The Role of Rice in Changing Food Consumption Patterns in West Africa[1]

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1. Motivation and background

This paper aims to document changing patterns of rice consumption in the context of broader consumption shifts in all starchy staples (cereals plus roots and tubers) in West Africa (WA) over the past 30 years, and to estimate the determinants of rice share in starchy staple calories. The findings will provide insights into how rice demand is likely to evolve in the future in the context of a broader shift in the mix of starchy staples (SS) consumed in WA, in order to draw implications for developing successful production and marketing strategies for rice and other SS in WA.

Rapid changes in the social and economic environment in WA during the last 30 years have resulted in substantial shifts in food consumption patterns. Growing demand for rice has been driven by population growth, urbanization, and the need of increasingly time-poor urban consumers and street-food vendors for a staple that is quick and convenient to prepare. But rice consumption is also growing in rural areas, as the mix of starchy staples consumed has shifted strongly in many countries over the past 30 years. Changes in relative prices triggered by major policy shifts such as the structural adjustment programs (SAP) and the 1994 CFA franc devaluation have also led to increasing domestic price of rice relative to that of the local coarse grains, thereby affecting rice consumption patterns.

Table 1 shows rice production and import data as well as the shares of production and imports in total domestic supply[2] for the ECOWAS countries in the period 1980-2009. Rice production in the region has been growing rapidly since the 1980s. Rice production shares for the region as a whole in the period 2005-2009 increased by about 6% while the share of imports decreased compared to the previous period. Rice production, however, has accounted for less than 65% of domestic rice supply throughout the period and rice has constituted a major part of imported cereals.

This general picture masks differences in production and imports across countries in the region. Production and import data as well as the shares in production and imports for selected countries[3] –Nigeria, Mali, Senegal and Cote d'Ivoire (Table 2), reveal an increase in production for Mali, Nigeria, Senegal and Cote d'Ivoire in 2005-2009 compared to 2000-2004. Mali (which produced over 85% of its total rice consumption) and Nigeria (around 75%) each has a higher level of self-sufficiency in rice compared to the regional average. Senegal, on the other hand, over time has experienced the highest deficit, as it has depended on imports for greater than 75% of its domestic rice supply. Prior to the mid-1990s in Cote d'Ivoire, the share of production in domestic rice supply decreased at the expense of that of imports. However, since the mid-1990s, the share of rice production in total domestic rice supply rose at the expense of imports.

2. Determinants of food consumption patterns

Population growth, urbanization, income growth and the relative price of rice compared with other SS are the major drivers of changes in rice consumption levels in the subregion.

2.1. *Population*

According to the UN (2011)[4], the average annual population growth rate for WA is 3%, and the population is forecasted to reach 430 million by 2020. The 2010 population figures reveal the overwhelming importance of the coastal countries (especially Cote d'Ivoire, Ghana and Nigeria) in the region's total population. Nigeria alone accounts for about three-fifths of the region's total population. Growing consumer population means growing aggregate demand for food. It is also anticipated that, increasingly in the future, the population of WA will be along the coast due to substantial out-migration from the inland countries of the Sudano-Sahelian belt (e.g., Burkina Faso and Mali) to the coastal countries in WA. [5] Such a shift is likely to have important consequences for how consumption patterns for the region evolve.

2.2. *Urbanization*

The population of WA is not only growing, but increasingly it is becoming more urban. In WA, 85% of the population lived in rural areas in 1960 but by 2020, the urban-rural ratio is expected to be around 60:40 %[6]. In 2010, roughly 137 million people lived in urban areas, as against 170 million rural dwellers. The 2010 figures reveal urban population shares of over 40% for 10 out of the 15 ECOWAS countries, and a share above 50% for the remaining 5 (Figure 1). The urban population share grew by more than 100% in the period 1980-2010 in 3 out of the 15 ECOWAS states (Burkina Faso, Cape Verde and Gambia); and by greater than 50% in 7 out of the 15 ECOWAS States (Benin, Ghana, Guinea Bissau, Liberia, Mali, Nigeria and Togo). A key question then is how the growth in the urban population is affecting food availability and consumption in the levels and composition?

2.3. Economic Growth

With the exception of a few countries (Cote d'Ivoire, Guinea Bissau, Liberia, Guinea and Togo), per capita gross domestic product (GDP), a measure of average purchasing power, has been growing for ECOWAS countries since 2000, and the growth rates have been largest for Cape Verde, Ghana, Nigeria, Burkina Faso, Mali and Sierra Leone.

Regmi and Dyck (2001) observe that urbanization is closely related to economic growth and that both interact together to bring about important changes in the composition of consumption—the specific effects of urbanization on consumption differ depending on the economic conditions. Urbanization may result in an overall increase in per capita consumption, an increase in diet quality (such as an increase in animal protein consumption), and an increase in the demand for processed or easy-to-prepare food (such as rice).

2.4. Food Prices

Changing relative prices have been found to promote substitution in cereals (Delgado 1989; Delgado and Reardon, 1992). The prices that ultimately matter for

consumers are retail prices. However, in the absence of domestic retail prices for SS at the country level for all ECOWAS countries, we make reference to the trends in the relative prices for rice, wheat, and maize in world markets given that the majority of rice consumed in region is imported from non-ECOWAS countries. World price ratios are plotted in Figure 2 and reveal a long-term decline in the relative price of rice despite large year-to-year variation.

3. Methodology and data

Section 4 uses country-level FAOSTAT food balance sheet (FBS) data from 1980-2009 to examine changes in the levels and composition of apparent per capita consumption of SS within the ECOWAS zone over a 30-year period in order to understand trends in consumption and substitution amongst major starchy staple types. The FBS shows national and per capita quantities of food available for human consumption as well as their contribution to total daily energy availability (DEA) for all countries. The descriptive analyses are structured as follows: (i) trend in the level of food availability; (ii) trend rice share in SS calories; (iii) trend in the composition of food availability by major SS types.

Section 5 then presents an econometric analysis to understand the factors explaining the share of rice in starchy staple calories. The share of rice in total SS calories is specified as a linear function of GDP per capita, country-level dummies and the urban population share.

