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IFPRI Discussion Paper 01300

October 2013

Revisiting Agricultural Input and Farm Support Subsidies in Africa — The Case of Ghana

Lessons from Four Large Government Programs (Mechanization, Fertilizer, Block Farms, and Marketing)

Samuel Benin

Michael Johnson

Emmanuel Abokyi

Gerald Ahorbo

Kipo Jimah

Gamel Nasser

Victor Owusu

Joe Taabazuing

Albert Tenga

Development Strategy and Governance Division

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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AUTHORS

Samuel Benin (s.benin@cgiar.org) is a research fellow in the Development Strategy and Governance Division of the International Food Policy Research Institute (IFPRI), Washington, DC.

Michael Johnson is a research fellow in the Development Strategy and Governance Division of IFPRI, Washington, DC.

Emmanuel Abokyi is a consultant for the Ghana Institute of Management & Public Administration, Accra, Ghana.

Gerald Ahorbo is a lecturer in the Department of Agricultural Engineering of the Ho Polytechnic, Ho, Ghana and consultant for SmarTeam Services Limited, Accra, Ghana.

Kipo Jimah is a research officer in the Development Strategy and Governance Division of IFPRI, Accra, Ghana.

Gamel Nasser is a consultant for the Ghana Institute of Management & Public Administration, Accra, Ghana.

Victor Owusu is a senior lecturer in the Department of Agricultural Economics, Agribusiness and Extension of the Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Joe Taabazuing is a senior lecturer at the Ghana Institute of Management and Public Administration, Accra, Ghana.

Albert Tenga is a consultant for the Ghana Institute of Management & Public Administration, Accra, Ghana.

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ACKNOWLEDGMENTS

Funding support for this study was provided by the United States Agency for International Development via its support to the Ghana Strategy Support Program. The authors wish to thank Shashi Kolavalli and members of the agricultural-sector working group for comments during a presentation of the preliminary results and all the stakeholders (Ministry of Food and Agriculture officials, local government officials, service providers, farmers, and so on) who set aside part of their time to participate in the surveys and provided invaluable information for the analyses leading to this report.

ABSTRACT

Use of agricultural input and farm support subsidies in Africa has returned strongly to the development agenda, particularly following the recent high food and input prices crisis. Many of the donors who opposed them in the past and subsequently put pressure to discontinue them due to their high cost and distortionary effect on the domestic economy are now providing aid in the form of farm support and agricultural subsidies. In Ghana, for example, the country of study in this paper, the government has since 2007 introduced four major subsidy and support programs on fertilizer, mechanization, block farms, and marketing. All four have some characteristics similar to those of many of the government-run programs that were introduced and then abandoned in the past. Therefore, a key question that arises is how the structure and policies of these current programs account for any of the general lessons and controversies experienced in the past and, in the process, achieve their intended goals in a more effective and economically viable manner.

To answer this question in the Ghana case, our study assesses all four government programs concerning their (1) consistency in achieving the goals and objectives of the agricultural-sector development plan, (2) resources expended, (3) outputs and outcomes achieved, and (4) economic viability. To evaluate the progress of program implementation and achievements, we compare the values of several indicators associated with the situation prior to introducing the programs in 2007/08 to any changes that occurred after their introduction. Due to data limitations, the economic viability of each program is assessed using the economic surplus approach. Each individual program is evaluated separately before considering all the programs' interaction and combined effects on yields, output, and incomes.

Results show that the three programs on fertilizer, mechanization, and block farming have indeed succeeded in raising the amount of the subsidized inputs and services used by farmers, which subsequently led to higher yields and outputs for the commodities affected. In addition, and even more important, we find substantial interaction effects among all four programs. In particular, the establishment and operation of the National Food Buffer Stock Company (NAFCO) seemed to enhance the positive effects of the other three programs and in the process ensured NAFCO's own viability. This is because the resulting higher yields and output have helped to keep prices low enough for NAFCO to profitably operate a buffer stock. In the long run, if all else remains unchanged, the combined present net worth across all four programs using the example of maize is projected to be quite high, between GHS (Ghanaian cedis) 329 million and GHS 401 million in 2011 constant prices during the period from 2010 to 2020 with a benefit–cost ratio in the range of 1.5 to 1.6. The results have important implications for improving the design and implementation of future public policies and programs on input subsidies and farm support in Ghana and developing countries in general.

Keywords: agricultural inputs, buffer stock, farm subsidies, fertilizer, Ghana, mechanization

ABBREVIATIONS AND ACRONYMS

AEA	agricultural extension agent
AEZ	agroecological zone
AESD	Agricultural Engineering Services Division
AMSEC	Agricultural Mechanization Service Center
BFP	Block Farms Program
FASDEP II	Food and Agricultural Sector Development Plan
FBO	farmer-based organization
FSP	Fertilizer Subsidy Program
GDP	gross domestic product
GFDC	Ghana Food Distribution Company
GHS	Ghanaian cedis
kg/ha	kilograms per hectare
LBC	licensed buying company
mt	metric ton
MMDA	metropolitan, municipal, and district assembly
MoFA	Ministry of Food and Agriculture
NAFCO	National Food Buffer Stock Company
NPK	nitrogen, phosphorous, potassium
SCP	structure, conduct, and performance
SOA	sulphate of ammonium

1. INTRODUCTION

Direct government interventions in agricultural production and marketing through agricultural input subsidies and farm and market support programs were a common element in African agricultural development in the 1960s and 1970s. The onset of structural adjustment and market reform programs in the 1980s and 1990s led to their abandonment as donors pressed for reforms and as governments faced an ever-increasing fiscal burden of continuing to maintain them indefinitely (Kherallah et al. 2002). The general opinion at the time was that the heavy-handed role of the public sector in the past had failed to deliver on development and instead only resulted in government overspending, rent-seeking behavior, and macroeconomic mismanagement. Drawing on neoclassical economic arguments, market interventions through input delivery systems, subsidies, and output procurement schemes were considered inefficient and ineffective because of their distortionary effects on resource allocations and production patterns based on comparative advantage.

The justification and effects of input subsidies are complex and often controversial. Because subsidies are paid to farmers and agribusinesses to supplement their income, manage the supply of agricultural commodities, and influence the cost and supply of such commodities, they have the direct effect of transferring income from the general taxpayers to farm and agribusiness owners. Nevertheless, their use has been helpful in promoting the adoption of improved technologies and practices during the early stages of development, as in the successful Green Revolutions in Asia, for example (Johnson, Hazell, and Gulati 2003). Under these conditions, both input and output markets are typically viewed as too thin and having high marketing transaction costs and risks that prohibit private-sector entry and investments (Dorward et al. 2009). In more developed regions of the world, subsidies have often been popular due to strong protectionist policies of a well-organized farming community and have boosted agricultural exports of major commodities.[1]

The debate about the value of agricultural input subsidies in African agriculture in particular has ensued following the structural adjustment and market liberalization reforms in the 1980s and 1990s, but it was not until after the recent 2008 global food prices crisis, when many countries witnessed severe food shortages and civil riots, that serious attention was given to it. To ensure against such crises in the future, many governments have since introduced input subsidies and various price stabilization schemes. Although the governments introducing these interventions are aware of the potential fiscal burden the interventions can have on their economies, the political imperative to stabilize prices and ensure food security was too important to ignore. Consequently, the debate about subsidies has since shifted away from whether to have them toward how to improve the efficiency and effectiveness of using them. At this time, the general consensus in development circles began to shift to the design and implementation of *smart subsidies* that target the poor and support, rather than undercut, the development of private agricultural input distribution markets. Agricultural subsidies have since been introduced in many African countries, with Ghana, Malawi, Nigeria, Tanzania, and Zambia at the forefront. Meanwhile, many of the donors who have traditionally pushed against subsides are now increasingly providing aid in the form of subsidies. Evidence of the policy reversal on input subsidies can be illustrated by the U-shaped trends in the share of public agriculture expenditure in total expenditures in many countries—see Table 1.1 for the examples of Ghana, Malawi, and Zambia—with the share's declining during the structural adjustment era in the late 1980s and in the 1990s and then increasing in the 2000s. All three countries now spend a large share of their public agriculture expenditures on agricultural subsidies and at proportions similar to or higher than those of the 1980s.

[1] In the European Union, for example, nearly 70 percent (€39 billion) of the €57 billion earmarked for agricultural development in 2010 was spent on direct subsidies (European Union 2013). In the United States, more than US$277 *billion* was spent on subsidies between 1995 and 2011 (about US$16.3 billion per year on average), and 30 percent of that went to subsidizing corn alone (EWG 2013). The results are impressive. In 2010, for example, the United States accounted for 39 percent of the world's total corn production and 54 percent of the world's total corn exports (USGG 2013).

Table 1.1 Public agriculture expenditures as share of total expenditures (%) in Ghana, Malawi, and Zambia, 1980–2010

Country	1980	1985	1990	1995	2000	2005	2010
Ghana	12.2	6.2	6.1	5.1	3.2	9.6	9.1
Malawi	10.2	8.4	11.1	11.1	8.8	12.6	28.9
Zambia	13.4	10.7	5.6	2.5	2.1	7.2	10.2

Source: Authors' calculations based on IFPRI (2011) and Benin and Yu (2013).

A key question that arises with the recent experience of policy reversals on input subsidies and other farm support schemes is how lessons from the past have shaped current policies. In Ghana, for example, since 2007 the government has introduced four major subsidy programs that have characteristics similar to those of many of the programs that were implemented and then abandoned in the past. The four programs being implemented by the Ministry of Food and Agriculture (MoFA) are

- subsidization of agricultural mechanization services via support to the establishment and operation of Agricultural Mechanization Service Centers (AMSECs),
- subsidization of fertilizers via the national Fertilizer Subsidy Program (FSP),
- establishment and management of block farms that benefit from subsidized mechanization services and inputs (fertilizers, improved seed, and pesticides) and extension services, and
- stabilization of output prices via the establishment and operation of the National Food Buffer Stock Company (NAFCO).

The aim of the AMSEC program is to make mechanization services for farm activities readily available and affordable within each district that has potential for mechanization. Initially piloted in 2007 with 12 centers in eight regions, many other centers have since been set up in the rest of the country. The overarching goal of the program is to increase agricultural output and productivity. To achieve this, the ministry has estimated that the country will need about 16,667 tractors by 2015. With few privately owned tractors and a total of about 2,642 tractors imported by MoFA since 2005, the deficit is quite large. The AMSEC program is a credit facility where qualified private-sector companies are given an average machinery package of 5 tractors with matching implements at a subsidized price and interest rate. Qualified applicants are required to pay 10–17 percent of the total value upfront and then pay the balance during the next five years. At the time of the study, and as of June 2012, 89 AMSECs in 55 districts had been established.

The FSP is implemented via the waybill system, where four types of fertilizer (nitrogen, phosphorous, potassium [NPK] 15:15:15, NPK 23:10:05, urea, and sulphate of ammonium [SOA]) are subsidized at the port entry, making the subsidy available to all types of farmers who can afford the subsidized price—about 64 percent of the retail market price. The waybill system is different from the voucher system that was implemented in 2008 and 2009, wherein the same types of fertilizer were subsidized, but it aimed at targeting small-scale farmers only. FSP, irrespective of the system of implementation, aims at increasing the national average rate of fertilizer use from 8 kilograms per hectare (kg/ha) to 20 kg/ha to increase crop yields and production, to raise the profitability of farm production, and to improve private-sector development in the fertilizer market. The main reasons given for the change from the voucher system to the waybill system was the high overhead and administrative costs, diversion of fertilizers from intended beneficiaries, and the large amount of time that MoFA staff members wasted in supervising and policing the distribution of vouchers and fertilizers (MoFA 2010a).

The Block Farms Program (BFP), which started with some pilots and, in 2009, in six regions (Ashanti, Brong Ahafo, Central, Northern, Upper East, and Upper West), aims at improving agriculture and farming as a business by targeting large tracts of arable land (in blocks) in different locations for the production of selected commodities in which the areas have comparative advantage. By bringing several beneficiaries together onto one large production area and providing them with extension services and

credit in the form of mechanization services (via the AMSEC program), certified seed, subsidized fertilizer (via FSP), and pesticides, BFP is conceptualized to exploit scale economies including lower unit cost of input and service delivery. It is expected that the credit will be paid back in kind at the time of harvest, on which the government's emergency food security is expected to be developed (see upcoming Background section on NAFCO). Designed to focus on youth, BFP is expected to generate employment among the rural poor, especially the youth; increase productivity; improve incomes among farmers; and increase food security. The program currently targets the major crops including maize grain and seed, rice grain and seed, soybean, sorghum, tomato, and onions. Fisheries, livestock, and agricultural business are expected to be included in the future.

The NAFCO program was set up as a limited liability company with an initial outlay from the government in the amount of GHS (Ghanaian cedis) 15 million in 2009 to manage the government's emergency food security and to purchase, sell, preserve, and distribute food stuff; to mop up excess produce from all farmers to reduce postharvest losses; to facilitate the export of excess stock; to guarantee farmers an assured income by providing a minimum guaranteed price and ready market; to expand the demand for food grown in Ghana by selling to all state institutions such as the military, schools, hospitals, prisons, and so on; and to employ a buffer stock mechanism to ensure stability in the demand and supply food.

Objective of the Study and Outline of the Report

The main objectives of the study are to assess the effectiveness and economic viability of each of the four subsidy programs concerning its (1) consistency against the conceptual design for achieving the goals and objectives of the Food and Agricultural Sector Development Plan (FASDEP II), (2) resources expended, (3) outputs achieved, (4) target population reached, and (5) potential economic rate of return. Second, it is to consider the potential interaction and combined effects of all four programs on agricultural yields, output, and overall incomes and to discuss the extent to which lessons from the past may have influenced the effectiveness and economic viability of the current programs.

The paper is organized as follows. In Section 2, we present a conceptual framework describing how the four subsidy programs are intended to contribute to the overarching goals of the government, paying particular attention to consistency and interactions across them. The methodological approach used in assessing the effectiveness and economic viability of the programs is also presented for sampling, data sources and collection, and estimation techniques. In Section 3, we describe the characteristics of the sample areas and those interviewed to get a sense of the context within which the programs have been implemented. Thereafter, Sections 4 through 7 assess each of the four programs individually, first presenting programmatic information, specific concepts, and methodology followed by the analysis, results, and conclusions. Section 8 then delves into the interaction effects across the four programs before concluding and discussing the policy implications of our results in Section 9.

2. OVERALL METHODOLOGY[2]

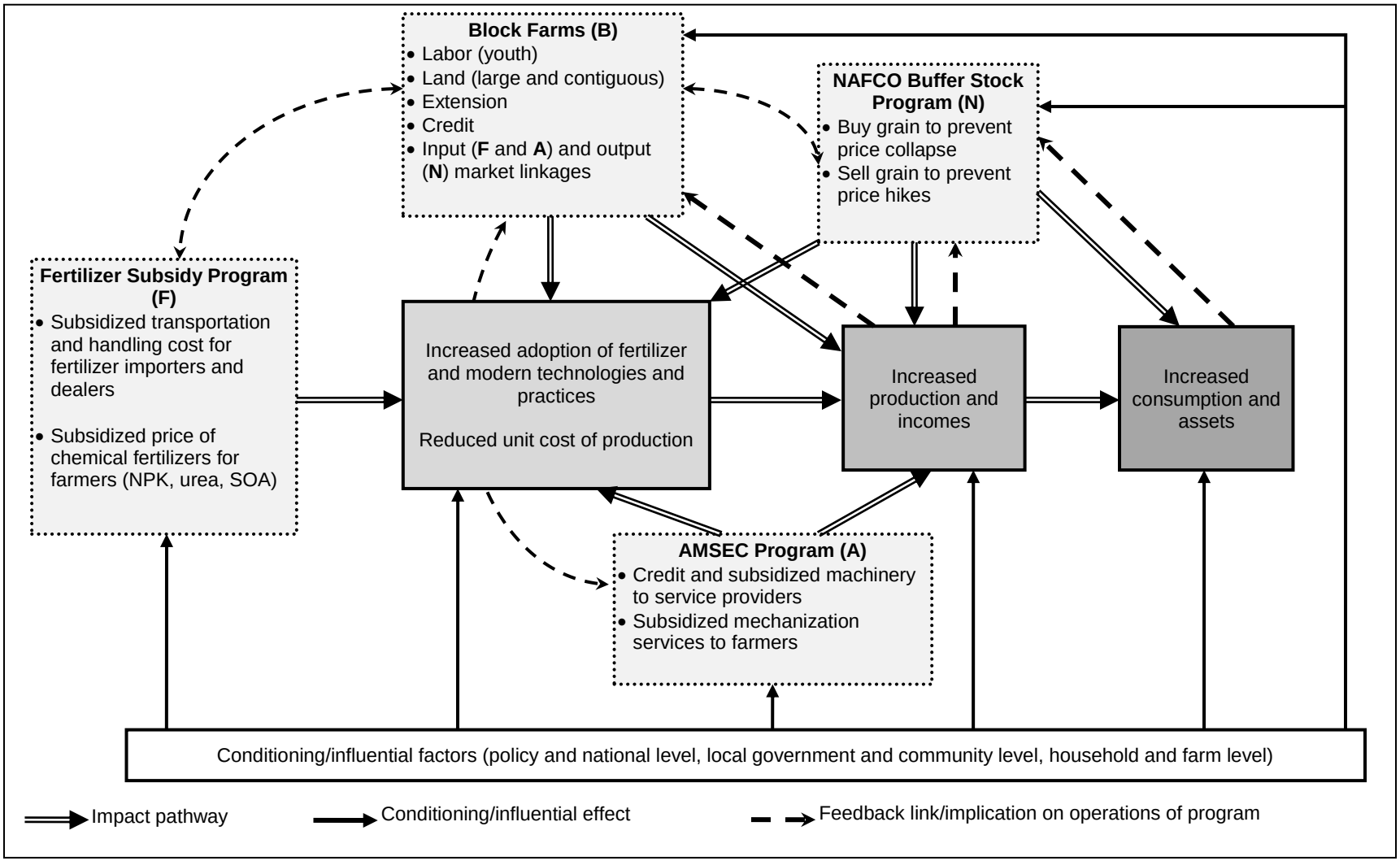
Conceptual Framework

The evaluation of the effectiveness and economic viability of each of the four subsidy programs of the Ghanaian government requires us to also consider how all four programs interact and complement each other toward achieving the goals of increasing agricultural output, incomes, and food and nutrition security for many reasons. There are three good reasons for this. First, many public investment programs are undertaken to take advantage of other programs through synergies. This means that evaluations of individual programs are likely to underestimate the costs and overestimate the benefits. Second, different types of public investment programs share common pathways in reaching the target population or having impact, suggesting that it may be difficult to attribute change in a specific desirable indicator to a single type of public investment. Therefore, one has to consider substitutability and complementarity among different investment programs in assessing their effects on outcome indicators. Finally, given a common goal and potential of the different programs to achieve the goal through different development pathways, the importance for coordination and sequencing of the programs becomes quickly apparent. Moreover, since individual programs compete for the same scarce resources, an evaluation of each program in isolation provides limited information for allocating resources more efficiently across the different programs. Thus, in looking at how the different subsidy programs in Ghana fit within the broader framework of FASDEP II, it is important to understand whether and how they complement or crowd out each other, including other actors in the marketplace (for example, the private sector, nongovernmental organizations).

To consider the interrelationships across the four programs, we begin by presenting a holistic conceptual framework for looking at the relationships among the different initiatives, first as inputs in the production-to-consumption continuum and then as their impacts on desirable development indicators or results. These relationships are summarized in Figure 2.1. Basically, the different initiatives through different pathways are expected to lead to increased adoption of chemical fertilizers and profitable technologies and practices by farm households, which in turn is expected to lead to improved outcomes including reduced unit cost of production and increased agricultural productivity, consumption, and assets. For example, all four programs contribute to increased adoption of inputs and technologies through different pathways. FSP (F) contributes directly through lower prices of fertilization as well as indirectly through the savings used to purchase other inputs and services. BFP (B) enhances the ability of farmers to adopt through in-kind credit for inputs and mechanizations services, extension, and creating market linkages.

[2] This section was coauthored by Samuel Benin (IFPRI, Davis, California, United States) and Michael Johnson (IFPRI, Washington, DC, United States).

Figure 2.1 Impact pathways and interaction effects among the four initiatives



Source: Authors' illustration.

Note: NAFCO = National Food Buffer Stock Company; NPK = nitrogen, phosphorous, potassium; SOA = sulphate of ammonium; AMSEC = Agricultural Mechanization Service Center.

Apart from enhancing the efficiency of input use, savings from subsidized mechanization services from the AMSEC program (A) can also be used to purchase other inputs and services. By providing an assured output market and reducing postharvest risk, the NAFCO buffer stock program (N) raises farmers' expectations for disposing of their produce and so can encourage them to invest in fertilizer use and other modern inputs and technologies.

However, whether farm households actually adopt the chemical fertilizers, use mechanization services, take part in the block farm project activities, or sell their output to NAFCO depends on certain conditioning factors, including the capacity of government and its implementing agencies to provide the services and the ability of farmers to adopt or use them, for example. The ability of farmers to adopt or use the services is in turn influenced by several household and farm-level socioeconomic characteristics, such as access to land, labor, capital, other assets, credit, livelihood options, and so on (Feder, Just, and Zilberman 1985; Feder and Umali 1993). The ability of farmers to participate to adopt the technologies or use the services offered by the different programs also hinges on timely supply or availability of the technologies and services. These are shaped by public policy priorities at both the national and the local-community level and typically are associated with political support and budgetary allocation decisions across the four programs and other priorities, including overall infrastructure development, promotion of nonfarm employment opportunities, and other price support schemes, among others. For example, availability of off-farm employment opportunities (or off-farm income) can contribute to agricultural income by providing resources for farmers to hire labor or to purchase inputs. On the other hand, off-farm employment opportunities may reduce farmers' incentive to invest in agriculture in general (and adoption of the programs' technologies and services in particular), as they become less dependent on the farmland and as the opportunity costs of their labor and capital are increased by having access to more profitable alternatives (Nkonya et al. 2004; Holden, Shiferaw, and Pender 2001).

The extent to which increased adoption of the programs' technologies and services will lead to increases in production, incomes, consumption, assets, and other desirable outcomes would depend on how well local markets and institutions function. Again BFP, the AMSEC program, and the NAFCO program are expected to play different roles for this to be realized. Ultimately, the successful operations of the programs are directly affected by the aggregate response and outcomes of farmers (these are represented by the feedback links). For example, capacity utilization of the buffer stock facilities directly depends on the aggregate output of farmers. Similarly, continued operation of the block farms directly depends on the output and income of farmers, which determines their ability to repay input credit. Therefore, synergies among the different programs are also important, most of which are anticipated via BFP. For example, if the local market functions well, then the price stabilization motive of NAFCO may not be an issue, and NAFCO may be restricted to meeting the emergency food needs of the country. Currently maize and rice recoveries from the block farms are sold to NAFCO. How well this succeeds depends a great deal on how well all four programs are designed and implemented, including how they interact with each other and other actors in the marketplace for agricultural inputs, service provisions, and output. Over time, through the development of more efficient agricultural markets and institutions, the need for public-sector interventions of this type is expected to be lessened and thus reduce the fiscal burden of such programs in the future. Political leaders may also decide to increase or reduce the budget allocated to the program depending on the outcomes of the programs in previous years. Thus, an important question to be asking now is whether the programs as designed are operating in ways that will lead to the achievement of FASDEP II goals for production and incomes, and in ways that are also economically and operationally efficient.

Several other factors condition and influence the impact pathways by which the programs lead to increased output and outcomes at various points. For example, other nongovernmental and private-sector actors are critical to the development of more efficient agricultural markets and institutions, which can also be enhanced by the aggregate demand for inputs and marketing services by farmers. However, if the programs and their own dynamic interactions in the market displace (crowd out) these private-sector

actors, this can ultimately undermine other desirable outcomes of FASDEP II such as increased private-sector development. Other important factors that condition and influence the impact pathways are those that influence the local production and marketing conditions (for example, agricultural potential, market access, and population pressure) guided by the notion that strategies for agricultural development in any given location depend largely on the comparative advantage of alternative livelihood strategies in that location (Pender, Place, and Ehui 1999). *Agricultural potential* refers to the suitability of biophysical characteristics for agricultural production as defined by the local agroecology and climate in the area and includes rainfall levels and distribution, altitude, soil type and depth, topography, presence of pests and diseases, presence of irrigation, and others. In Ghana, this can be broadly represented by the country's four major agroecological zones. Access to markets, on the other hand, is critical for determining the comparative advantage of a particular location, given its agricultural potential or absolute advantage, whereas population pressure affects the land–labor ratio and may induce innovations in technology, markets and institutions, or investments in infrastructure.

Aside from the four subsidy programs, other national-level programs, policies, and institutions influence the impact pathways at various points. For example, macroeconomic, trade, and market liberalization policies will affect the relative prices of commodities and inputs in general throughout the nation and may affect different people differently. Similarly, national infrastructure development, land tenure, and credit policies and programs may affect the awareness, opportunities, or constraints of different communities or households differently.

Drawing on the overall conceptual framework, we now present the empirical approach used to assess the effectiveness and economic viability of the program.[3] This primarily involves the structure, conduct, and performance (SCP) analysis examined along the entire chain—from the national administrative level to the farmer beneficiaries, using information from two main sources: (1) existing program documents and data and (2) individual and focus group interviews with implementing actors, knowledgeable experts, farmers, and other stakeholders using structured and semistructured instruments.

Evaluating the Effectiveness of the Programs

Evaluating Progress in Implementation and Achievement of Results

To evaluate progress in implementation of the programs and achievements based on several indicators, we compare the situation prior to implementation of the program (that is, in 2007/08, representing the baseline scenario) to any changes that have occurred in the three years following implementation of the program (that is, between 2008 and 2011). Because there are no specific baseline data for any of the four programs, we combine relevant secondary information with data values prior to or at the time of implementation of the programs. Where necessary, we obtain recall values of the indicators from stakeholder surveys to estimate the changes. To determine if the program has had an effect during this time period, we test whether any of the changes are significantly different from zero. However, we cannot directly attribute the changes to the four subsidy programs, as establishing such a causal relationship would require more detailed data and sophisticated estimation techniques that are beyond the scope of this study. For example, it would require the estimation of treatment effects, which fundamentally has to do with identifying a reliable counterfactual comparison group (control observations) against which to compare those who have been exposed to the program or treatment (treated observations).[4]

Because of limited data and time, we adopt a simplified approach to evaluating the effectiveness of the four programs. Our aim is to first establish, within a range of reasonable parameters, that the

[3] In Sections 4 through 7, we present the specific impact pathway adopted for each program to guide the empirical approach (that is, indicators, sampling, and data collection and analysis) used to assess the effectiveness of the program.

[4] Several methods have been proposed and employed in the literature to deal with these issues, ranging from traditional approaches, including fixed-effect methods from panel data analysis and instrumental variables methods, to experimental and quasi-experimental methods that try to establish alternative scenarios to represent the counterfactual. See Ravallion (2008) and Imbens and Wooldridge (2009) for reviews of issues and methods in program evaluation.

programs have led to an increase in the supply of inputs and services, an increase in the adoption of those inputs and services, or both. With the AMSEC program, for example, this means establishing that there was a significant increase in the use of mechanization services by farmers between 2008 and 2011 in general and, more so, that there was a greater increase in their use in areas where there is an AMSEC program compared to where there is none. The same applies to the FSP program. That is, establish that there has been a significant increase in the number of farmers using chemical fertilizers as well as in the amount used per unit area in 2010 and 2011 (that is, under the waybill system) compared to the levels in 2008 and 2009 (that is, under the voucher system). For the BFP program, the most important thing is to capture the learning effect by establishing that there has been greater use of inputs and services on the plots of farmers participating in the program (that is, on their plots off the block farm) compared to the plots of those not participating in the program. For the NAFCO program, the main thing to establish is that its presence is correlated with a reduction in the variability of prices, which we assume is positively correlated with risk behavior of farmers. That is, we assume that more stable prices lead to lower postharvest risk and encourage farmers to invest in modern inputs and technologies, which will in turn raise production and productivity.

Because we know that the ability of farmers to use the inputs and services associated with the programs hinges on several factors discussed earlier (see the Conceptual Framework subsection, above) and that changes between 2008 and 2011 are not explicitly controlled for in the analysis done here, we could expect our estimates to be conservative (inflationary) to the extent that changes in the factors are correlated with use of the inputs and services of the programs and contribute positively (negatively) to changes in outcomes, other factors being equal.

Sampling, Hypotheses, and Data Collection

To limit the bias from the omissions discussed above, we use a stratified sampling approach to account for differences in location and differential access by farmers in the different locations to the services of the different programs. The primary issue with the sampling of the target group is how to demarcate subpopulations into (1) those with access to or receiving the services of the program versus (2) those without access to or not receiving any services of the program. Because each of the programs is meant to cover the whole country, a clean *with* and *without* scenario is not possible, with the exception of the AMSEC program that is yet to be implemented in every district and to some extent the BFP because it is yet to be operational everywhere. Therefore, we considered the extent of farmers to potentially benefit from the services of the programs in doing the sampling, using a combination of purposive and random sampling of districts and communities. We obtained a list of all the districts' implementation of BFP, NAFCO program, and AMSEC program. Then, we purposively selected all six districts—Kwahu North, Ejura/Sekyedumase, Nkoranza South, Techiman Municipal, Tamale Metropolitan, and Yendi Municipal—where the services of all four MoFA programs were represented and potentially available to all farmers in the district to represent the cumulative or ultimate treatment of all four programs. Then, we selected corresponding districts so that they had similar local production and market conditions (measured by the four agroecological zones, population density, and market access),[5] considering varying access to the other MoFA programs. We now explain how the primary and corresponding districts/communities and stakeholders for each of the four subsidy programs were selected.

AMSEC Program

Because AMSEC service providers were located in fewer than one-half of the total number of districts in Ghana (84 AMSECs in 55 districts of the total 170 metropolitan, municipal, and district assemblies [MMDAs] districts) at the time of the survey and the effect of an AMSEC is more localized compared to

[5] A total of 150 persons per square kilometer of the district was used as the cutoff point to demarcate high and low population density, and up to two hours of travel time from district to the nearest town with a population of 50,000 or more people was used as the cutoff point to demarcate high and low market access (Chamberlin 2007).

the other three programs, we were able to define a cleaner *with* and *without* scenario of using the program's services. We used a combination of purposive and random sampling of service providers and corresponding districts and farmers to be interviewed. First, we randomly targeted 50 percent of the AMSEC service providers located or operating within each region, with a final count of 42 depending on those who were available and willing to participate in the survey. Then, for each selected AMSEC service provider we targeted at least 2 non-AMSEC service providers in the same area and reached a final count of 88 non-AMSEC service providers—giving a total of 130 mechanization service providers and 46 districts in which they were both operating. See Table 2.1 for the districts, their characteristics, and the presence of the other MoFA programs. From the districts and communities serviced by both types of service providers, 270 farmers were randomly selected to be interviewed, arriving at a breakdown of 52 (19 percent) of the farmers who received mechanization services from AMSEC service providers only, 155 (58 percent) of the farmers who received mechanization services from non-AMSEC service providers only, and 63 (23 percent) of the farmers who received mechanization services from both AMSEC and non-AMSEC service providers.

Table 2.1 Sampled districts for the AMSEC evaluation by AEZs, population density, market access, and presence of other MoFA programs

	High Population Density	Low Population Density	
AEZ	**High Market Access**	**High Market Access**	**Low Market Access**
Coastal savanna	Adentan Municipal (B1) Ga West (B1) Ashaiman Municipal (B1) Awutu-Senya (B1) Effutu Municipal (B1) Ga East Municipal Gomoa East (B1) North Tongu (B1) Sharma (B1)	Adaklu-Anyigbe (B1) Dangbe West (B1)	n.a.
Forest	Kwahu South (B1) Yilo Krobo (B1)	Asante Akim (B1) Ho Municipal (B1) Fanteakwa (B1) Hohoe Municipal (B1)	n.a.
Transition	Ahanta West (B1) Techiman Municipal (B1, N)	n.a.	Atebubu-Amantin (B1) Ejura Sekyedumase (B1, N) Kwahu North (B1) Nkoranza North (B1) Nkoranza South (B1, N) Sekyere-Afram Plains (B1) Wenchi Municipal (B1)
Guinea savanna	Bolgatanga Municipal (B1) Talisi Namdam (B1) Tamale Metro (B2, N)	Kassena-Nankana East (B1) Kassena-Nankana West (B1) Savelugu Nanton (B2) Tolon-Kumbugu (B2) Wa Municipal Yendi Municipal (B2, N)	Central Gonja (B2) Chereponi (B1) East Gonja (B2) Gushegu (B2) Jirapa (B1) Kintampo North (B1) Kintampo South (B1) Sawla-Tuna-Kalba (B1) West Gonja (B2) West Mamprusi (B2) Zabzugu-Tatale (B1)

Source: Authors' representation based on Chamberlin (2007).

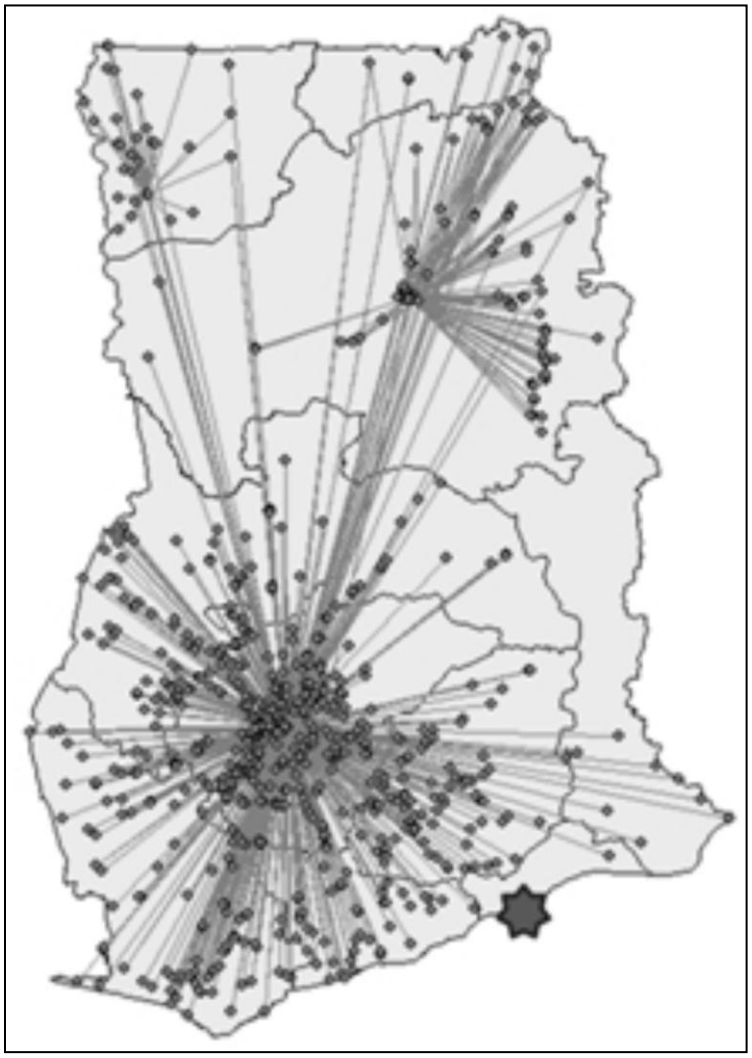
Notes: AMSEC = Agricultural Mechanization Service Center; AEZ = agroecological zones; MoFA = Ministry of Food and Agriculture. n.a. = no districts were selected in those strata, including areas of high population density and low market access, which are not shown.

B1, B2, and N indicate presence of block farms, pilot block farms, and National Food Buffer Stock Company warehouse, respectively.

Fertilizer Subsidy Program

Although all farmers are eligible to benefit from FSP, it is only those who actually buy the subsidized fertilizer who benefit from it. Figure 2.2, which shows the distribution network of fertilizers in the country, suggests that farmers who are closer to the main distribution points are more likely to benefit from the subsidy than those farther from them. This is because of the potentially greater availability of fertilizers closer to the main distribution points. For the evaluation here, 10 matching districts to the ultimate 6 given above were selected—giving a total of 16 districts. Then, in each of the selected districts, we randomly selected 2 MoFA zones (giving a total of 32 zones), within each of which 2 operational areas or communities were purposively selected, where 1 area has easy access to a major market where fertilizer is sold and the other area has lower or limited access—giving a total of 64 communities. The sampled districts and MoFA zones and the characteristics of their access to the other MoFA programs are presented in Tables 2.2 and 2.3. Table 2.2 shows a split in sample between low population density areas of the transition and guinea savanna zones on one hand and the high population density areas in different parts of the countries. The low population density areas of the transition and guinea savanna zones are more suitable large-scale mechanized operations, so we will expect greater amounts of fertilizer to be used there and a smaller share of the total fertilizer consumption to be used in the other parts.

Figure 2.2 Fertilizer distribution network in Ghana



Source: IFPRI and IFDC (2009).

Table 2.2 Sampled districts by AEZs, population density, market access, and presence of three MoFA subsidy programs

	High Population Density	Low Population Density	
AEZ	**High Market Access**	**High Market Access**	**Low Market Access**
Coastal savanna	Gomoa East (A) Ketu North	n.a.	n.a.
Forest	Kumasi Metropolitan (N)	Sunyani Municipal (N)	n.a.
Transition	Techiman Municipal (A, N)	n.a.	Kwahu North (A) Ejura/Sekyedumase (A, N) Nkoranza South (A, N) Sekyere East (A)
Guinea savanna	Tamale Metropolitan (A, B, N) Bongo (B)	Yendi (A, B, N) Nadowli (A) Savelugu-Nanton (A, B) Wa East (A)	West Gonja (A, B)

Source: Authors' representation.

Notes: AEZ = agroecological;zones, MoFA = Ministry of Food and Agriculture ; n.a. = no districts were selected in those strata, including areas of high population density and low market access, which are not shown.
A, B, and N indicate presence of the three MoFA programs, namely, Agricultural Mechanization Service Centers, block farms, and National Food Buffer Stock Company warehouses, respectively.

Table 2.3 Sampled districts and zones, by region and relative access to fertilizers

Region	Sampled District	Ministry of Food and Agriculture Zones
Eastern	1. Kwahu North	Maame Krobo (Y) Obotanso (N)
Ashanti	2. Ejura/Sekyedumase	Ejura (Y) Kobitri (N)
	3. Sekyere East	Anunya (Y) Apemso (N)
	4. Kumasi Metropolitan	Kwadaso (Y) Appiadu (N)
Brong Ahafo	5. Nkoranza South	Akuma (Y) Ashigumu (N)
	6. Techiman Municipal	Toubodum (Y) Aworowa (N)
	7. Sunyani Municipal	Yawhima (Y) Asufufu-Bediako (N)
Northern	8. Tamale Metropolitan	Baglahi (Y) Yondakplemle (N)
	9. Yendi Municipal	Zang (Y) Klukpanga (N)
	10. West Gonja	Kanteen (Y) Tuna (N)
	11. Savelugu-Nanton	Nakpanzoo (Y)
Upper East	12. Bongo	Kanbugo (Y) Beabankoo (N)
Upper West	13. Nadowli	Daffiama (Y) Kojoperi (N)
	14. Wa East	Bulinga (Y) Funsi (N)
Central	15. Gomoa East	Okyereko (Y) Gomoa Adawukwa (N)
Volta	16. Ketu North	Lave (Y) Klenomade (N)

Source: Authors' representation.

Notes: Y = easy access or closer to a market; N = difficult or no access or far from a market.

However, it is likely that greater intensities of fertilizer use (amount per unit area) in the high population density areas will be observed, reflecting the commonly observed inverse farm size–technology adoption relationship. Because all farmers are eligible to benefit from the fertilizer subsidy under the waybill system, materializing when they buy the subsidized fertilizer from the market, we expect greater amounts of fertilizer to be used under this system than under the voucher system, which is more targeted. Looking across the two groups and other factors being equal, we also expect farmers located closer to a fertilizer market to use more (subsidized) fertilizer than those located farther from it, to the extent that the location and distance influence the transaction cost of using the fertilizer. In each of the communities, a focus group (total of 64) discussion was held with farmers. This was followed by interviews of at least 2 households per community (total of 128), selected based on convenience or availability of the household head. Interviews were also conducted with district MoFA officers.

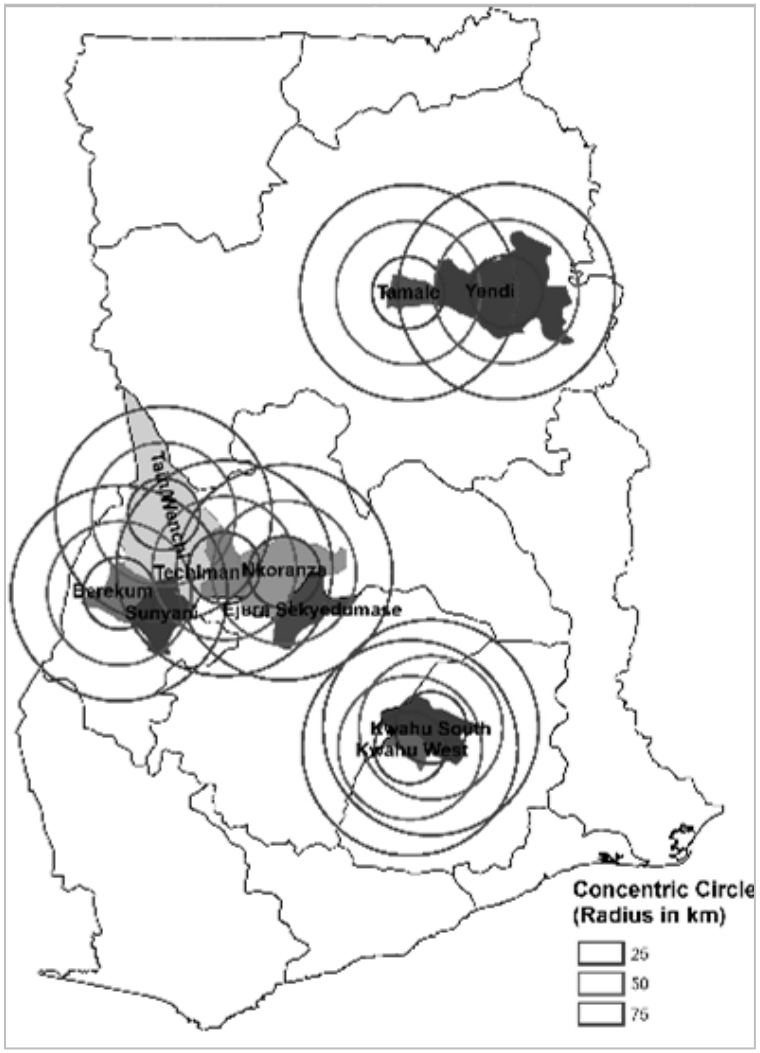
Block Farms Program

The sampling strategy used here is similar to the one used for FSP, leading to the selection of 16 districts, 32 zones, and 64 communities as well as the subsequent number of the different stakeholders who were interviewed. The main difference is how the subpopulations of BFP were defined. Because there were few districts where there were no block farms, we grouped the sample into three: (1) where a pilot block farm had been implemented—6 percent of the total number of districts, (2) where a block farm was recently established—88 percent of the total number of districts, and (3) where there was no block farm—6 percent of the total number of districts. This was used to capture the learning or extension effect for likely transfer of knowledge and practices from the block farm to farmers' own farms. In general, we expect better performance (for example, higher technology adoption, productivity, and marketable surplus) on the block farm than on farmers' own plots. Across the subsamples, we expect better performance on farmers' block farms in areas that had a pilot project compared to areas that did not, to the extent that the learning effect is greater and more widespread in the pilot project areas than in newer areas. Similarly, we expect the performance on farmers' own farms located in pilot project areas to be greater than those located in the other areas.

