mali, Ministère de l'Economie et des Finances, Institut National de la Statistique (INSTAT). 2011. Résultats préliminaires du volet ELIM. Bamako: République du Mali. http://www.maliapd.org/IMG/file/pdf/ACTUALITE/Rapport_ELIM_draft_06_06_11.pdf.

World Bank. 2016. Global Economic Monitor (GEM) Commodities website. http://databank.worldbank.org/data/reports.aspx?source=global-economic-monitor-(gem)-commodities.

CHAPTER 7

Projected Demand and Supply for Various Foods in West Africa: Implications for Investments and Food Policy[1,2]

Projections de la demande et de l'offre pour diverses denrées alimentaires en Afrique de l'Ouest : implications pour les investissements et la politique alimentaire

Yuan Zhou and John M. Staatz

Abstract

This chapter uses expenditure-elasticity estimates derived from budget-consumption studies in West Africa and hypotheses about alternative income growth trajectories to develop scenarios about the evolution of demand for various foods in the region over the period 2010–2040. It then compares the projected demand growth with projection of production growth in key commodities to identify potential or increasing demand–supply gaps. From this comparison, it derives implications for needed investments and policies regarding different commodities and components of the West African agrifood system. The analysis shows that in absolute terms, production shortfalls relative to demand for starchy staples, particularly rice and wheat, will continue to pose a major challenge for the Economic Community of West African States (ECOWAS) countries. In relative terms, however, imbalances between domestic production and demand will increase more quickly for foods with high income-elasticities of demand, such as meat, dairy products, seafood, fruits and vegetables and vegetable oils. Urban demand will grow two to four times faster than rural demand, depending on the commodity, putting increased pressure on already stressed urban food marketing systems. Substantial variations in supply–demand gaps across countries suggest that more fluid regional trade could help individual countries cope with these challenges. The findings also suggest that the focus of food policies in West Africa, historically on starchy staples, particularly cereals, needs to broaden to include a range of higher-value products for which demand is likely to increase very rapidly in the near future.

Résumé

Ce chapitre se base sur des estimations de l'élasticité des dépenses dérivées d'études budgets-consommation en Afrique de l'Ouest et sur des hypothèses se rapportant à divers scénarios d'augmentation des revenus pour élaborer les grandes tendances d'évolution de la demande de divers aliments dans la région sur la période 2010–2040. La projection de l'augmentation de la demande est ensuite comparée à la projection de l'augmentation de la production des produits de

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[1] A longer version of this chapter originally appeared in *Food Policy* 61 (2016) 198–212. Reprinted by permission.

[2] In this chapter, the term *West Africa* refers to the 15 countries that are members 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.

base-clés pour repérer les potentiels écarts ou disparités croissantes entre la demande et l'offre. Partant de cette comparaison, il a été déduit des besoins d'investissements et de politiques concernant divers produits de base et composantes du système agroalimentaire ouest-africain. L'analyse démontre qu'en termes absolus, le déficit de production par rapport à la demande de féculents, particulièrement le riz et le blé, continuera de poser un grave problème aux pays de la CEDEAO. En termes relatifs, toutefois, le déséquilibre entre la production intérieure et la demande augmentera plus rapidement pour les aliments à forte élasticité de la demande par rapport aux revenus, tels que la viande, les produits laitiers, les fruits de mer, les fruits et légumes frais et les huiles végétales. La demande urbaine progressera deux à quatre fois plus rapidement que la demande rurale, en fonction du produit de base, ce qui exercera une pression accrue sur des systèmes de commercialisation alimentaire urbaine déjà tendus. Ces fluctuations importantes de l'écart entre l'offre et la demande dans les pays laissent à penser que des échanges régionaux plus intenses pourraient aider les pays à relever individuellement ces défis. Ces conclusions semblent aussi indiquer que les politiques d'Afrique de l'Ouest, centrées dans le passé sur les féculents, particulièrement les céréales, doivent être élargies pour intégrer un éventail de produits de plus grande valeur marchande pour lesquels la demande devrait progresser très rapidement dans un avenir proche.

7.1. Introduction

As discussed in Chapters 4 and 5, food demand has been growing rapidly and changing in its composition over the past 30 years in West Africa. In addition to population and income growth, changes in lifestyles associated with globalization and the region's rapid urbanization appear to be major drivers of changing food demand in West Africa (Hollinger and Staatz 2015). West Africa is the most urbanized part of Sub-Saharan Africa, with 45% of the population living in cities in 2015, and one of the most rapidly urbanizing areas of the world (UNDESA 2014). A growing urban middle class (which the African Development Bank (2011) defines as those families living on more than US$2 per capita per day), combined with increasing time pressures on all urban consumers due to congestion and increased labor-force participation of women outside the home, are boosting the demand for more convenient, processed and prepared foods that are easy to prepare and consume. There is also increasing demand, especially among the middle class, for product attributes such as consistent quality, healthiness, and food safety (Bricas and Seck 2004; Hollinger and Staatz 2015).

The governments of all 15 ECOWAS member states and ECOWAS as a regional organization have increased their policy emphasis on agricultural growth since the food price spikes of 2008. All are in the process of adopting new investment programs and policy changes aimed at stimulating agricultural growth and food system transformation. In addition, starting in 2015 ECOWAS countries began instituting a common external tariff (CET), which aims at providing a uniform schedule across member countries of taxation of imported food products. The rapid evolution of food demand in West Africa, however, raises serious questions about how well West African agrifood systems will respond to the changing demand, quantitatively and qualitatively, over the coming 25 years, even with the new ECOWAS CET. If they cannot, the region will become increasingly dependent on food imports and/or face higher domestic food prices. In crafting improved policies and investments for the agrifood sector, it is therefore critical to have a better understanding of how demand is likely to evolve and compare this with likely trends in domestic supply.

This chapter provides such information. It compares projected rates of growth in expenditures for major food items, in rural and urban areas, with projected rates of growth in the supply of those items. These projections are made for the ECOWAS region as a whole and for individual West African countries over the period 2015-2040, relative to a baseline of 2010. The comparison is done in five-year increments from 2010 through 2040. This comparison allows identification of: (a) the shifting relative importance of rural and urban areas in total food demand and (b) food items where significant production shortfalls relative to demand may lead to burgeoning imports and/or increases in real prices. Such information will suggest possible areas where current food system development efforts will need to be modified.

7.2. Literature Review and Knowledge Gap

Economists have long noted that rising per capita incomes and urbanization typically lead to striking changes in dietary patterns (e.g., Bennett 1954). West Africa is no exception. Since the 1980s, policy makers in the region have been concerned about how urbanization and rising incomes were leading to substitution of rice and wheat—largely imported—for locally produced starchy staples, particularly cereals such as millet and sorghum (CILSS and OECD 1989). This substitution led to worries that the region's import-dependence for basic staples could reach financially unsustainable levels, and to proposals in the mid-1980s to increase import barriers in order to create a *regional cereals protected zone* (Gabas, Giri, and Mettetal et al. 1987).

The policy concerns stimulated analyses in the 1980s and early 1990s of the factors driving these shifts (e.g., Delgado and Miller 1985; Reardon, Thiombiano, and Delgado 1988; Delgado 1989; Rogers and Lowdermilk 1991). A major conclusion from these analyses was that while declining relative prices for the imports relative to locally produced staples played some role in stimulating the substitution (particularly in the CFA franc countries, where the currency was becoming increasingly overvalued during the 1980s and early 1990s, making imports cheaper for domestic consumers), much of the shift was prompted by urban consumers' desire for convenience. Wheat products (bread, pasta, etc.) are practically ready-to-eat, and rice is much quicker to prepare than traditional West African starchy staples (e.g., millet, sorghum, yams, and cassava). Time-pressed urban consumers increasingly shifted their consumption towards these *convenience foods*. Although processed forms of the traditional staples (e.g., packaged millet and sorghum flours and *instant* processed yams) have appeared in West African markets in recent years to try to capture some of this demand, their market share remains small relative to rice and wheat products (Hollinger and Staatz 2015).

During the 1990s and early 2000s, analysts' attention broadened beyond starchy staples to examine other forms of dietary diversification, including increased consumption of fruits, vegetables, animal products, and processed foods, particularly in urban areas, and increased attention to product quality (e.g., Cour and Snrech 1998; Bricas and Seck 2004). The OECD/Sahel and West Africa Club was particularly active in sponsoring studies examining the possible impacts of urbanization on the structure of West African agriculture and its likely capacity to compete with imports (e.g., OECD 2014). While some recent studies (OECD 2014; Bricas, Tchamda, and Thirion 2013; Hollinger and Staatz 2015) have drawn insights from budget-consumption studies to discuss changing patterns of rural and urban food consumption, none have used estimates of income-elasticities from such studies to make quantitative projections of future demand for different food products in West Africa or assess their implications for agricultural policies.[3]

In contrast, Tschirley et al. (2013, 2015) have conducted such analyses for East and Southern Africa. Their studies show very rapid likely growth in the demand for high-value products such as meats, seafood, dairy products, fruits and vegetables and a wide range of processed products, in response to rising incomes and urbanization. One implication of their results is that the level of investment in infrastructure and human capital in the post-farm parts of the food system (e.g., food processing and marketing), especially of perishables, will need to increase dramatically in the coming years if demand for these high-value products is to be met through local production rather than imports. This chapter provides a similar analysis for the West Africa region, drawing implications for needed policies and investments.