4. Trends in the level of food availability

The analysis of the trend in per capita DEA reveals that although the overall pattern for all ECOWAS countries has been a shift towards greater calorie consumption, the magnitude of growth has greatly varied and has been influenced by factors specific to each country, such as per capita income growth and the presence or absence of civil disruption. Figures 3-5 shows the trends in per capita DEA in the region. Overall, reported per capita DEA grew for most countries, particularly in the last two decades.

In the non-Coastal Sahel, Mali and Burkina Faso, with modest economic growth, showed modest increases in per capita DEA over time. In the Coastal Sahel, changes in reported per capita DEA have been less conspicuous. In the Coastal non-Sahel, Ghana and Nigeria experienced the largest growth in reported per capita DEA (50% and more) between 1980-85 and 2004-09. The analysis also highlighted the differences in the trend in per capita DEA in countries that have experienced civil disruption, like Liberia and Cote d'Ivoire.

The trend in total per capita DEA is driven mainly by SS calorie availability. The contribution of SS to per capita DEA has generally been greater than 50% in the region. In 2007-2009 for instance, with the exception of Cape Verde (SS share of 47%), the share of SS in total DEA ranged from 61% to 73%.

4.1 Trend in the share of rice in starchy staples calories

Table 3 shows rice share in SS calories. In the non-Coastal Sahel, rice share in SS calories ranged from 17% to 30% in Mali and increased by 49% in the study period. In Burkina Faso and Niger, rice share in daily SS calorie per capita has generally been below 10%.

Rice share in daily SS calorie supply per capita has been high in the Coastal Sahel compared to the non-Coastal Sahel. Cape Verde reveals a consistent positive trend in the contribution of rice to daily SS calories per capita – rice share increased by 195% in the study period. An examination of the contribution of individual SS types to total daily food supply (section 4.2) reveals that over time in Cape Verde, rice has been replacing maize as the dominant SS type. The contribution of rice to daily SS calories increased only by 8% in Senegal (absolute share stayed greater than 40%); but declined by 41% in the Gambia and by 3% in Guinea Bissau in the study period.[7]

In the Coastal non-Sahel, the contribution of rice to daily SS calorie supply per capita remained below 20% for Benin, Ghana, Nigeria and Togo. However, in Ghana, Togo and Benin, rice calorie share has been increasing slowly. Prior to the mid-1990s, rice share in daily SS calories per capita was greater than 60% for Liberia and greater than 70% for Sierra Leone. However, in the study period rice share dropped by 28% in Liberia and by 14% in Sierra Leone, in part because of substitution of wheat (particularly in Liberia) during these countries' civil wars when domestic rice production declined.

4.2 Trends in the availability of major starchy staple types

For further insight into changing SS consumption patterns and the place of rice, this section analyses the changes in the levels and in the composition of SS supply. Decomposing major SS food groups into specific commodity types permits us to understand the trend in supply of specific SS types and the relative importance of each SS type in the diet, identify any diversification or substitution amongst major SS types, and advance possible reasons for any shifts in consumption patterns. For instance, with increasing urbanization and per capita incomes, investigating the trend in the mix of SS will help to see descriptively, whether the expected shift from coarse grains (e.g., millet and sorghum) to rice is reflected in aggregate SS supply trends. Furthermore, increased supply per capita of starchy R&T could reflect two very different phenomena: (a) the poor shifting towards cheaper sources of calories, such as cassava and sweet potatoes, and (b) the middle class diversifying to a more European diet (potatoes—especially French fries).

4.2.1 Non- coastal Sahel

In terms of major SS groups, the general trend has been an increase in total supply of cereals in the Non-Coastal Sahel and an increase in the supply of starchy R&T, particularly for Mali (Me-Nsope & Staatz, 2013). Decomposing the aggregate trends into specific SS types, Table 4 reveals that while millet and sorghum were the dominant SS in Mali in the 1980s and 1990s, in the 2000s, the per capita supply of sorghum has declined and rice has replaced sorghum as the second most important cereal. This is not surprising because of the huge growth in rice production experienced by Mali in 2000s. Overall, in the period 1980-85 through to 2004-09 in Mali, absolute increases in per capita availability of SS were as follows: rice (31 kg/year), maize (17 kg/year), sweet potatoes (14 kg/year), millet (11 kg/year), Irish potatoes (6 kg/year), while that of wheat, sorghum, cassava and yams were generally below 5 kg/year.

In contrast to Mali, rice supply per capita in Burkina Faso increased only by 8 kg/year in the period 1980-85 through 2004-09. Though millet and sorghum continued to dominate as major SS in Burkina, absolute increases in apparent consumption were

largest for maize –32 kg/capita/year. Millet and sorghum supply increased by about 19 kg/capita/year. In Niger, millet remained overwhelmingly the dominant cereal, although rice consumption increased modestly over the 30-year period. Per capita availability of most other SS either were stable or declined.

4.2.2 Coastal Sahel

Contrasting trends for the Coastal Sahel are illustrated by Cape Verde and Senegal, as shown in Table 5.[8] In Cape Verde, maize dominated as the major starchy staple in the 1980s and the 1990s. However, the per capita supply of maize has fallen drastically over time, while that of rice has been increasing, with rice becoming the dominant starchy staple type in Cape Verde since the mid-2000s. In the period 1980-85 through to 2004-2009, there was an absolute increase in apparent per capita rice supply of 60 kg/year (almost all imported), while that of maize declined by 31 kg/year. Also very noticeable in Cape Verde is the fast growth in the apparent per capita supply of Irish potatoes, rising from an average of 11 kg/ year in the period 1980-1985 to an average of 29 kg/year in 2004-2009. This growth in the supply of Irish potatoes may reflect the rapid economic growth experienced in the last 20 years and changes in lifestyle–i.e., growth in the consumption of more French fries (chips) as people adopt a more Western diet.