Buffer Stock Program (NAFCO)

For the buffer stock program, although the benefits of its price stabilization activities are expected to be felt nationwide, districts where a NAFCO warehouse was located (7 in total) in addition to districts within the vicinity of the warehouses (see Figure 2.3) were considered to also have immediate or localized effects of the program. Therefore, two subpopulations were created: districts with a NAFCO warehouse (we selected all 7 of them) and those without (we selected 9 of them). This makes a total of 16 districts as presented earlier, including the selection of zones and communities (see Table 2.2) in addition to subsequent selection of stakeholders to be interviewed. Assuming NAFCO reduces postharvest risk of farmers more within the locality of its operations than elsewhere, we expect farmers in districts where a NAFCO warehouse is located to have a higher level of agricultural performance to the extent that the reduction in postharvest risk encourages investment in fertilizer use and other modern inputs and technologies, which in turn leads to higher yields, consumption, and welfare.

Figure 2.3 District location of NAFCO warehouses in Ghana



Source: Authors' illustration.
Note: NAFCO = National Food Buffer Stock Company ; km = kilometers.

Evaluating Economic Viability of the Programs

An important question to be addressed is whether the programs as designed are operating in ways that will not only lead to the achievement of the FASDEP II goals and objectives (that is, results) but do so in ways that are economically efficient. To evaluate the economic efficiency of the programs, we adopt a simple cost–benefit analysis of the programs ex ante (see Gittinger 1982; Alston, Norton, and Pardey 1995). These analyses are based on available information on program input costs (including the opportunity cost of time of government staff members and other intangible costs) and projected beneficiary outcomes (based on estimated farm productivity effects of the program and assumptions about the economywide net benefits). In addition, the consideration of potential leakages and complementarities with other programs are captured to the extent possible to minimize the bias of underestimating or overestimating actual net benefit flows that are captured by the data-collection efforts.

To assess the economic net benefits, we evaluate the future flow of benefits and costs with and without a program intervention using a simple partial equilibrium model of supply and demand. The reasons for doing this are several: First, all four programs are in their infancy without a sufficient lag time to assess their impacts. Furthermore, there was no baseline data to establish the situation prior to implementation of the programs, and thus there was a lack of sufficient data to undertake a before-and-after economic impact assessment. Also, because no economic feasibility studies for any of the programs were undertaken, our analysis helps to fill such a gap. The analysis offers a relatively simple approach to estimate the economic value of a program using the concept of economic surplus. The economic surplus approach has the advantage of accounting for producers' production costs and consumers' consumption values as they change in response to program interventions. These ultimately influence national equilibrium quantities and prices with important implications for overall economic welfare.

To undertake the economic analysis, basic assumptions on overall economic conditions, supply and demand behavior, growth in direct programs costs, indirect administrative costs, overall government budgets, and program effects on yields had to be made. Given the multiple programs involved, we chose to focus on the effects of each program on maize only and on production, prices, and thus overall economic and social welfare benefits derived at the national level. The combined economic effect of all four programs is presented in Section 8, and details of the approach and assumptions are provided in Appendix A.

3. CHANGES IN OVERALL AGRICULTURAL PRODUCTION ACTIVITIES[6]

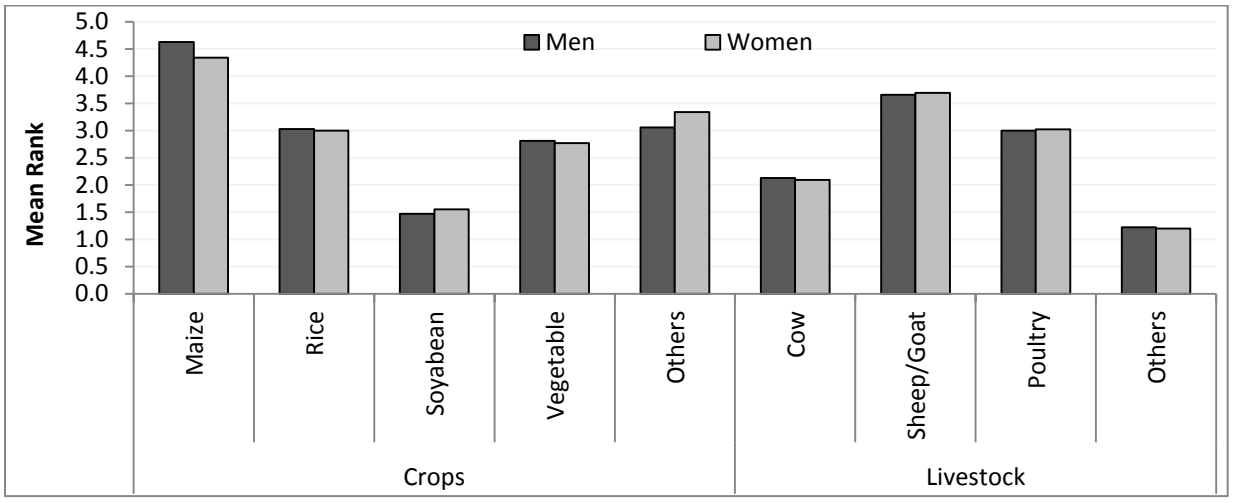
To get a sense of the context within which the programs were being implemented, we asked farmer focus groups to assess the situation in their production environment prior to when the programs were implemented (that is, 2008) as well as any changes that occurred in the next three years (that is, between 2008 and 2011) in several indicators. In this report, we focus on the following three indicators:

- Major agricultural activities engaged in, differentiated by males and females
- Access to farmland, differentiated by males and females
- Satisfaction with different agricultural inputs services

Agricultural Production Activities

Farmers were asked to rank (1 = *least important* to 5 = *most important*) the major cropping and livestock activities engaged in. For the crops, the communities ranked maize, rice, vegetables, and soya beans in order of importance for both males and females (see Figure 3.1). Regarding livestock, sheep and goats were perceived to be the most important, followed by poultry and cattle. Here, there were no differences between males and females.

Figure 3.1 Ranking of crop and livestock activities for men and women, 2008

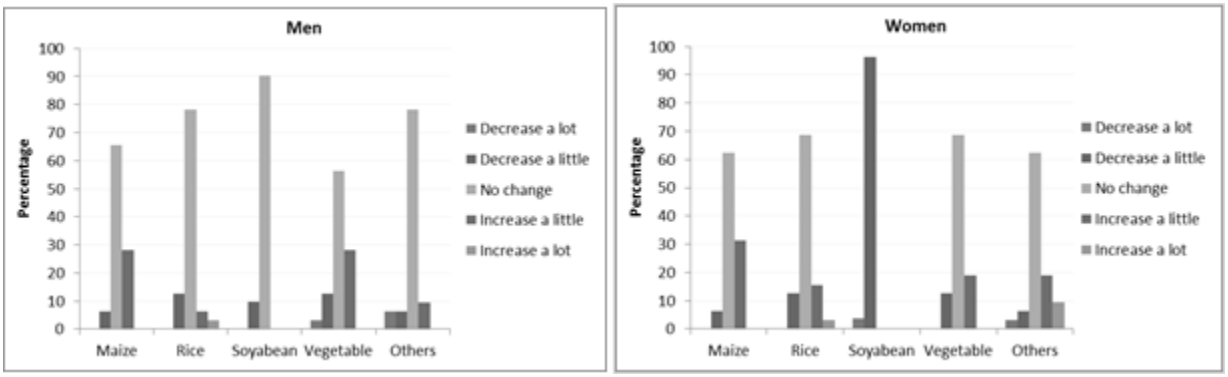


Source: Focus group surveys.
Note: Rank was based on 1 = *least important* to 5 = *most important.*

Looking at changes in farming activities in the past three years, the results show that the majority of the communities perceived that there were no changes in the crop (Figure 3.2) and livestock (Figure 3.3) production activities for both males and females, except with soya bean, where a majority perceived a slight decline for women (Figure 3.2, panel on right), which was blamed on poor marketing.

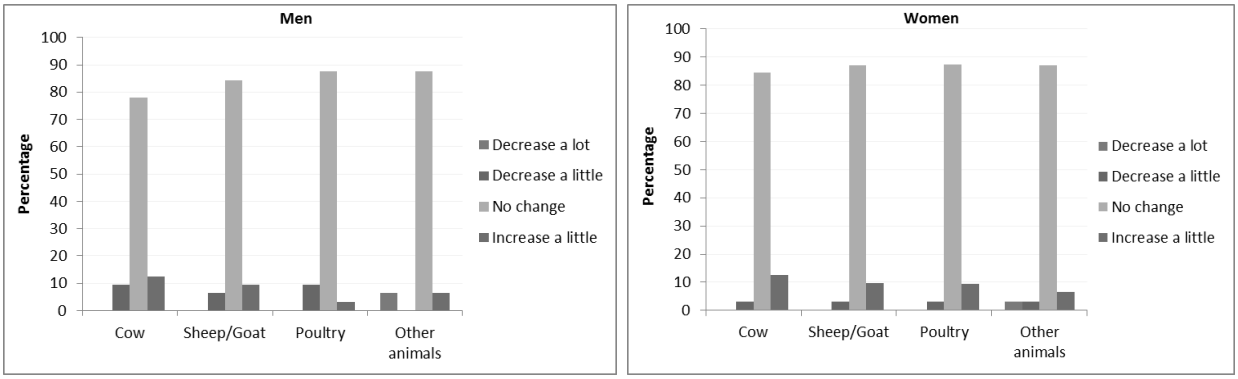
[6] This section was coauthored by Samuel Benin (IFPRI, Davis, California, United States) and Albert Tenga (Ghana Institute of Management and Public Administration (GIMPA) Consulting Services, Accra, Ghana).

Figure 3.2 Changes between 2008 and 2011 in crop production activities for men and women (percentage of communities reporting)



Source: Focus group surveys.

Figure 3.3 Changes between 2008 and 2011 in livestock production activities for men and women (percentage of communities reporting)

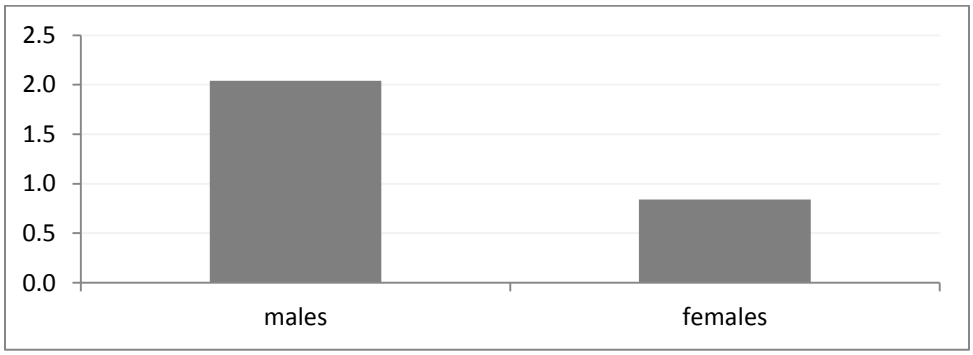


Source: Focus group surveys.

Access to Farmland

Access to farmland remains a concern in Ghana. This is especially the case for women, who are believed to constitute the largest part of the agricultural labor force in Ghana and account for producing the bulk of the total food that is consumed. Looking at the area farmed as an indicator of revealed access to farmland, we found that males cultivated about two and one-half times more farmland than females: Males had a little more than 2 ha per person on average, whereas females had about 0.8 ha per person on average (Figure 3.4). Here too, there were no significant changes in the past three years for both males and females.

Figure 3.4 Average farm size of males and females (hectares per person)

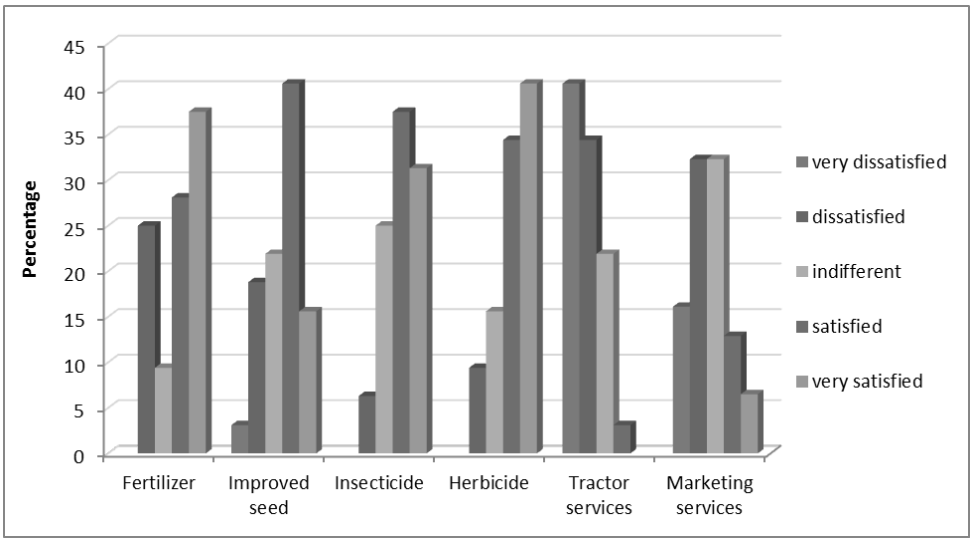


Source: Focus group surveys.

Satisfaction with Farm Inputs and Services

Farming communities were asked to indicate their level of satisfaction on their access to and benefits derived from farm inputs and services. The results in Figure 3.5 show that most of the communities were satisfied or very satisfied with the chemical inputs (that is, fertilizer, insecticides, and herbicides) and improved seed, with at least 55 percent of the communities reporting along those lines for any of the four inputs. Less than a quarter of the communities reported dissatisfaction with any of these inputs, with the proportion that were dissatisfied being higher for fertilizer (about 25 percent) and improved seed (18 percent). Quite an opposite picture is portrayed for mechanization and marketing services, with 73 and 47 of the communities expressing dissatisfaction with these services, respectively. These results suggest that land preparation and postharvest activities are limiting factors for raising agricultural productivity in the farming communities surveyed and elsewhere to the extent the communities surveyed are representative of other communities in Ghana.

Figure 3.5 Satisfaction with agricultural inputs and services (percentage of communities reporting)



Source: Focus group surveys.

Summary and Implications for Evaluating the Programs' Effects

To summarize, both men and women generally had similar livelihoods and preferences for farming prior to implementation of the four programs (that is, in 2007/08), and there had been no significant changes between 2008 and 2011 in their farming and overall income-earning activities. This is because there has not been any program that has radically changed the livelihood base of farmers or people in the rural areas. Basically, the programs that have been implemented have targeted the same major agricultural activities in which farmers have already been engaged. Therefore, assuming that provision by the government of credit facilities and subsidies to the private-sector input dealers has increased the supply of inputs and services available to farmers and that provision by the government of credit facilities and subsidies to farmers has increased their adoption of those inputs and services (the assumptions to be tested in this paper), then the programs should have a positive impact on agricultural productivity and other related outcomes.

4. AGRICULTURAL MECHANIZATION SERVICE CENTER (AMSEC) PROGRAM[7]

Background

The rationale for agricultural mechanization is well known. By increasing power inputs to farming activities, thereby increasing the scale of operation, and improving the timeliness, quality, and efficiency of farm operations, agricultural mechanization contributes to increasing production, productivity, and profitability of agriculture. Hitherto, it was considered that mechanization created unemployment because of displacement of labor in similar activities. However, by increasing the scale of operations, mechanization can increase the volume of manual farm operations associated with increase in scale and hence raise the demand for labor for farm operations such as fertilizer application, pruning, harvesting, and processing and marketing. The current situation of agriculture mechanization services in Ghana is dominated by tractor services largely for land preparation. In 2009, the tractor population was estimated at 5,200, which represented about 78 percent of the total required number of 6,667 at the time (Agricultural Engineering Services Division [AESD] 2011). A recent projection by AESD indicates that the country will need about 16,667 tractors by 2015 (assuming mechanized land of about four million hectares or 50 percent of the total mechanizable area) with a suggested deficit of 11,467 tractors (AESD 2011).

The AMSEC program is one of the major programs that MoFA has been implementing in Ghana's quest for the attainment of sustainable agricultural production systems. The program is a credit facility to assist the private sector in purchasing agricultural machinery and setting up commercially viable AMSECs in strategic locations. The facility is the government's response to the high entry barrier into the mechanization services industry—high initial capital investment in farm machinery and high cost of borrowing from commercial banks. Ultimately, support to the private sector enables farmers and agroprocessors to have widespread access to mechanization services at affordable prices and makes them more effective and efficient in their farming and processing operations. Historically, many farming districts and communities did not have access to even a single agricultural mechanization center where farmers could access tractors or power tillers for land preparation, let alone follow on services in the area of planting, crop maintenance, harvesting, and processing. Most of the available agricultural mechanization services were limited to medium and large commercial farmers. In addition, the available services targeting small-scale farmers were not being effectively used. As such, farm power for the majority of farmers relied overwhelmingly on human muscle power, and it was based on operations that depend on the hoe and other hand tools, placing limitations on the amount of land that could be cultivated per family. It also reduced and limited the effectiveness of essential farm operations such as cultivation and weeding, thereby reducing crop yields.

The aim of the AMSEC program, which was piloted in 2007 with 12 centers in eight regions, is to make mechanization services for farm activities available at farmers' doorsteps, with each district that has potential for mechanization having a least 1 AMSEC set up there. The idea is to raise the low tractor-to-farmer ratio estimated at 1:1800 and reduce the high number of aged tractors, with an estimated average age of more than 15 years (see AMSEC Proposal, AESD 2003). The major expected outcomes of the program are

[7] This section was coauthored by Gerald Ahorbo (SmarTeam Services Limited, Tema, Ghana), Victor Owusu (Kwame Nkrumah University of Science and Technology, Kumasi, Ghana), Samuel Benin (IFPRI, Davis, California, United States), and Michael Johnson (IFPRI, Washington, DC, United States). Kipo Jimah (IFPRI, Accra, Ghana) provided data collection and analysis support.

1. timely access to mechanized services, via one AMSEC per district;
2. efficient use of agricultural machinery;
3. reduction in drudgery and tedium associated with agriculture;
4. increase in production and yield;
5. rural employment generation; and
6. reduction in postharvest losses.

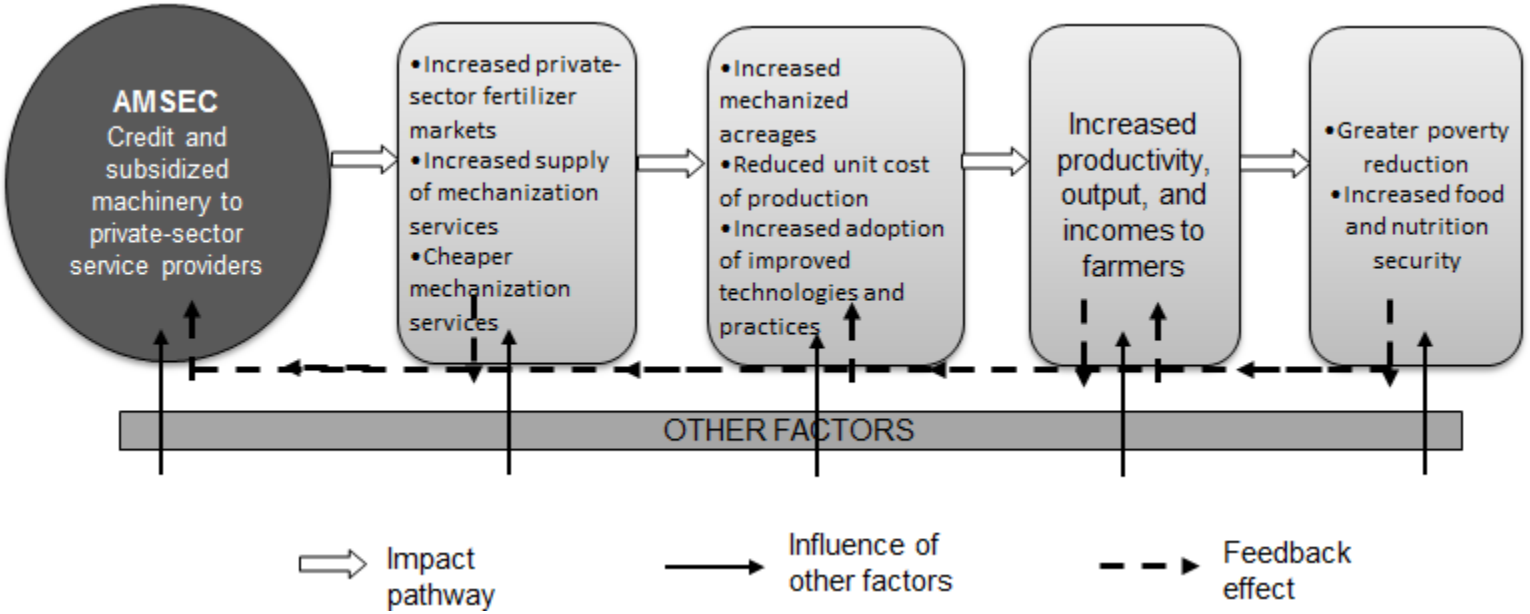
This section evaluates the AMSEC program by way of addressing the following specific major assessment questions:

1. How has the AMSEC program affected the development of the mechanization services rental market?
2. To what extent has the AMSEC program achieved its stated objectives and outcomes?
    a. Increased supply of and access to mechanization services
    b. Increased use of mechanization services
    c. Increased yields and production
    d. Improved private-sector development
3. What is the overall economic viability of the program?
4. What are emerging challenges of the program and potential ways to address them?

Conceptual Framework and Methodology

The fundamental issue the AMSEC program seeks to address is the lack of mechanization services due to high entry barriers, placing limitations on the amount of land that could be cultivated, which in turn leads to high unit cost of operation, low adoption of modern inputs and technologies, low yield, and low income to farmers. According to Fonteh (2010), a farmer using only hand hoes can prepare about 0.5 ha only for planting per season. Therefore, the underlying assumption, as shown in Figure 4.1, is that by providing low-interest credit and subsidized machinery and implements to mechanization service providers, there would be more and cheaper services available to all farmers so that more farmers could then purchase these services and expand their areas cultivated. They could then adopt more modern inputs (for example, fertilizer, pesticides) and practices (for example, row planting, specific spacing) that are also mechanized. By reducing the unit cost of production and raising productivity, incomes to farmers would increase, which in turn would affect their consumption and food and nutrition security positively. The fulfillment of this chain of outputs and outcomes depends on multiple other factors, including complementary interventions beyond just the AMSEC program. For example, creating and expanding market access to farm produce (such as envisioned with the NAFCO program) as well as making other agricultural inputs like certified seed, fertilizer, and pesticides easily accessible (as envisioned with the fertilizer subsidy and BFPs) are important. Farmers' characteristics, including their endowments of human, physical, financial, and social capital, are also important. There are also important feedback links underlying the relationship between the AMSEC program and the outcomes, which are represented by the dotted paths in Figure 4.1.

Figure 4.1 Impact pathways and associated indicators of the AMSEC program



Source: Authors' illustration based on program documents and literature review.

Note: AMSEC = Agricultural Mechanization Service Center.

In addition to obtaining secondary data from various sources, we interviewed different stakeholders along the value chain (AMSEC and non-AMSEC service providers, tractor operators, farmers, tractor mechanics, tractor spare parts dealers, traditional and local authorities, and experts working in the food and agricultural sector) to obtain relevant information to carry out the analysis.

Overview of the AMSEC Program and Provision of Mechanization Services in Ghana

The concept of AMSEC came up long before 2002, the year when it received serious attention and a proposal was finally prepared for the piloting of the concept in four locations: Kasoa, Asutuare, Nkoranza, and Walewale. Then nothing happened until October 2007, when 12 AMSECs were piloted in eight regions of the country. The number of AMSECs was expanded to 69 in 2009, 84 in 2010, and 88 by August 2011. At the time of the study, five thousand tractors (with accompanying disc ploughs, disc harrows, trailers, and power tillers) had been imported and made available to qualified private-sector operators and some farmers via the credit facility, leading to the establishment of 84 AMSEC companies, which constitutes about 6 percent of the total number of tractors available in the country. The bulk (31 percent) of the 84 AMSECs are located in the Northern region, followed by the Brong Ahafo (15 percent), Eastern (12 percent), and Upper West regions (11 percent) (see Table 4.1). The remainder were distributed somewhat equally across the other regions, except the Western region which had only one reported AMSEC established at the time of the study.

Table 4.1 Regional distribution of AMSECs, 2010

Region	Number	Percentage of Total
Northern	26	31
Upper West	9	11
Upper East	6	7
Ashanti	5	6
Greater Accra	3	4
Brong Ahafo	13	15
Central	4	5
Volta	7	8
Eastern	10	12
Western	1	1
Total	**84**	**100**

Source: Ghana, MoA (2013).
Note: AMSEC = Agricultural Mechanization Service Center.
This does not include other mechanization centers (or non– AMSECs).

Application Process and Brands/Types of Machinery and Implements Imported

The credit facility is open to all private-sector actors through an application process in response to an expression of interest by the government that is published in the national daily newspapers. A qualified applicant should be a registered company showing the ability to pay back as well as adhere to technical requirements for operating a mechanization center. Prospective awardees are provided with an allocation letter that states (1) the total cost of equipment given out on hire-purchase basis, (2) the initial payment required, and (3) the amount required to be paid in five annual installments. The initial payment of 10–17 percent of the total cost is paid by bankers draft to the chief accountant at MoFA headquarters, and then the receipt is presented at AESD for the delivery of the tractors and implements. On average, the delivery is made up of five tractors and accompanying basic implements including plough, harrow, and trailer. Table 4.2 summarizes the total number and brands/types of machines and implements given to the 84 AMSECs. The bulk of the purchases and allocation took place in 2009, with the John Deere and Farmtrac brands of tractors dominating; 51 and 28 percent, respectively, of the total. The Mahindra brand of tractors (15 percent of the total) was the sole one imported and distributed in 2010.

Table 4.2 Number and brands/types of tractors and implements allocated to AMSECs, 2007–2010

Brand/Type of Machinery and Implements	2007	2009	2010	Total
Machinery				
John Deere	2	229	0	231
Mahindra	0	0	63	63
Farmtrac	60	60	8	128
Yukon	27	1	0	28
Shakti power tiller	10	3	0	13
Maize sheller	0	3	1	4
Implement				
Rotovator	32	1	0	33
Plough	83	218	0	301
Harrow	56	3	0	59
Slasher	27	0	0	27
Trailer	83	36	0	119

Source: AESD (2011).

Notes: AMSEC = Agricultural Mechanization Service Center.
No machinery and implements were given in 2008.

MoFA-AESD imports the tractors, and the diversity in their brands is largely due to the source of support (including loans or grants) for supply of the equipment. The diversity of brands should not be much of a problem if the associated spare parts and maintenance support are readily available at affordable prices. As the number of tractors of a particular brand increases, then we will expect the market for related spare parts and maintenance to also increase. At the early stages, local distributors and service providers may not find it economical to branch out and specialize in supporting a few units of a particular model or brand. This means that starting out to import appropriate (that is, referring to robustness for the Ghanaian terrain and ease of maintenance and repair) models and brands of tractors is important.

AMSEC versus Non-AMSEC Operators

The AMSEC program allows for different types of ownerships of the centers to be established, including MMDAs, private-sector companies, farmer-based organizations (FBOs), and individual farmers. Most of the AMSEC service providers interviewed (77 percent of the total 48) were registered companies or associations, and the remainder AMSECs were mostly operated by individuals. About a third of the non-AMSECs (that is, those that did not access the government's credit facility but purchased the machinery and equipment on their own) were owned by associations, and the remainder by individuals. The centers were managed mostly by males, with 25 and 10 percent of the AMSECs and non-AMSECs, respectively, being managed by females.

Some of the AMSECs acquired machinery and equipment on their own, that is, outside of the government's credit facility. Among the AMSECs surveyed in this study (48 in total), together they had acquired on their own a total of 53 tractors, six planters, four combine harvesters, 13 maize shellers, five rice mills, and several other machines and equipment (see Table 4.3). Inventory of the machines and equipment owned by the non-AMSECs surveyed (88 in total), as shown in Table 4.3, indicates that they were less equipped than the AMSECs on a per-center basis. This is not surprising because, with the credit facility, many AMSECs could purchase other important machines and implements like maize shellers, power tillers, planters, combine harvesters, boom sprayers, and rice millers, as shown in Table 4.3. The inventories in Tables 4.2 and 4.3 suggest that the most common machines and implements for land preparation and carting are tractors, disc ploughs, disc harrows, and trailers. With limited machinery and equipment to undertake other services beyond land preparation, it is obvious that total mechanization of Ghana's agriculture sector is still underdeveloped.

Table 4.3 Number of own-purchased machines and equipment by AMSECs and non-AMSECs, 2008–2010

Type of Machines/Equipment	AMSECs (48 Centers)	Non-AMSECs (88 Centers)
Tractor	53	84
Disc plough	94	85
Trailer	14	25
Harrow	30	23
Maize sheller	13	8
Power tiller	3	7
Combine harvester	4	1
Planter	6	0
Boom sprayer	4	1
Thresher	1	2
Dryer	1	0
Rice mill	5	1

Source: Field survey of service providers.

Notes: AMSEC = Agricultural Mechanization Service Center.
For the AMSECs, this does not include machines and equipment obtained through the government's credit facility.

Assessment of Mechanization Services Provided

As Table 4.4 shows, the number of farmers and area served with mechanization has increased over time, with greater coverage and rapid growth in coverage occurring with more AMSECs' coming into place as well as more machinery and equipment's being accumulated over time. The average number of farmers and area served by an AMSEC are greater than those served by a non-AMSEC, which is consistent with the earlier observation of AMSECs' being better equipped with machines and equipment per center. In 2010, the average number of farmers and area served by an AMSEC was at least twice that served by a non-AMSEC, and the differences are statistically significant.

Table 4.4 Average number of farmers and area served AMSECs and non-AMSECs, 2008–2010

Farmers and Areas Served	AMSEC	Non-AMSEC	Significant Difference
Average number of farmers served			
2008	66	39	
2009	116	71	
2010	194	92	**
Average area served (acres)			
2008	204	177	
2009	420	263	
2010	786	351	*

Source: Field survey of service providers.

Notes: AMSEC = Agricultural Mechanization Service Center.
*Statistical significance at 10 percent level. **Statistical significance at 5 percent level.

The mode of payment for services rendered is important in the farming business as farmers may not have cash to pay for services. As Table 4.5 shows, a combination of cash, credit, and in-kind payment were common. A greater proportion of non-AMSECs (41 percent) than AMSECs (23 percent) accepted cash only. This partly explains why AMSECs served a greater number of farmers and area on average than non-AMSECs did to the extent that farmers who could not pay with cash risked not being served by a non-AMSEC provider.

Table 4.5 Mode of payment for services by AMSECs and non-AMSECs (percentage of total)

Mode of Payment	AMSECs	Non-AMSECs
Cash only	23	41
Credit only	6	3
Farm produce only	6	1
Combination of cash, credit, and farm produce	65	55

Source: Field survey of service providers.
Note: AMSEC = Agricultural Mechanization Service Center.

Performance of Machinery and Implements

Both AMSEC and non-AMSEC operators rated most of their machines and implements as being good, although the proportion of non-AMSEC operators who gave *good* or *excellent* ratings was higher, and a larger proportion of AMSEC operators gave *poor* ratings (Table 4.6). These perceptions are consistent with the results in Table 4.7, which shows that although AMSEC operators had newer machinery and equipment, they experienced the same frequency of or more frequent breakdowns and worked fewer months in a year. For example, the average age of AMSEC and non-AMSEC tractors was 2.7 and 5.3 years, respectively; AMSEC tractors worked about 4 months in a year whereas non-AMSEC tractors worked about 5 months. Furthermore, the tractors of both broke down an average of 3 times in a year. For AMSECs, this translates into 1.1 breakdowns per age-year and 0.7 per months of operation per year, compared to 0.7 breakdowns per age-year and 0.6 per months of operation per year for non-AMSECs. This is consistent with our observation of finding more broken-down and out-of-service tractors at many of the AMSEC stations. This is concerning as it is not expected that the newer machines and implements should be breaking down at the same rate as the older machines.

Table 4.6 Perception of performance of machines and equipment (percentage of providers)

	AMSECs				Non-AMSECs			
Implement	Excellent	Good	Average	Poor	Excellent	Good	Average	Poor
Tractor	7	47	33	13	26	40	26	8
Disc plough	9	38	20	33	22	58	14	7
Harrow	13	26	26	35	13	69	13	6
Trailer	24	47	18	12	30	60	11	0

Source: Field survey of service providers.
Note: AMSECs = Agricultural Mechanization Service Centers.

Table 4.7 Performance of farm machines and equipment

	AMSECs			Non-AMSECs		
Implement	Average Age (Years)	Average Number of Months Equipment Works in a Year	Number of Breakdowns in a Year	Average Age (Years)	Average Number of Months Equipment Works in a Year	Number of Breakdowns in a Year
Tractor	2.7	4.3	3	5.3	5.1	3
Disc plough	2.4	3.6	8	4.7	4.4	8
Harrow	2.8	4.3	8	4.6	4.8	2
Trailer	3.3	3.7	1	5.4	5.4	1

Source: Field survey of service providers.
Note: AMSECs = Agricultural Mechanization Service Centers.

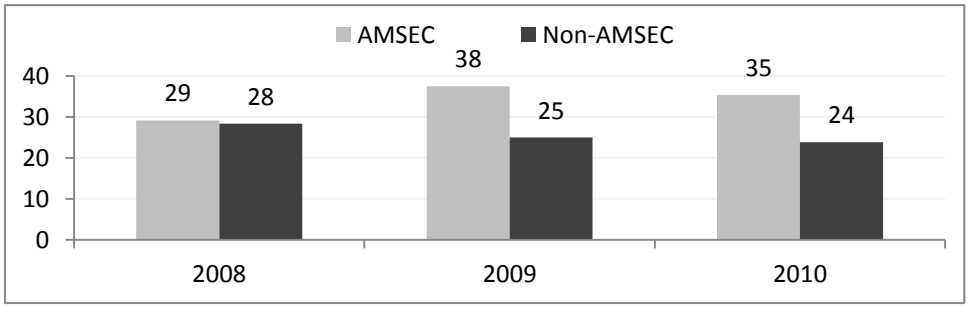
Could this be an issue of the quality of the machines and implements or the way they are handled? According to some farmers, the new tractors (as they refer to AMSEC tractors) are operated by the same old operators of other private tractor service providers in the district, who often work

haphazardly and hurriedly so that they can attend to other clients. The tractor operators admitted that they at times have to rush with their work to meet the targets set for them by their managers or the tractor owners. There was an instance when an AMSEC's management introduced a bonus scheme for operators who ploughed more than 10 acres in a day, compared to the commonly achieved average of 6 acres. Because of the incentive, some operators were plowing late into the night just to exceed the target, which is risky. Many of the operators interviewed placed some of the fault on the managers and owners. They revealed that some of the tractor owners do not adhere to routine servicing comprising timely change of oil and filters; they admit that some of the structural defects on the tractors are due to their negligence and partly due to the farmers' failing to notify owners of stumps on their farms.

Training and Maintenance

The proportion of AMSEC service operators who received training (29–38 percent) was higher than that of their non-AMSEC counterparts (24–28 percent) Figure 4.2. Although this does not match up with the previous observation of AMSEC machinery's experiencing more frequent breakdowns, the proportion of all providers receiving training is quite low, contributing to the overall frequent breakdowns. When they break down, it takes a while to get them fixed at the workshop. AESD has organized some training for some operators across the country, but this has not been very effective because of the high turnover of operators working with the private tractor owners and the limited funds available to expand the training to many operators. Some important areas identified for training are basic knowledge of mechanization and safe use of the machines, knowledge of the systems of a tractor and other farm machinery, routine maintenance of the machines and implements, appropriate setting of implements for field work, and the correct operation of the machines and implements.

Figure 4.2 Percentage of service providers who received training



Source: Field survey of service providers.
Note: AMSEC = Agricultural Mechanization Service Center.

Discussions with dealers and mechanics revealed that training for most of the mechanics has been limited to unstructured apprenticeships, without formal skills training or career development courses. Therefore, most of the work carried out on the new tractors is done using a trial-and-error approach. Another related issue is the lack of spare parts for newer brands of tractors because the common types and brands of the tractor spare parts that could easily be found on the market are for Massey Ferguson and Ford tractors, which are owned more by non-AMSECs.

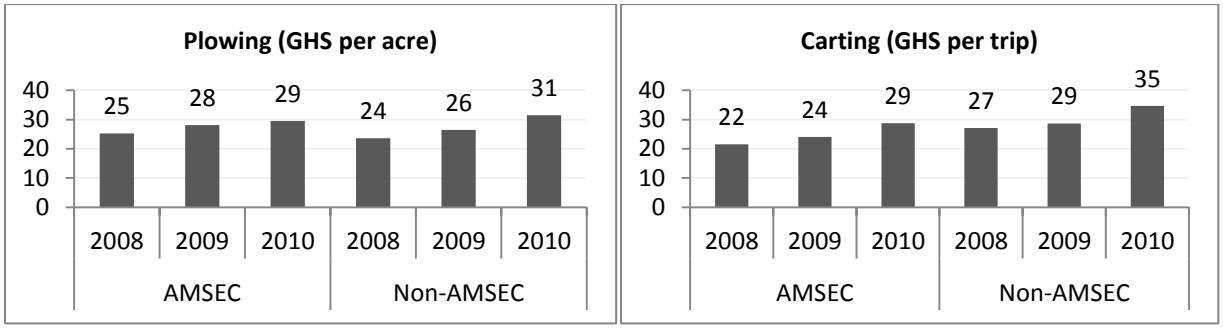
Effect of AMSECs on the Mechanization Services Market

Rental Charges of Mechanization Services

To get a good sense of the prices charged for mechanization services, we asked both service providers and farmers what the charges were for different services. In general, we find little difference in the prices quoted separately by providers and by farmers. Examples for plowing and carting services are shown

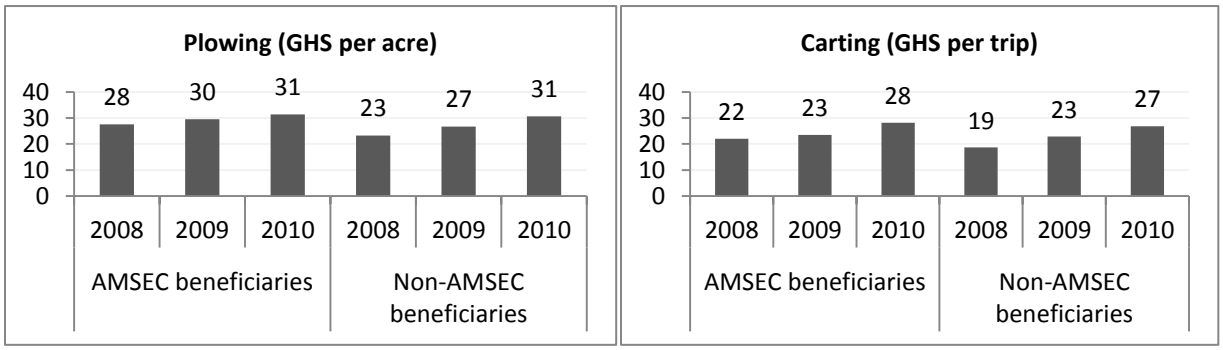
Figures 4.3 and 4.4 for service providers and farmers, respectively. In general, AMSECs charged slightly higher prices in 2008, that is, on entering the market, which is surprising but could be rationalized based on their newer machinery and potentially higher-quality services. However, the price gap closed over time, with non-AMSECs' increasing their prices at a faster rate by 15 percent per year for plowing compared to the 7 percent charged by AMSECs. The same pattern is observed across many of the services provided. Thus, it seems that the AMSEC program may have contributed to rising prices.

Figure 4.3 Average prices charged by service providers for plowing and carting, 2008–2010



Source: Field survey of service providers.
Note: AMSEC = Agricultural Mechanization Service Center.

Figure 4.4 Average prices paid by farmers for plowing and carting, 2008–2010



Source: Field survey of farmers.
Notes: AMSEC = Agricultural Mechanization Service Center.
AMSEC beneficiaries are farmers who used the services of AMSECs, and non-AMSEC beneficiaries are farmers who used solely the services of non-AMSECs.

Marketing Strategies

This section discusses strategies used by AMSECs to attract clients, compared with those used by non-AMSECs (see Table 4.8). Most of the service providers used meet-the-competition pricing, with some AMSECs' using some promotional pricing, which is expected because they were newer in the market. Price discounts and bonuses were used by both to promote sales, with more non-AMSECs (18 percent of the total) using price-quantity offers compared to AMSECs (9 percent of the total). Personal contacts were relied on by 75 percent of AMSECs and by all of the non-AMSECs to advertise their services. The remaining AMSECs (25 percent) used radio or television. This is not surprising due to the high cost involved in advertising and publicity.

Table 4.8 Marketing strategies used by AMSECs and non-AMSECs (percentage of providers)

Strategies	AMSEC	Non-AMSEC
Pricing		
Meet the competition	87	92
Price scheming	2	1
Penetration	5	7
Promotional	6	0
Sales promotion		
Price-quantity offers	9	18
Refund offers	2	4
Bonus packages	25	25
Price discounts	64	53
Advertising and publicity		
Newspapers	0	0
Radio and television	25	0
Public address system	0	0
Personal/direct contact (of individuals, institutions, organizations)	75	100

Source: Field survey of service providers.

Note: AMSEC = Agricultural Mechanization Service Center.

Barriers to Entry and Exit

Both AMSECs and non-AMSECs considered capital cost of machinery and access to operators and maintenance the key factors inhibiting entry into the market (Table 4.9). For example, 54–85 percent of AMSECs considered these two factors to be high or very high entry barriers compared to 51–91 percent of non-AMSECs. With financial support from the government, however, it is not surprising that the proportion of AMSECs rating capital cost to be a high or very high entry barrier factor was smaller than the proportion of non-AMSECs that had similar ratings. Other factors including advertising, geographic location, demand for services, regulations, and competition were not considered to be critical factors barring entry. They considered the demand for mechanization services to far outweigh the supply of services, and so they considered the government's credit facility to be a good thing.

Table 4.9 Perception of barriers to entry (percentage of providers)

	AMSEC				Non-AMSEC			
Barrier Factor	Zero	Low	High	Very High	Zero	Low	High	Very High
Advertising and marketing costs	83	8	8	0	85	10	3	1
Capital cost of the machinery	2	13	54	31	0	9	38	53
Favorable geographical location	35	35	17	13	20	30	43	7
Access to machinery and equipment operators	15	29	42	15	10	38	33	19
Low demand of services	58	29	13	0	66	20	13	1
Government regulations	88	13	0	0	85	11	3	0
Access to machinery and equipment mechanics	15	31	44	10	15	34	44	7
Existence of large firms providing similar services	69	17	10	4	47	34	16	3
Predatory or limiting pricing	65	21	13	2	67	23	10	0

Source: Field survey of service providers.

Notes: AMSEC = Agricultural Mechanization Service Center. Zero, low, high, and very high represent the levels of severity at which the factors are perceived to be barriers.

For exiting, most of the factors considered in the analysis were not perceived to be critical, with asset write-offs and little or no resale value for capital inputs (sunk costs) being moderately constraining (see Table 4.10). For example, 39–46 percent of AMSECs considered these two factors to be high or very high exit barriers compared to 46–48 percent of non-AMSECs. Other factors, including lack of alternative uses of capital items and closure and penalty costs, were not considered important factors deterring exit, with more than 60 percent or more of the providers rating these at zero or low importance.

Table 4.10 Perception of barriers to exit (percentage of providers)

	AMSEC				Non-AMSEC			
Barrier Factor	**Zero**	**Low**	**High**	**Very High**	**Zero**	**Low**	**High**	**Very High**
Asset write-offs	40	15	31	15	27	26	36	10
Lack of alternative use of assets	19	67	13	2	17	53	23	7
Little or no resale value for capital inputs (sunk costs)	21	40	29	10	15	38	42	6
Closure costs including redundancy costs	50	31	19	0	51	17	29	3
Penalty costs from ending leasing arrangements	46	21	25	8	68	13	17	2

Source: Field survey of service providers.

Notes: AMSEC = Agricultural Mechanization Service Center. Zero, low, high, and very high represent the levels of severity at which the factors are perceived to be barriers.

