GHANA'S MAIZE MARKET

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Maize is a widely consumed and cultivated staple crop in Ghana. It accounts for more than one-quarter of calories consumed, about double that of the second crop, cassava (GSS 2018). About three-quarters of maize consumption is from own production, suggesting maize has limited appeal as a cash crop (Gage et al. 2012). This is set to change as Ghana's Planting for Food and Jobs (PFJ) initiative, launched in 2017, prioritizes maize seed and fertilizer distribution and encourages market participation by smallholders (MoFA 2019). Already average maize output over the period 2017 to 2019 has been 40 percent higher than the average output achieved between 2013 and 2016 (MoFA 2020a). Government attributes this dramatic production response to PFJ. It is uncertain whether the maize market in Ghana can absorb increased this increased maize output without significant impacts on market prices or the profitability of maize cultivation.

POLICY ENVIRONMENT

Ghana's agricultural policy interventions are primarily focused on raising the productivity of smallholder farmers. Since the late-2000s, prominent interventions have included Agricultural Mechanization Services Enterprises Centers, the Fertilizer Subsidy Program (FSP), and the Block Farms Program (Benin et al. 2013). Many of these have now been rolled into the flagship Planting for Food and Jobs (PFJ) initiative (2017–2020).

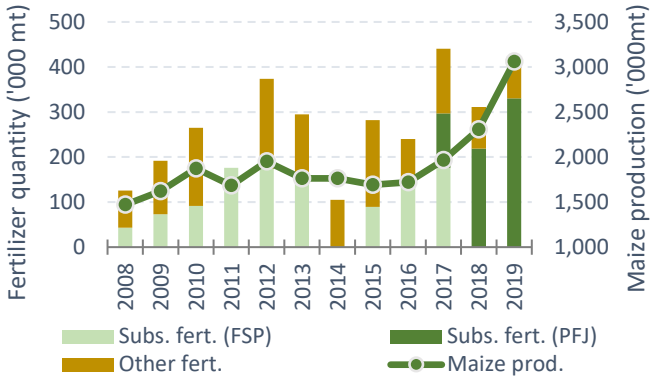
Although PFJ targets more than ten agricultural subsectors, maize is prioritized. The program primarily provides subsidized seed and fertilizer, with over 80 percent of the 2019 budget allocated to subsidies. Marketing support is also provided, but this program pillar is arguably being neglected, which raises concerns about the sustainability of production increases.

Ghana's National Buffer Stock Company (NAFCO) was created in 2010 with the objectives of regulating grain supply and stabilizing prices. Recently, the Ghana Grains Council (2015) and the Ghana Commodity Exchange (2017) emerged as prominent players in the domestic grain market. With respect to international trade, Ghana's industrialization strategy adopted in 2012 prioritizes exports and promotes import substitution. Maize currently receives protection in the form of a 20 percent import tariff (FAO 2016).

PRODUCTION AND CONSUMPTION

Maize production has been volatile over the last decade (Figure 1). National output increased from 1.47 to 1.87 million tons between 2008 and 2010, which coincided with the introduction and rapid expansion of FSP. Between 2011 and 2013, FSP delivered around 170,000 tons of subsidized fertilizer per year. FSP was suspended in 2014, reintroduced in 2015, and rolled into PFJ in 2017. Fertilizer supply under PFJ reached 330,000 tons in 2019. Although 40 percent of fertilizer in Ghana is likely applied to maize (IFDC 2014), the share of subsidized fertilizer allocated to maize may be higher due to policy design and targeting.

Figure 1: Maize production and (subsidized) fertilizer use, Ghana, 2008-2019



Source: Jayne et al. (2015); MoFA (2019, 2020a) ; Africa Fertilizer (2020).
Note: "Other fertilizer" in the figure includes commercially procured fertilizer as well as fertilizer supplied to the cocoa sector, which is regularly subsidized.

