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MAIZE PRODUCTIVITY IN GHANA

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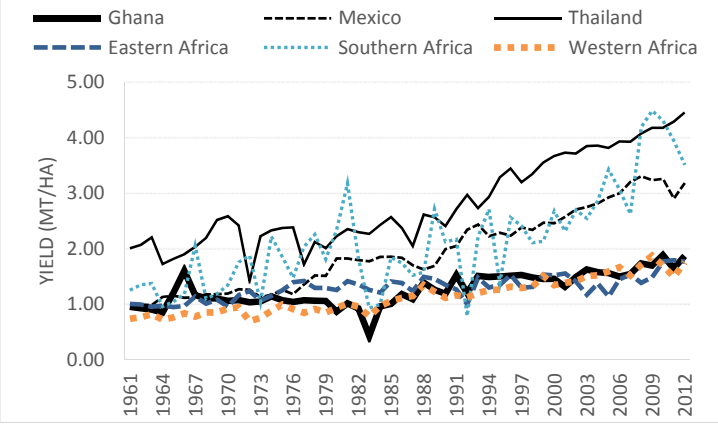
LOW PRODUCTIVITY DESPITE SIGNIFICANT INVESTMENTS IN THE PAST

Maize is an important food crop in Ghana, accounting for more than 50 percent of the country's total cereal production. The Ghana Grains Development Project (1979–1997) and the Food Crops Development Project (2000–2008) made major investments to improve maize yield. Despite these efforts, the average maize yield in Ghana remains one of the lowest in the world, much lower than the average for Africa south of the Sahara. It is also lower than yields achieved in similar lowland, rainfed, tropical environments in Thailand and southern Mexico (Figure 1). Yields have been growing by only 1.1 percent per annum in Ghana. In 2012, maize yields in Ghana averaged 1.2–1.8 metric tons (mt) per hectare (ha), far below the potential yield of 4–6 mt/ha achieved in on-station trials. This note examines maize productivity against this backdrop. It looks at the state of technology adoption, markets and policies, and attainable yield potential to explain the persistently low productivity of maize in Ghana.

Figure 1—Comparison of maize yield in Ghana to yields in selected countries and regions (1961-2012)



Source: FAOSTAT

MAIZE PRODUCTION IS PROFITABLE

Rising population, urbanization, and growing poultry and fish sectors in Ghana have contributed to increased demand for maize. Per capita consumption, mainly of white maize, grew only marginally from 38.4 kg in 1980 to 43.8 kg in 2011 (MoFA 2010; MoFA 2012). However, the poultry industry's demand for maize, used as feed, was estimated to have grown by 10 percent annually between 2000 and 2009 and would currently surpass 540,000 mt if birds were fed a proper ration (Hurelbrink and Boohene 2011). Feed companies prefer yellow maize, which currently accounts for almost all maize imports (FAO 2013). Without productivity improvements, especially for yellow maize, Ghana's Ministry of Food and Agriculture (MoFA) estimates that 267,000 mt of maize will have to be imported in 2015 to meet domestic demand (FAO 2013).

Ghanaian maize producers face favorable input prices. Fertilizer is subsidized by the Ghanaian government. The cost of fertilizer as a ratio of maize grain prices is lower than in Thailand, but slightly higher than in southern Mexico (Table 1). The prices of open-pollinated variety (OPV) seeds as a ratio of maize grain prices are higher, but the prices of public hybrid seeds are much lower in Ghana compared with Thailand. Prices of privately-developed hybrid seeds in Ghana are comparable to those in Thailand.

Using data collected from medium and large-scale famers in Ghana in 2013, gross margins from maize production in different agroecological zones under various combinations of seeds and fertilizers were estimated to be marginally positive, except for local maize without fertilizer in the Sudan Savannah zone (Table 2). However, if the costs of family labor are included in the calculation, gross margins are negative under nearly all conditions. The returns from maize production, even when family labor costs are not included, vary considerably. The returns for Obatanpa, an open-pollinated variety (OPV), with fertilizer use is about 20 percent in the Transition and Sudan Savannah zones, but considerably less in the Guinea Savannah zone. We observed similar results with the use of hybrid seeds: Gross margins are considerably lower in the Guinea Savannah zone compared with the other two zones.