Effect of AMSEC on Use of Mechanization Services by Farmers

We surveyed farmers to assess the effect of AMSECs on their use of mechanization services and unit cost production. To better get a sense of this, we demarcated the sample of farmers into (1) those using the services of AMSECs only, hereafter referred to as *AMSEC beneficiaries or users,* which make up 19 percent of the 270 farmers surveyed; (2) those using the services of non-AMSECs only, hereafter referred to as *non-AMSEC beneficiaries or users,* which make up 58 percent of the 270 farmers surveyed; and (3) those using the services of both AMSECs and non-AMSECs, hereafter referred to as *both beneficiaries or users,* which make up the remaining 23 percent of the 270 farmers surveyed. Assuming that using services of AMSECs confers greater benefits than using services of non-AMSECs, we would expect outcomes to be greater for the AMSEC beneficiaries, followed by those using services from both AMSECs and non-AMSECs, and then non-AMSEC beneficiaries, other factors remaining unchanged. Before looking at the results, we examine the characteristics of the three groups of farmers to assess any similarities and differences that may influence their use of mechanization services and outcomes.

Characteristics of AMSEC versus Non-AMSEC Beneficiaries

Looking at the results in Table 4.11, it is clear that although the three groups of farmers were similar or not too different in some of the characteristics, particularly age and farming experience, they were dissimilar in many others, including gender, education attainment, engagement in nonfarm activities, membership in farmers' organizations, and farm size. For example, there were many more females among the AMSEC beneficiaries, nearly 40 percent, compared to 28 percent among the non-AMSEC beneficiaries, and only 8 percent of the other group. There were slightly more farmers with no formal education among the AMSEC beneficiaries, which is consistent with the lower primary and secondary education attainment for the group. A larger proportion of the AMSEC beneficiaries engaged in nonfarm employment, about 44 percent, compared to 26 and 30 percent of the non-AMSEC and other group, respectively. Those using the services of both AMSECs and non-AMSECs were more often members of FBOs (65 percent) than were AMSEC beneficiaries (52 percent) and non-AMSEC beneficiaries (44 percent). AMSEC beneficiaries and those using both service providers cultivated on average the same

farm size, although AMSEC beneficiaries had larger block farms whereas the other group had larger own farms. The non-AMSEC beneficiaries had lower total farm size on average. Maize was the most widely cultivated crop across the three groups. Although groundnut and yam were the second and third most important crops among the AMSEC beneficiaries, beans and cassava were incorporated into the farms of the other two groups.

Table 4.11 Characteristics of AMSEC and non-AMSEC beneficiaries

Characteristics	AMSEC	Non-AMSEC	Both
Household-level characteristics			
Gender (% of farmers who are males)	61.5	72.3	92.1
Age (years)	45.2	43.9	41.5
Education level (% of farmers)			
None	40.4	34.2	33.3
Primary	5.8	12.9	14.3
Junior Secondary/Middle	34.6	34.2	30.2
Senior Secondary	3.8	9.7	11.1
Vocational/Technical	7.7	4.5	7.9
Tertiary	7.7	4.5	3.2
Farming experience (number of years)	18.5	19.1	17.8
Membership in farmer-based organization (% of farmers)	51.9	44.5	65.1
Nonfarm activity (% of farmers)	44.2	26.5	30.2
Farm-level characteristics			
Total farm size (acres)	22.6	14.9	23.8
Block farm size (acres)	10.8	4.4	7.1
Other farm size (acres)	11.8	10.5	16.7
Distance to block farm (km)	4.7	4.0	5.0
Distance to other farms (km)	4.7	4.7	6.0
Crops grown according to proportion growing them			
First most important	Maize	Maize	Maize
Second most important	Groundnut	Beans/Yam	Beans/Yam
Third most important	Yam	Cassava	Groundnut/ Cassava

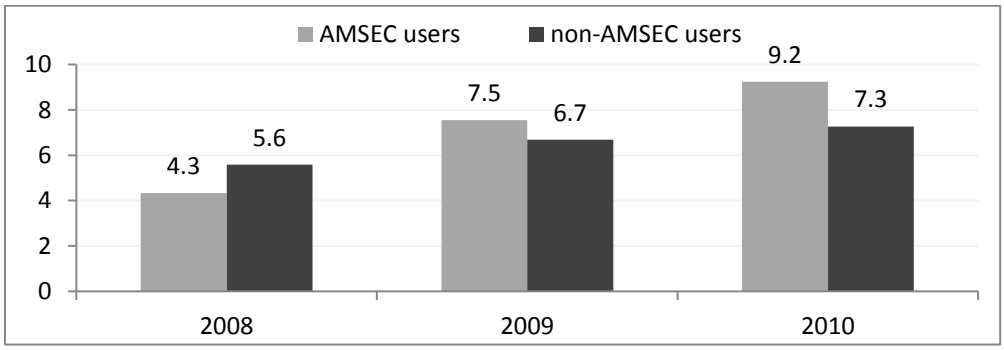
Source: Field survey of farmers.

Note: AMSEC = Agricultural Mechanization Service Center; km = kilometers.

Effect of AMSEC on Acreage Mechanized

Figure 4.5 shows the average area mechanized for different groups from 2008 to 2010. Although the average area mechanized was lower among the AMSEC beneficiaries in 2008 (about 4.3 acres per farmer), the average mechanized area increased rapidly by about 46 percent per year to reach 7.5 and 9.2 acres in 2009 and 2010, surpassing the average among the non-AMSEC beneficiaries. The average area mechanized among the non-AMSEC users also increased over the years, but at a lower growth rate of about 14 percent per year, raising the average mechanized area from 5.6 acres in 2008 to 6.7 and 7.3 acres in 2009 and 2010, respectively. Therefore, the AMSEC program has contributed to raising the overall average area mechanized from about 5.3 acres in 2008 to 6.9 and 7.8 acres in 2009 and 2010, respectively. All the farmers interviewed admitted that the presence of the new tractors, as they commonly refer to the AMSEC service providers, have brought relief in getting tractor services. They said farm acreages that are mechanized have been increased and a lot of the farmers have done extensive farming. Since AMSEC beneficiaries had more land on block farms, which tend to be mechanized, the results are not surprising, but they also highlight the importance of the complementary program in enhancing the impact. We will discuss program interaction effects in Section 8.

Figure 4.5 Average acreage mechanized by AMSEC and non-AMSEC users



Source: Field survey of farmers.
Note: AMSEC = Agricultural Mechanization Service Center.

Effectiveness and Efficiency of Delivery of Mechanization Services

Availability of Mechanization Services

The majority of AMSEC beneficiaries (about 62 percent) were satisfied or very satisfied with the availability of tractor services, and many more, about 87 percent, said availability had improved in the past three years (Table 4.12). Relatively not as many non-AMSEC beneficiaries perceived things the same way. Actually, about 50 percent of the non-AMSEC beneficiaries were dissatisfied or very dissatisfied with the availability of tractor services, whereas about 49 percent thought there had been no change in availability in the past three years. Those using both AMSEC and non-AMSEC services were nearly as positive as the AMSEC beneficiaries. The farmers and other stakeholders in the value chain in general claim that the availability of tractor services is low; tractor services are still difficult to access since the demand is much higher than the supply. In some of the communities that cultivate irrigated rice, respondents said some of the newer two-wheel-drive tractors are not able to enter their fields when the ground is wet. This touches on some of the quality issues discussed next.

Table 4.12 Perception of availability of tractor services (percentage of farmers reporting)

Category	AMSEC Users	Non-AMSEC Users	Both
Level of satisfaction in 2010			
Very dissatisfied	0.0	22.2	7.9
Dissatisfied	34.0	28.1	27.0
Indifferent	4.0	13.7	4.8
Satisfied	46.0	30.7	52.4
Very satisfied	16.0	5.2	7.9
Change in availability (2008 to 2010)			
Deteriorated	5.3	10.4	10.0
No change	7.9	45.9	18.0
Improved	84.2	40.0	62.0
Improved a lot	2.5	3.7	10.0

Source: Field survey of farmers.
Note: AMSEC = Agricultural Mechanization Service Center.

Quality of Mechanization Services and Farmers' Constraints on Use of Mechanized Services

The majority of AMSEC beneficiaries felt the quality of different services was good and had improved in the past three years, as the examples of plowing and carting services show in Table 4.13. For example, all the AMSEC beneficiaries thought plowing services were good or very good. Here too those using the services of both AMSECs and non-AMSECs were nearly as positive as the AMSEC beneficiaries. Other mechanization services including harrowing, shelling, ridging, and tilling are not reviewed, because only a small proportion of farmers across the board engage in them. Looking at the constraints faced by farmers in using mechanization services, Table 4.14 shows that there are several limiting factors including access to and prices of modern inputs, access to credit, and the effort (including labor), implements, and complexity (including information and knowledge) required to mechanize. Land and the opportunity cost of investment were not considered to be constraining factors.

Table 4.13 Perception of quality of mechanization services (percentage of farmers reporting)

Level of satisfaction in 2010	AMSEC Users	Non-AMSEC Users	Both
Plowing services			
Very good	34.7	n.a.	23.8
Good	65.3	n.a.	61.9
Poor	0.0	n.a.	14.3
Change in availability (2008 to 2010)			
Deteriorated	4.8	n.a.	5.5
No change	38.1	n.a.	45.5
Improved	50.0	n.a.	43.5
Improved a lot	7.1	n.a.	5.5
Carting services			
Very good	42.3	n.a.	25.7
Good	53.8	n.a.	62.9
Poor	3.8	n.a.	11.4
Change in availability (2008 to 2010)			
Deteriorated	0.0	n.a.	7.4
No change	33.3	n.a.	37.0
Improved	58.4	n.a.	51.9
Improved a lot	8.3	n.a.	3.7

Source: Field survey of farmers.

Notes: AMSEC = Agricultural Mechanization Service Center; n.a. = not available because data on non-AMSEC users were erroneously not collected.

Table 4.14 Perception of factors constraining use of mechanization (percentage of farmers reporting)

	AMSEC Users			Non-AMSEC Users					Both					
Factor	Very High	High	Low	Very Low	None	Very High	High	Low	Very Low	None	Very High	High	Low	Very Low	None
Lack of access to inputs	26.9	42.3	11.5	9.6	9.6	16.1	29.0	18.7	7.1	29.0	23.8	46.0	12.7	1.6	15.9
High prices of inputs	36.5	44.2	9.6	7.7	1.9	20.0	49.7	20.0	5.2	5.2	36.5	33.3	17.5	7.9	4.8
Lack of access to credit	42.3	36.5	15.4	1.9	1.9	53.5	34.8	7.1	6.0	3.9	54.8	33.9	8.1	1.6	1.6
Lack of land	7.8	25.5	21.6	7.8	37.3	15.5	18.1	16.8	14.8	34.2	9.5	19.0	23.8	12.7	33.3
High effort of applying mechanized operations	5.8	61.5	21.2	7.7	3.8	17.5	50.0	14.9	3.9	13.6	11.1	50.8	22.2	11.1	4.8
Lack of implements or tools to perform mechanized operations	28.8	51.9	9.6	3.8	3.8	48.4	38.7	6.5	0.0	6.5	39.7	41.3	12.7	3.2	3.2
Complexity of operations	18.4	49.0	20.4	6.1	6.1	32.0	42.5	15.0	4.6	5.9	11.7	53.3	28.3	5.0	1.7
High costs due to forgone short-term productivity	8.0	24.0	26.0	4.0	38.0	11.7	32.5	17.5	4.5	33.1	6.5	29.0	19.4	1.6	41.9
High labor for farming	28.8	28.8	19.2	3.8	19.2	26.1	35.9	19.6	2.6	15.0	26.2	29.5	19.7	9.8	13.1
Lack of information on possible mechanized operations	23.1	46.2	19.2	7.7	3.8	36.8	41.3	12.9	6.5	2.6	36.5	28.6	22.2	7.9	3.2
Lack of knowledge about how to perform mechanized operations	23.1	53.8	11.5	3.8	7.7	41.9	32.9	15.5	5.8	3.9	22.2	41.3	23.8	6.3	4.8

Source: Field survey of farmers.

Note: AMSEC = Agricultural Mechanization Service Center.

Pricing, Profits, and Efficiency Performance of Service Providers

To understand the financial performance of service providers and their efficiency in carrying out their operations, we asked about the frequency of price changes in a year, level of profits relative to cost, and how long it takes to complete their tasks—see Table 4.15 for details about the results. The majority of both AMSECs and non-AMSECs said service fees change only once a year, indicating stability in the market. Nearly half of the AMSECs said they obtained positive profits, compared to 35 percent of the non-AMSECs, but could not tell us how much they were relative to costs. Some of them were able to tell us the level of their profits in relative terms, with 22 percent of the AMSECs saying they were about a quarter, whereas 10 and 12 percent of them said they were one-half and three-quarters, respectively.

Table 4.15 Opinion about price, profit, and efficiency performance of service providers (percentage of providers reporting)

Category	AMSEC	Non-AMSEC
Pricing		
Service fee changes once a year	0.88	0.91
Service fee changes twice a year	0.10	0.09
Service fee changes thrice a year	0.02	0.00
Profits		
Profits are positive	0.54	0.35
Profits are one-quarter of the operating costs	0.22	0.40
Profits are half of the operating costs	0.10	0.10
Profits are three-quarters of the operating costs	0.12	0.02
Profits are equal to operating costs	0.02	0.13
Efficiency		
Unable to complete task for a day	0.34	0.53
Unable to complete 10% task for a day	0.32	0.30
Unable to complete 20% task for a day	0.29	0.22
Unable to complete 30% task for a day	0.13	0.08
Unable to complete 40% task for a day	0.10	0.10
Unable to complete 50% task for a day	0.16	0.30

Source: Field survey of service providers.

Note: AMSEC = Agricultural Mechanization Service Center.

Analysis of Potential Economic Viability of the AMSEC Program

To assess the potential economic viability of the AMSEC program, we estimate economic rates of return based on a projected flow of future economic costs and benefits of the program using the partial equilibrium and economic surplus method. Essentially, the analysis is an ex ante impact assessment in which we compare a situation with and without the AMSEC program. We apply it to maize because maize is a major staple and also one of the major commodities targeted by the different programs. We project the total program costs and benefits derived from the program during a nine-year horizon, that is, from 2011 to 2020. Details of the model, overall assumptions, and underlying data are provided in Appendix A. The results are presented in Table 4.16.

Table 4.16 Summary of results of the economic analysis of the AMSEC program

Scenario	A			B		
Elasticity of demand	–0.4			–0.7		
	2010	2020	Growth	2010	2020	Growth
Yield without program (kg/ha)	1,714	1,893	1.0			
Yield with program (kg/ha)	1,900	2,143	1.2			
Adoption rate (%)	2.0	10.3	17.6			
Unit production cost (2011 GHS/ha)	191	257	3.0			
Resulting production and price changes						
National production without any programs (1,000 mt)	1,669	2,247	3.0	1,669	2,247	3.0
National production with AMSEC program (1,000 mt)	1,675	2,301	3.2	1,671	2,271	3.1
Share of AMSEC in national production (%)	0.4	2.4	19.9	0.2	1.1	19.9
Maize prices without AMSEC, at autarky (2011 GHS/kg)	0.55	0.55	0.0	0.55	0.55	0.0
Maize prices with AMSEC, at autarky (2011 GHS/kg)	0.55	0.52	–0.6	0.56	0.55	–0.2
Change in program costs and coverage						
Increase in area under AMSEC for maize (1,000 ha)	19.8	122.6	20.0			
Total cost of AMSEC program (million 2011 GHS)	1.5	2.6	5.0			
Direct costs of program (million 2011 GHS)	1.5	2.3	4.5			
Indirect costs of program (million 2011 GHS)	0.1	0.4	10.3			
Total cost of program as share of MoFA's budget (%)	2.3	2.1				
Direct costs as share of MoFA's investment budget (%)	3.0	6.8				
Program net worth (with AMSEC and open trade)						
Net economic benefits (million 2011 GHS)	1.5	23.4	31.8	1.5	22.9	31.6
Discounted net worth (million 2011 GHS)		49.1			48.3	
Benefit–cost ratio		4.3			4.3	
Program net worth (with AMSEC and at autarky)						
Net economic benefits (million 2011 GHS)	1.5	21.8	31.0	1.5	22.5	31.3
Discounted net worth (million 2011 GHS)		46.9			47.9	
Benefit–cost ratio		4.2			4.2	

Source: Authors assumptions and calculations based on literature review, project reports, and surveys.

Notes: AMSEC = Agricultural Mechanization Service Center; kg = kilograms; ha = hectare; GHS = Ghanaian cedis; mt = metric tons; MoFA = Ministry of Food and Agriculture.
Scenario A represents buyers' being less sensitive to price changes, compared to scenario B, wherein buyers are more sensitive to price changes. Values in the column headed Growth are annual percentage growth rates.

Because the costs of managing and implementing the AMSEC program are quite small, assuming mechanized implements are sold at full market price, much of the cost is captured by losses from credit recovery and in administering the program. Individual operators are also assumed to break even, with no added cost to society. We therefore ignore any costs and benefits flowing from this sector in analyzing the overall national welfare benefits flowing from the maize sector as a result of increased mechanized services from the program.

The results show high positive returns, with a benefit–cost ratio of about 4.2. Total net worth of the program turns out to be about GHS 49.1 million, falling only slightly if we take into account any price changes as a result of the maize output growth. This occurs because the change in price is minimal, –0.2 percent to –0.6 percent per year, given a very small contribution of output growth from mechanization to national output (about 0.4 percent in 2010 and 2.4 percent in 2020); growth in national production increases from 3 to 3.2 percent per year.

The high economic return of the program is likely grossly overestimated, considering the potential environmental costs not considered in this analysis. Future estimates of such long-run costs will also need to be considered. A short-term challenge for the AMSEC program will be improving the efficiencies and ability of service providers to expand their coverage, especially considering the many challenges highlighted in the surveys, discussed above and reviewed in the next section.

Emerging Challenges and Solutions

Cost Recovery by MoFA Improved over Time

Generally, repayment of the overall loans taken by the AMSECs has been lower than expected, particularly the loans given in 2007, where the recovery rate is only 26 percent compared to the anticipated 68 percent that should have been recovered by 2011 (Table 4.17). Recovery rates of the loans given in 2009 and 2010 actually surpass the target, suggesting that administration of an effective recovery system has improved over time. The option for repossession exits because it is stated in the contract that in a situation of default the equipment will be repossessed. However, this has not been enforced yet. Perhaps another institution or agency outside MoFA—but working in close collaboration with MoFA—that tracks defaulters, tries to work with them to repay, and then repossesses machinery in the event they are still not able to repay will be needed.

Table 4.17 Repayment of AMSEC credit facility

Year	Total Outlays (GHS)	Total Payment Recovered		Expected Recovery Rate by 2011 (%)
		GHS	% of Outlays	
2007	1,043,700	271,800	26	68
2009	2,302,563	950,400	41	34
2010	1,046,650	328,700	31	17
Total	4,392,913	1,550,900	35	38

Source: Obtained from AESD (2011).

Notes: AMSEC = Agricultural Mechanization Service Center; GHS = Ghanaina cedis.
Expected recovery rate is based on accumulated amount of expected payment out of five equal installments of the total outlays, less 15 percent down payment.

Lack of Skilled Operators and Mechanics and Spare Parts

Among several problems with the program that the study identified (see Appendix B for details), there was a lack of skilled tractor operators and mechanics. Basically, most of the tractor operators were not formerly or properly trained but just picked up the skill by observing and practicing what their masters (most of whom were also not formally trained) were doing. Another worrying issue is the difficulty of getting operators in some farming areas. At Asutuare, the power tiller operators have shifted to a less tedious work of transporting people with a motor bike. For each of the 13 experienced mechanics interviewed across the country, for example, we learned that there were about 5 to 10 others who are experienced mechanics operating within the district. Those interviewed have worked on the more common tractors such as the Massey Ferguson and Ford brands, but not the newer brands such as John Deere, Farmtrac, and Mahindra. Generally, all the mechanics interviewed said they do not limit their operations to a specific district but often travel to other districts to solve problems for different clients. Spare parts for the newer brands were also rare (particularly the piston rings and clutch disks of the John Deere brands and the hydraulic components and gearbox parts of the Farmtrac), being less rare only in districts where the tractor population is high, especially in Ejura-Sekyeredumase, South Tongu, Atebubu-Amantin, and Kwahu North. We learned that the peak period of sale of tractor and implement spare parts is prior to the main farming season in March and that this continues into July in the Northern and Upper regions of the country and September in the Afram Plains area. These two periods are when servicing is done in readiness for plowing and when dealing with mechanical faults deep into or close to the end of the season, respectively. A joint effort by MoFA-AESD and the commercial spare parts dealers, building on existing formal training of operators and mechanics by MoFA-AESD, may help overcome the challenges. MoFA-AESD can provide information about its anticipated import activities so that spare parts dealers and maintenance providers can respond to the anticipated demand. MoFA-AESD may also expand its training to cover more operators and mechanics across the country.

Limited Scope of Mechanization Services

Plowing, harrowing, and carting services were the common services provided and, in many cases, the only ones provided. Yet planting, fertilizer application, weed control, irrigation, harvesting, and processing are needed for total mechanization to drive down the unit cost of operation and reduce drudgery further. Other services are the making of ridges for the cultivation of root crops and vegetables and destumping. The demand for these services is growing rapidly because of the high cost of hired labor and limited family labor as most farmers are increasingly sending their children to school. Interesting to note, using hired labor for any operation costs the same and sometimes more than using tractor services; using hired labor also takes a longer time, and the quality of the work done is poor.

Potential Impact of Mechanization on the Environment

There has been significant runoff of topsoil along slopes due to plowing along the slopes. The consequence of this is the loss of soil nutrients and the silting of rivers and streams. Surprisingly, these problems are known to most of the operators, but they deliberately do plow along the slopes because of the convenience of plowing and, particularly, to avoid making the several tractor turns required to achieve good plowing across the slopes. As such, there is a need for more education and sensitization of the farmers to demand that the plowing be done well.

Conclusions and Recommendations

- Against the background of high capital costs of machinery and implements deterring entry into the mechanization services market, the AMSEC program has contributed to improving access by all farmers to those services and raised the average area mechanized by the surveyed farmers from 5.3 acres per farmer in 2008 to 7.8 acres per farmer in 2010, representing a 21 percent per year increase in the area mechanized. Because the demand for mechanization far outstrips the supply the program has not crowded out private-sector investments in the market, as indicated by both investors and farmers and substantiated by the observation of stable market shares and slightly higher prices for service providers that have not benefited from the government's credit facility. However, the newer tractors seem to break down more frequently, about 17–64 percent more, which is due to lack of skilled operators and mechanics as well as spare parts for the newer brands of tractors imported via the program. Poorly prepared fields with stumps have contributed greatly to most of the damage to all brands of tractors.
- Expanding and deepening the training offered by AESD using the Ghana Society of Agricultural Engineering is inevitable, particularly when different brands of tractors than what are commonly used are imported on such a large scale. As experts in the field indicated, each brand of tractor is different, and specific skills have to be learned to operate them well. Such training should encompass education and sensitization on the environmental degradation issues associated with plowing along the slopes rather than across them as well as stronger links with research and development.
- Until the time when use of expensive bulldozers for proper land preparation becomes economically viable, the issue of poorly prepared fields with stumps can be addressed by farmers' erecting guide poles on farms to guide tractor operators from obstacles (such as stumps, stones, and depressions).
- The potentially high economic welfare returns of the program to society stress the important contribution mechanization could have to maize productivity and output growth. However, because the analysis did not consider potential environmental costs, such results should be taken with caution.

5. FERTILIZER SUBSIDY PROGRAM (FSP) [8]

Background

Use of fertilizers has been recognized as crucial for achieving an African Green Revolution in the face of rapidly rising population and declining soil fertility. With fertilizer use averaging about 8 kg/ha, the continent lags far behind other developing regions of the world including Latin America (86 kg/ha), south Asia (104 kg/ha), and southeast Asia (142 kg/ha) (Crawford et al. 2006). In June 2006, the African Union ministers of agriculture convened in Abuja for the Africa Fertilizer Summit and resolved to increase the level of use of fertilizer on the continent from the current average of 8 kg/ha to an average of at least 50 kg/ha by 2015. Ghana is among the low performers on the continent with an average use of 7.4 kg/ha, which is low compared to neighboring countries such as Côte d'Ivoire (35.2 kg/ha) and other middle-income countries like Morocco (47.5 kg/ha) and South Africa (65.4 kg/ha) (MoFA 2009).

How to increase the amount of fertilizer used by farmers has always been a policy debate in realization that most farmers in Africa are poor and have limited access to fertilizer, which is exacerbated by the prohibitive market prices. This has prompted many countries all over the world to implement fertilizer subsidies at some point in time. Fertilizers are given as free inputs or at subsidized prices that are redeemable at retail stores with coupons or vouchers. They can also be given in the form of credit or loans at subsidized interest rates.[9]

In an effort to increase the productivity of Ghanaian farmers and modernize agriculture, the government of Ghana in July 2008 instituted a countrywide subsidy on four types of fertilizer (NPK 15:15:15, NPK 23:10:05, urea, and SOA). The subsidy was also a response to dramatic increases in fertilizer and food prices. For example, between June 2007 and March 2008 the price of NPK 15:15:15, the most widely used food crop fertilizer in Ghana, increased by 34 percent from GHS 26 to GHS 35 per 50-kilogram bag, and the price of maize rose by about 77 percent (Banful 2009). The stated goals and objectives of FSP are

- to increase the average application rate of fertilizer by farmers from 8 to 20 kg per hectare,
- to increase crop yields and production,
- to raise the profitability of farm production, and
- to improve private-sector development.

In 2008 and 2009 the subsidy was implemented via the voucher system and then via the waybill system starting in 2010 (more to come on the rationale for the switch). Although the subsidy under the voucher system was conceived to target small-scale farmers, the subsidy under the waybill system is available for all types of farms and farmers who can afford to buy fertilizer at the subsidized price. In this section we evaluate FSP, with a focus on the waybill system.[10] The specific major research questions to address include the following:

[8] This section was coauthored by Joe Taabazuing (GIMPA Consulting Services, Accra, Ghana), Samuel Benin (IFPRI, Davis, California, United States), and Michael Johnson (IFPRI, Washington, DC, United States). Kipo Jimah (IFPRI, Accra, Ghana) and Gamel Nasser (GIMPA Consulting Services, Accra, Ghana) provided data collection and analysis support.

[9] In Malawi, for example, the subsidy program started at 100 percent of the retail price in 1998–2004 with a starter pack (that is, given to farmers for free) and then graduated to a 72 percent subsidy starting in 2005–2006 (see Minde et al. 2008; SOAS 2008). In Zambia, the subsidy was about 50 percent of the retail price (in addition to other various credit schemes) between 1991 and 2003, and then it was increased to 75 percent in 2008 (*Lusaka Times*, November 2008). In Nigeria, there was a subsidy of about 82 percent in 1990, which was abolished in 1997 and 1998 and then reintroduced in 1999 at 25 percent (Nagy and Edun 2002).

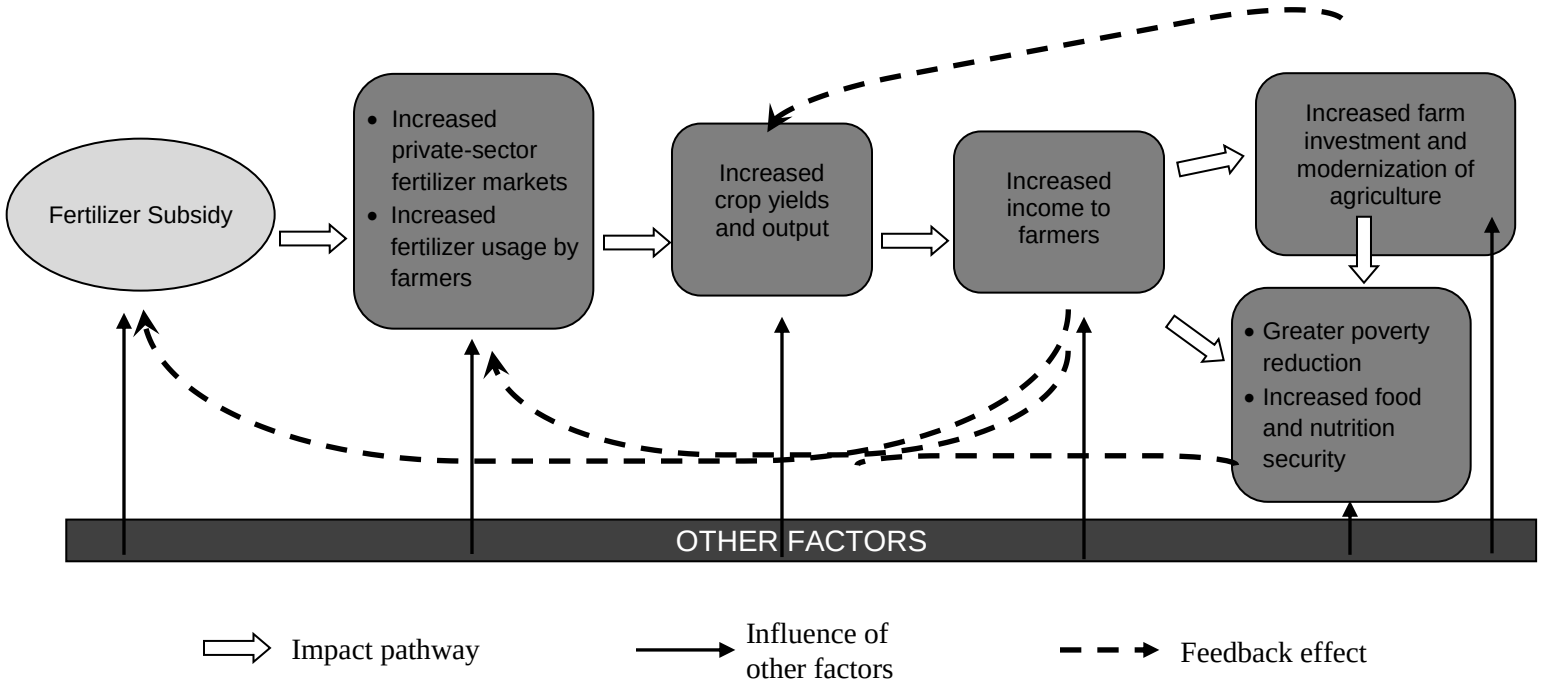
[10] The voucher system has been analyzed in detail (see, for example, Banful 2009).

1. Is the waybill system a more effective way of subsidizing fertilizers compared to other systems?
2. How has the subsidy affected the development of fertilizer markets?
3. To what extent has the program achieved its stated objectives?
    a. Increased average application rate to 20 kg/ha
    b. Increased crop yields and production
    c. Raised profitability of farm production
    d. Improved private-sector development
4. What is the overall economic viability of the program?
5. What are the major challenges of the program, and what can be done to make it more cost-effective?

Conceptual Framework

Although the overall methodology, sampling techniques, data collection, analysis methods, and approaches were already reviewed in the Overall Methodology section, here we present a theoretical framework specific to evaluating FSP, which is grounded in the theory of change (Organizational Research Services 2004; Lederach et al. 2007). Figure 5.1 shows how FSP is expected to generate the anticipated chain of outputs, outcomes, and impact in addition to the associated performance indicators on which to collect data and carry out the assessment.

Figure 5.1 Impact pathways and associated indicators of the FSP



Source: Authors' illustration based on program documents and literature review.
Note: FSP = Fertilizer Subsidy Program.

The fundamental issue that FSP seeks to address is the high cost of fertilizer in the open market, leading to low fertilizer demand, purchases, and application, which in turn leads to low yields and low income to farmers. Therefore, the underlying assumption in Figure 5.1 is that by reducing the cost of fertilizers to farmers through the subsidy (that is, lowering the retail price paid by farmers), more farmers would be able to purchase and use fertilizers on their farms, which would in turn lead to increased yields and incomes to farmers. This would eventually trigger (re)investment of surplus income into the farm enterprise (including improved technologies and high-value commodities) toward modernization, which together with the increased income would lead to greater consumption, lower poverty, and increased food and nutrition security. In addition, the subsidy is meant to encourage greater private-sector development and participation in fertilizer markets. Such analysis and such a line of thinking appears logical and is consistent with the national policy of modernizing agriculture, as captured in FASDEP II, as well as with the literature on agricultural household models (Singh, Squire, and Strauss 1986; de Janvry, Fafchamps, and Sadoulet 1991), adoption of agricultural technologies (Feder, Just, and Zilberman 1985; Feder and Umali 1993), and determinants of farm investments (Ervin and Ervin 1982).

However, as the literature and past studies show, the fulfillment of this chain of outcomes depends on other multiple factors (see Overall Methodology section), including complementary interventions beyond just the fertilizer subsidy. For example, creating and expanding market access to farm produce (such as envisioned with the NAFCO initiative) as well as making other agricultural inputs like farm machinery easily accessible and affordable (as envisioned with the AMSEC initiative) are important. Farmers' characteristics, including their endowments of human, physical, financial, and social capital are also important. These affect, among others, the attitudinal orientation of farmers toward farming as a business, which has become the subject of inducing behavioral change among farmers. There are also important feedback links underlying the relationship between FSP and the outcomes. These are represented by the dotted paths in Figure 5.1. For example, households realizing an increase in productivity and farm output from using more fertilizers in one season may decide to drop the adoption in the subsequent season if they were unable to sell their produce for a profit, which could occur due to low prices resulting from increased aggregate supply. Political leaders may also decide to increase or reduce the budget allocated to the program depending on the outcomes in previous years.

Overview of FSP

The Voucher System (2008 and 2009)

FSP in 2008 and 2009 was implemented using vouchers that were given to farmers to redeem from participating input dealers (see, for example, Banful 2009 for details on implementation and results). This involved four major fertilizer companies, Yara Ghana Limited (and Wienco Ghana Limited), Chemico Limited, Dizengoff Ghana Limited, and Golden Stork Ghana Limited. These companies provided information to the government about the total fertilizer consumption in the country, including regional disaggregation, which was used by the government to estimate the quantities of the four types of fertilizer to be subsidized. Coupons were printed and allocated to regional agricultural development units, which in turn issued them to their respective district agricultural development units based on estimated district fertilizer consumption. In each district agricultural development unit, the vouchers were allocated to agricultural extension agents (AEAs) who in turn issued them to farmers who were identified by their community leaders. On receipt of a voucher, a farmer used it in addition to the face value amount of the subsidy to purchase fertilizer from the nearest participating retail fertilizer outlet. This system was repeated in 2009, maintaining the 2008 prices paid by farmers. The total amount of subsidized fertilizer was 43,176 metric tons (mt) and 72,795 mt in 2008 and 2009, respectively. Reported lessons emerging from the coupon system included high overhead and administrative costs, diversion of fertilizers from intended target beneficiaries, and large amounts of time spent by the head office, the district directors, and the staff members of MoFA in policing the distribution process (MoFA 2010a).

The Waybill System (2010 and 2011)

Following the lessons reported above, the voucher system was replaced with a waybill system in 2010 and 2011 and is still in place. Under the new system, the government absorbed port handling, loading, and transport costs as well as agents' commissions and margins to arrive at prices that are deemed affordable to small-scale farmers but also depend on the government's budget for the subsidy. MoFA, the implementer of the program, adopts a price buildup approach. The ministry makes a request for expression of interest in the supply of fertilizer. Bidders state indicative prices plus the cost of transportation to all regional capitals and further distributions to district agents (see January 11 edition of the *Daily Graphic*, 14). This enables the ministry to estimate the price buildup from port to the district agents, and then the ministry is able to negotiate with the companies on the price at which to sell the fertilizer to farmers.

The principal objective is to ensure the program reaches all farmers at the agreed-on prices in all regions and districts. The operational details of the subsidy include determining the subsidy price as well as ensuring distribution, monitoring, oversight, and payments based on validated sales receipts. To begin with, retail prices of fertilizer in the domestic market are set up front, and then through negotiations between the importers and the government, taking into consideration the fluctuation of the fertilizer price in the international market and exchange rate fluctuations, the different cost components along the domestic fertilizer supply chain are estimated. Table 5.1 shows the cost buildup and final subsidy (GHS 15–17 per 50-kilogram bag) for the different types of fertilizer in 2010, for example (MoFA 2010a). The companies involved in the program are then allowed to send a specific amount of subsidized fertilizers to each region and district based on historical fertilizer consumption patterns. This may be regarded as a unique example of a public–private partnership in which the government consults with fertilizer importers in the design stage and relies exclusively on the existing private distribution system to deliver fertilizer to farmers.

Table 5.1 Subsidy payable on each 50-kilogram bag of fertilizer (in Ghanaian cedis), 2010

Fertilizer Type	Port Charges	Transport Loading	Incidentals	Total Subsidy
Nitrogen, phosphorous, potassium	6.5	5	5.5	17
Urea	6.5	5	3.5	15
Sulphate of ammonium	6.5	5	4.5	16

Source: Ghana, MoFA (2010a).

As the name suggests, with the waybill receipt system, receipts showing deliveries and sales have to be submitted to the government for payment. The receipts or waybills must be countersigned by the district director of agriculture after he or she consults with the district coordinating director. Essentially, fertilizer companies import the fertilizers, clear them from the ports, and pay all charges. On delivery to designated districts for sale to farmers by their registered sales agents, the subsidy is then paid after presentation and reconciliation of the relevant waybill receipts. The quantity of fertilizer sold to farmers in each district is compiled by the district fertilizer desk officer and cross-checked by the district and regional directors of agriculture before the waybills and receipts are passed to the national fertilizer coordinator to compute the subsidy payments to the various fertilizer distributors. Sales of subsidized fertilizer are permitted only during the six to seven months of the year when the subsidy is in effect, that is, during the production season (usually May through October).[11]

[11] Companies that sell at greater than the recommended prices during the period that the subsidy is in effect are expected to be sanctioned by paying to the government the excess of the recommended price.

Overall Financial Costs of the Subsidies, 2008–2012

In 2008 and 2009, the subsidy cost the government an amount of GHS 20.6 million and GHS 34.4 million, respectively. The cost went down slightly in 2010 to GHS 32.0 million, and then it went up sharply to GHS 69.8 million in 2011 and GHS 118.1 million in 2012 (see Table 5.2). As Table 5.2 also shows, the unit cost paid by the government declined initially between 2008 and 2010 and then went up significantly after that, reflecting the increase in international prices of fertilizers and the simultaneous effort to keep the prices paid by farmers at levels similar to those offered in the past. But with the government's bill rising significantly over time, the prices paid by farmers have also increased, as shown in Table 5.2 by the prices in 2012 compared to the previous years' prices. In 2013, for example, the prices announced to be paid by farmers are GHS 51, GHS 50, and GHS 44 per 50-kilogram bag of NPK, SOA, and urea, respectively (MoFA 2013), representing about a 30 percent increase on average over the 2012 prices.

Table 5.2 Subsidized fertilizer prices and cost of subsidy, 2008–2010

Category	2008	2009	2010	2011	2012
Prices paid by farmers (GHS per 50-kilogram bag)					
NPK 15:15:15	26	26	27	30	39
NPK 23:10:05	24	24	—	—	—
SOA	18	18	18	26	38
Urea	26	26	25	29	35
Total fertilizer subsidized (mt)	43,176	72,795	91,244	150,000	173,000
Total cost (GHS millions)	20.6	34.4	32.0	78.8	118.1
Cost per unit (GHS per mt)	478.4	472.6	350.7	525.3	682.7

Source: Authors' calculations based on Ghana, MoFA (2010a, 2012) and Development Institute (2012).

Notes: GHS = Ghanaian cedis; NPK = nitrogen, phosphorous, potassium; SOA = sulphate of ammonium; mt = metric tons; Dashes indicate no data.

Internal Consistency of the Waybill System

Even though there is no documentary evidence to our knowledge that shows the analysis that informed the initial planning and design of FSP, there is a strong implicit knowledge among the program designers as to the issues underpinning the program in general, including the high cost of fertilizers to farmers. Interviews of various MoFA staff members implementing the program also pointed to a continuous, ongoing analysis being carried out by the field officers of FSP, which feed into possible review of strategies. It was clear from our interviews that the coupon system was associated with high administrative cost and opportunity cost of time (that is, time that MoFA staff members would have spent on technical issues with farmers rather than on policing the coupon distribution and redemption process). It is this anecdotal evidence and the desire to reach all types of farmers and farming activities that resulted in the shift from the coupon system of subsidy to the waybill and receipt system.

Another stated concern about the coupon system prompting the switch to the waybill system is the diversion of the subsidized fertilizers from intended beneficiaries. Due to lack of data, we were unable to assess the magnitude of this problem. However, a recent incident reported in the newspaper about security agencies' intercepting two vehicles that were in the process of smuggling more than 200 bags of fertilizer (worth about GHS 6,000) to neighboring Togo (Ghana News Agency 2011) shows that the problem of diversion is not unique to the coupon system. Other countries face similar problems. Basically, as the gap between the subsidized price and the international (or border) price widens, leakages tend to increase. In India, for example, it is reported that the recent flare-up in oil prices in 2008–2009 caused fertilizer input prices to spike (leading to a more than doubling of the fertilizer subsidy bill from Indian rupees (INR) 43,000 crore in 2007–2008 to INR 99,500 crore in 2008–2009) and also increased fertilizer smuggling to neighboring countries and to other industries like plywood—it is estimated that

about one-fifth of the subsidized fertilizer leaks out (Ramoo 2011). To limit the leakage, the implementers in 2012 added the farmers' passbook for monitoring fertilizer supply to farmers throughout the country. Basically, the passbook is a form of identity for farmers to use to purchase subsidized fertilizer and seed. In the program implementation guideline for 2012, it is stated that only fertilizers and seeds bought by farmers with passbooks will be paid for by the government.

Although it was not possible to assess the magnitude of the diversion problem under the two systems to assess the validity in making the switch, the other objectives and assumptions that underpinned the waybill system are consistent with the logical framework presented earlier and with the national policy of modernizing agriculture, as captured in FASDEP II. As with the coupon system, the waybill system complements and reinforces other MoFA initiatives in increasing the productivity of Ghanaian farmers and encourages them to shift from subsistence agriculture to market-oriented production using appropriate technologies, high-yielding inputs, and machines.

All respondents felt that the waybill system, built around government–private sector collaboration, is an improvement over the coupon system. Also, there is no incentive for farmers to use the subsidy (that is, coupon) for other consumables. However, some concerns were raised by different stakeholders. For example, farmers and retailers complained about the poor timeliness of the subsidy. Basically, farmers in areas where the season starts relatively early (that is, in the south to the middle belt of Ghana) felt the subsidy and prices were announced late and there was no subsidized fertilizer at the onset of the cropping season, when it is most needed. Thus, it benefited only those farmers in areas where the season starts later (that is, from the middle belt toward the north). But this problem of timeliness was also present under the voucher system (Banful 2009). Fertilizer distributors also felt that the procedures associated with the waybill system were cumbersome and that there was a lack of clarity about the procedures on all aspects of the operations. For example, they complained of too many forms to be filled out (four in total) by distributors and retailers in addition to the challenge of the retailers' filling out the forms correctly and getting the district directors of MoFA to endorse them in a timely manner, which introduces delays and frustrations. Again, these are not necessarily new concerns, because under the voucher system too forms had to be filled out, checked, and signed off by a MoFA staff member before payment of the subsidy to the participating companies.

In sum, it seems that whereas the overall administrative cost associated with implementing the coupon system, including the opportunity cost of time of MoFA staff members in policing the coupon distribution and redemption process, was portrayed as being relatively higher than that associated with the waybill system, we found that many of the issues raised for making the switch from the coupon system to the waybill system were common to both systems. Further research to quantify the relative magnitudes of these costs to both the government and the private sector under the two systems, in addition to other costs and the benefits, is required to say which system is more cost-effective. This is outside the scope of this paper. We now address the other research questions associated with evaluating FSP, particularly the waybill system.

Effect of the Program on the Development of Fertilizer Markets

Fertilizer Imports

The introduction of FSP in 2008 seems to have led to an increase in agricultural input dealers, which in turn has increased the availability of agricultural inputs including fertilizers for farmers. First, the amount of fertilizers imported into the country between 2008 and 2010, when subsidies were in place, increased significantly by about 39.5 percent per year, compared to an only 2.4 percent per year growth rate prior to the program, that is, in 2004–2007 (Table 5.3). This is quite an achievement considering that the amount of the subsidized fertilizer as a share of the total fertilizer imports declined over time (Table 5.3). Discussions with officials at the Crop Services Directorate revealed that the increases could be more than what were reported because the increases reported do not include fertilizer imports from some companies that do not require permits to import fertilizers. The Ghana Cocoa Board, for example, directly imports

fertilizers for its operations without reference to the Crop Services Directorate, and therefore, such imports are not captured in the statistics compiled by the Crop Services Directorate. That notwithstanding, the increases in fertilizer imports are largely attributed to FSP.

