Evaluation of Four Special Initiatives of the Ministry of Food and Agriculture, Government of Ghana

Fertilizer Subsidy
Agricultural Mechanization
Block Farms and Youth in Agriculture
National Buffer Stock Company (NAFCO)

A Draft Report

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Executive Summary

Background

The Ministry of Food and Agriculture (MOFA) in line with its mandate to accelerate the modernization of agriculture and to increase the productivity of the Ghanaian farmer has started implementing four major subsidy and credit programs to achieve this mandate. The Ministry is looking to assess these programs to primarily guide government policy and improve their performance. The four initiatives are:

- Subsidization of agricultural mechanization services via support to the establishment and operation of Agricultural Mechanization Service Centers (AMSEC);
- Subsidization of fertilizers via the National Fertilizer Subsidy Program;
- 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 four MOFA programs

The AMSEC program is a credit facility where qualified private sector companies are given an average machinery package of 5 tractors with matching basic implements (plough, harrow and trailer) at a subsidized price and interest so that they can make agricultural mechanization services readily available in a timely and affordable manner to the majority of rural farmers. This is expected to lead to reduction in drudgery and tedium associated with agriculture, increased production and productivity, increased rural employment, and reduction in post-harvest losses.

The fertilizer subsidy program, which is currently implemented via the waybill system by subsidizing it at the port entry, makes the subsidy available to all types of farmers that can afford the subsidized price, which come to about 64 percent of the retail market price. The program aims at increasing the national average rate of fertilizer use 8 kg per hectare to 20 kg per hectare, in order to increase crop yields and production, to raise the profitability of farm production, and to improve private sector development in the fertilizer market.

The block farms program, which is conceptualized to exploit scale economies including lower unit cost of input and service delivery, brings several beneficiaries together onto one large production area and provides them with extension services and credit in form of mechanization services (via the AMSEC program), certified seed, subsidized fertilizer (via the FSP) and pesticides. In addition to increasing adoption of modern inputs, productivity and incomes of

farmers, the program targets the youth and aims at improving agriculture and farming as a business.

NAFCO, which was set up as a limited liability company with an initial outlay from the government, is expected to manage the government's emergency food security and, in addition, to stabilize prices by providing a minimum guaranteed price (to mop up excess produce from farmers at time of harvest) as well as a maximum price (to sell produce during lean season to avoid price hikes). These and related activities are expected to raise farmers' expectations for disposing of their produce and so can encourage them to invest in fertilizer use and other modern inputs and technologies, leading to the outcomes mentioned above.

Goal and objectives of study

The overall goal of the study is to critically assess the four initiatives with the view to shape policy for government in respect of change in strategy and improvement in implementation of the subsidy. The specific objectives are to:

- assess progress and preliminary results in the implementation of the subsidy, in terms of resources allocated and expended, outputs achieved, and target populations reached;
- provide recommendations and options (including institutional arrangements) for improving the efficiency and effectiveness of the subsidy, including an exit strategy where feasible; and
- establish a baseline for regular monitoring and future reviews and evaluation of subsidy projects.

Conceptual and empirical approach

To evaluate the program's operational efficiency and achievement of results, each program's design and progress of implementation is assessed in terms of its achievement of milestones and targets for resource allocation, input and service provision, and outcomes achieved to date. Program specific impact pathways are conceptualized to guide the empirical approach (including indicators, sampling, and data collection and analysis) and help set up such a framework for future monitoring and evaluation (M&E) of the programs.

To evaluate the economic efficiency of the programs, ex-ante cost-benefit analyses of the programs are undertaken, based on available information on program input costs (including the opportunity cost of time of government staff and other intangible costs) and projected beneficiary outcomes (based on estimated farm productivity effects of the program and assumptions of the economy wide net benefits).

With regards to assessing the programs' impacts, *with* and *without* program scenarios as well as *before* and *after* program implementation were employed in the survey instruments and data collection to the extent possible, given the nation-wide nature of the programs as well as the programs being in their infancy (less than 3 years) of implementation. The information used for the analyses is obtained from two main sources: (1) existing program documents and data; and (2) interviews with implementing actors, knowledgeable experts, farmers, and other stakeholders along the entire value chain using structured and semi-structured instruments. The survey data were collected based on a combination of purposive and random sampling of districts, communities, and households. The data were analyzed using simple difference measures of change in the value of the desired indicator over time across the different sampling strata.

We now present the key findings and recommendations.

Fertilizer subsidy program

We find that there has been increase in application of fertilizers due to the subsidy program, and that farmers who applied fertilizer on their farms obtained not only higher yields, which is expected, but a positive net income than those who did not use any. The program also led to an increase in the volume of trade and number private-sector actors in the market, despite the fact that the fertilizer distribution network to different rural areas may still be underdeveloped. 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 delays supply and distribution of the fertilizers, place limitations on the potential benefits of the program.

To forestall delays in the fertilizer importation and distribution, it is recommended that government starts the negotiations with the importers early so that the fertilizers are in stock in the regions and districts prior to the planting season. To minimize the potential risks of putting a large burden on MOFA's budget, policy makers may wish to consider a maximum threshold upon which no further funds would be made available under the program and, correspondingly, laying out a clear exist strategy over time. Similarly, ensuring that rapid growth in output does not depress output prices significantly will be critical. Policies that promote greater access to export markets in the region would help maintain ensure positive welfare gains of the program overtime will thus be important.

NAFCO program

The evidence shows that there was stabilization of maize price in 2010 compared to preceding years', for which there are some lessons to be learned. However, due to data limitations, further

research is needed on the role of NAFCO in this stabilization in order to inform the government and NAFCO on how to strategize to sustain or improve upon it. To help carry out such a further study in an effective manner, NAFCO needs to provide data with more sub-national disaggregation as well as more frequent periods. Although NAFCO is financially viable under current conditions projected in the short term, 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 it revenues, make realistic projections, and find ways to minimize its variability. NAFCO should also put in place a transparent information system about it prices, identification of its buying agents, and the location of any buying and selling depots. Based on a simple projection of NAFCO's role in stabilizing prices, we find that potential escalating costs that can easily become a burden on fiscal spending in the future. Focusing on its food security role could have high payoffs if 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.

Block farms program

We find that there is keen interest in the block farms program on the part of farmers. 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 have led to greater productivity, production, and incomes. Therefore, farmers need to be encouraged to pay back to raise the current low recovery rates, otherwise it is difficult to see how the government can sustain the program. Similarly, it is difficult to see how farmers too will be able to buy and pay for such inputs and services on their own. Contrary to expectation, the youth have not been a strong focus of the program as it was conceived, because, being relatively inexperienced, the youth are considered a riskier venture in terms of being able to properly manage the farm and inputs and services given to obtain decent yields and be able to pay back. This exacerbated by the pressure agricultural extension agents (AEAs) and district MOFA staff face in delivering results and recoveries.

AMSEC program

Given the high capital cost of machinery and implements which deters entry into the mechanization services market, the AMSEC program has contributed to improving the 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 services far outstrips the demand, the program has not crowded out private-sector investments in the market. This was corroborated by both investors and framers and substantiated by the observation of stable market shares and prices. However, we find that the newer tractors associated with the

AMSEC program seem to break down more frequently than those operated by non-AMSEC agents, about 17-64 percent more, which is due to lack of skilled operators, mechanics and spare parts for the newer brand of tractors imported via the program. Poorly prepared fields with stumps have contributed greatly to most of the damages to all brands of tractors.

Therefore, expanding and deepening the training offered by the agricultural engineering services directorate (AESD) of MOFA is inevitable, particularly when different brands of tractors than what is 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 in order to operate it well. Such training should encompass education and sensitization on the environmental degradation issues associated with ploughing along the slopes rather than across it. Until the time when use of very expensive bulldozers for proper land preparation become 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).

Program interaction effects and overall economic viability of the programs

Evidently, the presence of NAFCO seems to enhance the positive effects of the other programs. The important implication of this is that, by offering a fixed and assured output price when farmers make resource allocation decisions at the beginning of the production stage, it lowers farmers' uncertainty about future prices and permits higher purchases of inputs. Thus, the roles of the AMSEC, fertilizer and block farms programs seem to be inherently linked to the success of the NAFCO program by ensuring higher yields and outputs. But even more importantly, how much the fertilizer subsidy for example may also be contributing to more stable production growth to meet the growing consumer demand remains an important question to address when trying to isolate the direct effects of NAFCO activities on prices. Addressing this question and other related ones needs long lag time relative to the inception of the programs.

1. Introduction

Background

The Ministry of Food and Agriculture (MOFA) in line with its mandate to accelerate the modernization of agriculture and to increase the productivity of the Ghanaian farmer, as elaborated in the Food and Agricultural Sector Development Policy (FASDEP II) has introduced a number of programs, projects and initiatives to achieve this mandate. The Ministry is looking to assess four of its major initiatives to primarily guide government policy and improve their performance. The four initiatives are:

- Subsidization of agricultural mechanization services via support to the establishment and operation of Agricultural Mechanization Service Centers (AMSEC);
- Subsidization of fertilizers via the National Fertilizer Subsidy Program;
- 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, which was piloted in 2007 with twelve 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 one AMSEC set up there. This is expected to make agricultural mechanization services readily available in a timely and affordable manner to the majority of rural farmers, leading to reduction in drudgery and tedium associated with agriculture, increased production and productivity, increased rural employment, and reduction in post-harvest losses. With 89 centers currently established in 55 districts, the program is a credit facility where qualified private sector companies are given an average machinery package of 5 tractors with matching basic implements (plough, harrow and trailer) at a subsidized price and interest. Qualifies applicants are required to pay a deposit of 10–17 percent of the value as down payment with the balance payable over five years.

The fertilizer subsidy program (FSP) is implemented via the waybill system, where four types of fertilizer (NPK15:15:15, NPK 23:10:05, Urea, and Sulphate of ammonia) are subsidized at the port entry, making the subsidy available to all types of farmers that 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, where the same types of fertilizer were subsidized, but aimed at targeting small-scale farmers only. The FSP, irrespective of the system of implementation, aims at increasing the national average rate of fertilizer use 8 kg per hectare to 20 kg per hectare, in order 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 to the waybill system was of the high overhead and administrative costs, diversion of fertilizers from intended beneficiaries, as well as the large amount of time that MOFA staff wasted in policing the distribution process associated with the voucher system (MOFA 2010).

The block farms program (BFP), which also started with some pilots but 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 tracks 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 form of mechanization services (via the AMSEC program), certified seed, subsidized fertilizer (via the FSP) and pesticides, the BFP is conceptualized to exploit scale economies including lower unit cost of input and service delivery. The credit is expected to be paid back in kind at the time of harvest, upon which the government's emergency food security is expected to be developed (see upcoming introduction on NAFCO). Designed to focus on the youth, the 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.

NAFCO was set up as a limited liability company with an initial outlay from the government in the amount of GHS 15 million in 2009 to manage the government's emergency food security and, in addition, to purchase, sell, preserve and distribute food stuff, to mop up excess produce from all farmers in order to reduce post-harvest 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, etc. and to employ a buffer stock mechanism to ensure stability in the demand and supply food.

Goal and objectives of the study

Two consultancy firms, GIMPA Consulting Services and SmarTeam Services Limited, were selected by MOFA and recruited by IFPRI to evaluate the individual initiatives. Based on the terms of reference, the overall goal of the study is to critically assess the four initiatives with the view to shape policy for government in respect of change in strategy and improvement in implementation of the subsidy. The specific objectives are to:

- assess progress and preliminary results in the implementation of the subsidy, in terms of resources allocated and expended, outputs achieved, and target populations reached;

- provide recommendations and options (including institutional arrangements) for improving the efficiency and effectiveness of the subsidy, including an exit strategy where feasible;
- establish a baseline for regular monitoring and future reviews and evaluation of subsidy projects.

Key assessment questions

The key assessment questions to be answered in the evaluation study are organized into two components: those that are common to all the initiatives (*general assessment questions*); and those that are specific to the different initiatives (*specific assessment questions*). Under each of these components, the questions are organized to first look at issues of choice and consistency of the initiatives and instruments for achieving the broader FASDEP II goals and objectives. This is followed by questions related to implementation of the initiatives and their achievements.

General assessment questions

1. *Choice of initiative*
    a. What background documentation exists for each of the initiatives that states clearly:
        i. The goals, objectives, activities, outputs and outcomes, as well as the channels and mechanisms for achieving any stated targets?
        ii. The types of analysis done to support and guide the chosen initiatives?
    b. How do the initiatives fit within the broader strategic goals and objectives of FASDEP II (e.g. crowd out or complement other MOFA initiatives as well as private sector investments)?
    c. How sustainable are the initiatives and do they provide an adequate exit strategy?

2. *Efficiency and effectiveness of implementation*
    a. Were the implementation plans informed by any detailed cost-benefit analysis and/or stakeholder consultations?
    b. Are the initiatives being implemented efficiently and effectively given resource constraints?
        i. Are there lessons to draw from past experiences in Ghana or from other countries?
        ii. What are other lower-cost alternative approaches?
    c. To what extent have the targeted outputs been met?
    d. To what extent have the targeted population been reached and their behavior and outcomes affected?
    e. What are some emerging key challenges and potential ways to address them?
        i. How can synergies among the different initiatives be enhanced?

ii. How should the private sector be better integrated?

f. What mechanisms are in place to regularly monitor and guide implementation and how can they be improved?

Program-specific assessment questions

1. AMSEC program

a. What is the effect of AMSEC on mechanization rental services market structure, conduct and performance?
   i. How is the subsidized rental price determined?

b. To what extent is AMSEC achieving its outputs?
   i. 4 million hectares of agricultural land under mechanization by 2015.
   ii. 1 AMSEC per district.

c. What are emerging challenges (e.g. repayment of loan facility, capacity utilization and maintenance of machinery and equipment) and potential ways to address them?

d. How financially viable is an AMSEC?

e. Assess the performance of machinery acquired for the AMSECs.

2. Fertilizer subsidy program

a. Is the Waybill System a more economic/effective/efficient way of subsidizing fertilizers compared to other systems (Coupon System and others)?
   b. How has the subsidy affected the development of fertilizer markets (structure, conduct and performance)?

c. What opportunities exist for the targeting of fertilizer formulations to local agro-conditions as a complementary effort to the subsidies?

d. To what extent has the programme achieved its goal and objectives?
   i. Increased average application rate to 20 kg/ha.
   ii. Increased crop yields and production.
   iii. Raised the profitability of farm production.
   iv. Improved private sector development.

e. What are the major challenges of the waybill system and what can be done to improve on them or reduce their negative impacts in future programmes?

f. Assess constraints to the use of improved seeds as complimentary inputs to fertilizer use.

g. Explore opportunities for adding subsidized improved seeds as complimentary input to the fertilizer.

3. NAFCO

a. How have lessons from the erstwhile GFDC contributed to the design and implementation of NAFCO?

b. How does NAFCO (institutional set up and operations) compare and contrast with other price stabilization schemes (e.g. WRS)?
c. What are major potential implications of NAFCO on the development of domestic output markets along the value chain (especially for rice, maize, and soybean)?
    i. How is the NAFCO's minimum purchase price determined?
    ii. To what extent does NAFCO potentially crowd out private-sector market actors and investments?
    iii. To what degree does NAFCO boost agro-processing industry?
d. To what extent is NAFCO potentially achieving its outputs?
    i. Stabilizing prices?
    ii. Stabilizing food grain supplies?
    iii. Creating employment?
    iv. As a foreign exchange earner?
    v. Increasing food self-sufficiency?
    vi. Improving emergency food reserve (financing stocks and storage capacity)?
e. What are the potential externalities of NAFCO's activities and outputs on regional markets, trade and food security?
f. What are emerging challenges (e.g. capacity utilization and price competition with other actors especially during lean harvest) and potential ways to address them?
g. Is NAFCO a financially viable model?
h. Assess effectiveness of the purchasing system.

4. Block farms program

a. Assess the effectiveness and efficiency of the block farms program
b. How does the block farming, compared with other farming model (e.g. nuclear, out-grower and contract farming), reduce transaction costs associated with service delivery and accessing input and output markets (inputs and outputs)?
c. To what extent does block farming benefit farmers and is it achieving its outputs?
    i. Increasing employment among the youth?
    ii. Raising perception of and practicing agriculture as a business?
    iii. Increased productivity
d. What are emerging challenges and potential ways to address them?
    i. Recovery rates of investments, both cash and kind.
    ii. Providing incentives among beneficiaries to join and continue to participate in block farming.
    iii. Timely provision of inputs
    iv. Recovery challenges (both cash and kind)
e. What is the financial viability of a block farm in the long run?
f. Assess operational linkages between the block farm, NAFCO and AMSEC.

Outline of the report

In the next chapter, we present the overall conceptual framework and methodological approach (including sampling, data sources and collection, and estimation techniques) for all the four studies, paying particular attention to consistency and interaction effects across the four programs. In chapter 3, we describe the characteristics of the sample and those interviewed as well as the environment within which the programs have been implemented and the evaluation carried out. Thereafter, each chapter from 4 through 7 is dedicated one of the four initiatives; first presenting programmatic information, specific concepts and methodology, followed by the analysis, results, conclusions and recommendations. In chapter 8, we present the interaction effects across the different programs and overall economic cost-benefit analysis of the programs, followed by overall conclusions and implications in chapter 9.

2. Overall Methodology

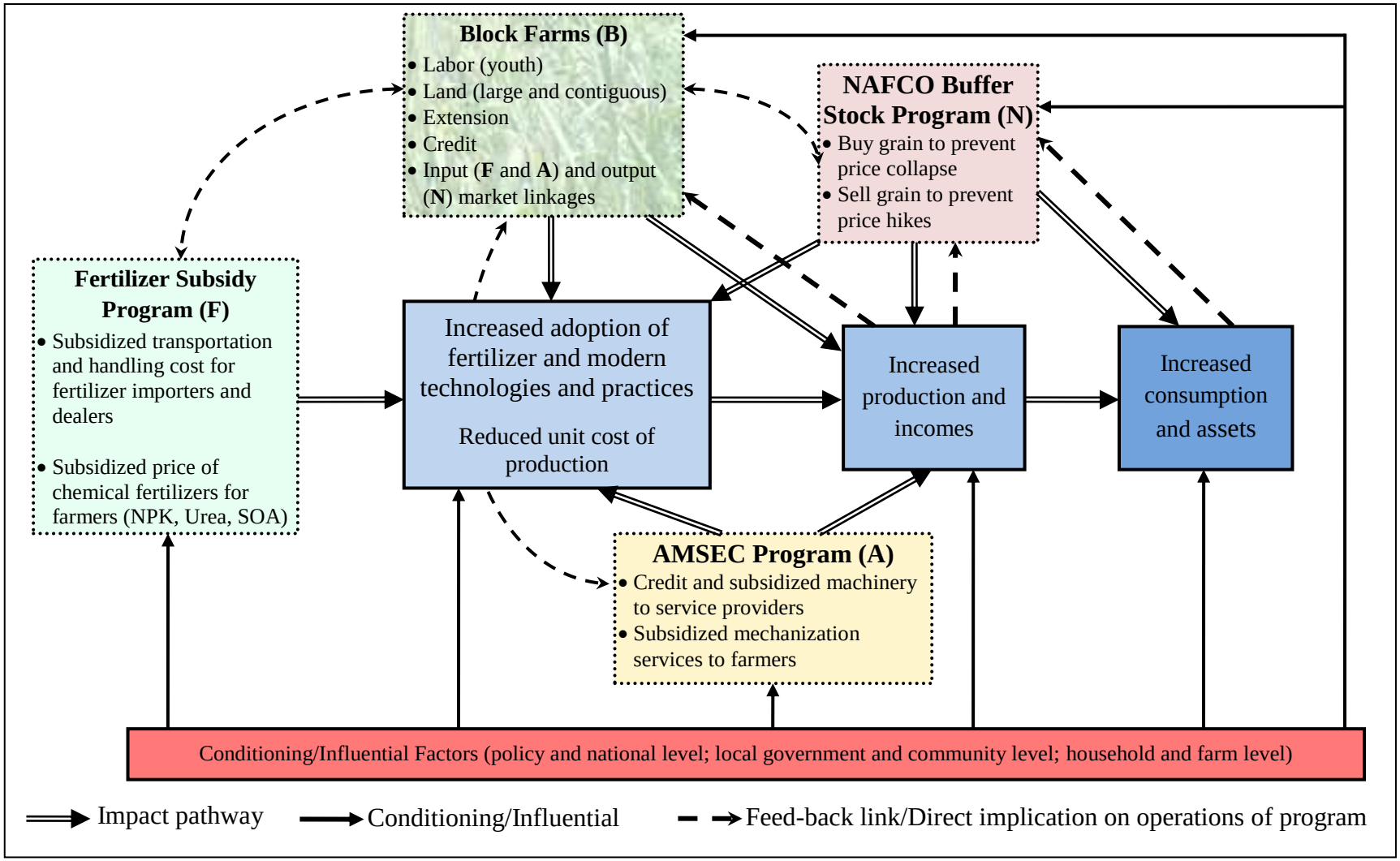
Conceptual framework

It is important to look at how the various programs interact and complement each other, including with other actors in the market place, toward achieving the goals of increasing agricultural output, incomes and food and nutrition security for many reasons. 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. Furthermore, 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. And so issues of coordination among different implementing agencies also become critical, as is sequencing of programs. With limited resources, different programs compete for the same resources and so evaluation of single programs provides little information for choosing among alternative programs. Thus, in looking at how the different initiatives fit within the broader strategic goals and objectives of FASDEP II, it is important to understand whether and how the different initiatives crowd out or complement each other, including other actors in the market place (e.g. the private sector, NGOs).

