GHANA

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A Review of the Ghana Planting for Food and Jobs Program: 2017-2020

Implementation, Impact, and Further Analysis

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ACRONYMS AND ABBREVIATIONS

GDP	Gross Domestic Product
GH¢	Ghana Cedi (currency)
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
FSP	Fertilizer Subsidy Program
FUE	Fertilizer Use Efficiency
MoFA	Ministry of Food and Agriculture
PFJ	Planting for Food and Jobs
US$	United States Dollar (currency)

Currency: Ghanaian cedi (GH¢): US$ 1.00 ≈ GH¢ 5.74, March 2021

ABSTRACT

This report examines the evolution of farm input subsidy programs in Ghana, with a focus on the Planting for Food and Jobs (PFJ) initiative, which was introduced in 2017 and replaced the Fertilizer Subsidy Program (FSP) that was launched in 2008. A review of PFJ implementation reports and other official data sources reveal that information on general program features, such as beneficiary numbers, subsidized input quantities, and program budget is readily available and useful for understanding program design and implementation. National crop production estimates are also reported annually, and these provide evidence of rapid output growth in the agricultural sector, especially within the cereals subsector. However, the implementing agency, the Ministry of Food and Agriculture (MoFA), lacks a system for closely monitoring and reporting PFJ program impacts at farm-level. Consequently, most of the published information on the marginal contribution of PFJ to national crop output is based on simulations, which make strong assumptions about seeding rates, fertilizer use by crop, and input use efficiency on beneficiary farms. With this drawback in mind, these simulations show that PFJ contributed substantially to crop output growth, a result which is not implausible considering the quantities of inputs provided, but one that requires further on-farm validation. Recommendations are offered around beneficiary targeting, interpretation of employment impacts, and the need for regular monitoring of farm-level impacts, all of which will help improve transparency of the program.

1. INTRODUCTION

One of the defining features of economic transformation in sub-Saharan Africa in recent decades has been the movement of workers out of agriculture, as expected, but not into manufacturing sector jobs, as per the Asian Green Revolution experience, but into largely urban, informal trade services sectors (Diao, McMillan and Rodrik 2017). Services now account for over half of gross domestic product (GDP) in sub-Saharan Africa, whereas the manufacturing sector's share has shrunk—prematurely, according to Rodrik (2018), considering the level of development—from 15 to 10 percent since 1975.

This brings about several policy challenges. First, since many workers are moving into informal trade services where productivity is not necessarily higher than in agriculture, any structural transformation that has occurred has not always been growth-inducing; instead, growth has often been dependent on within-sector productivity growth. Second, since informal retail trade services are non-tradable, its growth is constrained by national income. In contrast, in other contexts where structural change has entailed movement into tradeable manufacturing sectors, firms were able to compete within larger global markets. A third challenge relates to transformation of the agri-food system itself. Africa's growing urban middle class increasingly demands higher quality processed foods (Tschirley, et al. 2015). Many observers consider this to be an opportunity for modernizing and expanding local agri-food value chains. However, African food needs are increasingly being met through imports (Rakotoarisoa, Lafrate and Paschali 2012). Evidence of this is that the food production index for sub-Saharan Africa increased 24 percent in the decade from 2005–2014, whereas the value of food imports increased 185 percent over the same period in US Dollar terms (World Bank 2018).

The apparent inability of agricultural producers and agroprocessing firms in sub-Saharan Africa to exploit emerging domestic market opportunities may be due to the poor business climate in many African countries, which Gelb, Meyer, and Ramachandran (2014) link to, among other things, high transport, energy, and regulatory compliance costs faced by manufacturers. However, it may also reflect challenges specific to the agri-food system, a collective term for food-related activities, including primary production (classified in the system of national accounts as "agriculture"), food- and agroprocessing ("manufacturing"), and food trade and transport as well as restaurant or catering services ("services"). At the primary production level, low productivity and subsistence farming continue to dominate in many African contexts, and sustainable agricultural intensification practices are not being adopted at the pace required to maintain soil fertility and per capita production levels (Binswanger-Mkhize and Savastano 2017). Further downstream, food safety or quality standards demanded by urban consumers or regulators (Hensen and Jaffee 2006), barriers to enter urban food markets due to monopolistic behavior along the value chain (Ngeleza and Robinson 2013), logistical challenges, or low profit margins (Demont, Fiamohe and Kinkpé 2017) could explain why domestic agroprocessing firms or wholesale and retail traders often find it more convenient or even more cost-effective to link into international supply chains as opposed to domestic ones.

African countries need to find ways to counter the dual trends of deindustrialization and the growing reliance on imported food. Unfortunately, high unit labor costs make it unlikely for African firms to emulate Asian ones and produce globally competitive manufactures (Ceglowski, et al. 2015). However, Africa continues to have—at least in principle—a comparative advantage in primary food production due its relative abundance of natural resources and rural labor. Commercial opportunities are also emerging for local agroprocessing or food services firms due to rapid urbanization and income growth. Given these factors, it is conceivable that continued

investment in primary agricultural production with the objective of developing a more commercially oriented agricultural sector, coupled with investments in cost-efficient agroprocessing capacity and quality food services to strengthen and expand food markets, could pay off. A new narrative of strengthening or transforming the entire agri-food system rather than focusing on primary agricultural production alone is fast gaining traction among African policymakers and development partners.

Investments for agri-food system transformation involve four complementary areas of spending: 1) traditional investments that target agricultural productivity by relieving input market constraints and promoting technology adoption; 2) investments that facilitate access to markets and market information with a view to create a more competitive and commercially oriented agricultural sector that can provide a reliable supply of intermediate inputs to the agroprocessing sector; 3) investments in agroprocessing capacity and efficiency; and 4) improvements in the overall business climate or policy environment to ensure that food processors can effectively link to urban markets and compete with imported foods or in international markets. These four areas require equal and coordinated interventions: without a reliable market, farmers will have no incentive to produce a surplus or adopt modern technologies (Fafchamps 1992, Radchenko and Corral 2018); likewise, without a reliable supply of inputs or a conducive business environment to operate within, agroprocessing firms cannot compete with international firms in their own urban markets, let alone in highly competitive global ones (Gelb, Meyer and Ramachandran 2014).

It is within this context that the government of Ghana conceived of and implemented the Planting for Food and Jobs (PFJ) initiative in 2017. PFJ is the flagship strategy for boosting agricultural production on smallholder farms, facilitating market linkages, and creating jobs along several agricultural value chains. At its inception, PFJ targeted maize, rice, sorghum, soya, and vegetables (onion, tomato, and chili pepper) value chains. In 2018 and 2019 the program was expanded to include groundnut, cowpea, various root crops, and several other vegetable crops. However, the largest share of the benefits provided under the program continue to be directed towards the maize and rice sectors, and in recent years, soya bean. Implemented by the Ministry of Food and Agriculture (MoFA), PFJ ambitiously set out to increase the number of smallholder beneficiary farmers from around 200,000 in 2017 to 1.6 million by 2020. The initial budget estimate was a total of GH₵ 3.3 billion over four years (MoFA 2017), starting at a modest GH₵ 190 million in 2017, but rising rapidly to GH₵ 1.6 billion by 2020. The fact that the entire budget allocation to MoFA for the 2016 financial year was only GH₵ 501 million (MoF 2015) illustrates how ambitious the original PFJ spending plan was.

Broadly, PFJ program benefits include the provision of on-farm production support in the form of improved extension services and subsidized seed and fertilizer, with the fertilizer subsidy component essentially replacing the longstanding national Fertilizer Subsidy Program (FSP) implemented between 2008 and 2017; investments in marketing and processing infrastructure, such as warehouses or processing plants, with a specific emphasis on private enterprise development; and improvements in market information systems to facilitate market access and strategic decision-making by actors in agri-food value chains. These interventions are formally organized within five program ‘pillars’, namely: 1) seed access and development; 2) fertilizers; 3) extension services; 4) marketing; and 5) e-agriculture (MoFA 2017).

Since 2017, several new PFJ program modules have been introduced to create a portfolio of interventions under an expanded PFJ umbrella. These include a tree crop module called Planting for Export and Rural Development, and a livestock module called Rearing for Food and Jobs. Programs that predate the PFJ, including the Agricultural Mechanization Services program and a horticulture capacity development program called the Greenhouse Villages program were also

incorporated under the PFJ umbrella. The PFJ program as originally conceived is now referred to as the Food Crops Module, although throughout this text any reference to “PFJ” specifically means the Food Crops Module of the PFJ program, unless otherwise specified.

The scale and rapid growth of PFJ warrants an in-depth analysis of program impacts and implementation modalities to inform design and budget allocation with the ultimate objective of improving the effectiveness of the program. This report provides the contextual background necessary to better understand the role and impact of input subsidies in Ghana. This report is structured as follows. Section 2 gives an overview of the rational for and evolution of input subsidy programs in Ghana and provides further details of the implementation modalities of the PFJ. Section 3 focuses on supply and use of (subsidized) agricultural inputs in Ghana in the context of crop production trends and agricultural growth. Finally, section 4 draws conclusions and highlights areas for policy reform or further analysis.

2. INPUT SUBSIDY PROGRAMS IN GHANA

Rationale and evolution

Lack of access to markets and financial resources as well as input supply bottlenecks often prevent smallholders from using modern seed varieties and fertilizer needed to raise agricultural productivity (Bizikova, et al. 2017). Low input adoption is particularly problematic in Ghana. While the recommended inorganic fertilizer use per the Abuja Declaration of 2006 was 50 kilograms per hectare (kg/ha), the average fertilizer application rate in Ghana in the early 2000s was only around 8 kg/ha (Benin, et al. 2013). Likewise, in the case of maize, recycled open-pollinated seed varieties continue to be widely used, even though yields of some hybrid varieties have been found to be 20 to 50 percent higher (Van Asselt, et al. 2018).