Table 5.3 Imports of fertilizer and subsidized amounts (mt)

Category	2004	2005	2006	2007	2008	2009	2010	Annual Average Percentage Change	
								2004–2007	2007–2010
Total fertilizer imports (1,000 mt)	223.7	91.3	189.9	189.6	187.0	335.2	473.1[a]	2.4	25.7
Total subsidized fertilizer (1,000 mt))	n.a.	n.a.	n.a.	n.a.	43.2	72.8	91.2	n.a.	46.9
Total subsidized fertilizer (percentage of total imports)	n.a.	n.a.	n.a.	n.a.	38.3	21.7	19.3	n.a.	n.a.

Source: Authors' calculations based on Ghana, MoFA (2010a, 2011a).

Note: mt = metric tons; n.a. = not applicable. [a.] Excludes muriate of potash.

NPK fertilizers constituted the largest portion of the total amount of fertilizers imported (up to one-half of the total), which is not surprising as they are the most promoted by MoFA and demanded by farmers. SOA is the second most imported fertilizer, constituting up to 10 percent, although it is quickly being overtaken by others such as triple super phosphate and urea. Imports of potash, which is used in preparing the compound NPK, increased significantly in 2010 and 2011. A personal conversation with a private-sector actor revealed that this is likely due to the growing demand for local blending of NPK fertilizers—including the well-known blends: Asaase Wura for cocoa, Activa for maize, NPK 30:0:16+ for top dressing of maize, and others for cotton, oil palm, rubber, and pineapple, which are being tried out. Therefore, it also seems that the increase in the total amount of fertilizer spurred on by the subsidy has also contributed to opening up opportunities for targeting different fertilizer formulations (or blends) to local agroconditions. Because the study team did not look into this aspect of the fertilizer market, having learned about it only at the end of the study, further analysis is required before any evidence-based recommendations can be put forth. Nevertheless, it seems prudent for the government to find ways of supporting this activity, including at a minimum developing and enforcing safety and handling regulations, because of our observations in the field of how many people mishandle these chemicals, posing severe health hazards.

Fertilizer Distribution Network and Retail Outlets

Implementation of FSP is also associated with an increase in the number of agricultural input dealers and outlets, which is estimated to have increased by 15 percent; this is substantiated by farmers' perceptions that the distances to dealer points to purchase fertilizer has been reduced (Ghana, MoFA 2009). This in turn is substantiated by our own findings of increased use of fertilizers, which we present later on. Nevertheless, it seems that development of the fertilizer distribution network in various rural areas is lagging behind and is not creating the desired incentives for private investors to expand the distribution network, likely limiting the benefits many farmers in many rural areas might receive from the fertilizer subsidy. First, the bulk of the fertilizer imported into the country is sent to storage and distribution centers that are typically owned in association with the major importers such as Yara-Wienco. The largest storage and distribution centers are in Kumasi and Tamale, which serve the central and northern parts of the country. For the southern parts of the country, storage and distribution are operated mostly out of Tema and managed by the importing companies directly. From these three large storage and distribution centers, fertilizers are sold to independent distributors and wholesalers, who then sell to the many retailers and small input dealers scattered across the country, who in turn sell directly to farmers (Fuentes et al. 2011).

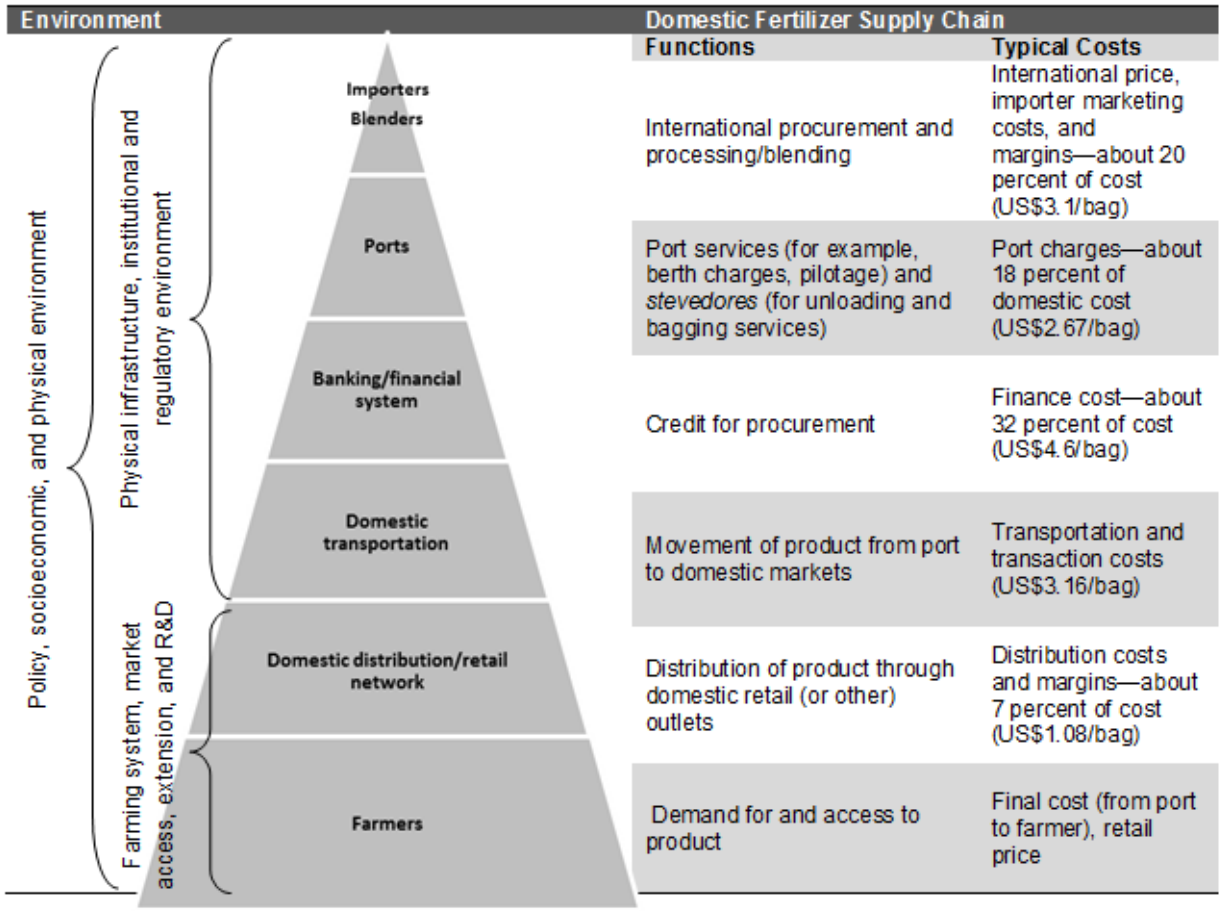
Because retailers are not involved in any negotiations with the government about the implementation of the program, particularly in determination of the fertilizer price and transportation cost, they become price takers and have to succumb to terms dictated by the wholesalers. Many of the fertilizer retailers whom we interviewed indicated that the wholesalers usually offer them GHS 0.50 to 1.00 per 50-kilogram bag for transportation and a margin of GHS 0.70 per 50-kilogram bag. Many of the retailers said this was not adequate. For example, a fertilizer retailer in Nadowli explained that even though he is given the transport allowance of GHS 1.00 per 50-kilogram bag by the wholesaler in Wa (Antika) with whom he trades, he pays about GHS 1.20 per 50-kilogram bag to transport the fertilizer from Wa to Nadowli. Consequently, this dips into his allocated margin of GHS 0.70 per 50-kilogram bag, leaving him with a margin of GHS 0.50 per 50-kilogram bag. Thus, for an average of 200 bags of fertilizer that he sells in one month, he makes only a gross return of GHS 100 (that is, 200 bags × GHS 0.50 per bag), which he considered to be low because he has to pay for other costs (including the wages of a salesperson, rental charges for the store, and so on), leaving little to compensate him for the opportunity cost of his investment capital and time.

Because this can limit entry into the fertilizer retail market, particularly in rural areas that are far from wholesale markets (relative to the transport allowance given by the wholesaler), and thereby lower the potential of farmers to benefit from the subsidy in affected rural areas, the distribution of the fertilizer transport subsidy (that is, the flat rate of GHS 5.00 per 50-kilogram bag that is offered by the government) along the value chain needs to be studied further. Currently, it may appear that the benefits are captured disproportionately by those closer to larger towns where retailing abounds and by larger and more commercial farmers who have the means and financial capability to purchase in bulk directly from the wholesalers. The same applies to farmers who have organized themselves to be able to purchase in bulk as well as those under BFP, under which the fertilizer is distributed to them directly via credit arrangements.

Fertilizer Supply Chain

This section analyses the cost and price structure of fertilizer along the supply chain to identify how the fertilizer subsidy affects the different actors and functions along the chain, and vice versa, and how the actors influence the determination of the subsidy and its distribution along the chain. Because the fertilizer market in Ghana is relatively small and cannot influence the international price, the analysis focuses on the domestic market, which can be influenced directly by government policies and actions. As Figure 5.2 shows, the domestic fertilizer supply chain has many actors at different levels and with different functions and costs. The pyramid structure illustrates the number of actors along the supply chain, with a small number of importers and blenders at the top and a large number of farmers at the bottom; much of the retail price of fertilizer to farmers may be traced to various factors along the chain, such as port charges, costs of credit, domestic transportation costs, and distribution costs, including margins. These are analyzed next, drawing from the work of Fuentes, Johnson, and Bumb (2011).

Figure 5.2 Domestic supply chain functions and cost structure



Source: Fuentes, Johnson, and Bumb (2011).
Note: R&D = research and development.

High Cost and Inefficiencies at Port

Port charges include those for the use of port facilities including site occupation or berth charges, wharf charges, pilotage service, vessel unloading, and bagging, which account for about 18 percent of the domestic fertilizer cost (US$2.57[12] per bag), compared to about 15.6 percent in other ports. This relatively high port cost may be attributed to a number of operational inefficiencies in port services and the port's limited capacity. These inefficiencies include the regulation of permitting only port employees (stevedores) to perform the work of unloading and bagging products at port without allowing for direct negotiations with importers and introduce inefficiency in the process and additional demurrage charges. Currently, labor compensation for vessel unloading and product bagging at port is on an hourly basis at rates pre-established by the Ghana Harbors and Port Authority, and port regulations do not allow for direct contractual arrangements between importers and stevedores. Such an arrangement does not provide an incentive for workers to increase productivity, leading to inefficiencies associated with the unloading and bagging process. According to importers, this cost could be reduced if the contractual arrangements with the stevedores could be changed. This situation is compounded by the insufficient, ill-maintained, and at times obsolete port equipment.

[12] All dollars are US dollars.

High Finance Cost and Poor Access to Credit

In Ghana, finance is the highest cost component along the fertilizer domestic supply chain, accounting for an average of 32 percent of the domestic price of fertilizer. Domestic fertilizer distributors and retailers have to borrow money for their business at high interest rates of between 20 to 30 percent, unlike the major importing firms which enjoy better access to finance in international markets and at more favorable terms like interest rate of between 5 and 10 percent. Furthermore, the low margin to fertilizer retailers is a disincentive for them to borrow money at high interest rates to expand their business. The tendency is to rely on their own limited capital for the business, leading to limited scale operations of many fertilizer retailers thereby limiting accessibility of the fertilizer to many rural communities.

High Domestic Transportation Cost

Transportation cost which includes movement of the fertilizer from the port to the retailer, as well as loading and unloading of trucks is the third highest cost component along the domestic supply chain, representing an average of 21 percent of the domestic cost of fertilizer. The government has offered a flat transportation fee of GHS 5.00 per 50-kilogram bag irrespective of the distance that the fertilizer has to be transported, which may limit widespread distribution of fertilizers. Furthermore, the deteriorated roads and high cost of fuel has increased the road transport cost of fertilizer, leading to complaints that the GHS 5.00 per bag offered by the government for transportation is inadequate. Arguably, there is scope for lowering transportation costs through improved roads, greater efficiencies of transportation networks, and other options for improving the effectiveness of the transportation subsidy (for example, through a competitive bidding system). The situation is complicated by the lack of adequate storage facilities at the various regional and district capitals to store the fertilizer for further retail. Although the most-used mode of domestic transportation in Ghana is trucks over the roads, there may be a need to exploit the potential for water transportation using the Volta waterway to move fertilizer to the Northern and Eastern regions, for which proper infrastructure will need to be developed.

Spatial Distribution and Targeting of Fertilizer

It is reported that about 50 percent of the total amount of fertilizer is sold in the Northern, Upper East, and Upper West regions. In 2010, for example, the Northern region alone accounted for 30 percent of total subsidized fertilizer sales, followed by the Brong Ahafo region with 15 percent, and then the Ashanti and Upper East and West regions, with each accounting for 10 percent (Table 5.4). The Western region accounted for the lowest amount of sales, at about 2 percent. For sales per unit area or intensity of application, Table 5.5 shows that the Greater Accra region followed by the Upper East region were by far the largest consumers—12.4 and 10.6 kg/ha, respectively. The other regions had less than 5 kg/ha, with the Western region again taking the bottom with only 0.8 kg/ha.[13] Looking at the channels of sales of subsidized fertilizer to farmers, almost 80 percent of the 91,243 mt was sold directly to farmers via their purchases in the retail market, whereas 18 percent was channeled via BFP and the remaining 2 percent was sold to cotton farmers (Table 5.6).

[13] We used total land area in the calculations because we did not have information about arable land area or other relevant measures depicting actual or potential agricultural land area.

Table 5.4 Regional sales of subsidized fertilizer, 2010

Region	Type of Fertilizer (Bags)			Total		Percentage
	NPK	SOA	Urea	Bags	Metric Tons	
Greater Accra	48,938	+	8,752	91,244	4,562	5
Eastern	78,301	53,687	14,003	145,991	7,300	8
Volta	48,938	33,554	8,752	91,244	4,562	5
Central	48,938	33,554	8,752	91,244	4,562	5
Western	19,575	13,422	3,501	36,498	1,825	2
Ashanti	97,877	67,108	17,503	182,488	9,124	10
Brong Ahafo	146,815	100,663	26,255	273,733	13,687	15
Northern	293,630	201,325	52,510	547,465	27,373	30
Upper West	97,877	67,108	17,503	182,488	9,124	10
Upper East	97,877	67,108	17,503	182,488	9,124	10
Total	978,766	671,083	175,034	1,824,883	91,243	100

Source: Based on information received from the Directorate of Agricultural Extension Services of Ghana, MoFA (2010).
Note: NPK = nitrogen, phosphorous, potassium; SOA = sulphate of ammonium.

Table 5.5 Regional sales of subsidized fertilizer per unit area, 2010

Region	Total Sales		Sales per Hectare	
	Metric Tons	Percentage	Kilograms per Hectare	Rank
Greater Accra	4,562	5	12.4	1
Eastern	7,300	8	4.4	5
Volta	4,562	5	2.6	9
Central	4,562	5	4.7	4
Western	1,825	2	0.8	10
Ashanti	9,124	10	3.7	7
Brong Ahafo	13,687	15	3.7	7
Northern	27,373	30	3.9	6
Upper West	9,124	10	4.8	3
Upper East	9,124	10	10.6	2
Total	91,243	100	4.0	n.a.

Source: Authors' calculations based on information received from the Directorate of Agricultural Extension Services of Ghana, MoFA and total area of region (2010).
Notes: n.a. = not applicable.

Table 5.6 Channels of sales of subsidized fertilizer to farmers, 2010

Sales Outlet	Quantity (mt)	Percentage of Total
Sold directly to farmers	72,891	78.9
Sold to block farms	16,597	18.2
Sold to cotton farmers through Ministry of Trade and Industries	1,756	1.9

Source: Based on information received from the Directorate of Agricultural Extension Services of Ghana, MoFA (2010).
Note: mt = metric tons.

Assessing the Achievement of Program's Objectives

This section focuses on assessing FSP's achievement of the following stated objectives:

- Increase fertilizer application rate to 20 kg/ha
- Increase crop yield
- Raise profitability of farm production

Application Rate of Fertilizer

First we asked the focus groups to assess change in the past three years (2008 to time of study) in the number of farmers using fertilizer as well as the amount used per unit area. All the groups in the different communities reported that both the number of farmers applying fertilizer and the amount applied per unit area had increased over time and particularly since the subsidy began to be implemented in 2008. It was only in one community that the group said there had been no change in both indicators. Although the groups also agreed that availability of and access to fertilizer were much better under the waybill system compared to the voucher system (reasoning that not all farmers who wanted to use fertilizer were successful in obtaining vouchers), we were unable to ascertain how much greater the increase in fertilizer use and application rates were under the waybill system compared to the voucher system. From the household surveys that we administered, we estimated the average fertilizer application rate in 2010 at about 13.4 kg/ha for all farmers in the sample, that is, including those who used fertilizer as well as those who did not use it.[14] As expected, Table 5.7 and Figure 5.3 show that the application rate (when counting only those who used fertilizer) varied across different parts of the country (by region and stratum). By region, we find that the application rate was greatest among those surveyed in the Ashanti region (average of 295 kg/ha) and least among those in the Upper East and West regions (average of 125 kg/ha). By agroecology, those located in the forest zone applied the most (average of 313 kg/ha), followed by those in the transition zone (average of 271 kg/ha), and then the coastal (225 kg/ha) and guinea (191 kg/ha) savanna zones. Therefore, although the bulk of the subsidized fertilizer was sold in the Northern and Upper East and West regions (see Tables 5.4 and 5.5), because of the relatively abundant land there, the intensity of fertilizer use is highest in the forest and transition zones where the relatively better moisture availability reduces the risk of using larger amounts of fertilizer per unit area.

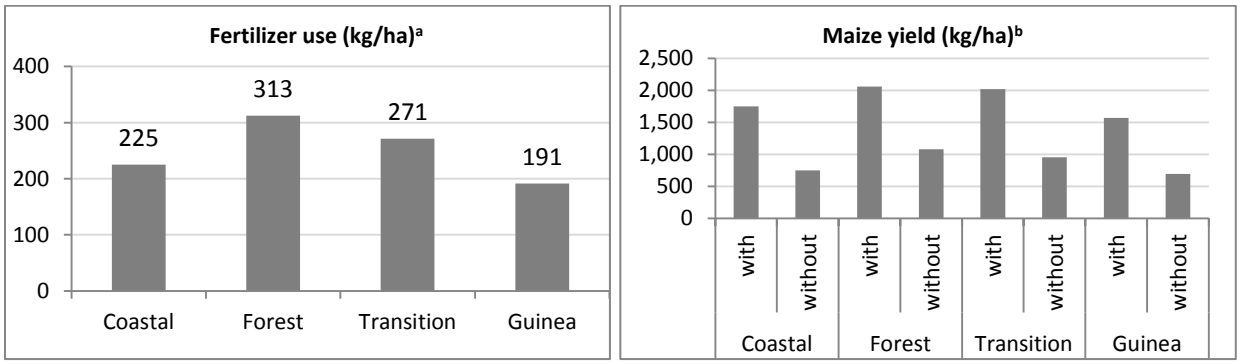
Table 5.7 Fertilizer usage and maize yield in sampled communities, by region

Region	Average Fertilizer Application (Kilograms per Hectare)[a]	Average Yield (Kilograms per Hectare)[b]		
		With Fertilizer	Without Fertilizer	Percentage Difference
Ashanti	295	2,150	1,150	87
Brong Ahafo	265	1,900	958	98
Northern	200	1,820	800	128
Eastern	250	2,165	750	189
Upper West	125	1,550	688	125
Upper East	125	1,375	438	214
Volta	250	2,150	750	187
Central	250	1,750	750	133
All	251	2,128	923	131

Source: Authors' calculations based on household and focus group surveys.
Notes: [a.] Applicable to when fertilizer is used only, based on household surveys. [b.] Based on focus group surveys.

[14] This is based on the average application rate of the 64 farm households that were interviewed.

Figure 5.3 Fertilizer use and maize yield in sampled communities, by agroecological zone



Source: Authors' calculations based on household and focus group surveys.

Note: kg/ha = kilograms per hectare.

a. Applicable to when fertilizer is used only, based on household surveys. b. with = using fertilizer (based on focus group surveys); without = not using fertilizer (based on focus group surveys).

Crop Yield

The focus group discussions and analysis of data also revealed variation in crop yield across different parts of the country, and not surprisingly, average yields were significantly higher when fertilizer was applied than when it was not. Table 5.7 and Figure 5.3 show the variation in maize yield across different parts of the country under the two scenarios. When fertilizer was applied, the average maize yield was higher in the forest and transition zones than the average yield in the two savanna zones (see Figure 5.3), which is consistent with the higher fertilizer application rates there, in addition to the more favorable agricultural production conditions concerning rainfall, soil organic matter, and other factors. Without application of fertilizer, the situation in the Upper East is quite dire at less than half a metric ton[15] per hectare, compared to 750 kg/ha in the coastal zone, 955 kg/ha in the transitional zone, and 1,083 kg/ha in the forest zone. The relative low yield response to fertilizer in the savannah zones needs attention. Promoting measures to increase yield response there (including strategies to build up soil organic matter) will be important to enhance the profitability of fertilizer usage there.

Profitability of Farms

The profitability of fertilizer application was estimated by comparing the crop budget of farmers who applied fertilizer on their maize farms with those who did not apply any fertilizer. The results in Table 5.8 show that those using fertilizer for maize production realized an average profit margin estimated at 13 percent of the total cost of production. Without using fertilizer in the production process, a loss equivalent to about 22 percent of the total cost of production was incurred on average. Because farmers usually use family labor, which is not normally costed, unlike we have done here, the economics (net benefit or loss) of using fertilizer may not be apparent to many farmers.

[15] All tons are metric tons.

Table 5.8 Profitability analysis for production of maize, with and without using fertilizer

Cost Item	With	Without
Labor for land clearing (GHS per ha)	44.90	44.90
Labor for land plowing (GHS per ha)	51.43	51.43
Labor for land harrowing (GHS per ha)	11.13	11.13
Labor for planting (GHS per ha)	58.55	58.55
Labor for herbicide spraying (GHS per ha)	24.90	24.90
Labor for first fertilizer application (GHS per ha)	38.75	n.a.
Labor for second fertilizer application (GHS per ha)	33.65	n.a.
Labor for first weeding (GHS per ha)	49.25	49.25
Labor for harvesting by slashing (GHS per ha)	58.70	58.70
Labor for gathering and handling (GHS per ha)	51.58	51.58
Labor for transportation of output (GHS per ha)	50.00	50.00
Seed (GHS per ha)	24.63	n.a.
NPK (GHS per ha)	77.78	n.a.
SOA (GHS per ha)	51.25	n.a.
Herbicide (GHS per ha)	32.45	32.45
Total cost of production (GHS per ha)	658.95	432.88
Average output (kg)	1,875.00	845.00
Average price of output (GHS per 100 kg)	39.71	39.71
Total revenue (GHS per ha)	744.65	335.53
Gross margin/profit (GHS per ha)	85.70	(97.38)
Profit margin (percentage of total cost)	13.01	(22.49)

Source: Authors' calculations based on household and focus group surveys.

Notes: with = using fertilizer; without = not using fertilizer; GHS = Ghanaina cedis; ha = hectare; n.a. = not applicable; NPK = nitrogen, phosphorous, potassium; SOA = sulphate of ammonium; kg = kilograms.

Assessing the Potential Economic Viability of FSP

As with the AMSEC program, we assess the overall economic viability of FSP by estimating its economic rate of return using the economic surplus method ex ante. We apply it to maize only because maize is one of the major commodities targeted by the program. We project the total program costs and benefits derived from the program over a nine-year horizon, that is, from 2011 to 2020. Details of the model, overall assumptions, and underlying data are provided in the Appendix A. Here we only summarize the results, with details provided in Table 5.9.

With the direct and indirect costs, the fertilizer subsidy bill for MoFA could easily rise to GHS 136 million in constant 2011 prices by 2020 and account for more than 35 percent of the MoFA budget (and 188 percent of the typical investment budget). This is a significant increase from the current estimated share of the development budget of about 17 percent (Benin et al. 2008). Part of the dramatic increase is due to our assumption of a steady rise in projected world prices for fertilizer, in addition to the 10 percent growth in the amount of fertilizer that is subsidized. The MoFA budget has typically grown at about 5.5 percent per year in real terms, whereas the fertilizer program costs have grown at an average rate of 54 percent per year in nominal terms (see Table 5.2).

Table 5.9 Summary of results of the economic analysis of the FSP

Variable	Scenario A			Scenario B		
Elasticity of Demand	–0.4			–0.7		
	2010	2020	Growth	2010	2020	Growth
Maize yield without program (kg/ha)	1,714	1,893	1.0			
Maize yield with program (kg/ha)	2,128	2,449	1.4			
Adoption rate (%)	9.4	23.1	9.5			
Unit production cost (2011 GHS/ha)	226	354	4.6			
Resulting production and price changes						
National production without program (1,000 mt)	1,669	2,247	3.0	1,669	2,247	3.0
National production with program (1,000 mt)	1,775	2,647	4.1	1,715	2,422	3.5
Production due to the program, as share of total (%)	6.4	17.8	10.8	2.8	7.8	10.8
Maize prices without program (2011 GHS/kg)	0.55	0.55	0.0	0.55	0.55	0.0
Maize prices with program at autarky (2011 GHS/kg)	0.47	0.31	–3.9	0.53	0.49	–0.8
Change in program costs and coverage						
Total subsidized fertilizer (1,000 mt)	91.2	236.7	10.0			
Total cost of program (million 2011 GHS)	37.9	136.0	14.5			
Direct costs of program (million 2011 GHS)	36.8	132.0	14.5			
Indirect costs of program (million 2011 GHS)	1.1	4.0	14.5			
Total cost of program as share of MoFA's budget (%)	16.8	35.3				
Direct costs as share of MoFA's investment budget (%)	76.3	118.9				
Program net worth (assuming no price effects)						
Net economic benefits (million 2011 GHS)	16.0	98.2	18.2	13.3	70.4	16.1
Net worth (million 2011 GHS)		297.9			234.8	
Benefit–cost ratio		1.6			1.5	
Program net worth (with price effects)						
Net economic benefits (million 2011 GHS)	7.4	–6.0		11.3	47.4	0.0
Net worth (million 2011 GHS)		75.8			184.2	
Benefit–cost ratio		1.2			1.4	

Source: Authors' assumptions and calculations based on literature review, project reports, and surveys.

Notes: kg = kilograms; ha = hectare; GHS = Ghanaina cedis; mt = metric tons; MoFA = Ministry of Food and Agriculture. Scenario A represents buyers' being less sensitive to price changes, compared to scenario B, wherein buyers are more sensitive to price changes. Values in the column headed Growth are annual percentage growth rates.

In examining the potential effect of the program on maize yields and output, we analyze shifts in maize supply resulting from the gains in yield between a national average yield of 1.7 mt/ha and a yield of 2.1 mt/ha to represent the situations of without and with FSP, respectively. Yield and total production under the program are expected to grow over time based on the growth rate in the amount of fertilizer subsidized—assumed to grow at about 10 percent per year—which leads to greater use and adoption, higher output, and rising production costs as real fertilizer prices are assumed to continue rising slowly over time in global markets.

The average increase in maize output at 4.1 percent per year would potentially depress maize prices if there were no matching increase in demand, such as from increased exports or expanded agro-industries that use maize (falling at about 4 percent per year). The decrease in prices is less rapid if we assume a higher elasticity of demand (for example, –0.7), falling at a rate of 0.8 percent per year. This occurs because under this scenario buyers are more sensitive to price changes, increasing their purchases of maize following small reductions in price, explaining the smaller percentage change in price given the same percentage change in output compared to the situation wherein the elasticity of demand is lower.

Given the effects of the program on total quantities of maize produced and price effects, we estimate their impact on net economic welfare based on the combined benefits (or losses) of producer and consumer surplus, discounted by an opportunity cost of capital of 12.9 percent. As it turns out, the net economic benefits rise sharply through time, if we assume prices will not fall as long as export opportunities exist, from about GHS 17 million in 2011 to GHS 102 million in 2020—translating into an

accumulated net worth of GHS 309.9 million and a high cost–benefit ratio of 1.7. However, this changes quickly if prices are allowed to fall because there are no additional markets to absorb any excess supply, and the net worth of the program falls to GHS 83.1 million and a cost–benefit ratio of 1.2. With the higher elasticity assumption, however, the net worth is GHS 50.2 million in constant 2011 Ghanaian cedis and a cost–benefit ratio of 1.4.

In summary, our simple economic analysis of FSP reveals that it has potentially high economic returns given the increase in fertilizer use and large gains in yields and output. However, there will always be risks associated with it. Such gains can be maintained only as long as the program's costs do not rise too sharply, which would put a heavy burden on the MoFA budget. For example, by 2020, we expect the share to have doubled to 35 percent, which is enormous. Costs are difficult to control as they are highly dependent on trends in world fertilizer prices. Finally, economic returns could easily become negative due to a price collapse if there are insufficient export markets or new agribusiness activities using maize, such as poultry feed manufacturing in the region, to absorb any rapid growth in excess output. However, as long as global prices for maize are expected to remain high indefinitely and Ghanaian farmers have ready access to regional or global markets, such a risk would be less likely.

Emerging Challenges of FSP

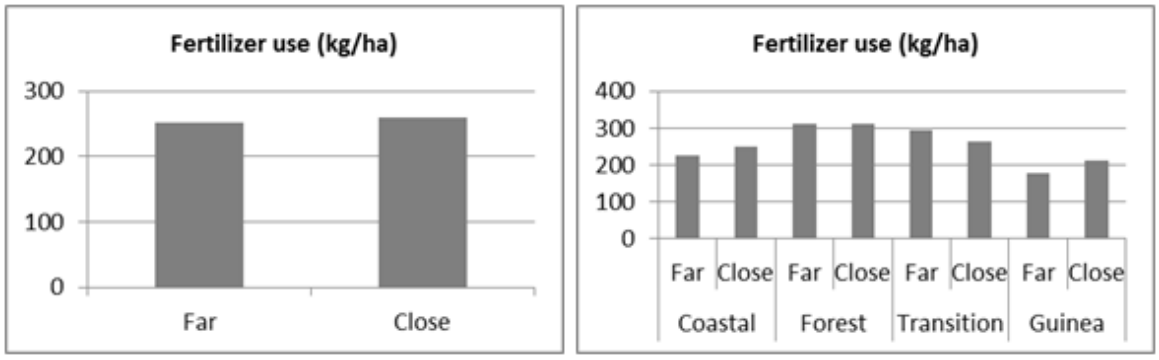
One of the main challenges of such programs is the potential budgetary constraints on countries, which are perpetuated by the lack of successful exit strategies in poor countries. Evidence from Malawi and Nigeria suggests that fertilizer subsidies have had adverse impacts on other services delivered by the agricultural sector in implementing countries. In Malawi, for example, in the 2005/06 fiscal year, the government spent MK 6.9 billion on the subsidy, which was 45 percent greater than the budgeted level. In the 2006/07 and 2007/08 fiscal years, the subsidy accounted for 45 percent and 51 percent of the Ministry of Agriculture and Food Security budget, respectively. This affected the delivery of other services by the Ministry of Agriculture and Food Security, including research and extension, as the budget available for those other sectors plummeted (SOAS et al. 2008). In Nigeria, there were reports of the fertilizer subsidy's exceeding the budget for the entire agricultural sector, likely due to overinvoicing by retailers (Nagy and Edun 2002). These are potential challenges for Ghana too, as the cost of the program grew at 54 percent per year in nominal terms on average between 2008 and 2012 (see Table 5.2).

In addition to the challenges of high cost and inefficiencies at the port as well as high finance cost and poor access to credit by retailers that we identified when we analyzed the fertilizer supply chain, we highlight other major challenges below:

- *Delayed negotiations and supply of fertilizer:* Fertilizer importers raised concerns about the delayed negotiations with the government as well as delayed payments of the subsidy by the government. As a result, there is a delay in the importation and distribution of fertilizers, which makes the subsidized fertilizer unavailable to farmers during some critical periods of demand. For example, distribution of subsidized fertilizers commenced around May 12, 2011, by which time many farmers in the southern sector were far into the planting season (which starts in April), but there was no subsidized fertilizer to be purchased. Farmers looking to use fertilizer had to either buy it at the higher market price or simply go without it.
- *Uniform transportation subsidy:* The uniform transportation subsidy of GHS 5.00 per 50-kilogram bag of fertilizer, irrespective of distance of transportation, was raised as a disincentive to those who transport the fertilizer long distances, which could limit the ability of farmers in remote areas to benefit from the program. The evidence, however, does not support this claim. As Figure 5.4 shows, the application rate was not significantly different among those relatively farther away from a major market compared to those who are relatively closer. Still, it may be prudent to assess this further.

- *Cumbersome and time-consuming procedures:* The waybill system is considered cumbersome by many of the distributors and retailers whom we interviewed. Because of the requirement that only the district agricultural officer should sign the waybill, there were reported many cases of frustration when such officers were not readily available. Others raised the issue of lack of clarity about the procedures.
- *Inadequate storage facilities for fertilizers:* Many fertilizer retailers are confronted with the challenge of inadequate storage facilities for fertilizer, which is likely to place considerable limitations on fertilizer availability in areas distant from the main supply hubs.
- *Weak quality control:* Quality control of the fertilizers supplied to farmers seems weak. It was reported that in 2010, in the north, crops were damaged due to the application of a compound fertilizer (16:16:16); AEAs and other officials could not diagnose the problem or provide any solutions.

Figure 5.4 Average fertilizer usage in sampled communities, by agroecological zone



Source: Authors' calculations based on household surveys.

Notes: kg/ha = kilograms per hectare; Far = farther from a main market; Close = closer to a main market. Applicable to when fertilizer is used only.

Conclusions and Recommendations

The fertilizer subsidy is witnessing a resurgence on the continent following its withdrawal during the structural adjustment periods (see, for example, Jayne et al. 2002; Kherallah et al. 2002). The removal of subsidies is argued to have negatively affected fertilizer use as a result of increasing fertilizer prices (see, for example, Morris et al. 2007). So it seems the fertilizer subsidy has come to stay. We examined the progress of FSP in Ghana in achieving its main objectives of increasing the fertilizer application rate and increasing yields and incomes of farmers. The program started in 2008, and it was implemented as a voucher system for two years that aimed at targeting small-scale farmers, and then it was changed to a waybill receipt system, which is still in place; the subsidy is available to all farmers who purchase the subsidized fertilizer during the cropping seasons during which it is implemented. Below are the main conclusions and recommendations.

Conclusions

- The evidence from the study shows that there has been an increase in the application of fertilizers due to the subsidy program. Those farmers who applied fertilizer on their farms obtained higher yields than those who did not use any and positive net income.
- Application of fertilizers, for example, on maize, tends to be more profitable for farmers in the forest and transitional zones than for those in the coastal and guinea savannah zones.
- Implementation of the subsidy program has increased the volume of the fertilizer trade and the number of private-sector actors in the fertilizer market, although the fertilizer distribution network to various rural areas may still be underdeveloped.
- Delays in negotiations between the government and fertilizer importers delay supply and distribution of the fertilizers, thereby limiting the benefits of the program.
- The overall future economic return of the program is positive, with an estimated benefit–cost ratio of 1.7. However, this comes with high risks. Costs associated with the program overtime could easily take up a larger share of the MoFA budget (up to 35 percent by 2020). There is a possibility of significant reductions in output prices as supply expands rapidly, unless regional markets can be tapped.

Recommendations

- To forestall delays in importation and distribution of fertilizer, the government should start and complete negotiations with the importers early so that the fertilizers are in stock in the regions and districts prior to the planting season.
- To further improve widespread distribution of fertilizers, a differential or spatial transport subsidy could be considered following in-depth study of the current situation as alternative incentives to promote more retail in more remote areas. This may include provision of credit facilities to identified fertilizer retailers in remote areas to expand their trade there.
- With credit costs' being high, probably due to high perceived risks by financial institutions, MoFA, in collaboration with Ministry of Finance and Economic Planning, should examine the possibilities to develop guarantee mechanisms, thus reducing the cost of credit and consequently the cost of the subsidy.
- There is a need for strengthening the administrative and technical capacity of actors in the value chain on the procedures of the waybill system. Having alternative signatories to the waybills and receipts should be considered.
- Quality control and standards should be strengthened, including training and education in proper management, storage, handling, and use of agrochemicals, and stronger links with the research and development department should be promoted.
- To minimize the potential risks of putting a large burden on MoFA's budget, a maximum threshold should be considered beyond which no further funds would be made available under the program and, correspondingly, that would lay out a gradual and clear exit strategy over time.
- To ensure that rapid growth in output will not depress output prices significantly, policies that promote greater access to export markets in the region would help ensure positive welfare gains of the program overtime.

6. BLOCK FARMS PROGRAM (BFP)[16]

Background

The BFP, which was launched in 2009 as a pilot in several locations in six regions, is intended to bring in large tracts of arable land (in blocks) for the production of selected commodities in which the locations (regions and districts) have comparative advantage. The notion was to exploit economies of scale and ensure that the block farms benefited from subsidized mechanization services and inputs (fertilizers, improved seed, and pesticides) in the form of credit, as well as extension services, that were delivered to the farms and farmers by MoFA. By bundling the delivery of inputs and services, it is envisaged that they are delivered timely and at a lower unit cost. AEAs are supposed to work closely with the farmers so that they follow recommended practices to meet yield expectations. Following harvest, AEAs recover in kind the cost of the services and inputs provided by the government to the block farmers. The objectives of BFP are

- to generate employment among the rural poor, especially the youth—at least 60,000 farmers;
- to improve incomes among farmers by at least 50 percent;
- to increase food security through the use of science and technology, leading to increased productivity and higher yields; and
- to improve farming as a business.

In this section we evaluate BFP by way of addressing the following major research questions:

1. How does block farming, compared with other farming models (for example, nuclear, outgrower, and contract farming), reduce transaction costs associated with service delivery and accessing input and output markets?
2. To what extent has the program achieved its stated objectives?

a. Raised perceptions and practice of agriculture as a business

b. Increased employment among the youth

c. Increased productivity

3. What is the overall economic viability of the program?
4. What are emerging challenges and potential ways to address them?

Conceptual Framework and Methodological Approach

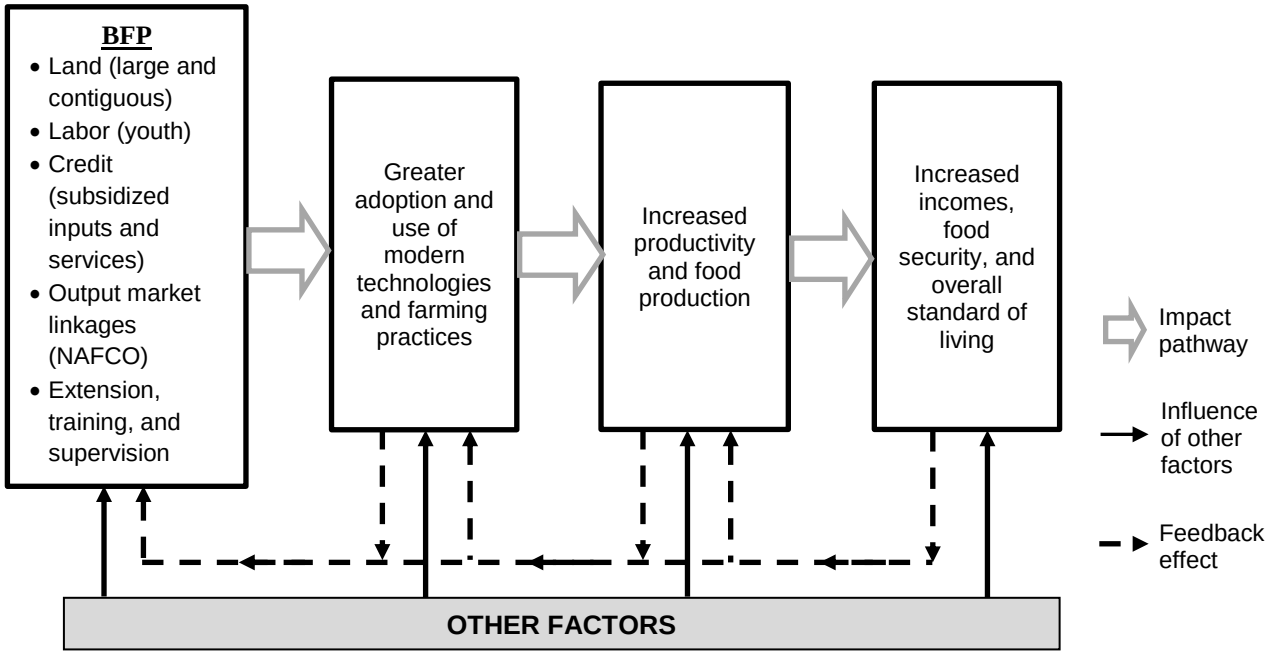
Three main assumptions/hypotheses about BFP can be established:

- Youth can be attracted into farming if they are incubated on block farms with access to inputs and services, financial services, technology and extension support, and well-paying markets for their produce.
- Following their experience and learning on block farms, farmers, including youth, will reorient their attitudes and agricultural practices to pursue farming as a business, which will raise their productivity and profits on block farms.
- Following their experience on block farms, farmers will transfer the lessons to their plots off the block farms, leading to higher returns and incomes for farmers and, consequently, increased food security and overall well-being.

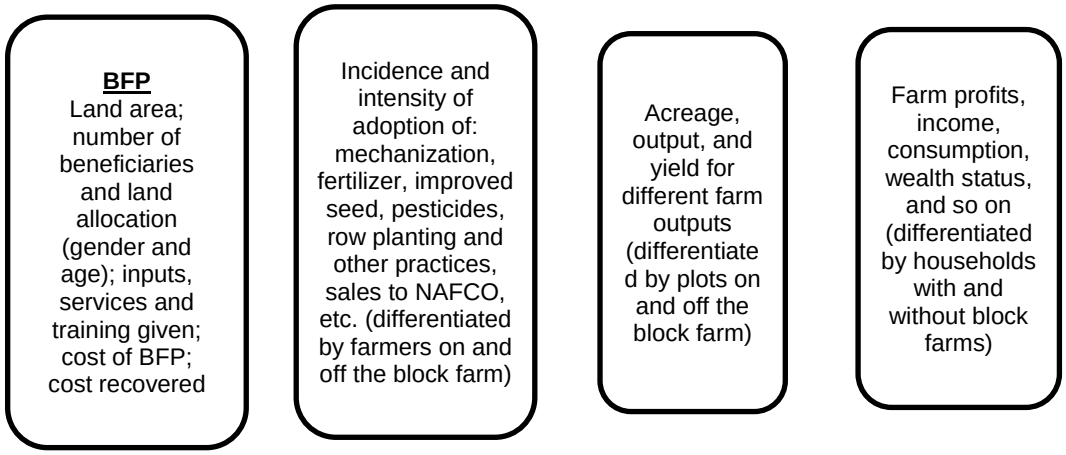
[16] This section was coauthored by Albert Tenga (GIMPA Consulting Services, Accra, Ghana), Samuel Benin (IFPRI, Davis, California, United States), and Michael Johnson (IFPRI, Washington, DC, United States). Kipo Jimah (IFPRI, Accra, Ghana) and Gamel Nasser (GIMPA Consulting Services, Accra, Ghana) provided data collection and analysis support.

These underpin the impact pathways shown in Figure 6.1 that guided the evaluation of BFP, based on how the program is expected to generate the anticipated chain of outputs, outcomes, and impact as well as the associated performance indicators on which to collect data and carry out the assessment. From the secondary data, surveys, and interviews, we collected both quantitative and qualitative data on the indicators. Many of the quantitative indicators are listed Figure 6.1. Qualitative data included satisfaction with the quality and timeliness of inputs and services provided, perception of change in well-being, and several other factors related to the block farm.

Figure 6.1 Impact pathways and associated indicators of the BFP



Respective indicators and data requirements:



Source: Authors' illustration based on program documents and literature review.
Notes: BFP = Block Farms Program; NAFCO = National Food Buffer Stock Company.