In Senegal, rice was the dominant starchy staple type (greater than 55 kg/capita/year) throughout the study period. However, apparent per capita rice consumption increased by just 5 kg/year over the 30-year period. The largest absolute increases in apparent per capita consumption of SS in Senegal in the period 1980-85 through to 2004-09 were for cassava (15 kg/year), maize (15 kg/year), and wheat (13 kg/year). Millet and sorghum experienced absolute decreases in per capita availability of about 29 kg/year and 13 kg/year respectively. Contrary to the growth in Irish potatoes supply in Cape Verde, the growth in cassava in Senegal supply may reflect the poor shifting to cheaper sources of calories.

4.2.3 Coastal non-Sahel

Table 6 illustrates contrasting trends in the supply of major starchy staple types in selected countries in the Coastal non-Sahel (Ghana, Nigeria, Cote d'Ivoire, Liberia and Sierra Leone).[9] In Ghana, cassava, yams and other roots (e.g., cocoyam) are the dominant starchy staple types. With the exception of millet (whose per capita availability remained basically unchanged), Ghana experienced absolute increases in the supply per capita of all major SS types in the period 1980-85 through to 2004-09. In particular, cassava availability increased by 86 kg/year, that of yams increased by about 67 kg/year, that of rice by 19 kg/year, that of wheat by 8 kg/year, and that of maize by about 6 kg/year.

In Nigeria, as was the case for Ghana, cassava and yams dominate as major SS, and both have experienced the biggest absolute increase in per capita availability in the period 1980-85 through to 2004-09 – about 36 kg/year for cassava and about 57 kg/year for yams. In the same period, sweet potato availability per capita increased by about 14 kg/year. As was with cassava, the growth in sweet potatoes availability may reflect the poor switching to cheaper sources of calories. In the case of cereals, per capita availability of maize increased by17 kg/year, that of wheat by 4 kg/year, that of rice by about 7 kg/year; that of millet by 10 kg/year and that of sorghum by 6

kg/year in the study period. Compared to other Coastal non-Sahelian countries, Nigeria has had the largest millet supply per capita over time, as Nigeria alone amongst these countries also has a large Sudano-Sahelian zone, where millet is produced.

In Cote d'Ivoire, with the exception of millet (with unchanged per capita availability), sweet potatoes (increased by about 1 kg/year) and yams (increased by about 4 kg/year), per capita supply dropped for all other major SS in the study period. By the very end of the period, however, per capita rice availability had recovered to slightly exceed the level of 1980-82. These declines may reflect the economic decline and social upheaval the country suffered during this period.

Rice and cassava are major SS types in Liberia. However, per capita availability of rice declined by 48 kg/year and that of cassava increased by about 12 kg/year in the period 1980-85 through to 2004-09. In Liberia, following a period of low and relatively stable supply of wheat in the 1980s, per capita wheat supply jumped from an average of 9 kg/year in the period 1992-1994 to 52 kg/year in the period 1995-1997, representing an increase of about 477%. This corresponded to the period when the first Liberian civil war ended. Per capita availability of rice also fell in Liberia during this period, and most likely the spike in wheat supplies reflects an influx of imported wheat to substitute for domestic rice production that had been decimated by the civil war.

In Sierra Leone, per capita supply of cassava grew by 36 kg/year, while that for rice decreased by 7 kg/year in the study period). This reflects some degree of substitution of cassava for rice as improved cassava varieties from Nigeria have been introduced into Sierra Leone.

In summary, the analysis of per capita food availability from the FBS reveals complex and diverse patterns of substitution amongst different SS types in the different sub-regions. From these results it is clear that the substitution is not just between rice and wheat and traditional SS (millet and sorghum), but also involves other SS types like cassava, yams, sweet potatoes, Irish potatoes and maize.

5. Econometric analysis of the determinants of rice share in starchy staples calories

To analyze the determinants of the share of rice in total starchy-staple calories available per capita in the different countries, the following model was specified:

$$S_t = \alpha_t + \sum_{i=1}^{14} \beta_i d_i + \gamma V + \sigma X_t + \delta U_t + \varphi U_t * X_t + \sum_{i=1}^{14} \emptyset_i d_i U_t + \varepsilon_t$$

S_t is the share (%) of rice in total SS calories in year t. d_i is a country level dummy, where d_i equals 1 if in country i and 0 otherwise. X_t represents per capita GDP in constant US dollar amounts and its effect on rice calorie share is captured by σ , and it is expected to be >0. U_t is the urban population share (%) at time t and its coefficient (δ) is expected to be positive following (Delgado 1989; Delgado & Reardon, 1992). The interaction between the urban population share and per capita incomes is to capture any joint effect of urbanization and per capita income on rice

calories share. The interaction between country dummies and urbanization is to capture any additional country specific effect of urbanization on rice calorie share. V is a dummy variable to capture the effects of the 1994 FCFA devaluation on rice calorie shares. The devaluation may have had its impact on per capita incomes. However, the introduction of the dummy variable helps us capture its effect on any changes in consumption habits for reasons other than changes in per capita incomes—e.g. an increase in the price of rice relative to other SS. Although not all ECOWAS countries have the FCFA as their currency, the effect of the devaluation is likely to have been felt by even the non- FCFA countries through regional trade (formal and informal). ε_t is the error term. Supplementary data on annual urban population shares and constant GDP per capita in US dollars was obtained from World Bank Statistics.

Table 7 presents some descriptive statistics of the data used in estimating the determinants of the share of rice in SS calories. Table 8 presents the estimated coefficients of the regression model. The dummy variable for devaluation as well as the interaction between urbanization and per capita income was not statistically significant hence they were excluded in the final estimation model. The total number of observations estimated was 450, the R-square for the estimated model is 0.97 and the regression is statistically significant at 5% (Prob>F = 0.0000). The coefficients on the country dummies indicate some country-level differences in rice calorie share. The default country is Togo. Ten of the country-level dummies are statistically significant at a 10% level, and four of them are not statistically significant.