Low adoption rates only partly relate to farmers’ resource constraints. Numerous supply-side challenges have been well-documented. With respect to fertilizer, Ghanaian farmers often have limited choices available. Historically, NPK 15-15-15 was distributed widely across the country despite significant variations in soil fertility and soil types across different agroecological zones (Jayne, et al. 2015, Chapoto and Tetteh 2014). The quality of fertilizer has also been a concern; for example, a government study found that less than one-third of new fertilizer samples analyzed conformed to technical requirements (GoG 2015), although more recent evidence suggests the problem is no longer as prevalent (Andam, Asante and Simons 2020) The combination of inappropriate or substandard fertilizer and poor soil quality reduces the effectiveness and, therefore, profitability of inorganic fertilizer use, which may constrain adoption. With respect to modern or hybrid seed, demand-side factors constraining adoption include cost, resource constraints, or the risks associated with investing in seed when farming under rainfed conditions or in environments where output markets are uncertain. On the supply-side, factors such as lack of availability of well-performing seeds or distrust in input dealers believed to be selling inauthentic seeds also affect adoption (Van Asselt, et al. 2018).

These challenges have persisted for many years and are not unique to Ghana. As in many other sub-Saharan African countries, Ghana’s agricultural policy in the 1960s and 1970s was characterized by large-scale interventions in the form of input subsidies and fertilizer price support policies (Resnick and Mather 2016). However, subsidy programs generally did not result in the expected agricultural growth, partly due to ineffective implementation, high administrative and fiscal costs, and failure in identifying differentiated production systems and needs (Morris, et al. 2007). As a result, many interventions were suspended during the liberalization drive under the Structural Adjustment Programs of the 1980s and 1990s.

Since the mid-2000s, input subsidy programs have once again became popular in sub-Saharan Africa as policymakers increasingly felt that market-led poverty reduction strategies failed to achieve their goals. The main innovation for the new wave of “smart” subsidy programs was their emphasis on the development of private input supply systems in parallel to the traditional approach of reducing the cost of inputs to farmers (Dorward and Morrison 2015). By 2011, ten sub-Saharan African countries studied by Jayne and Rashid (2013) allocated almost 30 percent of their agricultural budgets to subsidy programs. While a country such as Malawi, which launched its large-scale subsidy program in 2005, was a pioneer in the modern era of smart input subsidies in sub-Saharan Africa, the 2007–2008 food and energy price crisis and associated fertilizer price spikes triggered the launch of the several subsidy programs elsewhere on the continent, including in Ghana, where the national Fertilizer Subsidy Program (FSP) was launched in 2008 (Benin, et al. 2013, Banful 2011).

Fertilizer Subsidy Program (FSP): 2008–2017

The FSP intended to improve production and food security while reducing poverty (Fearon, Adraki and Boateng 2015). It also aimed to develop and strengthen fertilizer markets and encourage private sector participation in those markets (Benin, et al. 2013). With a goal to raise fertilizer use to the recommended 50 kg/ha by 2015, the government supplied NPK 15-15-15, sulphate of ammonia (SOA), NPK 23-10-5, and urea, initially with a subsidy of 50 percent. The fertilizer price itself was negotiated beforehand with fertilizer importers and fixed for the season (Banful 2011). Fertilizer was initially disbursed using a voucher system, but logistical challenges—including the fact that less than half of the vouchers were redeemed—meant that the voucher system was discarded in favor of a waybill receipt system in 2010. The belief was that this would address issues around low uptake rates, high transaction costs, and fertilizer diversion (Houssou, Andam and Asante-Addo 2017). Initially the subsidy was universally available. However, this was believed to be associated with inefficiencies, so by 2013 the official stance was that only farmers with a maximum of two hectares of land could access the subsidy.

Some successes were recorded. Jayne et al. (2015) estimate that FSP accounted for around 40 percent of national fertilizer use between 2011 and 2013, while the number of farmers using fertilizer increased alongside an increase in fertilizer application rates from 8 to 13 kg/ha (Benin, et al. 2013). On the downside, there were reports of late delivery of fertilizer stocks, which meant farmers could not always access fertilizer in time for the planting season (Yawson, et al. 2010). Lack of storage facilities and quality control were other challenges hampering logistics, while fiscal pressure meant government was unable to pay input suppliers on time on several occasions. The most consequential incident occurred in 2013 when non-payment eventually led to the temporary suspension of the program in 2014 as fertilizer importers were unwilling to participate before debts were settled. The subsidy rate on offer under FSP also varied significantly over time. Presumably, this feature of the program was linked to fiscal pressures felt by government, but variable subsidy rates made it difficult for beneficiaries to plan their annual farm budgets in advance.

Targeting was highlighted as another problem of the FSP. Despite the reforms of 2013, which in principle made the program available only to smallholders with less than two hectares, many recipients were larger-scale, wealthier farmers (Houssou, Andam and Asante-Addo 2017). This meant the restriction on farm size was effectively only a restriction on the quantity of subsidized fertilizer that could be acquired; farmers’ actual landholdings (or wealth) were not being monitored to determine eligibility. This likely had an adverse effect on the poverty-reducing potential of the program.

Planting for Food and Jobs (PFJ): 2017–2020

In 2017 the government launched the Planting for Food and Jobs (PFJ) initiative, which at its core is a seed and fertilizer subsidy program, but with ambitions of boosting smallholder agricultural production and creating jobs along agricultural value chains through other complementary interventions. PFJ is one of sixteen flagship programs of the government of Ghana. However, whereas FSP provided subsidized seeds only in some years, seed subsidies are an integral part of PFJ, in addition to the provision of a variety of services to smallholder farmers, such as extension advice and marketing support. Beyond raising smallholder productivity, PFJ has adopted a clear employment agenda of significant job creation along priority agricultural value chains. As such, compared to FSP, PFJ is billed as a more holistic policy support package for farmers and other actors up and down agricultural value chains. At its inception, PFJ targeted maize, rice, sorghum, soya, and vegetables (onion, tomato, and chili pepper) value chains. In 2018 and 2019 crop coverage was expanded to include groundnut, cowpea, various root crops, and several additional vegetable crops.

Budget projections, beneficiary targets, and planned input distribution under Planting for Food and Jobs

PFJ is an ambitious initiative. The original implementation plan (MoFA 2017) projected a total budget of GH¢ 3.3 billion over the four implementation years, starting at GH¢ 190 million in 2017 but expanding exponentially to GH¢ 1.6 billion by 2020 (initial budget figures were presumably expressed in constant 2017 prices). The budget estimates were consistent with the rapid increase in projected beneficiary numbers and planned quantities of subsidized inputs provided (Table 2.1).

Table 2.1: Planting for Food and Jobs program targets and reported achievements

		2017	2018	2019	2020[2]
Budget (*GH¢ millions*)	Projected *(2017 prices)* [1]	189.5	525.3	1,049.3	1,571.0
	Actual (current prices)	*476.4*	*448.4*	*656.3*	*1,143.1*
	Actual (2017 prices)	*476.4*	*408.2*	*547.3*	*867.6*
Beneficiary farmers	Planned[1]	202,860	562,400	1,123,500	1,682,000
	Actual	*202,000*	*677,000*	*1,183,000*	*1,736,510*
Projected job creation [1]		863,500	1,036,200	1,243,440	1,492,128
Seed distribution (*metric tons*) [1, 2]					
Maize	Planned	1,339	9,114	17,753	18,617
	Actual	*2,370*	*4,029*	*9,031*	*13,951*
Rice	Planned	700	6,231	12,377	12,992
	Actual	*1,698*	*2,399*	*6,544*	*10,951*
Soybean	Planned	0	3,150	6,650	7,000
	Actual	*180*	*339*	*2,729*	*3,860*
Sorghum	Planned	0	1,185	2,502	2,633
	Actual	*147*	*35*	*0*	*300*
Vegetables	Planned	3.6	27.5	54.2	56.9
	Actual	*4.0*	*9.0*	*29.0*	*35.0*
Fertilizer distribution (*metric tons*) [1, 2]					
All fertilizer	Planned	40,763	320,841	632,037	663,157
	Actual	297,000[3]	247,039	331,348	423,473

Source: MoFA (2017, 2019, 2020) and MoFA & GHS (2021).
Notes: (1) All projected or planned estimates are taken from the original PFJ Implementation Plan (MoFA 2017), acknowledging that MoFA did revise its annual projections each year thereafter.
(2) The quantities of fertilizer and seed reported as "actual" for 2020 are revised planned quantities for 2020 as reported by MoFA (2020). Although a breakdown by seed type is not available, a more recent report suggests the aggregate seed supply target of 29,097 metric tons was achieved (MoFA & GHS 2021). Likewise, the "actual" budget estimate for 2020 is a projection based on revised planned quantities of inputs.
(3) The "actual" fertilizer quantity shown for 2017 includes 121,000 metric tons of fertilizer supplied under FSP. FSP and PFJ were jointly implemented in 2017, but FSP was discontinued in 2018.

The fact that the entire budget allocation to MoFA for the 2016 financial year was only GH¢ 501 million (MoF 2015) illustrates how ambitious the projected spending plan was. Actual PFJ expenditures for 2017–2019 and provisional budget estimates for 2020 (Ibrahim 2020) reveal that, with the exception of 2017, the projected PFJ budget was never achieved.[1] When converted to 2017 constant values to allow comparison with the projected budget and assuming the projected budget for 2020 is realized, the total expenditure on PFJ would come to GH¢ 2.3 billion inclusive of FSP fertilizer spending in 2017. This total is GH¢ 1.0 billion less than or 69 percent of the projected overall FSP budget of GH¢ 3.3 billion.