Thus, we first present a holistic conceptual framework for looking at the relationships among the different initiatives, first as inputs in the production-to-consumption continuum and then their impacts on desirable development indicators. These relationships are summarized in Figure 2.1 below. 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

the four programs contribute to increased adoption of inputs and technologies through different pathways. The Fertilizer Subsidy Program (F) contributes directly through lower prices of fertilization as well as indirectly through the savings used to purchase other inputs and services. The Block Farms Program (B) enhances the ability of farmers to adopt through in-kind credit for inputs and mechanizations services, extension, and creating market linkages. 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 post-harvest 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.

Figure 2.1: Impact pathways and interaction effects among the four initiatives



However, whether farm households actually do adopt the chemical fertilizers, use mechanization services, take part in the block farm project activities, or sell their output to NAFCO depends on several conditioning factors, including the capacity of government and their implementing agencies to deliver them as well as on the ability of farmers to adopt or use them. The latter is influenced by their constraints with respect to several household and farm level factors, including land, labor, capital, other assets, credit, livelihood options, and so forth (Feder et al. 1985; Feder and Umali 1993). The ability of farmers to participate (i.e. adopt the chemical fertilizers, use mechanization services, take part in the block farm project activities, or sell their output to NAFCO) also hinges on timely supply or availability of the technologies and services which is typically shaped by local government and community factors as well as national-level and policy factors that are typically associated with political support and budget allocation for the programs in particular as well as with overall infrastructure development, promotion of nonfarm employment opportunities, and prices, 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 et al. 2001).

The extent to which increased adoption of the programs' technologies and services, and consequent increase in agricultural production, will lead to increase in incomes, consumption, assets and other desirable outcomes would depend on how well local markets and institutions function. Again the Block Farms, AMSEC and NAFCO programs 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 the Block Farms program. 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 market place for agricultural inputs, service provisions, and output. Overtime, 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 not only lead to the achievement of FASDEP goals for production and incomes, but in ways that are also economically and operationally efficient.

Several other factors condition and influence the pathways by which the programs lead to increased output and outcomes at various points. For example, other non-governmental and private-sector actors are important the development of more efficient agricultural markets and institutions (which are critical for the success of the programs), which can also be enhanced by the aggregate demand for inputs and marketing services by farmers. However, the initiatives, including the dynamics among them, can ultimately displace (crowd-out) these private-sector actors (increased private-sector development is a desirable outcome). Other important factors that condition and influence the pathways are those that capture farmers' local production and marketing conditions guided by the notion that strategies for agricultural development in any given situation depend largely on the comparative advantage of alternative livelihood strategies in that situation. Agricultural potential, market access, and population pressure are among the primary factors to consider (Pender et al. 1999). Agricultural potential, demarcated by the 4 main agroecological zones in Ghana for example, is an abstraction of many factors—including rainfall level and distribution, altitude, soil type and depth, topography, presence of pests and diseases, presence of irrigation, and others— that influence the absolute (as opposed to comparative) advantage of producing agricultural commodities in a particular place. Access to market is critical for determining the comparative advantage of a particular location, given its agricultural potential, while population pressure affects the land-labour ratio, and may induce innovations in technology, markets and institutions, or investments in infrastructure.

Other national-level programs, policies and institutions may influence the 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.

The information required for the analyses is obtained from two main sources: (1) existing program documents and data; and (2) interviews with implementing actors, knowledgeable experts, farmers, and other stakeholders all along the entire value chain using structured and semi-structured instruments.

Evaluating economic and operational efficiencies

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 FASDEP goals for production and incomes, but in ways that are also economically and operationally efficient. To evaluate the operational efficiency and achievement of results, each program's design and progress of implementation is assessed in terms of its achievement of milestones and targets for resource allocation, input and

service provision, and outcomes achieved to date. Program specific impact pathways, are adopted to guide the empirical approach (including indicators, sampling, and data collection and analysis) and help set up such a framework for future monitoring and evaluation (M&E) of the programs. As part of this, structure, conduct and performance are examined along the entire supply chain—from the national administrative level to the farmer beneficiaries.

To evaluate the economic efficiency of the programs, ex-ante cost-benefit analyses of the programs are undertaken (Gittinger 1982; Alston, Norton and Pardey, 1995). These are based on available information on program input costs (including the opportunity cost of time of government staff and other intangible costs) and projected beneficiary outcomes (based on estimated farm productivity effects of the program and assumptions of the economy wide net benefits). Additionally, the consideration of potential leakages and complementarities with other programs is captured to the extent possible to avoid underestimating or overestimating actual net benefit flows 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 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 on 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.. To simplify the analysis further, especially given the multiple programs involved, we focus on the effects of each program on maize 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 chapter 8 and details of the approach and assumptions are provided in Appendix A.

Assessing the impacts

The main issue here is how to attribute any changes in the desired outcome indicators associated with the target group to the initiatives. If we let *y* represent the outcome of interest (e.g. amount

of fertilizer used or agricultural productivity or income), then, in the program evaluation literature, the impact associated with any program (*PROG*) *i* can be measured by the difference between the expected value of *y* earned by each member *j* of the target group participating in the program and the expected value of *y* the member would have received if he or she had not participated in the program. This difference is the impact of the program or the Average Treatment effect of the Treated (ATT_j^i):

$$ATT_j^i = E\left[y_{1j}^i \middle| PROG_j^i = 1\right] - E\left[y_{0j}^i \middle| PROG_j^i = 1\right] \quad \ldots\ldots\ldots\ldots(1)$$

Where y_{1j}^i is the value of the outcome of member *j* after participation in the program and y_{0j}^i is the value of the outcome of the same member *j* if he or she had not participated in the program. Unfortunately, we cannot observe the counterfactual, i.e., the value of the outcome of the member if he or she had not participated in the program. In addition, since individual farm households may choose to participate or not participate in the program, those who choose to participate are likely to be different from and benefit more than those who choose to not participate. These differences in behavior, if they influence the outcome, may invalidate the results from simply comparing outcomes by treatment status and, possibly, even after adjusting for differences in observed covariates of the outcome.

The common practice is to select non-beneficiaries or controls that are as similar as possible to the beneficiaries (i.e. having similar characteristics) prior to when the program was implemented. Only then can we be confident that the difference in the outcome between the two is due to the program. With data on the treatment (*j*) and control (*j'*) groups before (*t*0) and after (*t*1) implementation of the program, the impact can be estimated using a difference-in-difference (DID) or double-difference (DD) estimator (Ravallion 2008) according to:

$$ATT_j^i = E\left[y_{t1,j}^i - y_{t0,j}^i \middle| PROG_j^i = 1\right] - E\left[y_{t1,j'}^i - y_{t0,j'}^i \middle| PROG_{j'}^i = 0\right] \quad \ldots\ldots\ldots\ldots(2).$$

The 'first difference' measures the change in the value of the desired indicator over time within each group, and then the 'second difference' measures the difference in the change between the two groups. In other words, the DID or DD method measures the average gain or change in the outcome *y* over time in the treatment group less the average gain or change in the outcome *y* over time in the control group. Applying this method relies on the assumption that the outcome indicator of interest was growing or changing at the same rate between the treatment group and the control group prior to the treatment. Albeit simple, this method removes biases in the comparison between the two groups that may be due to permanent differences between the two groups (e.g. location effect), as well as biases from comparison over time in the treatment group that may be due to time trends unrelated to the treatment.

The impact of the program can be estimated simply by first obtaining the mean change in the indicator within each group and then testing for the significant difference across the two groups. In the event that the value of the difference (or test value) is statistically significant, then the value of the difference represents the magnitude of the impact of the program. This is the approach used here.[1] The indicators used in the analysis are discussed later when the individual programs are presented in chapters 3 to 6.

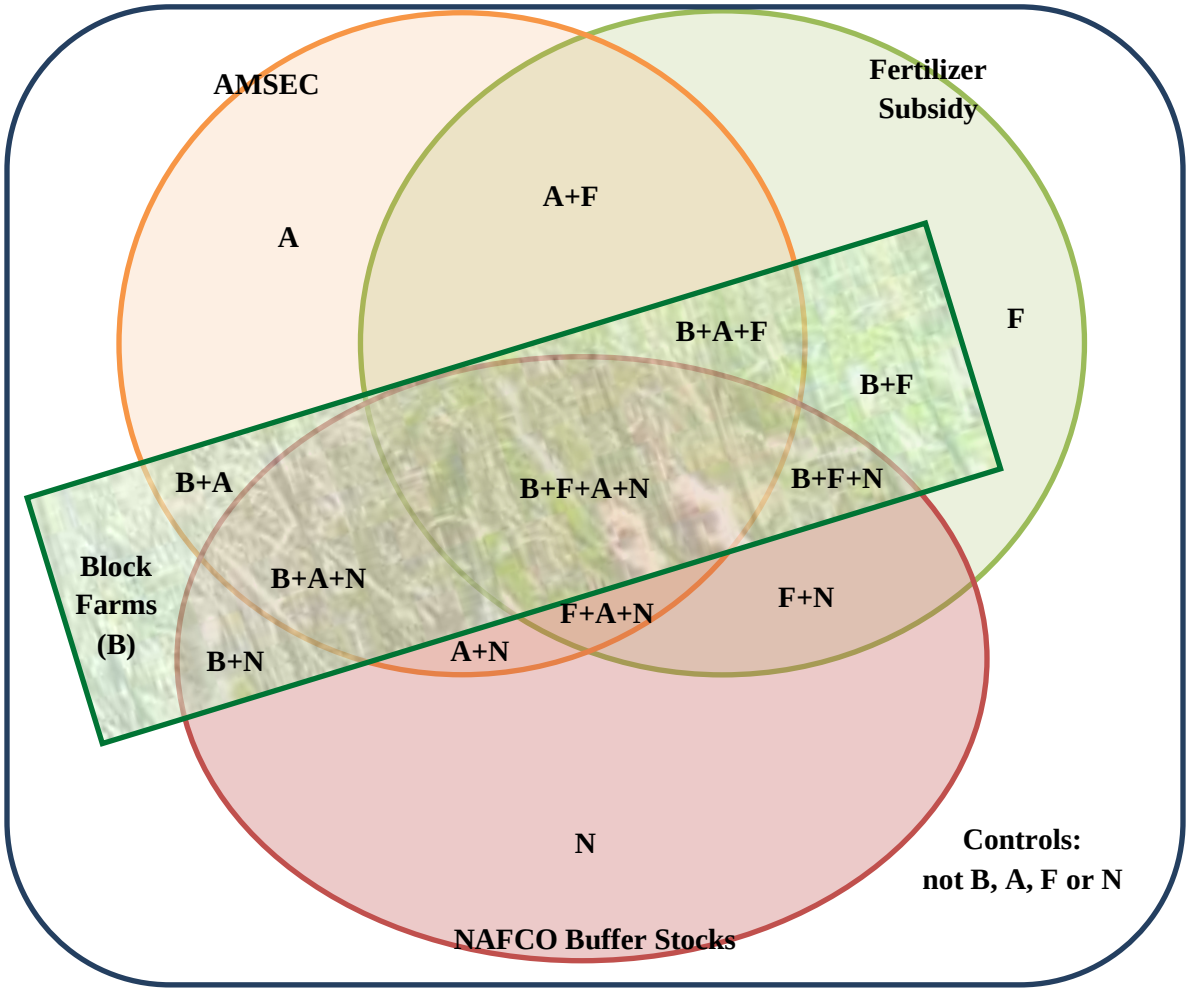
Because of the potential interaction effects among the different initiatives, implementation of equation 2 calls for a careful sampling strategy and measurement of desired indicators at a minimum of two points in time, with the first measurement representing a baseline. Unfortunately, there were no specific baselines for any of the four initiatives. Therefore, we combine relevant secondary information with data values prior to or at the time of implementation of the programs in addition to obtaining recall values of the indicators in the stakeholder surveys. In some cases in the surveys, qualitative measures of change (e.g. increase, no change, decrease) are elicited and used to capture the first difference. Regarding the sampling, Figure 2.2 shows all the different possible combinations of beneficiaries of the four different programs. The non-beneficiaries or controls are those not receiving any of the benefits associated with the programs, which is unlikely given the national nature of the programs. How we addressed this issue and carried out the actual sampling is discussed further in the next sub-section.

Assuming that participation in several programs confers greater benefits than participation in fewer programs, and participation in any program confers greater benefits than no participation at all, then we would expect $ATT_{B+F+A+N} > ATT_{B+F+A}$ or ATT_{B+F+N} or ATT_{B+A+N} $ATT_{F+A+N} > ATT_{B+F}$ or ATT_{B+A} or ATT_{B+N} or ATT_{F+A} or ATT_{F+N} or $ATT_{A+N} > ATT_{B}$ or ATT_{F} or ATT_{A} or $ATT_{N} > 0$. Furthermore, assessing the impact of any program independently or jointly would involve sampling from the relevant parts of the circles or rectangle in figure 2.2, including intersections among them, otherwise the impact of any one program alone could be overestimated. For example, assessing the impact of AMSEC alone, which is measured by ATT_{A}, should ideally be based on the treatment sample from **A** alone (i.e. excluding the intersections A+F, A+N, B+A, B+A+N, B+A+F, F+A+N, and B+F+A+N) in comparison with the controls. But this is difficult

[1] Other sophisticated methods include estimation of equation 2 by regression methods, while controlling for factors that are likely to affect the decision of the farmer to participate in the program or not to participate in addition to factors that affect the outcome. Common regression methods to use include: instrumental variables method, which, as the name implies, tries to identify suitable instruments for the decision to participate or not; and fixed-effect method from panel data analysis where the assumption is that unobserved differences between the two groups are constant over time and are correlated with the independent variables, which is also correlated with the unobserved individual specific effect. More recent methods such as experimental and quasi-experimental methods try to establish alternative scenarios that represent the counterfactual situation by ensuring that the composition of the two groups remains the same over the course of the treatment. See Imbens and Wooldridge (2009) for review of issues and methods in program evaluation.

to implement because it is virtually impossible to find a sample that uses AMSEC services but does not benefit from any of the other three interventions. Therefore, this will be estimated based on two subsamples: treatment made up of all those that benefited from the AMSEC program (A, A+F, A+N, B+A, B+A+N, B+A+F, F+A+N, and B+F+A+N) versus those that did not benefit from the program (B, F, N, B+F, B+N, F+N, B+F+N), excluding those that did not benefit from any program from the two subsamples. We now discuss how we carried out the sampling and created the subsamples for evaluating the individual programs.

Figure 2.2: Sampling frame for evaluating the impacts on the MOFA initiatives: combinations of beneficiaries of the different initiatives



Source: Authors' illustration.
Notes: All possible combinations have been included to be exhaustive, although some of the combinations may not exist or they will be insignificant in practice. For example, we did not observe farmers in B alone without benefiting from any of the other programs.

Sampling

The main issue with the sampling of the target group is how to demarcate subpopulations into: (a) those with access to or receiving the services of the program versus (b) those without access to or not receiving any services of the program. Because of the national nature of the programs, 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 Block Farms program 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 in terms of implementation of the Block Farms, NAFCO, and AMSEC programs (see annex 1 for details). Then, we purposively selected all the six districts—Kwahu North, Ejura/Sekyedumase, Nkoranza South, Techiman Municipal, Tamale Metropolitan, and Yendi Municipal—where the services of all the four MOFA programs were represented and potentially available to all farmers in the district to represent the cumulative or ultimate treatment of all the four programs. Then, we selected matching districts so that they had similar local production and market conditions (measured by the four agroecological zones, population density, and market access),[2] considering varying access to the other MOFA programs. We now explain how the matching districts and corresponding communities and stakeholders that were interviewed were selected for evaluating each of the four programs.[3]

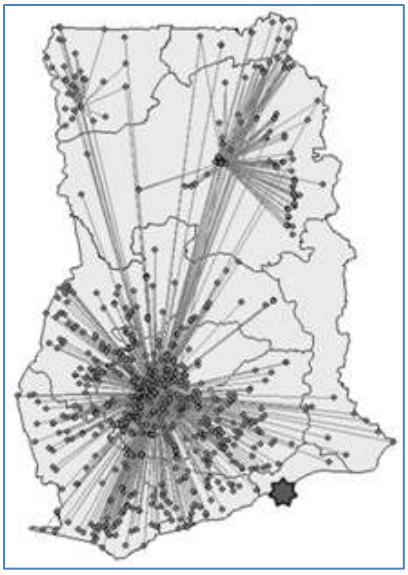
Fertilizer subsidy program

Regarding the fertilizer subsidy program, although all farmers are eligible to benefit from the program, it is only those that actually buy the subsidized fertilizer that benefit from it. Figure 2.3, which shows the distribution network of fertilizers in the country, suggests that farmers that are closer to the main distribution points are more likely to benefit from the subsidy than those further from them. This is because of the potentially greater availability of fertilizers closer to the

Figure 2.3: Fertilizer distribution network in Ghana

[2] 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 points to demarcate high and low market access (Chamberlin 2005).

[3] Details of each program are given in chapters 3 to 6.



Source: IFPRI/IFDC (2009).

main distribution points. For the evaluation here, ten matching districts to the ultimate six given above were selected—giving a total of 16 districts. Then, in each of the selected districts, we randomly selected two MOFA zones (giving a total of 32 zones), within each of which two operational areas were purposively selected to reflect those with easy access to a major market where fertilizer is sold and another with lower or limited access—giving a total of 64 communities. The sampled districts and communities (operational areas) and their characteristics in terms of access to the other MOFA programs are presented in Tables 2.1 and 2.2. Table 2.1 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 former is more suitable large scale mechanized operations and 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. However, it is likely to observe greater intensities of fertilizer use (amount per unit area) in the high population density areas, reflecting the commonly observed inverse farm size technology adoption relationship.

Table 2.1: Sampled districts by agroecological zones (AEZs), population density, market access, and presence of MOFA programs

AEZ	High population density	Low population density	
	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)

Notes: A, B and N indicate presence of AMSEC, Block Farms and NAFCO warehouses, respectively. N.a. means no districts were selected in those strata, including areas of high population density and low market access which are not shown.

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 which 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 further 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, followed by interviews of at least two households (total of 128), selected based on convenience or availability of the household head. Interviews were also conducted with district MOFA officers. The instruments used are presented in the annex.

Table 2.2: Sampled districts and communities by region and relative access to a fertilizer

Region	Sampled district	Selected communities (operational areas)
Eastern	1. Kwahu North	Maame Krobo Obotanso
Ashanti	2. Ejura/Sekyedumase	Ejura Kobitri
	3. Sekyere East	Anunya Apemso
	4. Kumasi Metropolitan	Kwadaso Appiadu
Brong Ahafo	5. Nkoranza South	Akuma Ashigumu
	6. Techiman Municipal	Toubodum Aworowa
	7. Sunyani Municipal	Yawhima Asufufu-Bediako
Northern	8. Tamale Metropolitan	Baglahi Yondakplemle
	9. Yendi Municipal	Zang Klukpanga
	10. West Gonja	Kanteen Tuna
	11. Savelugu-Nanton	Nakpanzoo

Upper East	12. Bongo	Kanbugo Beabankoo
Upper West	13. Nadowli	Daffiama Kojoperi
	14. Wa East	Bulinga Funsi
Central	15. Gomoa East	Okyereko Gomoa Adawukwa
Volta	16. Ketu North	Lave Klenomade

Block farms program

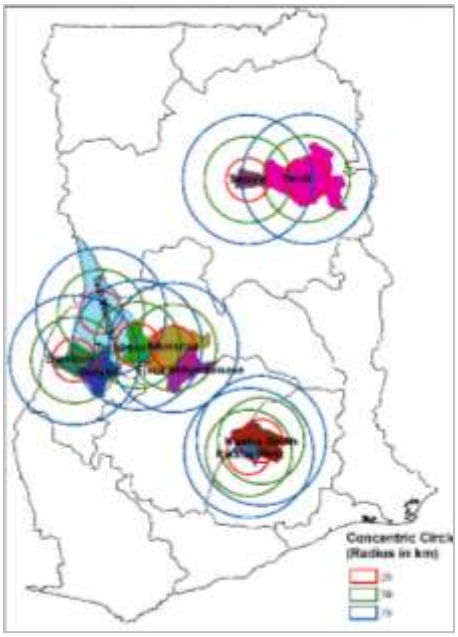
The sampling strategy used here is similar to the one used for the evaluation of the fertilizer subsidy program leading to selection of 16 districts, 32 zones and 64 communities, as well as the subsequent number of the different stakeholders that were interviewed (see the annex for the instruments used). The main difference is how the subpopulations of the block farms program were defined. Because there were very few districts where there were no block farms (see Annex 1), we grouped the sample into three: (i) where a pilot block farm had been implemented—6 percent of the total number of districts; (ii) where a block farm was recently established—88 percent of the total number of districts; and (iii) where there was no block farm—6 percent of the total number of districts. This was used to capture the learning or extension effect in terms of likely transfer of knowledge and practices from the block farm to farmers' own farms. In general, we expect better performance (e.g. 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 area that had a pilot compared to areas that did not to extent that the learning effect is greater and widespread in the pilot areas than in newer areas. Similarly, we expect the performance on farmers' own farms located in pilot 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 (seven in total) in addition to those within their vicinity (Figure 2.4) were considered to also have immediate or localized effects of the program. Therefore, two subpopulations were created: districts with a NAFCO warehouse and we selected all seven; and those without, where we selected nine of them. This makes a total of 16 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 post-harvest risk of farmers more within the locality of its operations than elsewhere, then 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 post-

harvest risk encourages investment in fertilizer use and other modern inputs and technologies, which in turns lead to higher yields, consumption, and welfare.

