Long term Outlook for Rice Production and Trade in West Africa: A Set of Productivity Growth Scenarios

By
Nancy Cochrane, James Hansen, Getachew Nigatu, and Ralph Seeley,
Cochrane@ers.usda.gov, Jhansen@ers.usda.gov, Gsnigatu@ers.usda.gov, Rseeley@ers.usda.gov
Market and Trade Economic Division, Economic Research Service, USDA
355 East Street, SW, Washington DC

Selected Poster/Paper prepared for presentation at the Agricultural & Applied Economics Association's 2016 AAEA Annual Meeting, Boston, Massachusetts, July 31-August 2, 2016

The Economic Community of West African States (ECOWAS) was formed in 1975, with the fundamental objective to facilitate trade among member states, raise productivity, and ensure food security for the population. The region includes 15 countries ranging in size from Nigeria with 182 million people in 2015 to Guinea Bissau with a population of just 1.8 million (United Nations 2015). The southern tier countries tend to be surplus producers of corn and other grains, while households in the northern, more arid countries, such as Mali, rely more on livestock for their livelihoods.

Diets vary considerably throughout the region. In the coastal countries in particular, rice is becoming an increasingly important source of calories. Per capita rice consumption is highest in Guinea, Guinea-Bissau, Liberia, Mali, Senegal, and Sierra Leone—in Senegal rice accounts for 29 percent of daily calorie intake on average (United Nations, 2013). Rice consumption is lower in other countries—rice makes up just 7 percent of daily calorie intake in Burkina Faso, for example.

Food security is a critical issue throughout the region, and many of the countries rely heavily on rice imports to maintain adequate food supplies. In 2015/16 imports made up 45 percent of rice supplies, according to USDA's Production, Supply and Distribution (P&SD) database. Agricultural productivity is low. USDA/PSD estimates show rice yields of 2.11 metric tons per hectare on a rough basis for 2015/16. USDA 2016 Baseline projections show slow growth in yields over the next decade. At the same time, food demand for rice continues to expand, driven by population and income growth. Under current policies and production practices, production will not be able to keep up with demand, and dependence on imports will grow to 52 percent of consumption by 2025/26.

Following the 2008 food price spike, the region has been aggressively pursuing policies aimed at achieving self-sufficiency in rice and drastically reducing dependence on imports. This paper will focus on the region's rice policies and potential productivity growth in that sector. The regional goal is to reach self-sufficiency by 2025. The region is relying in part on increased trade restrictions to achieve this goal. But most efforts, which are supported by international donors, are devoted to reducing losses and accelerating yield growth by expanding areas planted to improved varieties, expanding irrigation, and facilitating farmers' access to improved seeds and fertilizers.

ECOWAS institutions and international donors are making considerable investments in the region. The main objectives are to facilitate trade along selected output and input value chains, work with country governments to harmonize phytosanitary protocols, remove export bans and other barriers to trade, promote agricultural research and technology transfer, develop strategies to cope with climate change, and strengthen governments' capacity to address food insecurity. Commodities of focus are maize, sorghum, millet, rice, and livestock (principally cattle, sheep, and goats). Expected outcomes are a reduction of transport costs and regional trade bottlenecks and faster yield growth through increased use of modern crop varieties and high-quality inputs.

The process of integration has been slow. ECOWAS implemented a common external tariff (CET) in 2015 with the goal of removing all barriers to trade among member countries. But there remain serious obstacles to the smooth flow of goods within the region, documented by several in-depth studies by the United States Agency for International Development (USAID) funded Trade Hub. Barriers include high intra-regional transport costs, an array of fees that

many countries still impose at border crossings, seasonal import/export bans on the part of individual countries, excessive check-points, and other non-tariff barriers.

In this paper the authors explore potential long-term impacts of alternative growth and productivity scenarios for ECOWAS rice production and trade. The scenarios analyzed include:

- Expansion of area under irrigation. Currently, only 11 percent of rice area is irrigated, while 43 percent is upland and 40 percent is lowland (Diagne et al, 2013). Average yields on irrigated land are 57 percent higher than those for non-irrigated lowland rice.
- Increased access to and use of fertilizer. Estimates of yield gains from fertilizer use range from 1.5 to 2 tons per hectare (Bumb et al, 2011, IFDC, 2013). But there are many barriers to increased fertilizer use, including high prices, transportation bottlenecks, and inconsistent standards. Reduction of these barriers could increase access to fertilizer and lead to significant yield gains.

In general we find that these yield gains result in faster production growth and lower domestic prices. But we do not find significant decreases in imports. The lower prices stimulate higher per capita consumption, leading to an improved food security situation. But due to the demand stimulus combined with rapid population growth, production still does not keep up with total demand.

Overview of ECOWAS Rice Sector

The region's rice production has expanded rapidly in recent decades. According to the USDA/PSD database, total ECOWAS rice output was 9.1 million tons, more than double the level of 2000/01. Yields increased from 2004 through 2009, but since then have leveled off, with no increase from 2009 through 2015. Production growth since 2009 has been mainly due to area expansion.