7.3. Methods and Data

Four steps are involved in carrying out the comparison of the rates of growth of food expenditures with those of the supply of different food items: (1) projecting the increases in per capita expenditures on total food as well as individual food items due to income growth, in both urban and rural areas, for each country for which data are available, under different income-growth scenarios; (2) converting estimates of rural and urban per capita expenditures in a given year into total expenditures by multiplying the per capita figures by the projected rural and urban populations for that year; (3) aggregating expenditure figures across countries to come up with a regional expenditure estimate for the ECOWAS zone; and (4) making projections of the growth in supply for each of the future years to compare with the projected expenditures. Each of these steps is explained in more detail in the following paragraphs.

Projection of Per Capita Expenditures

Expenditure projections: obtaining initial elasticity estimates. For expenditure projections, we used expenditure elasticity estimates for both rural and urban areas calculated from budget-expenditure study data in eight ECOWAS countries: Burkina Faso, Côte d'Ivoire, Ghana, Mali, Niger, Nigeria, Senegal, and Togo. For seven of the countries, we used expenditure elasticities estimated by the Regional Strategic Analysis and Knowledge Support System (ReSAKSS) in collaboration with national research teams (Tayondyandé and Yade 2012 as reported in Hollinger and Staatz 2015).[4] As estimates for Nigeria were not available from ReSAKSS, we developed such estimates using based on a Tobit model using 2013 Nigerian Living Standards Measurement Study (LSMS) data. The eight countries account for 89% of the total population in West Africa. Table 7.1 summarizes the expenditure elasticity estimates for 18 food groups in both urban and rural areas. A major advantage of using these elasticity estimates as opposed to those available from

[3] Income elasticities of demand are a measure of how quickly demand for a product increases as incomes rise. If demand grows at the same rate as income growth, the elasticity has a value of 1.0; product demands that grow more than proportionally with higher incomes have an elasticity greater than one, and those that grow less quickly than income have a value below one.

[4] Although the elasticities estimated by ReSAKSS are reported in Hollinger and Staatz (2015) as income-elasticities of demand, the underlying studies upon which they were based used total household expenditures as a proxy for income; thus, in reality, these estimates are expenditure elasticities of demand.

United States Department of Agriculture (USDA) (Mohammad et al. 2011) is that the latter are not disaggregated by rural and urban areas. The shifting geographic location of food consumption has major policy implications for West Africa.

All expenditure data are in real per capita U.S. dollars in purchasing power parity (PPP) terms, using constant 2010 international dollars. When the latest data for a given country were before or after 2010, total expenditure values were brought to 2010 levels using the average Gross Domestic Product (GDP) growth rate between the survey year and 2010.

Adjusting expenditure elasticity estimates to take account of future income growth. One challenge in using expenditure elasticity estimates to project consumption patterns more than a few years into the future is that the expenditure elasticities of demand for food generally decline as total expenditures rise. In other words, as a household's income rises, it typically spends less of each additional dollar on food and more on non-food items, a relationship known as Engel's Law. Since we are making demand projections over the period 2010-2040, it is very important to estimate how much average expenditure elasticities will decline over this 30-year period, when per capita incomes are expected to rise substantially under all the growth scenarios (see the next section).

Zhou and Staatz (2016) provide details on how the elasticity estimates were adjusted as projected future per capita income levels increased. The adjustments were made based on observed patterns of declining elasticities among higher-income consumers in Nigeria (for all countries except Nigeria and Ghana, where projected future income levels were highest) and South Africa (for Ghana and Nigeria). After these adjustments were made, the projected change in per capita expenditure for a given item in a given year was calculated relative to 2010 levels by multiplying the estimated expenditure elasticity for the item in that year by the estimated change in per capita income relative to 2010, under six different growth scenarios, as explained below.

Growth scenarios: Two key sources of predictive uncertainty regarding the future demand for different food items are the rate of growth in real per capita expenditure and the distribution of that growth (Tschirley, Haggblade, and Reardon 2013). We developed three scenarios of the rate of per capita income growth: business as usual (BAU), low-case development (LC), and high-case development (HC). LC refers to an outcome resulting from an unfavorable environment while HC indicates a favorable economic climate. Under BAU, the average per capita income growth rates were determined as follows: for the period 2010-15, we took an average of the rates reported in the World Bank's World Development Indicators for 2010-13 and the projections for 2014 and 2015 from the International Monetary Fund (IMF). The average growth rate projections for the period 2016-2040 were based on various IMF country reports (IMF 2014).

All these reports have GDP growth rate projections for 2024 and 2034, which we took as the average growth rate for 2020-30 and 2030-40 respectively. For the LC scenario, we assumed that the annual rate of per capita income growth was 1% less than BAU across countries. For HC, the assumption was that the growth rate was 1% higher than BAU.

Table 7.19. Expenditure Elasticities of Demand for Food Products, by Country and Place of Residence

	Burkina Faso		Côte d'Ivoire		Ghana		Mali		Niger		Nigeria*		Senegal		Togo	
Product	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**
Rice	0.9	1.4	0.4	0.7	1.25	1.17	0.5	1.2	0.8	1.4	0.77	0.92	0.6	0.9	0.8	1.2
Wheat products	1.5	1.7	1	1.2	1.11	1.24	1.3	0.8	1.7	1.5	0.97	1.28	0.7	1.1	1.2	2
Maize	0.4	0.7	0	0.5	0.74	0.81	0.4	0.5	0.8	1.3	0.68	0.58			0.2	0.7
Millet and sorghum*	-0.2	0.6				0.19	0.2	0.5	0.5	0.9	0.84	0.44	0.5	0.9	0.5	0.6
Cassava			0.5	0.7	0.98	1.65					0.49	0.85			0.7	1.1
Yam			0.6	0.5	1.27	2.19					0.79	1.22			1	1.4
Banana-plantains			0.6	0.7	0.37	1.31										
Beans/cowpeas									0.6	1.1	#	#			0.5	1
Pulses							0.7	1.1			0.76	0.87				
Fruits and vegetables	0.9	1	0.8	0.9	0.94	1.31	0.7	0.7	1	1.3	0.78	0.87	1	1.4	1	1.1
Oils and oilseeds	0.9	1.1	0.6	0.7	0.51	0.88	0.7	0.9	1.1	1.2	0.67	0.71	0.6	1	0.8	1
Meat	1.4	1.5	1	1.2	1.16	1.46	1	1.3	1.3	1.3	1.48	1.62	1.3	2.4	1.3	1.6
Fish and seafood	0.9	1.2	0.7	0.8	0.99	0.89	0.6	0.9	0.9	1	0.66	1.08	1	0.9	1	1.2
Dairy products	1.5	1.3	1.3	1.4	1.34	0.51	1.1	1.3	1.2	0.9	1.41	1.42	1.1	2.1	1.7	2.1
Sugar							0.6	0.8			0.94	0.89	0.6	1		
Beverages and stimulant:	1	1.1	1.3	1.3	1.81	1.61			1.1	1.4	1.34	1.78			1.3	1.1
Outside dining			3.2	4.3							1.10	1.18			1.6	1.3
Other food products	0.7	1	1.2	1.5	1.67	1.37	0.8	0.9	1	1.1			1	0.9	0.9	0.9

* For Nigeria, expenditure elasticities of demand were estimated in more disaggregated form for the following products. Figures shown in this table are weighted averages means of the individual ite (with the weights corresponding to individual items' budget shares), but in expenditure projections reported later in paper, individual disaggregated elasticities were used and resulting amounts for each individual item were aggregated to get total amounts of these "aggregated" commodities:

- Millet and sorghum--each estimated separtely
- Cassava: gari and "other cassava" estimated separately
- Meat: spearate estimates for beef, mutton and goat, poultry and other meat.

Source: Tayondyandé and Yade 2012 as reported in Hollinger and Staatz 2015, for countries other than Nigeria. Authors' estimates for Nigeria based on 2012/13 LSMS data.

To address the issue of income distribution, we created two sub-scenarios of distribution of growth across rural and urban areas for all the scenarios. *Urban bias* implies that the rate of growth in per capita income in urban areas will grow 20% faster than the national average, while *equitable growth* assumes that the growth rates for urban and rural areas will be the same. These result in six scenarios in total: BAU1 (urban bias), BAU2 (equitable growth), LC1 (urban bias), LC2 (equitable growth), HC1 (urban bias) and HC2 (equitable growth).

For reasons of brevity, we present below results for only three scenarios, which illustrate the range of possibilities: BAU1 (growth in per capita incomes at the levels projected by the IMF, with the current patterns of urban bias continued into the future); LC1 (the national average per capita growth rate 1% lower than the IMF forecast but with urban incomes continuing to grow faster than rural incomes); and HC2 (growth of per capita incomes 1% higher than the IMF forecast, with urban and rural incomes growing at the same rate).