Figure 2.4: District location of NAFCO warehouses in Ghana



Source: Authors' illustration.

AMSEC program

Because AMSEC service providers were located in less than one-half of the total number districts (84 AMSECs in 55 districts of the total 170 MMDAs districts, see Annex 1) at the time of the survey and the effect of an AMSEC is more localized compared to the other three programs, we were able to define a cleaner *with* and *without* scenario of using the program's services. Again 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 of 42 depending on those that 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 2.3 on the districts and their characteristics in terms of presence of the other MOFA programs. From the districts and communities serviced by the 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. The different instruments used are presented in the annex.

Table 2.3: Sampled districts for the AMSEC evaluation by agroecological zones (AEZs), population density, market access, and presence of other MOFA programs

AEZ	High population density	Low population density	
	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)	Central Gonja (B2) Chereponi (B1) East Gonja (B2) Gushegu (B2)

	Wa Municipal	Jirapa (B1)
	Yendi Municipal (B2,N)	Kintampo North (B1)
		Kintampo South (B1)
		Sawla-Tuna-Kalba (B1)
		West Gonja (B2)
		West Mamprusi (B2)
		Zabzugu-Tatale (B1)

Notes: B1, B2 and N indicate presence AMSEC, Block Farms, Pilot Block Farms and NAFCO warehouse, respectively. N.a. means no districts were selected in those strata, including areas of high population density and low market access which are not shown.

Survey instruments, fieldwork and analysis

We held several meetings to discuss the survey instruments to ensure that 'before and after' program scenarios as well as 'with and without' program scenarios that are critical to evaluation and impact assessment studies were adequately captured in the surveys. First, the teams from GIMPA and SmarTeam drafted the surveys and then the team from IFPRI made revisions and provided comments relating primarily to the before/after and with/without considerations. The revised surveys were pretested in a community in the central region. More discussions were held and then GIMPA and SmarTeam finalized them for their respective studies and then started the fieldwork in early July 2011. This continued through to mid-August, followed by data entry, analysis and drafting through September. The entire team then got together in early October at a retreat to review the analysis and drafts, followed by a presentation of the preliminary findings and recommendations to MOFA. This report incorporates feedback from the presentation.

3. Agricultural Production Environment

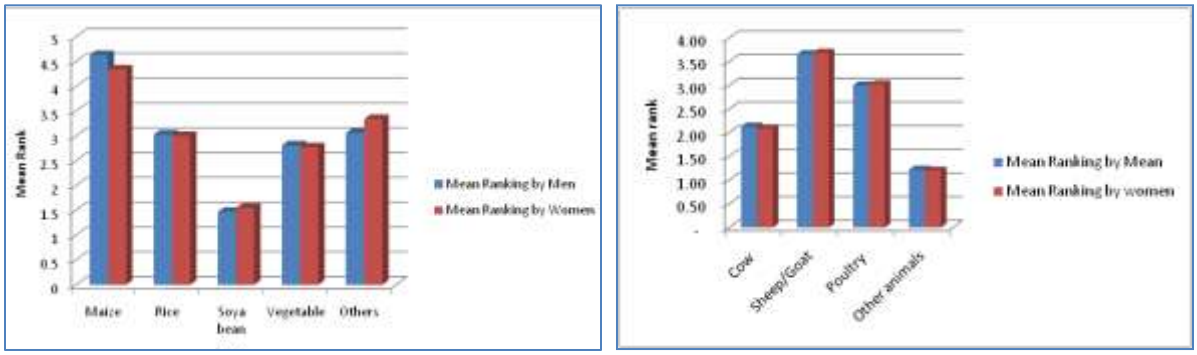
To get a sense of the context within which the programs were being implemented we asked the respondents in the focus group discussions to indicate their perception of the situation in their production environment prior to when the programs were implemented (i.e. 2008) as well as any changes that have occurred in the last three years (i.e. between 2008 and 2011). The key areas are stated below.

- Overall livelihoods and major agricultural activities engaged in, differentiated by males and females;
- Access to farmland, , differentiated by males and females; and
- Availability of, access to, and benefits derived from different agricultural inputs services.

Overall income-earning activities

Farmers were asked to rank (1=least important, …, 5=most important) the major cropping and livestock activities engaged in. For the crops, the communities ranked maize, rice, vegetables and soya bean in order of importance for both males and females (Figure 3.2). Regarding livestock, sheep and goats were perceived to be the most important, followed by poultry and cattle. Here too, there were no differences between males and females.

Figure 3.1: Ranking of crop and livestock activities

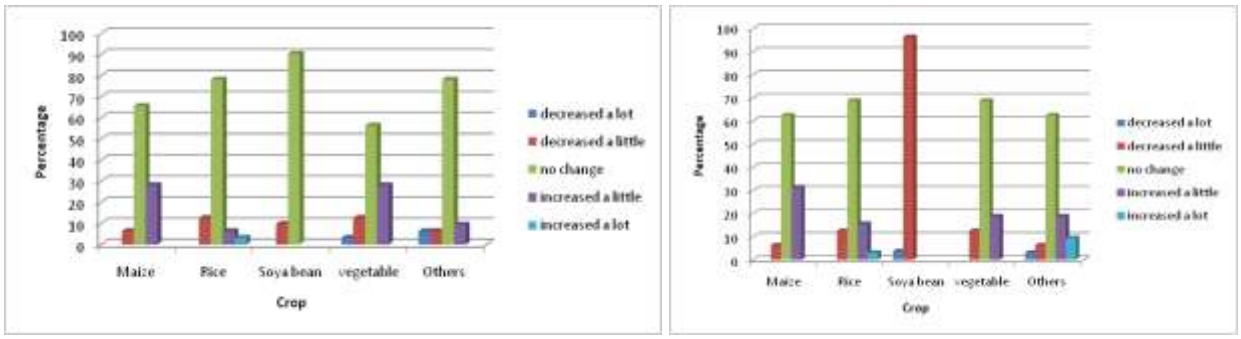


Source: Focus group surveys

Notes: rank was based on: 1=least important, …, 5=most important

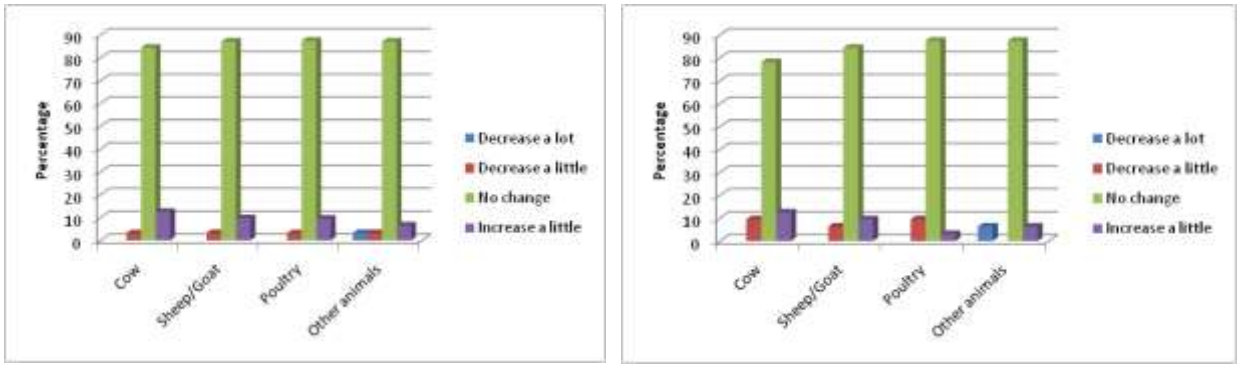
Looking at changes in farming activities in the last three years, the results in Figure 3.3 shows that majority of the communities perceived that there were no changes with crops (Figure 3.3) and livestock (Figure 3.4) for males and females, except in the case of soya where majority perceived a slight decline for women (Figure 3.3, second figure on right). The later suggests that soy bean cultivation by women has dwindled slightly. The main reason given was poor marketing.

Figure 3.2: Changes in crops between 2008 and 2011 (% of communities reporting)



Source: Focus group surveys

Figure 3.3: Changes in livestock between 2008 and 2011 (% of communities reporting)

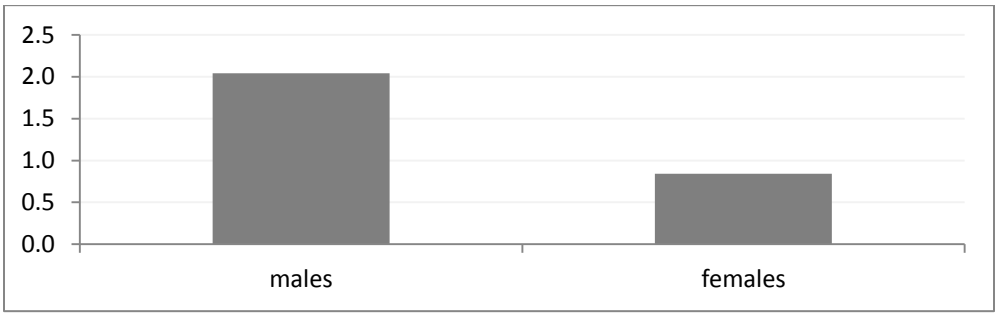


Source: Focus group surveys

Access to farmland

We found that males cultivated about two and one-half times more farmland than females: males had a little over 2 hectares per person on average; while females had about 0.8 hectares per person on average (Figure 3.5). Here too there were no significant changes in the last three years for both males and females.

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

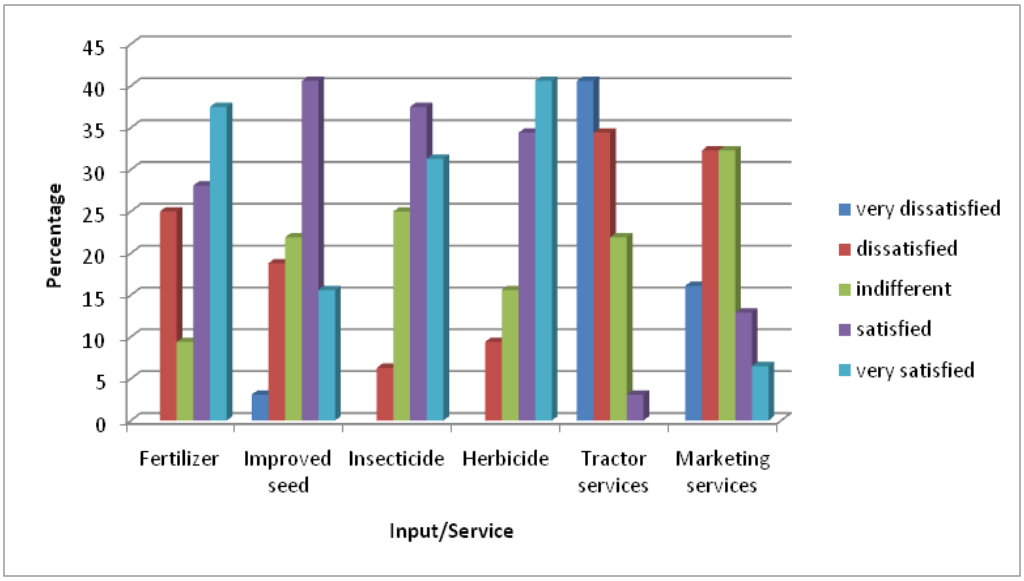


Source: Focus group surveys

Availability of and access to inputs and services

Farming communities were asked to indicate their level of satisfaction their access to and benefits derived from agricultural inputs and services. The results in Figure 3.5 shows that most of the communities were satisfied or very satisfied with the chemical inputs (i.e. 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 and improved seed. 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 suggest that land preparation and post-harvest activities are limiting factors for raising agricultural productivity in the farming communities surveyed and elsewhere to the extent the communities surveyed are representative of others in Ghana.

Figure 3.5: Perception of satisfaction with agricultural inputs and services (percent of communities reporting)



Source: Focus group surveys

Summary

To summarize the key findings in this chapter, both men and women generally had similar livelihoods and preferences for farming. Furthermore, there were no changes in the last three years 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 that farmers have already been engaged in. Therefore, assuming that provision by the government of credit facilities and subsidies to the private sector 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, then the programs should have a positive impact on agricultural productivity and the other related outcome variables.

Because we use a simplified DID or DD method to measure the impact, rather than employ sophisticated econometric analyses to establish cause-effect relationships between the program and the outcome variables, our aim is to first establish within reasonable parameters that the programs have led to an increase in the supply of inputs and services and/or an increase in the adoption of those inputs and services. With AMSEC program for example, this means establishing that there has been a significant increase in the use of mechanization services by farmers between 2008 and 2011 in general, but more in areas where there is an AMSEC program compared to where there is none. The same applies the FSP program. That is, establish that there has been a significant increase in number of farmers using chemical fertilizers as well as in the amount used per unit area in 2010 and 2011 (waybill system) compared to levels in 2008 and 2009 (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 own plots of farmers participating in the program (i.e. off the block farm) compared to the plots of those not participating in the program. For the NAFCO program, the main thing to first 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 leads to lower post-harvest risk and encourages farmers to invest in modern inputs and technologies, which will in turn raise their production and productivity.

Because we know that the ability of farmers to use the inputs and services of the programs hinges on several factors (see methodology chapter), whose change between 2008 and 2011 are not explicitly controlled for in the analysis done here, beyond the stratified sampling approach that accounts for difference in location and differential access by those in the different locations to the services of the different programs, we could expect estimates of the program impacts obtained from using the DID method to be conservative (inflatory) to the extent that the change in those factors are correlated with use of the inputs and services of the programs and contributes positively (negatively) to change in outcomes, other factors being equal. Furthermore, during the revision of the questionnaires by the GIMPA team, several of the before/after and with/without scenarios were omitted, limiting the extent to which the data can be used to characterize counterfactuals required for a comprehensive assessment of the impacts.

Given these limitations, there is more confidence in our findings to extent that the results are consistent with the logical framework, and there is credibility to our findings to the extent that the results conform to other literature.

4. The Fertilizer Subsidy Program (FSP)

Background

In an effort to increase productivity of Ghanaian farmers and modernize agriculture, the government of Ghana, in July 2008, instituted a country-wide subsidy on four types of fertilizer, namely; NPK15:15:15, NPK 23:10:05, Urea, and Sulphate of ammonia. The subsidy was also a response to dramatic increases in food and fertilizer prices. For example, between May 2007 and May 2008, the price of maize in Accra and Tamale rose by an average of 77 percent and the prices of other staples such as rice and wheat also spiked as a result of shocks in the global food market and skyrocketing energy costs. Similarly, the price of nitrogen-phosphorous-potassium (NPK) 15:15:15, the most widely used food crop fertilizer in Ghana increased from GHS 26 to GHS 35 per 50-kilogram (kg) bag between June 2007 and March 2008 (MOFA 2008). Furthermore, government realized that Ghana had one of the lowest rate of fertilizer use in Sub-Saharan Africa (8 kg per hectare), which contributes to low productivity and output of crops, high food prices, as well as low income and deepening poverty of farmers, particularly the small scale farmers (MOFA 2007). The fertilizer subsidy was therefore a strategic policy to address the various concerns of farmers as explained. The stated goal and objectives of the of the subsidy program are:

- To increase 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. In essence, the voucher system targeted small-scale farmers as conceived; while the subsidy under the waybill system is available for all types of farms and farmers that can afford the subsidized price.

This chapter evaluates the subsidy program, with focus on the waybill system to the extent possible. The overall goal of the evaluation is to critically assess the subsidization with the view to shape policy for government in respect of change in strategy and improvement in implementation of the subsidy. The specific assessment questions were presented in the introductory chapter.

Conceptual framework

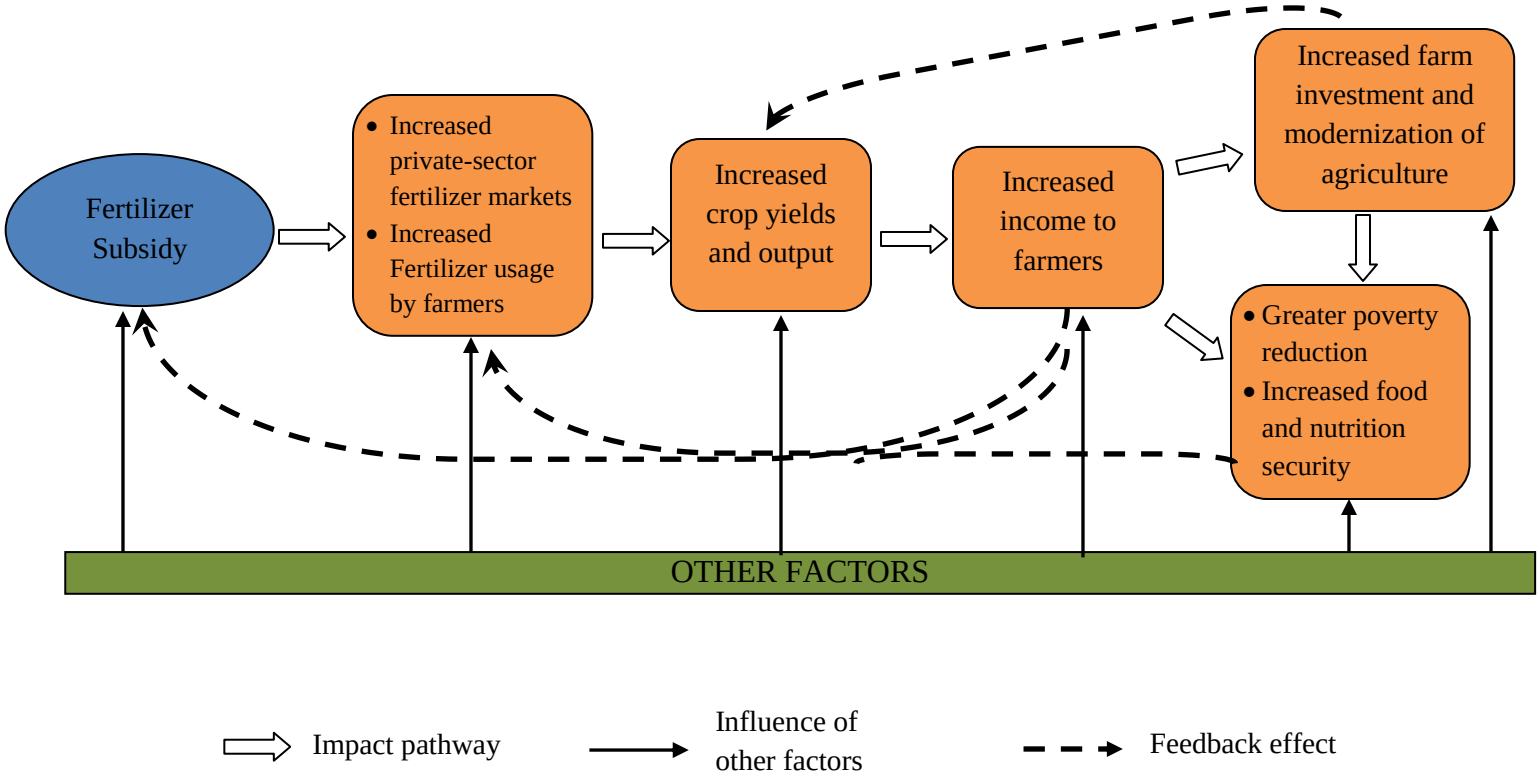
While the overall methodology, sampling techniques, data collection, analysis methods and approaches were already reviewed in the methodology chapter, here we present a theoretical framework specific to the FSP for the purpose of guiding the development of a future monitoring

and evaluation framework, which is grounded on the theory of change (ORS 2004; Lederach 2007). Figure 4.1 shows how the FSP 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.