Earlier studies reported positive and much higher profits, even after including family labor costs. Using data on a sample of growers in Upper West, Northern, and Brong Ahafo regions, Akramov and Malek (2012) concluded that maize production by efficient producers is profitable at both private and social prices, with or without costing for family labor. However, maize production is only marginally profitable for average producers after costing for family labor. Winter-Nelson and Aggrey-Fynn (2008) show that all maize systems they studied in Upper West and Brong Ahafo regions were profitable at private and social prices (including family labor costs). These earlier studies estimated higher profits because they assumed higher yields than those reported in the 2013 survey.

INCREASING FERTILIZER USE NOW COMPARABLE WITH OTHER COUNTRIES

Inorganic fertilizers are applied to nearly one half of the area planted with maize in Ghana. On average, 270 kg of fertilizer is applied per ha. This amount contains 47 kg of nitrogen (N), 20 kg of

Table 1. Relative input costs for maize production in Ghana, Thailand, and southern Mexico, 2012

Variables	Ghana *(In cedi= GH₵)*	Thailand *(In baht = THB)*	Southern Mexico *(In pesos=MXN$)*
Farmgate price of maize grain	GH₵0.60/kg	THB9.05/kg	MXN$3.94/kg
Fertilizer (urea)	GH₵0.74/kg (subsidized); GH₵1.46/kg (unsubsidized)	THB17/ kg	MXN$4.26/kg
Fertilizer price to maize grain price ratio	1.23 (subsidized fertilizer); 2.43 (unsubsidized fertilizer)	1.89	1.08
Seed price (per kg)	GH₵2.00/kg (OPV); GH₵1.00/kg (announced subsidized OPV seed price); GH₵3.50/kg (Mamaba public hybrid); GH₵/8.00 to 11.00/kg (private hybrid)	THB20/kg for seed of OPV; THB70/kg (Nakhon Sawan 3 public hybrid); THB/144/kg (average for private hybrid)	MXN$6.33/kg (creolized seed); MXN$3.51 (landrace); MXN$20.25/kg (hybrid)
Seed price to maize price ratio	3.33 (OPV); 1.67 (announced subsidized OPV seed price); 5.83 (public hybrid); 13.33–18.33 (private hybrid)	2.21 (OPV); 7.73 (public hybrid); 15.91 (private hybrid)	1.61 (creolized seed); 0.89 (landrace); 5.14 (hybrid)

Source: Ragasa (2014).

Table 2. Gross margins of various maize productions, 2012.

	Transition Zone					Guinea Savannah					Sudan Savannah				
	Local		Obatanpa		Hybrid	Local		Obatanpa		Hybrid	Local		Obatanpa		Hybrid
	No fert	With Fert	No fert	With Fert	With fert	No fert	With Fert	No fert	With Fert	With fert	No fert	With Fert	No fert	With Fert	With fert
Number of farmers	36	97	26	128	10	33	147	9	69	12	5	136	5	92	52
Yield (kg/ha planted)	756	1208	1054	1497	1819	745	914	868	1020	1444	547	1339	1226	1800	2374
Maize grain price (GH₵/kg)	0.60	0.60	0.60	0.60	0.60	0.40	0.40	0.40	0.40	0.40	0.50	0.50	0.50	0.50	0.50
Gross revenue	453	725	633	898	1091	298	366	347	408	578	294	680	716	891	1098
Total cash expenditures	415	647	315	701	725	110	304	143	307	397	332	521	156	687	650
Family labor and use of assets owned by farmer	363	383	315	238	307	271	246	155	218	256	391	479	1316	298	325
Total costs (incl. family labor and assets owned by farmer)	778	1029	630	939	1032	381	550	298	525	653	723	999	1472	985	975
Gross margins (GH₵/ha)															
Without family labor	**33**	**49**	**296**	**144**	**282**	**162**	**12**	**158**	**33**	**114**	**-65**	**122**	**535**	**155**	**393**
With family labor	**-325**	**-304**	**2**	**-40**	**59**	**-83**	**-184**	**49**	**-117**	**-75**	**-429**	**-319**	**-756**	**-94**	**123**
Returns to investment (gross margins/total cost excl. family labor)	**0.08**	**0.07**	**0.88**	**0.19**	**0.35**	**1.19**	**0.03**	**0.83**	**0.09**	**0.25**	**-0.18**	**0.22**	**2.96**	**0.21**	**0.56**