Maize output appears to have been responsive to the expansion of subsidized fertilizer supply between 2008 and 2010 and between 2015 and 2019. Output reached 3.06 million tons in 2019, the highest on record (MoFA 2020a). However, maize output fluctuated when the fertilizer policy environment was stable (e.g., 2011-2013), but also was unresponsive to the suspension of the subsidy in 2014. Consequently, the correlation between subsidized fertilizer supply and maize yields is weak ($r = 0.47$), which raises questions about the effectiveness of fertilizer subsidies. While this may reflect late delivery of subsidized inputs or inefficient use of fertilizer, it could also simply be that inputs are not necessarily used in the years that they are supplied.

The outlook for maize is favorable. Although PFJ targets a wide variety of crops, 60 percent of seed distributed under the program thus far has been maize (MoFA 2019b). Demand for maize is robust, especially from the expanding poultry feed sector (Andam et al. 2017). Although wealthier urban consumers are gradually shifting to rice, maize consumption is projected to continue to rise due to population growth (FAO 2016).

Table 1. Maize production and consumption, by agro-ecological zone

	Production, 2006 and 2016				Consumption, 2016/17			
	2006		2016					
Agro-ecological zone	Production, '000 mt	Share, %	Production, '000 mt	Share, %	Aggregate consumption, '000 mt	Share, %	Population, millions	Per capita consumption, kg/yr
Coastal	124	11.6	175	10.2	351	32.0	9.8	35.9
Forest/Transition	904	84.9	1,190	69.1	387	35.3	13.4	28.9
Savannah	161	15.1	357	20.7	359	32.7	4.7	75.7
National	*1,065*	*100.0*	*1,722*	*100.0*	*1,097*	*100.0*	*27.9*	*39.3*

Source: MoFA (2019a); GSS (2018)

Consumer preferences and agroecological conditions influence maize production and domestic trade flows. Per capita maize consumption is highest in northern Ghana's Savannah zone (Table 1), while roots and tubers are more widely consumed elsewhere (Cudjoe et al. 2010). However, production patterns do not mirror consumption. With a 10.2 percent output share, the Coastal zone is not traditionally a maize-growing area, yet its residents account for 32.0 percent of demand. By contrast, the Transition zone contributes 69.1 percent of national maize output but accounts for only 35.3 percent of consumption. Although maize output in the Savannah zone has more than doubled in the last decade, it still only contributes 20.7 percent of national production, while its small population accounts for 32.7 percent of consumption.

Domestic and International Trade

Spatial differences in production and consumption create spatial arbitrage opportunities for traders (Abdulai 2000; Ankamah-Yeboah 2012). Techiman in the Transition zone and Tamale in Savannah zone are important feeder markets from where maize is aggregated and transported to consumer markets, such as to Accra in the Coastal zone (FAO 2016). Ghana is self-sufficient in white maize production, and imports and exports – mostly informal and undocumented – have a negligible effect on domestic supply (FAO 2016). Formal net imports between 2016 and 2018 accounted for 3 percent of domestic supply (UN Comtrade 2019). Imports consist mostly of yellow maize for animal feed. Despite limited exposure to world markets, domestic maize prices are highly correlated with international ones (Cudjoe et al. 2010).

Piecing together information on consumption, production, trade, and stock carryovers (Gage et al. 2012; UN Comtrade 2019; MoFA 2020a; GSS 2018), total maize supply for 2016 is estimated at 1.94 million tons, of which 90 percent is sourced domestically. Around 870,000 tons of production is retained by the one million growers, of which an estimated 15 percent is lost during post-harvest handling and storage. Of the remaining 1.07 million tons that is marketed, private households consume 33 percent; the feed sector, 42 percent; and industrial processing the remaining 25 percent. Total household consumption is 1.10 million tons (Table 1), of which 68 percent is from own production.

Price Trends

Analysis of monthly price data collected by MoFA's Statistics, Research, and Information Directorate (SRID) shows – as expected – that retail and wholesale prices are highly correlated (r = 0.93) (Figure 2). The markup of retail over wholesale prices partly reflects the costs of handling and repackaging maize into smaller retail quantities. However, whereas the markup was around 20 percent between 2008 and 2016, it has averaged more than 40 percent during the PFJ era (2017-2019). Furthermore, a comparison of real (CPI-adjusted) wholesale and retail prices reveals that while real wholesale prices declined by one-fifth since 2012, real retail prices remained constant.