Beneficiary targeting

Despite operating with a smaller budget that projected, the achievements under PFJ were nevertheless impressive. Official reports suggest that beneficiary numbers—that is, the number of farmers receiving subsidized inputs—consistently exceeded targets. By 2020, 1.74 million farmers out of an estimated 2.6 million agricultural households received inputs (Table 2.1). The program also set job creation targets ranging from 863,500 in 2017 to 1,492,000 in 2020. Official reports suggested that the job creation targets were achieved in the first years of PFJ, although the definition of 'job creation' is not entirely clear. It appears that simple multiplier formulas were used to translate input supply quantities into crop outputs, which in turn was translated into estimates of the number of workers benefiting from their association with PFJ, either on farm (direct effect) or along agricultural input or output supply chains (indirect effects). Therefore, not only are job creation numbers estimated as opposed to being monitored, but it should be noted that the concept of benefiting from a policy intervention as a worker is very different from the more commonly accepted concept of job creation, namely, creating new, full-time employment opportunities.

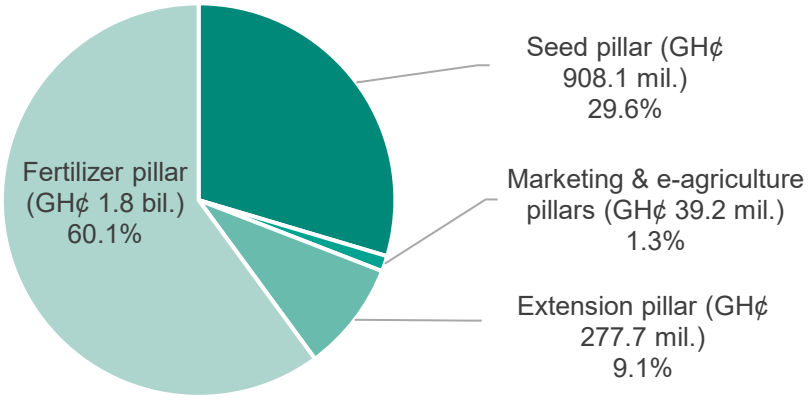
The official PFJ targeting criteria (MoFA 2019) state that, apart from a willingness to participate, beneficiary farmers should be resource poor (although the exact definition of poverty is not provided) and classified as smallholders with holdings of between 0.4 and 2.0 hectares. At least 40 percent of beneficiaries should be women. However, beneficiaries have evidently not been explicitly excluded if they did not meet the criteria, nor do there appear to be any attempts at actively recruiting those that matched the targeting criteria. The only control mechanism on access to PFJ benefits appears to be the quantity of subsidized inputs that can be acquired by a beneficiary farmer, which has been restricted to the quantities needed for use on up to two hectares of land. Moreover, the use of a waybill system since 2018, rather than coupons, effectively implies a "first-come, first-served" approach to subsidy program targeting. There is currently very limited evidence on how targeting played out in practice.

Planting for Food and Jobs implementation pillars

PFJ is designed around five pillars. The first is the seed pillar. While the earlier FSP sporadically subsidized seed, the seed subsidy has remained a constant feature under PFJ. The goal of the seed pillar is to improve seed use and seeding rates and to expand the seed varieties available to farmers. Development of the local seed sector is another important goal with a planned gradual shift to locally produced seeds to satisfy PFJ demand. It is now estimated that all FSP seed, except for hybrid maize, is sourced locally (MoFA 2020). Beneficiaries can acquire seed packs sufficient for up to two hectares of land at a subsidized price of 50 percent of the commercial cost. At inception, the expectation was that the seed pillar would cost around GH¢ 910 million over four years (2017–2020), or 29.6 percent of the overall PFJ budget (Figure 2.1).

[1] It should be noted that 43 percent, GH¢ 204.8 million, of the 2017 expenditure reported in Table 2.1 was technically on FSP fertilizer, as the two programs were implemented alongside one another that year.

Figure 2.1: Projected Planting for Food and Jobs budget breakdown by pillar, aggregate for period 2017 to 2020



Source: MoFA (2017)

Table 2.1 shows seed disbursements under PFJ between 2017 and 2020. The sorghum component was seemingly never prioritized, with less than 10 percent of the target quantity of seed supplied. The performance was somewhat better for the other crops, with between 42 percent (soybean) and 67 percent (rice) of the seed supply targets achieved.

The second PFJ implementation pillar is the fertilizer pillar, which provides subsidized fertilizer to smallholder farmers at a subsidy rate of 50 percent, a rate that has remained constant over the four implementation years. In the first year, beneficiaries also received a 50 percent credit on their down payment, i.e., the initial farmer contribution was only 25 percent of the commercial value of the fertilizer, while the remaining 25 percent had to be repaid after the harvest. This system was abandoned after the first year due to low post-harvest repayment rates by farmers.

As was the case under FSP, farmers could acquire subsidized fertilizer quantities sufficient for two hectares of land. Whereas FSP primarily provided NPK 15-15-15 as basal dressing and SOA as top-dressing, PFJ gradually shifted towards NPK 23-10-5 as basal dressing and urea as top-dressing. Both these products have higher nitrogen contents, which is associated with better plant growth and crop yields, and they are also now more commonly recommended given new insights from soil testing in Ghana. Other objectives under the fertilizer pillar include developing private sector fertilizer supply systems, promoting local blending of fertilizer, and ensuring the quality of fertilizer in the market. The initial budget for the fertilizer pillar was set at GH¢ 1.8 billion, or 60.1 percent of the overall budget (Figure 2.1). Table 2.1 reports fertilizer supply under PFJ between 2017 and 2020. The 2017 estimate includes 121,000 metric tons supplied under FSP that year. The combined supply under PFJ and FSP during 2017 to 2020 was around 78 percent of what was initially planned for distribution under PFJ.

The third PFJ implementation pillar is extension. At the program launch, the workforce of extension agents was estimated to be only around two-thirds of what was deemed necessary to provide an effective service and adequate coverage nationally. Hence, the extension pillar provided for more aggressive recruitment alongside expanded training of extension agents to ensure that farmers received more frequent visits and quality advice with a view to raise the efficiency of their use of farm inputs. This component was initially projected to cost about GH¢ 280 million, or 9.1 percent of the total budget (Figure 2.1).

The remaining two pillars were more vaguely defined and were initially budgeted to only receive 1.3 percent of the overall PFJ budget. Pillar four, the marketing pillar, was designed to encourage more active participation of private actors in agricultural value chains, including traders, processors, nucleus farmers, farmer-based organizations, food and feed enterprises, and

exporters. The pillar also provided resources for the rehabilitation and construction of warehouses. PFJ further aimed to develop private enterprises to undertake processing, value addition, packaging, and branding activities. This component had an initial budget of about GH¢ 10 million, or 0.3 percent of the budget.

The fifth PFJ implementation pillar, e-agriculture, has as its main objective the dissemination of reliable and accurate information through a complex network of stakeholders. Central to this was establishing a database of PFJ beneficiaries, which would record their land use and cropping patterns and the extension visits they received. The e-agriculture system was further envisioned to include the development of a supply chain management system for seed and fertilizer distribution; a database of subsidy rates, input prices, and suppliers; pest and weather early warning; a system for providing extension messaging and market information; and an e-payment accounting system for tracking payments from PFJ beneficiaries or to PFJ stakeholders and service providers. This component had a budget of GH¢ 29 million, or 0.9 percent of the overall budget. Progress in these areas seemingly have been minimal.

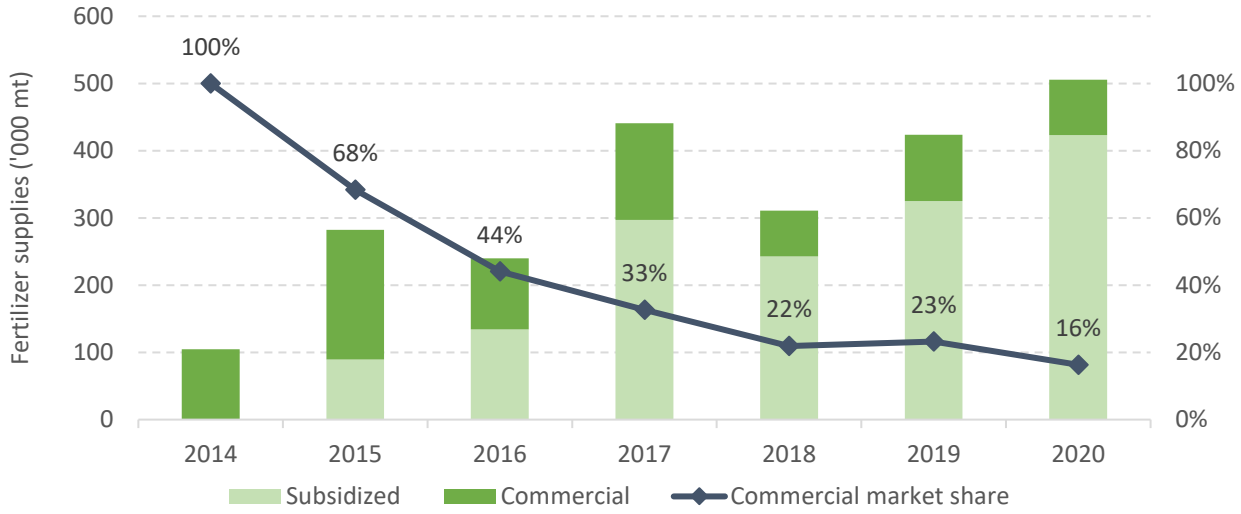
In summary, official reports suggest that PFJ reached the intended number of beneficiaries, but the budget allocation was only 69 percent of the projected budget. The budget estimates appear consistent with aggregate input provisioning. Although the PFJ monitoring system does not record average input receipts per farmer, the implication is that farmers would have received fewer inputs than what was originally envisioned. Nevertheless, the government is optimistic about the impacts of PFJ. As we elaborate in the next section, by 2019, production of maize, rice, and soya bean had increased 1.5 million tons compared to 2016 production levels. This equates to an average annual output growth rate of 16.2 percent (MoFA 2020). Based on recommended seeding rates, PFJ seed supplies are now enough to cover 54, 40, and 80 percent of the total maize, rice, and soya bean land area in the country, respectively, which implies at least half of the current output of these crops is associated with PFJ inputs. Although data for vegetable crops are harder to come by, PFJ appears to have been less effective in these value chains, with tomato, chili, and onion output seemingly growing at only around 1.3 percent per annum between 2016 and 2018 (FAO 2020). We elaborate on this in the next section and explore the extent to which recent crop production trends can be attributed to PFJ.