Source: IFPRI/SARI Survey on medium and large-scale famers and mechanization (2013).

phosphorus (P) and 20 kg of potassium (K). Although fertilizers are subsidized, maize producers apply only 50 to 60 percent of the levels of fertilizer application recommended by CSIR. The national average level of fertilizer applied to maize in Ghana is comparable to levels in Zambia and Malawi, but much lower than those in Kenya and northwestern Ethiopia. Ghanaian maize farmers who apply fertilizers do so at rates comparable to maize farmers in Thailand, Mexico, and southern Malawi. The proportion of maize farmers who apply fertilizers and the quantity that they apply varies, however. A higher proportion of producers in the Northern Savannah zone (87 percent) apply fertilizers, doing so at higher rates – 57 kg of N, 27 kg of P, and 27 kg of K per ha. Lowest fertilizer adoption levels are observed in the Forest zone, where 17 percent of the area under maize is fertilized at average rates of 27 kg of N, 16 kg of P, and 16 kg of K per ha. The fertilizer application rate is also low in the Coastal Savannah zone, where 37 percent of maize area is fertilized at an average rate of 29 kg of N, 17 kg of P, and 17 kg of K per ha.

The maize yield response to fertilizer application is higher in Ghana than in other African countries. Chapoto and Ragasa (2013) report that applying one kg of N per ha yields an additional 22–26 kg of maize per ha compared with 8 kg/ha in Malawi and 23 kg/ha in Uganda. The value-cost ratio for fertilizer application on maize, a rough measure of the profitability of using fertilizer, is much higher in Ghana than in other countries (Jayne and Rashid 2013). However, increasing dependence on chemical fertilizer and the continuous loss of organic matter in the soil may lead to a declining maize fertilizer response, as other countries have experienced (Jayne and Rashid 2013).

REASONS FOR SUB-OPTIMAL USE OF FERTILIZER

Based on recent survey results, possible reasons for sub-optimal use of fertilizer by farmers in Ghana include credit constraints, a lack of access to fertilizer, and farmers' perception about the soil fertility of their maize plots. While 48 percent of maize farmers who do not use fertilizer reported their plots are adequately fertile without it, 36 percent reported that they lack funds or that the fertilizer costs too much. The share of farmers reporting that their plots do not need fertilizer was greater in the South. In the North, a greater share of farmers who did not use fertilizer cited the high cost of fertilizer as prohibitive. Part of this high cost is due to the unavailability of subsidized fertilizer when it is needed most.

Econometric analysis of the factors associated with fertilizer use showed that the more of the harvest the farmer expects to sell, the more likely that farmer is to use fertilizer. Northern farmers who hire more labor per ha, plow their plots, plant in rows, and perceive their land to be less fertile are more likely to use fertilizer than others (Chapoto and Ragasa 2013). The intensity of fertilizer use was also associated with proximity of the farm to the local source of fertilizer.

ADOPTION OF MODERN VARIETIES AND CERTIFIED SEEDS IS LOW

In 2012, modern varieties were planted on 61 percent of Ghana's maize fields, an increase over the 54 percent observed in 1997 (Morris et al. 1998). However, maize farmers used certified seeds on only 15 percent of the total maize area. Econometric results show that plots planted with certified seed and fertilizer had higher yields by about 330 kg/ha than plots planted with uncertified seeds.

Obatanpa, an OPV released in 1992, is the dominant maize variety planted, and there are indications that it is becoming more popular even as newer varieties come on the market. Nearly 96 percent of the certified seeds produced in Ghana between 2001 and 2011 were of the Obatanpa variety. The weighted average varietal age of maize planted in Ghana is now 23 years even though Ghana's agricultural research system releases seven new varieties every 10 years on average. It may be that the new varieties do not perform significantly better than Obatanpa or that they are not being made sufficiently available to farmers via an effective seed system.

HYBRID MAIZE HAS NOT TAKEN OFF

Thailand, Mexico, and countries in southern Africa have increased maize yields under similar agroecological conditions by increasing the use of hybrid seeds. Analysis of a 2012 farmer survey conducted by the Council for Scientific and Industrial Research (CSIR) and IFPRI and information on certified seed production suggests that only about 2 percent of producers in Ghana use hybrid seed.