The results reveal that a US $100 increase in per capita GDP will increase the share of rice in SS calories by 2% and the effect is statistically significant at 1%. Table 9 shows the estimated effect of a 1% change in urban population share on rice share in SS calories. We observe mixed evidence of the relationship between urbanization and the share of rice in SS calories. For 11 out of 15 countries, the share of rice in SS calories increases with urbanization, while for the remaining 4 the relationship is negative. The four countries with a negative relationship (The Gambia, Liberia, Nigeria and Sierra Leone) all represent special cases. As shown earlier with the FBS data, in Liberia there was a large substitution of wheat for rice during the civil war. Also in Sierra Leone, there has been a substitution of cassava for rice, in part due to the civil war and in part to the spread of the new cassava technologies from Nigeria. In Nigeria, there was both the cassava revolution and periodic bans on imports of polished rice imports (perhaps offset by clandestine imports from Benin, where the "apparent" increase in consumption has been very high). In the Gambia, the decline in apparent rice consumption over time (which is strongly correlated with urbanization) is probably a statistical artifact resulting from an overestimation of rice availability per capita prior to the 1994 CFA franc devaluation, when there were large unrecorded re-exports of rice from the Gambia to Senegal. It is also important to note that domestic retail prices for rice and other staple foods are not included in the model due to lack of data. These variables are likely to be important determinants of rice consumption, and their omission may bias the parameter estimates for the variables included in the model.

6. Conclusion and policy implications

The goal of this paper was to document the role of rice in the context of broader changes in SS consumption patterns in WA using country-level FAOSTAT FBS data

from 1980-2009. West African diets are changing substantially, and understanding rice's role in these changing dietary patterns is critical to developing successful production and marketing strategies for WA. The descriptive analysis revealed a trend towards greater calorie supply for most ECOWAS countries. The study also reveals a positive growth in rice calorie supply over time. The contribution of rice to total daily SS calories increased for 10 of the 15 countries and grew the most in absolute and percentage terms in Mali (49%) and Cape Verde (195%) in the study period. The contribution of rice to SS calories declined the most in Gambia (41%) and Liberia (28%). The contribution of rice to SS calories remained less than 20% for 6 out of the 15 ECOWAS countries.

Rice availability per capita increased for most countries in the study period. In Cape Verde, for instance, there has been a replacement of maize with rice as the dominant cereal. In the Coastal Non-Sahel, starchy R&T still dominate as major starchy staple types. The analysis reveals a big cassava revolution that has taken place in some of the Coastal Non-Sahelian countries such as Nigeria, Ghana, and Sierra Leone, but also a large increase in per capita yam availability in some of these countries. The analysis also provides evidence of a striking growth in maize supply per capita in the Sahel (Burkina Faso, Mali and Senegal). Overall, these results suggest that per capita SS availability and consumption is improving in the region. Although food availability is only one dimension of food security, rising SS consumption is likely to have a positive impact for food security in the region.

The study provides evidence of a diversification in the composition of SS supply and some substitution amongst major SS types. This finding suggests some scope to encourage ongoing diversification and substitution in consumption. Given that rising opportunity cost of time (particularly for women), and the greater relative convenience of rice products compared to coarse grains have been identified in the literature as key drivers of rice consumption, efforts geared towards the promotion of value addition and processing of the other SS can contribute to improving their convenience, reduce preparation time, thereby encouraging substitution between the different SS type and thereby reducing the volatility of the prices of individual staples.

The results from the econometric analysis suggest that rising per capita GDP (proxy for income) is a driver of the share of rice in SS calories – a 100US$ increase in per capita GDP results in a 2% increase in rice share in SS calories. This finding supports the view that demand for rice will continue to grow as people get richer. Hence, efforts geared towards expanding rice production and reducing the unit cost of production are necessary to capture this growing effective demand. Conventional wisdom suggests that urbanization is a key driver of rising rice consumption. We find empirical evidence to support this view for 11 of the 15 ECOWAS countries, with the four "non-conforming" countries likely representing special cases due to data problems (The Gambia and Nigeria) and civil disruption (Sierra Leone and Liberia). Hence, our findings suggest that urbanization will continue to be an important driver of rice demand in the subregion.

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TABLES

Table 1. Trend in Cereal Production and Imports- West Africa (1000 Tons)

	Production	Imports	Domestic Supply	Production Share (%)	Import Share (%)
All Cereals					
1980-1984	16,439	4,467	20,766	79	22
1985-1989	25,597	3,932	29,077	88	14
1990-1994	30,683	4,482	35,268	87	13
1995-1999	34,869	5,569	40,492	86	14
2000-2004	37,209	9,125	45,700	81	20
2005-2009	46,868	9,779	56,500	83	17
Rice					
1980-1984	2,338	1,750	4,098	57	43
1985-1989	3,186	1,845	4,917	65	38
1990-1994	3,991	2,316	6,367	63	36
1995-1999	4,457	2,676	7,089	63	38
2000-2004	4,700	4,597	8,961	52	51
2005-2009	6,213	4,552	10,627	58	43

Source: Author's computation using FAOSTAT– Food Balance Sheet data

Table 2. Trend in Rice Production and Imports - Selected Countries (1000 Tons)

	Production	Imports	Domestic Supply	Production Share (%)	Import Share (%)
Mali					
1980-1984	99	65	188	53	35
1985-1989	174	86	252	69	34
1990-1994	272	24	302	90	8
1995-1999	417	73	479	87	15
2000-2004	540	136	619	87	22
2005-2009	888	190	818	109[10]	23
Nigeria					
1980-1984	822	512	1,334	62	38
1985-1989	1,335	316	1,583	84	20
1990-1994	1,931	315	2,313	83	14
1995-1999	2,116	552	2,668	79	21
2000-2004	2,058	1,365	3,264	63	42
2005-2009	2,451	636	3,430	71	19
Senegal					
1980-1984	74	340	418	18	81
1985-1989	99	345	444	22	78
1990-1994	118	378	496	24	76
1995-1999	112	515	611	18	84
2000-2004	136	741	864	16	86
2005-2009	210	880	959	22	92
Cote d'Ivoire					
1980-1984	367	285	642	57	44
1985-1989	394	395	744	53	53
1990-1994	380	448	847	45	53
1995-1999	465	426	914	51	47
2000-2004	722	433	1,103	65	39
2005-2009	979	446	1,420	69	31

Source: Author's computation using FAOSTAT– Food Balance Sheet data

Table 3. Trend in the share (%) of rice in starchy staples calories (1980-2009)