Overview of BFP

For the pilot phase of the program in 2009, potential beneficiaries of the program were initially identified, following a campaign on awareness of the program and registration of interested participants. On the block farm, participants were supported with mechanization services for land clearing, plowing, and harvesting; inputs including certified seeds, fertilizers, and pesticides; and training and extension services. AEAs then monitored the implementation of their farming activities. The strategy for the devolution of the program to the regions and districts involved communications with regional directors of MoFA to organize and implement the program by executing the following:

- Formation of regional block farm management committees
- Formation of district block farm management teams
- Identification of block farm locations and selection of crops
- Identification and registration of beneficiaries
- Sensitization and organization of youth into groups
- Development of implementation plans and schedules of operations
- Determination of inputs and services requirements (crop budgets)

The two main things taken into consideration for crops to be cultivated under the program were suitability to any of the four agroecological zones of Ghana and comparative advantage that the district/region has on the chosen crop. For the 2009 pilot program, six regions—Ashanti, Brong Ahafo, Central, Northern, Upper East, and Upper West—were selected to participate in the program, focusing on the following crops: maize seed and grain, rice seed and grain, and soybean. By 2010, all 10 regions of Ghana were participating in BFP, and more crops had been added, including sorghum, tomato, and onions. Fisheries, livestock, and agribusiness were also planned for implementation in 2010, but these never took off.

Targeted Acreage and Achievements

In the 2009 pilot phase, a total area of 14,186 ha was targeted for the six regions, but they managed to achieve 11,577 ha (or 81.6 percent) (Ghana, MoFA 2010b). Looking to scale up and to implement the program countrywide, a target of 150,000 was planned (Table 6.1), which was perceived by the national review as overly ambitious so the targets were revised downward. For the Northern region, for example, the initial target of 47,400 ha was slashed by more than half to 20,688 ha, of which the region managed to achieve only 69 percent (Table 6.2), with rice and maize being the focus (Figure 6.2).

Table 6.1 Initial planned land area of block farms by region (in hectares), 2010

Crop	NR	UER	UWR	BAR	CR	AR	ER	VR	WR	GAR	National
Maize grain	7,000	—	5,000	11,650	7,000	6,000	6,000	5,000	500	—	48,150
Maize seed	400	—	300	500	500	400	400	400	—	—	2,900
Rice grain	35,000	12,000	6,000	2,000	—	500	500	5,000	1,500	400	62,900
Rice seed	2,000	2,000	200	200	150	100	—	400	200	750	6,000
Soya bean	1,000	1,000	1,000	5,000	—	400	400	400	—	—	9,200
Sorghum	1,500	400	1,500	400	—	1,000	500	500	200	100	11,100
Tomato	—	4,000	—	4,000	100	2,000	400	200	200	100	11,000
Onion	500	2,000	—	—	50	—	—	1,000	—	500	4,050
Total	47,400	21,400	14,000	23,750	7,800	10,400	8,200	12,900	2,400	1,750	150,000

Source: Ghana, MoFA (2010b).

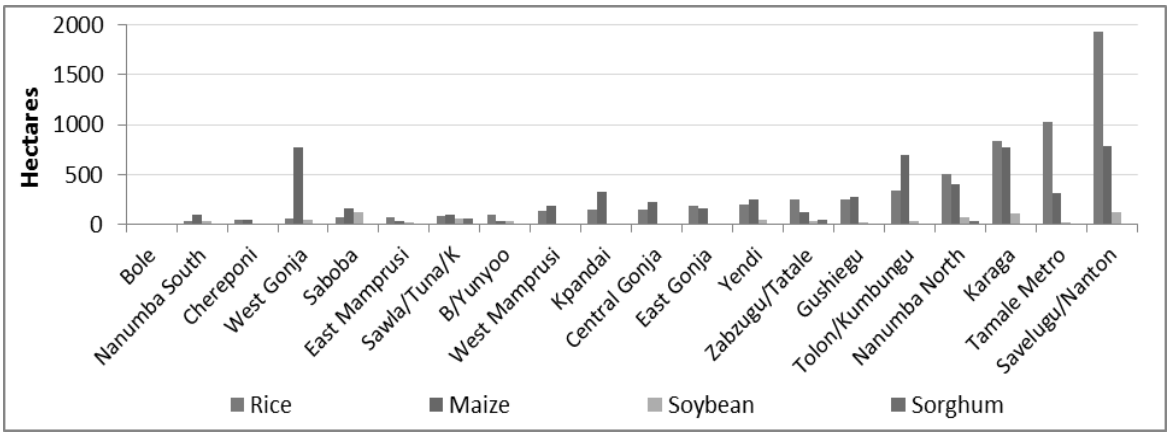
Notes: NR = Northern region; UER = Upper East region; UWR = Upper West region; BAR = Brong Ahafo region; CR = Central region; AR = Ashanti region; ER = Eastern region; VR = Volta region; WR = Western region; GAR = Greater Accra region. Dashes indicate no data.

Table 6.2 Revised land area target and achievement in the Northern region, 2010

Crop	National Target (Hectares)	Achievement (Hectares)	Percentage Achieved
Maize grain	5,498	5,619	102
Maize seed	1,500	374	25
Rice grain	10,000	6,715	67
Rice seed	1,500	588	39
Soybean grain	1,440	855	59
Soybean seed	50	16	33
Sorghum	700	120	17
Total	20,688	14,288	69

Source: Ministry of Food and Agriculture chief director's presentation on the Block Farms Program (2011b).

Figure 6.2 Block farm sizes (in hectares) for selected crops in the Northern region by district, 2010



Source: Ministry of Food and Agriculture chief director's presentation on the Block Farms Program (Ghana, MoFA 2011b).

Participation of MMDAs in the Program

We found that nearly all of the MMDAs were participating in the program, except in the Ashanti and Greater Accra regions, where the level of participation was less than 75 percent of the MMDAs in the region (Table 6.3). As expected, the level of participation varied across districts, depending on several factors including, foremost, availability of land, which mirrors population pressure, followed by agricultural potential and availability of mechanization or AMSECs in the district. For the 19 participating districts in the Northern region, for example, Savelugu-Nanton and a handful of others account for the bulk of the block farms in the region.

Table 6.3 Number of metropolitan, MMDAs participating in the BFP, 2010

Region	Total Number of MMDAs	Number of MMDAs with Block Farms	Percentage of MMDAs Participating
Ashanti	27	20	74
Brong Ahafo	22	22	100
Central	17	17	100
Greater Accra	10	6	60
Eastern	21	21	100
Northern	20	19	95
Upper East	9	9	100
Upper West	9	9	100
Volta	18	18	100
Western	17	17	100
Total MMDAs	170	163	96

Source: Based on information received from Ghana, MoFA (2011b).

Note: MMDA = municipal, and district assemblies; BFP = Block Farms Program.

Management of the Program and the Block Farms

Following agreements on operations and management of block farms in February 2010, the following management systems were recommended (Ghana, MoFA 2010b):

- Agricultural desk officers who will be solely responsible for the block farms, to be supervised by the regional directors
- Project coordinators outside MoFA to be supervised by regional directors
- Project management committees at the regional, district, and community levels to do the necessary sensitization and management of the program
- A management board at the community level involving chief farmers, opinion leaders, and AEA to be supervised by the district directors

It was also agreed that the regional directors would report to the national coordinator of BFP, who would also report to the national coordinator of the Youth in Agriculture Program.

In the scant background documentation on the program that we were able to access, there was little information about economic analysis; information was limited mostly to annual targets and progress about acreage, production levels, and input cost recoveries. Issues of sustainability were referred to in only a general way (Ghana, MoFA 2011c). There were no concrete sustainability measures of how beneficiary farmers will exit or graduate from the block farm and continue implementing its principles and practices on their own. In our interviews, virtually all the farmers who are currently part of block farms said they would want to remain on the block farms forever. There are some reasons for this. First, not all farmers are looking to pay back the cost of the inputs, which suggests that it could be difficult for those farmers to purchase the inputs on their own and they therefore do not want to leave the block farms. Although the district MoFA staff members have started to remove farmers who do not repay from the block farms as a lesson to others, the recoveries are still generally poor. Second, the MoFA district staff members admitted to selecting their best-performing farmers into the block farms to increase the rate of recovery, which they are under pressure to deliver. This undermines the project's objective of promoting youth employment because youth tend to be inexperienced and be underperformers, which makes them risky in the eyes of AEAs. Therefore, a situation of having the best-performing farmers permanently on the block farms, if the district is looking to effortlessly demonstrate good performance in cost recovery, is inevitable.

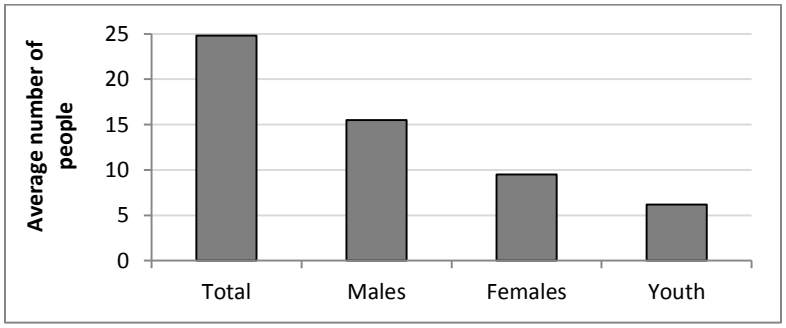
Assessing Achievement of the Program's Objectives

Youth Participation in Block Farming

The National Youth Policy of Ghana defines youth to include the period between childhood and adulthood, and it includes people between the ages of 15 and 35. The policy acknowledges the vulnerability of young people; it also recognizes their potential, numbers, vitality, and capabilities as change agents for national transformation. The policy envisages the empowerment of youth to participate in the national development agenda, and a key component of the policy is developing strategies to attract young people, especially youth in the informal sector, into agriculture (Ministry of Youth and Sports 2010). The motivations of youth to engage in a livelihood activity including agriculture are largely driven by the future prospects they anticipate from the activity. Young people are generally interested in getting quick money (National Youth Policy of Ghana 2010), and as such attracting and sustaining their participation in agriculture will require arousing their interest in agriculture through improving access to technology and encouraging technology adoption.

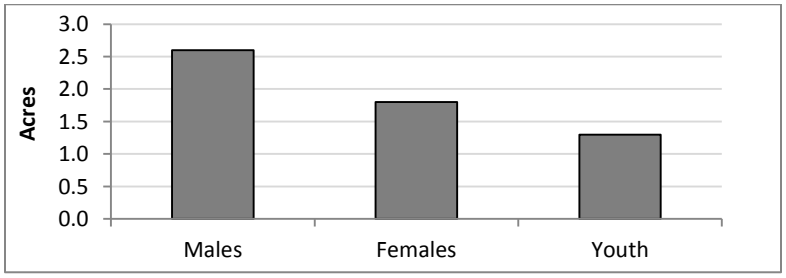
In the surveys, we followed the above definition of youth, which was consistent with the various definitions of youth given by the farmers; in most cases this was up to 35 years of age, with a few older than 35 years but not exceeding 45 years. We found that out of an average of 25 farmers participating in a block farm in a community, 6 of them, or 25 percent, were characterized as youth (Figure 6.3). Youth cultivated only slightly more than an acre on average, compared to 1.5 acres for adult females and 2.5 acres for adult males (Figure 6.4).

Figure 6.3 Average number of people who form a block farm



Source: Authors' calculations from the survey data.

Figure 6.4 Average acreages cultivated by members of the block farm

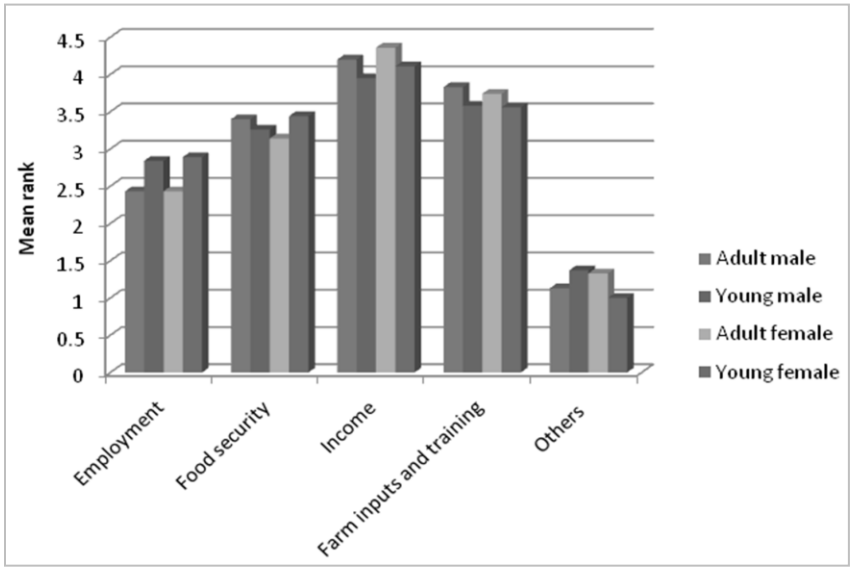


Source: Calculated from field survey data.

Various reasons were advanced by different participants (adults and youth, males and females) for joining BFP. The main reason across the board was for increasing or securing income, which was followed by access to farm inputs, and then food security (see Figure 6.5). Employment's not being a major reason for youth has introduced another challenge for the sector, demonstrating that high levels of

income are necessary for youth to get interested in it. Various reasons were advanced by different stakeholders of the value chain as to low youth participation: Although farmers perceived lack of land and high requirements by MoFA that youth could not meet, MoFA staff members generally perceived youth as risky or thought that youth did not perceive agriculture as a lucrative venture—see Table 6.4 for details. Of course, the major reasons cited are correlated with employment as with one another, so these results should be interpreted in this context. More research is needed to better understand the motivations of youth about agriculture as a way of life; we need to explore further how BFP, as a temporary program, can help transform the employment aspirations of youth in the long run.

Figure 6.5 Reasons for joining the block farm



Source: Authors' calculations based on field survey data.
Notes: For rank, 1 = *least important* through 5 = *most important.*

Table 6.4 Reasons for low participation of youth in block farms

Stakeholder	Reasons
Farmers	• Limited land availability • Own commitment required by some districts as part of the criteria for qualifying to join a block, which some of the youth may not have • Low market prices vis-à-vis youth expecting high income from farming
Ministry of Food and Agriculture district (and some regional) staff	• Youth are a risk to good performance • Prefer already existing, very-well-performing farmers to ensure good performance by the district • Many of the youth applying for or being sent to block farms are political groups • Limited land availability and land tenure problem • Fear of even poorer investment recovery when working with "unknown and untested youth farmers" • Youth are not interested in agriculture because of lack of market • Youth are more interested in "quick cash" • Block Farms Program not specifically targeted at youth—it is not limited to youth but open to all farmers • Some old people have taken over the Block Farms Program and crowded out youth • Youth would like to get higher incomes and are not getting it from agriculture • Youth think that agriculture is not profitable
Input (fertilizer) dealers	• Some farmers, including youth, receive block farm inputs and resell them, especially fertilizers

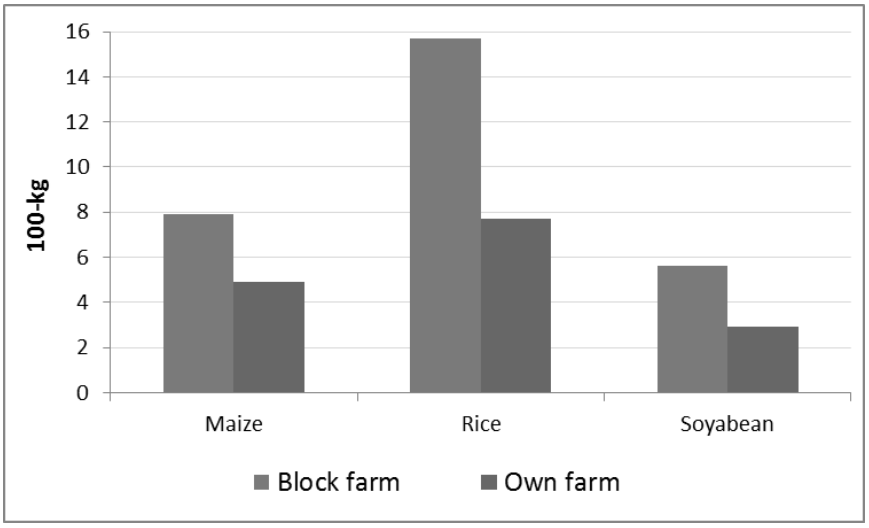
Source: Field surveys and expert interviews.

As other studies show, youth do not find agriculture to be profitable because of low yields and high postharvest losses, among other reasons. A survey of cocoa farmers in Ghana showed parents' apathy about their children's venturing into farming; parents said they prefer their children to continue their education and pick up good jobs in the cities so that they can send remittances for their livelihoods (see, for example, Asenso-Okyere et al. 2011). When they engage, youth are more likely to cultivate crops with short gestation periods and high market values, such as vegetables. This behavior also reflects the tendency of youth to face greater land tenure insecurity.

Crop Yields on and off the Block Farms

Figure 6.6 shows yields of the three main crops (maize, rice, and soya bean) targeted by the program. Basically, average yields were greater on the block farms than off them, with the difference for rice and soya beans being about double whereas that for maize was about 30 percent. As anticipated, the main reasons were greater fertilizer use, correct and timely application of inputs, readily available extension services, and the general following of recommended practices including row planting and spacing.

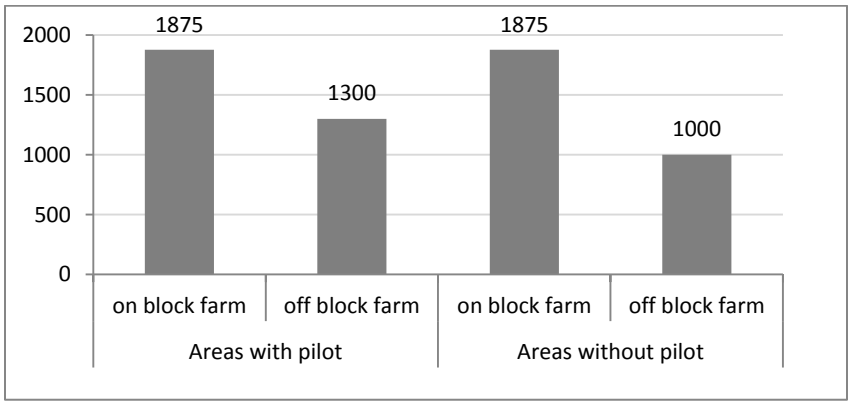
Figure 6.6 Average crop yields (100 kilograms per acre) on and off block farms



Source: Authors' calculations based on field survey data.
Note: kg = kilogram.

However, the more interesting question is whether those participating in BFP are indeed transferring the knowledge and experience to their own farms. This is one of the key questions to answer in assessing the impact of the program, that is, testing the learning effect, which we do by analyzing average yields on own plots of farmers who have been participating in the program for a long time (that is, where there was a pilot program) compared to similar plots of farmers who recently started participating in the program (that is, where there was no pilot program). As Figure 6.7 shows, although average maize yield is the same on the block farms in both areas (that is, where there was a pilot and where there was not), the average yield is higher by about 30 percent on own farms where there was a pilot than where there was not, suggesting that there is some learning effect, which takes times to materialize.

Figure 6.7 Average maize yields (kilograms per hectare) on and off block farms



Source: Authors' calculations based on field survey data.

Note: This was done for communities in the northern part of Ghana only, where there were districts in which the pilot program had been implemented as well as others in which it had not.

Effectiveness and Efficiency of the Program

Operational Definition of a Block Farm

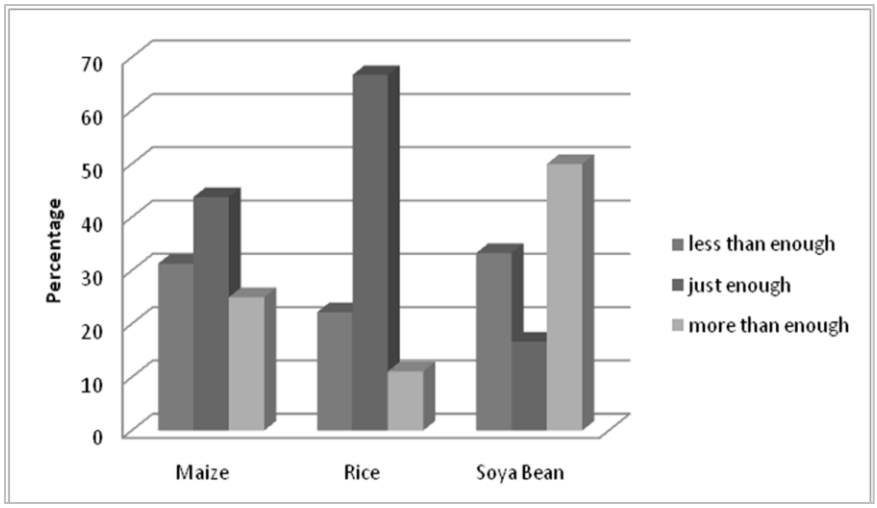
The conceptual notion of a block farm as having several farmers on a single, large piece of land was not always observed. The existing land tenure system does not allow easy procurement of this type of farmland by a single entity. With almost 80 percent of all land held outside state ownership, it is not easy to see how the government can acquire and make large tracts of land available for agriculture. In many cases, the block farm was often a collection of small pieces of land owned by neighboring farmers (with farms bordering each other) who had gotten together to form a block farm. We also observed cases wherein the farms were not close to each other at all, that is, they are still fragmented and far from each other. Therefore, the notion of delivering inputs and services at low unit costs is called into question, particularly for mechanization and extension services. Invariably, getting access to interest-free credit in the form of subsidized inputs and mechanization services as a package seems to be the motivation of farmers for participating in the program. Without any land being available via the program for interested participants, it will be difficult to involve new farmers, particularly those without land of their own, including youth. The Ejura block farms in the Ejura-Sekyedumase district present a unique case with 1,000 participants. This is due to the defunct government-owned Ejura Farms Company Limited and distribution of large tracts of land to former employees of the company. They also enjoy extensive tractor services and warehousing and storage facilities within a vibrant farmers market with large numbers of international customers from the West Africa subregion.

Nevertheless, flexibility in implementation of the program seems to have been key in the success of the program so far. The concept of *farm clusters*, following the popular crop clusters concept (Porter 1998, 199) in which a cluster is defined as "a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities" better describes how block farms are operated. In advanced cases, the cluster includes associated institutions like universities, standards agencies, and trade associations. Industrial clusters, for example, are formed by businesses and industries linked vertically or horizontally. Government agencies play a key role in shaping the business environment for the cluster. Besides geographical proximity, other key characteristics of a cluster include the accumulation of interrelated actors and networks and a common value-added product. The crop clusters concept has been applied to the cocoa, cashew, and shea nut subsectors in Ghana (Hueck 2011). With a number of individual farmers or households whose farms are contiguous to each other coming together to form a block farm, the rationale for BFP, that is, economies of scale and low unit cost of input and service delivery, is largely preserved.

Adequacy, Timeliness, and Quality of Services

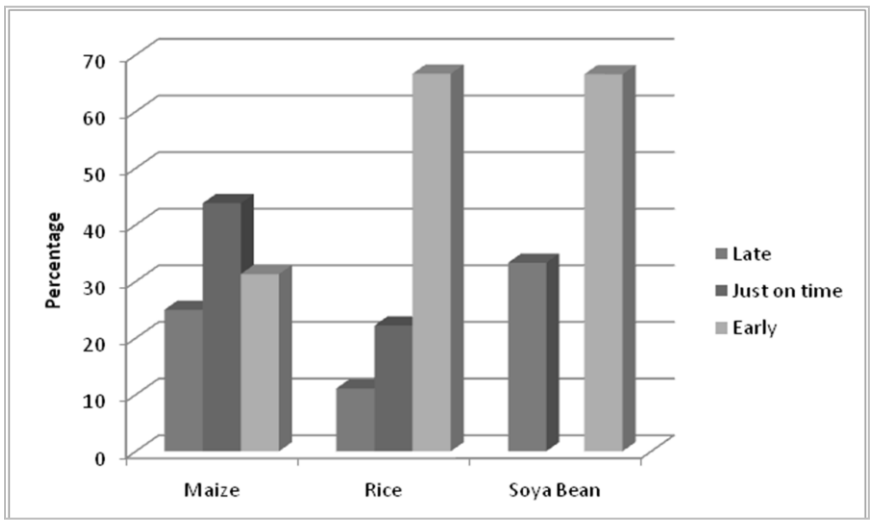
We asked farmers and MoFA staff members about their perceptions of the adequacy, quality, and timeliness of delivery of access and use of services. Detailed results are shown in Figures 6.8 through 6.15. The most striking results that point out areas needing the most attention for improvement are timeliness of inputs, which many farmers perceived to be late (Figure 6.12), and adequacy of land and engagement of youth, with which MoFA staff members were dissatisfied (Figures 6.14 and 6.15, respectively). The issues of lack of land and inability to stimulate youth to take up farming as a profession are concerning because they are supposed to be the bedrock of BFP. Otherwise, the majority of farmers and MoFA staff members were satisfied with the adequacy and quality of the inputs and services obtained via the program.

Figure 6.8 Farmers' perceptions of adequacy of farmland for crops (percentage of communities)



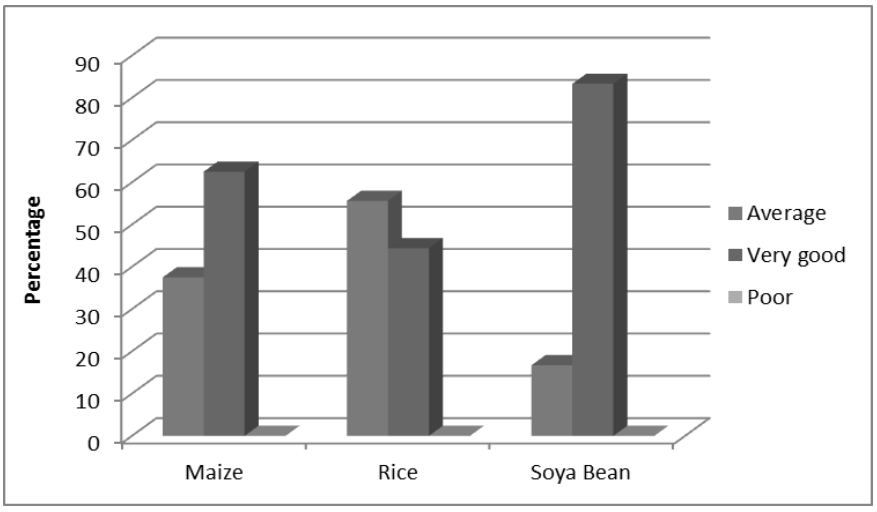
Source: Authors' calculations based on field survey data.

Figure 6.9 Farmers' perceptions of timeliness of farmland distribution (percentage of communities)



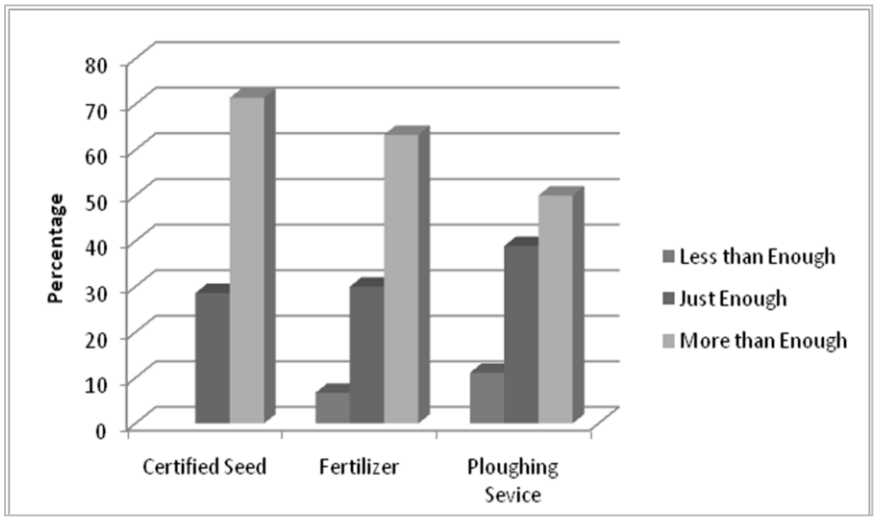
Source: Authors' calculations based on field survey data.

Figure 6.10 Farmers' perceptions of quality of farmland (percentage of communities)



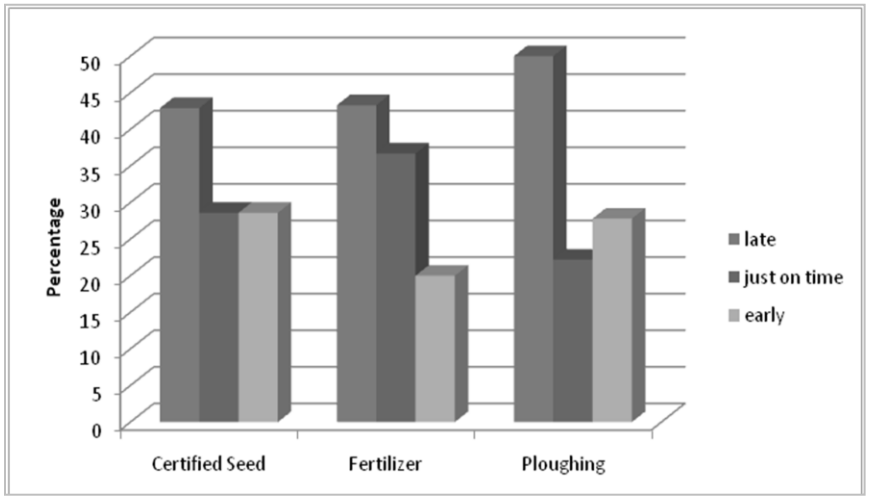
Source: Authors' calculations based on field survey data.

Figure 6.11 Farmers' perceptions of adequacy of inputs/services (percentage of communities)



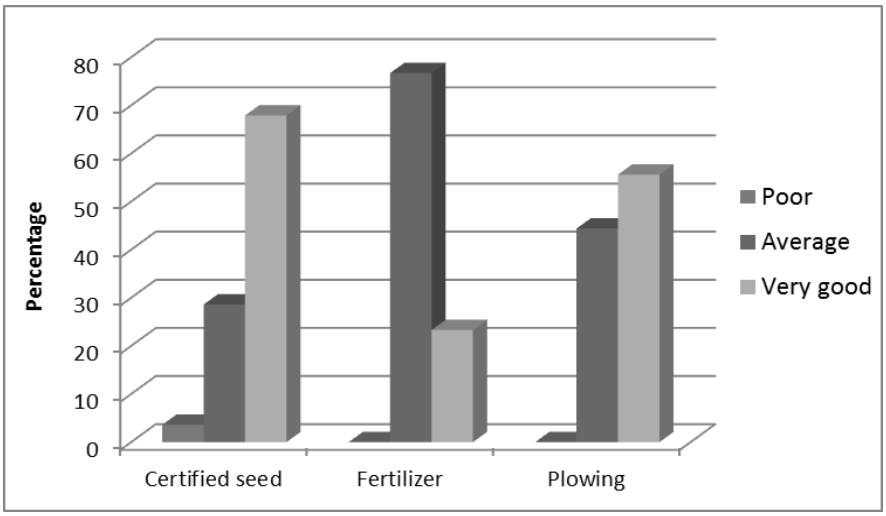
Source: Authors' calculations based on field survey data.

Figure 6.12 Farmers' perceptions of timeliness of inputs/service (percentage of communities)



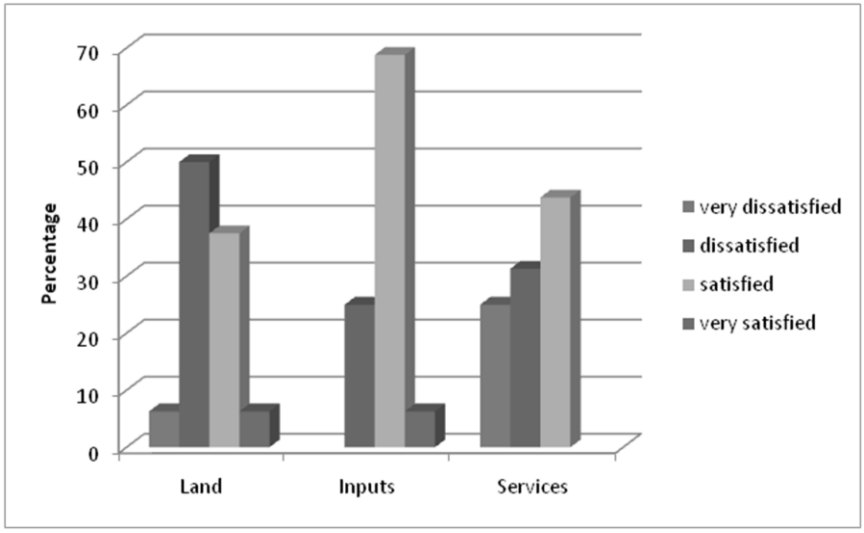
Source: Authors' calculations based on field survey data.

Figure 6.13 Farmers' perceptions of quality of inputs/service (percentage of communities)



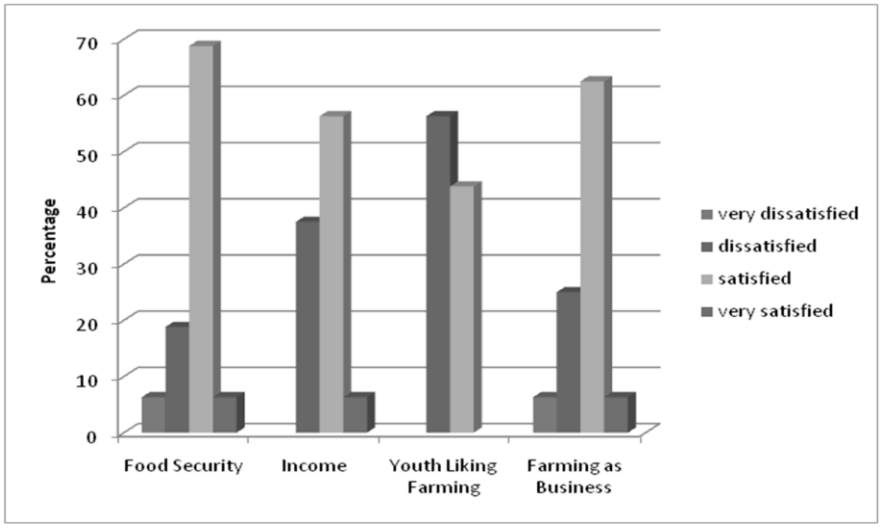
Source: Authors' calculations based on field survey data.

Figure 6.14 MoFA staff's satisfaction with provision of land, inputs, and services to farmers on the block farms (percentage of staff)



Source: Authors' calculations based on field survey data.
Note: MoFA = Ministry of Food and Agriculture.

Figure 6.15 MoFA staff's satisfaction with achieving objectives of the BFP (percentage of staff)



Source: Authors' calculations based on field survey data.
Note: MoFA = Ministry of Food and Agriculture.

Cost Recovery and Financial Analysis

An area of major concern is the level of recovery of the cost of inputs (certified seed, fertilizer, and pesticides) and mechanization services supplied to farmers on the block farm. These were mostly in-kind recoveries—three bags of maize, for example—with a few cases of cash payments. In general, we found that the reports and records of recoveries were not adequately organized to be able to obtain a clear picture of the level of recoveries. In several cases, the reported recoveries did not match up with other accompanying information on the amount spent and the outstanding balance. Based on the limited information that we obtained, it was clear that the reported recoveries were low across the board (regions and districts), as the example for 2009 shows in Table 6.5. Except in the Ashanti region, recoveries were up to only a quarter of what was expected. Therefore, the area of cost recoveries calls for further intensification of efforts.

Table 6.5 Expenditures made on and recovered from the block farms (in GHS), 2009

Region	Expenditures Expected to Be Recovered	Expenditures Recovered	Balance Outstanding	Expenditures Recovered (%)
Upper East	212,458	39,693	174,447	18.7
Upper West[a]	189,049	120,663	116,280	n.a.
Northern	1,322,589	346,238	893,303	26.2
Brong Ahafo	785,191	59,521	725,670	7.6
Ashanti	113,070	79,695	33,345	70.5
Central	14,838	n.a.	n.a.	n.a.
Total	2,637,193	n.a.	n.a.	n.a.

Source: Ghana, MoFA (various documents on summary of block farms production and recoveries in 2009).
Note: GHS = Ghanain cedi; n.a. = not available. [a] Information provided did not match up.

Assessment of the Economic Viability of BFP

As in the other programs, a number of key assumptions were made to assess the economic viability of BFP ex ante. One important observation is the special instance of block farms in accessing high-value inputs such as mechanization, improved seeds, fertilizer, chemicals, and output markets. It is special because the program is intended not only to help expand production but to provide a learning environment for promoting commercialization and other improved farming practices, as an on-farm demonstration plot. Ultimately, the programs are intended to help change attitudes about the perception of agriculture as a profitable and viable commercial livelihood, especially among youth. As such, we do not expect the block farms to expand much and impose a growth rate in area coverage of about 10 percent per year until 2020. The program is therefore less likely to make a big dent in national production levels.

Assuming current recovery rates, and together with our assumptions about both direct and indirect costs in Appendix A, the growth in acreage will lead to increasing program costs over time. Results in Table 6.6 show a more than doubling of total costs by 2020—from GHS 15.9 million in 2010 (of which GHS 3.6 million and GHS 12.3 million are direct and indirect costs, respectively) to GHS 39.1 million by 2020 (of which GHS 9.8 million and GHS 29.3 million are direct and indirect costs, respectively).

Table 6.6 Summary of results of the economic analysis of BFP

Scenario Elasticity of Demand	A –0.4			B –0.7		
	2010	2020	Growth	2010	2020	Growth
Yield without program (kg/ha)	1,714	1,893	1.0			
Yield with program (kg/ha)	2,200	2,546	1.5			
Adoption rate (%)	2.9	7.6	9.7			
Unit production cost (2011 GHS/ha)	320	448	3.4			
Resulting production and price changes						
National production without any programs (1,000 mt)	1,669	2,247	3.0	1,669	2,247	3.0
National production with Block Farms Program (1,000 mt)	1,704	2,395	3.5	1,684	2,312	3.2
Share of BF as share of national production (%)	2.1	6.6	12.0	0.9	2.9	12.0
Maize prices without BF, at autarky (2011 GHS/kg)	0.55	0.55	0.0	0.55	0.55	0.0
Maize prices with BF, at autarky (2011 GHS/kg)	0.53	0.46	–1.3	0.55	0.53	–0.3
Change in program costs and coverage						
Increase in area under BF (1,000 ha)	129.3	353.7	10.3			
Total cost of program (million 2011 GHS)	15.9	39.1	9.7			
Direct costs of program (million 2011 GHS)	3.6	9.8	10.3			
Indirect costs of program (million 2011 GHS)	12.3	29.3	9.6			
Total cost of program as share of MoFA's budget (%)	7.0	10.2				
Direct costs as share of MoFA's investment budget (%)	8.5	8.8				
Program net worth (with BF and open trade)						
Net economic benefits (million 2011 GHS)	1.1	36.3	33.9	0.8	32.4	35.1
Discounted net worth (million 2011 GHS)		83.6			75.2	
Benefit–cost ratio		1.5			1.4	
Program net worth (with BF and at autarky)						
Net economic benefits (million 2011 GHS)	0.4	23.8	38.0	0.8	29.5	35.0
Discounted net worth (million 2011 GHS)		57.3			69.1	
Benefit–cost ratio		1.3			1.4	

Source: Authors' assumptions and calculations based on literature review, project reports, and surveys.

Notes: kg = kilograms; ha = hectare; GHS = Ghanaian cedi; mt = metric tons; BF = block farms; MoFA = Ministry of Food and Agriculture. Scenario A represents buyers' being less sensitive to price changes, compared to scenario B, wherein buyers are more sensitive to price changes. Values in the column headed Growth are annual percentage growth rates.

Benefits flowing from BFP come from the maize yield increases. Because we focus on only a single commodity, these are only partial benefits. Adoption rates refer to the share of block farm acreage to the national maize area, increasing from a base of 2.9 percent in 2010 to 7.6 percent by 2010 (assuming that total maize area grows at a rate of 2 percent per year). Yield differences are compared with a national average. The result is an increasing share of national maize output coming from block farms, from 2.1 to 6.6 percent by 2020 (under the lower own-price elasticity of demand, –0.4) or 0.9 to 2.9 percent (under the higher own-price elasticity of demand, –0.7).

The total net worth to society of BFP is quite substantial: valued at GHS 83.6 million in constant 2011 prices and discounted at an interest rate of 12.5 percent, the average return to capital investment in Ghana—under the lower own-price elasticity of demand of –0.4 and GHS 75.2 million—under the higher own-price elasticity of demand of –0.7. This is assuming that domestic prices are not affected as long as there is sufficient market to export any excess supply.

Overall, the effect on domestic maize prices under the condition of no trade is small given the program's low share in total production, falling between 0.3 percent and 1.3 percent per year, depending on the demand elasticity assumption. Nevertheless, the falling prices can potentially affect the net worth of the project, falling to GHS 57.3 million from GHS 83.6 million, for example. The benefit–cost ratio remains positive, including the internal rate of return. Benefit–cost ratios range between 1.3 and 1.4.

Lessons and Challenges of the Program

We asked both farmers and MoFA staff members about their experiences with BFP, looking at lessons and success on one hand and challenges and opportunities on the other hand—see Tables 6.7 and 6.8 for details. Both farmers and MoFA staff members attest to the success of the program, with farmers' using greater amounts of inputs and mechanization services as well as adopting recommended practices promoted by extension, which together has led to greater productivity and production. Farmers participating in the program appreciate MoFA staff members more now because they deliver the technologies that they promote and then work more closely with them on adopting the recommendations. Similarly, MoFA staff members, particularly AEAs, are now more excited about their work because they are observing the positive outcomes of their work: greater productivity and production.

Table 6.7 Farmers' perspectives on lessons and challenges of the BFP

Lessons and Successes	Challenges and Recommended Changes
• Group learning and participation are helpful. • Inputs are always ensured. • We now use more fertilizer. • We get quality seeds. • Modernization of our farming is occurring. • There is an increase in yield due to adoption of new technology. • There is an increase in income levels through increased acreages and production. • There is an increase in food production, which is enhancing or increasing food security and employment. • There is no borrowing of money anymore.	• Early delivery of inputs, especially fertilizer, is much needed. • Improved access to land is needed. • Increased farm acreages are needed. • More tractors are needed—if possible one for each village. • Provision of harvesters is needed. • Provision of dryers is needed. • Maize shelling machines should be provided. • There should be a group guarantee for recovery to apply group/peer pressure and enforce recovery to avoid losing our block farms. • The opportunity to involve the National Food Buffer Stock Company in the repayment should be considered.

Source: Focus group surveys.

Note: BFP = Block Farms Program

There are also challenges, particularly low cost recovery, increased demand for postharvest technologies and services, and lack of commensurate support for AEAs in delivering their increased workload. The issue of low cost recovery seems to be a moral one rather than the inability of farmers to pay back. This is because—with the exception of a few isolated cases in which there was crop failure due to unanticipated pest infestation or other problems that MoFA staff could not address, thus wiping out the produce from which to potentially recover the cost—both farmers and MoFA staff members agree that the output obtained far outweighs the cost (which for maize, for example, is valued at 3 bags out of the average 8 to 10 bags of output). Thus, farmers should have no problem paying back unless they see this as a free lunch, in which case they may have made up their minds from the start to not pay back their loans. Nevertheless, political interference and, perhaps, insufficient sensitization and commitment at the farm group formation stage are also contributing factors in the low cost recovery.