3. AGRICULTURAL INPUTS AND CROP PRODUCTION

Fertilizer inputs

Figure 3.1 reports total fertilizer supplies in Ghana over the period 2014 to 2019 based on recorded imports, as well as projected supply estimates for 2020. Fertilizer supplies are further broken down by subsidized supplies, which includes any fertilizer supplied under the FSP or PFJ programs, and commercial supplies, which includes fertilizer sold at the full commercial retail price and fertilizer supplied to the cocoa sector. The latter may at times have been subsidized by the Ghana Cocoa Board. Following the suspension of FSP in 2014, the program was reintroduced in 2015 and scaled up, with fertilizer supplies reaching 176,000 metric tons in 2017. PFJ was launched alongside FSP in 2017 and supplied an additional 121,000 metric tons of subsidized fertilizer that year for a total supply of subsidized fertilizer of 297,000 metric tons. FSP was rolled into PFJ in 2018 resulting in a slight decline in total subsidized fertilizer supply in 2018, but PFJ fertilizer supplies grew rapidly since, reaching 331,000 metric tons in 2019 and 423,000 metric tons in 2020.

Figure 3.1: Subsidized and commercial fertilizer supplies in Ghana, 2014–2020



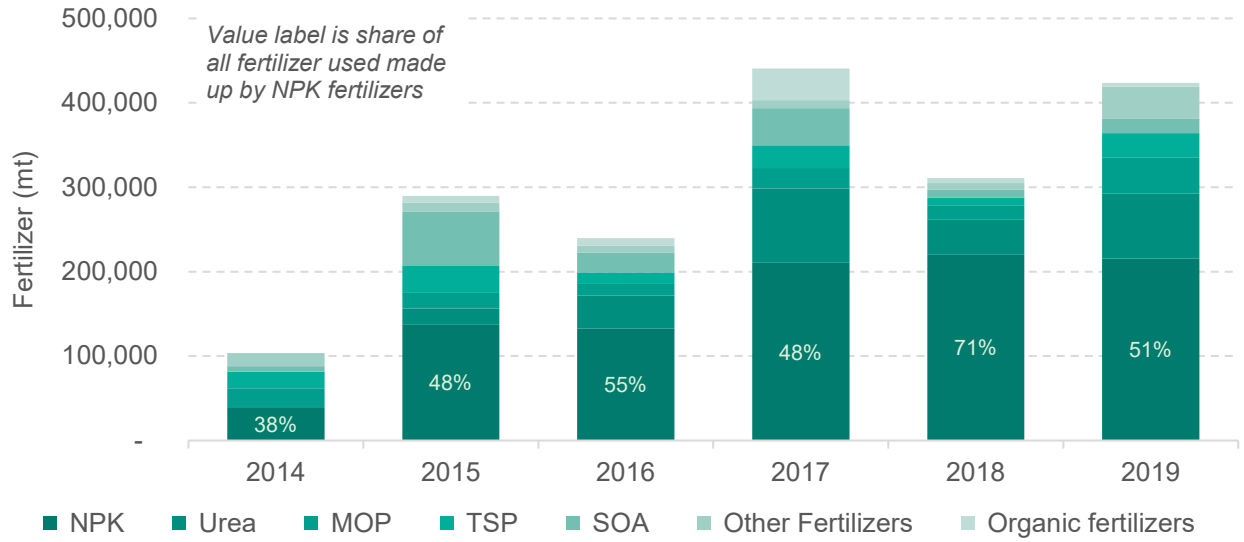
Source: Africa Fertilizer (2020) and MoFA (2019, 2020).
Note: Subsidized fertilizer supply for 2020 is provisional (see Table 2.1), while commercial sales for 2020 are projected based on an estimated displacement rate of 16.4 percent (see below).

Although the overall amount of fertilizer in Ghana has increased dramatically since 2014, a consequence of the rapid expansion of subsidized fertilizer supplies has been a gradual crowding out of commercial fertilizer sales. As shown in Figure 3.1, the share of commercial supplies declined from 68 percent in 2015 to around 20 percent in recent years. A simple linear model applied to subsidized and commercial fertilizer trends over the period 2014 to 2019 suggests that for every 1,000 kilograms by which subsidized fertilizer supply increases, commercially supplied fertilizer declines by 164 kilograms; that is, the commercial fertilizer displacement rate is 16.4 percent. Based on this displacement rate and subsidized fertilizer supplies of 423,000 metric tons in 2020 (MoFA 2020), commercial sales will likely shrink to 82,000 metric tons in 2020, or 16 percent of total supplies.

From the short term perspective of fertilizer importers and retailers, crowding out is not a major concern—fertilizer suppliers are indifferent whether they sell direct to consumers or through a subsidy program. Ultimately, increased turnover means higher profits for incumbents or more opportunities for new entrants in the fertilizer value chain. However, the longer-term sustainability of the commercial fertilizer market is a concern. Recent growth in fertilizer demand has been driven entirely by the government subsidy program. If beneficiary farmers fail over time to switch to commercial fertilizer, should PFJ be phased out, the fertilizer sector could face collapse.

Figure 3.2 reports the annual apparent fertilizer consumption for Ghana over the period 2014 to 2019, broken down by main fertilizer product. Since neither on-farm fertilizer use nor carry-over stocks are closely monitored in Ghana, agricultural use estimates are based on recorded imports, which also represent total supplies, net of re-exports and non-agricultural fertilizer use (e.g., in mining). Official fertilizer re-exports from Ghana to neighboring countries is negligible, but illicit smuggling of subsidized fertilizer to neighboring Burkina Faso is thought to be endemic in Ghana's northern regions (Nkegbe 2018). Evidence in this regard is mostly anecdotal and is not factored into the use estimates.

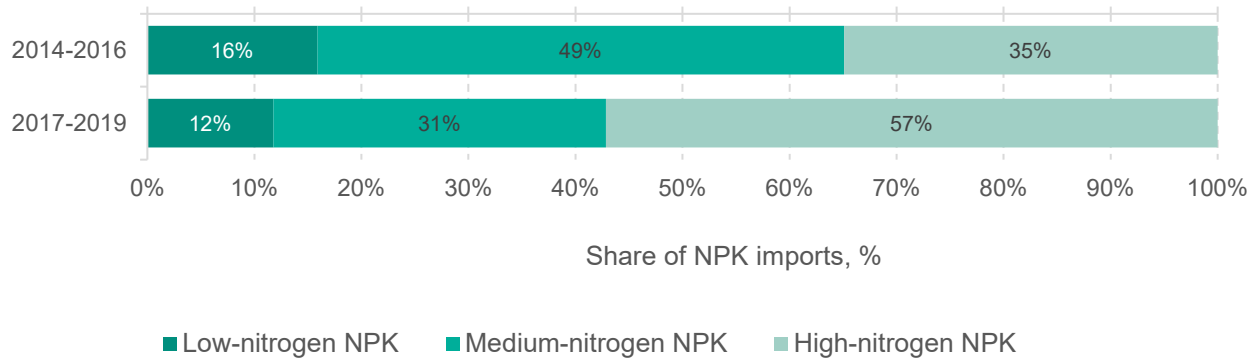
Figure 3.2: Apparent fertilizer consumption for agricultural use in Ghana, 2014–2019, by type



Source: Africa Fertilizer (2020).
Notes: NPK = nitrogen, phosphorus and potassium compound; MOP = muriate of potash; TSP = triple super phosphate; SOA = sulphate of ammonia.

Ghana recorded an almost four-fold increase in organic and chemical fertilizer imports for agricultural use between 2014 and 2019, from around 111,000 to 425,000 metric tons (Africa Fertilizer 2020). Further evident from Figure 3.2 is that compound NPK fertilizer is the most widely used product, accounting for an average of 55 percent of fertilizer consumption over the period 2014 to 2019. NPK is a common basal fertilizer for cereals, and to a lesser extent, vegetables. NPK is also used widely in the cocoa sector. Since the introduction of PFJ in 2017, there has been a sharp increase in the absolute quantity of NPK in the market. Another notable change is the decline in sulphate of ammonia (SOA), which is gradually being replaced by urea as the top-dressing fertilizer of choice on cereals. Phosphate products, such as triple super phosphate (TSP), which is typically applied to leguminous crops, or potassium products, such as muriate of potash (MOP), which is commonly applied to vegetables, are used in smaller quantities in Ghana.

Figure 3.3: Changes in NPK inorganic fertilizer grades imported to Ghana between 2014 and 2019



Source: Africa Fertilizer (2020)

Nitrogen is associated with leaf growth and increased crop yields. The substitution of SOA for urea is significant as it implies an increase in nitrogen availability in soils. Urea has a 46 percent nitrogen content compared to 23 percent in SOA. Apart from the increase in overall NPK quantities, there has also been a significant shift in the chemical composition of NPKs imported

into Ghana (Figure 3.3). NPK fertilizers with a lower nitrogen content are typically used in the cocoa sector (e.g., 5-16-15), while medium (e.g., NPK 15-15-15) or high-nitrogen NPKs (e.g., 23-10-5) are recommended for cereals crops and vegetables. Whereas Ghanaian farmers have traditionally applied NPK 15-15-15 on cereals, high-nitrogen fertilizers are now more often recommended and supplied under PFJ. Figure 3.3 reveals declines in the shares of low- and medium-nitrogen fertilizer imported, while the high-nitrogen NPK import share has increased significantly from 35 to 57 percent since the period before PFJ (2014-2016).