The fundamental issue the fertilizer subsidy program seeks to address is the high cost of fertilizer in the open market leading to low fertilizer demand and utilization, which in turn leads to low yield and low income to farmers. Therefore, the underlying assumption in Figure 4.1 is that by reducing the cost of fertilizers to farmers through the subsidy, more famers would use fertilizer on their farms and that farmers would increase the application of fertilizer on their farms, leading to increased yields and income to farmers. This would eventually trigger (re)investment of the surplus income into the farm enterprise (including improved technologies and high-value commodities) towards modernization, which together with the increased income will lead to greater consumption, lower poverty, and increased food and nutrition security. Additionally, the subsidy is also meant to encourage greater private sector development and participation in fertilizer markets. Such analysis and line of thinking appears logical, and is consistent with the national policy of modernizing agriculture, as captured in FASDEP II, as well with the literature on agricultural household models (Singh et al. 1986; de Janvry et al. 1991), adoption of agricultural technologies (Feder et al. 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 methodology chapter), including complementary interventions beyond just 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 (as envisioned with the AMSEC initiative) is 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 important feedback links underlying the relationship between the fertilizer program and the outcomes. These are represented by the dotted paths. For example, households realizing an increase in productivity and farm output from using more fertilizer in one season may decide to drop the adoption in the subsequent season if they were unable to sell their produce for a profit due to low prices resulting from increased supply, for example. Political leaders may also decide to increase or reduce the budget allocated to the program depending on the outcomes in previous years.

Figure 4.1: Impact pathways and associated indicators of the fertilizer subsidy program



Overview of the fertilizer subsidy program

The voucher system (2008 and 2009)

The 2008 and 2009 fertilizer subsidy program took the form of vouchers, involving four major fertilizer companies, YARA (and WIENCO), CHEMICO, DIZENGOFF and GOLDEN STOCK. These companies provided information to the government on the total fertilizer consumption in the country (Table 4.1), including regional disaggregation, which was used by the government to estimate the quantities of four types of fertilizer to be subsidized. Coupons were printed and allocated to Regional Agricultural Development Units (RADUs), who in turn issued them to their respective District Agricultural Development Units (DADUs) based on estimated district fertilizer consumption. In each DADU, the vouchers were allocated to agricultural extension agents (AEAs) who in turn issued them to farmers. Upon 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, with government absorbing additional cost of fertilizer to maintain the 2008 prices. The total amount of subsidized fertilizer were 43,176 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 and District Directors and the staff of MOFA in policing the distribution process (MOFA 2010).

Table 4.1: Estimated national consumption of fertilizers, 2008

Type of fertilizer	MT
Urea	2,912
SOA	5,825
NPK: 15-15-15	16,893
NPK: 23-10-05	4,369
Total	30,000

Source: IFPRI/GSSP survey data (2008)

The waybill system (2010 and 2011)

Following the lessons reported above, the voucher system was been replaced with a waybill system in 2010 and 2011. Under the waybill system, the government absorbs port handling, loading and transport costs as well as agents' commission and margins to arrive at prices that are affordable to the small scale farmers. The principal objective is to ensure the program reaches all farmers at the agreed upon low prices in all regions. The operational details of the subsidy include determining the subsidy price, ensuring distribution, monitoring and oversight, and payments based on validated sales receipts. To begin with, retail prices of fertilizer in the domestic market are set up-front, through negotiation between the importers and the Government of Ghana (GoG), taking into consideration the fluctuation of the fertilizer price in the international market, the different cost components along the domestic fertilizer supply chain and

the expected exchange rate fluctuations. This may be regarded as a unique example of a public-private partnership in which the government consults heavily with fertilizer importers in the design stage and rely exclusively on the existing private distribution system to deliver fertilizer to farmers. For the companies involved, they are allowed a certain amount of subsidized fertilizers to be sent to each region based on historical fertilizer consumption patterns. Based on MOFA's Guidelines of the 2010 Subsidy program (MOFA 2010a), the subsidy payable on each 50 kg bag of fertilizer is 15-17 GHS per 50-kg bag (Table 4.2).

Table 4.2: Subsidy payable on each 50-kg bag of fertilizer in 2010

Fertilizer type	Port charges	Transport loading	Incidentals	Total subsidy
NPK	6.5	5	5.5	17
Urea	6.5	5	3.5	15
SOA	6.5	5	4.5	16

Source: MOFA (2010a)

As the name suggests with the waybill receipt system, receipts have to be submitted for payment and must be countersigned by the District Director of Agriculture (DDA) who should also inform the District Coordinating Director (DCD). Essentially, fertilizer companies can import, clear the fertilizers from the ports and pay all charges. Upon 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 crossed checked by the District and Regional Directors of Agriculture before passing the waybills and receipts to the National Fertilizer Coordinator to compute the subsidy payments to the various fertilizer distributors. Sales of subsidized fertilizer are only permitted during the 6-7 months of the year when the subsidy is in effect, i.e. over the production season (usually May through October). Companies that sell above the recommended prices during the period the subsidy is in effect will be sanctioned to pay the difference between the higher price and the recommended price. Under waybill system in 2010, a total of 91,244 MT of subsidized fertilizer was sold, of which almost 80 percent reached farmers directly via purchases in the market, while 18 percent was channeled via the block farm program, and the remaining 2 percent sold to cotton farmers (Table 4.3).

Table 4.3: Farmer beneficiaries of the waybill system in 2010

Sales outlet	Quantity in MT	Percentage
Sold directly to farmers	72,891	78.9
Sold to block farms	16,597	18.2
Sold to cotton farmers through MOTI	1,756	1.9

Source: MOFA (2010b)

Note: MOTI is Ministry of Trade and Industries.

Overall financial costs of the subsidies, 2008–2010

In 2008 and 2009, the subsidy cost the government an amount of GHS 20.6 and 34.4 million, respectively; with a slight decline in the cost in 2010, GHS 32.0 million, and then a sharp increase to GHS 69.8 million in 2011 (Table 4.4). As Table 4.4 also shows, the unit cost paid by the government has declined over time, despite keeping the prices paid by farmers at same level (average of GHS 17.06 per 50-kg bag in 2008-2009 and GHS 28.33 per 50-kg bag in 2011).

Table 4.4: Subsidized fertilizer prices and cost of subsidy, 2008–2010

	2008	2009	2010	2011[1]
Price (GHS per 50-kg bag)				
NPK: 15-15-15	26	26	27	30
NPK: 23-10-05	24	24	--	--
SOA	18	18	18	26
Urea	26	26	25	29
Total fertilizer subsidized (MT)	43,176	72,795	91,244	150,000
Total cost (GHS millions)	20.654	34.400	32.002	69.800
Cost per unit (GHS per MT)	478.4	472.6	350.7	465.3

Source: MOFA (2010a)
Notes: [1] Estimate.

Internal consistency of the waybill system

Even though there is no documentary evidence to our knowledge that show the analysis that informed the initial planning and design of the programme, there is a strong implicit knowledge among the programme designers, as to the issues underpinning the subsidy programme in general, including the high cost of fertilizers to farmers. Interviews of various the MOFA staff implementing the programme also pointed to a continuous on-going analysis being carried out by the field officers of the fertilizer subsidy programme, 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 (i.e. time that MOFA staff 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 type farmers and farming activities that resulted in the shift from the coupon system of subsidy to the waybill and receipt system.

Another stated concern of 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 (GNA 2011) shows that the problem of diversion is not unique to the coupon system. Other countries

face similar problem. 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 2008-09 caused fertilizer input prices to also spike (leading to a more than doubling of the fertilizer subsidy bill from Rs 43,000 crore in 2007-08 to Rs 99,500 crore in 2008-09) and increased fertilizer smuggling to neighboring countries and to other industries like plywood—about one-fifth of the fertilizer leaks out (Ramoo 2011).

Therefore, while it was not possible to assess the magnitude of diversion problem under the two systems to assess its validity in making the switch, the other objectives and assumptions that underpinned the waybill system are logical and consistent with the logical framework presented earlier as well as 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 productivity of the Ghanaian farmer and encouraging them to shift from subsistence agriculture to market-oriented production using appropriate technologies like high-yielding inputs and machines.

All respondents felt the waybill system, built around government–private sector collaboration, is an improvement to the coupon system. Also, there is no incentive for farmers to use the subsidy for other consumables. However, concerns were raised by different stakeholders. Farmers and retailers complained about the poor timeliness of the subsidy. Basically, for farmers in areas (in the south to the middle belt) where the season starts relatively early, they felt the subsidy and prices were announced late and there were no subsidized fertilizer at the onset of the cropping season when they are most needed. Thus, it benefited only those farmers in areas where the season starts later (from the middle belt toward the north). This problem of timeliness was also present under the voucher system (Banful 2009). Fertilizer distributors also felt procedures associated with the waybill system were cumbersome and there was lack of clarity of the procedures on all aspects of the operations. For example, they complained of too many forms to be filled (4 in total) by distributors and retailers, and there is often the challenge of filling these forms correctly by the retailers and getting the district directors of MOFA to endorse them, as these officers are sometimes not readily available thereby introducing delays and frustrations. Again, these are not necessarily new concerns, because under the voucher system too forms had to be filled and checked and signed off by MOFA staff before payment of subsidy to participating companies were paid.

Effect of the program on the development of fertilizer markets

Fertilizer imports

The introduction of the subsidy program seems to have led to an increase in agro input dealers, which in turn has increased access to agro inputs including fertilizers for farmers. First, the amount of fertilizers imported into the country in from 2008 to 2010, when subsidy was in place, increased significantly by 161.5 percent per year as compared to the amount imported in 2007

(Table 4.5). This is quite an achievement considering that the amount of the subsidized fertilizer in the total fertilizer imports declined over time (Table 4.5). Discussions with officials at the Crop Services directorate (CSD-MOFA) revealed that the increase could be more than as reported because the increases reported do not include fertilizer imports from some companies that do not require permit to import fertilizers. COCOBOD for example directly imports fertilizers for their operations without reference to CSD-MOFA and, therefore, such imports are captured in the statistics compiled by CSD-MOFA. That notwithstanding, the increases in fertilizer imports are largely attributed to the fertilizer subsidy program.

Table 4.5: Imports of fertilizer and subsidized amounts (mt)

	2007	2008	2009	2010	Annual average % change	
					xxxx-2007	2008-2010
Total fertilizer imports	149,706	112,704	335,186	-		161.5
Total subsidized fertilizer	n.a.	43,176	72,795	91,244		46.9
Share of subsidized in total fertilizer imports (%)	n.a.	38.3	21.7	-	n.a.	n.a.

Source: Authors' calculation based on MOFA (2009a and 2010b).
Notes: N.a. means not applicable

NPK fertilizers constituted a greater portion of total amount of fertilizers imported, increased from 27 percent in 2007 to 58 percent in 2009. Imports of potash, which is used in preparing the compound NPK, increased significantly in 2010 and 2011. Personal conversation with an private-sector actor in the fertilizer business 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 total amount of fertilizer spurned on the subsidy has also contributed to opening up opportunities for targeting different fertilizer formulations (or blends) to local agro-conditions. Because the study team did not look into this aspect of the fertilizer market, having only learned about at the end of the study, further analysis is required before any evidenced-based recommendations can be out forth. Nevertheless, it seems prudent for the government to find ways of supporting this activity, including a minimum of developing and enforcing safety and handling regulations because of our observations in the field on how many people mishandle these chemicals which pose severe health hazards. Sulphate of ammonium (SOA) is the second most imported fertilizer constituting up to 10 percent, although it is quickly being taken over by others such as triple super phosphate and urea.

Fertilizer distribution network and retail outlets

Implementation of the subsidy program is also associated with an increase in the number of permanent agricultural input dealers and outlets, which is estimated to have increased by 15

percent, and substantiated by farmers' perception that the distances to dealer points to purchase fertilizer has reduced (MOFA 2009). This is substantiated by our own findings of increased use in fertilizers which we present later on. Nevertheless, it seems that the fertilizer distribution network to various rural areas is underdeveloped and not creating the desired incentives for private investments to fully expand the distribution network, likely limiting many farmers in many rural areas to benefit from the fertilizer subsidy. First, all the fertilizer imported into the country is first sent to Kumasi, and then wholesalers transport the fertilizer from the port to their main distribution outlets which are mostly in the regional capitals (see Figure 2.3), where retailers have to go and purchase their fertilizer and then sell to farmers. Since these retailers were not involved in any negotiations with government in relation to the fertilizer price and transportation cost they become price takers, and the wholesalers dictate the terms to the retailers. Many of the fertilizer retailers that we interviewed indicated that the wholesalers usually offer them between GHS 0.50 and GHS 1.00 per 50-kg bag for transportation and a margin of GHS 0.70 per 50-kg bag, which many of the retailers said it was inadequate. For example, a fertilizer retailer in Nadowli explained that even though he is given the transport allowance of GHS 1.00 per 50-kg bag from the wholesaler in Wa (Antika) that he trades with, he pays about GHS 1.20 per 50-kg bag to transport the fertilizer from Wa to Nadowli, including loading and off-loading. Consequently, this dips into his allocated margin of GHS 0.70 per 50-kg bag in order to offset the extra transport and handling cost, leaving him with a margin of GHS 0.50 per 50-kg bag. Thus, for an average of 200 bags of fertilizer that he sells in one month, he makes a gross return of GHS 100 (i.e. 200 bags * GHS 0.50 per bag), which he considered to be low because he had to pay for other costs (including wages of a sales person, rental charges for the store) and compensate for the opportunity cost of the investment capital and his time.

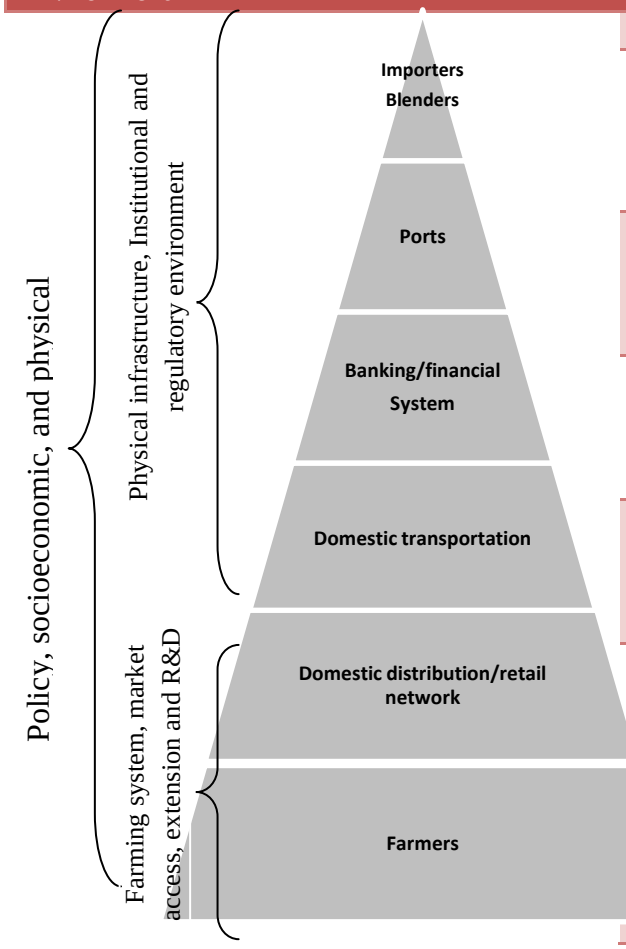
Because this can limit entry into the fertilizer retail market, particularly in rural areas, and thereby lower the potential of farmers to benefit from the subsidy in affected rural areas, the distribution of the of the fertilizer transport subsidy (i.e. the flat rate of GHS 5 per 50-kg bag) along the values 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 famers that have organized themselves to be able to purchase in bulk as well as those under the block farms project where 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 impacts the different actors and functions along the chain, and vice versa in terms affecting how the subsidy is determined and distributed 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 4.2 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; and much of the retail price of fertilizer to farmers may be traced to various factors along the supply chain, such as port charges, cost of credit, domestic transportation cost as well as distribution costs, including margins. These are analyzed below, drawing from the work of Funtes, Johnson and Bumb (2011).

Figure 4.2: Domestic supply chain functions and cost structure



Domestic Fertilizer Supply Chain	
Functions	Typical costs
International procurement and processing/blending	International price, importer marketing costs & margins. About 20% of cost ($3.1/bag)
Port services (e.g. berth charges, pilotage) and *stevedores* (for unloading and bagging services)	Port charges. About 18% of domestic cost ($2.67/bag)
Credit for procurement	Finance cost. About 32% of cost ($4.6/bag)
Movement of product from port to domestic markets	Transportation and transaction costs ($3.16/bag)
Distribution of product through domestic retail (or other) outlets	Distribution costs and margins. About 7% of cost ($1.08/bag
Demand and access to product	Final cost (from port to farmer), retail price

Source: Funtes, Johnson and Bumb (2011)

High cost and inefficiencies at the port

Port charges include 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 ($2.57 per bag), compared to about15.6 percent in other ports. This relatively high port cost may be attributed to a number of operational inefficiencies in port services and the port limited capacity. These inefficiencies include the regulation of permitting

only port employees (stevedores) to perform the work of unloading and bagging of products at port without allowing for direct negotiations with importers, introduces 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 importer 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.

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.

Domestic transportation

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 domestic cost of fertilizer. The government has offered a flat transportation fee of GHS 5.00 per 50-kg 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 road transport cost of fertilizer, leading to complains that the GHS 5.00 per bag offered by government for transportation is inadequate. 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 for domestic transportation in Ghana is by trucks over the road, there may be 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 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, the Northern region alone accounted for 30 percent of the total subsidized fertilizer sales, followed by the Brong-Ahafo region with 15 percent, and then the Ashanti and Upper East and West regions, respectively (Table 4.6). The western region accounted for least amount of sales of about 2 percent. In terms of sales per unit area, Table 4.7 shows that the Greater Accra region followed by the Upper East region were by far the largest consumers in terms of intensity—12.4 and 10.6 kg/ha, respectively. The other regions had less that 5 kg/ha, with the western region again taking the bottom with only 0.8 kg/ha.[4]

Table 4.6: Regional sales of subsidized fertilizer in 2010

Region	Type of fertilizer (bags)			Total		Percent
	NPK	SOA	UREA	Bags	MT	
Greater Accra	48,938	33,554	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: MOFA (2009)

Table 4.7: Regional sales of subsidized fertilizer per unit area in 2010

Region	Total sales		Sales per ha	
	MT	Percent	kg/ha	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

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

Total	91,243	100	4.0	--

Source: Authors' calculation based on MOFA (2009a) and total area of region

Assessing the achievement of program's objectives

This section focuses on assessing the achievements of the fertilizer subsidy program in the terms of the following stated objectives:

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

Application rate of fertilizer

First we asked farmers in the focus group discussions their perception of change in the last three years (2008 to present) regarding the number of farmers using fertilizer as well as the amount used per unit area. All the communities reported that both number of farmers applying it as well as amount of applied per unit area has increased over time and particularly since the subsidy began to be implemented in 2008, with the exception of one community where they thought there has been no change. Although the respondents also agreed that availability of and access to fertilizer was much better under the waybill system compared to the voucher system (reasoning that not all farmers who wanted use fertilizer obtained the coupon), we were unable to ascertain how 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 per hectare for all farmers, including those using it as well as those not using it.[5] As expected, Table 4.8 and Figure 4.3 show that the application rate (when counting only those using it) varied across different parts of the country (by region and stratum). By region, we find that the application rate was highest among communities in the Ashanti region (average of 295 kg per hectare) and least among those in the Upper East and West regions (average of 125 kg per hectare). Communities located in the forest zone applied the most (average of 313 kg per hectare), followed by those in the transition zone (average of 271 kg per hectare), and then the coastal (225 kg per hectare) and guinea (191 kg per hectare) savanna zones. Therefore, although the bulk of the subsidized fertilizer was sold in the Northern and Upper East and West regions (see Table 4.6), 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 larger amounts per unit.

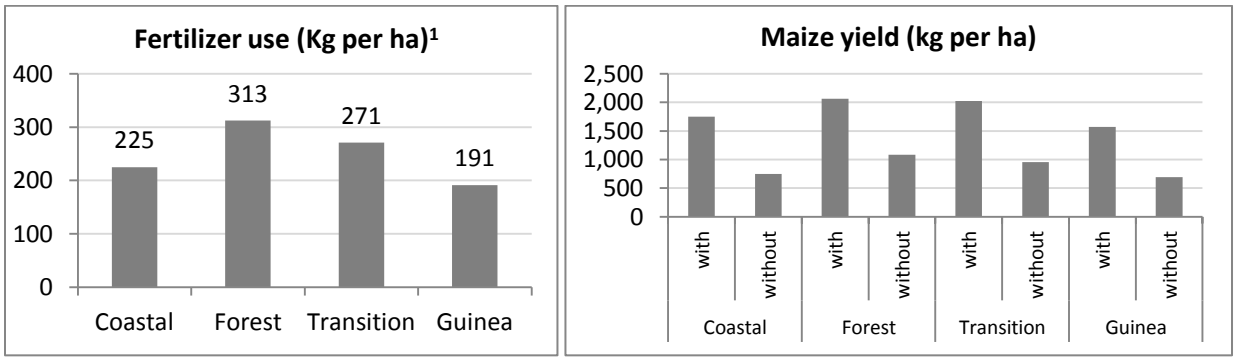
Table 4.8: Fertilizer usage and maize yield in sampled communities by region

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

Region	Average fertilizer application[1] (kg per hectare)	Average yield (kg per hectare)		
		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: household and focus group surveys
Notes: [1] applicable to when fertilizer is used only

Figure 4.3: Fertilizer usage and maize yield in sampled communities by AEZ



Source: household and focus group surveys
Notes: [1] applicable to when fertilizer is used only. With and without mean using and not using fertilizer, respectively.