These averages obscure some significant differences among the member countries. Nigeria is by far the largest producer, followed by Ghana. But per capita production is highest in Mali, Sierra Leone, and Guinea (fig. 1). The largest consumers on a per capita basis are Guinea, Guinea-Bissau, Sierra Leone, Liberia, Mali, Senegal, Cote D'Ivoire, and the Gambia. The remaining countries derive most of their calories from other sources.

Imports averaged 8.3 million tons between 2013/14 and 2015/16. The main suppliers are Thailand, Vietnam, and India. Most of the imported rice is parboiled, which is preferred by the population. In general imported rice is preferred over domestic due to its better quality.

Despite the high regional imports, the degree of import dependence varies considerably across member countries. Among the largest consumers, Gambia, Senegal, Guinea-Bissau, Liberia, and Cote D'Ivoire show the greatest gaps between production and consumption. While Nigeria is by far the largest importer and depends on imports for around half its rice supply, Nigeria is less dependent on rice as a source of calories (figs 2 and 3). In contrast, dependence on rice imports is a more serious issue in Senegal, where rice makes up 29 percent of average daily calories intake (FAO, 2013). Senegal imports between 76 and 80 percent of its rice supply (USDA/PSD).

Figure 1: ECOWAS members' dependence on rice imports varies considerably

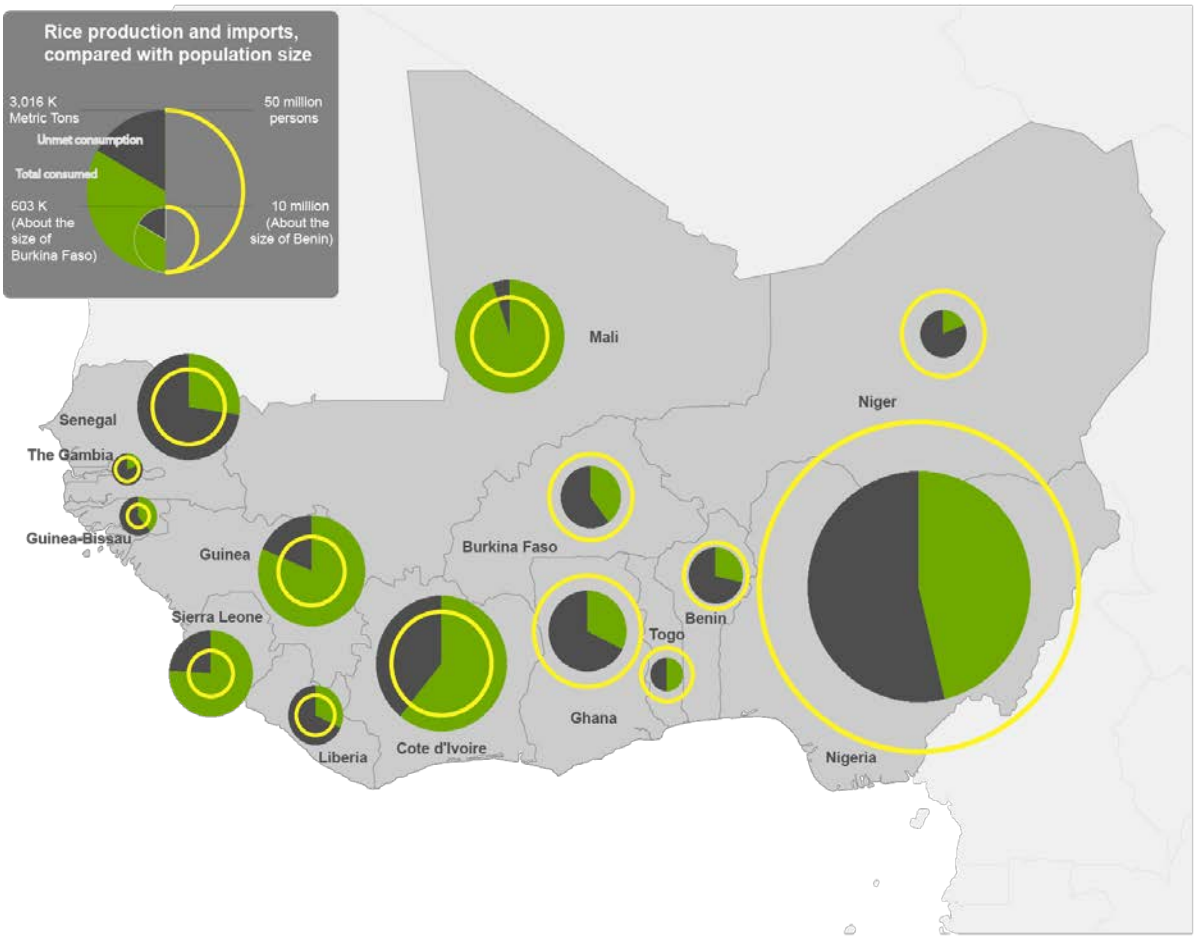