Non-coastal Sahel	1980-82	1983-85	1986-88	1989-91	1992-94	1995-97	1998-00	2001-03	2004-06	2007-09	% change 1980-85 to 2004-09
Mali	21	19	17	17	21	25	31	29	30	29	49
Niger	5	7	7	6	6	7	8	12	13	7	62
Burkina Faso	6	10	7	6	7	11	11	10	9	9	18
Coastal Sahel											
Cape Verde	12	14	15	18	22	29	32	34	39	40	195
Gambia	58	59	53	57	52	56	38	32	31	38	-41
Guinea Bissau	53	60	61	67	68	66	63	61	51	58	-3
Senegal	45	43	41	42	43	47	52	51	47	48	8
Coastal non-Sahelian											
Benin	5	8	7	10	10	11	7	10	17	18	171
Cote d'Ivoire	29	30	30	30	30	30	26	28	30	33	6
Guinea	49	49	54	59	63	62	59	60	59	61	23
Ghana	5	5	6	8	9	5	6	11	12	14	151
Liberia	69	71	65	65	60	31	40	43	44	56	-28
Nigeria	16	14	12	15	12	12	13	14	13	12	-14
Sierra Leone	79	78	78	79	75	65	69	67	66	68	-14
Togo	6	6	7	7	7	9	14	11	15	12	119

Source: Author's computation using FAOSTAT FBS

Table 4. Starchy staples availability (kg/capita/year) - Non-coastal Sahel

	1980 to 1982	1983 to 1985	1986 to 1988	1989 to 1991	1992 to 1994	1995 to 1997	1998 to 2000	2001 to 2003	2004 to 2006	2007 to 2009
Burkina Faso										
Wheat	4	4	4	3	5	7	7	3	7	7
Rice (Milled)	7	14	13	13	15	21	21	20	19	18
Maize	16	15	20	34	28	30	35	39	45	49
Millet	49	49	69	78	76	65	70	70	72	65
Sorghum	71	66	89	87	104	99	82	89	88	87
Cassava	4	3	1	0	0	0	0	0	0	0
Sweet Potatoes	4	3	3	2	1	1	2	3	4	4
Yams	10	10	11	4	5	4	4	3	3	3
Mali										
Wheat	6	7	9	5	4	4	8	8	9	9
Rice (Milled)	22	25	27	26	32	39	50	50	54	55
Maize	8	16	20	18	20	23	23	26	28	29
Millet	47	58	75	70	56	61	54	59	62	64
Sorghum	37	45	52	60	62	53	44	44	44	44
Potatoes	0	0	0	2	5	5	5	6	7	4
Sweet potatoes	1	1	1	1	1	1	3	6	10	19
Cassava	0	0	0	0	0	0	1	2	3	1
Yams	2	2	1	1	1	1	3	3	4	6
Niger										
Wheat	6	7	6	8	7	4	5	6	5	5
Rice (Milled)	8	11	10	10	9	10	12	18	20	11
Maize	2	3	2	1	1	3	6	4	4	2
Millet	136	142	140	155	149	147	145	141	130	148
Sorghum	44	38	40	37	35	35	30	33	39	42
Cassava	28	25	24	16	9	13	16	10	9	8
Sweet Potatoes	3	7	5	4	4	4	4	3	3	3

Source: Author's computation using FAOSTAT FBS

Table 5. Starchy staples availability (kg/capita/year) - Coastal Sahel

	1980 to 1982	1983 to 1985	1986 to 1988	1989 to 1991	1992 to 1994	1995 to 1997	1998 to 2000	2001 to 2003	2004 to 2006	2007 to 2009
Cape Verde										
Wheat	41	45	45	35	37	35	36	37	38	43
Rice (Milled)	17	21	22	24	29	34	39	41	50	49
Maize	94	94	85	78	75	52	53	44	36	32
Cassava	8	5	14	12	7	7	7	6	7	8
Potatoes	10	12	14	13	17	17	22	26	29	29
Sweet potatoes	14	6	29	27	7	7	8	8	8	10
Senegal										
Wheat	20	19	19	25	23	23	25	28	30	33
Rice (Milled)	68	66	60	64	57	62	69	69	69	74
Maize	13	16	17	16	14	11	9	11	27	28
Millet	54	54	62	60	51	47	36	34	28	25
Sorghum	21	24	16	15	12	11	11	12	9	8
Cassava	4	3	8	6	6	4	9	12	16	19
Potatoes	2	3	3	3	3	2	3	3	5	6
Sweet Potatoes	1	1	1	0	0	0	1	3	2	3

Source: Author's computation using FAOSTAT food balance sheet data

Table 6. Starchy staples availability (kg/capita/year) - Coastal non-Sahel

	1980 to 1982	1983 to 1985	1986 to 1988	1989 to 1991	1992 to 1994	1995 to 1997	1998 to 2000	2001 to 2003	2004 to 2006	2007 to 2009
Cote d'Ivoire										
Wheat	22	20	20	17	15	14	16	16	15	16
Rice (Milled)	61	59	56	54	53	53	46	50	53	64
Maize	29	28	26	24	26	26	23	21	20	19
Millet	1	1	2	2	2	2	2	1	1	1
Sorghum	2	1	1	1	1	1	1	1	1	1
Cassava	109	106	102	100	98	101	110	103	101	110
Potatoes	1	1	1	1	1	1	1	1	1	1
Sweet Potatoes	1	1	2	2	2	2	3	2	2	2
Yams	189	177	170	166	165	162	170	172	180	193
Ghana										
Wheat	10	8	10	12	12	8	13	11	16	18
Rice (Milled)	6	7	9	12	17	11	12	22	24	27
Maize	25	33	34	36	43	43	40	42	41	28
Millet	7	7	7	6	7	8	6	6	6	6
Sorghum	8	8	8	9	12	13	11	9	9	10
Cassava	126	120	148	163	198	231	219	215	206	212
Sweet Potatoes	0	0	0	0	0	3	5	4	4	5
Yams	45	68	64	61	74	95	110	117	114	132
Other roots	45	51	60	59	59	67	69	67	57	55