Table 6.8 MoFA staff's perspectives on lessons and challenges of the BFPs

Lessons and Successes	Challenges and Recommended Changes
• There is good intervention for the whole value chain; technology adoption is faster and higher now. • BFP has made MoFA active to reach out to the farmers more now than before. • Farmers for the first time have better access to inputs as credit without interest, and there is technology transfer, making it a unique package. • BFP is reviving the communal spirit, making farmers more business oriented; group formation/BFP enhances extension delivery. • BFP has improved the level of appreciation of AEAs. • Food security is improving: Farmers' output has increased from an average of 4 maxi bags of maize per acre to 10 maxi bags per acre. • Some farmers obtained 68 maxi bags of paddy rice from only four acres using the jasmine variety. • After paying 85–100 percent of the loans, some farmers still made a lot of money and bought building materials and motorbikes (confirmed by the farmers in districts such as Yendi, Tamale, and Ejura-Sekyedumase). • Some BFP participants increased their acreages from 20 to 60 (at Savelugu-Nanton, for example) and were able to buy their own tractors. • There is a reduction in social vices, and even the poorer youth are now able to go into farming. • Some farmers assessed the value of BFP against other programs and opted out of those programs to join BFP.	• Plowing of the block farms takes place too late, and supply of the inputs, such as certified seeds and fertilizers, is late. • Plowing services are not well done. The task should not be given to a few operators, as the few cannot reach out to many farmers at the same time. • The nature of land fragmentation makes monitoring difficult. Where government land is limited for BFP, farmers should be allowed to use their lands to expand and make use of the acquired technologies and other inputs. • AEAs have more monitoring and outreach work but no increase in support to do this effectively: (1) transport allowance has been the same during the past three years, and (2) tools (protective dresses, moisture meters, GPS instruments, and so on) are lacking. • There is inadequate staff to match increased work load. • Cost recovery is challenging, as farmers manage to harvest without knowledge of the AEAs. There should be more sensitization on paying back at the block farms group formation stage. • There is diversion of inputs from the block farms (to own farms or to sell). • Political influence also increases the default rate. • Prices at the time of harvest are too low to cover farming costs. • With increased output in maize, for example, there is a lack of maize shelling machines (farmers have also requested this—see Table 6.7).

Source: Focus group surveys.

Note: MoFA = Ministry of Food and Agriculture; BFP = Block Farms Program; AEA = agricultural extension agents.

Conclusions and Recommendations

Based on our observations and analysis, a few key conclusions and recommendations can be made.

- There is keen interest in BFP on the part of farmers. Those participating in the program have attested to the benefits, including access to low-cost credit in the form of inputs and mechanization services, which have greater productivity, production, and incomes. Therefore, farmers need to be encouraged to pay back; otherwise it is difficult to see how the government can sustain the program. Similarly, it is difficult to see how farmers will buy and pay for such inputs and services on their own.
- Youth are not a strong focus of the program as it was conceived of when it was initiated. Because they are inexperienced, youth tend to be a risky venture for being able to properly manage the farms and the inputs and services given to meet expectations, given the pressure AEAs and district MoFA staff members face in delivering results and recoveries. Special programs should be designed to get youth enthused about agriculture and facilitate their access to productive resources.
- Another area needing attention is the increased demand for postharvest technologies and services as a result of the greater productivity and production, particularly of maize.
- To keep the enthusiasm of MoFA ground staff members going, there is a need to beef up logistical support, particularly transportation and protective gear, for AEAs in delivering

their increased workload. This could be included in the cost of the inputs and services given to farmers.

- There is a need to evaluate and perhaps reorganize the role of AEAs in BFP management as AEAs will be progressively transferred to District Assemblies.
- The positive economic returns of the program primarily capture the gains from productivity improvement on the block farms as well as its effects on total economic welfare as consumers benefit from stable supplies and prices and producers benefit from lower unit costs of production. Benefits also come from the program's enjoying significant input subsidies for fertilizer, credit, and extension. The primary issue, therefore, as in FSP, is the fiscal sustainability of the program. As long as the program can refrain from expanding too fast and maintain strong recovery rates of credit, it can serve an important public good in training future commercial farmers among the youth while keeping costs at a reasonable share of the total budget (about 10 percent). When considering the function of training future commercial farmers, limits could be set, for example, on the period (number of years) any farmer could be part of BFP.

7. THE NATIONAL FOOD BUFFER STOCK COMPANY (NAFCO) PROGRAM[17]

Background

The main idea behind the establishment of NAFCO by the government was the management of an emergency food security stockpile, which was also motivated by the anticipated increases in production as a result of implementing the three subsidy programs (AMSEC, FSP, and BFP). As such, a major objective of the NAFCO program is to insulate farmers against losses resulting from the anticipated increases in production. The government set up NAFCO in 2009 with the following mandate:

- To guarantee farmers an assured income by providing a minimum guaranteed price and ready market
- To mop up excess produce from all farmers to reduce postharvest losses resulting from spoilage due to poor storage, thereby protecting farm incomes
- To purchase, sell, preserve, and distribute foodstuffs
- To employ a buffer stock mechanism to ensure stability in demand and supply
- To expand the demand for food grown in Ghana by selling to state institutions such as the military, schools, hospitals, and prisons
- To manage the government's emergency food security
- To facilitate the export of excess stock
- To carry out such other activities that are incidental to the attainment of the above objects or such other duties as may from time to time be assigned by the Minister of Food and Agriculture

This section evaluates the NAFCO program by way of answering the following major assessment questions:

1. How have lessons from the erstwhile Ghana Food Distribution Company (GFDC) contributed to the design and implementation of NAFCO, and how does NAFCO (institutional setup and operations) compare with other price stabilization schemes?
2. How has NAFCO affected the development of domestic grain markets?
3. To what extent has NAFCO achieved its stated objectives?

a. Stabilized prices

b. Created employment and improved private-sector development

c. Improved emergency food reserve

4. What is the overall economic viability of the program?
5. What are emerging challenges and potential ways to address them?

Conceptual Framework and Methodological Approach

Theoretically, a buffer stock scheme is used as a commodity storage for stabilizing prices in an entire economy or, more commonly, in an individual commodity or produce market (Bellemare, Barrett, and Just 2010). Specifically, commodities are bought when there is a surplus in the economy, are stored, and then are sold from these stores when there are economic shortages in the economy. Most buffer stock schemes work along two main lines: First, two prices are determined, a floor (minimum) and a ceiling (maximum) price. When the market price drops close to the floor price and is anticipated to drop below it (which typically occurs around harvest of the main season's crop), the scheme operator will start buying

[17] This section was coauthored by Emmanuel Abokyi (GIMPA Consulting Services, Accra, Ghana) and Michael Johnson (IFPRI, Washington, DC, United States). Kipo Jimah (IFPRI, Accra, Ghana) provided data collection support.

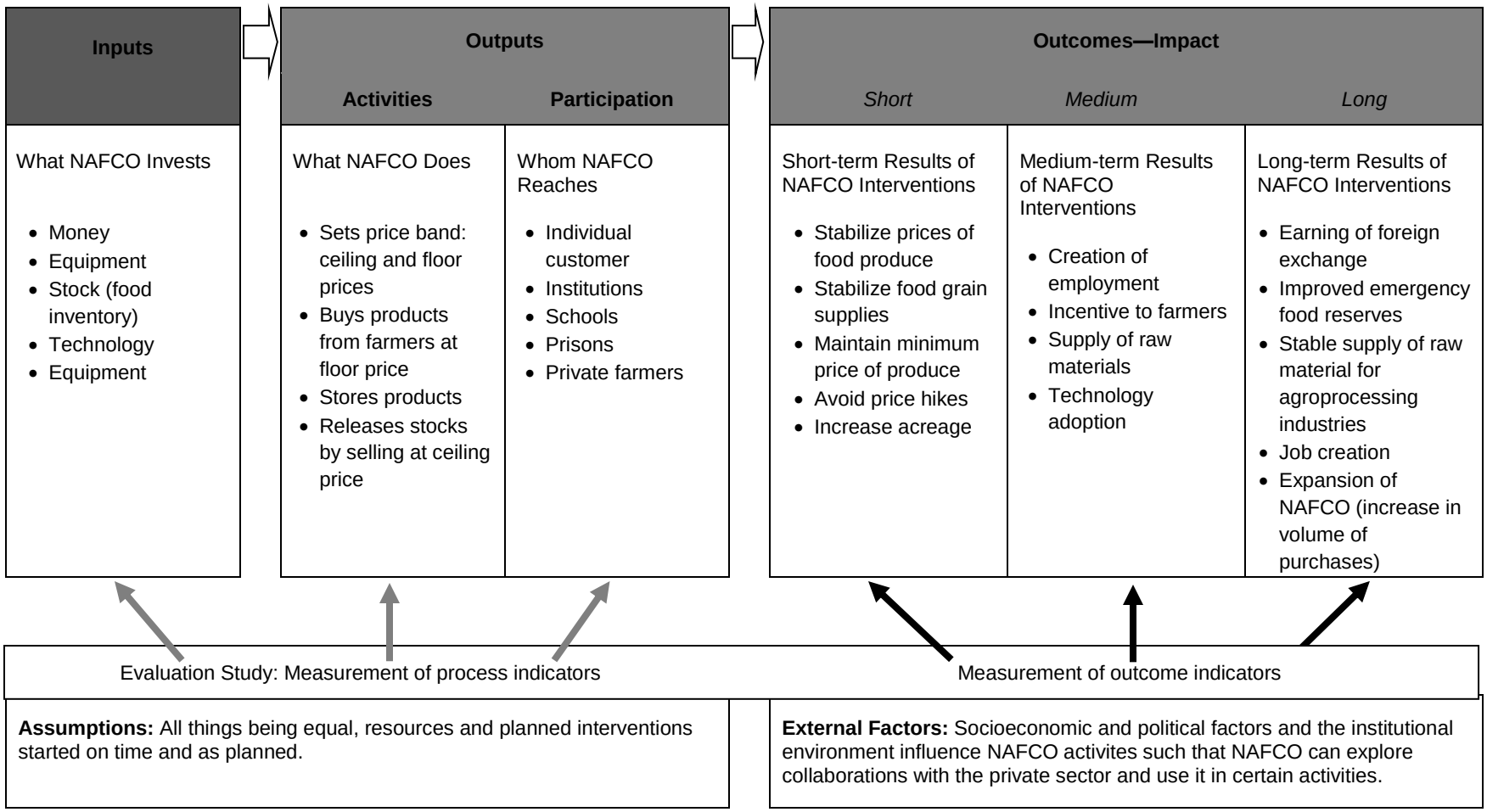
up stock, ensuring that the market price does not fall further. Likewise, when the market price rises close to the ceiling price, the operator sells off its holdings, ensuring that the market price does not rise further. In the meantime, the operator must keep its stock out of the market by storing it, but depending on the storage capacity, any excess may have to be destroyed. To also maintain a good-quality stock for when it becomes needed, a strategic method of continuous recycling of the stock is needed, without affecting the market price. If a basket of commodities is used in the scheme, its price stabilization can in turn stabilize the overall price level, preventing an undesirable large rise and fall in prices.

According to Bellemare, Barrett, and Just (2010), throughout history and all over the world, governments have frequently set commodity price stability—defined here as the absence of price fluctuations around a mean price level—as an important goal of economic policy. Thus, for buffer stock schemes to be viable, the margin between the selling price and the buying price must be able to pay for the direct cost of the stabilization. In agriculture, stabilizing the price of produce can also be achieved by varying imports and exports through import and export tariffs: for example, raising taxes to reduce trade and lowering them to increase trade. In developing countries, price stabilization schemes through buffer stock systems have typically focused on food staples, for example, rice in the Philippines, South Korea, and Bangladesh; wheat and rice in India; and maize and wheat in Mexico (Myers 2006). The schemes are generally managed by an independent entity, typically a parastatal, with the initial goal of being self-supporting unless its primary goal is subsidizing consumption. Although most rely on direct purchases and sales in domestic markets, there are examples wherein buffer stocks are maintained through imports supplemented by domestic procurement. However, in all cases, buffer stocks have also been used to control trade flows.

One of the key justifications for introducing such schemes is the desire by governments to stabilize real incomes of both producers and consumers in circumstances where there is market failure and thus high market transaction costs that result in very low farmgate prices in rural areas and high consumer prices in urban areas. In Asia, the presence of buffer stock schemes has been referred to as having played a critical role in the early years of the Green Revolution by ensuring higher incomes for producers and lower prices for consumers (see Cummings, Rashid, and Gulati 2006). Ultimately, this contributed to the widespread adoption of new high-yielding wheat and rice varieties, agricultural-sector growth, overall economic growth, reduced vulnerability to food security crises, and poverty reduction. Over time, however, the maintenance of such schemes has increasingly added a higher fiscal burden on governments. India offers a good lesson on this. According to Cummings, Rashid, and Gulati (2006), the government's bill for India's buffer stock scheme rose sharply over a 10-year period, from $160 million in 1992 to $1.6 billion by 2002; basically, it doubled every year. The sharp annual rise in costs was explained by the emergence of political lobby groups among the key actors involved in the scheme—such as the Food Corporation of India and the National Food Authority—that inevitably had a vested interest in continuously maintaining higher producer prices.

NAFCO's conceptualization makes it a typical example of a buffer stock scheme, with an illustrative impact pathway shown in Figure 7.1. Basically, NAFCO is expected to buy cereal from farmers during the bumper harvest when prices are at their lowest levels and store it for sale in the lean season when prices are at their highest levels. This is expected to give farmers a certain assured minimum price for their produce and to protect them from the exploitation of market operators during glut—supply being more than demand. In the lean season, when NAFCO is expected to put out supplies to meet the demand and hence prevent an escalation of prices, it protects the real income of consumers, including farmers who are net buyers of food. The expected consequences of NAFCO's interventions are stable prices and a ready market in which farmers can sell their produce, thus motivating farmers to expand their acreages, adopt modern technologies, and increase production and their productivity. Figure 7.1 thus helps to identify the indicators and data needs for undertaking the assessment, including input indicators, which measure what went into running the project; output indicators, which measure NAFCO's SCP in the market; and outcome indicators, which are based on specific results that NAFCO was established to achieve.

Figure 7.1 NAFCO's impact pathways



Source: Authors' illustration based on program documents and literature review

Note: NAFCO = National Food Buffer Stock Company.

To evaluate Ghana's NAFCO buffer stock scheme, a combination of cost–benefit analysis, price trends analysis, and market SCP analysis were undertaken. We used a financial benefit–cost ratio analysis to analyze NAFCO's competitiveness in the market and then a social (or economic) benefit–cost ratio analysis to reveal its comparative advantage in the market. The price trend analysis, which is based on measuring the standard deviation or dispersion of monthly prices from the annual average, is for assessing NAFCO's price stabilization efforts. Basically, the more spread apart the prices are from the mean, the higher is the deviation, and thus there is a lower price stabilization outcome. The SCP analysis is intended to examine how the structure of the market and the behavior of sellers of different commodities and services affect the performance of markets and consequently the potential implications of NAFCO's entrance into this market (see Table 7.1 on the different elements that are explored in the SCP analysis).

Market structure consists of the relatively stable features of the market that influence the rivalry among the buyers and sellers operating in a market. Market conduct refers to the patterns of behavior that traders and other market participants adopt to affect or adjust to the markets in which they sell or buy (including price-setting behavior). Market performance refers to how well the market fulfills certain outcomes desirable to social and private objectives (for example, price levels and price stability, profit levels, costs, quantities, and quality of commodities). There are various elements in SCP that relate to the specific market under study.

Table 7.1 Factors considered in the structure, conduct, and performance analysis

Market Structure	Market Conduct	Market Performance
Number of buyers and sellers: With few buyers and sellers, they may engage in noncompetitive behaviors such as collusion and price discrimination.	Price-setting behavior: Who sets the price? How are prices determined?	Price levels and stability in the short and long run
Barriers to entry are factors that restrict the participation of households or traders in the market.	Buying and selling practices: Are there standard units of measurement in the market for volumes traded, such as weighing scales?	Profits (net returns): Do traders receive excessive profits or net returns from sales of food commodities compared to farmers?
		Margins and costs: There are large differences between prices paid by consumers and prices received by farmers compared to marketing, processing, and transaction costs for a given commodity.
Vertical coordination or integration refers to whether farmers get less income depending on whether they sell directly to traders, middlemen, and so on.	Are there price negotiations?	Volumes, distribution channels, quality of produce

Source: USAID (2008).

Overview of the NAFCO Program

Establishment of NAFCO

Here, we look at how NAFCO was established, including sources of finance and lessons from the erstwhile GFDC. The establishment of NAFCO followed a recommendation by the National Post Harvest Committee in 2009 in a proposal for funding postharvest management of the Youth in Employment BFP (see Section 6). The recommendation was based on the anticipated increase in the production of farm produce as a result of the introduction of BFP and FSP. The proposal of the National Post Harvest Committee seems to have been based on field visitations to inspect and take stock of block farms, combined harvesters, silos, and warehouses in the country. NAFCO was incorporated on March 11, 2010,

under the companies' code of Ghana 1963, Act 179, with registration number CA-72,140, and is wholly owned by the government of Ghana. Subsequent to the setting up of the company, the Ministry of Finance and Economic Planning released GHS 15 million for its implementation—see Table 7.2. NAFCO started operating in 2010, and its core mandate is to purchase and sell farm produce, with the eight objectives listed in its background statements.

Table 7.2 Breakdown of NAFCO source of funds

Source	Amount (GHS)	Warrant Numbers
Donors (HIPC)	10,000,000	MoFA/QTR.1/2010/HIPC/01
Government of Ghana	5,000,000	MoFA/QTR.1/2010/INVE/10-6
Total	15,000,000	

Source: NAFCO (2011).
Note: NAFCO = National Food Buffer Stock Company; GHS = Ghanaian cedi; HIPC = donor funding through the Highly Indebted Poor Country grants window.

NAFCO currently has an eight-member board of directors that is chaired by the minister of MoFA. The board gave approval for the business plan and operations manual of the company, which was subsequently submitted to the Ministry of Finance and Economic Planning before it started operation. The company also has a chief executive officer who is responsible for the daily operations.

Even though there is no documentary evidence to show how lessons from other initiatives were incorporated in the setup of NAFCO, an interview with the chief executive officer of the company revealed that lessons from the erstwhile GFDC were incorporated in the design and setup of NAFCO. For example, NAFCO, unlike GFDC, is not into the purchase and sale of perishable farm produce, because it does not have a relatively long shelf life and the cost of preserving it is also high. Hence the decision was to concentrate on cereals and grains, which have longer shelf lives and can be stored for the lean season. It was also revealed that GFDC could not influence the prevailing market prices at the time. Hence it was the strategy of NAFCO to select a product that it could store for a reasonably longer period and be able to employ the floor and ceiling prices to stabilize market prices. To this end it was appropriate to choose maize and rice as the major crops to deal with.

NAFCO and FASDEP II

Evidence from available documentation shows that among the numerous constraints that the FASDEP II policy seeks to address are market access and food insecurity. In trying to overcome these and many other problems, the government of Ghana has a new focus in its efforts at greater effectiveness, sustainability, and equity in impacts. In particular, a few commodities are targeted for support. It has been proposed that a value chain approach to agricultural development be adopted, with value addition and market access given more attention. Efforts are expected to be intensified to build capacity toward meeting the challenges of quality standards in the international market, with a focus on increasing productivity along the value chain. Although it is stated that imports will not be controlled by quotas and tariffs, standards are expected to be used to control imports of poor-quality produce. Attention is also expected to be given to improving standards in local markets and to improving food safety (Ghana, MoFA 2007).

The setting up of NAFCO is expected not only to help give farmers greater access to markets but to serve as a driver to motivate farmers to produce more, which in turn is expected to influence the demand for inputs and thereby have greater impact along the value chain. The success of NAFCO could also set a standard for the marketing of agricultural produce in the country, especially maize and rice. The program also seeks to control prices of food, which is an important element in the food security agenda.

Therefore, NAFCO seems to fit well into the broad strategic goals and objectives of FASDEP II, and it complements the other initiatives such as AMSEC, FSP, and BFP, at least as conceptualized.

NAFCO's Operations and Price Determination

Following the setup of NAFCO, the government released to NAFCO all the properties of GFDC that had not been divested. The various regional directors of MoFA supervised the activities of NAFCO in the regions on behalf of the chief executive officer. At the time of the study in 2011, NAFCO was operating in six regions, defined around the locations of its warehouses (see Table 7.3). Although NAFCO intends to purchase grains from all areas in the country, it was in 2011 operating in the Ashanti, Brong Ahafo, Northern, Upper East, and Upper West regions, with plans to expand operations to the other regions. Our visual observations from visits to most of the warehouses across the country showed that the grains were well packaged and stored in a hygienically clean environment. The use of Pro Cocoon[18] technology in storing the grains was working well for preventing pest infestations. At one of the warehouse locations that contained rice that had yet to be milled and properly stored, however, the study team cited the activities of rodents. At most of the warehouse locations, the study team observed that there were no fire-prevention mechanisms.

Table 7.3 NAFCO warehouse distribution and regional coverage

Region	Warehouse Locations	Supervised By
Ashanti	Kumasi, Abofour, Ejura	Ashanti regional MoFA director
Brong Ahafo and Upper West	Sunyani, Berekum, Techiman, Wenchi, Nkoranza	Brong Ahafo regional MoFA director
Northern and Upper East	Tamale, Yendi	Northern regional MoFA director

Source: NAFCO (2011).

Note: NAFCO = National Food Buffer Stock Company; MoFA = Ministry of Food and Agriculture.

The main activities of NAFCO at the time were purchases and sales of maize and rice, with the intention of adding soya bean at some point. The purchasing process was initially done by the company itself, and then this role was transferred to the private sector by contracting a total of 52 licensed buying companies (LBCs). These LBCs go to the various villages to purchase maize and rice from farmers at a minimum purchasing price (that is, floor price) that is determined by NAFCO.

The determination of the floor prices was based on a report by the National Post Harvest Committee on the analysis of the cost of production of different farm products (NAFCO 2011). The purchasing prices were set at the total cost of production plus a profit margin for farmers, which is 15 percent of the total cost for maize. Although there may be spatial differences in the cost of production due to differences in the local production and market conditions, there is no spatial differentiation in the floor price. At the time of the study, the prices at which NAFCO's LBCs were supposed to buy grain from farmers were GHS 48 per 100-kilogram bag of maize and GHS 35 per 50-kilogram bag of paddy rice (see Table 7.4), meeting certain moisture content and purity requirements. For the ceiling price, NAFCO considers its cost of operations plus some profit margin.

[18] GrainPro Cocoons are airtight (hermetic), unsupported, rectangular structures made of lightweight ultraviolet-resistant polyvinyl chloride (PVC). The simple two-piece cocoon consists of a top cover and a bottom floor piece joined together with a PVC tongue-and-groove zipper similar to those used to close environmental safety suits. Insects trapped in the bagged grain expire in a matter of days as a result of an increase in carbon dioxide and a reduction of oxygen. Cocoons are packed folded in a carry bag for transport and can be made ready for use in minutes. Cocoons are designed to store bagged commodities such as grains, seeds, cocoa and coffee beans, and other agricultural products.

Table 7.4 Determination of ceiling price of NAFCO

Description of Cost Item	Maize (GHS per 100 kilograms)	Rice (GHS per 50 kilograms)
Purchase from licensed buying company	48.00	35.00
Handling and administrative cost	3.00	6.50
Warehousing and insurance	2.00	1.00
Parboiling and milling	n.a.	13.00
Total cost	53.00	55.50
Profit margin[a]	2.00	13.88
Ceiling price	55.00	70.00

Source: NAFCO (2011).

Note: NAFCO = National Food Buffer Stock Company; GHS = Ghanaian cedi; n.a. = not applicable

[a.] Profit margin is 3.8 and 25.0 percent of the total cost of maize and rice, respectively.

Compared to the prevailing open market prices at the time of the study, NAFCO seemed to be subsidizing the operations or consumption of those to whom it was selling maize and rice. For example, the average open market price of maize was about GHS 75 per 100-kilogram bag. Therefore, NAFCO was giving a GHS 25 (or 27 percent of the market price) subsidy on each 100 kilograms of maize sold. The main beneficiaries of this at the time of the study were poultry farmers, schools, and other public institutions. The implicit subsidy passed on is much higher for rice, up to GHS 80 per 50-kilogram bag. This is based on the average open market price of GHS 150 at the time, although this is much higher due to taste and other quality characteristics of imported rice compared to the locally produced perfumed rice with which NAFCO deals.

Assessing the Achievements of NAFCO's Objectives

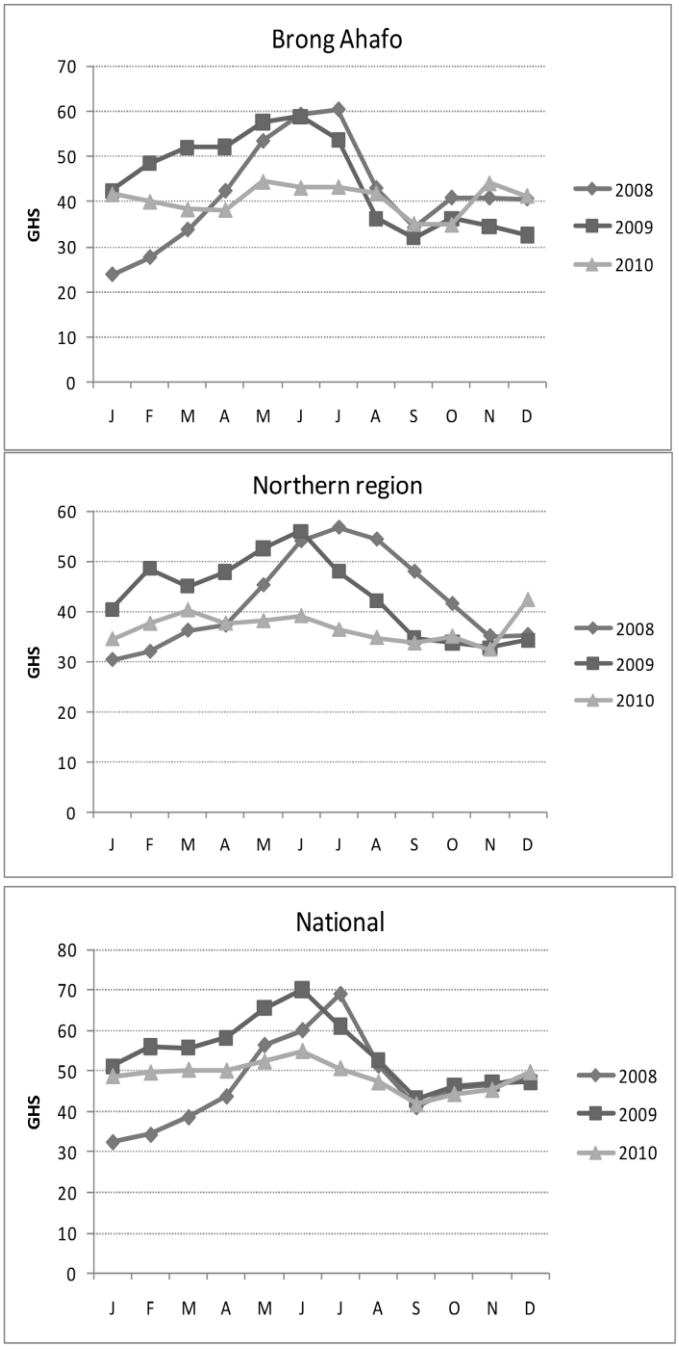
The main goal of NAFCO is to employ a buffer stock mechanism to stabilize demand, supply, and thus commodity prices for producers and consumers. To evaluate the extent to which there have been any changes in price fluctuations due to NAFCO's operations, we examine price trends of maize and rice—of which NAFCO has made purchases, carried stocks, and made sales—prior to and after NAFCO's entry into the market. The variability in domestic prices over time is also compared with variability in international prices. For domestic prices, we used regional producer prices obtained from MoFA. International prices (converted to import parity prices) of maize and rice were obtained from the International Monetary Fund database on world commodity prices.

Price Stabilization

Monthly Trends of Maize Prices from 2008 to 2010

Figure 7.2 and Table 7.5 show that monthly prices of maize generally continued to vary, but with different levels of fluctuation in 2008, 2009, and 2010, with relatively low prices during the harvesting periods (around September for the major season crop and January for the minor season crop) and a steady increase that peaked prior to the next harvesting season. In the Brong Ahafo region, for example, the average wholesale prices for maize in 2008 and 2009 had a wider variation compared to the price in 2010 (top-left graph in Figure 7.2). Take the trends for 2009 and 2010, for example: The starting price in January was the same, but whereas the price in 2009 steadily went up and peaked in July and then deceased sharply, the price in 2010 was quite stable throughout the year. The same pattern is observed in the Northern region and at the national level (top-right and bottom graphs in Figure 7.2, respectively). Table 7.5 reflects these patterns of smaller standard deviations in 2010 compared to those in 2008 and 2009. However, because we observe a similar pattern elsewhere in the country including where NAFCO was not operating at the time, for example, the Central region, further research is needed to determine attribution in stabilization of prices to NAFCO's activities.

Figure 7.2 Maize price trends in Ghana (GHS per 100 kilograms), 2008–2010



Source: Wholesale prices from Ghana (MoFA 2011a).

Note: GHS = Ghanaian cedi; JFMAMJJASOND = January, February, March, April, May, June, July, August, September, October, November, December.

Table 7.5 Variability of monthly maize prices, 2008–2010

Region	Year	Minimum	Maximum	Mean	Standard Deviation
Ghana (GHS per 100 kilograms)					
Brong Ahafo region	2008	23.8	60.4	41.6	11.4
	2009	32.1	58.8	44.7	10.1
	2010	34.8	44.4	40.5	3.3
Northern region	2008	30.3	56.7	41.6	10.0
	2009	32.8	56.0	43.9	7.7
	2010	32.4	42.3	36.8	2.9
Central region	2008	37.1	75.7	50.6	12.8
	2009	41.8	77.3	63.5	11.2
	2010	47.6	70.4	61.3	7.8
National	2008	32.57	68.9	47.3	10.6
	2009	43.15	70.0	54.5	8.2
	2010	41.80	54.9	48.8	3.6
World (US$ per metric ton)	2008	158.2	287.1	223.2	39.2
	2009	150.6	180.3	165.5	10.0
	2010	164.3	757.6	287.2	35.1

Source: Authors' calculations based on MoFA (2011a) for domestic prices and International Monetary Fund (IMF 2011) for international prices.

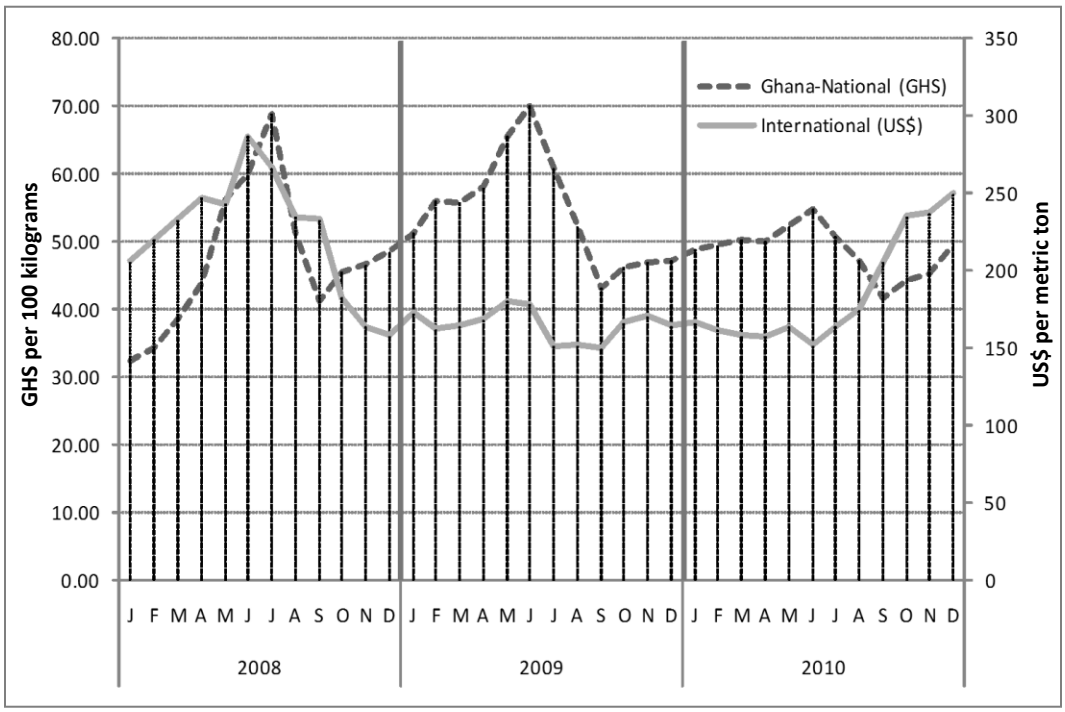
Note: GHS = Ghanaian cedi.

Although it is tempting from the preceding analysis to conclude that the operations of NAFCO in at least the Brong Ahafo and Northern regions helped to stabilize maize prices there, more detailed analysis is needed, including analysis of the monthly shares of NAFCO purchases and sales in the total traded volumes, and at a lower subnational disaggregation. Information about this was not available. Considering the share of NAFCO's purchases in the national market, however, the total purchases of about 10,000 mt made in 2010 represent a small amount at the national level, which is less than 5 percent, assuming that 60 percent of the total production, which is estimated at 1.7 million mt, reaches the marketplace.[19]

In comparing the national-level trends in the maize price with those of the world price, we see divergence in the patterns between the two as illustrated in Figure 7.3. After rising significantly following the food price crisis in 2008, world prices for maize stabilized through 2009 and the first half of 2010. This trend is clearly changing as prices begin to rise again. Domestically, although the national share of NAFCO's activities are quite small, NAFCO can potentially affect prices in more localized markets by purchasing in large quantities in one market that is experiencing a glut and selling in another market with limited supplies (interspatial) as well as between seasons when supplies vary widely (intertemporal). Ideally, such interventions would be unnecessary in perfectly functioning and well-integrated markets. This role of NAFCO as a buyer of last resort may have occurred in the Brong Ahafo and Northern regions when maize surplus during the major harvest season was purchased and sold to poultry farmers and public institutions (for example, schools) elsewhere. Out of a total of 5,450 mt purchased by NAFCO up to May 2011, 5,300 mt (or 97 percent) was subsequently sold, implying a close to zero stocking rate. However, we cannot conclude this without knowing more about NAFCO's underlying decision to take on this action—whether it was to stabilize local prices or simply to manage stocks and service its primary clients among government institutions and select government investment programs (for example, feeding schools and expanding the poultry feed industry). According to expert interviews, the poultry farmers and the various institutions purchased maize in relatively large volumes from NAFCO to the extent that they did not have to rely on the open market. This potentially could have localized dampening effects on hitherto-rising market prices from such large bulk purchases. Here too, unfortunately, there was no information about actual monthly purchases, sales, and stocks to undertake a more detailed assessment.

[19] The share of production reaching the market is estimated based on the focus group surveys, whereas the total production is based on the projected estimate by the Ministry of Food and Agriculture (2011a).

Figure 7.3 Maize price trend, comparing domestic and international prices



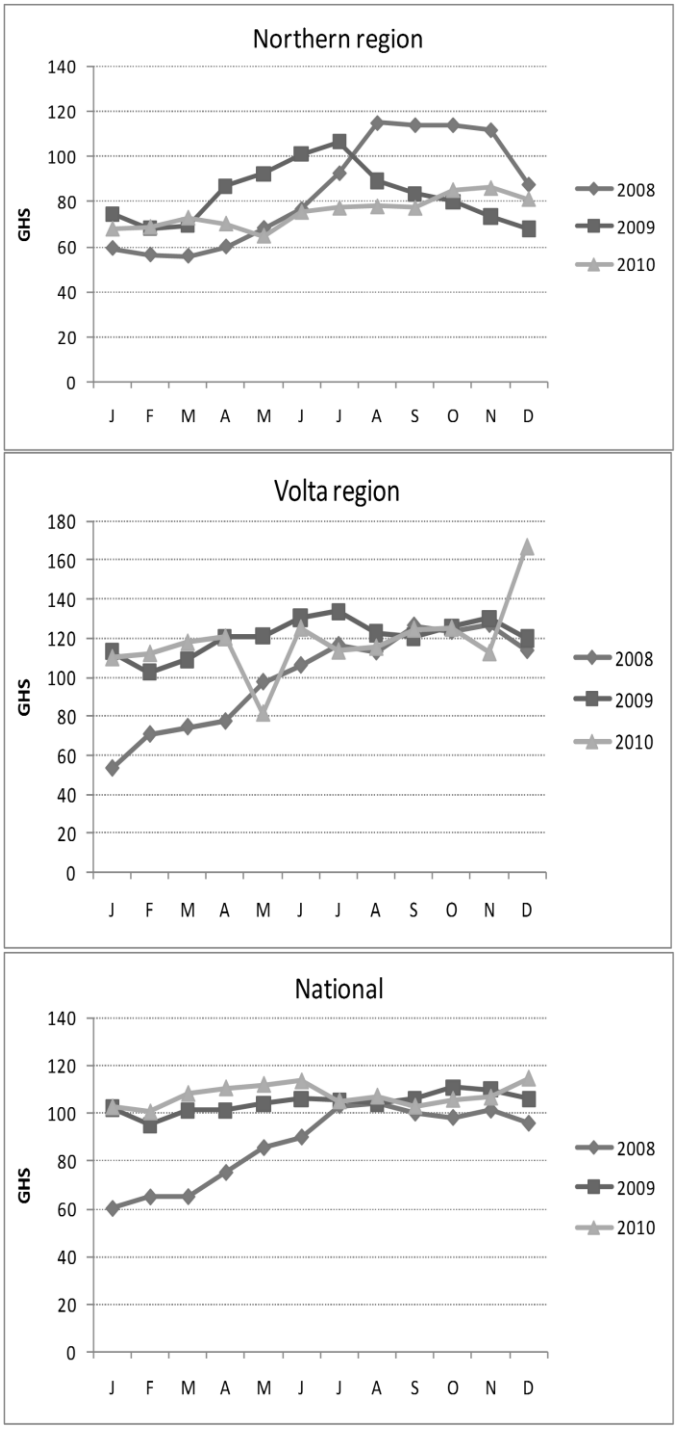
Source: Authors' calculations based on MoFA (2011a) for domestic prices and International Monetary Fund (IMF 2011) for international prices.

Note: GHS = Ghanaian cedi; JFMAMJJASOND = January, February, March, April, May, June, July, August, September, October, November, December.

Monthly Trends of Rice Prices from 2008 to 2010

The average wholesale price for rice seemed to stabilize more in the Northern region in 2010 compared to other regions (see Figure 7.4). As it turns out, this is also the region in which the activities of NAFCO for rice were extensive compared to all the other regions, including the Volta region, which is shown in Figure 7.4. In addition to the caveats raised in trying to attribute the relative stability in maize prices to NAFCO's activities, the rice market is peculiar, and the attribution will be even more difficult to make because of competition with imported rice. In fact, the general pattern in domestic rice prices in 2009 and 2010 mimics the pattern in global prices (see Figure 7.5). On examining the standard deviations of monthly rice prices from the annual average (see Table 7.6), although we see a continuous decline from 2008 to 2010 in the Northern region, those for the Volta region and those at the national level show mixed patterns—decreasing from 2008 to 2009 and then increasing from 2009 to 2010. Although rice production in the Volta region is also quite extensive, there were no reported NAFCO activities in the region at the time of the study.

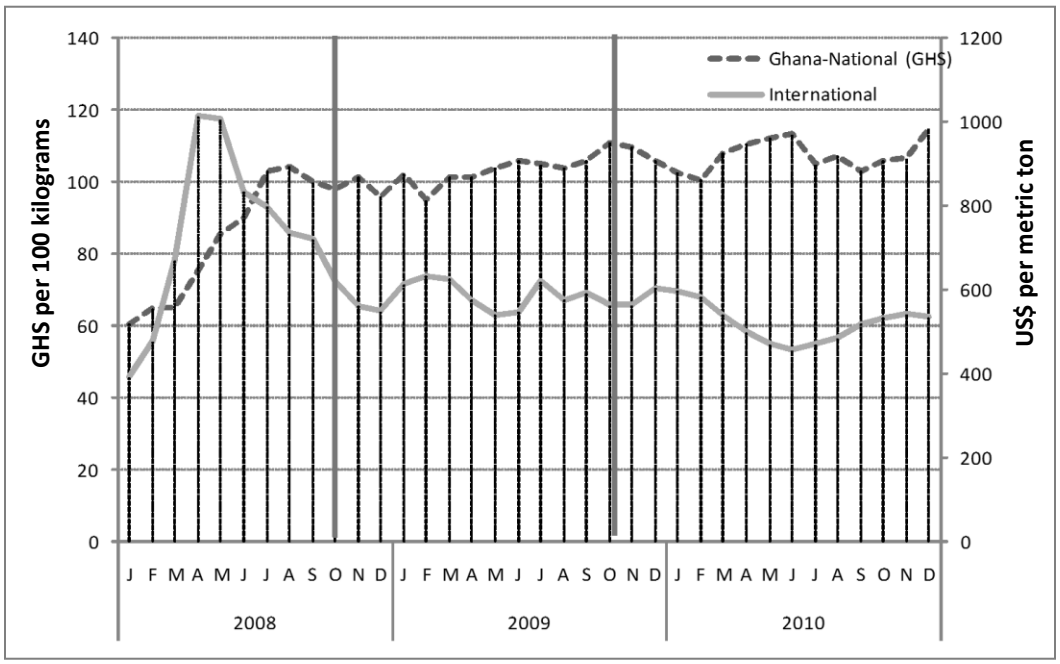
Figure 7.4 Rice price trends in Ghana (GHS per 100 kilograms), 2008–2010



Source: Wholesale prices from Ghana MoFA (2011a).

Note: GHS = Ghanain cedi.
JFMAMJJASOND = January, February, March, April, May, June, July, August, September, October, November, December.

Figure 7.5 Rice price trend, comparing domestic and international prices



Source: Authors' calculations based on MoFA (2011a) for domestic prices and International Monetary Fund (IMF 2011) for international prices.

Note: JFMAMJJASOND = January, February, March, April, May, June, July, August, September, October, November, December.

Table 7.6 Variability of monthly rice prices

Region	Year	Minimum	Maximum	Mean	Standard Deviation
Ghana (GHS per 100 kilograms)					
Northern region	2008	55.8	114.9	78.3	22.5
	2009	68.0	106.5	83.0	13.5
	2010	64.8	86.1	75.4	6.8
Volta region	2008	53.2	126.8	99.7	24.9
	2009	102.6	133.7	120.7	9.0
	2010	81.3	167.2	118.7	19.2
National	2008	60.4	104.2	87.0	16.3
	2009	95.1	110.8	104.3	4.2
	2010	72.9	114.6	104.2	10.7
World (US$ per metric ton)	2008	393.5	1015.2	700.2	194.0
	2009	540.8	634.0	589.4	31.3
	2010	458.6	598.0	520.6	44.3

Source: Authors' calculations based on MoFA (2011a) for domestic prices and International Monetary Fund (IMF 2011) for international prices.

Note: GHS = Ghanain cedi.

Employment Creation

Another important objective of NAFCO is employment creation, which we assess in this section. NAFCO has contractual arrangements with 52 LBCs in the purchase of maize and rice from farmers. Each LBC has a permanent staff of 13 to 75 employees, bringing the total to 800 across all 52 LBCs. For rice activities, NAFCO also supports processing in the form of milling and parboiling. For example, the Nasia Rice Mill, which had been inactive for several years, was recently revived by NAFCO, and the mill now has 35 permanent staff members. The mill was revived following the appointment of an experienced

miller and engineer who is also currently training four young engineers to equip them with the necessary skills to take over the milling process in the future. Parboiling of rice has attracted the services of women's groups, with the number of members benefiting estimated at more than 5,000—see Table 7.7 for three major groups involved.

Table 7.7 Women's groups involved in the parboiling of rice for NAFCO

Name of Group	Year of Formation	Membership in 2009	Membership as of June 2011
Tuyumba Rice Processors Association	2002	50	1,500
Nyebu-Biyoona Rice Processors Association	2005	51	1,000
Lolandi Rice Processors Association	1995	300	1,200

Source: Focus group survey.

Note: NAFCO = National Food Buffer Stock Company.