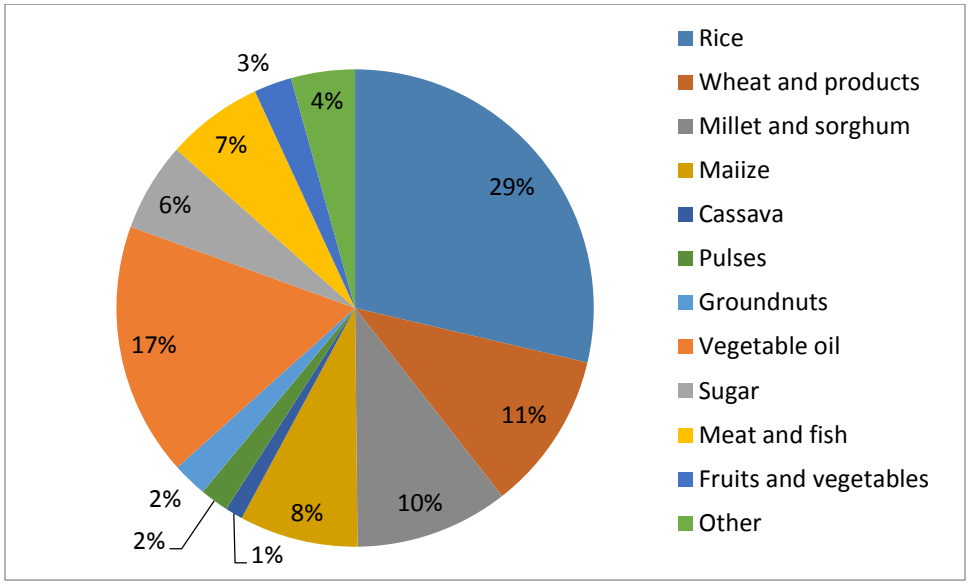
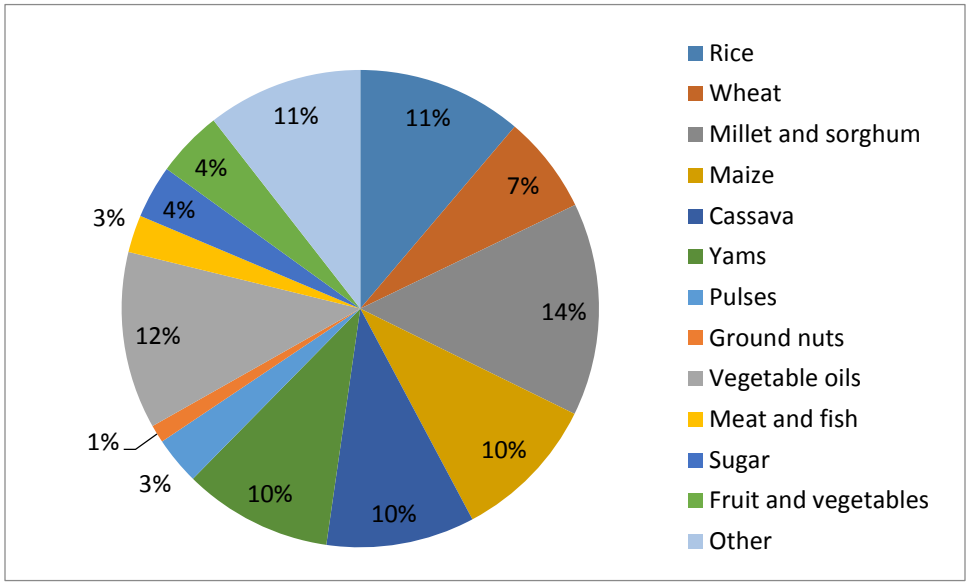


Figure 2: Senegal depends on rice for 29 percent of average daily calorie intake



Source: U.N. Food and Agricultural Organization food balance, 2014

Figure 3: While in Nigeria rice makes up just 11 percent of average daily calorie intake



Source: U.N. Food and Agricultural Organization food balances, 2014

USDA Baseline Model Used to Model Alternative scenarios

This study analyzes a set of productivity scenarios using the USDA-ERS Country-Commodity Linked System (CCLS), which ERS uses for the primary modeling tools to support the USDA interagency process that produces the Department's 10-year agricultural projections. This is a large-scale dynamic partial equilibrium simulation system consisting of 42 country and regional models. The country models incorporate domestic and trade policies and institutional behavior,

such as tariffs, subsidies, and TRQs. Production, consumption, imports, and exports are endogenous and depend on domestic and world prices. Macroeconomic assumptions and projections for this analysis are exogenous, based on USDA's 10 year agricultural projections (USDA, 2016). The system reaches simultaneous equilibrium in prices and quantities for 24 world commodity markets, for each of the 10 projected years in the analysis to 2025. The 24 commodity markets include coarse grains, food grains, oilseeds, meals, oils, cotton, sugar, and animal products.