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 4.8 and Figure 4.3 show the variation in maize yield across different parts of the country under the two scenarios. When fertilizer was applied, average maize yield was higher in the forest and transition zones than the average yield in the two savanna zone (Figure 4.3), which is consistent with the higher fertilizer application rates there, in addition to the more favorable agricultural production conditions in terms 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 per hectare, compared to 750 kg per ha in the coastal zone, 955 kg per ha in the transitional zone, and 1,083 kg per 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 4.9 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 benefit of using fertilizer may not be apparent to many farmers.

Table 4.9: 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 ploughing (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 100kg)	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 (percent of total cost)	13.01	(22.49)

Source: household and focus group surveys

Notes: With and without mean using and not using fertilizer, respectively. N.a. means not applicable.

Assessing potential economic and social returns

To assess the overall economic returns of the fertilizer subsidy program, we estimate the 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 fertilizer program. We apply it to the case of maize only because maize is one of the largest beneficiary commodities of the program, although not the only one. We project out the total program costs and economic benefits derived from the program over a 9-year horizon, i.e. from 2011 to 2020. Details of the model, overall assumptions, and underlying data are provided in the annex. Here we only summarize the results in Table 4.10.

Table 4.10: Summary of results of economic analysis of Fertilizer Program

Scenario	A			B		
Elasticity of demand (ed)		-0.4			-0.7	
	2010	2020	*Growth*	2010	2020	*Growth*
Yield without program (kg/ha)	1,714	1,893	*1.0*			
Yield with program, Y (kg/ha)	2,128	2,449	*1.4*			
Adoption rate, t (%)	9.4%	23.1%	*9.5*			
Unit production cost (2011 GHS/ha)	226	354	*4.6*			
Resulting production and price changes:						
National production with program, Q (1000 MT)	1,669	2,247	*3.0*	1,669	2,247	*3.0*
National production without program (1000 MT)	1,775	2,647	*4.1*	1,715	2,422	*3.5*
Production due to the program, as percent 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 (Million 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 (2011 GHS, million):		297.9			234.8	
B-C Ratio:		1.6			1.5	
Program Net Worth (with price effects):						
Net Economic Benefits (NB = B - C), million 2011 GHS	7.4	-6.0	-	11.3	47.4	*0.0*
Net Worth (2011 GHS, million):		75.8			184.2	
B-C Ratio:		1.2			1.4	

Source: Authors calculations.

Notes: Values under the column headed growth are annual percentage growth rates.

With the direct and indirect cost, the fertilizer subsidy bill for MOFA could easily rise to GHS 136 million in constant 2011 prices by 2020 and account for over 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, while the fertilizer program costs could easily grow at rates between 30 and 50 percent per year.

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 with and without the fertilizer subsidy program, respectively. Both 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 is no matching increase in demand, such as from increased exports (falling at about 4 percent per year). The decrease in prices is less rapid if we assume a higher elasticity of demand (e.g. -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 percent change in price given the same percentage change in output as compared to the situation when 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 so 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 very 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 fall 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 GHS and a cost-benefit ratio of 1.4.

In summary, our simple economic analysis of the fertilizer subsidy program 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 only be maintained so 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

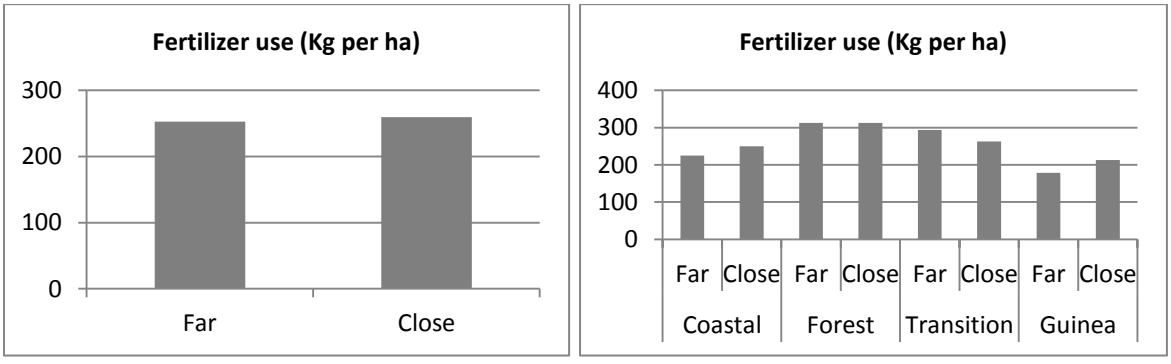
is enormous. Costs are difficult to control as they are highly dependent on trends in world fertilizer prices. Finally, economic returns could easily become negative due to a price collapse if there are insufficient export markets in the region to absorb any rapid growth in excess output.

Emerging challenges of the fertilizer subsidy program

In addition to some of the challenges raised when analysis the fertilizer supply chain, including high cost and inefficiencies at the port and high finance cost and poor access to credit by retailers, we highlight the major ones below:

- *Delayed negotiations and supply of fertilizer*: Fertilizer importers raised concern about the delayed negotiations with government as well as delayed payments of the subsidy by government. As a result, there is delay in the importation and distribution of fertilizers, which make the subsidized fertilizer unavailable to farmers during some critical periods of demand. For example, distribution of subsidized fertilizers commenced around 12th May 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 per 50-kg bag of fertilizer, irrespective of distance of transportation, was raised as a disincentive to those who transport the fertilizer over 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 4.4 shows, the application rate was not significantly different among those relatively farther away from a major market compared those that are relatively closer. Still it may be prudent to assess this further.

Figure 4.4: Average fertilizer usage in sampled communities by AEZ



Source: household and focus group surveys

Notes: [1] applicable to when fertilizer is used only. Far and close mean farther and closer to a main market, respectively.

- *Cumbersome procedure*: The waybill system is considered cumbersome by many of the distributors and retailers that we interviewed. Because of the requirement that only the District Agricultural Officer should sign the waybill, there were reported many cases of frustrations when such officers are not readily available. Others raised the issue of lack of clarity of the procedures.
- *Inadequate storage facilities for fertilizers*: Many fertilizer retailers are confronted with the challenge of inadequate storage facilities to store fertilizers, 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. There was reported incidence in the north of damage to crops in 2010 due to application of a compound fertilizer (16-16-16) that AEAs and other officials could not diagnose or provide any solutions.

Conclusions and recommendations

Conclusions

- The evidence from the study shows that there has been increase in application of fertilizers due to the subsidy programme. Those farmers who applied fertilizer on their farms obtained higher yields and positive net income than those who did not use any.
- Application of fertilizers, e.g. on maize, tends to be more profitable for farmers in the forest and transitional zones than those in the coastal and guinea savannah zones.
- Implementation of the subsidy program lead to an increase in the volume of trade and number private-sector actors in the market, despite that the fertilizer distribution network to various rural areas may still be underdeveloped.
- Delays in negotiations between government and fertilizer importers delays 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). The possibility for significant reductions in output prices as supply expands rapidly is there, unless regional markets can be tapped.

Recommendations

- To forestall delays in the fertilizer importation and distribution, it is recommended that government starts the 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 is 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.
- Strengthen quality control and standards and promote stronger links with the research and development department.
- To minimize the potential risks of putting a large burden on MOFA's budget, policy makers may wish to consider a maximum threshold upon which no further funds would be made available under the program and, correspondingly, laying out a clear exist 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 maintain ensure positive welfare gains of the program overtime.

5. The National Buffer Stock Company (NAFCO) Program

Background

To ensure the security of farmers and insulate them against losses resulting from the anticipated increases in production as well as ensuring national food security, MOFA set up the National Buffer Stock Company (NAFCO) in the year 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 in order to reduce post-harvest losses resulting from spoilage due to poor storage, thereby protecting farm incomes
- To purchase, sell, preserve and distribute food stuff
- 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, prisons, etc
- To manage 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 chapter evaluates the NAFCO program with the overall goal of critically assessing its activities and plans as well as any achievements so far with the view to shape policy for government in respect of change in strategy and improvement in implementation. The specific assessment questions were presented in the introductory chapter.

Conceptual framework and methodological approach

Theoretically, a buffer stock scheme (commonly implemented as intervention storage) is an attempt to use commodity storage for the purposes of stabilizing prices in an entire economy or, more commonly, an individual (commodity or produce) market (Bellemare et al. 2010). Specifically, commodities are bought when there is a surplus in the economy, stored, and are then 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 and a ceiling (minimum and maximum price). When the price drops close to the floor price (occurs around harvest of the main season's crop, for example), the scheme operator (usually government) will start buying up the stock, ensuring that the price does not fall further. Likewise, when the price rises close to the ceiling, the operator depresses the price by selling off its holdings. In the meantime, it must either store the commodity or otherwise keep it out of the market (for

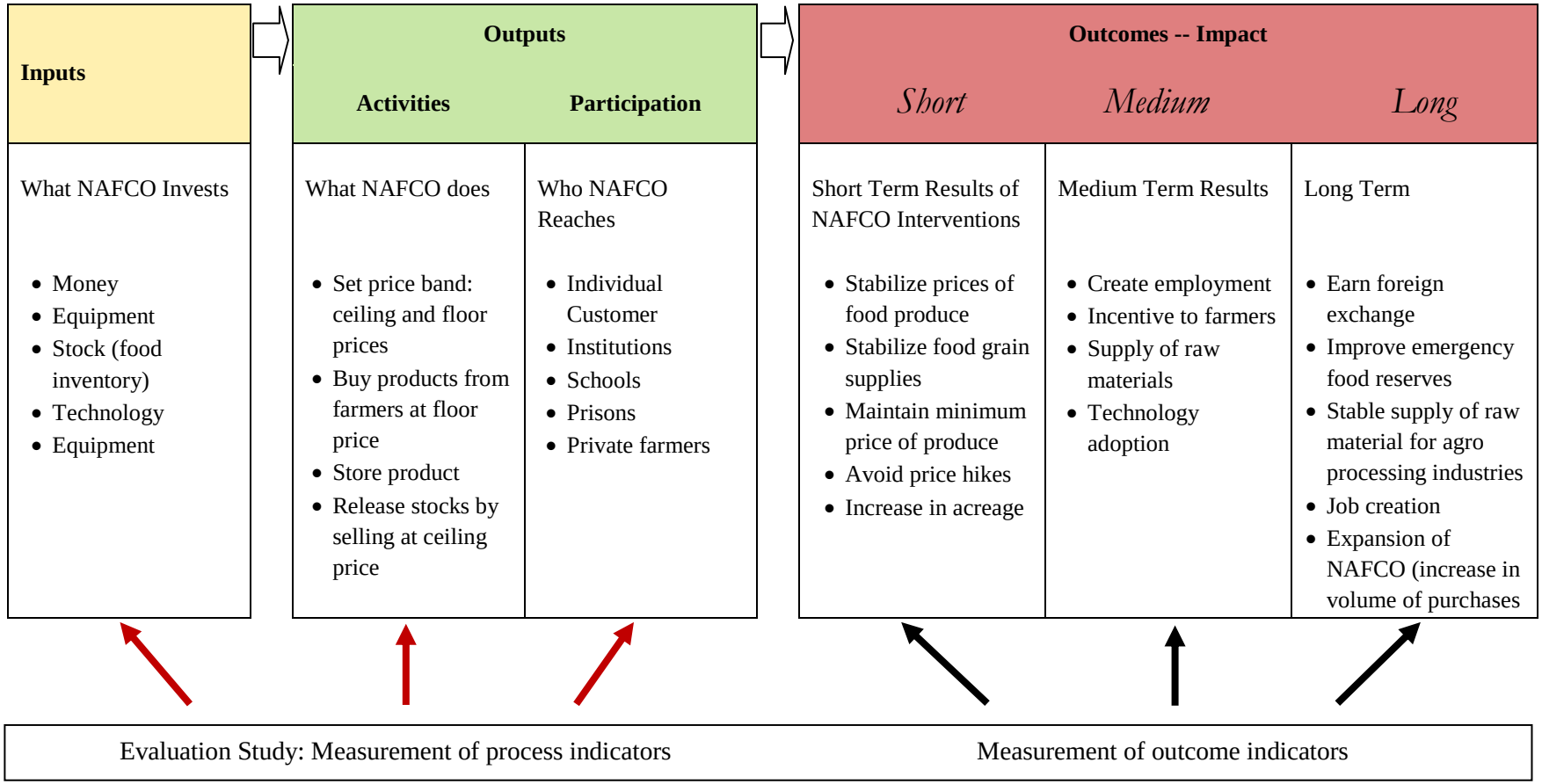
example, by destroying it). If a basket of commodities is stored, their price stabilization can in turn stabilize the overall price level, preventing rise in prices.

According to Bellemare et al. (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 the 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 be achieved by varying imports and export mostly through import tariffs: taxes imposed on imports as a control measure. 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. While most rely on direct purchases and sales in domestic markets, there are examples where buffer stocks are maintained through imports supplemented by domestic procurement. However, in all cases, buffer stocks also seek to control trade flows.

One of the key justifications for introducing such schemes is the desire by governments to stabilize incomes for both producers and consumers in circumstances where there is market failure, and thus high market transaction costs that result in very low producer prices at farm gate and high consumer prices in urban areas. In Asia, the presence of buffers stock schemes has been referred to as having played a critical role in the early years of the green revolution by ensuring higher incomes among producers and lower prices for consumers. Ultimately, this would contribute 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 (Cummings, Rashid and Gulati 2006). Over time, the maintenance of such schemes has increasingly added higher fiscal burdens on governments. For example, the government of India's bill for its buffer stock scheme rose from about US$160 million in 1992 to US$1.6 billion in 2002 (Cummings, Rashid and Gulati 2006). In the Indian case, political lobby groups emerged from the key actors involved in the scheme, the Food Corporation of India (FCI), farmer lobbies, and the National Food Authority, to continuously maintain higher producer prices. Clearly, having an exit strategy is critical.

NAFCO is an example of a buffer stock scheme initiated by the government in Ghana. To better understand what to evaluate, we illustrates the impact pathway of the program in Figure 5.1. Basically, NAFCO buys cereal from farmers during the (bumper) harvest and stores it for sale in the lean season. This allows farmers to get a certain assured minimum price for their produce.

Figure 5.1: NAFCO impact pathway



Assumptions: All things being equal, resources and planned interventions started on time and as planned

External Factors:
The socio-economic, political factors and institutional environment that influence NAFCO activites such that NAFCO can explore collaborations with, and using the private sector in certain activities

This also gives farmers an assured market for their produce and protects them from the exploitation of market operators during glut—supply being more than demand. In the lean period, NAFCO put out supplies to meet the demand and hence prevent an escalation of prices. The consequences of NAFCO's interventions are stable prices and ready market for produce, thus giving the farmers the assurance of a ready market for their produce and motivation to expand their acreages, adopt modern technologies, and increase production and their productivity. Figure 5.1 thus helps to identify data needs for the undertaking the assessment. Input indicators measures what went in to develop the project, whereas output indicators measure activities of NAFCO and institutions they were designed to reach. Outcome indicators are based on specific objectives for the establishment of NAFCO.

To evaluate the NAFCO buffer stock scheme in Ghana, a combination of cost benefit analysis, price trends analysis, and market structure, conduct and performance (SCP) were undertaken. The financial benefit-cost ratio (FBCR) is intended to help reveal competitiveness and calculated using market or financial prices to value costs and benefits. The social (or economic) benefit-cost ratio (SBCR or EBCR) helps reveal comparative advantage is estimated using shadow or economic prices to value costs and benefits.

A price trend analysis is also conducted to identify the trends in changing prices, particularly in computing the level of price stabilization, by measuring the standard deviation or dispersion of monthly prices from the annual average. The more spread apart the prices are from the mean, the higher the deviation.

The Structure-Conduct-Performance (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. 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 (e.g. price levels and price stability, profit levels, costs, quantities and quality of commodities). There are various elements in the structure, conduct and the performance in relation to the specific market under study. In the case of NAFCO, Table 5.1 gives elements that are explored in the SCP analysis.

Overview of the NAFCO program

Establishment of NAFCO, sources of finance, and lessons from the erstwhile Ghana Food Distribution Company

NAFCO was incorporated on 11 March 2010 under the companies' code of Ghana 1963, ACT 179, with registration number with CA-72,140 and is wholly owned by the Government of Ghana. The core mandate of NAFCO is to purchase and sell farm produce with eight objectives

as stated in the introduction. The establishment of the company followed a recommendation by the National Post Harvest Committee on proposal for funding post-harvest management of the Youth in Employment Block Farm Programme in 2009. The recommendation was based on the anticipated increase in the production of farm produces a result of the introduction of the block farm and the fertilizer subsidy programmes. The committee also took a field visitation to inspect block farms, combined harvesters, silo drying and warehouses in the country and report gave a status of the various warehouse identified. NAFCO currently has an eight member Board of Directors chaired by the Hon. Minister of Food and Agriculture. The Board gave approval of the business plan and operations manual of the company, which was subsequently submitted to the Ministry of Finance and Economic Planning (MFEP) before it started operation. The company also has a Chief Executive Officer (CEO) who is responsible for the daily operations. Though the national buffer stock programme was initiated in 2009, the first year was the formative year and the real purchases of the company started in 2010.

Table 5.1: Factors considered in the structure-conduct-performance (SCP) analysis

Elements of market structure	Elements of market conduct	Elements of market performance
Number of buyers and sellers: With few buyers and sellers, they may engage in noncompetitive behaviors such as collusion and price discrimination.	Pricing setting behavior: Who sets the price? How are prices determined?	Price levels and stability in the short and long run.
Barriers to entry: This refers to factors that restrict the participation of households or traders in the market	Buying and selling practices: Are there standard units of measurements in the market for volumes traded such as weighing scales?	Profits (net returns), does traders receive excessive profits or net returns from sales of food commodities compare 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: whether farmers get less income or depending on whether they sell directly to traders, middlemen etc.	Are there price negotiations?	Volumes, distribution channels, quality of produce,

Source: USAID (2008).

The activities of the company are wholly financed by the Government of Ghana. Subsequent to the setting up of the company the MFEP released GHS15 million to MOFA for its implementation—see Table 5.2 for details.

Table 5.2: 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)

Notes: HIPC is donor funding through the Highly-Indebted Poor Country grants window

Even though there is no documentary evidence to show how lesson from other initiatives were incorporated in the setup of NAFCO, an interview with the CEO of the company revealed that lessons from the erstwhile GFDC were incorporated in the design and setting up of NAFCO. For example , NAFCO is not into the purchase and sale of perishable farm produces since they do not have relatively longer shelve live and the cost of preserving then is also high and hence decided to concentrate on cereals and grains which have longer shelve life 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 can store for a reasonable longer period and be able to employ the floor and ceiling prices to influence market prices. To this end it was appropriate to choose maize and rice as the major crops to deal with.

NAFCO and the Food and Agriculture Sector Development Policy II (FASDEP II)

Evidence from available documentations shows that among the numerous constraints that the FASDEP II Policy seeks to address included market access and food insecurity. In trying to overcome these and many other problems, the Government of Ghana now have a new focus in its efforts for greater effectiveness, sustainability and equity in impacts. In particular, a few commodities will be targeted for support. A value chain approach to agricultural development has been adopted with value addition and market access given more attention. Efforts will be intensified to build capacity towards meeting challenges of quality standards in the international market, with focus on increasing productivity along the value chain. While imports will not be controlled by quotas and tariffs, the use of standards to control imports of poor quality produce will be pursued. Attention will be given to improving standards in local markets and for food safety (MOFA 2007).

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

The National Buffer Stock programme therefore fits well into the broad strategic goals and objectives of FASDEP II and it complements other initiatives such as the fertilizer subsidy and block farms programs.

Logistical set up of NAFCO, operations, and price determination

Following the setup of NAFCO, the government released to NAFCO all 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 CEO. Currently NAFCO is operating in 6 regions, defined around the locations of its warehouses (Table 5.3).

Table 5.3: 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)

Though NAFCO intends to purchase grains from all areas in the country, it is currently operating in the Ashanti, Brong-Ahafo, Northern, Upper East and Upper West regions. The company has plans to start operations in the Eastern region by the end of the 2011 crop season. Our visual observations from visits to most of the warehouses across the country show that the grains are well packaged and stored in a hygienically clean environment. The use of the Pro Cocoon technology in storing the grains was working well in terms of preventing pests' infestations. At one of the warehouse locations that contained rice that had yet to be milled and properly stored, however, the team sited the activities of rodents. At most of the warehouse locations too, the team observed that there were no fire preventive mechanisms.