Source: Author's computation using FAOSTAT food balance sheet data

Table 6. Continued. Starchy Staples Availability (kg/capita/year)–Coastal Non-Sahel										
	1980 to 1982	1983 to 1985	1986 to 1988	1989 to 1991	1992 to 1994	1995 to 1997	1998 to 2000	2001 to 2003	2004 to 2006	2007 to 2009
Liberia										
Wheat	8	8	8	6	9	52	36	24	31	22
Rice (Milled)	124	117	114	106	81	39	54	57	60	85
Maize	0	0	0	0	1	7	6	5	2	0
Cassava	152	118	167	159	132	107	139	159	148	145
Sweet Potatoes	7	7	7	7	8	7	6	5	5	5
Yams	7	7	7	7	8	9	7	6	6	5
Other roots	7	7	7	7	8	9	8	8	7	7
Nigeria										
Wheat	16	14	6	4	9	8	15	17	18	21
Rice (Milled)	16	14	15	21	20	20	22	23	22	21
Maize	7	9	28	31	33	29	22	20	23	27
Millet	24	28	32	35	32	36	36	32	35	37
Sorghum	33	37	42	34	39	44	43	40	43	39
Cassava	81	74	84	115	155	151	144	114	116	110
Sweet Potatoes	1	1	1	1	2	9	12	14	16	13
Yams	24	20	25	48	72	72	74	73	72	85
Potatoes	0	0	0	0	1	0	2	3	3	4

Source: Author's computation using FAOSTAT food balance sheet data

Table 7. Descriptive summary: Mean of regression variables

Country	Rice Share (%)	GDP per capita (Constant US $)	Urban Population Share (%)
Benin	10 (4.37)	343 (29.4)	36 (4.23)
Burkina Faso	9 (2.50)	198 (38.1)	15 (3.01)
Cape Verde	26 (10.3)	1041 (388.5)	46 (10.4)
Cote d'Ivoire	30 (1.78)	668 (97.1)	42 (3.74)
Gambia	47 (11.5)	597 (23.7)	43 (9.04)
Ghana	8 (3.25)	248 (40.7)	40 (6.3)
Guinea	58 (5.11)	354 (21.7)	29 (3.10)
Guinea Bissau	61 (5.81)	187 (20.9)	27 (7.86)
Liberia	54 (14.1)	294 (201.5)	49 (7.87)
Mali	24 (5.70)	210 (29.2)	25 (4.22)
Niger	8 (2.76)	189 (27.3)	15 (0.93)
Nigeria	13 (1.70)	376 (55.5)	39 (6.27)
Senegal	46 (4.07)	497 (30.7)	40 (1.92)
Sierra Leone	73 (6.11)	191 (31.82)	34 (2.52)
Togo	10 (3.39)	275 (26.3)	33 (5.52)

Figures in parenthesis are the estimated standard deviations

Table 8. Determinants of rice share in starchy staples calories

Explanatory Variables	Coefficient	Robust Std. Err.	P>|t|
GDP per Capita (Constant US$)	0.018	0.006	0.002
Urban population Share	0.545	0.061	0.000
Country dummies			
Benin	-6.038	4.533	0.184
Burkina Faso	16.092	3.335	0.000
Cape Verde	6.650	4.434	0.134
Cote d'Ivoire	10.780	7.648	0.159
Gambia	94.869	6.118	0.000
Ghana	5.383	3.092	0.082
Guinea	32.010	6.128	0.000
Guinea Bissau	56.899	5.593	0.000
Liberia	104.837	11.863	0.000
Mali	9.298	4.871	0.057
Niger	-11.656	6.630	0.079
Nigeria	28.232	3.091	0.000
Senegal	8.587	10.964	0.434
Sierra-Leone	140.814	5.732	0.000
Interaction between Country dummies and urbanization			
Benin	0.122	0.142	0.392
Burkina Faso	-0.370	0.167	0.027
Cape Verde	-0.246	0.196	0.210
Cote d'Ivoire	-0.062	0.141	0.660
Gambia	-1.585	0.148	0.000
Ghana	-0.253	0.088	0.004
Guinea	0.566	0.204	0.006
Guinea Bissau	-0.028	0.213	0.897
Liberia	-1.408	0.247	0.000
Mali	0.416	0.170	0.015
Niger	1.364	0.452	0.003
Nigeria	-0.761	0.096	0.000
Senegal	0.514	0.284	0.071
Sierra-Leone	-2.257	0.175	0.000
Constant	-13.553	2.784	0.000

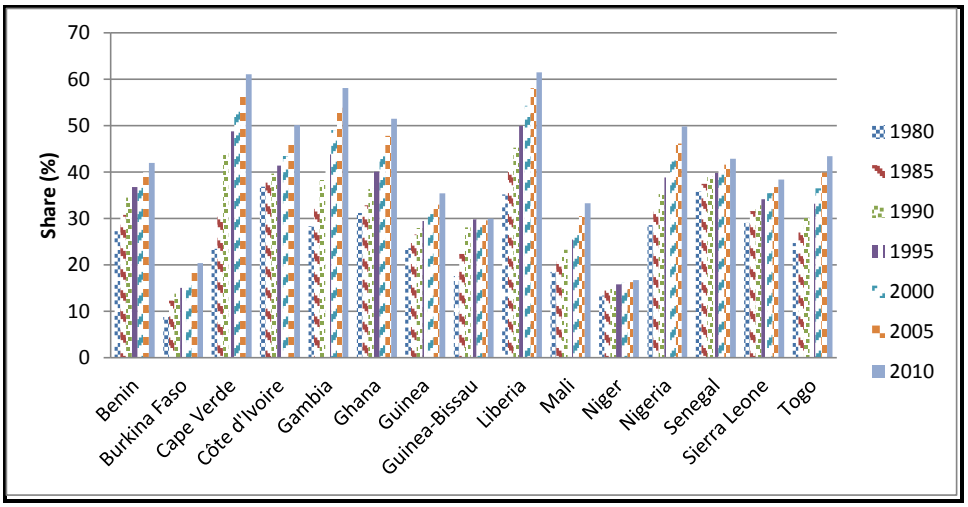
The default country dummy is Togo

Table 9. Estimated effect of urbanization on rice share (%) in starchy staples calories