As part of the CCLS, ERS has built 42 country or region models, including one for the ECOWAS region. The country models feed into the 10-year commodity projection, but also are used for analyzing alternative policy and productivity scenarios and their impacts on international and U.S. agricultural markets and trade. The grain sectors of the models have four major components: 1) price and expected revenue equations; 2) production and consumption; 3) feed demand linked to livestock sectors; and 4) trade equations. Crop production is calculated from area harvested and yield equations. Area harvested and yields are determined by expected returns for a given crop and substitute crops.

Food demand is a function of own consumer price, substitute food prices, and income. For some country models, food demand is modeled by rural and urban per capita consumption. Feed demand is modeled as a derived demand, based on quantity of beef, pork, and poultry produced in the commercial and specialized livestock sectors. Imports and exports can be modeled in different ways. In some country models trade is used to close the model and is an identity, such as consumption and ending stocks minus production and beginning stocks, to derive net trade. Trade can also be modeled as import demand functions or export supply equations with variables for domestic and international prices to determine levels of trade. Producer or farm prices are either solved through price transmission from the global markets or solved within the country model to obtain equilibrium. Production, consumption, and domestic prices are affected by the international price through global equilibrium in all countries' import demand and export supply functions.

Primary data sources are USDA's Production, Supply, and Distribution, (USDA, November 2015), USDA's National Agricultural Statistical Service, the United Nations Food and Agricultural Organization's FAOSTAT, and data from individual country.

ECOWAS model

The ECOWAS model has 12 commodity sectors. The meat sector includes beef, pork, and poultry. The grains include wheat, rice, corn, sorghum, and other coarse grains. The oilseed sector includes other oilseeds, meal, and oils, which are mainly groundnut and palm oil. Additional commodities include cotton, sugar, and cocoa. The rice sector in the ECOWAS model includes area harvested, yield, and production for three different types of rice production systems. Additional variables include per capita rice consumption, food loss, total consumption, imports, exports, food aid imports, producer prices, and consumer prices.

The three rice production systems include non-irrigated upland rice, irrigated low-land rice, and non-irrigated low-land rice. The area planted to rice is determined by expected gross returns, which depends on lagged prices. In the area harvested equations, area is a function of expected

gross returns for rice, as well as returns for corn, sorghum and other coarse grains. Per capita rice consumption is a function of income and consumer prices. Domestic prices are endogenous and close the model, balancing supply and demand. The rice import demand equation depends on the domestic consumer price and the import price of rice with price elasticities. An increase in domestic rice prices leads to an increase in imports. As the import price increases, imports will decrease. Imports are also affected by the import price of corn and other coarse grain, while rice exports are a function of the export price and consumer price.

Baseline model results show rapid rise in food demand, slow production growth

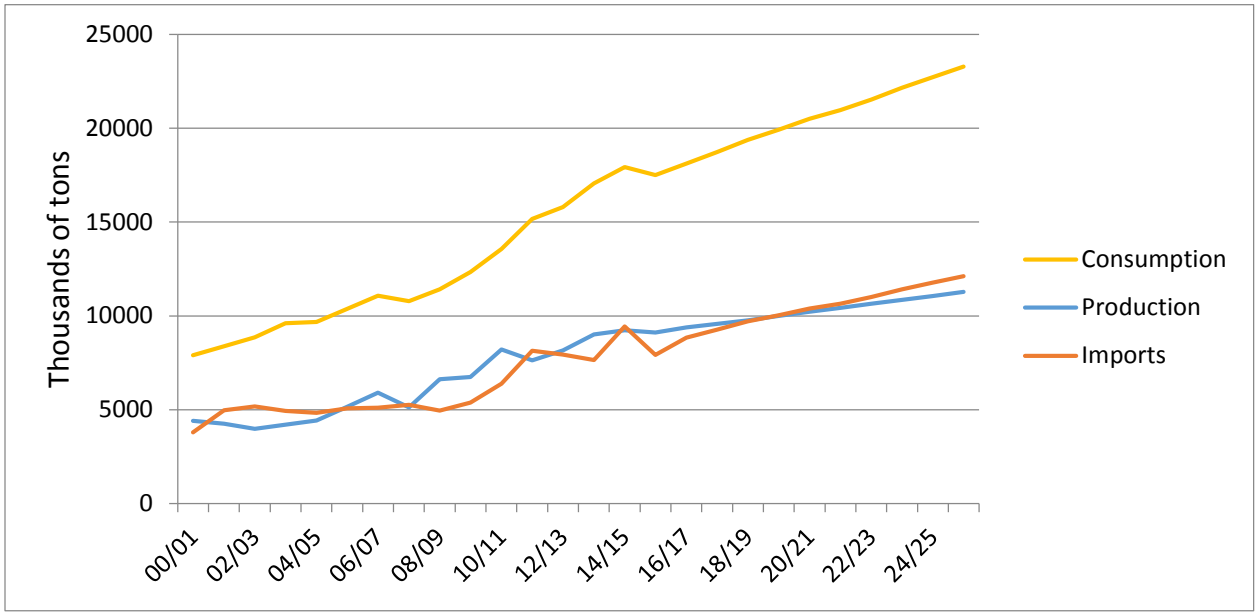
The 2014 ERS Baseline Model provides projections of supply, demand, and trade from 2014/15 to 2024/25. The main assumptions are as follow:

- Real GDP grows at a rate of 4.8 percent per year over the ten year projections period.
- Population grows at a rate of 2.44 percent per year. The result is that per capita GDP grows by just 2.3 percent per year.
- The Common External Tariff went into effect in January 2015.