In our discussions with the groups, it was revealed that their engagement with NAFCO has driven up their membership substantially (Table 7.7), which the groups attributed to the increase in income they have been earning from parboiling rice for NAFCO. The age distribution of the members ranged from 17 to 72 years. They estimated that each member earns an average daily wage of GHS 9 from the services they render to NAFCO. Although the services rendered are not all year round, they are able to work up to eight months in a year or 24 days per month, earning an average of GHS 216 per person per month during the eight months. They revealed further that because of the increase in income, they are now able to purchase household items and clothes and meet basic needs such as payment of school fees and health insurance premiums. In addition, their access to and the affordability of adequate nutritional food has improved a lot. They also felt there has been an improvement in their status as women with dignified work. Together, the three groups have been able to recall about 30 women between the ages of 17 and 25 from the cities where they were engaged in manual labor (*kayayo*) to join their families. Of those recalled, 16 were currently operating in Tamale, 9 in Kumasi, and 5 in Accra. They observed that had it not been for the parboiling contracts with NAFCO, about 10 percent of their current membership would have gone into kayayo in the cities.

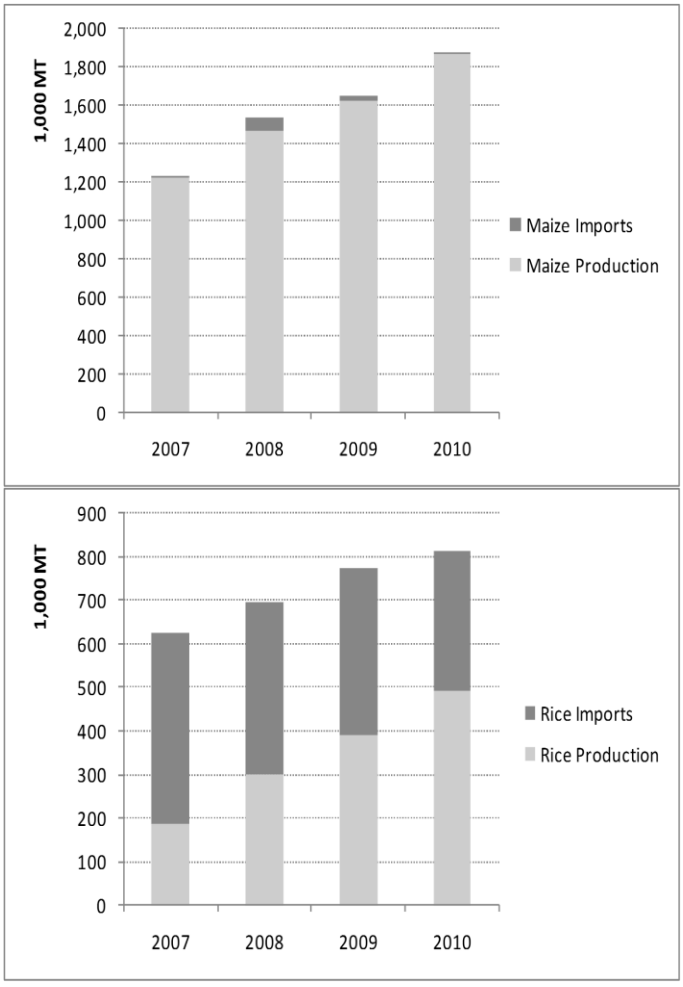
NAFCO has created casual work for 150 loading boys in Kumasi and Tamale who help in loading and offloading maize and rice at their warehouses. At Ejura, NAFCO has also provided casual employment to 30 youth who assist in the processing of maize. Transporters have increased their activities by frequently loading trucks of maize and rice to and from the various NAFCO warehouses in Tamale and Kumasi.

Grain Supply and Reserves—Buffer Stocks

Available production and import figures from MoFA show that although production levels of maize and rice in the country have been increasing, import levels have been decreasing (Figure 7.6). However, the amount of maize imports is so small relative to domestic production that such trends are difficult to interpret. Nevertheless, there seems to be a substitution effect, with the increase in production displacing imports of maize for feed by the poultry industry. With NAFCO now in the picture, buying grain at glut and then selling at less than market prices to the poultry industry, it is enhancing the substitution effect. What is not clear is whether NAFCO is actually operating a buffer stock and only selling stocks as a means of replacing old stock with new.[20] With rice, which is a major import commodity, we still observe the substitution effect, although the volumes of import are still high, unlike with maize. But production of rice more than doubled between 2007 and 2010 from about 0.2 to 0.5 million tons, so the substitution effect is not surprising. Again NAFCO's activities can enhance this process.

[20] Further investigation is needed to determine total annual supplies in the country (production plus net imports, plus carryover stocks). These should be compared with the stock holdings and activities of NAFCO in this market.

Figure 7.6 Production and import of maize and rice, 2007–2010



Source: Ghana, MoFA (2011a).
Note: mt = metric ton.

So far NAFCO's sales have equalized its purchases with few stocks. What is currently in stock is the government's cost recovery from the block farms. The team only learned of this toward the end of the study and so could not analyze its implications. However, it seems this is what would form the basis for operating the emergency food stocks.

Crowding-out Effects

There is the potential for crowding out of private markets for storage, which is more likely for maize than for rice given the narrower price range that NAFCO wishes to enforce for maize (GHS 48–55 per 100-kilogram bag) than for rice (GHS 35–70 per 50-kilogram bag)—see Table 7.4. Although we do not assess this, because reducing price variability significantly has to do with enforcing a narrower price range, it is likely that some private storage providers (that is, those operating at a relatively high cost) will be crowded out (Greenfield 2003). But crowding out private storage could also lead to rising costs for NAFCO to stabilize the maize market, which will affect its overall cost–benefit balance. Further analysis is needed to quantify these effects in Ghana.

Efficiency and Effectiveness of NAFCO's Activities

Market SCP Analysis

The maize and rice markets are characterized by many sellers and buyers, with no known dominant operators. This is to be expected as maize and rice are major food staples. Currently, the share of NAFCO in the market is too small—less than 5 percent in both the maize and the rice markets—to crowd out other operators in the market. Because NAFCO's strategy has been to mop up excess produce and it thus enters the market only at critical times, the traditional operators buy what their capacity can cope with before NAFCO even comes in to mop up the excess. In addition, NAFCO has focused on selling to public institutions and selling maize to the poultry industry. One unique aspect of the rice market on which NAFCO can have an impact is product differentiation between local and imported rice by helping to improve the quality of locally parboiled and perfumed rice.

A key characteristic of the maize market in Ghana that is common to other countries in the region is *market queens*. In some of the major markets such as Ejura and Techiman, these market queens have taken over the responsibility of overseeing various activities including deciding who can sell in the market. For example, if a farmer brings maize to the market to sell, he or she cannot sell directly to a wholesaler unless through a middleman. Furthermore, the farmer receives his or her payment only after the middleman has been paid by the wholesaler, making the farmer a financier of the market transactions. Farmers become price takers as they cannot negotiate prices, a function that is taken over by the market queens and the middlemen. As a result, maize and rice farmers in Ghana sell more than 90 percent of their marketable surplus at the farmgate to wholesalers, middlemen, or both. The rest is sold in their local retail markets and to other food processors, particularly the *kenkey* (local food made out of maize) industry. Very few farmers could distinguish NAFCO or the LBCs from other wholesale buyers or market agents because the LBCs who purchase maize on behalf of NAFCO do not always identify themselves as representatives of NAFCO.

Farmers revealed that they would sell to anyone who offered the best price, although other factors were important in deciding to whom to sell. So we asked farmers to rank their reasons for selling their produce to different marketing agents. Using Kendall's concordance analysis, we find that prefinance and contract payments were ranked as the most important, followed by competitive price offers, and then convenience and ease of sale (see Table 7.8). Thus, although farmers could not claim any known sales to NAFCO at the time of the study, the results show that potential sales to NAFCO will abound in time of glut when the market price falls below NAFCO's floor price.

Table 7.8 Reasons farmers sell maize and rice to different agents

Reason	Mean Rank	Rank
Price offered is more competitive	2.70	2
Low or no transport cost	3.67	4
Convenience and ease of sale	3.30	3
Prompt payment	4.17	5
Prefinanced or contract payment	1.17	1

Source: Authors' calculations based on focus group survey.

Financial Cost–benefit Analysis

In conducting the cost–benefit analysis, we used only a three-year time frame given the limited data on making projections far into the future. We also focused on the financial costs and benefits, that is, excluding externalities such as opportunity cost of MoFA staff time used in supervising warehouse operations and economywide price effects, to mention a few. Based on the actual costs and benefits of purchases and sales for the first year of operation, we made projections for the second and third year and then carried out the cost–benefit analysis using a discount rate of 12.5 percent. A summary of the financial analysis including sensitivity to changes in key parameters is presented in Table 7.9. As the first row of the results indicates, NAFCO was found to be financially viable under current conditions with a

net present value of GHS 2.390, benefit–cost ratio of 1.20, and internal rate of return of 38.5 percent. The internal rate of return of 38.5 percent is far greater than the 12.5 percent cost of the capital (that is, discount rate) invested by the government of Ghana. NAFCO can therefore be described as having been a financially viable venture under current market conditions. We deal with the economic analysis later on. To test for its sensitivity to changing market conditions, our financial sensitivity analysis in Table 7.9 suggests that NAFCO could still remain viable if costs or the discount rate increased by 10 percent. On the other hand, if benefits or revenue streams declined by 10 percent, NAFCO would cease to be financially viable.

Table 7.9 Financial analysis of investment worth of NAFCO and sensitivity analysis results

Variables	Net Present Value (GHS Millions)	Benefit–cost Ratio	Internal Rate of Return (%)	Viability
Financial analysis	2.390	1.20	38.5	Yes
Sensitivity				
10% increase in NAFCO's total cost	0.3145	1.09	16.4	Yes
10% decrease in NAFCO's total benefit	(0.091)	1.08	11.3	No
10% increase in discount rate	1.316	1.20	38.5	Yes

Source: Authors' calculations based data from NAFCO (2011).

Note: NAFCO = National Food Buffer Stock Company; GHS = Ghanaian cedi.

Although the financial returns generally look attractive and present NAFCO as a self-supporting scheme, the record with buffer stocks around the world has shown that such schemes can become expensive over time, as the example of India illustrated earlier. In Africa, this is also evident in the example of Kenya, where the government spent up to $80 million in 2006 to maintain a price stabilization scheme under the buffer stock mechanism alone (Minot 2011). These state-sponsored price stabilization schemes experience rising costs as larger procurements, overheads, and storage and handling requirements become necessary to keep up with rising production outlays whereas pricing policies adjust little to changing supply and demand conditions. In Ghana, for example, NAFCO is barely two years old, and it has not been tested on facing market prices that are lower than its floor price for a sustained period of time.

Assessment of the Economic Viability of the NAFCO Program

In assessing the economic viability of the NAFCO program ex ante, two main objectives of the NAFCO program are considered: (1) price stabilization (maintaining a floor and ceiling price, purchasing stock whenever prices fall below the floor price, and selling when prices rise above the ceiling price) and (2) food security reserve (maintaining a sufficient reserve in times of food shortages due to unforeseeable reductions in food staples production). NAFCO also purchases grain to supply major government institutions (schools and prisons) in addition to serving as a food security emergency reserve. To determine the economic value of the NAFCO program, assuming a floor price commitment is in effect and prices remain unchanged with open trade results in no action required by NAFCO. This is reasonable if we have assumed that growth in supply and demand in maize markets remains unchanged such that prices remain equal to the floor price of GHS 0.55 per kilogram. If we instead assume NAFCO will continue stocking at a modest pace, growing at about 30 percent per year for food security purposes, for example, and assuming price does not change given sufficient trade with neighboring countries, the total net worth of the program would simply be its total net discounted costs during the period, GHS 43.2 million, as shown in Table 7.10. Under such a strategy, NAFCO's share of the total supply in the market would rise from 0.7 percent to 7.2 percent by 2020. Should a food security crisis emerge, such stock levels may be more than adequate in the short run. However, if there is no open trade with other countries, such actions by NAFCO could influence prices in the domestic market, with prices rising by about 1.3 percent per year, from GHS 56 to 65 per kilogram by 2020. The total net worth of the program would

become even more costly as consumers experience losses in consumer surplus and at rates higher than any gains in producer surplus.

Such results stress the potential difficulties of managing a buffer stock for price stabilization purposes under conditions wherein there is steady growth in supply and demand and thus stable prices. However, should the patterns of growth change, such as from a rapid acceleration in production output, such a role could become positive, as we will show in Section 8 when we consider the presence of the three other national programs. Finally, NAFCO's potential role as a food reserve may still be worthwhile, especially in the event of any food shortages. If this occurs, the benefits could easily outweigh the costs.

Table 7.10 Summary of results of the economic analysis of the NAFCO program

Scenario	**A**			**B**		
Elasticity of Demand	**–0.4**			**–0.7**		
	2010	**2020**	**Growth**	**2010**	**2020**	**Growth**
Resulting production and price changes						
National production without any programs (1,000 mt)	1,669	2,247	3.0	1,669	2,247	3.0
Supply in domestic markets, less stocks (1,000 mt)	1,658	2,096	2.4	1,658	2,096	2.4
Share of stock in total production (%)	0.7	7.2	27.0	0.7	7.2	27.0
Maize prices without NAFCO, autarky (2011 GHS/kg)	0.55	0.55	0.0	0.55	0.55	0.0
Maize prices with NAFCO, autarky (2011 GHS/kg)	0.56	0.65	1.3	0.56	0.61	0.8
Change in program costs and coverage						
Volume of stocks handled annually (1,000 mt)	10.9	150.8	30.0			
Total cost of NAFCO program (million 2011 GHS)	17.7 (1.2[a])	12.05	29.1			
Direct costs of program (million 2011 GHS)	15.9 (1.1[a])	11.82	30.0			
Indirect costs of program (million 2011 GHS)	1.8 (0.1[a])	0.22	10.0			
Total cost of program as share of MoFA's budget (%)	8.9 (0.4[a])	0.6				
Direct costs as share of MoFA's investment budget (%)	174.3 (1.8[a])	2.0				
Program net worth (with no price effects)						
Net economic benefits (million 2011 GHS)	–17.7 (–1.1[a])	–11.8		–17.7	–11.8	
Discounted net worth (million 2011 GHS)		–43.2			–43.2	
Benefit–cost ratio		0.0			0.0	
Program net worth (with price effects)						
Net economic benefits (million 2011 GHS)	–23.7 (–9.0[a])	–95.5		–23.7	–95.5	
Discounted net worth (million 2011 GHS)		–214.5			–214.5	
Benefit–cost ratio		–4.0			–4.0	

Source: Authors' assumptions and calculations based on literature review, project reports, and surveys.

Notes: NAFCO = National Food Buffer Stock Company; mt = metric tons; GHS = Ghanaian cedi; kg = kilograms; MoFA = Ministry of Food and Agriculture. Scenario A represents buyers' being less sensitive to price changes, compared to scenario B, wherein buyers are more sensitive to price changes. Values in the column headed Growth are annual percentage growth rates.

[a] The base year in 2010 included the upfront investment cost of GHS 15 million for setting up NAFCO. The numbers in parentheses are 2011 levels, which grow modestly until 2020.

Emerging Challenges

The current means of purchasing grains through the private sector (LBCs) has been seen as a means that will help the development of the private sector and create employment. However, NAFCO is confronted with some challenges in the purchasing process, such as the following:

- Farmers have been unable to identify LBCs as agents of NAFCO and have lacked knowledge of NAFCO minimum prices to use in negotiations. Therefore, NAFCO could be seen by farmers as being more useful to traders (LBCs) than to farmers.
- One way of being closer to farmers and offering them more opportunities could be to set up a purchasing policy by which FBOs or even individual farmers (providing minimum quantities and quality requirements) could sell directly to NAFCO.
- High monitoring costs on the part of NAFCO to ensure that the LBCs are purchasing at the price set by NAFCO may lead to moral hazard issues and the potential transfer of subsidy to LBCs to the extent that LBCs purchase at lower than the minimum floor price and then sell to NAFCO at the minimum price.
- Because LBCs are active buyers in their own right, it is difficult to differentiate their own activities from those intended for NAFCO.

NAFCO also has logistical, infrastructural, and human resources challenges in its daily operations, such as the following:

- Warehouse capacity is inadequate. Although NAFCO has upgraded some storage infrastructure of the defunct GFDC that was handed over to it, the company still has limited storage capacity.
- The current capacity of 34,000 tons has not been tested in the event of a bumper harvest resulting in market price lower than NAFCO's minimum that is sustained over a long period of time. This capacity represents only about 3.3 percent of the estimated total marketed maize alone in 2010, for example.
- Logistics such as trucks and instruments for determining the moisture content of grains are inadequate.
- Staffing at the regional levels is inadequate. The company currently relies on MoFA staff at the regional level for some of its activities. This is not factored into the cost of its operations.

Conclusions and Recommendations

- Although maize prices stabilized in 2010 compared to preceding years' prices, this cannot be directly attributed to NAFCO's presence as global prices seem to have also stabilized some during this period—after the 2008 food price crisis. There are some lessons to be learned here that this study is not able to unravel at this time. Further research is needed and will require sufficient access to more data from NAFCO at a subnational level and during more frequent periods such as weeks or months.
- Although NAFCO is financially viable under current conditions, a decline in its revenue could pose problems and likely force the government to spend more on its operations than intended. Therefore, NAFCO should carefully track its revenues, make realistic projections, and find ways to minimize its variability.
- NAFCO can potentially serve as a food security reserve mechanism in the short run, but it would help in the long run to develop a stronger regional market in West Africa. This also has the advantage of requiring less frequent interventions by NAFCO to stabilize

prices, which can be far more costly under conditions of no trade. The experience and history of Mali's food security grain reserve is worth looking into.

- New perspectives in the national market, for example, the poultry feed market that should be rapidly expanding, should be considered.
- NAFCO should put in place a transparent information system about its prices, the identification of LBCs, and the location of any buying and selling depots.
- NAFCO should not displace the role of private traders in the market. Therefore, it must always focus more attention on its own critical role of maintaining food security emergency reserves and, at a minimum, assist with stabilizing markets in key target areas where there is evidence of market failure or weak integration with larger markets.

Are There Alternatives to the Buffer Stock Scheme for Stabilizing Prices?

Ideally more open international trade can offer other, more efficient means of stabilizing domestic food prices (Dorosh 2002). Trade flows add to domestic supplies in times of shortage (or provide an additional market in times of surplus), with adjustments in trade taxes providing a mechanism to influence both traded quantities and domestic prices. However, because of market failures or imperfections, especially among millions of isolated smallholder farmers, such trade opportunities are lacking given high transportation, transaction, and information costs. Another alternative to the buffer stock is the warehouse receipt system. Focusing more on promoting and providing incentives for the emergence and profitability of private-sector warehousing companies, the warehouse receipt system is often favored over the heavy state interventionist approach of buffer stock programs, and the Ghana Grains Council is in the process of developing a warehouse receipt system.[21] Although these alternatives exist, they are entirely different concepts. The objectives of NAFCO are different from those of the Ghana Grains Council. NAFCO keeps two categories of stocks, namely, operational stock and government emergency stocks. Operational stocks run and operate the company, and emergency government stocks are held for the government for use in emergency situations.

Publicly held stocks (buffer stocks) have generally proved workable, especially as long as price bands are wide enough and transparent. But the high costs involved typically discourage their use except for meeting key development or welfare goals, such as food security emergency stocks, which could be used in times of shortages and high prices affecting the poor; such stocks would have to be rotated, and doing so, NAFCO could target special markets, namely, public institutions. In Ghana, a country that wants to achieve food security and increase production levels, its goal of adopting a value chain approach in its FASDEP II policy offers what could be a viable approach to price stabilization if managed well and prevented from growing too large. Certainly, there are ways such a scheme could be improved, based on experiences elsewhere.

Here, we draw on the review and recommendations offered by the work of Cummings, Rashid, and Gulati (2006).

- First, the scheme should always limit itself to managing very few commodities, only among key food staples.
- Second, it should focus on areas where markets are still imperfect and weak, with high poverty levels.
- Third, the stabilized prices should be allowed to deviate around an international price trend as a benchmark to always reflect a commodity's scarcity value.

[21] The Ghana Grains Council is a private-sector-led initiative formed by leaders in the grains business with the aim of intervening in the grains value chain to achieve improvement in productivity and quality as well as greater commercialization of the industry.

- Fourth, stabilization within a larger band is preferable to allow sufficient flexibility for the open market to function, avoiding potential errors in precision and ultimately lowering the costs of intervention.
- Fifth, to guard against food security crises and domestic price spikes, it must be emphasized that when the problem is localized, strong links with regional and international markets can actually offer a quicker and more flexible response. The example of Bangladesh during the 1998 flood, when the private market quickly responded with supplies from India, provides a good reference.
- Sixth, a spatial dimension to floor and ceiling prices is just as important to account for transportation and logistical costs for moving grains and, in the process, avoid crowding out private operators.
- Finally, establishing transparent and clear rules for operations and the distribution of buffer stocks would encourage the emergence of more private operators and traders.

8. PROGRAM INTERACTION EFFECTS AND OVERALL ECONOMIC ANALYSIS[22]

Introduction

As discussed in the Overall Methodology section, all four programs contribute to the impact pathway for achieving the government's broader FASDEP II strategy while giving rise to potential interaction effects along it either directly (during implementation) or indirectly (through their combined effect on specific outputs).[23] For example, the NAFCO buffer stock scheme is directly linked to BFP. The key commodities (maize, rice, and soya beans) that NAFCO deals with are the same key commodities grown on the block farms. So by offering the floor price to buy farmers' produce at harvest time when market prices normally plummet, the NAFCO program provides an assured output market and reduces postharvest risk to farmers, which raises their expectations of disposing of their produce and in turn encourages them to invest in mechanization, fertilizer, and other modern inputs and technologies, resulting in higher productivity and greater outputs. Details of these expected pathways, their realization, and challenges associated with implementing each of the four programs (AMSEC, FSP, BFP, and NAFCO) were presented in the preceding sections. In this section, we assess the interaction effects of the different programs. We focus on maize and rice yields for a combination of the programs. In particular, we assess the presence of NAFCO (measured by where a NAFCO warehouse is located) on (1) yields on block farms and (2) yields on farms with and without using fertilizer in combination with and without an AMSEC. We also undertake economic analysis for different combinations of the programs.

Program Interaction Effects

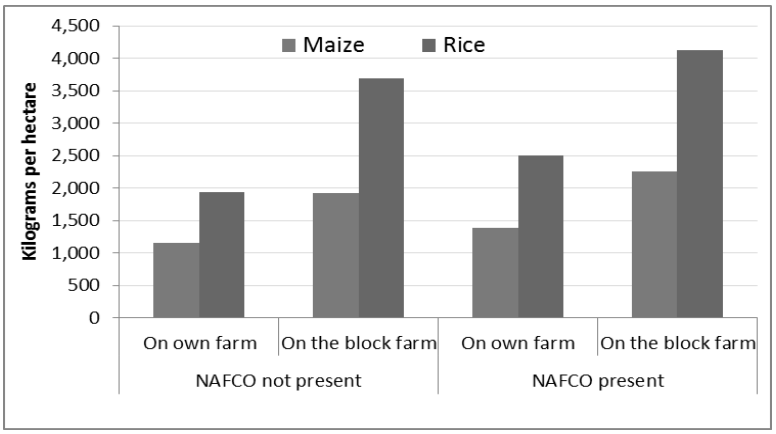
NAFCO and Block Farms

Evidently, the presence of NAFCO in places around the country where the block farms have been established seems to have resulted in higher yields as reported by farmers. As noted in Figure 8.1, the presence of NAFCO (measured by the presence of a NAFCO warehouse—see Figure 2.3 is associated with higher average yields than when NAFCO is not present. This is true for yields on and off the block farm. In the block farms example, the average rice yield reported with a NAFCO present is about 4.1 mt per hectare compared to 2.5 where NAFCO is absent. Off the block farms or on own farms, the average rice yield reported with a NAFCO present is about 3.7 mt per hectare compared to 1.5 where NAFCO is absent. The same pattern is observed for average maize yields. The important implication of these observations is that the presence of NAFCO, either on the block farm or off it, has some important effects on the behavior of farmers as we hypothesized in the overall Introduction section. By offering fixed and certain output prices when farmers make resource allocation decisions at the beginning of the production stage, it lowers a farmer's uncertainty about future prices and permits higher purchases of inputs.

[22] This section was coauthored by Michael Johnson (IFPRI, Washington, DC, United States) and Samuel Benin (IFPRI, Davis, California, United States).

[23] See Figure 2.1 and the related discussion in Section 2.

Figure 8.1 Average yields (kg/ha) across block farms, with and without NAFCO



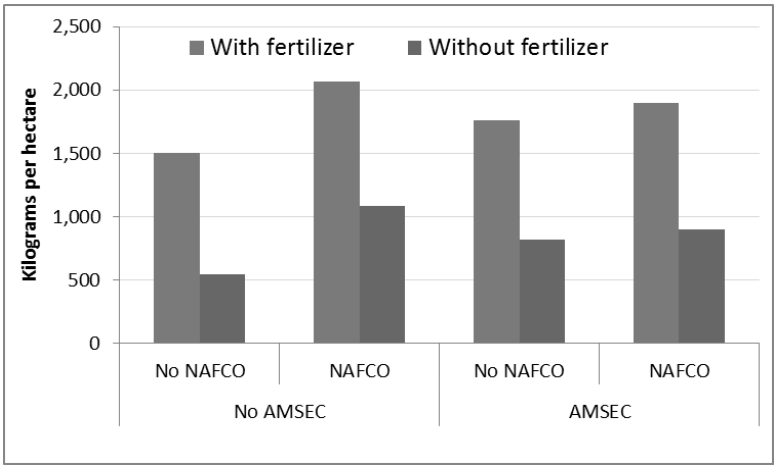
Source: Field survey of farmers.

Note: kg = kilogram; ha = hectare; NAFCO = National Food Buffer Stock Company.

NAFCO, AMSEC, and Fertilizer Use

The same pattern is observed in the presence of NAFCO with or without fertilizer use, with or without AMSEC. As depicted in Figure 8.2, the average maize yield is higher where NAFCO is present compared to areas where it is not present, with or without fertilizer, as well as with or without an AMSEC. Thus, the role of the fertilizer subsidy is inherently linked to the success of the NAFCO program by ensuring that higher marketable surplus due to higher yields and outputs can be disposed of by farmers. How much the fertilizer subsidy may also be contributing to more stable production growth to meet growing consumer demand remains an important question to address when trying to isolate the direct effects of NAFCO activities on prices. This question cannot be answered with the currently available information and the short duration of the NAFCO program since its inception. It is also quite possible that NAFCO was initially operating in areas where productivity was already high.

Figure 8.2 Average maize yields (kg/ha) with and without fertilizer, with and without AMSEC and NAFCO



Source: Field survey of farmers.

Note: kg = kilogram; ha = hectare; AMSEC = Agricultural Mechanization Service Center; NAFCO = National Food Buffer Stock Company.

Assessing the Overall Economic Cost and Benefit of All Four Programs

To assess the potential economic benefits flowing from the potential interaction across all four programs, we combined the individual benefits flowing from each of the three programs that have direct effects on yields and output growth with those of the NAFCO program targeted at stabilizing prices. This becomes especially important considering that the economic analysis of the fertilizer program in section 5 showed that FSP can have a significant effect on lowering domestic prices of maize to levels well below the NAFCO floor price of GHS 0.55 per kilogram, under the assumption of no trade.

AMSEC, FSP, and BFP

To simulate the combined effect of all programs, we begin by looking into the three programs focused on increasing productivity through greater use of fertilizers, mechanization, and credit via the block farms. Table 8.1 summarizes the results. Details about the assumptions and the extent to which program costs are calculated are provided in Appendix A. Not surprisingly, the combined cost of all three programs—AMSEC, FSP, and BFP—increases significantly as a share of the projected total MoFA budget to 2020, from an estimated 25 percent in 2010 to about half of the budget by 2020. The bulk of the cost is carried by FSP, accounting for 35 percent of the MoFA budget in 2020. About 15 percent of the budget is borne by AMSEC and BFP combined.

Table 8.1 Summary of results of the economic analysis of the AMSEC, Fertilizer Subsidy, and BF programs without NAFCO

Scenario Elasticity of Demand	A –0.4			B –0.7		
	2010	2020	Growth	2010	2020	Growth
Yield without program (kg/ha)	1,714	1,893	1.0			
Yield with program (kg/ha)	2,200	2,546	1.5			
Adoption rate (%)	2.0	7.6	14.3			
Unit production cost (2011 GHS/ha)	320	448	3.4			
Resulting production and price changes						
National production without any programs (1,000 mt)	1,669	2,247	3.0	1,669	2,247	3.0
National production with all three programs (1,000 mt)	1,817	2,850	4.6	1,734	2,510	3.8
Share of all three in national production (%)	8.9	26.8	11.7	3.9	11.7	11.7
Maize prices without programs, autarky (2011 GHS/kg)	0.55	0.55	0.0	0.55	0.55	0.0
Maize prices with three programs, autarky (2011 GHS/kg)	0.44	0.18	–6.9	0.53	0.46	–1.2
Change in program costs and coverage						
Total cost of three programs (million 2011 GHS)	55.3	177.7	13.0			
Direct costs of three programs (million 2011 GHS)	41.8	144.1	13.9			
Indirect costs of three programs (million 2011 GHS)	13.5	33.7	10.0			
Total cost of three programs as share of MoFA's budget (%)	25.0	47.5				
Direct costs as share of MoFA's investment budget (%)	87.8	134.5				
Program net worth (with programs and open trade)						
Net economic benefits (million 2011 GHS)	18.6	157.8	21.8	15.6	125.7	20.9
Discounted net worth (million 2011 GHS)		430.5			358.4	
Benefit–cost ratio		1.7			1.5	
Program net worth (with programs and at autarky)						
Net economic benefits (million 2011 GHS)	2.7	–67.3		12.4	74.9	0.2
Discounted net worth (million 2011 GHS)		–30.6			252.1	
Benefit–cost ratio		1.0			1.4	

Source: Authors' assumptions and calculations based on literature review, project reports, and surveys.

Notes: AMSEC = Agricultural Mechanization Service Center; BF = Block Farms; NAFCO = National Food Buffer Stock Company; kg = kilograms; ha = hectare; GHS = Ghanaina cedi; mt = metric tons; MoFA = Ministry of Food and Agriculture. Scenario A represents buyers' being less sensitive to price changes, compared to scenario B, wherein buyers are more sensitive to price changes. Values in the column headed Growth are annual percentage growth rates.

One key result is the effect of the three programs on domestic prices if there is no trade and if we assume the lower own maize price demand elasticity of –0.4. Maize prices initially fall to GHS 0.44 in

2010 and continue to decline until they reach GHS 0.18 by 2020. Although benefiting consumers, such an outcome lowers producer returns significantly and, as a result, produces overall negative economic returns at a level of GHS 30 million. Under the higher elasticity of demand of –0.7, however, returns are positive and result in a discounted net worth value of GHS 352 million with a benefit–cost ratio of 1.4.

The significant effect on domestic prices assumes there is no trade. If we assume regional markets are easily accessible to which to export excess grain, the picture changes. Both assumptions on demand elasticities result in positive economic returns across all three programs—valued at GHS 430 million (with a benefit–cost ratio of 1.7) and GHS 358 million (with a benefit–cost ratio of 1.5), respectively.

AMSEC, FSP, BFP, and NAFCO

Aside from trade, the NAFCO program could also assert its goal of stabilizing domestic prices. Table 8.2 considers the inclusion of the NAFCO program to counteract the potential collapse in domestic maize prices under the condition of autarky (or no trade). Economic returns are positive, with a high program net worth across all four programs, about GHS 414 million to GHS 605 million between 2010 and 2020. Under this scenario, NAFCO obviously achieves its goals of stabilizing prices with positive economic returns. However, this comes at a great fiscal cost, with all four programs combined easily making up close to 90 percent of the projected MoFA budget by 2020, this from an estimated 35 percent in 2010.

Table 8.2 Summary of results of the economic analysis of the AMSEC, Fertilizer Subsidy, and BF programs with NAFCO (committing to floor price)

Scenario Elasticity of Demand	A –0.4			B –0.7		
	2011[a]	2020	Growth	2011[a]	2020	Growth
Volume of stocks handled annually	190.3	1,741.9	42.7	36.1	151.7	22.8
Total cost of NAFCO program (million 2011 GHS)	16.41	150.2	27.3	3.11	13.1	17.3
Indirect costs of program (million 2011 GHS)	1.49	13.7	27.3	0.28	1.2	17.3
Resulting production and price changes						
Quantity produced from all three programs (1,000 mt)	1,892	2,850	4.6	1,794	2,510	3.8
Supply in domestic markets, less stocks (1,000 mt)	1,701	1,108	–2.8	1,758	2,359	3.3
Share of stock in total production (%)	10.5	61.1	36.5	2.1	6.0	18.4
Maize prices with three programs, autarky (2011 GHS/kg)	0.42	0.18	–7.8	0.52	0.46	–1.3
Maize prices with all four programs, autarky (2011 GHS/kg)	0.55	0.55	0.0	0.55	0.55	0.0
Change in program costs and coverage						
Total cost of all four programs (million 2011 GHS)	72.2	327.9	17.8	58.9	190.8	13.8
Direct costs of all four programs (million 2011 GHS)	56.9	280.6	18.9	44.8	156.0	14.6
Indirect costs of all four programs (million 2011 GHS)	15.3	47.3	13.1	14.1	34.9	10.6
Total cost of four programs as share of MoFA's budget (%)	35.3	86.6		28.8	50.9	
Direct costs as share of MoFA's investment budget (%)	162.8	257.4		139.8	145.2	
Program net worth (with programs and open trade)						
Net economic benefits (million 2011 GHS)	14.3	7.6	–15.9	23.9	112.7	–32.1
Discounted net worth (million 2011 GHS)		132.0			301.3	
Benefit–cost ratio		1.1			1.4	
Program net worth (with programs and at autarky)						
Net economic benefits (million 2011 GHS)	71.6	100.5	–15.6	37.4	131.8	–39.6
Discounted net worth (million 2011 GHS)		605.1			414.2	
Benefit–cost ratio		1.6			1.6	

Source: Authors' assumptions and calculations based on literature review, project reports, and surveys.

Notes: AMSEC = Agricultural Mechanization Service Center; BF = Block Farms; NAFCO = National Food Buffer Stock Company; kg = kilograms; ha = hectare; GHS = Ghanaina cedi; mt = metric tons; MoFA = Ministry of Food and Agriculture. Scenario A represents buyers' being less sensitive to price changes, compared to scenario B, wherein buyers are more sensitive to price changes. Values in the column headed Growth are annual percentage growth rates. The differences in the volume of maize in stock under the lower or higher elasticity of demand assumption is explained by the need to mop up excess production to maintain a floor price of GHS 0.55 per kilogram. It therefore becomes far more costly to do so under the assumption of a lower elasticity of demand as prices do not change as much for each unit of quantity added to the stock (that is, removed from the domestic market).

[a.] Although we report the year 2011, 2010 remains the base year.

A more realistic strategy on the fiscal budget is allowing for gradual increases in the total stock volumes each year, which we assume in our case to grow at about 10 percent per year (see Table 8.3). Total costs across all four programs rise to 35 percent of the MoFA budget by 2020 instead. The overall net worth value of all four programs is GHS 329 million to GHS 401 million across the 10 years if we assume open trade. However, if domestic prices fall as a result of the rapid increase in output growth, declining at about 7.8 percent per year, the net worth quickly becomes negative.

Table 8.3 Summary of results of the economic analysis of AMSEC, Fertilizer Subsidy, and BF programs with NAFCO (with a gradual increase in stock)

Scenario Elasticity of Demand	A –0.4			B –0.7		
	2010	2020	Growth	2010	2020	Growth
Volume of stocks handled annually	12.0	28.4	10.0			
Total cost of NAFCO program (million 2011 GHS)	1.04	2.4	10.0			
Indirect costs of program (million 2011 GHS)	0.09	0.22	10.0			
Resulting production and price changes						
Quantity produced from all three program (1,000 mt)	1,892	2,850	4.6	1,794	2,510	3.8
Supply in domestic markets, less stocks (1,000 mt)	2,037	2,821	4.5	1,909	2,482	3.7
Share of stock in total production (%)	0.6	1.0	5.2	0.7	1.1	6.1
Maize prices with three programs, autarky (2011 GHS/kg)	0.42	0.18	–7.8	0.52	0.46	–1.3
Maize prices with all four programs, autarky (2011 GHS/kg)	0.42	0.19	–7.7	0.52	0.47	–1.2
Change in program costs and coverage						
Total cost of all four programs (million 2011 GHS)	56.8	180.2	13.5			
Direct costs of all four programs (million 2011 GHS)	42.9	146.3	14.4			
Indirect costs of all four programs (million 2011 GHS)	13.9	33.9	10.4			
Total cost of four programs as share of MoFA's budget (%)	25.4	40.9				
Direct costs as share of MoFA's investment budget (%)	125.6	136.5				
Program net worth (with programs and open trade)						
Net economic benefits (million 2011 GHS)	29.7	155.4	20.5	25.9	123.3	19.3
Discounted net worth (million 2011 GHS)		401.3			329.1	
Benefit–cost ratio		1.6			1.5	
Program net worth (with programs and at autarky)						
Net economic benefits (million 2011 GHS)	3.0	–74.9		14.5	59.3	17.7
Discounted net worth (million 2011 GHS)		–100.2			162.2	
Benefit–cost ratio		0.9			1.2	

Source: Authors' assumptions and calculations based on literature review, project reports, and surveys.

Notes: AMSEC = Agricultural Mechanization Service Center; BF = Block Farms; NAFCO = National Food Buffer Stock Company; kg = kilograms; ha = hectare; GHS = Ghanaian cedi; mt = metric tons; MoFA = Ministry of Food and Agriculture. Scenario A represents buyers' being less sensitive to price changes, compared to scenario B, wherein buyers are more sensitive to price changes. Values in the column headed Growth are annual percentage growth rates.

In summary, therefore, there is a real advantage to promoting greater access to trade with regional maize markets as well as alternative uses for maize such as animal feed. This is likely to result in much higher economic returns and a lower burden on the fiscal budget across all four programs, but with NAFCO increasingly playing more the role of a food security grain reserve. In local isolated markets, NAFCO can still play a critical role in procuring output where such need exists. As the evidence from the surveys showed, areas where NAFCO was operating seem to have exhibited higher yields. Although yet to be validated, it is possible that offering fixed and certain output prices when farmers make resource allocation decisions at the beginning of the production stage lowers a farmer's uncertainty about future prices and permits higher purchases of inputs.

9. CONCLUSIONS AND IMPLICATIONS[24]

Study Objectives and Methodology

The use of agricultural subsidies in Africa has returned strongly to the development agenda, particularly so following the recent food prices crisis. Still, the main arguments put forth for abandoning agricultural subsidies during the structural adjustment era (that is, that they were ineffective and inefficient policy instruments and that they contributed to government overspending and fiscal and macroeconomic problems) remain. Therefore, a key question that arises is how the current subsidy programs are different from those of the past.

To answer this question, four large agricultural subsidy and price stabilization programs that are being implemented by the government of Ghana were examined closely: (1) subsidization of agricultural mechanization services via support to the establishment and operation of AMSEC, (2) subsidization of fertilizers via the national FSP, (3) establishment and management of block farms that benefit from subsidized mechanization services and inputs (fertilizers, improved seed, and pesticides) and extension services, and (4) stabilization of output prices via the establishment and operation of NAFCO.

More specifically, the study assessed the effectiveness and economic viability of each individual program concerning its (1) consistency against the conceptual design for achieving the goals and objectives of FASDEP II, (2) resources expended, (3) outputs and outcomes achieved, and (4) potential economic rate of return. The specific research questions that we dealt with included the following:

1. How have the programs affected the development of the agricultural input and output markets?
2. To what extent have the programs achieved their stated objectives and outcomes?
    a. Increased supply of and access to agricultural input and output services
    b. Increased use of agricultural technologies and improved practices
    c. Increased yields and production
    d. Improved private-sector and market development
3. What is the overall economic viability of the programs?
4. What are the emerging challenges of the programs and potential ways to address them?

The empirical approach used in the assessment relied on a theoretical framework of the impact pathways for each individual program, including the selection of indicators, sampling, and data collection and analysis. The information used in the empirical analysis was obtained from two main sources: (1) existing program documents and data and (2) individual and focus group interviews with implementing actors, knowledgeable experts, farmers, and other stakeholders along the entire value chain using structured and semistructured instruments. To evaluate the progress and effectiveness of program implementation and achievements, we compared the values of several indicators associated with the situation before and after three years of implementation (2008 to 2011) to determine if any significant changes had occurred. We undertook the fieldwork and data collection efforts for the study in 2011. To assess the economic viability of the programs, we evaluated the future (up to the year 2020) flow of benefits and costs with and without a program intervention using a simple partial equilibrium model of supply and demand. This was done for the four programs separately and then for a combination of the programs to consider their interaction effects.

[24] This section was authored by Samuel Benin (IFPRI, Davis, California, United States).

Results and Implications

AMSEC

Given the high capital cost of machinery and implements, which deters entry into the mechanization services market, the AMSEC program seems to have contributed to improving access by all farmers to those services and has raised the average area mechanized by the surveyed farmers from 5.3 acres per farmer in 2008 to 7.8 acres per farmer in 2010, representing a 21 percent per year increase in the area mechanized. Because the demand for mechanization services far outstrips the supply, the program has not crowded out private-sector investments in the market. However, we find that the newer tractors associated with the AMSEC program seem to break down more frequently (about 17–64 percent more) than those operated by non-AMSEC agents, which is due to a lack of skilled operators, mechanics, and spare parts for the newer brands of tractors imported via the program. Therefore, expanding and deepening the training offered by AESD of MoFA is inevitable. Total net worth of the program up to 2020 was estimated at GHS 46 million to GHS 49 million, with a benefit–cost ratio of about 4.3. This is high because the change in underlying output prices due to the effect of the program on total output growth is small, given the small starting point share of output from mechanization to national output. Also, potential environmental costs were not considered, something that future analysis should handle.

FSP

For FSP, we find that there has been an increase in the application of fertilizers and that farmers who applied fertilizer on their farms obtained not only higher yields, which is expected, but a positive net income compared to those who did not apply any fertilizer. The overall future economic return of the program is positive, with an estimated benefit–cost ratio of 1.7, although this comes with high risks because costs associated with the program overtime could easily take up a larger share of the MoFA budget (up to 35 percent by 2020). Delays in negotiations between the government and fertilizer importers, which delay the supply and distribution of the fertilizers, place limitations on the potential benefits of the program. To forestall delays in fertilizer importation and distribution, it is recommended that the government start negotiations with the importers early so that the fertilizers are in stock in the regions and districts prior to the planting season.

BFP

BFP has generated keen interest among farmers because those participating in the program have attested to the benefits they received, including access to low-cost credit in the form of inputs and mechanization services, which has led to greater productivity, production, and incomes. Recovery rates were surprisingly low, which constrains continuous operation of the program, despite its positive overall economic net benefit, with an estimated benefit–cost ratio between 1.3 and 1.5. For the government to sustain the program, farmers need to be encouraged to pay back. Contrary to expectations, we find that youth have not been a strong focus of the program as it was conceived, because, being relatively inexperienced, youth are considered a riskier venture for being able to properly manage the farm, inputs, and services given to obtain decent yields and being able to pay back. To deliver on the youth goals, which are important, special mechanisms should be used to get youth enthused about agriculture and to facilitate their access to productive resources.

NAFCO Buffer Stock Program

Evidence about the NAFCO program shows that there was stabilization of the maize price in 2010 compared to preceding years' prices, for example, for which there are some lessons to be learned, although data limitations do not allow us to distill the role of NAFCO in this stabilization. We found NAFCO to be financially viable under current conditions projected into the immediate future, that is, to 2020. But a decline in its revenue could pose problems and likely force the government to spend more on

its operations than intended. Therefore, NAFCO should carefully track its revenues, make realistic projections, and find ways to minimize its variability. Based on a simple projection of NAFCO's role in stabilizing prices, we find that potential escalating costs can easily become a burden on fiscal spending in the future. Focusing attention on its useful food security role of managing strategic food grain reserves could have high payoffs if the country were suddenly faced with severe food shortages. In the long run, improving trade ties with regional markets could also help dampen any negative price effects, either from a rapid acceleration in output or from a shortfall of supply in local markets. In more isolated markets, NAFCO should still play a critical role in procuring output where such need exists. As the evidence from the surveys showed, areas where NAFCO was operating also seem to have exhibited higher yields.