Country	Effect of a 1% change in Urban population Share
Benin	0.67
Burkina Faso	0.17
Cape Verde	0.30
Cote d'Ivoire	0.48
Gambia	-1.04
Ghana	0.29
Guinea	1.11
Guinea Bissau	0.52
Liberia	-0.86
Mali	0.96
Niger	1.91
Nigeria	-0.22
Senegal	1.06
Sierra-Leone	-1.71
Togo	0.55

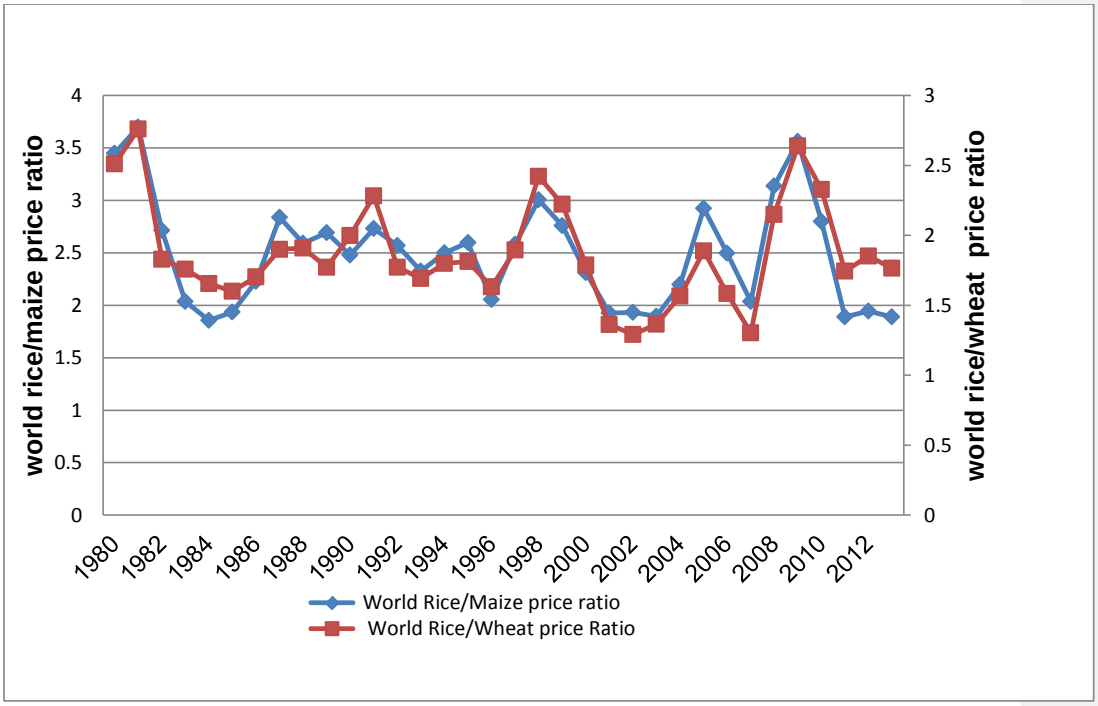
List of figures

Figure 1. Urban population shares (%) -West Africa (1980-2010)



Source: Author's computation using data from World Bank 2013
Program used-MS Excel

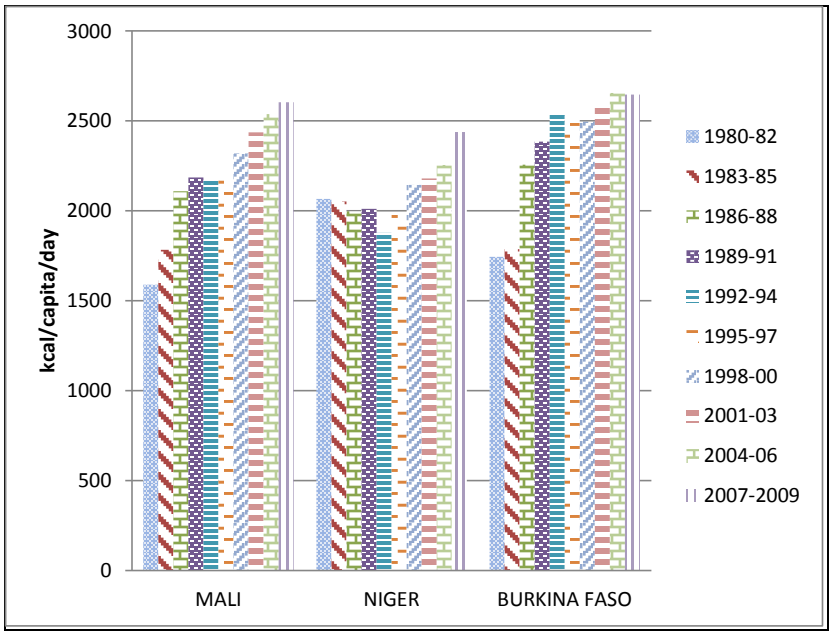
Figure 2. Trends in World rice prices relative to world maize and wheat prices 1980-2013



Source: IMF Primary Commodity Prices database.
Notes:
a/ World prices for wheat, maize, and rice refer to the following: wheat, No.1 Hard Red Winter,
ordinary protein, FOB Gulf of Mexico; maize, U.S. No.2 Yellow, FOB Gulf of Mexico; and rice,5% broken milled white, Thailand nominal price quote.