Some key results for the ECOWAS region are (figs. 4 and 5):

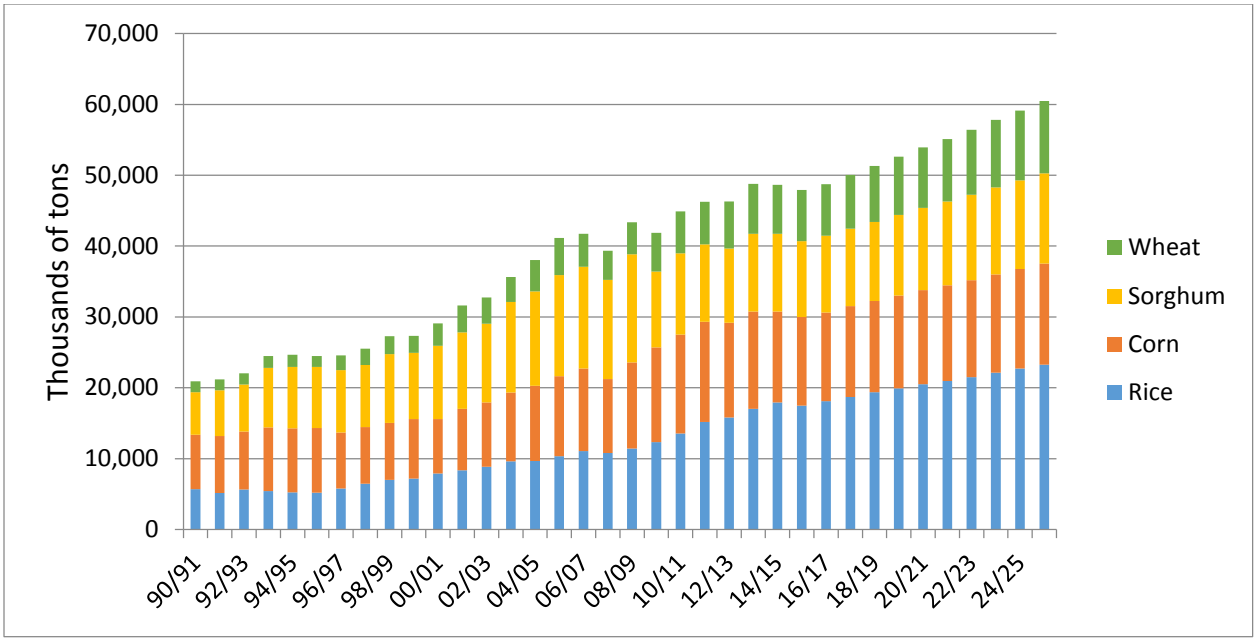
- Slow growth in rice yields over the next decade. At the same time rapid population growth is projected to continue. As a result, ever increasing imports of rice will be needed to feed the growing population.
- The share of rice in per capita food consumption rises, as the shares of corn, sorghum and wheat decline.

Figure 4: Under current policies and production practices, rice production fails to keep up with demand



Source: USDA Economic Research Service

Figure 5: Demand for rice and wheat grows at the expense of corn and sorghum



Source: USDA Economic Research Service

ECOWAS Policy Aims at Self-Sufficiency

The official goal of ECOWAS is to achieve rice self-sufficiency by 2020. To that end, ECOWAS institutions and international donors are making considerable investments in the region. The main objectives are to facilitate trade along selected output and input value chains, work with country governments to harmonize phytosanitary protocols, remove export bans and other barriers to trade, promote agricultural research and technology transfer, develop strategies to cope with climate change, and strengthen governments' capacity to address food insecurity. Commodities of focus are maize, sorghum, millet, rice, and livestock (principally cattle, sheep, and goats). Expected outcomes are a reduction of transport costs and regional trade bottlenecks and faster yield growth through increased use of modern crop varieties and high-quality inputs.

In this paper we focus on policies aimed at boosting productivity of rice production. We analyze two sets of scenarios. The first is an expansion of irrigated area—yields are substantially higher on irrigated land, and it assumed that as more land goes under irrigation, average yields will rise. The second is increased use of fertilizer. Scenario results are described in the next two sections.