Projection of Total Expenditures by Country

For each of the projection years, we multiplied the projected rural and urban per capita expenditures for different food items times the forecast mid-year rural and urban populations as developed by the UN Department of Economic and Social Affairs (UNDESA 2014). This procedure yielded the projected total daily expenditures for rural and urban areas for the respective years. Adding up the rural and urban figures gives a projection of total daily expenditures for the country.

Projection of Regional Expenditures

We provide projections of expenditure growth for the entire 15-country ECOWAS zone as well as for selected individual countries. The motivation to provide projections for the zone as a whole arises because, as described in Parts I and IV of this volume, ECOWAS is a key player in the design and implementation of agricultural investments and policies in West Africa.

Nigeria is by far the largest economy in ECOWAS, accounting for 53% of the total population and 64% of the GDP in 2009/10 (UNDESA 2014; World Bank 2011). Therefore, in projecting regional totals, we first calculate the expenditures for Nigeria, based on the elasticities and income growth projections for that country, and then add these to the projected expenditures for the rest of the zone. The non-Nigeria ECOWAS expenditure projections are calculated by taking the sum of total expenditures for the seven remaining countries for which we have budget-consumption data and inflating them in a given year by those countries' share of the total projected non-Nigerian population of ECOWAS. That share varies between 76% and 79% over the period 2015 and 2040. The inflated figures thus assume that expenditures in the smaller non-Nigerian countries for which we have no budget-consumption data will grow at the same rate as those of the seven countries for which data are available. Adding this estimate for all the non-Nigerian countries to the corresponding projected expenditure for Nigeria yields the estimated ECOWAS regional total.

In the analysis that follows, the levels of food expenditures in the projection years (2015 to 2040), both in per capita and total terms, are expressed as ratios, showing their level relative to the corresponding expenditures in 2010.

Projections of Supply Growth Rates

Supply projections are based on production and trade data from FAOSTAT for crop and livestock products and from FAO's FIGIS database for seafood. FAO provides historical data on both volume and value of production and trade of different commodities, with values estimated based on farm-level prices. In making projections of the rate of growth of supply based on these data, one needs to decide: (a) whether to base the projections on volume or value figures; (b) the baseline period used for the projection; and (c) whether to project past rates of growth or develop a more sophisticated supply model to estimate future supply. With respect to (a), we opted, with one exception, to use volume rather than value estimates, as projecting value estimates based on past data would implicitly assume that the patterns of change in prices of the products in baseline period would continue into the future. Since we had no evidence to support this assumption (particularly with respect to the rapid increase in prices starting in 2008), we opted to project growth rates in volume terms. This approach is the equivalent of projecting the rate of growth of the value of production under the assumption that that the real prices of the different commodities will remain unchanged from those prevailing in the baseline year of 2010. Further implications of this assumption are discussed below. The one exception to the use of volume estimates was the supply projections for fruits and vegetables, for which FAOSTAT only provides trade data in value terms (presumably because of concerns that the highly heterogeneous nature of this food group would make tonnage estimates not meaningful). For this food category, we used FAOSTAT data on value of production and trade.

With respect to the choice of a baseline period, we observe that agricultural growth rates in West Africa vary widely from year to year (Hollinger and Staatz 2015, ch. 2), in part because production is largely rainfed.[5] Projection of future growth rates based on short periods is subject to considerable variation depending on the period chosen. We therefore opted to calculate growth rates by commodity over a 10-year period (2004-13) rather than a shorter period.[6] We estimated the annual growth rate by following the World Bank methodology of regressing the natural logs of the production data against time (http://data.worldbank.org/about/data-overview/methodologies). This approach is less sensitive to the choice of beginning and end dates than are alternative measures, such as the average annual or cumulative annual growth rates. For this analysis, we opted for simply projecting past rates of growth forward, with sensitivity analysis of some of the more extreme growth rates to test the robustness of the results. Constructing a full supply model, including incorporating possible impacts of climate change on the production of the various commodities involved, would have been well beyond the scope of the data and time at our disposal.[7]

[5] Only 10% of total cropland in the ECOWAS zone is irrigated (Hollinger and Staatz 2015).

[6] For comparison, we also calculated growth rates for the more recent period, 2009-13, to see if the rates had changed markedly in the period since 2008, when most West African countries began designing and implementing their Comprehensive Africa Agriculture Development Programme (CAADP) investment programs. The results show for the ECOWAS zone as a whole, there was very little difference in the annual rate of growth for rice production (the crop that received the largest attention from West African governments) between the 2004-13 period (7.8%) and the more recent 2009-13 period (7.9%). In the more recent period, the rates of growth of meat and milk production were negative as opposed to positive in the 2004-13 period, perhaps reflecting short-term effects of drought in 2011 in much of the area, but slightly less negative for millet and sorghum production.

[7] IFPRI's IMPACT model (Rosegrant et al. 2012) is a computable general equilibrium model that makes such projections on both the supply and demand side for global and regional markets. Its estimates are based on a different set of elasticity estimates than we use (those of Mohammad et al. 2011), which do not take into consideration differences between rural and urban demand patterns. Using the IMPACT model for these

A country's supply of a given product in a given year equals the sum of domestic production and net trade, assuming no net changes in stocks. Therefore, in order to calculate the projected growth in total supply due to the growth in domestic production, we multiplied the projected growth rate in domestic production by the country's self-sufficiency rate (SSR) for that commodity, where the SSR is defined as the domestic production divided by the sum of domestic production plus imports minus exports.[8] Thus, for example, if the estimated annual rate of growth of domestic production of commodity X was 6% and the SSR was 50%, the estimated growth rate of total supply due to the growth in domestic production would be 3%.

This figure represents the growth rate of total supply *assuming* that net imports of the good are frozen at 2010 (baseline) levels. The assumption that net imports remain frozen is simply a heuristic device used to calculate the amount by which domestic supply would have to increase beyond its historical growth rate to completely meet the projected increase in demand. As discussed below, in reality the greater the calculated demand-supply gap, the more imports would likely increase and the more domestic prices would increase to close the resulting gap.

Comparing Projections of Growth of Expenditures and Supply

Following the methods described above yielded projections of the rate of growth of total expenditures for different food items, expressed as an index relative to 2010 expenditures, and projections of the supply of those items, also expressed as an index relative to 2010 levels, under the initial assumption that all changes in supply are due solely to changes in domestic production. In 2010, each index is equal to 1.0, and expenditures are assumed to equal total supply (domestic production plus net trade). At any point of in the future, if the index for expenditures exceeds that of projected supply, the difference between the two indices represents the degree to which expenditures would exceed supply, assuming no growth in imports and no change in real prices from those prevailing in 2010. This index is expressed as a proportion of the 2010 expenditure on that item. For example, suppose that in 2030 in country X, the projected total expenditures for meat are 1.55 times the amount spent in 2010 while supply is 1.20. This implies a shortfall in supply equal to 0.35 times the 2010 level of meat expenditures. This deficit represents the amount by which imports would have to increase to avoid a real price increase in meat. If imports did not increase by this amount, real prices would increase, which would close the deficit by reducing per capita expenditures (demand response) and increasing domestic supply (likely with a lag). If the index for the supply exceeds that for expenditure, the opposite situation prevails. Comparing the magnitudes of the projected deficits and surpluses across commodities and countries gives a relative picture of the degree to which various food items are likely to face supply-demand imbalances and hence some combination of changing levels of imports and real prices.

In comparing the indices for the growth in expenditures and supply, however, several caveats must be borne in mind. First, the demand projections, being based on budget-consumption studies, reflect only the projected future expenditures for direct human consumption of these

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projections would therefore involve forgoing analysis of the shifting nature of demand between rural and urban areas, which is a central focus of this chapter.

[8] For our analysis, we calculate the SSRs based on the average production and trade data over the period 2006-2010. SSRs vary over time (long-term trends) but show less year-to-year variation than do production figures; therefore, we opted for a shorter, more recent period for the SSRs (to capture ongoing trends) than the longer 2004-2013 period used for calculating our annual production growth rates.

items. To the extent that demand for other uses of the commodities, such as animal feed or industrial uses increases, these expenditure projections are likely to underestimate the total growth in demand. The animal feed demand is likely to be strongest for maize, which we have excluded from the tables below to focus our analysis on the rising demand for direct human consumption. Second, the *demand* projection is in terms of expenditures while, with the exception of fruits and vegetables, the supply projection implicitly implies no change in the real prices of various food items compared with those that prevailed in 2010. However, as consumers' incomes increase, they typically buy higher quality products (e.g., moving from broken rice to whole-grain rice); therefore, one would expect expenditures to increase more quickly than the physical quantities purchased. Therefore, some degree of *apparent deficit* (perhaps 20 to 30%) could be accounted for by this quality upgrading, and thus, not represent a physical deficit.