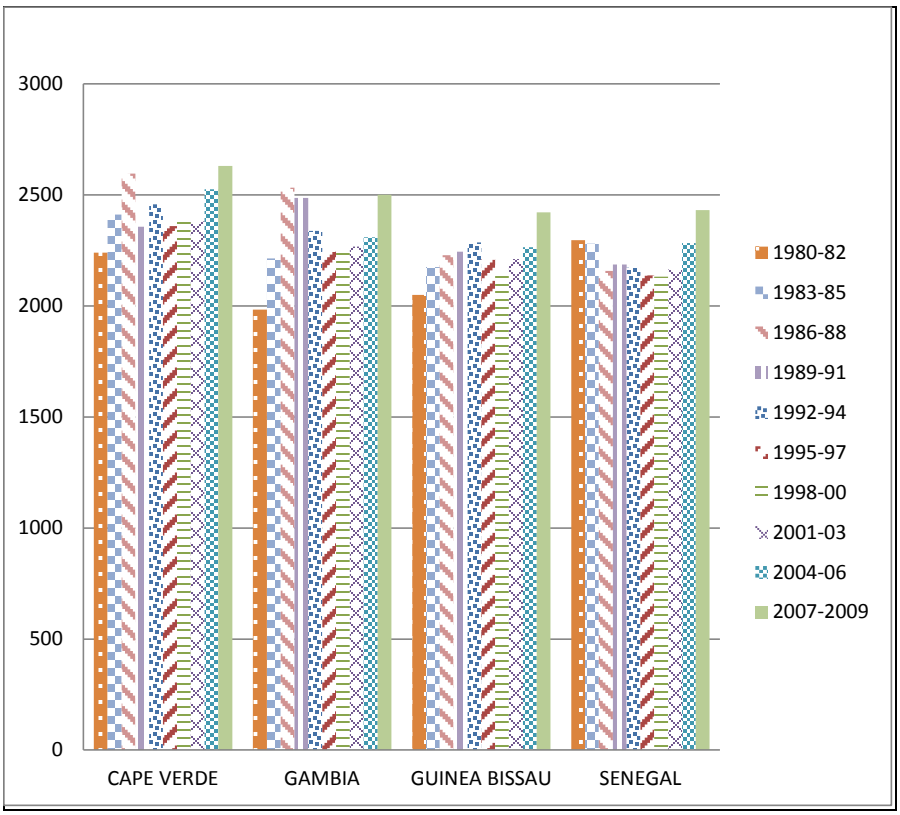
b/ Program used-MS Excel

Figure 3. Daily energy availability (kcal/capita/day) - Non-Coastal Sahel



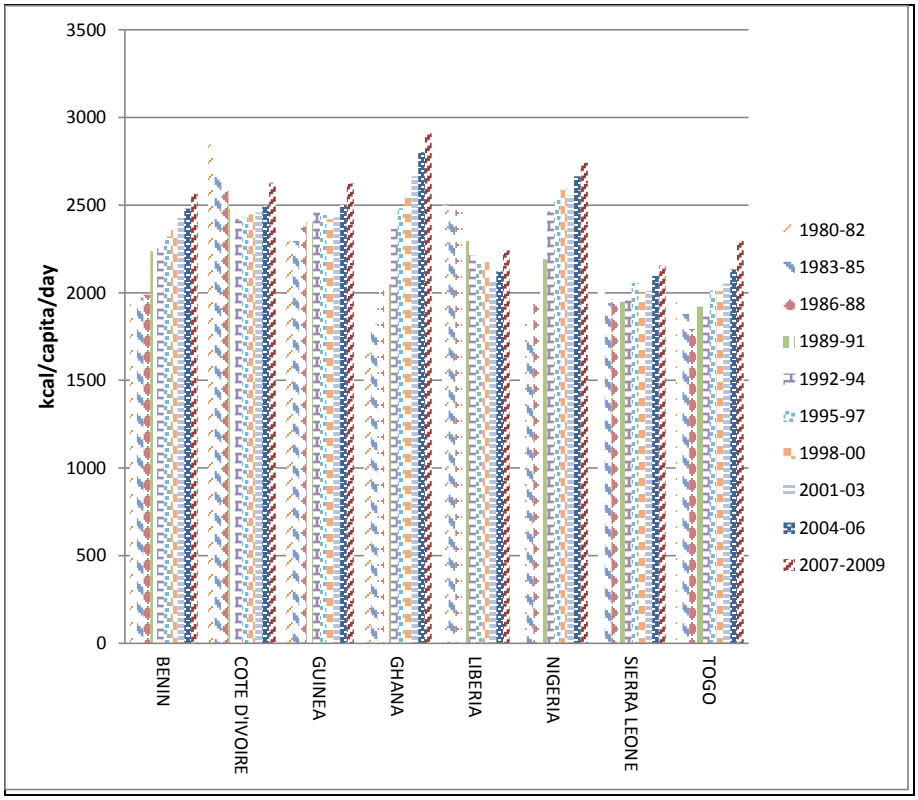
Source: Author's calculations using FAOSTAT– Food Balance Sheets data Program used-MS Excel

Figure 4. Daily energy availability (kcal/capita/day) - Coastal Sahel



Source: Author's calculations using FAOSTAT– Food Balance Sheets data.
Program used-MS Excel

Figure 5. Daily energy availability (kcal/capita/day) - Coastal Non-Sahel



Source: Author's calculations using FAOSTAT– Food Balance Sheets data
Program used-MS Excel

ENDNOTES

[1] The authors gratefully acknowledge support for this work provided by the Syngenta Foundation for Sustainable Agriculture via its grant to Michigan State University on Strengthening Regional Agricultural Integration but accept sole responsibility for statements made in this paper

[2] Domestic supply is calculated as production plus imports, plus stocks, and less exports. As a result, the shares may not sum to unity.

[3] Selected because of their representativeness in rice market development efforts in the region. Nigeria is the largest importer of rice in West Africa, followed by Senegal, and Cote d'Ivoire in third place. Mali was selected because of its high rice production.

[4] http://www.ohchr.org/EN/Countries/AfricaRegion/Pages/WestAfricaSummary1011.aspx

[5] http://www.unep.org/dewa/africa/publications/aeo-1/120.htm

[6] http://westafricainsight.org/articles/PDF/92

[7] The decline in apparent per capita availability in the Gambia may represent a decline in previously very high re-exportation of rice to Senegal following the CFA franc devaluation.

[8] Results for all countries in this sub-region are available in Me-Nsope and Staatz (2013).

[9] See Me-Nsope and Staatz (2013) for full results for all the countries in this sub-region.

[10] Domestic supply is calculated as production plus imports, plus stocks, and less exports. The drop in domestic supply in this period reflects changes in stocks. Average net reduction in stocks in this period was minus 260,000 tons which when added to the sum of production and imports gives a total domestic supply of 818,000 tons.