CSIR has released ten hybrids. Of these, only two, Mamaba and Etubi, reached the stage of certified seed production and adoption. Their seed production has averaged 30 mt/year, which is enough to plant 1,500 hectares, assuming a seed rate of 20 kg/ha. Hybrid seed, such as Pannar 53 (white) and Pannar 12 (yellow), are also sold in the country by private companies.

The 2012 CSIR/IFPRI survey of 630 maize farmers (2 percent of whom grew hybrid, mainly Pannar) shows a 65 percent higher yield from hybrids than from the popular OPV Obatanpa. A 2013 survey of 1,251 maize farmers in the North and Brong Ahafo (80 of whom grew hybrid) shows that Pannar outperformed Mamaba, the public hybrid. Half of the farmers using Pannar hybrid seed with fertilizer obtained yields of at least 2.2 mt/ha compared with a median yield of 1.4 mt/ha for Mamaba with fertilizer (Table 3). The improved performance of Pannar may be due to better input usage and management practices, as it was grown under an outgrower program. However, Mamaba seems to have no significant yield advantage over Obatanpa. While Pannar seed costs ₵8-11/kg, and Obatanpa costs ₵2-3/kg, Pannar offers profits estimated to be 60 to 70 percent higher than with Obatanpa due to the greater yields it provides. However, note that producers in the 25th percentile, including those who used imported hybrids, obtained yields that did not provide positive net gross margins.

Table 3—Maize yield with or without fertilizer, by seed type (metric tons/hectare)

	Count	Average	p25	p50	p75
Without Fertilizer					
Local variety	90	0.77	0.37	0.62	0.99
Mamaba (public) hybrid)	1	0.49	0.49	0.49	0.49
Obatanpa	47	1.04	0.56	0.99	1.48
Other improved	57	0.87	0.37	0.7	1.23
With Fertilizer					
Local variety	453	1.20	0.62	0.99	1.48
Mamaba (public) hybrid)	29	1.74	1.07	1.36	2.47
Pannar (imported) hybrid)	67	2.34	1.48	2.18	3.09
Obatanpa	332	1.47	0.81	1.24	1.98
Other improved	408	1.62	0.86	1.48	2.2

Source: IFPRI/SARI Survey on medium and large-scale farmers and mechanization survey (2013).

Some local seed companies that have been supported by the Alliance for a Green Revolution in Africa (AGRA) to produce hybrid maize seed report obtaining yields of 3.5 mt/ha from Mamaba compared to 2.5 mt/ha from Obatanpa. However, other seed producers report that Mamaba outperforms Obatanpa only under drought conditions. Key informants in the seed industry suggest that the commercialization of Ghana's first public hybrid has been delayed because of poor quality seed. The informants said the inbred lines they buy from CSIR for their crosses are impure. The companies said they obtain yields from on-station trials of Mamaba of only 2.5 to 3.5 mt/ha instead of the expected 6.5 mt/ha.

Although Ghana has revised its seed policies to encourage private sector participation, it has been slow to make quality hybrid maize seed available. A number of local private seed companies have emerged, although an effective system to make locally released genetic material available to farmers remains to be developed. This is partly due to the government still not playing the public sector and regulatory role that it should to encourage private seed sector development (Tripp and Mensah-Bonsu 2013).

ACTIONS TO CONSIDER

- There is urgent need to encourage the adoption of modern OPV and hybrid varieties which are more responsive to applications of inputs to raise maize productivity. This will require varieties significantly superior to those now in use, an effective seed system, and mechanisms to overcome some of the market failures that discourage technology adoption.
- Varietal testing and release processes need to be strengthened to identify appropriate varieties for different agroecological conditions. Complementary cultivation practices also need to

be identified in order to obtain higher yields with greater consistency than has been the case with recently released varieties.

- A vibrant seed sector is required to effectively disseminate publicly developed hybrid varieties. In addition to the seed policy favorable to private sector that is already in place, the following actions need to be taken to encourage private seed sector development: adoption of transparent processes for varietal releases; stricter enforcement of seed quality control; protection of consumers; promotion of seeds; maintenance of the quality of breeder seed; and adequately trained staff for seed certification.
- Consider examining and replicating successful maize outgrower schemes such as Masara N'arziki (Guyver and MacCarthy 2011). In these schemes farmers are supported with credit, information, and output markets to encourage intensification of maize production. Such support may nudge farmers away from nutrient-mining strategies in their maize production.

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