Third, we acknowledge that projecting annual growth rates calculated for the 2004-13 decade unchanged through 2040 is fraught with risks. While yields in West Africa have increased in recent years, the bulk of the growth in production in the region since 1980 has been due to area expansion rather than yield increases, a process that is unlikely to continue over the next 25 years without causing serious environmental costs. In addition, for a few commodities, percentage annual growth rates of production over the 2004-13 decade have been exceptionally high (e.g., for rice), in part because of the small initial production base, and it is unlikely that these high percentage growth rates can be sustained. On the other hand, for a few commodities (notably millet and sorghum in Nigeria), production has fallen, and projecting the decreases onward for 25 years would imply a near end to production of those goods by 2040. In these cases, we use sensitivity analysis of the supply growth rates to examine what are likely more reasonable long-term assumptions on future supply-demand balances. Fourth, our projections of supply-demand balance are based on the assumption of constant real prices. In reality, if significant deficits or surpluses emerged, domestic prices would likely change (assuming that imports are not perfectly price-elastic); inducing responses on both the supply and demand side that would tend to bring supply and demand back into equilibrium.

The bottom line is that our analysis is not intended to provide precise estimates of future levels of food expenditures and supply. Rather, it is a *what if* analysis that uses elasticity estimates to compare the order of magnitude of supply and demand imbalances that would emerge in if present trends continued. The results therefore suggest areas where changes in current agricultural investments and policies may be needed and, where, absent those, significant changes in food imports and prices will occur.

7.4. Results

Growth in Per Capita Expenditures on All Foods

Table 7.2 shows the projection results of per capita per day food expenditure under three growth scenarios. For brevity, the results are shown in 10-year increments rather than 5-year increments. For BAU1, the level of food expenditure by 2020 would grow by 40% in Nigeria and by 86% in Ghana compared to the base year of 2010; by 2040, total expenditures would be over three times higher in those countries than in 2010.[9] The incremental growth in Mali and Niger is the lowest, reflecting the modest rates of income growth projected for those countries. Under the LC1 scenario (slower growth, urban-biased), the growth levels are relatively modest, with only Ghana growing more than three times the initial level. In contrast, under the HC2 scenario (higher growth, more equal rural-urban income distribution), the growth ratio between 2010 and 2040 is about 5.8 for Ghana and 4.0 for Nigeria. The average per capita per day food expenditure in Ghana increases from US$2.02 in 2010 to US$11.75 in 2040, which is the highest amongst all the selected countries.

Table 7.20. Per Capita per Day Food Expenditure Projections for Selected Countries in West Africa (US$ in Purchasing Power Parity (PPP) Terms, Constant 2010)

	Burkina Faso	Côte d'Ivoire	Ghana	Mali	Niger	Nigeria	Senegal	Togo
Scenario 1: BAU1								
2010	$1.17	$1.04	$2.02	$1.09	$1.00	$1.83	$1.02	$1.25
2020	$1.53	$1.43	$3.75	$1.22	$1.28	$2.56	$1.18	$1.72
2030	$2.05	$1.82	$5.44	$1.41	$1.43	$3.75	$1.56	$2.10
2040	$2.71	$2.33	$8.80	$1.63	$1.62	$5.76	$2.12	$2.63
Growth ratio 2010-40	2.32	2.23	4.37	1.50	1.62	3.14	2.08	2.11
Scenario 2: LC1								
2010	$1.17	$1.04	$2.02	$1.09	$1.00	$1.83	$1.02	$1.25
2020	$1.48	$1.38	$3.54	$1.18	$1.23	$2.45	$1.13	$1.64
2030	$1.84	$1.63	$4.58	$1.28	$1.27	$3.26	$1.36	$1.83
2040	$2.28	$1.94	$6.61	$1.38	$1.33	$4.54	$1.71	$2.09
Growth ratio 2010-40	1.95	1.86	3.28	1.27	1.33	2.48	1.68	1.67
Scenario 3: HC2								
2010	$1.17	$1.04	$2.02	$1.09	$1.00	$1.83	$1.02	$1.25
2020	$1.59	$1.49	$3.96	$1.26	$1.33	$2.69	$1.23	$1.79
2030	$2.28	$2.03	$6.44	$1.56	$1.60	$4.32	$1.77	$2.41
2040	$3.22	$2.80	$11.75	$1.91	$1.97	$7.33	$2.60	$3.29
Growth ratio 2010-40	2.75	2.69	5.83	1.75	1.96	4.00	2.56	2.64

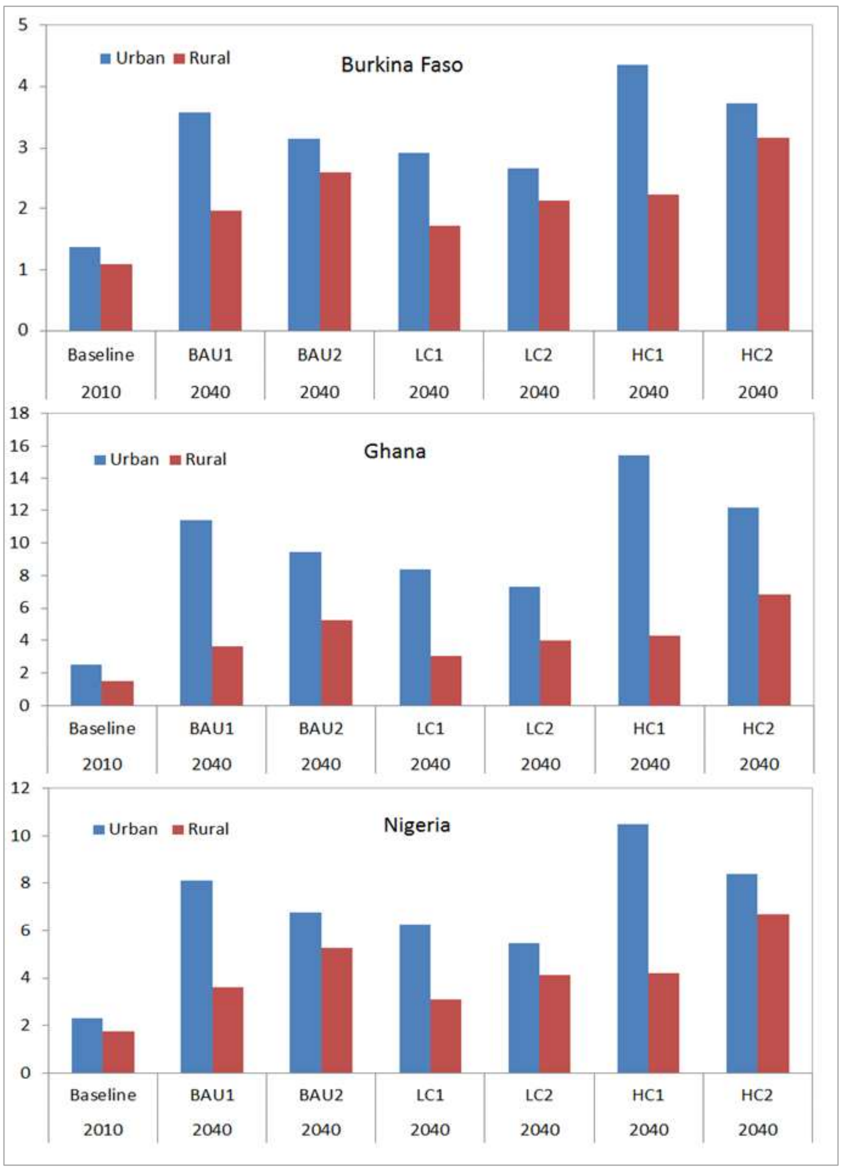
Source for this and following tables, unless otherwise noted: authors based on model results.

[9] This growth includes the value of home-produced as well as marketed food. As more and more people will be relying on the market for food over time, the growth in demand for marketing services will grow even faster than these figures imply. For comparison, in the United States over the 11-year period from 2013/14 through 2024/25, domestic demand for wheat is projected to grow by less than 3%, and demand for chicken, one of the food products with the fastest growing consumption, is projected to grow at 23% (calculated from data in U.S. Department of Agriculture 2015).

The results exhibit clear differences across the six scenarios. Figure 7.1 illustrates the changes in three countries, selected to show a range of outcomes. In all the countries, the baseline situation is that the food expenditure is higher in urban areas than rural areas.

The projection shows that this will continue to be the case through 2040 across all the six scenarios. However, given the priority that hungry people give to allocating income to acquire food, the disparities in per capita food expenditures between urban and rural areas under the *equitable growth* setting are considerably reduced compared to those under the urban bias income growth scenarios.