Figure 2: National average maize prices in wholesale and retail markets, 2008 to 2019

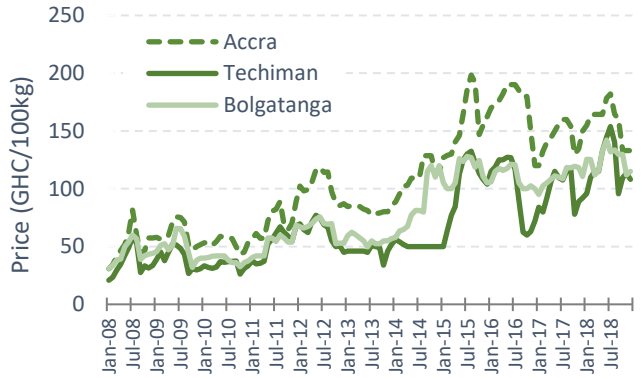
Source: MoFA (2020b)

The real decline in wholesale prices may be linked to input subsidy-induced production cost declines at farm-level. However, further analysis is required to ascertain this and – importantly – to understand why gains are not being passed on to consumers in retail markets, as this could have important implications for food security and consumer welfare. This is especially true for areas where maize is a dominant staple (Savannah) or where consumers rely more on marketed foods (Coastal). Rising maize retail prices may partly explain the increase in the rural poverty headcount in Ghana's northern regions from 55 to 68 percent between 2012 and 2017 (GSS 2018).

Figure 3 plots wholesale maize market prices in Techiman, a key feeder market, and in the main consumer markets of Accra and Bolgatanga over the period from 2008 to 2018. Prices across these markets are relatively

well-integrated, especially between Techiman and Accra. Price differentials across integrated markets usually reflect transport costs. However, although Accra and Bolgatanga are equidistant from Techiman, the Accra-Techiman markup is significantly higher (62 percent) than the Bolgatanga-Techiman markup (22 percent) and has increased over time. This may reflect quality differences of stocks available in these markets or stronger competition in Bolgatanga market.

Figure 3: Maize wholesale prices by region, 2008 to 2018



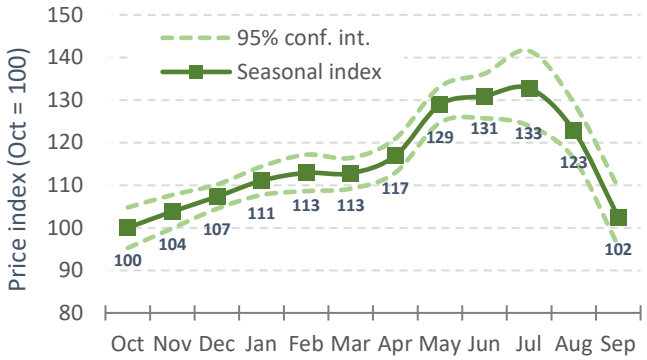
Source: MoFA (2020b). Regional prices were only available through 2018.

Maize production is seasonal. Consequently, prices are low immediately after the harvest when supply is abundant but rise over the course of the marketing season. Maize is also highly storable; therefore, seasonal price movements allow agents to engage in temporal arbitrage, i.e., store to sell later at a profit. Temporal arbitrage is attractive when the expected price increase covers storage-related costs, such as transport, handling, insurance, and interest. When unanticipated shocks cause prices to deviate from their normal seasonal patterns, risks increase. Price shocks may be caused by global market shocks or adverse weather as well as unanticipated interventions in food markets by government, donors, or private sector actors (Kaminski et al. 2016).

Market analysts are as much interested in identifying the predictable seasonal price patterns as they are in understanding how prices have historically varied in an unpredictable manner around the seasonal trend. Different methods can be used for doing so. The widely-used multiplicative model defines price (P_t) at time t as $P_t = (T_t \times C_t) \times (S_t \times R_t)$. T_t and C_t are long-term trend and cyclical components, and S_t and R_t are short-term seasonal and random (or unpredictable) components (Tschirley 1995). Here this model is applied to maize prices observed between 2006 and mid-2017, i.e., until just prior to the launch of PFJ. The objective is to see whether price patterns from mid-2017 onwards deviated from expected trends as forecasted by the model.