Program Interaction Effects

We found substantial interaction effects among the four programs. In particular, the presence of NAFCO seems to enhance the positive effects of the other programs. By offering a fixed and assured output price when farmers make resource allocation decisions at the beginning of the production stage, NAFCO seems to lower farmers' uncertainty about future output prices and permits them to make higher purchases of the subsidized inputs and obtain higher yields, outputs, and incomes. By enhancing the success of the other three programs, NAFCO ensures its own viability; that is, higher aggregate yields and outputs at harvest time keep prices low enough at NAFCO's floor price for NAFCO to be able to procure adequate stocks to profitably operate a buffer stock. So far this seems to be working quite well given NAFCO's current capacity of 34,000 mt, which has yet to be tested in the event of a bumper harvest resulting in market prices lower than NAFCO's floor prices that are sustained over a long period of time. NAFCO's 34,000-mt capacity represents only about 3.3 percent of the estimated total marketed maize alone. Allowing for gradual increases in the total stock of NAFCO each year and assuming open trade, the overall net worth value of all four programs is GHS 329 million to GHS 401 million during 2010–20, with an estimated benefit–cost ratio between 1.5 and 1.6. However, if domestic prices fall below the floor price as a result of the rapid increase in output growth and NAFCO is unable to mop up the excess, the net worth quickly becomes negative.

APPENDIX A: ECONOMIC SURPLUS APPROACH[25]

Background

Considering that all four programs were recently launched, we use a simple economic surplus method to estimate future economic net benefits associated with them. The principal goal for this ex ante–type analysis is to compare situations with and without the program as opposed to comparing situations before and after. The economic surplus method used here is a partial equilibrium and single commodity analysis, using maize in this study. The analysis and application of an economic surplus method has many advantages. It offers a relatively simple, flexible approach to estimate the economic value of a program using the concepts of supply, demand, and equilibrium, which account for producers' production costs and consumers' consumption values. As these interact and respond to program interventions (for example, a program designed to increase yields), equilibrium quantities and prices also change with important implications for overall economic welfare.

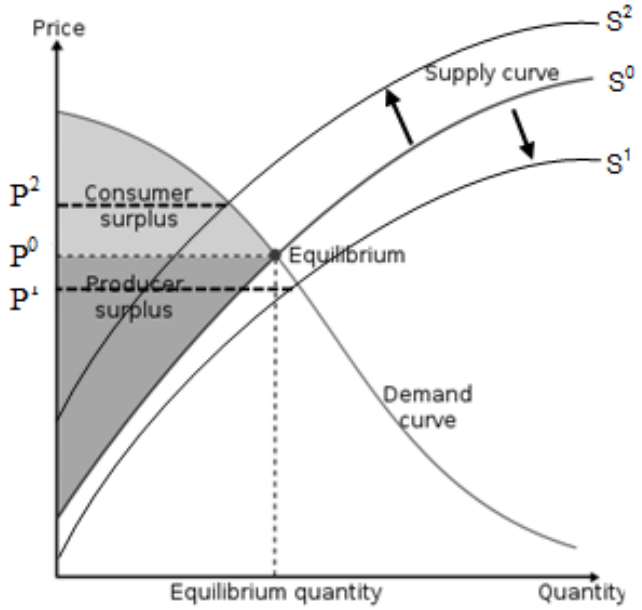
One critical advantage of using the economic surplus approach is that it requires fewer data except for sufficient information about the flow of production and program costs as well as assumptions about supply and demand behavior over time and the flow of benefits. For production cost, detailed information about the use of a wide range of inputs, such as land, labor, seeds, and fertilizer, can be incorporated. For program costs, both direct and indirect costs (for example, administrative costs) should be used. On the benefit side, initial output prices are critical to help project any price changes over time that have important implications for production incentives and therefore overall supply.

On the demand side, as on the supply side, prices influence quantities consumed since consumers generally demand less of a commodity at higher prices, depending on the type of commodity and income levels. For example, if maize is easily substitutable with cassava, rising maize prices due to shortage and reduced supply would simply shift demand to lower-priced cassava products. In this case, demand for maize would fall and put a downward pressure on maize prices as markets become saturated with fewer buyers of maize. Eventually, reduction in maize prices would bring maize buyers back and stabilize prices. If maize were a critical staple, most buyers would still be forced to buy at the higher price (although they would buy less of it)—providing incentives for producers to expand maize output and supply until a new temporary equilibrium was reached.

What is important is that for some particular commodity market, we can observe the market price and equilibrium quantity supplied and demanded, which help describe the economic situation facing both producers and consumers at some point in time (see Figure A.1). Ultimately, their behavior and welfare concerns can be explained by the shape of their supply and demand curves, which also measure the social value of given production and consumption levels or the area between the supply and demand curves. Referred to as the "economic surplus" welfare measure, it provides a monetary value of the sum of the gain by consumers by purchasing the commodity at a price that is less than the highest price that they would have been willing to pay (consumer surplus) and the gain by producers by selling the commodity at a price that is higher than the least that they would have been willing to sell for (producer surplus)—see Figure A.1.

[25] This appendix was authored by Michael Johnson (IFPRI, Washington, DC, United States).

Figure A.1 Illustration of consumer and producer surpluses



Source: Author's illustration.
Notes: P^0 = initial equilibrium price; P^1 = lower price; P^2 = higher price; S^0 = initial supply curve; S^1 = greater supply; S^2 = smaller supply.

If an individual program shifts the supply curve downward or to the right of the initial supply curve (that is, from S^0 to S^1 in Figure A.1), by expanding production, for example, some additional economic surplus is gained as the new equilibrium price (P^1) is lower than the previous one (P^0) for consumers, hence mostly a consumer surplus gain. A good example is the Fertilizer Subsidy Program (FSP), which increases yields and overall output and thus ultimately lowers output prices as supply shifts out and consumers pay less for each unit of output. Producer surplus may go up, go down, or remain unchanged depending on the slope of the curves and how much the price drops. Often producers, especially smallholders, tend to be net buyers of food, so lower prices tend to be beneficial across the board. However, when prices drop to the extent that producers also lose out, then they are likely to cut back production in the next season, creating shortages and then high prices—which is not good.

Now consider, in addition to FSP, a program that dampens or reduces the full supply effect of the fertilizer program (particularly where the reduction in prices would have been disastrous), as when the National Food Buffer Stock Company (NAFCO) buys up stock at a higher price than P^1 but still lower than P^0. Then we can see a situation wherein both consumers and producers gain from the supply effect of FSP as well as the price-stabilization effect of a NAFCO-type program. Basically, consumers benefit from the lower prices, and producers benefit from the higher-than-normal prices. A similar analysis of benefits can be done with a decrease in supply (that is, shift of the supply curve from S^0 to S^2 in Figure A.1) to look at how prices would increase and then a NAFCO-type intervention would release its stocks to prevent the price from rising too high.

Because the four programs are all looking to reduce production costs, increase production directly or indirectly, or both, which will in turn lower prices, the objective of the economic surplus approach used here is to assess the value of the gain to consumers (that is, increase in consumer surplus) relative to the loss to producers (that is, reduction in producer surplus) associated with any reduction in prices resulting from a shift in output supply. If the increase in output associated with any of the programs represents a very small share of the total supply in the marketplace, the change (that is, increase in output due to the program) may be too small to provide any significant welfare gains at the national level.

Data and Assumptions

To undertake the analysis, data on some key socioeconomic indicators are needed in addition to program costs and benefits. We therefore begin by providing estimates of total program costs, inclusive of both direct and indirect costs. Together with some assumptions about future growth in expenditures over time, this provides a good basis for estimating the flow of program costs that we can compare to a flow of social benefits in the economic analysis later on.

Assumptions of Future Growth

Table A.1 summarizes some of the basic assumptions. For example, we assume the Ghanaian economy will continue to grow at a modest rate as it has done in the past, at about 8.3 percent for real gross domestic product (GDP) growth. Agricultural GDP grows at an average rate of about 5.5 percent. Within the maize sector, we assume average yields without any of the programs will grow slowly, at about 1 percent per year, with the area under maize growing at about 2 percent per year, which translates into a production growth rate of 3 percent per year as our base case scenario. We also assume some growth rates of world fertilizer prices as these can have important implications on the fertilizer subsidy costs, for example. All monetary values are converted to constant 2011 prices using the GDP deflator.

Estimation of Program Costs

Estimates of program costs are needed for undertaking the analysis. Estimating these as shares MoFA's budget over time can help determine the fiscal burden of the programs. The costs are projected out to 2020 using information about the goals of all four programs, using a number of assumptions about the future growth of overall government expenditures, and based on the projections of overall economic and agricultural-sector performance (see Table A.1). Data come from various sources: primary data from surveys conducted under each program, MoFA, Bureau of Statistics, Food and Agriculture Organization of the United Nations, and World Bank. Past studies on public expenditures in Ghana are also relied on heavily.

The various assumptions about budgetary expenditures and program costs are summarized in a range of tables and figures below. Table A.2 presents projections of growth in public budgets and expenditures based on their shares to total agricultural-sector GDP growth assumptions. The shares are taken from data in Benin et al. (2008) and other government documents. We chose to maintain a MoFA budget ratio to total agricultural GDP at 1.5 percent, which implies a growth rate similar to sector growth, 5.5 percent per year. As a share of total government spending, this translates into a rate of about 4.6 percent in 2010, which is close to the shares observed in 2007 for which the most recent data were available.

Across the four programs, assumptions of growth in scale and intensity over time were made, based partially on program goals or past growth trends (see Table A.3). For FSP, additional assumptions about future projections of domestic demand and global prices were introduced (see Table A.4). We discuss these in more detail later under each program.

Table A.1 Assumptions and projections of key economic indicators, resources, and commodities, 2010–2020

Category	Annual average growth rate (%)	Annual values										
	2010–2020	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Key economic indicators												
GDP deflator (base 2011)	–15.1	1.15	1.00	0.87	0.76	0.66	0.57	0.50	0.44	0.38	0.33	0.29
Exchange rate (US$1)	3.0	1.42	1.50	1.55	1.59	1.64	1.69	1.74	1.79	1.84	1.90	1.96
GDP (constant 2011 GHS, billion)	8.3	51.5	55.7	60.3	65.3	70.7	76.5	82.9	89.7	97.1	105.2	113.9
Agricultural GDP (constant 2011 GHS, billion	5.5	15.0	15.8	16.7	17.6	18.6	19.6	20.7	21.8	23.0	24.3	25.6
Share of agriculture in GDP (%)	–2.5	29.1	28.4	27.6	26.9	26.3	25.6	24.9	24.3	23.7	23.1	22.5
Commodities and resources												
Average maize yield (mt/ha)	1.0	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.9	1.9	1.9
Maize area (million ha)	2.0	0.97	0.99	1.01	1.03	1.05	1.07	1.10	1.12	1.14	1.16	1.19
Total arable land (million ha)	0.5	4.42	4.44	4.47	4.49	4.51	4.53	4.56	4.58	4.60	4.63	4.65
National population (million)	2.2	24.4	25.0	25.5	26.1	26.7	27.3	27.9	28.5	29.1	29.7	30.3
Fertilizer prices (constant 2011 GHS/kg)												
Price at port of entry	4.6	0.40	0.43	0.45	0.47	0.49	0.51	0.54	0.56	0.58	0.61	0.64
Domestic price with no subsidy	4.6	0.81	0.87	0.91	0.95	1.00	1.04	1.09	1.14	1.19	1.24	1.29
Effective price with subsidy	4.6	0.41	0.50	0.52	0.54	0.57	0.59	0.62	0.65	0.67	0.70	0.74

Source: GDP deflator and economic growth projections based on past trends using World Bank Development Indicators (1990–2010). Shares based on IFPRI's public expenditure database and Benin et al. (2008).

Note: GDP = gross domestic product; GHS = Ghanaina cedi; mt = metric tons; ha = hectare; kg = kilogram.

Table A.2 Breakdown of MoFA expenditures, 2010–2020

Category	Annual average growth rate (%)	Annual values										
	2010-20	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total Government Spending (Constant 2011 GHS, Billion)												
Total GoG	8.3	4.91	5.32	5.76	6.24	6.75	7.31	7.91	8.57	9.28	10.04	10.87
Total GoG in agriculture	5.5	0.94	1.00	1.05	1.11	1.17	1.23	1.30	1.37	1.45	1.53	1.61
MoFA	5.5	0.23	0.24	0.25	0.26	0.28	0.29	0.31	0.33	0.35	0.36	0.38
DoF	5.5	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.12
CSIR	5.5	0.26	0.27	0.29	0.30	0.32	0.34	0.35	0.37	0.39	0.42	0.44
COCOBOD	5.5	0.31	0.32	0.34	0.36	0.38	0.40	0.42	0.45	0.47	0.50	0.53
PSI	5.5	0.08	0.09	0.09	0.10	0.10	0.11	0.12	0.12	0.13	0.14	0.14
Percentage Shares (%)												
Total GoG as % of GDP		9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
MoFA as % of GoG		4.6	4.5	4.4	4.2	4.1	4.0	3.9	3.8	3.7	3.6	3.5
MoFA as % of agricultural GDP		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Breakdown of MoFA Spending (Constant 2011 GHS, Million)												
Salaries	4.5	143.7	150.1	156.8	163.8	171.1	178.8	186.7	195.1	203.8	212.9	222.4
Administration	4.5	21.3	22.2	23.2	24.3	25.4	26.5	27.7	28.9	30.2	31.6	33.0
Services	4.5	11.9	12.5	13.0	13.6	14.2	14.9	15.5	16.2	17.0	17.7	18.5
Investments	8.7	48.2	52.7	57.5	62.7	68.3	74.2	80.6	87.5	94.8	102.7	111.1
Total	5.5	225.1	237.5	250.6	264.4	279.0	294.4	310.6	327.7	345.8	364.9	385.0

Source: Authors' assumptions based on annual growth rates calculated from Benin et al. (2008).

Notes: MoFA = Ministry of Food and Agriculture; GHS = Ghanaian cedi; GoG = government of Ghana; DoF = Department of Forestry; CSIR = Council for Scientific and Industrial Research; COCOBOD = Ghana Cocoa Board; PSI = Presidential Special Initiative; GDP = gross domestic product.

Table A.3 Assumptions of future growth across all four programs

Category	Annual average growth rate (%)[a] 2008-20	Annual values 2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
MoFA Programs Coverage														
FSP (total, 1,000 mt)	10.0	43	73	91	100	110	121	134	147	162	178	196	215	237
BFP (total area, 1,000 ha)	10.0	—	12	129	150	165	182	200	220	242	266	292	322	354
NAFCO[1] (total volume, 1,000 mt)	30.0	—	—	11	14	18	24	31	41	53	69	89	116	151
NAFCO[2] (total volume, 1,000 mt)	42.7	—	—	11	190	230	279	343	425	535	686	901	1,222	1,742
AMSEC (total area, 1,000 ha)	20.0	2	29	66	79	95	114	137	164	197	237	284	341	409
Per unit (kg/ha or ratios)														
FSP (kg/ha)	10.0	9.8	16.5	20.6	22.6	24.7	27.1	29.6	32.4	35.5	38.8	42.5	46.5	50.9
BFP (% of arable land)	9.7	—	0.3	2.9	3.4	3.7	4.0	4.4	4.8	5.3	5.8	6.4	7.0	7.6
NAFCO[1] (total volume, kg/ha)	9.5	—	—	2.5	3.2	4.1	5.4	6.9	9.0	11.6	15.0	19.4	25.1	32.5
NAFCO[2] (total volume, kg/ha)	42.0	—	—	2.5	42.8	51.4	62.2	76.0	93.8	117.5	149.9	195.7	264.2	374.7
AMSEC (% of arable land)	22.4	0.1	0.7	1.5	1.8	2.1	2.5	3.0	3.6	4.3	5.2	6.2	7.4	8.8

Source: Authors' calculations and data from program reports.

Notes: MoFA = Ministry of Food and Agriculture; FSP = Fertilizer Subsidy Program; mt = metric tons; BFP = Block Farms Program; ha = hectare; NAFCO = National Food Buffer Stock Company; AMSEC = Agricultural Mechanization Service Center; kg = kilogram. Dashes indicate data not available.

[a] Target assumptions. For FSP, we assume the amount subsidized each year will grow at about 10 percent per year. For BFP, we restrict growth to about 10 percent per year, growing beyond the targeted goal of 150,000 hectares. For NAFCO, we offer two alternatives: NAFCO[1] assumes a gradual increase in stocks that grow at about 10 percent per year. NAFCO[2], on the other hand, seeks to maintain the floor price under conditions when domestic prices fall with the introduction of all three other programs.

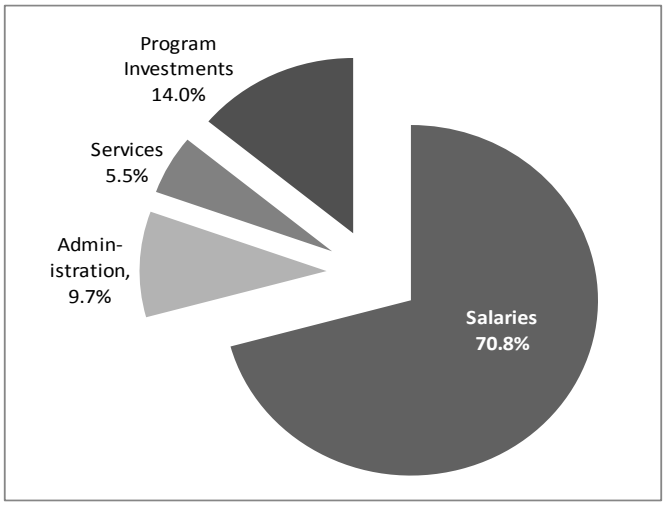
Table A.4 Breakdown of assumptions on future fertilizer quantities (imported and subsidized) and prices, 2010–2020

Category	Annual average 2010-20	Annual										
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Quantities												
	Growth rate (%)											
Total imports (1,000 mt)	10.0	228.1	250.9	276.0	303.6	334.0	367.4	404.1	444.5	489.0	537.9	591.7
Subsidized quantity (1,000 mt)—A	10.0	91.2	100.4	110.4	121.4	133.6	146.9	161.6	177.8	195.6	215.1	236.7
Direct subsidy cost (2011 GHS)—B	10.0	32.0	36.3	49.9	65.9	86.9	114.7	151.4	199.9	263.8	348.2	459.6
Price breakdown (GHS/kg)												
	Share of domestic price (%)											
International price at port	49.3	0.40	0.43	0.45	0.47	0.49	0.51	0.54	0.56	0.58	0.61	0.64
Importer marketing margins	10.8	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.12	0.13	0.13	0.14
Port charges	9.3	0.08	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.12
Credit and finance	16.0	0.13	0.14	0.15	0.15	0.16	0.17	0.17	0.18	0.19	0.20	0.21
Wholesale price	85.4	0.69	0.75	0.78	0.81	0.85	0.89	0.93	0.97	1.01	1.06	1.10
Transportation and distribution	14.6	0.12	0.13	0.13	0.14	0.15	0.15	0.16	0.17	0.17	0.18	0.19
Domestic market price	100.0	0.81	0.87	0.91	0.95	1.00	1.04	1.09	1.14	1.19	1.24	1.29
Subsidy												
Effective subsidy cost (B/A above)		0.40	0.38	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.53	0.56
Subsidized domestic price		0.41	0.50	0.52	0.54	0.57	0.59	0.62	0.65	0.67	0.70	0.74

Source: Authors' projections based on breakdown in Fuentes, Johnson, and Bumb (2011).
Notes: mt = metric tons; GHS = Ghanaian cedi; kg = kilogram.

For MoFA's own budget, shares allocated to salaries versus investments are drawn from 2005 data, as illustrated in Figure A.2. Salaries make up the bulk of the budget, estimated at GHS 143 million out of a total of GHS 225 million in 2010, which is about 71 percent of the total budget. We assume indirect costs or MoFA administrative and technical oversight costs for each of the programs to be drawn from salaries (or the opportunity cost of time of MoFA staff), whereas direct program costs are directly related to program investment costs and come out of the investments line item of the budget. The ratio of indirect to direct costs is assumed to remain unchanged for each program, implying that indirect costs for administering and providing technical oversight are tied to any changes in the scale of direct program costs. On the other hand, we expect the ratio of indirect program costs to MoFA salaries to change over time as the two do not always move in tandem.

Figure A.2 Assumed distribution of MoFA budget based on past shares



Source: Based on the 2005 Ghana, Controller and Accountant General's Department public accounts report.
Note: MoFA = Ministry of Food and Agriculture.

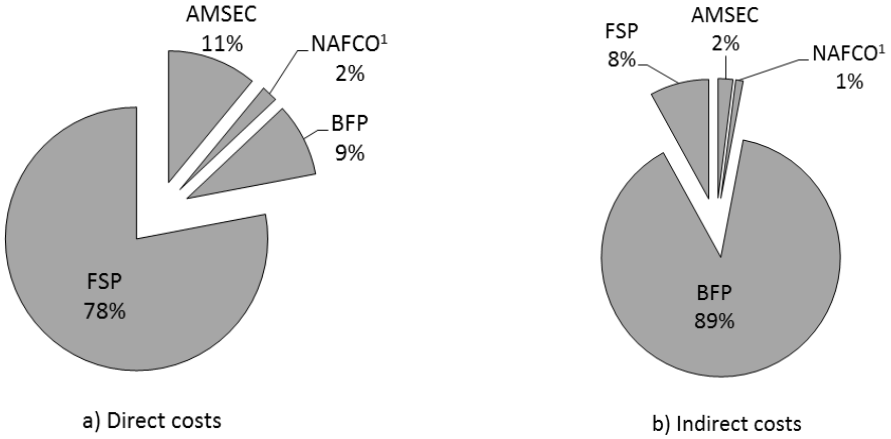
Based on these assumptions, Table A.5 shows the BFP to have the highest ratio of indirect to direct costs, emphasizing the extent to which the program already depends a lot on MoFA extension services and administration. As a share of MoFA salaries, this translates into 8.3 percent initially as a rough estimate, growing to 13.2 percent by 2020 as the program expands further with unchanged recovery rates. Overall, BFP is estimated to have accounted for almost 90 percent of the total indirect costs incurred across the four programs in 2011 (see Figure A.3). Not surprisingly, FSP accounted for the largest share of direct program costs.

Table A.5 Assumptions of program indirect costs to MoFA

Program	Ratio of Indirect to Total Direct Program Costs	Indirect Program Costs as a Share of MoFA Salaries (%)	
	2011–20	2011	2020
FSP	0.03	0.7	1.8
BFP	3.00	8.3	13.2
NAFCO[1]	0.11	0.1	0.1
NAFCO[2]	0.11	1.0	6.1
AMSEC	0.07	0.2	0.2

Source: Authors' assumptions and calculations using data from Table A.2 and resulting Table A.4.
Notes: MoFA = Ministry of Food and Agriculture; FSP = Fertilizer Subsidy Program; BFP = Block Farms Program; NAFCO = National Food Buffer Stock Company: NAFCO[1] assumes a gradual increase in stocks that grow at about 10 percent per year. NAFCO[2], on the other hand, seeks to maintain the floor price under conditions when domestic prices fall with the introduction of all three other programs. AMSEC = Agricultural Mechanization Service Center.

Figure A.3 Comparing across programs, direct and indirect program costs (percentage share of total across four programs), 2011



Source: Authors' calculations based on Table A.3 and resulting Table A.4.

Notes: AMSEC = Agricultural Mechanization Service Center; FSP = Fertilizer Subsidy Program; BFP = Block Farms Program; NAFCO = National Food Buffer Stock Company (NAFCO[1] assumes a gradual increase in stocks that grow at about 10 percent per year).

Based on all these various assumptions, the resulting budget projections to 2020 across the four programs, disaggregated by direct and indirect costs, are presented in Table A.6. Table A.7 calculates the changing shares of each program to the total projected MoFA budget. We now review the assumptions and cost projections for each of the four programs in more detail.

Table A.6 Estimating total costs of four programs—direct and indirect costs (constant 2011 GHS, millions)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Direct costs											
FSP	36.8	36.3	43.4	49.9	57.4	65.9	75.7	87.0	100.0	114.9	132.0
BFP	4.1	4.1	4.6	5.0	5.5	6.1	6.7	7.3	8.1	8.9	9.8
NAFCO[a]	15.9	1.1	1.4	1.9	2.4	3.2	4.1	5.4	7.0	9.1	11.8
NAFCO[b]	15.9	14.9	18.0	21.9	26.9	33.3	42.0	53.8	70.6	95.8	136.5
AMSEC	1.5	5.1	5.3	5.6	5.8	6.1	6.3	6.6	6.9	7.2	7.6
Subtotal[a]	58.3	46.6	54.7	62.4	71.1	81.3	92.8	106.3	122.0	140.1	161.2
Subtotal[b]	58.3	60.4	71.3	82.4	95.6	111.4	130.7	154.7	185.6	226.8	285.9
Indirect costs											
FSP	1.1	1.1	1.3	1.5	1.7	2.0	2.3	2.6	3.0	3.4	4.0
BFP	12.3	12.4	13.7	15.0	16.6	18.2	20.0	22.0	24.2	26.7	29.3
NAFCO[a]	1.8	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
NAFCO[b]	1.8	1.5	1.8	2.2	2.7	3.3	4.2	5.4	7.1	9.6	13.7
AMSEC	0.1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4
Subtotal[a]	15.3	13.9	15.4	16.9	18.7	20.6	22.8	25.1	27.7	30.7	33.9
Subtotal[b]	15.3	15.3	17.1	19.0	21.3	23.8	26.8	30.3	34.6	40.1	47.4
Total direct and indirect costs											
FSP	37.9	37.4	44.7	51.4	59.1	67.9	78.0	89.6	103.0	118.3	136.0
BFP	16.4	16.5	18.3	20.0	22.1	24.3	26.7	29.3	32.3	35.6	39.1
NAFCO[a]	17.7	1.2	1.6	2.0	2.6	3.3	4.3	5.5	7.2	9.3	12.0
NAFCO[b]	17.7	16.4	19.8	24.1	29.6	36.7	46.2	59.2	77.7	105.4	150.2
AMSEC	1.6	5.4	5.6	5.9	6.1	6.4	6.6	6.9	7.2	7.6	8.0
Total[a]	73.6	60.5	70.2	79.3	89.9	101.9	115.6	131.3	149.7	170.8	195.1
Subtotal[b]	73.6	75.7	88.4	101.4	116.9	135.3	157.5	185.0	220.2	266.9	333.3

Source: GDP deflator and economic growth projections based on past trends using World Bank Development Indicators (1990–2010). Shares based on IFPRI's public expenditure database and Benin et al. (2008).

Notes: FSP = Fertilizer Subsidy Program; BFP = Block Farms Program; NAFCO = National Food Buffer Stock Company; AMSEC = Agricultural Mechanization Service Center. An important assumption here is that direct program costs are assumed to come out of the investments portion of the Ministry of Food and Agriculture budget. Indirect program expenses refer to administrative and management costs for overseeing and managing each of the programs, inclusive of extension services provided to the block farms, for instance.

[a.] Assumes a gradual increase in NAFCO stocks that grow at about 10 percent per year. [b.] Here NAFCO seeks to maintain a floor price under conditions when domestic prices fall below this threshold.

Table A.7 Estimating total program costs (direct and indirect) as a share of MoFA's budget (%)

	2011	2020
Total program cost (% of MoFA's budget)		
FSP	15.7	35.3
BFP	7.0	2.9
NAFCO	0.4	0.6
AMSEC	2.3	2.1
All four programs		
Total cost (% of MoFA's budget)	25.4	40.9
Direct costs (% of MoFA's development spending)	88.2	130.2
Indirect costs (% of MoFA's spending on salaries)	9.2	5.8

Source: Authors' calculations using data from Table A.3.

Notes: MoFA = Ministry of Food and Agriculture; FSP = Fertilizer Subsidy Program; BFP = Block Farms Program; NAFCO = National Food Buffer Stock Company; AMSEC = Agricultural Mechanization Service Center. The shares result from individual program assumptions based on expected growth of activities and coverage to 2020 in program investments and indirect costs.

Costs of the AMSEC Program

We assume the costs of managing and implementing the AMSEC program are quite small, assuming mechanized implements are sold at full market price. Much of the cost is due to losses from credit recovery and administering the program. Individual operators are assumed to break even, with no added cost to society. We therefore ignore any costs and benefits flowing from this sector in analyzing the overall national welfare benefits flowing from the maize sector as a result of increased mechanized services from the program. Indirect costs are assumed to be about 0.05 times direct costs (Table A.4).

Costs of FSP

As a futuristic projection, a number of important assumptions were required based on past trends and program goals and expectations. To begin with, a flow of direct and indirect program costs between 2011 and 2020 are estimated assuming fertilizer quantities subsidized will grow at a modest rate of about 10 percent per year from the base of 91.2 million metric tons[26] in 2010. The costs of the subsidies are calculated based on the per-ton cost of current subsidies. Indirect costs are added assuming some level of administrative and coordination costs for managing the program, which are assumed to be 0.03 times the total direct cost of the program (Table A.5). For example, with a total cost of GHS 36.8 million in 2011 constant prices, indirect costs are estimated to be about GHS 1.1 million in 2011, rising to GHS 4 million in 2020 (Table A.6).

Costs of BFP

Direct costs of BFP are based on the rate of cost recovery for inputs (reviewed further below). From 2010, for example, a total of GHS 17.87 million was spent on inputs, transporting inputs, national monitoring, and national-level meetings for a total coverage of 129,300 ha among existing block farms. Of this amount, GHS 14.3 million was recovered as in-kind payments from the participants. This translates into a recovery rate of 80 percent on average. Using this information, we assume a similar recovery rate to be maintained into the future, resulting in a per-hectare upfront cost for MoFA of GHS 138, of which GHS 111 is typically recovered. Future direct cost projections are ultimately determined by these unit costs, depending on the total acreage under block farms.

We assume that indirect costs are much higher than direct costs. This is because among all the programs, BFP requires the most intensive administrative oversight from MoFA and level of effort

[26] All tons are metric tons.

provided by extension staff. As such, we assume its indirect costs to be about three times its direct costs, less recoveries (Table A.5). This is a government-sponsored and -administered program and therefore potentially comes at a high cost to MoFA. As shown in Table A.6, total costs are expected to more than double by 2020 as the acreage under block farms grows by 10 percent per year—from GHS 15.9 million in 2010 (of which GHS 3.6 million and GHS 12.3 million are direct and indirect costs, respectively) to GHS 39.1 million by 2020 (of which GHS 9.8 million and GHS 29.3 million are direct and indirect costs, respectively).

Costs of the NAFCO BSP

For NAFCO, we chose to adopt two alternative goals. The first would be to mop up any excess supply of maize in the market by maintaining a floor price of GHS 0.55. The second is to gradually increase stock by about 10 percent. For the latter, maize stock would rise to about 28,000 mt by 2020, a little more than double current levels but still below its total capacity of 34,000 mt. For the first scenario, stock would rise dramatically to about 1.7 million mt, significantly greater than its current storage capacity. Costs are therefore expected to rise faster under this scenario.

Since any increase in stocking levels is expected to lead to higher costs in managing the associated activities of buying and selling throughout the period, as well as maintaining the stock itself, we assume a unit cost per ton. To estimate such a cost, we borrowed from the work of Rashid and Lemma (2011) in which they estimate a unit cost for maintaining and managing stocks in Ethiopia at about US$34.84[27] per mt. We adjust this upward to $52.26 per mt for NAFCO to account for the relatively higher labor costs in Ghana. We also assume indirect costs associated with MoFA's own administrative oversight of the program, which we estimated to be about 0.1 percent of MoFA's budget for salaries.

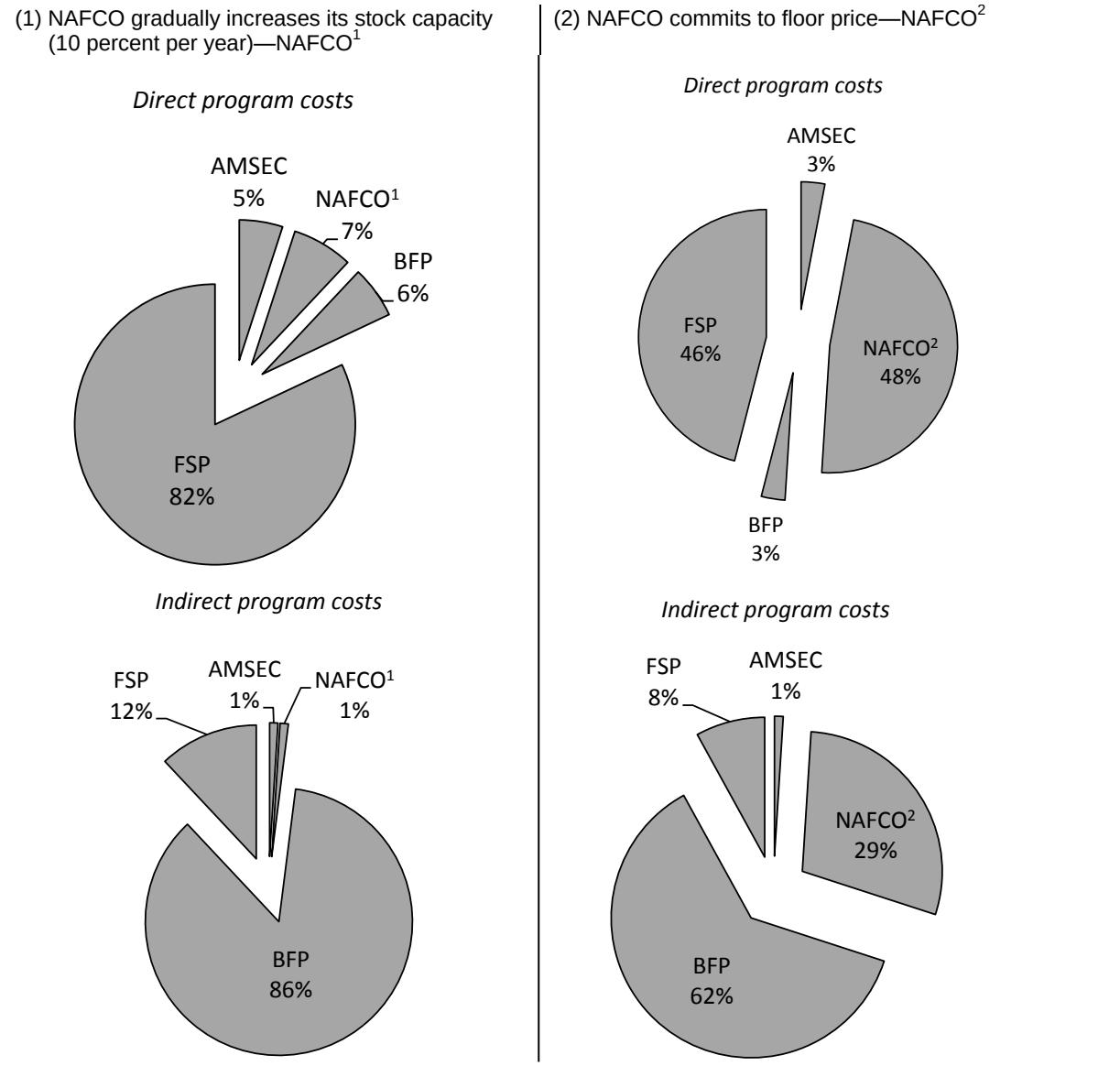
Table A.6 shows results under the two alternative goals: (1) to gradually increase stock by about 10 percent and (2) to mop up any excess supply of maize in the market by maintaining a floor price of GHS 0.55, represented as $NAFCO^1$ and $NAFCO^2$, respectively. Under the first scenario, total costs rise only modestly, from GHS 1.2 million to GHS 12 million per year by 2020. This is a growth of about 29 percent per year, reflecting the gradually increasing capacity for handling greater stock volumes, reaching 150,800 mt by 2020. If, on the other hand, NAFCO is forced to mop up any surplus maize in the market, the picture can change dramatically. Costs quickly rise to about $150 million by 2020 if we assume there are no trade opportunities to export any surplus or absorb it in local industries from our maize production growth assumptions. Here NAFCO would be absorbing much of the surplus. However, we expect this to be the least likely scenario given reasonable expectations of open trade in regional and global markets and future sustained favorable global prices given an assumed rapidly growing demand for the food, feed, and biofuels markets.

Comparing Costs across all Four Programs

Figure A.4 and Table A.7 provide an overall summary of the programs costs, compared across each other and when projected to 2020. Not surprisingly, based on our assumptions and the structure of the programs, FSP would make up almost 90 percent of the direct program costs by 2020. On the other end, BFP's indirect costs rise by 2020, making up more than 60 percent of this. For NAFCO, committing to a floor price with all four programs in place begins to cost as much as FSP and replaces BFP with the highest indirect costs.

[27] All dollars are US dollars.

Figure A.4 Comparison of programs' direct and indirect program costs (percentage share of total across four programs), 2020



Source: Authors' calculations.

Notes: FSP = Fertilizer Subsidy Program; BFP = Block Farms Program; NAFCO = National Food Buffer Stock Company (NAFCO[1] assumes a gradual increase in stocks that grow at about 10 percent per year. NAFCO[2], on the other hand, seeks to maintain the floor price under conditions when domestic prices fall with the introduction of all three other programs.); AMSEC = Agricultural Mechanization Service Center.

APPENDIX B: PROBLEMS WITH AND SOURCES OF DIFFERENT FARM MACHINERY[28]

Problems Associated with Different Brands of Farm Machinery

Farmtrac (General Problems)

- Overheating of the engine: This has been attributed to poor airflow through the radiator because of dirt clogs.
- Seizure of the fuel injection pump: The cause could be traced to the malfunctioning of the filters. In most cases other, cheaper filters were used, not the recommended Farmtrac filters.
- Seizure of the hydraulic pump: The cause could be dirt, and this can be associated with a delay in changing the filters.
- Kingpin damage: Kingpins were damaged as a result of the design, which could not stand the rugged terrain and the frequent collision of the front beam with obstacles such as stumps in the field.
- Plough disc hub bearings breakage: Most of the plough disc hub bearings were breaking down often, and these have to be replaced with hubs for Massey Ferguson disc ploughs.
- Hydraulic oil leakage: Frequent leakage of hydraulic oil along the pipes is the result of obstacles entangling the pipes and pulling them apart during fieldwork and the rubbing effect on the pipes. There has also been hydraulic leakage at the steering pot and the lift assembly; this has been found to be the result of damaged seals.
- Broken crankshaft bearings on some of the Farmtrac brands: These needed to be replaced.

In addition to the above general issues, specific models and brands have unique problems.

Farmtrac 60

- Oil sumps frequently dent mainly due to obstacles (especially stumps) in the field.
- Steering bushings in the steering pot must be changed frequently due to wear.
- There are problems associated with the gears in the gearbox, often due to wear.
- Ford 4000 parts could be used for some aspects of the Farmtrac engines. Parts ranging from the gearbox to the hydraulic lifts can be gotten only from the supplier of Farmtrac.

Farmtrac 70

- The bolts on the base plate of the gearbox often slack and drop when the tractor is in the field working. As a result, the oil drips, and the gears run dry and wear or break. With this particular design of the gearbox, the lower links are attached to the base plate, whereas in the Farmtrac 60, Farmtrac 80, and all other tractors, the lower links are attached to either the main housing of the gearbox or the back axle of the tractor.
- Gearbox replacement parts are difficult to get. Currently some of the mechanics depend on scrap dealers for some of the gears.
- Ford 4000 engine parts also serve some purpose, as with the Farmtrac 60.

[28] This appendix was coauthored by Gerald Ahorbo (SmarTeam Services Limited, Tema, Ghana) and Victor Owusu (Kwame Nkrumah University of Science and Technology, Kumasi, Ghana).

Farmtrac 80 (There are two types of Farmtrac 80, one with a Perkins engine and the other with a Siemens engine. Both have the general problems listed above.)

- The Perkins engine model's parts are interchangeable with Massey Ferguson engine parts.
- The fuel pump for the Farmtrac 80 with the Siemens engine is difficult to find on the open market.
- MF188 parts are compatible with some parts of the Farmtrac 80 with the Perkins engine.

John Deere

- There are frequent problems with the clutch disc plates, which often need adjustment or replacement due to wear.
- The position of the hydraulic filters is low, and the filters and the hose break easily because they entangle obstacles in the field during land preparation.
- The injection pump breaks down due to a delay in changing fuel filters; this could be helped by changing the injector nozzles.
- The disc plough and harrow are poorly fabricated. None could be used for fieldwork, and they cannot be repaired because of a fundamental engineering problem with the poor-quality material used.

Mahindra

- Frequent wear is associated with the cam followers. Currently, these are fabricated because there are no spares available with the supplier's representative.
- Frequent problems are associated with the gearbox, which often requires the change of gears that have gotten damaged or worn.
- There is frequent wear with the bearings associated with the steering.
- The clutches wear often. This type of clutch was found to match the MF135 clutch; however, other mechanics have adopted the Benz truck clutch, which lasts longer.
- Some seals on the hydraulic pump often break.
- There are complaints of broken drive shafts.
- Engine overhaul is common.

Yukon

- Almost all are parked because of lack of spare parts. A common problematic part is the clutch.

Shakti Power Tiller

- The major problem is worn-out pistons and rings after just a year of use.
- The engine becomes weak after a year of use and does not perform even after overhauling.

Suppliers of Farm Machinery and Implements

The four main tractor and implements suppliers for the AMSEC program are: Foundry and Agricultural Machinery Company Limited, which supplied Farmtrac tractors and Shakti power tillers; AMANK Agricultural and Equipment Company Limited, which supplied John Deere tractors; Foston Ghana Limited, which supplied Mahindra tractors; and Biga Company Limited, which supplied Yukon tractors.

Foundry and Agricultural Machinery Company Limited

The total number of Farmtrac tractors sold to MoFA from 2003 to date is 1,481 (tractor head, trailer, disc plough, and disc harrow), out of which 430 are Farmtrac 60, 900 are Farmtrac 70, and 151 are Farmtrac 80. In addition, 200 Shakti power tillers were sold to MoFA. The Farmtrac engines are Perkins and Siemens models, which are similar to Massey Ferguson and Ford engines, respectively. The tractors received were all manufactured and assembled in India. Most parts of the Perkins engine can be gotten from African Motors and the open market.

AMANK Agricultural and Equipment Company Limited

The company started sales in 2008, and a total of 512 tractors have been sold. Out of this number, 500 tractors, 500 ploughs, 250 trailers, and 150 harrows were sold to MoFA. All the tractors sold are of the 5000 series, and their engines are John Deere models. The tractors received were all manufactured and assembled in India. All the parts can be gotten from the main supplier through five satellite centers at strategic points in the country.

Foston Ghana Limited

The company started sales of the 605- and 705-series tractors in Ghana in 2008 and has so far sold 262 tractors with ploughs, harrows, and trailers to MoFA. The tractors received were all manufactured and assembled in India. Spare parts can be gotten only from the supplier's representative in Kumasi. Currently, there are no spare parts distribution or sales points in any part of the country apart from Kumasi.

Biga Company Limited

The company has sold 262 Yukon tractors with ploughs, harrows, and trailers to MoFA. The tractors received were all manufactured and assembled in the Czech Republic. Spare parts for the tractor can be gotten only from the supplier's representative in Accra. Currently, there are no spare parts distribution or sales points in any part of the country apart from Accra.

Table B.1 Main sources of tractor spare parts on the open market

Name/Description of Shop	Location	Types of Spare Parts
Mechanical Lloyd	Accra, Kumasi	Engine, engine parts
Tractor & Equipment Mantrac	Accra, Kumasi	Engine, transmission
Japan motors	Accra, Tamale	Engine, hydraulics
Automotive Genuine Parts Supply Limited	Accra	Engine, engine parts, bearing, liners, pistons, connecting rods, engine valves, hydraulic system
Automotive Genuine Parts Supply Limited	Kumasi	Engine, engine parts, bearing, liners, pistons, connecting rods, engine valves, hydraulic system
Alex Nkrumah Enterprise	Kumasi	Engine parts, filters, gears, hydraulic parts
A Scrap Dealer	Tamale	Input shaft, gears

Source: Field survey.

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2033 K Street, NW
Washington, DC 20006-1002 USA
Tel.: +1-202-862-5600
Fax: +1-202-467-4439
Email: ifpri@cgiar.org