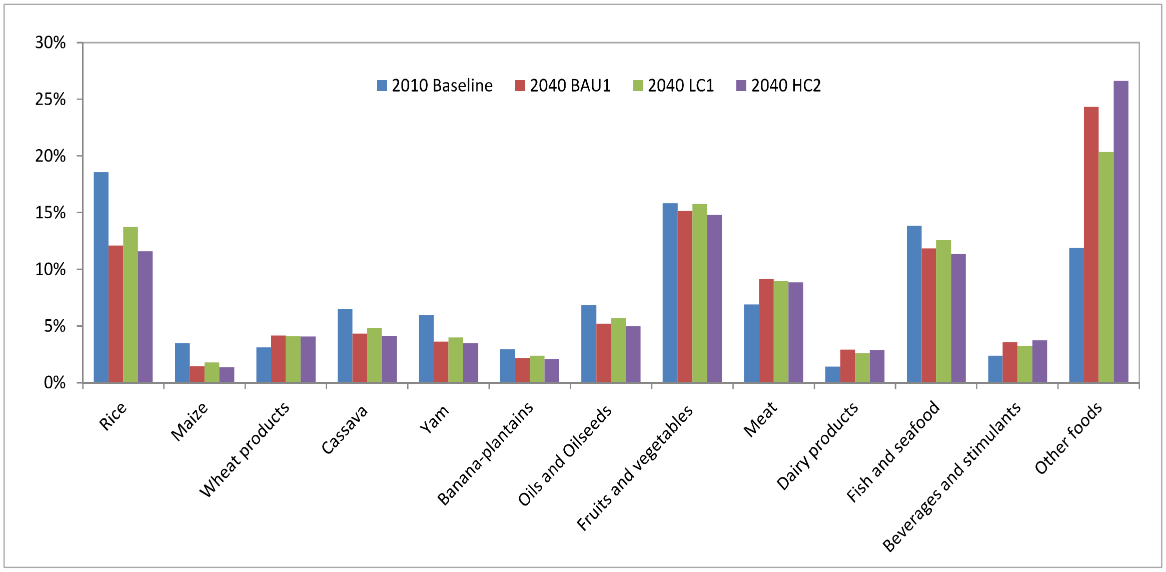
Figure 7.1. Urban vs. Rural Food Expenditure Growth Trajectory under Six Scenarios (US$, PPP)



Source: Model results.

As the total food expenditure grows over the years, the composition of spending across food groups keeps changing. With additional income, households spend more on starchy staples (cereals, roots, and tubers) until such expenditures reach a plateau. Take Côte d'Ivoire as an example (Figure 7.2). Its food budget shares are changing from 2010 to 2040, and there are clear differences across the three main scenarios. The budget shares for most staple crops come down while the shares for meat, dairy, beverages and other foods go up.

Figure 7.2. Food Budget Shares in Côte d'Ivoire by Detailed Food Groups in 2010 and in 2040 under Three Scenarios



Source: Model results.

Growth in Total Expenditures on All Foods

The projected total annual food expenditures for the eight countries (Table 7.3) reflect the combined effects of higher incomes, population growth, and increased urbanization. Under the BAU1 scenario, total food expenditure is projected to increase more than five times over the period of 2010-40 for Burkina Faso, Ghana, Niger, and Nigeria. Notably, total food expenditures in Nigeria and Ghana would increase seven-fold. Even in countries where per capita food expenditure grows relatively slowly, such as in Mali and Togo, the overall food demand expansion is remarkable, due to rapid population growth. For example, by 2040 the food demand would be 3.7 times larger in Mali and 4 times bigger in Togo than it was in 2010.

Under the HC2 scenario, the situation is more dramatic. The total food demand would grow over eight-fold for Nigeria and Ghana by 2040, driven by their high income growth and shift in consumption towards higher-value products. Burkina Faso and Niger would expect food demand over six times bigger by 2040. These would be remarkable changes. To meet the surge in demand, the region's food and agricultural sector needs a major boost in investment.

Table 7.21. Total Annual Food Expenditure Projections for Selected Countries (in Billions PPP US$, Constant 2010)

	Burkina Faso	Côte d'Ivoire	Ghana	Mali	Niger	Nigeria	Senegal	Togo
Scenario 1: BAU1								
2010	$6.64	$7.23	$17.85	$5.56	$5.83	$109.49	$4.80	$2.88
2020	$11.47	$12.44	$45.17	$8.45	$10.95	$200.85	$7.36	$5.06
2030	$19.86	$19.37	$69.98	$13.42	$17.95	$385.41	$12.41	$7.69
2040	$33.17	$30.14	$130.82	$20.73	$29.48	$768.23	$21.01	$11.71
Growth ratio (2010-40)	5.00	4.17	7.33	3.73	5.06	7.02	4.38	4.07
Scenario 2: LC1								
2010	$6.64	$7.23	$17.85	$5.56	$5.83	$109.49	$4.80	$2.88
2020	$11.07	$11.98	$42.66	$8.18	$10.54	$192.12	$7.04	$4.83
2030	$17.83	$17.34	$58.99	$12.15	$16.00	$336.48	$10.87	$6.70
2040	$27.82	$25.09	$98.16	$17.57	$24.23	$610.04	$16.95	$9.31
Growth ratio (2010-40)	4.19	3.47	5.50	3.16	4.16	5.57	3.53	3.24
Scenario 3: HC2								
2010	$6.64	$7.23	$17.85	$5.56	$5.83	$109.49	$4.80	$2.88
2020	$12.28	$12.92	$47.06	$8.82	$12.00	$211.77	$7.79	$5.34
2030	$23.42	$21.29	$78.89	$15.01	$21.86	$439.44	$14.50	$8.84
2040	$41.88	$34.65	$154.67	$24.55	$39.35	$927.38	$26.60	$14.43
Growth ratio (2010-40)	6.31	4.79	8.66	4.42	6.75	8.47	5.54	5.02

Growth in Total Expenditures on Selected Food Items, by Region and Selected Countries, Compared with Projected Supply

Table 7.4 presents the projected growth of expenditures by food category for ECOWAS as a whole, through 2040, expressed as a ratio of the 2010 expenditures in the three scenarios. It also compares the growth of expenditures with the projected growth of domestic supply (as explained above, using parameters shown in Table 7.5) and calculates the deficit or surplus in 2040, expressed as a proportion of the 2010 level of expenditures.

Several points emerge from Table 7.4. First, for the region as a whole, projected demand (expenditures) outstrips projected supply for all commodities examined, but the relative gap between the two is greatest for meat, dairy products, vegetable oil, and fruits and vegetables. For example, Table 7.4 projects that under BAU1, expenditures on dairy products will increase by 2040 to 9.92 times the level of 2010 dairy expenditures, yet domestic supply (holding imports constant) would increase only 1.98 times, leaving a gap equivalent to nearly 8 times the 2010 level of total expenditures on dairy products in the zone. This gap would need to be closed by increased imports and/or higher prices. In contrast, the relative size of the projected deficit in rice is only 2.07 times the 2010 expenditure levels on that commodity. In absolute terms, however, because estimated 2010 expenditures on rice are so much higher than those on dairy products (US$ 21.5 billion vs. US$ 3.8 billion [PPP]), the value of absolute deficit in rice in 2040 would still be 45% larger than that of dairy products (US$44.5 billion vs. US$30.5 billion (PPP), respectively).

Table 7.22. Indices of Projected Total Expenditures on and Supply of Selected Commodities in ECOWAS Region, 2020-2040 (2010 = 1.00)

Commodity	Year	Domestic supply index	Indices of Projected Total Expenditures under Different Growth Scenarios								
			BAU 1**			LC1**			HC2**		
			Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
Rice	2020	1.43	1.84	2.23	1.41	1.77	2.14	1.36	1.93	2.25	1.58
	2030	2.13	3.09	4.14	1.93	2.77	3.67	1.77	3.48	4.25	2.62
	2040	3.16	5.23	7.51	2.70	4.43	6.30	2.35	6.14	7.76	4.34
	*2040 deficit/ surplus**		-2.07			-1.26			-2.98		
Millet & Sorghum	2020	0.72	1.45	1.98	1.36	1.42	1.91	1.33	1.54	1.99	1.46
	2030	0.50	2.08	3.79	1.79	1.95	3.44	1.69	2.36	3.86	2.10
	2040	0.35	3.01	6.98	2.33	2.71	6.00	2.14	3.55	7.16	2.93
	*2040 deficit/ surplus**		-2.66			-2.36			-3.20		
Cassava	2020	1.36	1.75	1.75	1.75	1.69	2.01	1.37	1.84	2.09	1.59
	2030	1.91	2.68	3.46	1.90	2.46	3.17	1.75	3.08	3.52	2.63
	2040	2.68	4.15	5.62	2.67	3.67	5.00	2.33	5.11	5.73	4.49
	*2040 deficit/ surplus**		-1.47			-0.99			-2.43		
Meat	2020	1.25	2.20	2.71	1.59	2.06	2.51	1.52	2.37	2.74	1.92
	2030	1.59	4.86	6.79	2.56	3.93	5.37	2.22	5.88	7.10	4.43
	2040	2.03	12.14	18.66	4.39	8.35	12.47	3.45	16.02	19.84	11.48
	*2040 deficit/ surplus**		-10.12			-6.32			-14.00		
Fish & Seafood	2020	1.33	1.82	2.21	1.40	1.76	2.12	1.36	1.91	2.22	1.58
	2030	1.83	2.92	3.84	1.90	2.63	3.44	1.74	3.30	3.94	2.61
	2040	2.52	4.74	6.63	2.65	4.07	5.66	2.31	5.66	6.83	4.38
	*2040 deficit/ surplus**		-2.21			-1.55			-3.14		

Table 7.4 (cont'd.). Indices of Projected Total Expenditures on and Supply of Selected Commodities in the ECOWAS Region, 2010-2040