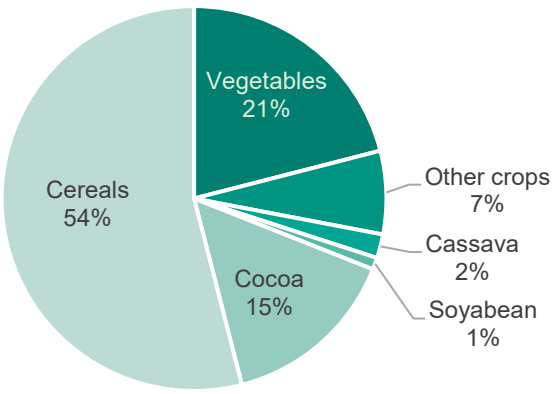
Assuming a two-to-one ratio of basal fertilizer to top-dressing, we estimate that the shift towards high-nitrogen fertilizer and urea has likely increased the average nitrogen content per unit of fertilizer from 21 percent in 2014 to over 25 percent by 2019. As we elaborate further below, fertilizer use efficiency is usually expressed in marginal terms as the additional kilograms of grain produced per additional kilogram of nitrogen applied. The higher nitrogen content implies a 19 percent increase in the conversion factor from the quantity of fertilizer to quantity of nitrogen availability, which means the yield response per unit of fertilizer will increase by that same margin. Such shifts in fertilizer use patterns are important to take into consideration when assessing the returns to investment of fertilizer subsidy programs.

Fertilizer use by crop

Estimates in Ghana of fertilizer use by crop are weak. Since an unsuccessful attempt 15 years ago by the Food and Agriculture Organization to analyze fertilizer use by crop (FAO 2005), and despite continued large-scale investments in fertilizer subsidy programs, Ghana's statistical institutions still do not collect demand (farm-level) or supply (retail sales) information on fertilizer use patterns by crop or fertilizer product. A major challenge in this regard is the prevalence of intercropping, which makes it hard to estimate the allocation of land area and fertilizer across different crops planted on the same piece of land. This also complicates the estimation of fertilizer use efficiency.

Given difficulties in directly observing fertilizer use patterns, a second-best approach is to combine information on fertilizer imports and fertilizer use recommendations to impute fertilizer use by crop. Using such an approach, IFDC (2019) estimated that 54 percent of fertilizer is applied to cereals, 21 percent to vegetables, and 15 percent to cocoa (Figure 3.4). Considering that maize accounts for around 64 percent of the area of land planted to cereals, the estimate for cereals (54 percent) is reasonably consistent with Jatoe's (2018) estimate that 40 percent of fertilizers used on food crops (i.e., excluding cocoa) is applied to maize. Likewise, the estimate for cocoa is consistent with the share of low-nitrogen NPK imports into Ghana (Figure 3.3). Allocations to cassava (2 percent), soya bean (1 percent), and other crops (7 percent) are minimal.

Figure 3.4: Estimated fertilizer use by crop in Ghana. 2019



Source: IFDC (2019)

At 21 percent, fertilizer application on vegetables is high relative to the area of land allocated to these crops. Although vegetable crop production is probably underreported in the FAO data (FAO 2020), cropland allocation to vegetables may be as low as 1 to 3 percent. Relatively high use of fertilizer on vegetables is likely due to two reasons. First, as a high-value, commercial crop, nearly all vegetable farmers surveyed in a study by Van Asselt et al. (2018) reported using fertilizer. Second, fertilizer application rates are usually relatively high for vegetables. For example, compared to a recommended application of 250 kg/ha of NPK as the basal application and 100 to 150 kg/ha of SOA or urea as the top-dressing in cereals, vegetable farmers in Van Asselt et al.'s (2018) study report applying, on average, 350 kg/ha on tomatoes, 510 kg/ha on onions, 775 kg/ha on carrots, and 905 kg/ha on Scotch bonnet chilies.

Accurate fertilizer use by crop data are crucial for understanding the potential impacts of fertilizer subsidy programs across different crops. Although PFJ prioritizes specific crops, it does not prescribe how subsidized fertilizer should be applied across crops. Farmers may access subsidized seed, subsidized fertilizer, or both, and they may use inputs in combination with unsubsidized inputs. With no records currently of how subsidized inputs are applied on farmer plots, the farm-level impacts of PFJ are hard to assess. For these reasons it remains important to collect information on fertilizer use by crop, especially for subsidized fertilizer, which now makes up over 80 percent of the fertilizer market.

Fertilizer use efficiency

Two indicators are useful for assessing the farm-level returns to investments in fertilizer or the national benefit-cost ratio of subsidy programs. Fertilizer use efficiency (FUE) is typically expressed as the marginal output per unit of fertilizer. More specifically, since the measure is usually applied to grain and nitrogen-based fertilizer, and recognizing that fertilizer products have different nitrogen contents, the FUE is usually expressed as "additional kilograms of grain per additional kilogram of nitrogen added to the soil (per hectare)". A related measure is the value-cost ratio (VCR), expressed as the ratio of the grain price (P_G) and nitrogen price (P_N) multiplied by the FUE. The nitrogen price is derived from the fertilizer price by adjusting for the nitrogen content of the fertilizer, which as discussed above, has increased substantially in recent years due to changes in fertilizer use recommendations and consequent higher nutrient content overall in the inorganic fertilizers imported into Ghana.

$$VCR = \frac{P_G}{P_N}.FUE$$

Whereas the FUE expresses the physical response of grain to fertilizer use—which reflects in part the quality of the seed and soil, the appropriateness and quality of the fertilizer used, the skills of the farmer, and other factors, such as rainfall patterns or pest and disease pressures—the VCR expresses whether it is profitable to acquire additional fertilizer, whether at commercial or subsidized fertilizer prices, considering the value of additional grain produced. Although a value greater than one implies profitability of fertilizer use, studies have shown that VCRs of two or more are required for smallholders to demand fertilizer on a sustained basis (Jayne, et al. 2015).

Unfortunately, there is a dearth of evidence on returns to fertilizer in Ghana, owing partly to fertilizer use by crop data being generally unavailable. Nevertheless, Chapoto and Ragasa (2013) estimate an FUE of 22 kg additional maize per kg of nitrogen applied per hectare for maize farmers. In follow-up study, Ragasa and Chapoto (2017) find that one kilogram of nitrogen leads to around 27 kg of additional rice output. These returns are generally higher than those estimated (or assumed) elsewhere. For example, in their assessment of the impacts of Malawi's fertilizer subsidy program, Chirwa and Dorwood (2013) argue that nitrogen response rates of 10 to 12 kg for local

maize varieties, 15 kg for open pollinated maize varieties, and 18 to 20 kg for hybrid varieties are reasonable to assume.

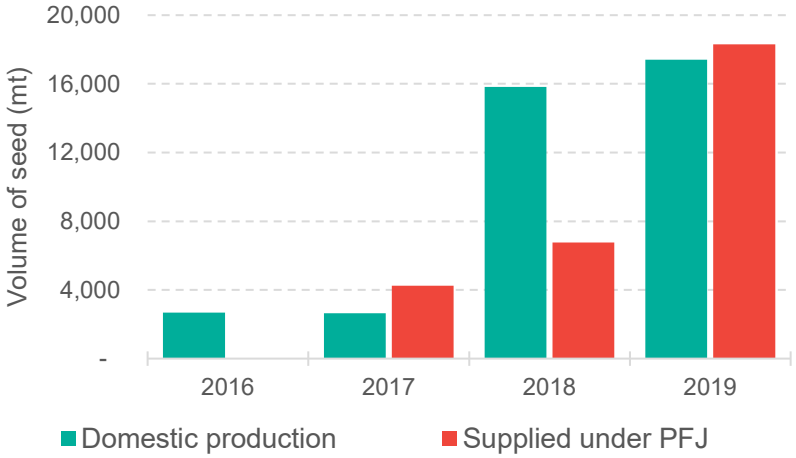
Jayne and Rashid (2013) survey ten studies which show a much wider range of outcomes across sub-Saharan Africa, from as low as 8 kg to as high as 24 kg per kg of nitrogen applied. While they describe this wide range as “unsurprising” given the variations in soil, rainfall, and market conditions across the region, they also point at “a concentration at the lower end” of these estimates, which suggest a range of 8 to 15 kg may be a more reasonable average for smallholders in sub-Saharan Africa. Incidentally, Jayne and Rashid (2013) sourced only a single estimate for West Africa (10 kg), with most estimates coming from Eastern and Southern Africa. Nevertheless, it is evident that the few estimates currently available for Ghana are optimistic compared to estimates from elsewhere.

Of the ten studies surveyed in Jayne and Rashid (2013), all report VCRs greater than one, although in three of those cases a range is provided where only the upper bound exceeds one. Only one study reports VCRs greater than two, an unofficial benchmark for sustained adoption by smallholder farmers. Assuming FUE rates of 12 to 15 kg, Jayne et al. (2015) compute VCRs mostly below two in Ghana for maize for the period 2007 to 2011, but these rise substantially in 2012 and 2013 when maize prices were high. They further argue that fertilizer adoption may not be profitable for many smallholders at commercial fertilizer prices. This serves as an important justification for fertilizer subsidies in the short run, but in the long run the structural challenge of low returns to fertilizer needs to be addressed. And determining whether maize farmers across the board attain FUEs of 12 kg or 27 kg per kg of nitrogen applied is a crucial missing piece of information on the returns to investments in input subsidy programs.