Figure 4 plots the seasonal index derived from the short-term predictable component (S_t) and associated confidence interval, which is estimated from variations in the unpredictable component (R_t). The latter reveals that the average variation of R_t around the seasonal trend is (S_t) ± 8 percent, although deviations of ± 15 percent or more are frequently observed. Prices are lowest during harvest in October and rise gradually through March as new stocks continue to enter the market. (The October index value is arbitrarily set at 100.)

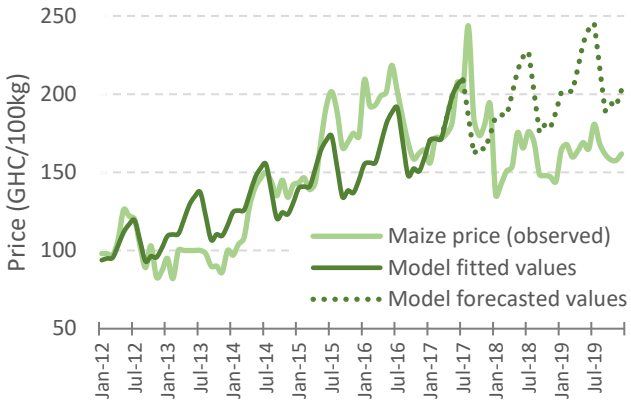
Figure 4: Short-term seasonal maize price expectations (S_t)



Source: Analysis of MoFA (2020b)

Prices rise more rapidly from April onwards, peaking at 133 in July. Thus, a trader who procures maize in October can reasonably expect to achieve a premium of 33 percent in real terms if the maize is sold in July. However, the confidence interval suggests that there is a 5 percent chance that the July price will fall outside of the range of 124 to 142. To put this risk into perspective, storage costs (as quoted by the Ghana Grains Council) and interest on a loan (as quoted by the Agricultural Development Bank) alone sum to 28 percent of the value of the grain over a nine-month storage period.

Figure 5: Forecasted maize prices against observed



Source: Analysis of MoFA (2020b)

Figure 5 plots model fitted values (2012 to 2017) and forecasted prices (2017 to 2019) against observed prices. This comparison of forecasted and observed prices reveals whether prices observed during the PFJ era followed the anticipated trend and seasonal path predicted by the model. The figure shows that while maize prices continued exhibiting a normal seasonal pattern since the start of PFJ, national average wholesale prices were below the expected level – the trend appears to have flattened out. This may be a cyclical deviation which could correct itself. But, considered alongside Figure 2, producers may be

absorbing a price decline as a result of PFJ, while traders—rather than consumers—are capturing the rents.

CONCLUSIONS

A quarter of calories consumed by Ghanaian households come from maize. Maize is prioritized under Ghana's PFJ initiative, which, through the supply of improved seed and fertilizer, has likely contributed to the recent 40 percent increase in maize output. However, despite this impact, questions remain over the efficiency of (subsidized) fertilizer use in Ghana, as maize yields have historically been uncorrelated with subsidized fertilizer supply.

The market analysis here highlights several distinct maize market features and related recommendations. First, while real wholesale prices declined in recent years, gains have apparently not been passed on to consumers in retail markets. A related concern is the increase in the price spread between feeder and consumer markets, which may reflect uncompetitive behavior. More efficient price transmission mechanisms and an improved regulatory environment are imperative for improving food security and reducing poverty.

Second, seasonal price patterns suggest that the national wholesale market price increases on average by 33 percent during the October to July marketing season. At current storage costs, temporal arbitrage may not be lucrative; however, traders may well find combinations of market pairs for which a combined spatial and temporal arbitrage strategy is profitable. High interest rates raise the opportunity cost of holding stocks – this remains perhaps the most significant deterrent to engaging in maize trade in Ghana.

Lastly, the analysis suggests that, while PFJ may have caused real wholesale prices to decline, the program has not had a significant impact on seasonal maize price patterns. This suggests that the market is reasonably efficient at absorbing increased production without causing the seasonal price-spread to increase.

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