Commodity	Year	Domestic supply index	Indices of Projected Total Expenditures under Different Growth Scenarios								
			BAU1			LC1			HC2		
			Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
Dairy Products (milk equiv.)	2020	1.24	2.20	2.71	1.52	2.07	2.52	1.46	2.32	2.75	1.76
	2030	1.56	4.54	6.23	2.28	3.75	5.03	2.03	5.20	6.52	3.44
	2040	1.98	9.92	14.69	3.52	7.29	10.55	2.91	11.88	15.58	6.91
	*2040 deficit/ surplus**		-7.94			-5.31			-9.90		
Vegetable Oil	2020	0.92	1.65	2.01	1.34	1.60	1.94	1.31	1.72	2.02	1.47
	2030	0.85	2.59	3.57	1.77	2.38	3.24	1.65	2.88	3.64	2.25
	2040	0.77	4.05	6.06	2.36	3.57	5.30	2.12	4.67	6.21	3.38
	*2040 deficit/surplus***		-3.27			-2.80			-3.90		
Fruits & Vegetables	2020	1.18	1.85	2.22	1.41	1.77	2.12	1.37	1.94	2.24	1.59
	2030	1.41	3.05	4.03	1.91	2.73	3.56	1.75	3.43	4.15	2.59
	2040	1.69	5.14	7.28	2.64	4.32	6.06	2.30	6.03	7.55	4.25
	*2040 deficit/ surplus**		-3.44			-2.63			-4.33		

*Deficit/Surplus expressed as a proportion of 2010 expenditures on the item

Table 7.23. Supply Parameters Used in ECOWAS Supply Projections

Domestic Supply Parameters	Domestic production annual growth rate	SSR	Annual growth rate of total supply
Rice	7.82%	51.8%	4.05%
Millet & Sorghum	-3.52%	101.6%	-3.58%
Cassava	3.46%	113.4%	3.93%
Meat	2.66%	120.5%	3.21%
Fish & Seafood	3.40%	112.2%	3.82%
Dairy products	4.09%	58.2%	2.38%
Veg. Oil	-1.10%	79.9%	-0.88%
Fruits & Vegetables	1.81%	101.1%	1.83%

Source: Calculated from FAO's FAOSTAT 2016 and FIGIS 2016 databases.

Third, the pace and distribution of income growth have a strong impact on the evolution of expenditures, particularly for foods that have a high income elasticity of demand. This is most evident for animal-based foods, where the projected deficits for meat, dairy products, and fish under scenario HC2 are roughly double those under LC1.

Fourth, for all commodities, the rate of growth in demand is more rapid in urban areas than in rural areas, in some cases strikingly so. For example, the rate of increase of expenditures on meat products relative to 2010 levels under scenario BAU1 is over four times as rapid in urban areas as in rural areas. Even under HC2, where rural incomes increase more rapidly, the rate of growth of urban demand is double that of rural demand. For a starchy staple like cassava, the pattern is less extreme, but even there, projected urban expenditures under BAU1 grow twice as fast as rural expenditures.

The size of the deficit in 2040 for a particular commodity is a function of four variables: the income elasticity of demand for the good, the projected rate of income growth and its distribution, the rate of growth of domestic production and the initial level of the self-sufficiency rate for the good. For millet and sorghum, demand growth is very modest, but because the 2004-13 growth rate of production for the region is negative (due to a sharp fall in Nigeria), a substantial deficit appears for 2040—the equivalent of 2.66 times the 2010 level of expenditures. However, if the annual growth rate in production increased from the baseline level of -3.5% to +3.8%, then the deficit would disappear. For vegetable oil, an annual growth rate of +6.1% would eliminate the deficit, while an increase in the rate for fruits and vegetables from +1.8% to +5.1% would do the same for those commodities. In contrast, the demand for meat and dairy products is projected to grow so fast, and the import dependence for dairy products is so high, that even increasing domestic growth rates of production of each of those commodities to 8%/year would still leave deficits equivalent to 4.2 times the 2010 level of expenditures for meat and 6.2 times for dairy products. The projected deficits for fish would be substantially lower than those for meat; this strongly suggests that in reality the price of fish (currently the most widely consumed form of animal protein in the coastal states of West Africa) would increase relative to meat as consumers shifted even more from meat to fish consumption.

Because Nigeria is the giant in ECOWAS, it is useful to disaggregate the regional results between Nigeria and the rest of the region (Tables 7.6 and 7.7). Outside Nigeria (Table 7.6), the baseline growth rates for production are generally higher except for fish. As a result, the projected deficits are smaller, and in the case of cassava, there is even a small surplus under the LC1 scenario.[10] Nonetheless, the general patterns noted above for the overall region hold, with larger relative deficits for meats, dairy products, vegetable oils, and fruits and vegetables than for starchy staples. As with the regional figures, projected growth in expenditures is more rapid in urban than in rural areas and the overall rate and pattern of income growth across the different scenarios have a strong effect on the projected supply-demand balances.

For Nigeria (Table 7.7), some of the large projected deficits are due to negative growth rates in the 2004-13 baseline periods. For millet and sorghum, projecting the -8.38% growth rate through 2040 results in the near elimination of national production, a clearly unrealistic development. If the growth rate for these commodities could be raised to 4% per annum, the 2040 deficit would be eliminated. Similarly, the baseline growth rate for vegetable oils in Nigeria is also negative (-3.75%/year). This rate would need to increase to +6.7%/year to eliminate the 2040 deficit. In 2011, the Nigerian government announced an ambitious new Agricultural Transformation Agenda. This aimed at, among other things, reversing the declines in sorghum and oil palm production and accelerating growth in other subsectors, such as livestock and cassava (Nigeria Federal Ministry of Agriculture and Rural Development 2011). To the extent that these plans succeed, the deficits shown in Table 7.7 should be smaller. The one bright spot in the current projections is for fish, which shows a surplus for 2040 under BAU1 and LC1, but which drops to near zero in the case of more rapid and less urban-biased growth (HC2). As with the previous examples, growth in expenditures is much more rapid in urban areas than in rural areas under all scenarios.

Space does not permit us to illustrate the full range of variation of demand patterns across all eight countries for which we have done projections. The impact of income growth on the growth of demand, however, is well illustrated by Ghana (Table 7.8). This country has had very robust economic growth in recent years, including in certain agricultural subsectors such as rice, cassava, and export horticulture. Despite the rapid growth in domestic rice production over the baseline period of 2004-13 (over 11%), the high income-elasticity of demand, rapid income growth and low initial rate of rice self-sufficiency result in substantial projected shortfalls by 2040. In contrast, despite tepid growth in domestic production, the lower income-elasticity of demand for millet and sorghum results in a near balance of projected expenditures and supply under all scenarios. The rapid growth of cassava production relative to expenditures for direct human consumption leads to large projected surpluses in 2040, although these could be reduced by increasing demand for cassava for animal feed and industrial products (e.g., starch, flour, and beer). Ghana's strong production performance in horticultural products results in a continuing exportable surplus of fruits and vegetables in 2040, although the actual volumes depend on the pace and pattern of economic growth (cf. LC1 and HC2). Like the other cases examined above, rapid income growth, high income-elasticities of demand, and slow growth of domestic production result in very large projected deficits for meat and dairy products, as well as for vegetable oil.

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[10] Although if industrial demand for cassava increases, as seems to be occurring in recent years, this surplus could quickly turn into a deficit.

Table 7.24. Indices of Projected Total Expenditures on and Supply of Selected Commodities in ECOWAS outside Nigeria in 2040 (2010 = 1.00)

Commodity	Domestic supply index*	Indices of Projected Total Expenditures under Different Growth Scenarios								
		BAU 1			LC1			HC2		
		Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
Rice	4.02	5.13	7.13	2.73	4.25	5.86	2.32	6.12	7.49	4.46
*2040 surplus***		-1.11			-0.23			-2.10		
Millet and Sorghum	2.56	3.00	4.47	2.79	2.73	4.25	2.51	3.75	4.58	3.64
*2040 surplus***		-0.44			-0.17			-1.19		
Cassava	4.68	4.67	6.05	2.92	3.91	5.09	2.41	6.05	6.29	5.75
*2040 surplus***		0.00			0.77			-1.37		
Meat	2.18	6.65	8.55	3.37	5.13	6.52	2.74	8.26	9.30	6.45
*2040 surplus***		-4.47			-2.96			-6.08		
Fish & Seafood	1.54	4.46	6.45	2.17	3.75	5.33	1.92	5.08	6.76	3.15
*2040 surplus***		-2.92			-2.21			-3.54		
Dairy Products (milk equivalent)	2.33	7.30	10.24	3.13	5.51	7.53	2.63	8.76	11.19	5.31
*2040 surplus***		-4.97			-3.18			-6.43		
Vegetable Oil	2.17	3.60	4.82	2.48	3.16	4.24	2.17	4.33	5.02	3.68
*2040 surplus***		-1.43			-1.00			-2.16		
Fruits & Vegetables	2.74	4.84	6.34	2.71	4.03	5.24	2.31	5.79	6.69	4.50
*2040 surplus***		-2.10			-1.29			-3.05		
***Domestic Supply Parameters:**			Rice	Millet &	Cassava	Meat	Fish &	Dairy	Veg. Oil	Fruits &
Production annual growth rate			9.88%	3.20%	5.47%	3.12%	1.52%	4.18%	3.29%	3.29%
SSR			49.8%	102.8%	99.9%	87.4%	98.2%	70.7%	82.1%	107.7%
Annual growth rate of total supply			4.92%	3.30%	5.47%	2.72%	1.49%	2.96%	2.70%	3.54%