Seed inputs

As was the case with fertilizer supplies, subsidized seed supplies, although remaining below the initial annual targets (Table 2.1), increased rapidly under PFJ. At the onset of the program, government relied on imported seed. However, the ambition was always to switch to domestically produced seed. Figure 3.5 compares domestic production of maize, rice and soya seed against seed quantities supplied under PFJ. In the first year of the program, government relied on imported seed for about 80 percent of PFJ seed supplies (Ibrahim 2017). This was presumably due to procurement and logistical reasons, as domestic production could have theoretically satisfied around 60 percent of PFJ seed demands. The following year saw a dramatic—ostensibly PFJ-induced—increase in domestic seed production, to the extent that domestic supply far outweighed demand from PFJ. By 2019 the situation was reversed again, with PFJ seed demand outstripping domestic supply. However, by now, all seed for PFJ was sourced domestically, with the only exception being hybrid maize seed, which continues to be imported (MoFA 2020).

Figure 3.5: Volume of maize, rice, and soybean seed in total supplied under Planting for Food and Jobs program relative to domestic seed production, 2017–2019



Source: MoFA (2020)

While the shift to domestic supplies is encouraging and was an ambition of the program, it also appears that the commercial market for seed has been crowded out entirely by PFJ. As is the case with fertilizer, the question is whether farmers will continue to buy modern seeds should PFJ be scaled back or suspended. If farmers stop buying seed, the investments made by seed producers and other seed value chain actors to respond to the increase in demand may be lost. More needs to be done to strengthen the commercial arm of the Ghanaian seed market.

Crop production, economic growth, and the contribution of Planting for Food and Jobs

Official crop production estimates

Crop production estimates are produced annually by the Statistics, Research, and Information Directorate of MoFA. These estimates correspond with FAOSTAT crop production estimates compiled by the Food and Agriculture Organization. Table 3.1 draws on both MoFA (2020) and FAO (2020) and shows output (in metric tons), cropped area (in hectares), and yields (in metric tons per hectare) between 2016 and 2019. Detailed crop estimates for 2020 were not yet available at the time of writing (see table note).

Output of maize, rice, sorghum, and soya bean, the four original field crops targeted by PFJ in 2017, all increased at an average annual rate of more than ten percent per year, with growth in maize production outstripping the rest at 18.9 percent per annum. Although subsidized sorghum seed supplied under PFJ was negligible, this crop also performed well, growing at 14.7 percent per annum. A notable feature for all these crops is that the cropping areas generally expanded quicker than yields. A simple decomposition exercise shows that yield growth contributed as little as 13.0 percent to output growth of soya bean, and slightly more for rice (38.7 percent) and maize (44.8 percent). The exception is sorghum, where yield growth was 10.3 percent, while area expansion was only 4.0 percent—yield growth accounted for 73.1 percent of total sorghum output growth.

Output growth of the three original PFJ vegetable crops has been much slower, with tomatoes growing at 3.8 percent, onions at 2.8 percent, and chilies at 3.2 percent per annum. For these crops, yield growth also contributed less than half of the output growth (i.e., 39.8, 47.8, and 49.8 percent, respectively). Yield growth for groundnut (9.4 percent) and cassava (7.5 percent), crops that were added to PFJ in 2018, were also reasonably high. Cowpea (6.2 percent), yam (5.6

percent), and plantain (6.9 percent) were added in 2019, and showed strong output growth, but sweet potato output growth grew at only 2.2 percent, with PFJ seemingly creating little incentive for increased cultivation of this crop. In general, however, input supplies for these “new” PFJ crops were more limited compared to inputs for the “core” PFJ crops, such as maize or rice.

Attributing crop production growth to Planting for Food and Jobs

An important question when evaluating the impact of subsidy programs such as PFJ is how to attribute outcomes to the intervention. As shown in Table 3.1, output of the PFJ field crops grew very rapidly. For example, the combined output growth for maize and rice was 16.6 percent per annum, with around 44.9 percent of that output growth attributed to yield growth. With the rapid increase in supply of subsidized fertilizer and seed (Figure 3.1 and Figure 3.5), combined with increased use of high-nitrogen content fertilizer and increased access to extension services, the expectation is that PFJ played an important role in output growth. However, this does not mean that all output growth realized between 2017 and 2020 can be attributed to PFJ, i.e., a simple pre- and post-PFJ comparison is not appropriate.

Table 3.1: Crop production estimates, PFJ and selected non-PFJ crops, 2016-2019

	Year crop added to PFJ	Production ('000 mt)			Avg. annual growth 2016-2019 (%)	Area ('000 ha)			Avg. annual growth 2016-2019 (%)	Yield (mt/ha)			Avg. annual growth 2016-2019 (%)	Yield growth share output growth
		2016	2019	Change		2016	2019	Change		2016	2019	Change		
Planting for Food and Jobs (PFJ) crops														
Maize	2017	1,722	2,896	1,174	18.9	865	1,149	284	9.9	1.99	2.52	0.5	8.2	44.8
Rice	2017	688	920	232	10.2	236	281	45	6.0	2.92	3.27	0.4	3.9	38.7
Sorghum	2017	230	346	117	14.7	201	226	25	4.0	1.14	1.53	0.4	10.3	73.1
Cowpea	2019	206	247	41	6.2	147	169	23	4.9	1.41	1.46	0.1	1.2	19.5
Groundnuts	2018	426	558	132	9.4	327	336	9	0.9	1.30	1.66	0.4	8.5	91.3
Soybean	2017	143	193	50	10.5	87	112	25	8.9	1.65	1.72	0.1	1.4	13.0
Cassava	2018	17,798	22,127	4,329	7.5	879	1,021	142	5.1	20.25	21.67	1.4	2.3	30.3
Sweet potatoes	2019	145	155	10	2.2	74	74	0	0.0	1.94	2.08	0.1	2.3	100.0
Yam	2019	7,440	8,753	1,312	5.6	427	500	72	5.4	17.42	17.52	0.1	0.2	3.4
Plantain	2019	4,000	4,887	886	6.9	358	409	51	4.5	11.17	11.94	0.8	2.3	32.7
Tomatoes	2017	376	420	44	3.8	49	52	3	2.2	7.68	8.03	0.3	1.5	39.8
Onions	2017	153	166	13	2.8	9	9	0	1.4	17.42	18.12	0.7	1.3	47.8
Chili (green)	2017	129	141	13	3.2	15	16	1	1.6	8.61	9.02	0.4	1.6	49.8
Other crops														
Millet	N/A	159	230	71	13.2	137	148	11	2.6	1.16	1.56	0.4	10.3	81.3
Cocoyam	N/A	1,344	1,413	70	1.7	206	214	8	1.3	6.53	6.60	0.1	0.4	21.7
Oil palm	N/A	1,867	2,080	213	3.7	338	360	22	2.1	5.52	5.77	0.2	1.5	40.9
Cocoa	N/A	859	947	89	3.3	1,684	1,785	102	2.0	0.51	0.53	0.0	1.3	40.0

Source: Authors' compilation based on MoFA (2020) and FAO (2020).
Note: Carrot, cucumber, lettuce, and cabbage were added as priority crops in 2018, but no crop production estimates are available for these vegetables.
Although detailed crop estimates for 2020 were not yet available at the time of writing, provisional production estimates for maize (3,071,000 mt), paddy rice (973,000 mt) and sorghum (356,000 mt) were published in MoFA and GHS (2021). These numbers suggest a slight slowdown in crop output growth in 2020—despite a large increase in subsidized inputs—resulting in average annual growth over the period from 2016 to 2020 declining to 15.6, 9.1, and 11.6 percent for maize, rice, and sorghum, respectively.

There are several other approached to attributing outcomes to an intervention. The simplest method, which has also been adopted by MoFA (2019), is to estimate the quantity of output that is associated with inputs supplied under PFJ. The starting point is the total quantity of seed supplied by crop, from which cropped areas are estimated by dividing seed supplies by recommended seeding rates. The cropped areas are then multiplied by the yields achieved by beneficiary farmers—these could be based on assumptions or field observations—to estimate the output associated with those subsidized inputs. Expressing this as a share of national crop output reveals the contribution of the program.

Using this method, MoFA (2019) estimated PFJ contributions to be 485,000 and 637,200 metric tons of maize in 2017 and 2018 (Table 3.2). Although there are some inconsistencies in the calculations (see table notes), these maize outputs translate into PFJ attribution shares of 24.1 and 27.6 percent in 2017 and 2018. Likewise, for rice, attribution shares of 24.8 and 54.1 percent are reported. Following a crop-cutting exercise in 2019, apparently on PFJ beneficiary farms, MoFA reported that PFJ maize farmers achieved yields of 2.75 mt/ha and rice farmers 4.54 mt/ha.