The main activities of NAFCO currently are the purchases and sales of maize and rice. It has the intention of adding soya bean to the commodities dealt with in the near future. The purchasing process was initially done by the company itself, but it has now given this role to the private sector by contracting a total of 52 licensed buying companies (LBCs—see Table A5.1 in the appendix to this chapter for the list). These LBCs go to the various villages to purchase maize and rice from farmers at a minimum purchasing price (i.e. floor price) determined by NAFCO.

The determination of the floor prices was based on the report by the post-harvest committee within MOFA 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 and allowing a profit margin

for farmers—15 percent in the case maize. Although there may be spatial differences in the cost of productions due to differences in the local production and market conditions (see introductory chapter), there is no spatial differentiation in the floor price. At the time of study, the prices at which NAFCO was buying grain from farmers were GHS 48 per 100-kg bag of maize and GHS 35 per 50-kg bag of paddy rice (see first of data in Table 5.4), meeting certain moisture content and purity requirements. For the ceiling price, NAFCO considers its cost of operations and allows for some profit margin (Table 5.4). Compared to the prevailing open market prices at the time of the study, NAFCO seems to be subsidizing the operations or consumption of those it was selling maize and rice to. For example, the average open market price of maize was about GHS 75 per 100-kg bag. Therefore, NAFCO was giving GHS 25 (or 27 percent of the market price) subsidy on each 100-kg of maize sold. The main beneficiaries currently are poultry farmers, schools and other public institutions. The implicit subsidy passed on is much higher in the case of rice, up to GHS 80 per 50-kg 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 that NAFCO deals with.

Table 5.4: NAFCO determination of ceiling price (GHS per 100-kg bag)

Description of cost item	Maize (100 kg)	Rice (50 kg)
Purchase from LBC	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)

Notes: LBC is licensed buying company. [a] profit margin is 3.8 and 25.0 percent of the total cost of maize and rice, respectively.

Assessing the achievements of NAFCO's objectives

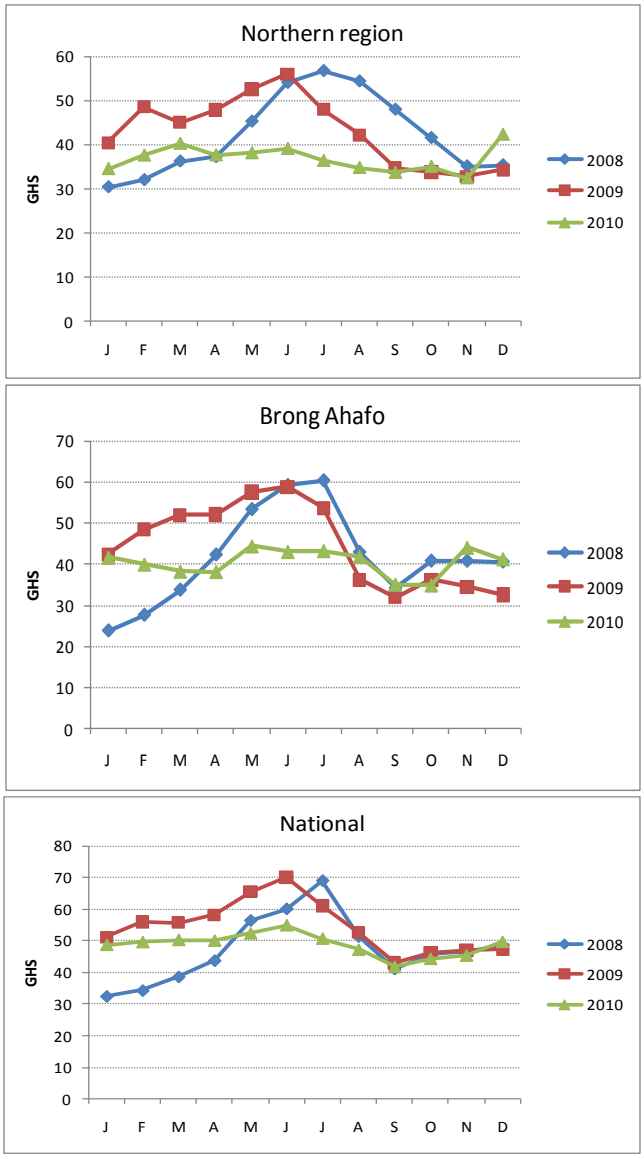
The main goal of NAFCO is to employ a buffer stock mechanism to stabilize demand and supply and, thus, commodity prices for producers and consumers. To evaluate the extent to which there have been any changes in price fluctuations due to NAFCO's operations, we examine price trends of maize and rice—which NAFCO has made purchases, carried stocks, and made sales—prior to and after NAFCO's entry in the market. The variability in domestic prices over time is also compared with that of international prices. For the 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 IMF database on world commodity prices (reference and website link).

Price stabilization

Monthly trends of maize prices from 2008 to 2010

Figure 5.2 and Table 5.5 show that monthly prices of maize generally continued to vary, but with different levels of fluctuations 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 steady increase that peaks 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 that in 2010 (top graph in Figure 5.2).

Figure 5.2: Maize price trends in Ghana, 2008-2010



Sources: Wholesale prices from MOFA.

Take the trends for 2009 and 2010 for example, the starting price in January was the same; but while 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 also observed in the Northern region and at national level (middle and bottom graphs in Figure 5.2, respectively). Table 5.5 reflects these patterns in terms 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, e.g. Central region, further research is needed to determine attribution in stabilization of prices to NAFCO's activities.

Table 5.5: Variability of monthly maize prices, 2008-2010

Region	Year	Minimum	Maximum	Mean	Standard deviation
Ghana (GHS per 100 kg)					
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 MT)	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

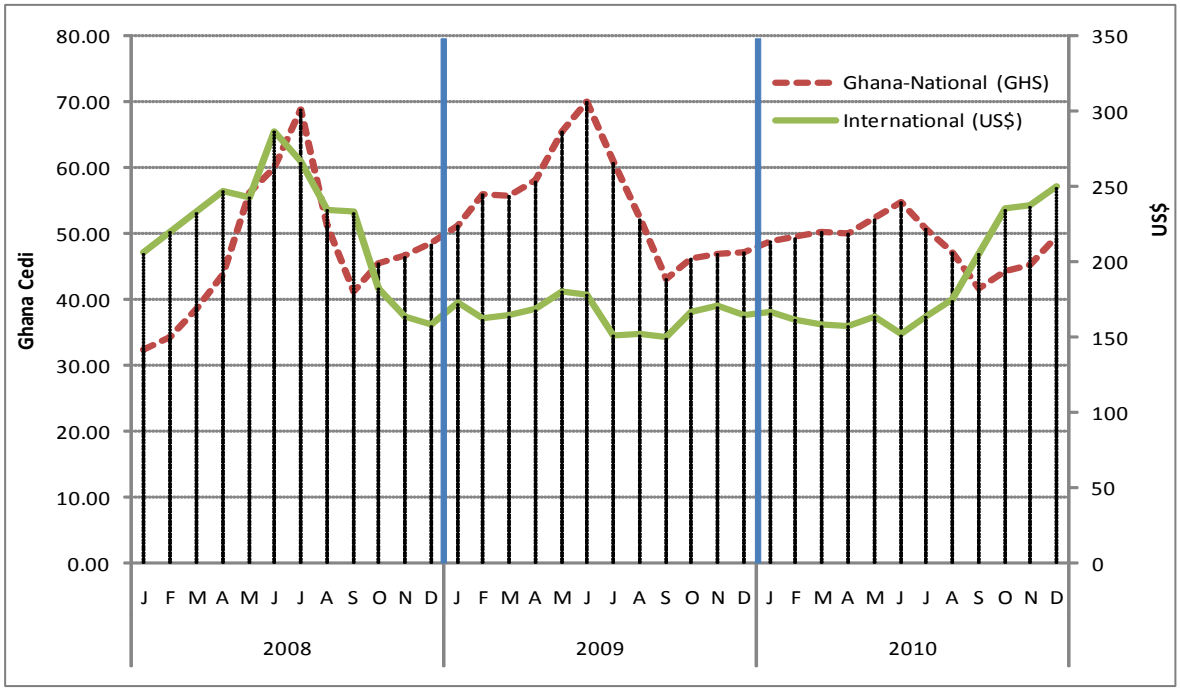
Source: Authors' calculations based on data from MOFA for domestic prices and IMF for world prices.

While it is tempting form 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 on 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 represents a very 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 market place.[6]

[6] Share of production reaching the market is estimated based on the focus group surveys, while the total production is based on the projected estimate by MOFA (MOFA 2010b).

In comparing the national level trends in maize price with those of the world price, we see divergence in the patterns between the two as illustrated in Figure 5.3. 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, adding fears of a looming crisis by 2012.

Figure 5.3: Maize price trend, comparing domestic and international prices



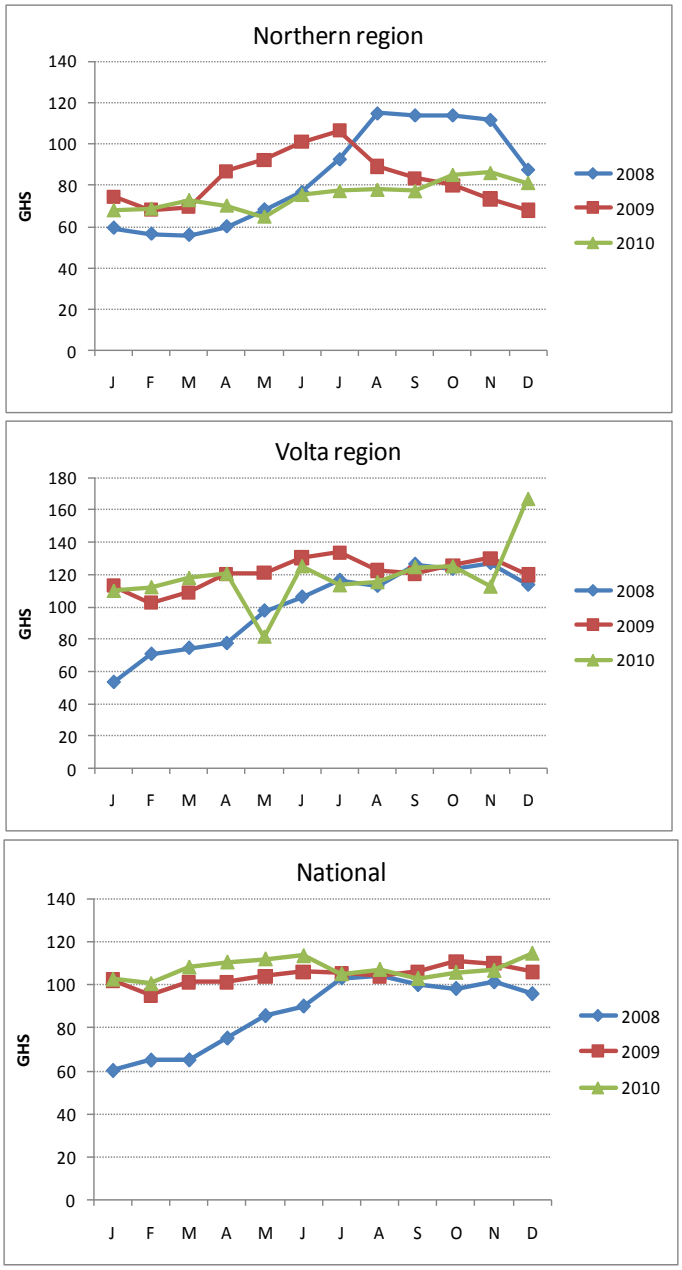
Source: Authors' calculations based on data from MOFA for domestic prices and IMF for world prices

Domestically, while the national share of NAFCO's activities are quite small, they can potentially affect prices in more localized markets by purchasing in one market and selling in another (inter-spatial), as well as between seasons (inter-temporal). This may have occurred in the Brong-Ahafo and Northern regions to the extent that maize surplus during the major harvest season was purchased and then sold to poultry farmers and public institutions (e.g. schools). Out of a total of 5450 MT purchased by NAFCO up to May 2011, 5300 MT (or 97 percent) was subsequently sold, implying close to zero stocking rate. 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 could potentially have localized dampening effects on hitherto rising market prices from such large bulk purchases. Here too, unfortunately, there was no information on actual monthly purchases, sales, and stocks to undertake a more detailed assessment.

Monthly trends of rice prices from 2008 to 2010

In the case of rice, the average wholesale price for rice seems to have stabilized more in the Northern region in 2010 compared to other regions (Figure 5.4). As it turns out, this is also the region in which activities of NAFCO for rice was very extensive compared to all the other regions, including Volta region which is shown in the middle graph of Figure 5.4.

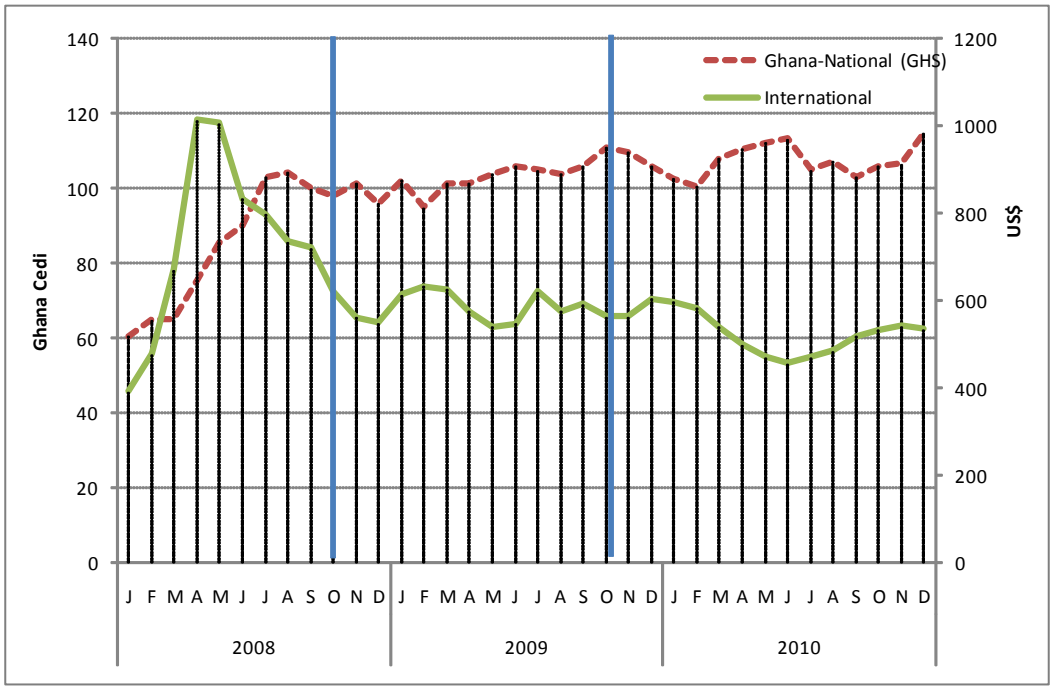
Figure 5.4: Rice price trends in Ghana, 2008-2010



Source: Wholesale prices from MOFA

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 5.5).

Figure 5.5: Rice price trend, comparing domestic and international prices



Source: Authors' calculations based on data from MOFA for domestic prices and IMF for world prices

Table 5.6: Variability of monthly rice prices

Region	Year	Minimum	Maximum	Mean	Standard deviation
Ghana (GHS per 100 kg)					
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 MT)	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: Computed with data from MOFA for domestic prices and IMF for world prices

Upon examining the standard deviations of monthly rice prices from the annual average (Table 5.6), while we see a continuous decline from 2008 to 2010 in the Northern region, those for the Volta region and 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.

Employment creation

Another important objective of NAFCO is employment creation, which we assess in this section. As pointed out earlier, 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 the activities regarding rice, NAFCO also supports processing in the form of milling and parboiling. For example, the Nasia Rice Mill which has been inactive for several years was recently revived by NAFCO and the mill now has 35 permanent staff. The mill was revived following the appointment of an experienced miller and engineer who is also currently training four 4 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 groups, with the number members benefiting estimated at over 5000—see Table 5.7 for three major groups involved.

Table 5.7: Women's groups involved in the parboiling of rice for NAFCO

Name of Group	Year of Formation	Membership in 2009	Membership as at June 2011
Tuyumba Rice Processors Association	2002	50	1500
Nyebu-Biyoona Rice Processors Association	2005	51	1000
Lolandi Rice Processors Association	1995	300	1200

Source: Focus group survey

In our discussions with the groups, it was revealed that their engagement with NAFCO has driven up their membership substantially (Table 5.7), 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 also estimated that each member earns an average daily wage of GHS 9 from the services they render to NAFCO. Though the services rendered are not all year round, they are able to work up to 8 months in a year or 24 days per month, earning an average of GHS 216 per person per month during the 8 months. They revealed further that, because of the increase in income, they are now able to purchase household items, clothes, and meet basic needs such as payment of school fees and health insurance. In addition, their access to

and affordability of adequate nutritional food has also 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 females between the ages of 17 to 25 years back from the cities where they were engaged in manual labor (*kayayo*) to join their families. Sixteen of those recalled were now operating in Tamale, nine in Kumasi, and five 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 also created casual work for 150 loading boys in Kumasi and Tamale who help in loading and offloading of maize and rice at their warehouses. At Ejura, NAFCO has also provided casual employment to 30 youth who also assist in the processing of maize. Transporters have also increased their activities by frequently loading trucks of maize and rice to and from the various NAFCO warehouses in Tamale and Kumasi.

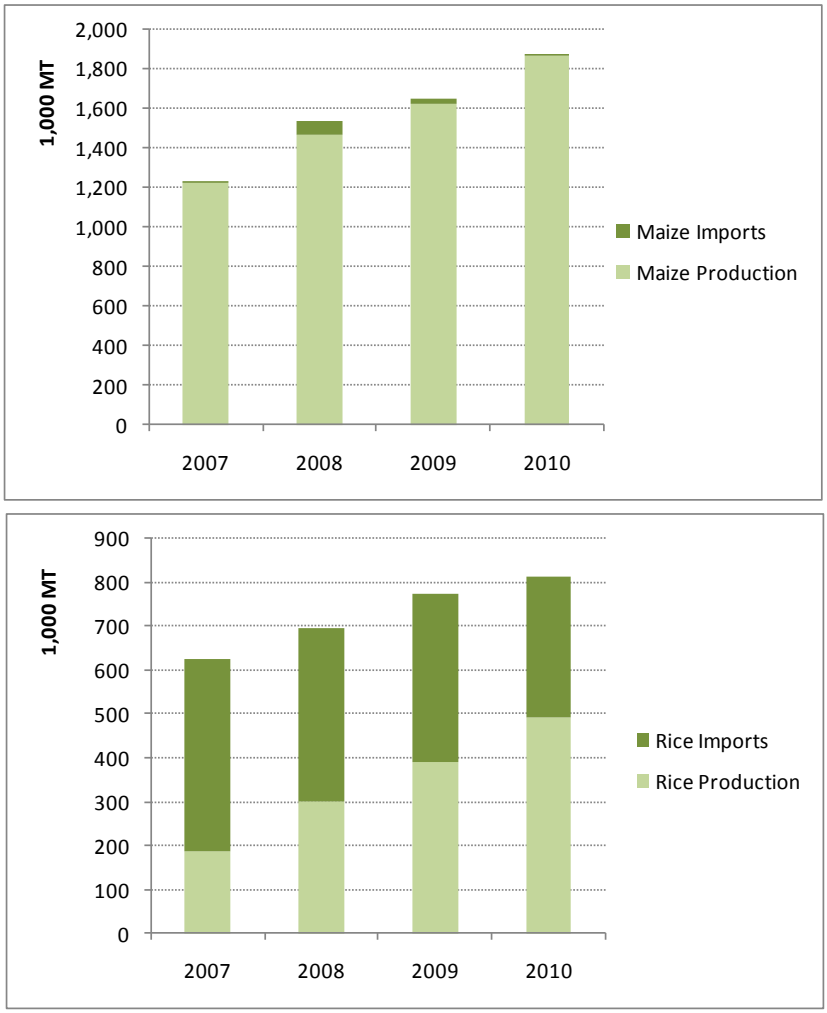
Grain supply and reserves—buffer stocks

Available production and import figures from MOFA show that while production levels of maize and rice in the country have been increasing, import levels have been decreasing (Figure 5.6). However, the amount of maize imports is very small relative to domestic production that such trends are difficult to interpret. Nevertheless, there seem to be a substitution effect, with increase in production displacing imports of maize for feed by the poultry industry. With NAFCO now in the picture and buying grain at glut and then selling at a less than market prices to the poultry industry, they are 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.[7] In the case of rice, which is a major import commodity, we still observe the substitution effect, though the volumes of import are still high unlike in the case of maize. But production of rice more than doubled between 2007 and 2010 from about 0.2 to 0.5 million metric tons, and so the substitution effect is not surprising. Again NAFCO's activities can enhance this process.

So far NAFCO's sales have equalized its sales with very little 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.