**Surplus expressed as a proportion of 2010 expenditures on the item. Negative values indicate a deficit.

Table 7.25. Indices of Projected Total Expenditures on and Supply of Selected Commodities in Nigeria in 2040 (2010 = 1.00)

		BAU 1			LC1			HC2		
		Total	**Urban**	**Rural**	**Total**	**Urban**	**Rural**	**Total**	**Urban**	**Rural**
Rice	2.13	5.41	7.97	2.73	4.64	6.77	2.41	6.29	8.13	4.36
*2040 surplus***		-3.28			-2.51			-4.16		
Millet and Sorghum	0.08	3.11	9.06	1.92	2.77	7.47	1.82	3.45	9.28	2.28
*2040 surplus***		-3.04			-2.69			-3.38		
Cassava	2.03	4.00	1.73	1.82	3.62	1.73	1.82	4.81	1.73	1.82
*2040 surplus***		-1.97			-1.60			-2.79		
Meat	1.62	15.10	25.53	4.82	10.09	16.53	3.75	20.18	27.01	13.45
*2040 surplus***		-13.47			-8.47			-18.56		
Fish & Seafood	6.39	5.05	6.92	3.06	4.40	6.05	2.64	6.22	7.03	5.35
*2040 surplus***		1.33			1.99			0.17		
Dairy Products (milk equivalent)	1.35	12.61	19.43	3.94	9.14	13.79	3.23	15.09	20.29	8.47
*2040 surplus***		-11.26			-7.79			-13.73		
Vegetable Oil	0.42	4.39	6.98	2.33	1.67	1.92	1.48	2.25	2.23	2.27
*2040 surplus***		-3.97			-1.25			-1.83		
Fruits & Vegetables	1.25	5.50	8.38	2.65	4.66	7.00	2.35	6.36	8.57	4.17
*2040 surplus***		-4.25			-3.42			-5.12		
***Domestic Supply Parameters:**			Rice	Millet & Sorghum	Cassava	Meat	Fish & Seafood	Dairy products	Veg. Oil	Fruits & Vegetables
Production annual growth rate			4.68%	-8.38%	2.47%	1.70%	7.33%	3.54%	-3.75%	0.78%
SSR			56.4%	100.9%	100.0%	98.9%	90.1%	29.6%	78.7%	98.3%
Annual growth rate of total supply			2.64%	-8.45%	2.47%	1.68%	6.60%	1.05%	-2.95%	0.76%

**Surplus expressed as a proportion of 2010 expenditures on the item. Negative values indicate a deficit.

Table 7.26. Indices of Projected Total Expenditures on and Supply of Selected Commodities in Ghana in 2040 (2010 = 1.00)

		BAU1			**LC1**			**HC2**		
		Total	**Urban**	**Rural**	**Total**	**Urban**	**Rural**	**Total**	**Urban**	**Rural**
Rice	2.51	7.36	9.94	2.52	5.71	7.60	2.16	8.34	10.52	4.23
*2040 surplus***		-4.84			-3.19			-5.82		
Millet and Sorghum	1.26	1.35	1.72	1.22	1.39	1.90	1.21	1.30	10.52	4.23
*2040 surplus***		-0.09			-0.13			-0.04		
Cassava	8.36	5.55	6.87	3.56	4.54	5.66	2.84	7.40	7.15	7.78
2040 surplus**		2.81			3.82			0.96		
Meat	1.36	7.02	8.79	3.11	5.54	6.89	2.55	8.28	9.26	6.12
*2040 surplus***		-5.66			-4.18			-6.92		
Fish & Seafood	0.78	4.67	6.96	2.05	3.91	5.73	1.83	5.25	7.25	2.95
*2040 surplus***		-3.89			-3.13			-4.46		
Dairy Products (milk equivalent)	1.09	9.07	11.23	1.55	6.83	8.37	1.47	9.70	11.96	1.79
*2040 surplus***		-7.98			-5.74			-8.60		
Vegetable Oil	1.02	2.93	3.57	2.03	2.73	3.37	1.82	3.32	3.60	2.91
*2040 surplus***		-1.91			-1.71			-2.29		
Fruits & Vegetables	6.90	5.10	6.50	2.79	4.26	5.42	2.34	6.11	6.75	5.06
*2040 surplus***		1.80			2.64			0.78		
***Domestic Supply Parameters:**			Rice	Millet & Sorghum	Cassava	Meat	Fish & Seafood	Dairy products	Veg. Oil	Fruits & Vegetables
Production annual growth rate			11.26%	0.79%	7.59%	1.62%	-0.87%	1.62%	0.13%	6.69%
SSR			28.7%	100.8%	100.1%	66.5%	96.6%	19.0%	67.7%	102.9%
Annual growth rate of total supply			3.23%	0.80%	7.60%	1.08%	-0.84%	0.31%	0.08%	6.89%

**Surplus expressed as a proportion of 2010 expenditures on the item. Negative values indicate a deficit.

In Ghana, the rapid growth in demand for animal protein is also manifested by a 2040 deficit for fish and seafood equal to between 3.1 and 4.5 times the 2010 level of expenditures (depending on the growth scenario). As with the other cases examined thus far, the growth in expenditures is much faster in urban areas than rural areas due to rapid urbanization and urban income growth.

Analysis of the other countries (not shown here due to space constraints) shows broadly similar patterns, with increasing relative deficits for animal protein products, fruits and vegetables, and vegetable oils almost everywhere. However, there is substantial variation between countries for individual products, depending on initial production levels, projected rates of income growth, and levels of initial self-sufficiency. Mali, for example, is projected to have a modest exportable surplus of meat products in 2040 unless scenario HC2 prevails (more rapid, less urban-biased growth). Such variations between countries point to the important potential role of regional trade in helping countries cope with shortfalls.

A few words are also warranted about the growing demand for processed and prepared products, for which no supply projections are presented here. Wheat products (e.g., breads and noodles) are a major example. They represent a type of *fast food*, which urban (and increasingly rural) consumers pressed for time are increasingly substituting for other staples. Consumption of products derived from wheat (almost all of which is imported) has increased sharply in West Africa since the 1980 (Me-Nsope and Staatz 2013). The estimated expenditure elasticities of demand for such products (Table 7.1) exceed unity for many of the sample countries, indicating that demand will continue to rise rapidly as long as per capita incomes continue to increase in the region. Similarly, while expenditure-elasticities of demand for prepared food eaten outside of the home are available for only three of the eight sample countries (Table 7.1), these elasticities are uniformly high, suggesting a potentially explosive growth in the demand for such products as urbanization and income growth continue. These findings suggest a very strong future demand for post-harvest processing and marketing services in West Africa, a finding consistent with that found for Eastern and Southern Africa by Tschirley et al. (2013, 2015).

7.5. Conclusions and Policy Implications

Any long-term projections, including those in this study, involve a degree of uncertainty. The demand and supply projections presented here must be used with caution and can be interpreted as indicating orders of magnitude of relative changes in supply-demand balances rather than point estimates. The projected food deficits shown above may be larger than are likely to occur, because of two reasons. First, some of the increased expenditures will go for increased quality of products rather than quantities. Second, the projected shortfalls would likely induce higher prices, which would in turn temper demand and induce increased domestic production.

Nonetheless, the relative patterns are strongly suggestive of how supply-demand balances are likely to evolve in the coming years and hence pressures on real prices. Bridging the gap between demand and supply for certain starchy staples (notably rice and wheat) will continue to be a challenge in absolute terms. However, in relative terms, the demand for other food groups—most notably meats, dairy products, fish, vegetable oils, and fruits and vegetables—will increase even faster relative to supply if current trends continue. This suggests that food policy in West Africa, which has historically focused primarily on starchy staples (especially cereals) needs to give greater emphasis in the future to a broader range of commodities and post-harvest services for which demand will be rising rapidly. While cereals demand (particularly for maize as an input into animal feed) will continue to increase, so will the demand for a much larger array of products. Many of these—livestock products, fish, fruits and vegetables—are perishable. They therefore require more sophisticated and tightly coordinated marketing systems and key investments such as cold chains to link West African producers effectively to these growing demands. The good news is that if such systems can be developed, the production, processing and marketing of these products is much more labor-intensive than cereal production, offering new employment opportunities for West Africa's burgeoning labor force. Similar comments apply for the growing demand for processed agricultural products and prepared foods (Hollinger and Staatz 2015).[11]

Fortunately, as part of a 2015 review of the ECOWAS agricultural policy's past performance and plans for its next 10 years, the regional organization and its stakeholders have recognized the importance of broadening the scope of its initiatives to put greater emphasis on perishables such as animal products and fruits and vegetables, for which demand is increasing rapidly (ECOWAS 2015).[12] One implication of this reorientation is that greater investment is needed in agricultural research in a range of both staple and non-staple foods. Such research is necessary in order to help reduce unit costs of production, so that production can be expanded without sharp increases in consumer prices, and to adapt production to changing environmental conditions in the region.