Table 3.2: Attributing output to Planting for Food and Jobs based on program seed distribution and expected yields, 2017 to 2020

	Maize				Rice			
	MoFA (2019)		Author's estimates		MoFA (2019)		Author's estimates	
	2017	2018	2019	2020	2017	2018	2019	2020
PFJ seed supplied, mt (1)	2,370	4,029	9,031	13,951	1,698	2,399	6,544	10,951
Seeding rate, kg/ha (2)	14.7	18.4	22.5	22.5	37.9	23.1	30.0	30.0
PFJ land area, ha (3)	161,700	218,800	401,378	620,044	44,800	104,000	218,133	365,033
PFJ farmer yields, mt/ha (4)	3.00	2.91	2.75	2.75	4.00	4.00	4.54	4.54
PFJ output, mt (5)	485,000	637,200	1,103,789	1,705,122	179,200	416,000	990,325	1,657,251
National crop, mt	2,011,200	2,306,400	2,896,290	3,071,025	722,080	769,400	919,519	973,027
PFJ attribution share, %	24.1	27.6	38.1	55.5	24.8	54.1	107.7	170.3

Source: MoFA (2019, 2020) and MoFA & GHS (2021).
Notes: (1) PFJ seed supplies as per PFJ reports (see source).
(2) Seeding rates for 2017 and 2018 are the implied seeding rates based on seed supplies and PFJ land areas reported by MoFA (2019). No explanation is provided for the inconsistency across years. For 2019 and 2020, we apply the official recommended rate for maize of 22.5 kg/ha and 30 kg/ha for rice, which is the average of the 2017 and 2018 rates.
(3) Land areas for 2017 and 2018 are from MoFA (2019). Land areas for 2019 and 2020 are calculated based on recommended seeding rates.
(4) Assumed crop yields for 2017 and 2018 are from MoFA (2019). Although the PFJ report states that a rate of 3.0 mt/ha was used for maize in 2018, the yield implied by the reported output and land areas was 2.91. Values assumed for 2019 and 2020 are based on a crop cutting exercise undertaken in 2019 (see https://bit.ly/399yj20).
(5) PFJ outputs for 2017 and 2018 are from MoFA (2019). Values for 2019 and 2020 are estimated using the MoFA methodology.

To date, MoFA has not published comparable attribution shares for 2019 and 2020. Therefore, using the method described above, we estimate that PFJ likely contributed 38.1 and 55.5 percent to the national maize crop in 2019 and 2020. While this seems plausible, the same method yields attribution rates of 107.7 and 170.3 percent for rice in 2019 and 2020, respectively, levels which are not plausible. Even at a seeding rate of 40kg/ha (recommended rice seeding rates range from 25 to 100 kg/ha depending on planting methods) and crop yield of 4.0 mt/ha (i.e., the rate used in 2017 and 2018), the attribution rate for rice would still exceed 100 percent in 2020. This highlights the sensitivity of this approach to assumptions about seeding rates and crop yields.

Another concern of this seed-based method to determine the impact of PFJ on national crop harvests is that it does not compare outcomes against an appropriate counterfactual, i.e., the outcome that would have materialized in the absence of an intervention. As we have seen from Table 3.1, the area of land under maize and rice cultivation expanded rapidly, by about 9.1 percent per year combined, and land expansion accounted for over half of output growth. Land expansion is common in countries with a growing population and limited land constraints. In Ghana, for

example, cereals land expanded annually by between 2 and 3 percent in the five years before FSP was suspended in 2014 (FAO 2020), a rate that is consistent with the country's population growth rate. While the rapid land expansion seen during the PFJ era is clearly linked to the incentives created by PFJ, at least some of that land expansion—and the associated output growth—would have likely occurred in the absence of the program. The same applies to yield growth. Over time, technologies improve, and farmers gradually intensify their production. Thus, while maize and rice yield growth during the PFJ era was certainly boosted by PFJ, some of that growth may have been inherent to the evolving cropping system.

An important aspect that should not be overlooked when considering what an appropriate counterfactual might look like is the displacement of commercial seed and fertilizer sales. While PFJ might attract new farmers or motivate expansion into previously uncultivated lands, a large proportion of beneficiaries are arguably existing farmers who continue to cultivate the same land area as they did before PFJ. The extent to which these farmers cease to procure inputs commercially once they receive subsidized inputs is an important consideration when doing such a benefit-cost analysis. As we have seen, for every 1,000 kilograms by which subsidized fertilizer supply increases, commercially supplied fertilizer is estimated to decline by 164 kilograms. Thus, even though the marginal program cost or investment to government is the subsidized portion of 1,000 kilograms of fertilizer, the marginal economic benefit is the value of additional output produced using the net injection of 836 kilograms of fertilizer. With some crowding out of commercial supplies of agricultural inputs, simple attribution methods overestimate the marginal contribution of subsidy programs to crop production.

Are national crop production estimates plausible?

The rapid increase in national crop output in Ghana has been attributed to the success of PFJ in raising yields and encouraging more people to take up farming. In this section we triangulate from different information sources to assess whether the reported trend in national maize output is plausible and to what extent PFJ contributed to that output growth. This is a different take on the Ministry's attribution exercise presented above, i.e., here we start with information on maize cropland and use a simulation model to project the total maize crop considering the impact of additional seed and fertilizer on crop yields. Unlike MoFA's method, this approach explicitly factors in the displacement effect on commercial fertilizer and endogenizes crop yields.

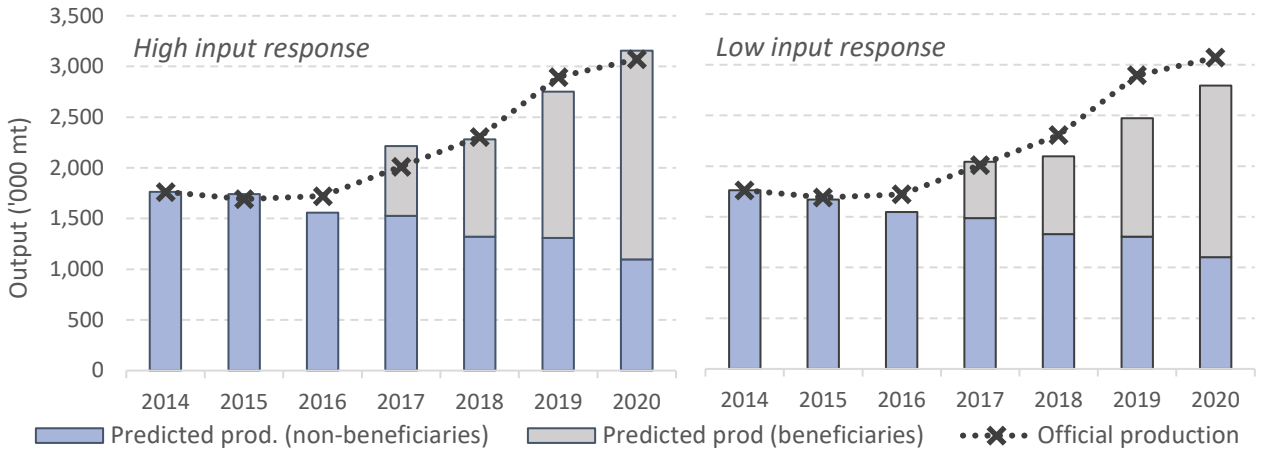
As this is a simulation exercise, several assumptions still have to be made. We assume that 40 percent of subsidized PFJ fertilizer is applied to maize, based on estimates of fertilizer use by crop from IFDC (2019). We further assume that recipients of this fertilizer apply it at the recommended application rate of 375 kg/ha to identify shares of maize land on which PFJ inputs are used (MoFA 2019). Subsidized maize seed, in turn, is applied at the recommended seeding rate of 22.5 kg/ha. These input application rates provide estimates of the area of land that received subsidized inputs. Since the proportionate quantities of fertilizer and seed distributed under PFJ are not always "balanced", therefore, some subsidized farms received only subsidized fertilizer, which means they combined this with unsubsidized seed inputs, e.g., in 2017 and 2018 there was relatively more fertilizer in the program. Likewise, sometimes subsidized farms received only subsidized seeds, which meant they combined this with unsubsidized fertilizer, e.g., in 2019 and 2020 there was relatively more seed in the program. In the latter case, we assume the same fertilization rate as on non-subsidized farms.

We further have two crop response scenarios that assume different fertilizer use efficiency rates. In a "high input response" scenario the fertilizer use efficiency (FUE) is assumed to be 22 kilograms grain per kilogram nitrogen (Chapoto and Ragasa 2013), while in the "low input response" scenario the FUE is 15 kilograms, which Jayne et al. (2015) consider a reasonable

upper bound estimate. In converting fertilizer to nitrogen, we assume a nitrogen content of 24.8 percent contained within the recommended fertilizer application regime for maize. The marginal yield response to using subsidized, modern maize seed is assumed to be 572 kilograms per hectare (Chapoto and Ragasa 2013).

Figure 3.6 shows the projected maize outputs by beneficiary and non-beneficiary farmers under the high (left panel) and low (right panel) input response scenarios. The projected crop output is reasonably close to official production estimates in the high input response scenario. This suggests that if all beneficiary farmers achieved a FUE rate of 22 kilograms grain per kilogram nitrogen, the national crop estimates are indeed plausible. Note that under the high input response scenario beneficiary farmers achieve an average maize yield of 3.7 mt/ha, which is more than double the 1.8 mt/ha likely achieved by non-beneficiary farmers. By comparison, the national average maize yield was 1.7 mt/ha in 2014 when there was no subsidy program, 1.9 mt/ha in 2016 before PFJ was introduced, and 2.5 mt/ha in 2020, while the recent crop cutting exercise suggested maize yields on PFJ farms was only 2.7 mt/ha (Table 3.2). From this perspective, the high input response scenario is perhaps too optimistic, and the national crop estimate is likely overestimated. Under the low input response scenario, official estimates are considerably higher than our projection from 2018 onwards.