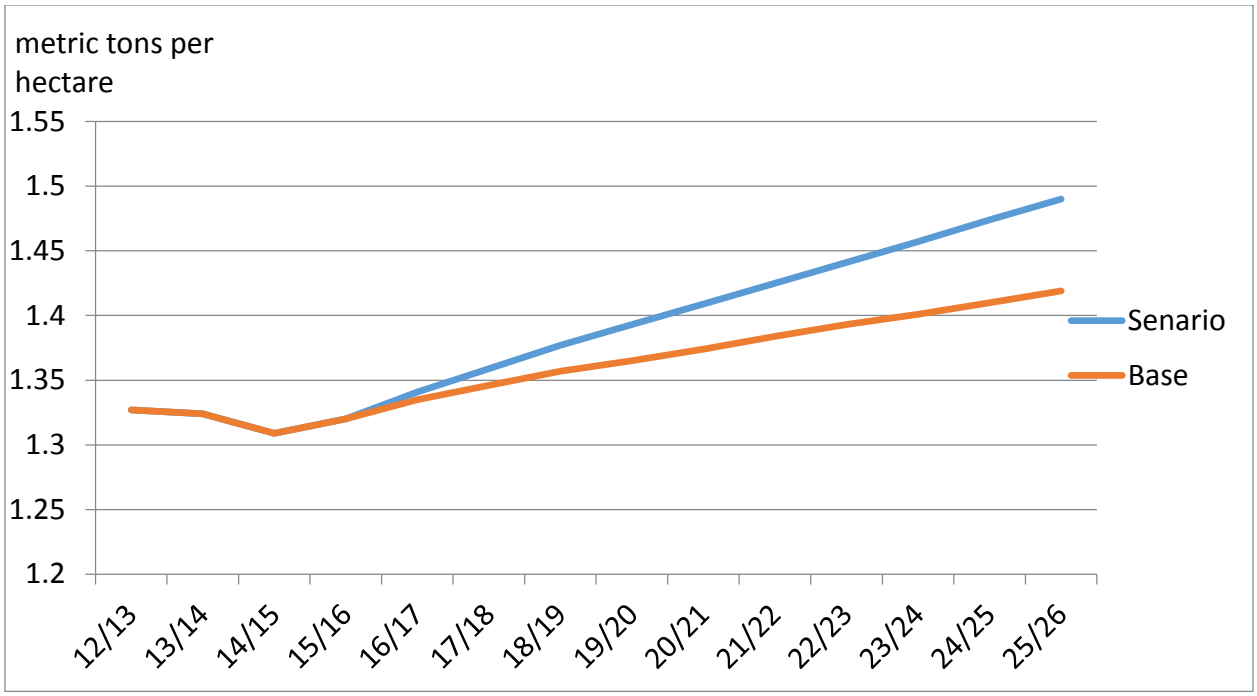
Irrigation

Under this scenario we assume that the share of irrigated land in total rice area rises by 50 percent from the current 11 percent. The irrigated area in the low-land is increased by converting the non-irrigated land into irrigated land. In scenario 1, irrigated land is increased by 25 percent by the end of the ten-year projection period and in scenario 2, irrigated land is increased by 50 percent. The decrease in non-irrigated land offsets the increase irrigated area

and is close to the same area as the increase in new irrigated area. However, the percentage change is smaller than on irrigated area, since the non-irrigated area is about 4 times larger than irrigated. Under scenario 1, a 25 percent increase, irrigated area increases by 211 thousand hectors by 2025 and under scenario 2, a 50 percent increase, irrigated area increases by 422 thousand hectors by 2025.

As a result of this shift average yields reach 1.49 tons per hectare versus 1.42 under the base scenario (fig. 6). Production rises accordingly, but imports fall only slightly—total imports are just 2 percent less in 2025/26 under this scenario than in the base. The reason is that consumer prices fall, stimulating an increase in consumption.

Figure 6: Average yields rise with a 50 percent increase in irrigated area



Source: USDA Economic Research Service

These results would bring an improvement in food security, since more rice would be available at a lower price. But this scenario does not come close to achieving the goal of self-sufficiency.