[7] 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 5.6: Production and import of maize and rice, 2007-2010



Source: MOFA (2011)

Efficiency and effectiveness of NAFCO's activities

Market structure, conduct and performance 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 rice markets, to crowd out other operators in the market. Because NAFCO's strategy has been to mop up excess produce and, thus, only enters the market at critical times, the traditional operators buy what their capacity can cope before NAFCO even comes in to mop up the excess. Additionally, NAFCO has focused on selling to public institutions and the poultry industry in the case of maize. One unique aspect of the rice market that 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 the "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 only receives his payment after the middlemen has been paid by the wholesaler; making the farmer a financier of the market transactions. Farmers also 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 over 90 percent of their produce at the farm gate to either wholesalers and/or middlemen. The rest is sold in their local retail markets and to others food processor particularly kenkey makers and sellers. In the case of sales to NAFCO, very few farmers could distinguish NAFCO or the LBCs from other wholesale buyers or market agents. This is because the LBCs that purchase the maize on behalf of NAFCO do not always identify themselves as representing NAFCO.

Farmers revealed that they would sell to anyone who offered the best price, although other factors were also important in deciding who to sell to. And so we asked farmers to rank their reasons for selling their produce to different marketing agents. Using Kendall's concordance analysis, we find that pre-finance and contract payments was ranked as the most important, followed by competitive price offers, and then convenience and ease of sale (see Table 5.8). Thus, while farmers could not claim any known sales to NAFCO at the time of the study, the results show that potential sales to NAFCO will abounds in time of glut when the market price falls below NAFCO's floor price.

Table 5.8: Reasons why 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
Pre-financed or contract payment	1.17	1

Source: Authors' calculation based on focus group survey

Financial cost-benefit analysis

In conducting the cost-benefit analysis (CBA), we only used 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, i.e. 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 for the first year of operation with respect to purchases and sales, we made projections for second and third year and then carried the CBA using a discount rate of 12.5 percent. A summary of the financial analysis including sensitivity to changes in key parameters are presented in Table 5.9.

Table 5.9: Financial analysis of investment worth of NAFCO and sensitivity analysis results

	NPV (GHS millions)	BCR	IRR (%)	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)

As the first row of the results indicate, NAFCO was found to be financially viable with a net present value (NPV) of GHS 2.390, benefit-cost ratio (BCR) of 1.20, and internal rate of return (IRR) of 38.5 percent. The IRR of 38.5 percent is far greater than the 12.5 percent cost of the capital (i.e. discount rate) invested by the Government of Ghana. NAFCO can therefore be described as a financially viable venture. We deal with the economic analysis later on. The financial sensitivity analysis results in Table 5.8 suggest that NAFCO could still be viable if its total cost or the discount rate should increase by 10 percent. If its total benefits should decline by 10 percent however, then NAFCO will cease to be viable. While these financial returns generally looks attractive and presents NAFCO as a self-supporting scheme, the record with buffer stocks around the world have shown that eventually such schemes become very expensive programs as the example of India that was illustrated earlier shows. Another example is the case of Kenya where the Government had spent up to $80 million by 2006 to maintain a price stabilization scheme through the buffer stock mechanism alone (Minot 2010). Over time, such state sponsored price stabilization efforts experience rising costs due to large procurements, overheads, storage and handling costs as production outlays rise and pricing policies adjust little to changing supply and demand conditions. In the case of Ghana, NAFCO is barely two years old and it has not been tested in terms facing market prices that are lower than its floor price for a sustained period of time, for example.

Analysis of NAFCO's potential economic welfare benefits

The analysis is based on the two main objectives of NAFCO: price stabilization (maintain a floor and ceiling price; purchase stock whenever prices fall below the floor price, and sell when prices rise above the ceiling price; and maintain a sufficient reserve in times of food shortages due to

unforeseeable reductions in food staples production. In addition, NAFCO also purchases grain to supply major government institutions (schools and prisons).

To determine the economic value of the NAFCO program, the situation in which a floor price commitment is in effect and assuming prices remain unchanged with open trade results in no actions 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 Kg. 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 over the period, GHS 43.2 million as shown in Table 5.10 below. 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.

Table 5.10: Summary of results of economic analysis of NAFCO Program

Scenario	A			B		
Elasticity of demand (ed)	-0.4			-0.7		
	2010	2020	*Growth*	2010	2020	*Growth*
Resulting production and price changes:						
National production without any programs (1000 MT)	1,669	2,247	*3.0*	1,669	2,247	*3.0*
Supply in domestic markets, less stocks (1000 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*)	12.05	*29.1*			
Direct Costs of Program (million 2011 GHS)	15.9 (1.1*)	11.82	*30.0*			
Indirect costs of program (million 2011 GHS)	1.8 (0.1*)	0.22	*10.0*			
Total cost of program as share of MOFA's Budget (%)	8.9 (0.4*)	0.6				
Direct Costs as share of MOFA's Investment Budget (%)	174.3 (1.8*)	2.0				
Program Net Worth (with no price effects):						
Net Economic Benefits (NB = B – C), million 2011 GHS	-17.7 (-1.1*)	-11.8	-	-17.7	-11.8	-
Discounted Net Worth (2011 GHs, million)		-43.2			-43.2	
B-C Ratio		0.0			0.0	
Program Net Worth (with price effects)						
Net Economic Benefits (NB = B – C), million 2011 GHS	-23.7 (-9.0*)	-95.5	-	-23.7	-95.5	-
Discounted Net Worth (2011 GHS million)		-214.5			-214.5	
B-C Ratio		-4.0			-4.0	

Source: Authors' calculations.

Notes: Values under the column headed growth are annual percentage growth rates. *The base year in 2010 included the upfront investment cost of GHS 15 million for setting up NAFCO. The numbers in brackets are 2011 levels which grow modestly until 2020.

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 0.56 to 65 per kg 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 when 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 later in Chapter 8 when we consider the presence of the 3 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.

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 creating employment. However, NAFCO is confronted with some challenges in the purchasing process such as:

- Inability of farmers to identify the LBCs as agents of NAFCO and lack of knowledge of NAFCO minimum prices to use in negotiations.
- High monitoring cost 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 potential transfer of subsidy to LBCs to the extent that LBCs purchase at lower than the minimum and the sell to NAFCO at the minimum price.
- Because LBCs are active buyers in their own right, it difficult to differentiate their own activities from those intended for NAFCO.

NAFCO also has logistics, infrastructural and human recourse challenges in its daily operations such as:

- Inadequate warehouse capacity. The current capacity of 34,000 metric 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. 34,000 MT represents only about 3.3 percent of the estimated total marketed maize alone in 2010 for example.
- Inadequate logistics such as trucks and instruments for determining the moisture content of grains.

- In adequate staff at the regional levels. The company currently relies heavily on the MOFA staff at the regional level for some of its activities. These are not factored into the cost of its operations.

Conclusions and recommendations

- The evidence shows that there was stabilization of maize price in 2010 compared to preceding years'. There are some lessons to be learned here that this study is not able to unravel. And so further research is needed in order to inform the government and NAFCO on how to strategize to sustain or improve upon it. To help carry out the study in an effective manner, NAFCO needs to provide data with more subnational disaggregation as well as more frequent periods (see Table A5.2 in the appendix to this chapter).
- 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 it 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 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 costly under conditions of no trade. The experience of Mali's food security grain reserve (or PRMC) is worth looking into.
- NAFCO should put in place a transparent information system about it prices, identification of LBCs, and the location of any buying and selling depots.

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 (WRS). Focusing more in promoting and providing incentives for the emergence and profitability of private sector warehousing companies, WRS is often favored over the heavy state interventionist approach of buffer stock programs Finally, publicly held stocks (buffer stock) have generally proved workable, especially so 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. In Ghana, a country that wants to achieve food security, increase production levels, its goals 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 a very few commodities and even only among key food staples.
- Second, it should also focus in 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 closer to a commodity's scarcity value.
- 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, string links with regional and international markets can actually offer a quicker and more flexible response. Here, Cummings, Rashid and Gulati (2006) site the example of Bangladesh during the 1998 flood when the private market quickly responded with supplies from India.
- 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 distributions of buffer stocks would encourage the emergence of more private operators and traders.

Appendix to chapter 5 on NAFCO

Table A5.1: List of NAFCO's Licensed Buying Companies

Name of company	Telephone/mobile numbers	Name of company	Telephone/mobile numbers
Nnabya Ltd.	0244163800	Kafin Machon Ventures	0243178540/0276467708
CDH Commodities Ltd.	0302671057/0208117178	Odometa Estate Ltd.	030237474/0241268188
Primesol Ghana Ltd.	0302448411	Byrivers Projects Ltd.	0202469625/0243118419
Namsec Ltd.	0244864799/0205944249	Midland Supplies Company Ltd.	0209380669
Makan Investment Ltd.	0244771375/0274123750	Cyprian Tsikata Ventures	0287334688
Eden Family Co Ltd.	0208137993	Abepa Produce Ltd.	0302669525/0244326006
Aawes Ventures Ltd.	0246186633/0208234526	Brada Ventures Ltd.	0302766419/0209778095
FCS Ltd.	0244810055/0243259328	International Business Group Ltd.	0302324994
Asafaco Consult Ltd.	0244612952	Masud Enterprise Ltd.	0265027417
Rualfu Mubak Ltd.	0208164867/0240800260	Dolanayana Company Ltd.	0209380669
Durga Agric Ltd.	0244716849/0208191360	VOB Enterprise	0244020230
Dosonec Ltd.	02442123187/0276221939	Jowak Commodities Ltd.	0244370657
Agrotropics Ltd.	0302233364	Wisdaf Company Ltd.	0244447680/202898623
Kuri Investment Ltd.	0203655040/0209619126	Kwasamay Ltd.	0244291878
Baress Ltd.	0201958199/0241260345	Upper East Commodities	0264935333
Citadel Investments Ltd.	0244367704	Kanof Ltd.	0244361646
E & D Associates Ltd.	0244254590	Victory Feeds Enterprise	0208182510
Lifeline Agrosciences	0545129039/0243040751	Excellent Roofing System Ltd.	0244373729
Agric Supplies Ghana Ltd.	0244824710/0265005683	George Ofosu Asante Enterprise	0244108555
Excel Bit Com Ltd.	0244823338/0203665864	Hard and Soft Company Ltd.	02443277962/020811695
BRMS Ltd.	0244486330	Farmers Commodity Exchange Gh.	0208151365
Tornia Co. Ltd.	0208191939/0242209174	Laud and Company Ltd.	0244369560
18th April Enterprise	0244825276/075603376	First Pole Ltd.	0244176538/0209454105
Monan Ent. Ltd.	027756110/0245251361	International Projects & Procurements	0244175969
Dramani & F Co. Ltd.	0208177584	Midikey International Ltd.	0247417771

Table A5.2: Indicators to track for future monitoring and evaluation

Indicator/Measurement	Baseline (May 2010)	Remarks
Cost of operation		
Own staff (GHS per staff)		Number of staff
MOFA staff time (GHS per personday)		Number of persondays
Other cost		Disaggregation recurrent and capital
Total capacity		Subnational disaggregation
Warehouse (MT)	34,000	
Other (MT)		
Total purchases (MT)		Monthly and subnational disaggregation; source (block farms, other farmers)
Maize	5,450	
Rice	10,498	
Floor price		
Maize (GHS per 100-kg bag)	34	
Rice, paddy (GHS per 85-kg bag)	33	
Ceiling price		
Maize (GHS per 100-kg bag)	34	
Rice, paddy (GHS per 85-kg bag)	33	
Price variability (coefficient of variation)		Monthly and subnational disaggregation
Maize	3.60	
Rice	10.74	
Total number of jobs created		Gender and subnational disaggregation
Permanent		
Casual		
Total volume of sales (MT)		Also value (GHS); Monthly and subnational disaggregation; by beneficiary (schools, prisons, poultry farmers, etc)
Maize		
Rice		
Stocks (MT)		Monthly and subnational disaggregation
Maize		
Rice		
Volume of imports (MT)		Also value (GHS); Monthly and subnational disaggregation
Maize	492	
Rice	320,152	

6. The Block Farms Program (BFP)

Background

The Block Farm Program (BFP), which was launched in 2009 as a pilot in several locations in six regions, is intended to bring in large tracks 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 ensuring 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 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 the 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.
- To improve farming as a business.

As in the two preceding chapters, this chapter evaluates the BFP with the overall goal of critically assessing its activities, outputs and achievements. The specific assessment questions were presented in the introductory chapter.

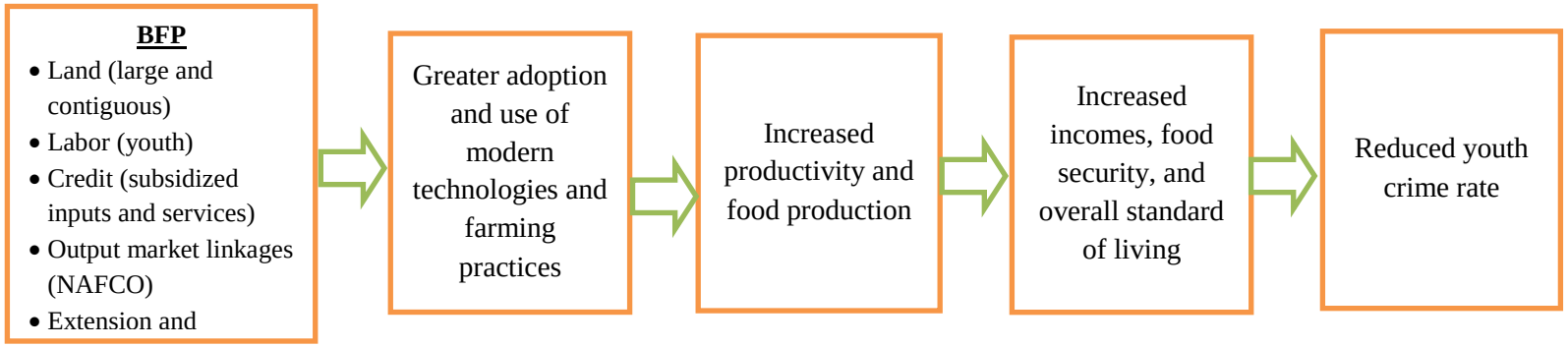
Conceptual framework and methodological approach

In the case of the BFP, three clear working assumptions and/or hypotheses can be established:

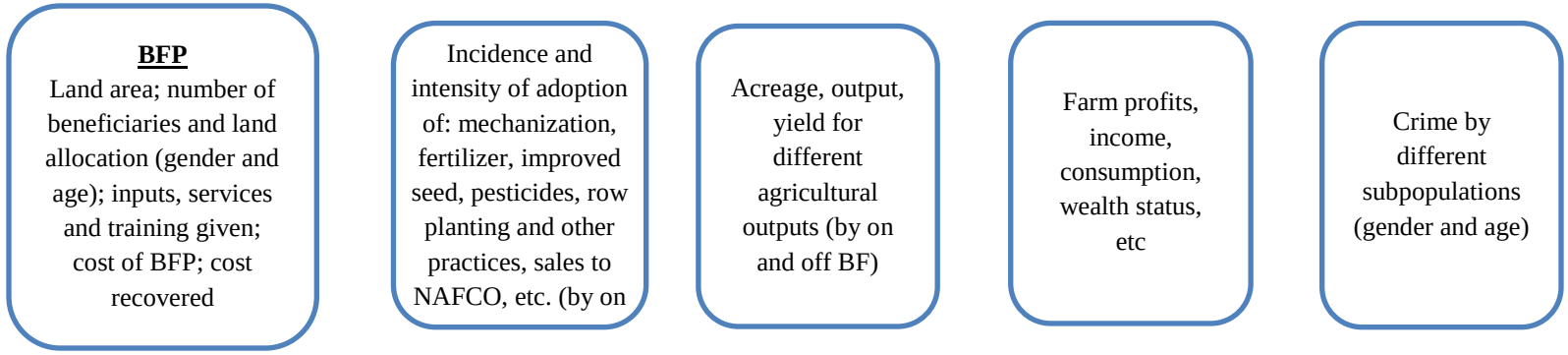
- The youth can be attracted into farming if they are incubated with access to input and services, financial services, technology and extension support, and well-paying markets for their produce;
- Following their experience and learning on the block farms, farmers will reorient their attitudes and agricultural practices to pursue farming as a business; and
- Higher productivity and output on block farms translate into same off the block farms leading to higher returns and incomes for farmers and, consequently, increased food security.

These underpin the impact pathways shown in Figure 6.1 that guided the evaluation of the BFP, based on how the program is expected to generate the anticipated chain of outputs, outcomes and

Figure 6.1: Impact pathways and associated indicators of the block farms program



Respective indicators



Source: Authors' illustration
Notes: See Impact pathway for the FSP (Figure 4.1) on indirect effects, feedback effects, and other influential factors.

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 those on the former are listed Figure 6.1. Qualitative data included satisfaction with quality and timeliness of inputs and services provided and perception of change in wellbeing and several other factors related to the block farm. See the appendix for the instruments in the collecting the data.

Overview of the block farms program

For the pilot phase of the program in 2009, potential beneficiaries of the program were initially identified, following a campaign on the awareness of program and registration of interested participants. On the block farm, participants were supported with mechanization services for land clearing, ploughing and harvesting; inputs including certified seeds, fertilizers and pesticides; as well as 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 farms management committees;
- formation of district block farms management teams;
- identification of block farms 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; and
- determination of inputs and services requirements (crop budgets).

The two main things taken into consideration in terms of crops to be cultivated under the program were: suitability to any of the four agro-ecological 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 the ten regions of Ghana were participating in the block farming program 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.

These comments were considered quite valid, and therefore, explored in this study. Some of the issues were already in the focus group discussion questionnaires for farmers and the expert interviews with district level MOFA staff. The questions/comments were investigated further back to the national level MOFA team/directors who designed the Block Farm Programme. Key stake holders like the Youth in Agriculture, Youth Employment Programme and National

Service Secretariat, which all work on employment placement programmes for the youth, are also part of understanding if they have any serious agricultural orientation programmes on the profitability and security of agricultural inputs businesses, production, processing and marketing to incubate the youth to take advantage of the Block Farms Programme.

Targeted acreage and achievements

In the 2009 pilot phase, a total area of 14,186 ha was targeted for the six regions, but managed to achieve 11,577 ha (or 81.6%) (MOFA 2010c). Looking to scale up and to implement the program country-wide, a target of 150,000 was planned (Table 6.1), which was perceived by the national review as overly ambitious and so the targets were revised downwards. For the Northern region for example, the initial target of 47,400 ha was slashed by more than half to 20,688, which the region only managed to achieve 69 percent (Table 6.2).

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

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
Soyabean	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: MOFA (2010c).

Notes: NR is Northern region, UER is Upper East region, UWR is Upper West region, BAR is Brong-Ahafo region, CR is Central region, AR is Ashanti region, ER is Eastern region, VR is Volta region, WR is Western region, and GAR is Greater Accra region.

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

Crop	National target (ha)	Achievement (ha)	% achieved
Maize grain	5,498	5,619	102
Maize seed	1500	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: MOFA Chief Director's presentation on the block farms programme (MOFA 2011a).

Table 6.3: Number of MMDAs participating in the block farms programme in 2010

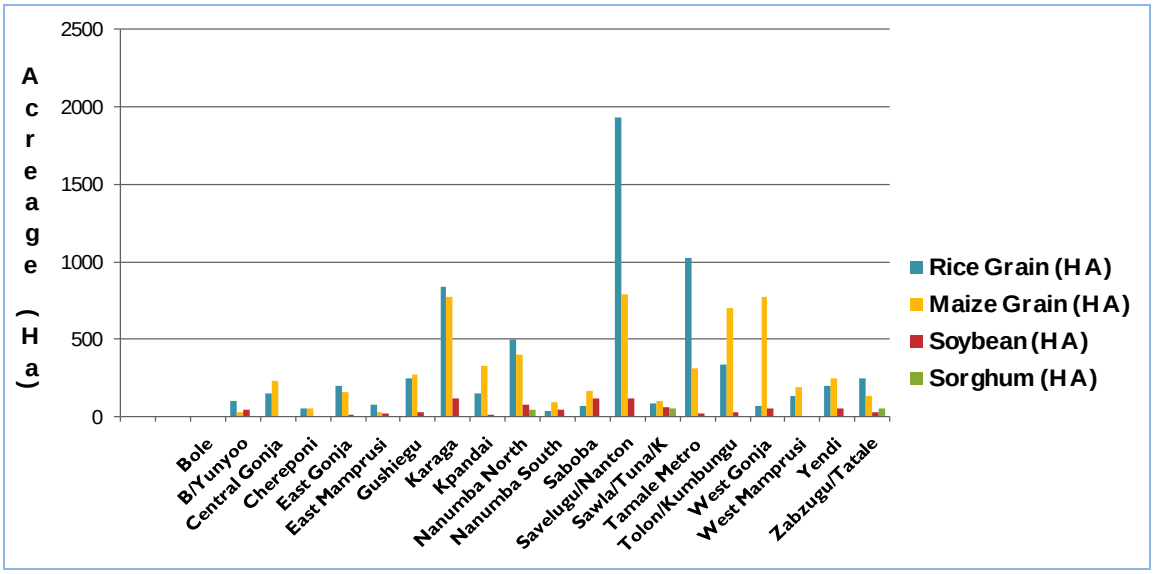
Region	Total number of MMDAs	Number of MMDAs with block farms	Percentage of MMDAs participating
Ashanti	27	20	74
Brong-Ahafo	22	22	100
Central	17	17	100
Greater Accra	10	6	60
Eastern	21	21	100
Northern	20	19	95
Upper East	9	9	100
Upper West	9	9	100
Volta	18	18	100
Western	17	17	100
Total MMDAs	170	163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

Source: MOFA and Expert Interviews.