Figure 3.6: Attributing crop output to Planting for Food and Jobs, factoring in fertilizer and seed use and response rates, 2014 to 2020



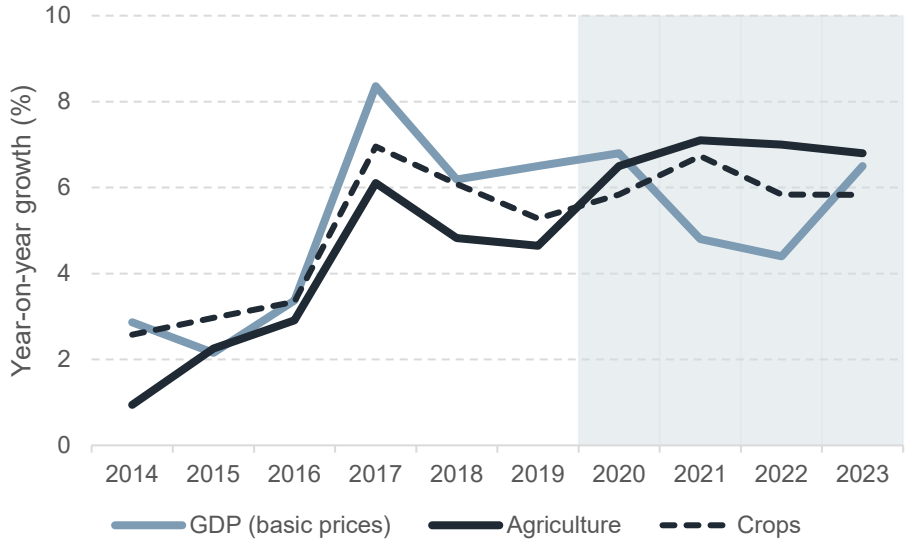
Source: Predicted values are own estimates based on input distribution and yield response assumptions. Crop estimates from MoFA (2020) and MoFA (2021).

Although the method demonstrated here improves on other methods by considering crowding out effects and endogenous yield responses to input use, simulation models (Arndt, Pauw and Thurlow 2016) or econometric program evaluation techniques (Jayne and Rashid 2013) are the gold standard for this type of analysis, data permitting.

Crop production growth and agricultural GDP

A country's Gross Domestic Product (GDP) is the monetary value of goods and services produced during a financial year. GDP can be reported at sector level (e.g., agriculture, industry, or services) or at subsector level (e.g., for the crops subsector within agriculture). Figure 3.7 reports observed GDP growth rates for the period 2014 to 2019, for the Ghanaian economy, the agricultural sector, and the crops subsector, as well as growth projections for 2020 to 2023. GDP growth rates are derived from an inflation-adjusted or real GDP series. Compared to 7.0 percent growth at national level, growth in the agricultural sector averaged 5.2 percent per year between 2016 and 2019, while the crops subsector grew at an average annual rate of 6.1 percent.

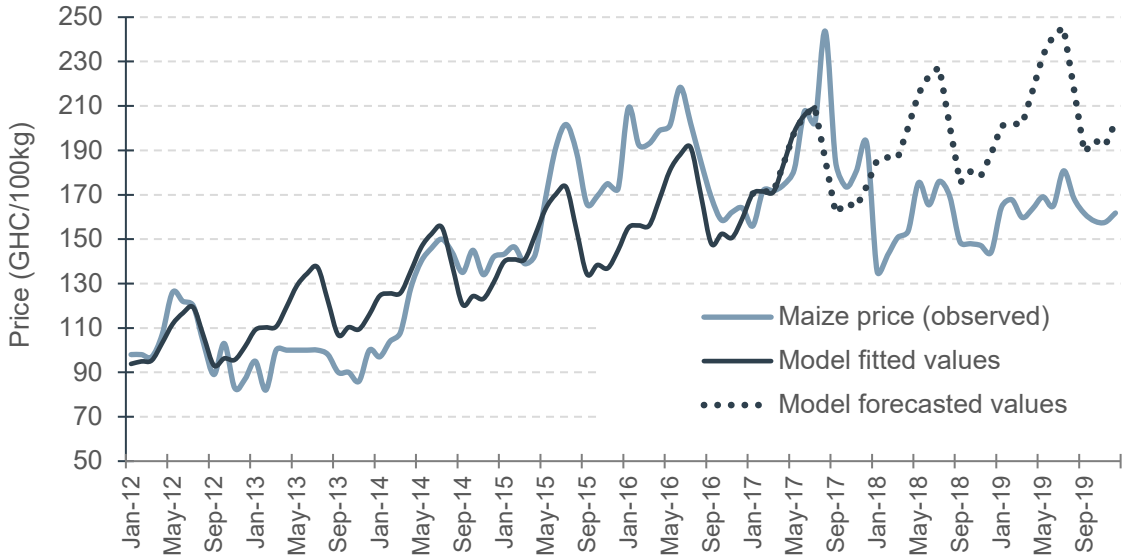
Figure 3.7: National and agricultural GDP trends in Ghana, 2014 to 2023



Source: GSS (2020).
Note: The growth rates for 2020–2023 (shaded) are projected rates.

The crops GDP measures value addition in the crops subsector and is a function of the value of crops produced each year. Using the crops listed in Table 3.1 and prices derived from the Social Accounting Matrix (SAM) for Ghana (Thurlow 2020), we estimate that the real output value in the crops sector grows at 8.6 percent per annum between 2016 and 2019 at constant real crop prices. This is significantly higher than the officially 6.1 percent growth in crops GDP over the same period. The implication is that, in real terms, crop prices did not stay constant but have, instead, declined, which is consistent with a large supply shock.

Figure 3.8: Average wholesale maize market prices in Ghana, 2012–2019



Source: IFPRI & MoFA (2020).

Further evidence of declining real prices is revealed in a recent analysis of seasonal maize price trends (IFPRI & MoFA 2020). This analysis shows that wholesale maize prices leveled out and trended below their expected levels since the introduction of PFJ (Figure 3.8). Maize is not a highly traded commodity in Ghana. Theory suggests that prices of non-tradable commodities will fall more than those of tradable commodities when supply is increased. This is because demand for tradable commodities is constrained by national income, whereas there are import substitution

or export opportunities for tradable commodities. Ultimately, the more prices of subsidized crops fall in real terms, the lower the marginal benefit of the program in terms of the value of crops produced and real benefits to the farmer. The evidence here raises questions about the absorptive capacity of the domestic market for a crop, such as maize, that is not traditionally exported.

4. CONCLUDING REMARKS AND FURTHER ANALYSIS

This report examines the evolution of farm input subsidy programs in Ghana, with a focus on the Planting for Food and Jobs (PFJ), which was introduced in 2017 and replaced the Fertilizer Subsidy Program (FSP) that was launched in 2008. The review of PFJ implementation reports and supplementary data reveal that information on general program features, such as beneficiary numbers, subsidized input quantities, and program budget is readily available and useful for understanding program design and implementation. National crop production estimates are also reported annually, and these provide evidence of rapid output growth in the agricultural sector, especially within the cereals subsector. However, the implementing agency, the Ministry of Food and Agriculture (MoFA), lacks a system for monitoring PFJ program impacts at farm-level. Consequently, most of the published information on the marginal contribution of PFJ to national crop output is based on simulations, which make strong assumptions about seeding rates, fertilizer use by crop, and input use efficiency on beneficiary farms. With this drawback in mind, PFJ has reportedly contributed substantially to crop output growth, a result which is plausible considering the quantities of inputs provided, but one that requires further on-farm validation.

Program impacts aside, some provisional recommendations can be drawn from the review of the evidence and program implementation. With respect to **beneficiary targeting**, it is evident that the use of a waybill system rather than coupons implies a “first-come, first-served” approach to beneficiary targeting, but there is limited evidence on how this plays out in practice against official targeting criteria. Officially, resource-poor smallholders are targeted, and at least 40 percent of beneficiaries should be women. Limiting the quantities of subsidized inputs, as is the current practice, does not necessarily exclude larger or wealthier farmers, and there does not appear to be any explicit attempt to give preferential access to women farmers. Ultimately, program objectives should determine the targeting mechanism adopted, but these objectives are not clearly articulated. For example, if national food security or returns to government investment were the main objectives, the most productive farmers should be targeted; conversely, if poverty-reduction or household food security were the main objectives, poor or food insecure subsistence farmers should be targeted. In general, however, irrespective of the program objectives, targeting farmers who would have purchased fertilizer in the absence of the subsidy leads to crowding out and represents a poor investment by government. Evidence suggests that both the commercial seed and fertilizer markets are being crowded out at a disturbing pace in Ghana.

PFJ initially set ambitious **job creation** targets. Government officials have claimed success based on imputations rather than official employment statistics. Messaging around the employment effects of PFJ is ambiguous. The term ‘job creation’ implies new jobs, which is not the same concept as ‘the number of workers associated directly or indirectly with the program’. The latter is likely implied by policymakers. More generally, however, agricultural productivity gains and economic transformation is traditionally associated with declining labor intensity in the rural sector. Even if agricultural intensification means the number of workers per hectare increases, positive transformation means the output per worker increases, which we define as labor productivity gains. Unless the output market grows proportionately to labor productivity gains, the net effect of transformation is reduced agricultural employment, often in absolute terms, and certainly in relative terms. Investing in off-farm production capacity and employment is crucial for facilitating the

movement of workers out of agriculture. Thus far PFJ has largely neglected off-farm investments, despite the program's broad mandate to also address off-farm constraints along value chains.

Lastly, with respect to **annual reporting** on PFJ, it is crucial that MoFA goes beyond providing information on beneficiary numbers, subsidized input quantities, and the program budget, alongside simulated estimates of on-farm impacts. A first step is to prioritize the development of a farmer registry and implement an appropriate targeting strategy. Through effective monitoring and more in-depth program evaluation activities, farm-level impacts, particularly with respect to input use and yield gains of beneficiaries compared to non-beneficiaries, can be better measured and validated. Government should also continue to monitor input quality, which includes implementing a system for testing fertilizer at different points along the supply chain and conducting systematic seed germination tests. Tracking input receipts by farmers and reconciling those with supply-side data will further ensure that all fertilizer reaches intended beneficiaries. In this regard, the practice of allowing farmer group representatives to collect inputs on behalf of farmers should be reviewed. The cost of such a monitoring exercise need not be excessive and will likely amount to between one and two percent of total program costs only. Ultimately, this small investment will bring about increased transparency and easier access to subsidy program data, which will encourage the private sector and development partners to support PFJ implementation.

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