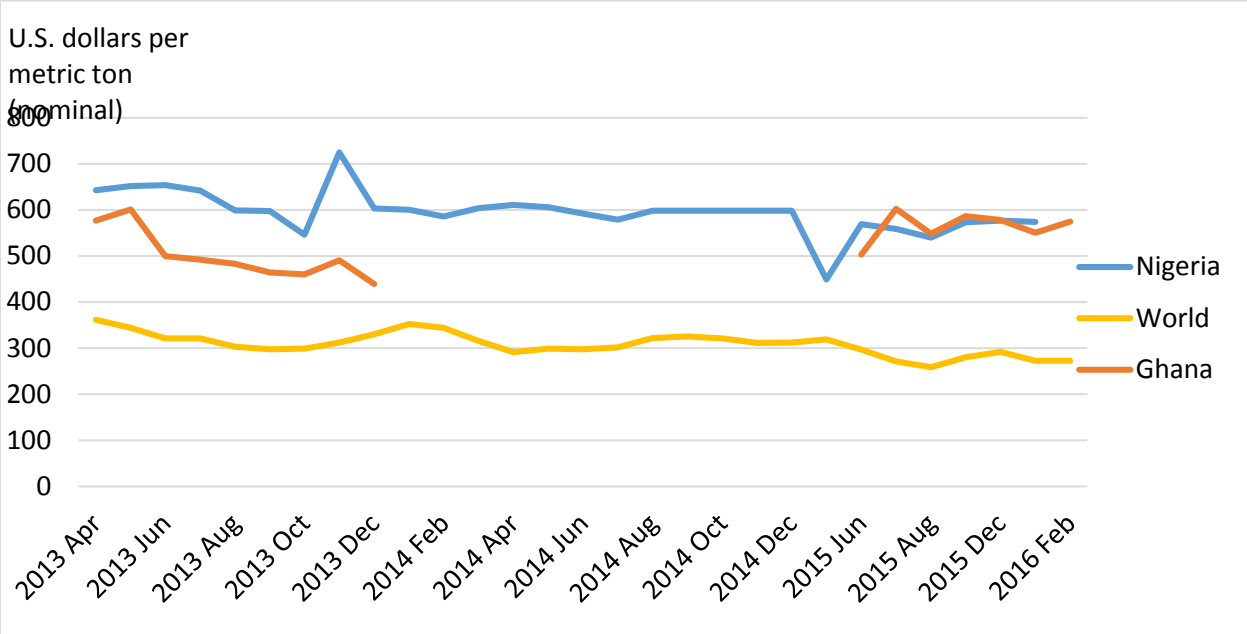
Increased Access to Fertilizer

A number of initiatives by both the ECOWAS Commission and foreign donors are aimed at making fertilizer more affordable to farmers. This goal can be achieved in two ways: through fertilizer subsidies or by reducing transport and marketing costs. Many member countries are already subsiding fertilizer, but we lack data on levels of subsidies or the share of subsidized fertilizer in total sales. Instead we focus on the second option.

Fertilizer is largely imported and under the Common External Tariff, most fertilizer enters at a zero tariff. Local fertilizer prices appear to follow international prices, but the gap between

domestic and international prices is large (fig. 7).[1] Because of high transport costs and inefficient marketing, the final (unsubsidized) price that farmers pay is nearly twice the border price.

Figure 7: World urea prices compared to domestic ECOWAS prices



Sources: www.AfricaFertilizer.org; World Bank

A study by the International Food Policy Research Institute (IFPRI) details some of the factors behind the wide gap between world fertilizer prices and the prices paid by West African farmers (Bumb et al., 2011). According to the authors' calculations using 2009 data, transport, taxes, and other marketing costs make up 52 percent of the retail price of urea in Mali, compared to just 19 percent in Thailand. Transport costs alone make up 32 percent of the retail price in Mali. Some of the factors behind these high costs outlined by the study are:

- High cost of transport from port to final destination: the major factors behind the high costs are roadblocks and checkpoints, a quota system for truckers, poor roads, and trucks that are old and in poor repair. A 2010 study by the USAID Trade Hub Project analyzing transport costs from the port of Tema, Ghana to Ouagadougou, Burkina Faso concluded that removal of such bottlenecks could reduce average transport costs by as much as $77 a ton (Annequin et al., 2010).
- High and inconsistent taxes. Despite the fact that the CET on imported fertilizer is zero, many member countries impose other taxes—some impose value added taxes of 18 percent.
- Inconsistent quality regulation: differing standards across countries prevent movement across country borders. Inconsistent standards also require custom blending in small lots.

[1] Urea is chosen as an example because that is the only product that is included in both the IFDC and the World Bank databases.

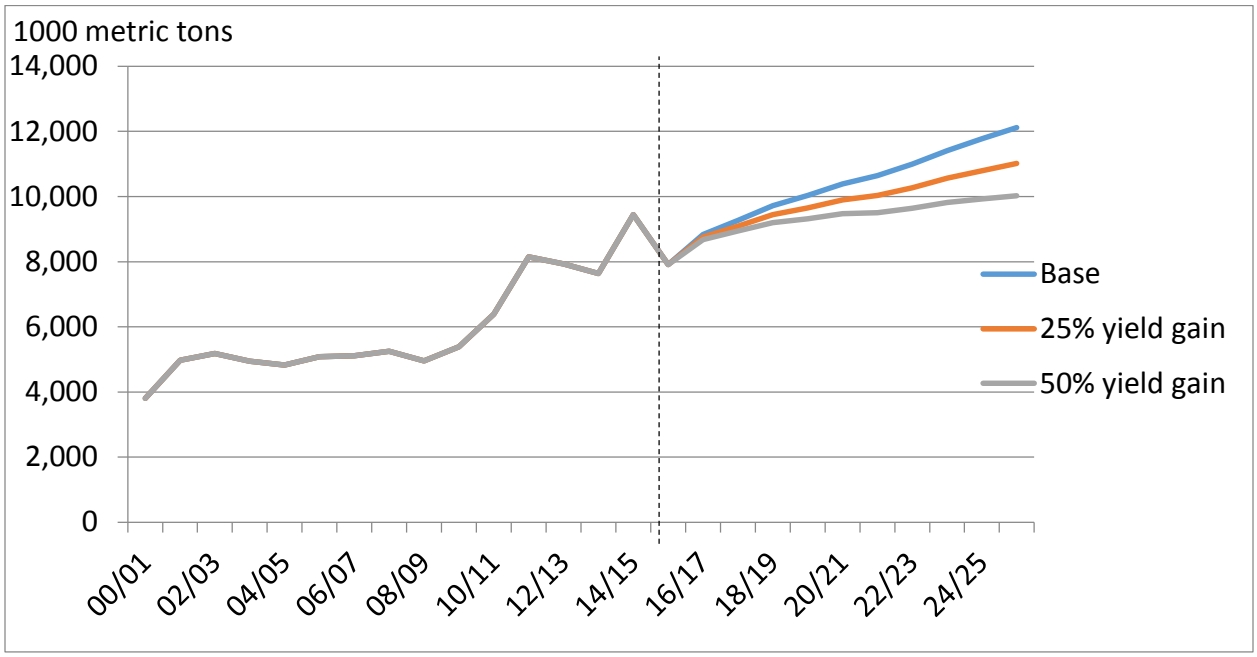
- Difficult access to finance forces importers to import in small lots, raising the cost of imports.
- Lack of market information.