Our analysis also shows that demand will be rising much more rapidly (from two to over four times more quickly) in urban areas than in rural areas, due to a combination of rapid urbanization and more rapid urban income growth. This implies enormous pressure on already stressed urban food marketing infrastructure, such as public markets, wholesaling systems and retail shops. While national and regional agricultural investment plans do include components to strengthen food-marketing systems, the bulk of the emphasis is at the farmer/first handler level. Improving urban marketing systems—and especially the critical role of improved wholesaling systems to link agro-processors to reliable local supplies of agricultural raw materials—is relatively neglected (Hollinger and Staatz 2015). This analysis strongly suggests the need for much greater policy attention to these urban marketing components, including investments in marketing infrastructure, cold stores, and reliable electricity supplies, which are crucial for the handling and processing of perishable products. In addition, promotion of a business climate that facilitates contracting arrangements between farmer organizations, wholesalers, agro-processors, and modern retailers that allow the downstream sellers more reliable supplies of raw agricultural materials is essential if the growing demand for more consumer-ready products is to be met by local production rather than imports (Ibid.).

Some of the projected shortfalls, particularly for vegetable oil, reflect falling domestic production of commodities for which West Africa historically had comparative advantage. For example, in the 1960s, Nigeria was the world's largest exporter of palm oil, and Senegal was a

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[11] As Tschirley et al. (2013, 2015) point out for East and Southern Africa, exploiting such employment opportunities will require substantially increased investments in labor-force skills for the post-harvest components of the agrifood system, as well as greater investments in marketing infrastructure.
[12] See also Chapter 13 in this volume.

major exporter of groundnut oil. The analysis suggests that if production can be revived in these commodities, there will be a strong local market for the output.

As the comparison across the three growth scenarios shows, the magnitude of the demand increases, particularly for the products with high demand elasticities, is very sensitive to the pace and distribution of future income growth. To the extent that ECOWAS countries are successful in stimulating more rapid, inclusive growth, they will face rapidly growing supply-demand imbalances for animal-based foods, fruits and vegetables, vegetable oils and processed and prepared foods.

Finally, as noted above, the variation in supply-demand balances across countries in West Africa emphasizes the important role that regional trade can play in helping ECOWAS countries face these coming challenges. Given widespread projected shortfalls across countries, food imports from outside the region are likely to grow; policy measures aimed at making ECOWAS's official policy of free trade of agricultural products within West Africa a reality could also be an important component in helping its member states deal with the rapid increases in demand for food they will face in the coming 25 years.

References

African Development Bank (AfDB). 2011. *The Middle of the Pyramid: Dynamics of the Middle Class in Africa*. Market Brief, April 20. Abidjan, Côte d'Ivoire: AfDB.

Bennett, M.K. 1954. *The World's Food*. New York: Harper and Brothers.

Bricas, N. and P.A. Seck. 2004. L'alimentation des villes du Sud: les raisons de craindre et d'espérer. *Cahiers Agricultures* 13.1: 10-14.

Bricas, N., C. Tchamda, and M.C. Thirion. 2013. Consommation alimentaire en Afrique de l'ouest et centrale : les productions locales tirées par la demande urbaine, mais les villes restent dépendantes des importations de riz et de blé. Déméter 2014 : économie et stratégies agricoles. Paris : Club Déméter, p. 125-142.

CILSS and OECD. Comité permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel and Organisation for Economic Co-operation and Development). 1989. Club du Sahel. Espaces Céréaliers en Afrique de l'Ouest/Regional Cereals Markets in West Africa. Documents presented at the Regional Markets Seminar, 6-11 November. Lomé, Togo.

Cour, Jean-Marie and Serge Snrech, eds. 1998. *Preparing for the Future: A Vision of West Africa in the Year 2020—West Africa Long-Term Perspective Study*. Paris; OECD/Club du Sahel.

Delgado, C. 1989. Why Is Rice and Wheat Consumption Increasing in West Africa? Paper Presented to the European Seminar of Agricultural Economists, May 29-June 2. Montpellier, France.

Delgado, C.L. and C.P.J Miller. 1985. Changing Food Patterns in West Africa: Implications for Policy Research. *Food Policy* 10.1: 55–62.

ECOWAS, Department of Agriculture, the Environment and Water Resources. 2015. Outlook, Orientations and Adjustments for ECOWAP for 2025. Paper presented at the International Conference on Agriculture in West Africa, ECOWAP+10 Appraisal and Outlook for 2025 Global Forum, 17-19 November. Dakar, Senegal.

FAOSTAT (FAO's Statistical Database). 2016. Accessed 2 January, 2016 at http://www.fao.org/faostat/en/#home.

FIGIS (Fisheries Global Information System, Food and Agriculture Organization of the UN). 2016. Accessed 2 January, 2016 at http://www.fao.org/fishery/statistics/global-production/query/en.

Gabas, Jean-Jacques, Jacques Giri, and Gilles Mettetal. 1987. *A Protected Regional Cereals Market: An Initial Exploration of a New Idea*. Paris: OECD/Cub du Sahel.

Hollinger, Frank and John M. Staatz, eds. 2015. *Agricultural Growth in West Africa: Market and Policy Drivers.* Rome: FAO and African Development Bank.

IMF. 2014. IMF Country Report 14/215 (Burkina Faso), IMF Country Report No. 14/358 (Côte D'Ivoire), IMF Country Report No. 14/129 (Ghana), IMF Country Report No. 14/337 (Mali), IMF Country Report No. 15/63 (Niger), IMF Country Report No. 14/103 (Nigeria), IMF Country Report No. 14/177 (Senegal), IMF Country Report No. 14/38 (Togo). Washington, DC: IMF.

Me-Nsope, Nathalie M. and John M. Staatz. 2013. *Trends in Per Capita Food Availability in West Africa, 1980-2009*. MSU International Development Working Paper No. 130. East Lansing, Michigan: Michigan State University.

Mohammad, Andrew, James L. Seale, Jr., Birgit Meade, and Anita Regmi. 2011. *International Evidence on Food Consumption Patterns: An Update Using 2005 International Comparison Program Data*. U.S. Department of Agriculture, Economic Research Service, Technical Bulletin No. 1929. Washington, DC: USDA.

Nigeria Federal Ministry of Agriculture and Rural Development. 2011. Agricultural Transformation Agenda: We Will Grow Nigeria's Agricultural Sector. Abuja, Nigeria: Federal Ministry of Agriculture and Rural Development.

OECD, Secrétariat Club du Sahel et de l'Afrique de l'Ouest. 2014. *Peuplement, marché et sécurité alimentaire*. Paris: OECD.

Reardon, T., T. Thiombiano, and C. Delgado. 1988. La substitution des céréales locales par les céréales importées : la consommation alimentaire des ménages à Ougadougou, Burkina Faso. Paper presented at the CEDRES/IFPRI Colloque sur la Consommation Alimentaire au Burkina Faso, 6-7 June, 1988, in Ouagadougou, Burkina Faso. Washington, DC: International Food Policy Research Institute.

Rogers, B.L. and M. Lowdermilk. 1991. Price Policy and Food Consumption in Urban Mali. *Food Policy* 16.6: 461-473.

Rosegrant, M.W. and The IMPACT Development Team. 2012. *International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT): Model Description.* Washington, DC: International Food Policy Research Institute.

Taondyandé, M. and M. Yade. 2012. Etude sur la Consommation Alimentaire en Afrique de l'Ouest. AGWA Background Paper. Ibadan, Nigeria: ReSAKSS West Africa.

Tschirley, D., S. Haggblade, and T. Reardon. 2013. Africa's Emerging Food System Transformation. Global Center for Food Systems Innovation, White Paper Series. East Lansing, Michigan: Michigan State University.

Tschirley, D., J. Snyder, M. Dolislager, T. Reardon, S. Haggblade, J. Goeb, L. Traub, F. Ejobi, and F. Meyer. 2015. Africa's Unfolding Diet Transformation: Implications for Agrifood System Employment. *Journal of Agribusiness in Developing and Emerging Economies* 5.1: 102-136.

UNDESA (United Nations, Department of Economic and Social Affairs), Population Division. 2014. World Urbanization Prospects: The 2014 Revision, CD-ROM Edition. http://esa.un.org/unpd/wup/CD-ROM/

U.S. Department of Agriculture, Office of the Chief Economist, World Agricultural Outlook Board. 2015. *USDA Agricultural Projections to 2024***.** Long-term Projections Report OCE-2015-1, Washington, DC: USDA.

World Bank. 2011. *World Development Indicators.* Washington, DC: World Bank.

Zhou, Y. and J. Staatz. 2016. Projected Demand and Supply for Various Foods in West Africa: Implications for Investments and Food Policy. *Food Policy* 61.C: 198-212.