Farmer demand for fertilizer is a function of the ratio of crop prices to fertilizer prices multiplied by the fertilizer response rate (Bumb et al., 2011). According to figures compiled by the authors of the IFPRI study, the fertilizer response rate for rice (additional yield per unit of fertilizer nutrient use) ranges from 1.32 to 2.16.

Two scenarios are modeled under assumptions of greater access to fertilizer. One assumes an average yield increase of 25 percent; the second assumes a 50 percent increase. The rice yields are increased by 25 and 50 percent for each of the three different types of rice area; upland rice, non-irrigated lowland rice, and irrigated lowland rice. Under scenario 3, yields increase 25 percent by the year 2025. Under scenario 3, total rice yields increase by 0.355 metric tons per hectare (mt/ha), from 1.42 to 1.77 mt/ha. Under scenario 4, a 50 percent increase, total rice yields increase by 0.71 mt/ha, from 1.42 to 2.13 mt/ha.

Results are similar to the irrigation scenarios. Production under scenario 4 (50 percent yield increase) grows by 6 percent per year versus 2 percent under the base scenario, reaching 16 million tons in 2025/26 compared to 11 million under the base scenario. But domestic prices fall, leading to more rapid consumption growth. The result is that imports continue to rise, although as a slower pace (fig. 8). The result is greater availability of rice at a lower cost to consumers and hence an improvement in the region's food security. But the goal of self-sufficiency is not achieved.

Figure 8: Imports under yield growth scenarios continue to rise, but at a slower pace



Conclusions and Directions for Further Research

We find that faster yield growth, whether from an increase in land under irrigation or greater access to and use of fertilizer, leads to higher production growth and lower domestic prices. However, while these productivity gains bring improvements to food security, the region does not achieve self-sufficiency.

Further gains could be achieved through improvements in marketing efficiency for rice. While rice imports enter at the CET of 15 percent, many member countries impose additional fees and levies on imported rice. Bottlenecks in the transport and distribution of rice raise the cost to the final consumers. Domestic rice is often of lower quality than imports, and many consumers prefer imported rice. Several scenarios could be developed focusing on improvements in marketing and reduction of transport costs. These will require additional data and remain a topic for further research.

References

Bumb, Balu L., Michael E. Johnson, and Porfirio A. Fuentes. 2011, *Policy Options for Improving Regional Fertilizer Markets in West Africa.* International Food Policy Research Institute Discussion Paper 01084. Washington DC.

Diagne, Aliou, et al. "Estimation of cultivated area, number of farming households and yield for major rice-growing environments in Africa." *Realizing Africa's Rice Promise* (2013): 35-45.

International Fertilizer Development Center (IFDC). 2013. "Developing Competitive Fertilizer Markets in Sub-Saharan Africa: A Background Paper on Fertilizer". Policy Experts Meeting on Technical Convening of Seed and Fertilizer Policy in Africa. Addis Ababa, Ethiopia, December 2013.

Mohanty, S., Wassmann, R., Nelson, A., Moya, P. and Jagadish, S.V.K., 2013. Rice and climate change: significance for food security and vulnerability. *International Rice Research Institute*

United Nations. 2015. *World Population Prospects: Key Findings and Advance Tables.* New York.

United Nations. 2013. "FAOSTAT." Food and Agriculture Organization, Rome, Italy. http://faostat.fao.org.

USDA, Agricultural Projections to 2025. (2016), Office of Chief Economist, USDA Interagency *Agricultural Projection Committee Long-Term Projections, OCE-2016-1, February 2016,* Washington DC, United States. http://ers.usda.gov/topics/farm-economy/agricultural-baseline-projections.aspx