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 MDAs 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.

Figure 6.2: Block farm acreages (ha) for selected crop in the Northern Region in 2010



Source: MOFA (2011b),

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 (MOFA 2010c):

- 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 programme;
- A management board at the community level involving chief farmers, opinion leaders and the AEA; to be supervised by the district directors.

It was also agreed that the regional directors will report to the national coordinator of the block farms program who will also report to the national coordinator of the Youth in Agriculture Program (YIAP).

From the scant background documentation on program that we were able to access, there was very little information on economic analysis; they were limited mostly to annual targets and progress with respect to acreage, production levels and input cost recoveries. Issues of sustainability were only referred to in a very general way (MOFA 2011c). There were no concrete sustainability measures in terms 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 in the block farmers 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 to purchase the inputs on their own; and therefore do not want to leave the block farms. Although, the district MOFA staff 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 admitted to selecting their best performing farmers into the block farms in order to increase the rate of recovery, which they are under pressure to deliver. This undermines the projective objective of promoting youth employment, because the youth tend to be inexperienced and under performers, which make them risky in the eyes of the 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

This section focuses on assessing the achievements of the block farms program in the terms of the following stated objectives:

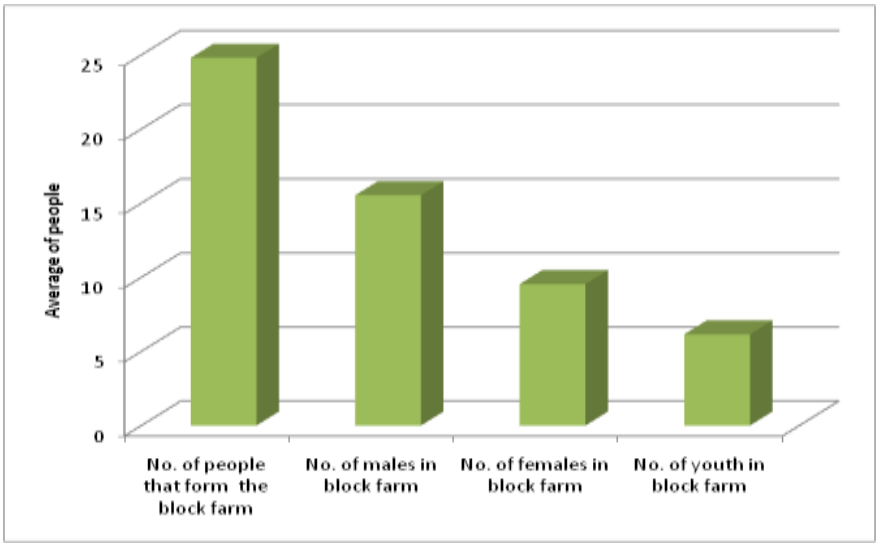
- To generate employment among the rural poor, especially the youth.

- To increase use of science and technology leading to higher yields.
- To improve incomes among farmers.
- To increase food security.
- To improve farming as a business.

Youth participation in block farming

We found that out of an average of 25 farmers participating in a block farm in a community, five of them or 20 percent were characterized as youth (Figure 6.3). Of course the definition of youth given by the farmers varied, but in most cases this was up to 35 years of age, with a few going above 35 years but not exceeding 45 years. The youth also 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).

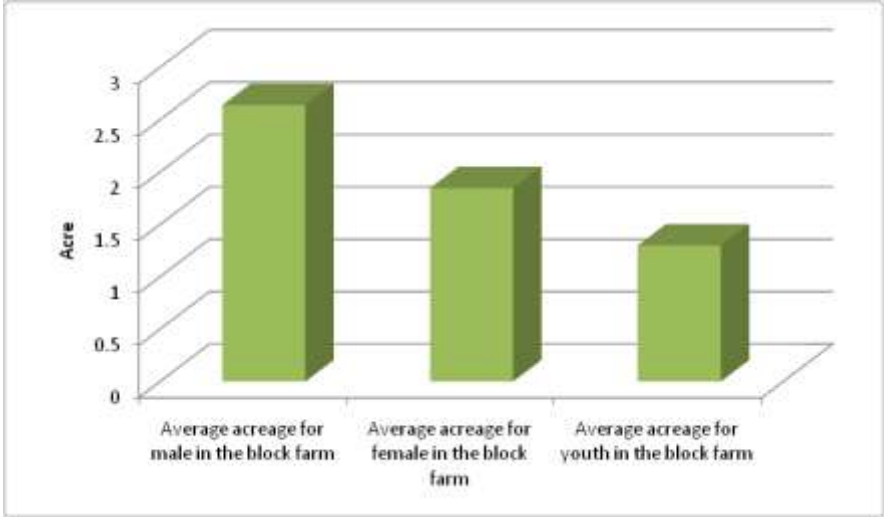
Figure 6.3: Average number of people in a block farm



Source: Authors' calculation from the survey data

Various reasons were advanced by different stakeholders of the value chain as to the low youth participation: while farmers perceived lack of land and high requirements by MOFA that the youth could not meet, MOFA staff generally perceived the youth as risky or that youth did not perceive agriculture as lucrative venture among other factors—see Table 6.4 for details. Generally, all those participants of the bock farm (adults and youth) revealed that they joined the program primarily for increasing or securing their income, followed by access to farm inputs and then for food security in that order (Figure 6.5). The fact that employment was not a major reason for the youth has introduced another challenge for the sector; demonstrating high levels of income for the youth in order to get interested in it. Of course, the major reasons cited are correlated with employment as with one another, and so these results should be interpreted in this context.

Figure 6.4: Average acreages cultivated by members of the block farm



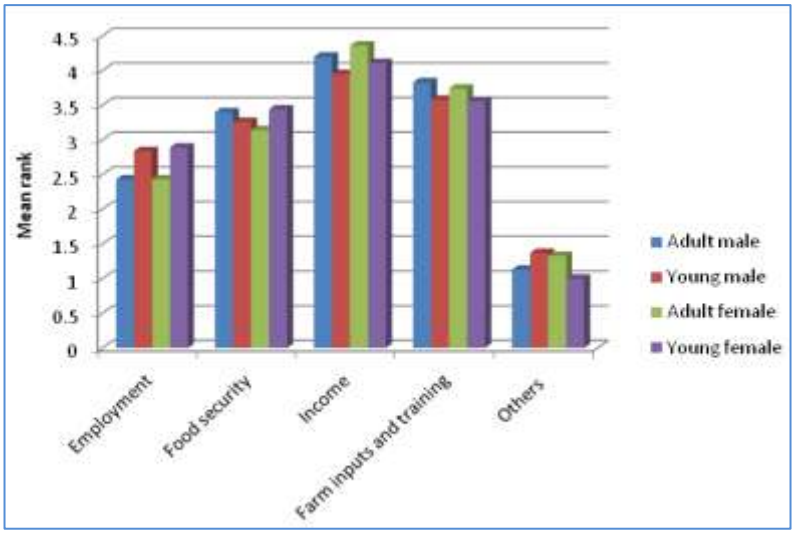
Source: calculated from field survey data, 2011

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 the youth expecting high income from farming
MOFA District (and some regional) Staff	• Youth are a risk to good performance • Prefer already existing very good performing farmers to assure 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 • The youth are more interested in "quick cash" • Block farms programme not specifically targeted at the youth. It is not limited to the youth but opened to all farmers • Some old people have taken over the block farms programme and crowded out the youth • The youth will like to get higher incomes and are not getting it from agriculture • The youth think that agriculture is not profitable
Input (fertilizer) dealers	• Some farmers, including the youth, receive block farm inputs and re-sell them, especially fertilizers

Source: Field surveys and expert interviews

Figure 6.5: Reasons for joining the block farm

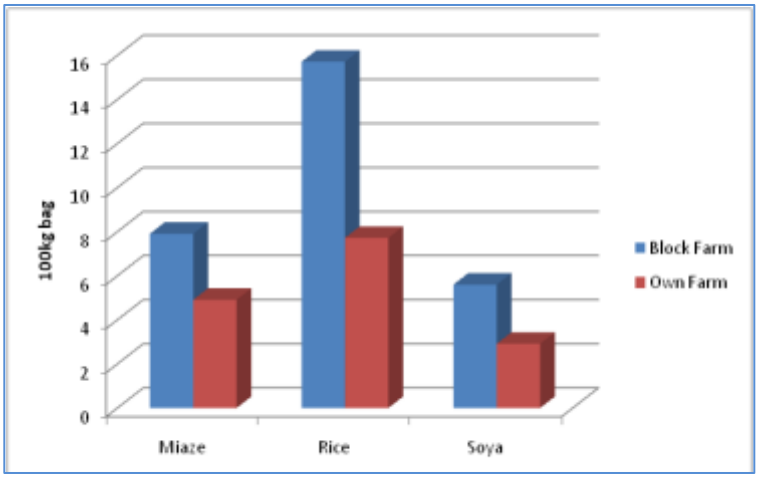


Source: Authors' calculation based on field survey data
Notes: Rank, 1=least important, … , 5=most important.

Use of inputs and services and crop yields

As we had discussed earlier in the introductory chapters, it is obvious that input use and yields would be greater on the block farm than off it, which the evidence in Figure 6.6 shows for yields of different crops. Basically, average yields of rice and soya beans on the block farms were double those off it or on non-block farms of the same farmer. The difference in the case of maize was not as high, about 30 percent higher on block farms. As anticipated, the main reasons were greater fertilizer use, correct and timely application of inputs, readily-available extension services, and generally following recommended practices including row planting and spacing.

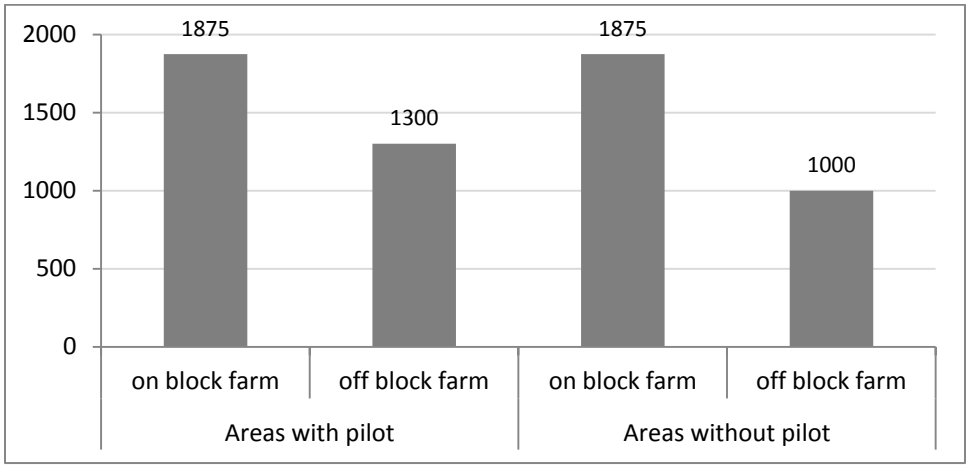
Figure 6.6: Average crop yields (100 kg per acre) on and off block farms



Source: Authors' calculation based on field survey data

However, the more interesting question is whether those participating on the block farm 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, i.e. testing the learning effect, which we do by analyzing the use of inputs and services and yield on own plots of farmers who have been participating in the program for a long time (i.e. where there was pilot program) compared to similar plots of farmers who recently started participating in the program (i.e. 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 (i.e. where there was pilot and 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 (kg per ha) on and off block farms



Source: Authors' calculation based on field survey data

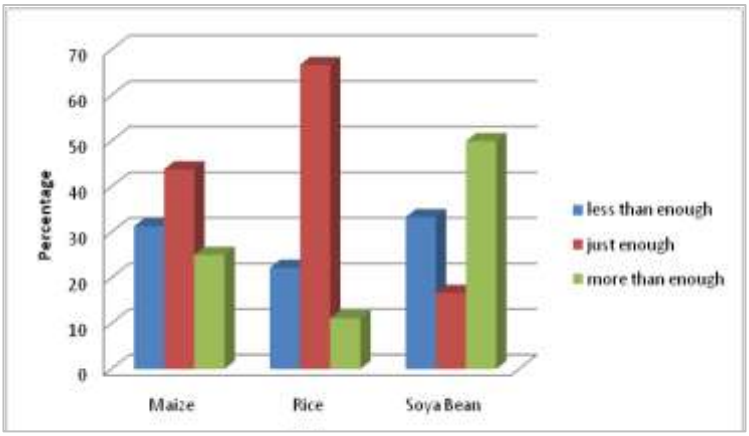
Notes: This was done for communities in the north where there were districts that the pilot program had been implemented as well as others that had not.

Effectiveness and efficiency of the program

Adequacy, timeliness and quality of services

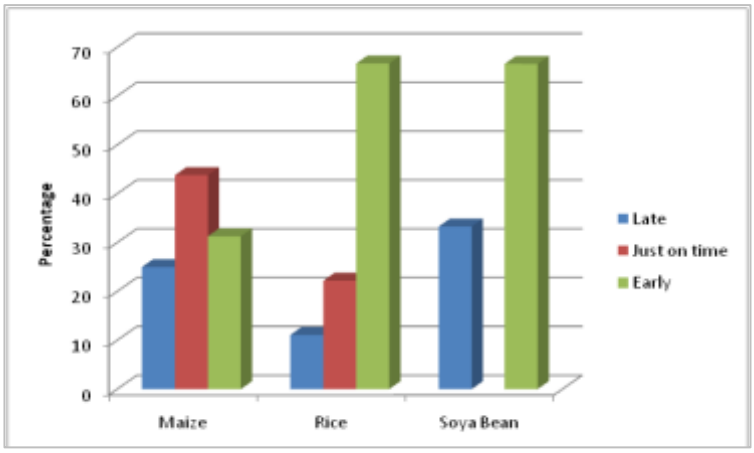
Here, we asked farmers and MOFA staff about their perception toward access and utilization of and services in terms of their adequacy, quality, and timeliness of delivery. Detailed results are shown in Figures 6.8 to 6.15. The most striking results that point out areas needing the most attention are: timeliness of inputs, which farmers many farmers perceived to be late (Figure 6.12); and adequacy of land and engagement of youth, which MOFA staff were dissatisfied with (Figure 6.14 and 6.15, respectively). The issues of lack of land and inability to stimulate the youth to take up farming as a profession are concerning, because they are the bedrock of the block farms program. Otherwise, majority of farmers and MOFA staff were satisfied with adequacy and quality of the inputs and services obtained via the program.

Figure 6.8: Farmers' perception of adequacy of farmland for crops (% of communities reporting)



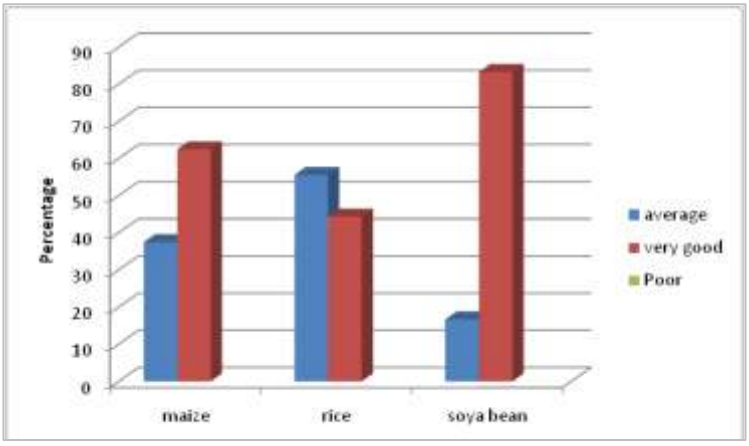
Source: Authors' calculation based on field survey data

Figure 6.9: Farmers' perception of timeliness of farmland distribution (% of communities)



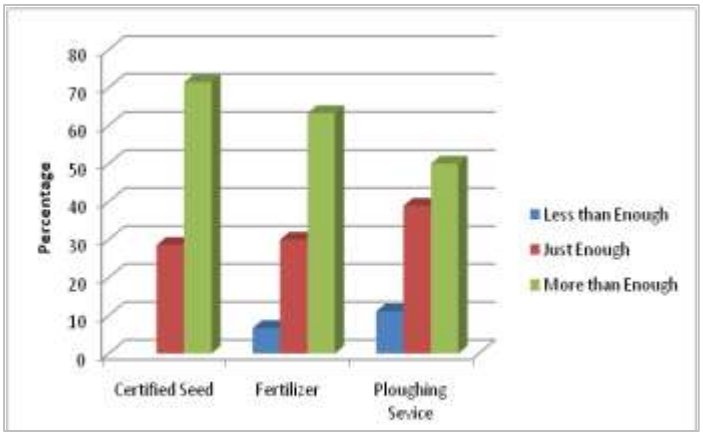
Source: Authors' calculation based on field survey data

Figure 6.10: Framers' perception of quality of farmland (% of communities)



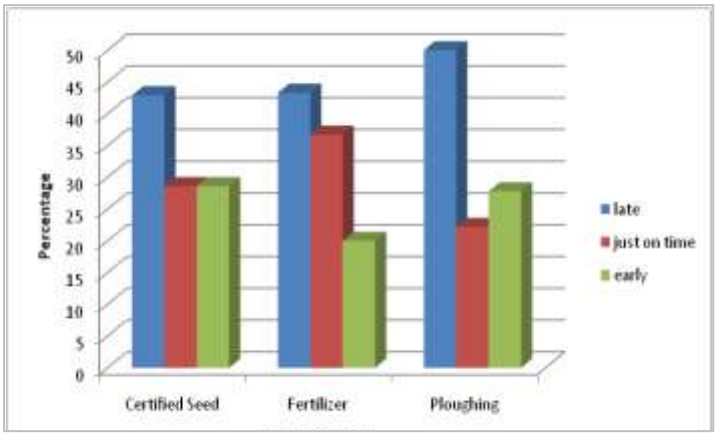
Source: Authors' calculation based on field survey data

Figure 6.11: Farmers' perception of adequacy of inputs and services (% of communities)



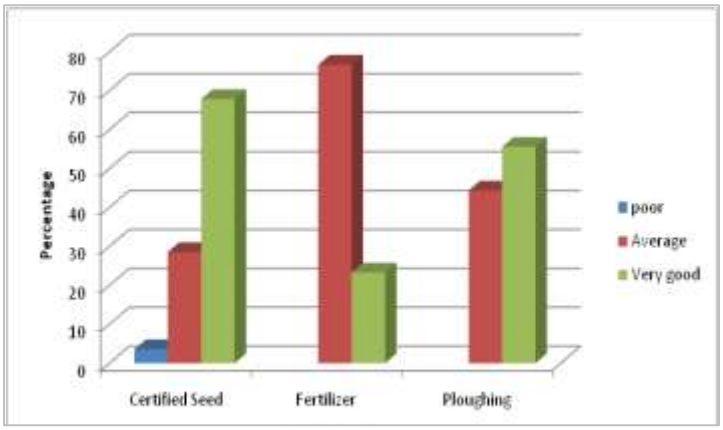
Source: Authors' calculation based on field survey data

Figure 6.12: Farmers' perception of timeliness of input/service supply (% of communities)



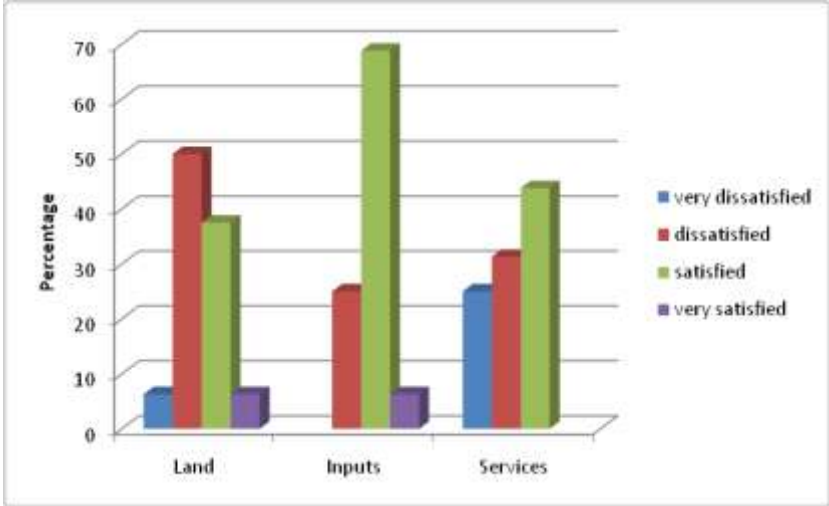
Source: Authors' calculation based on field survey data

Figure 6.13: Farmers' perception of quality of input/service supplied (% of communities)



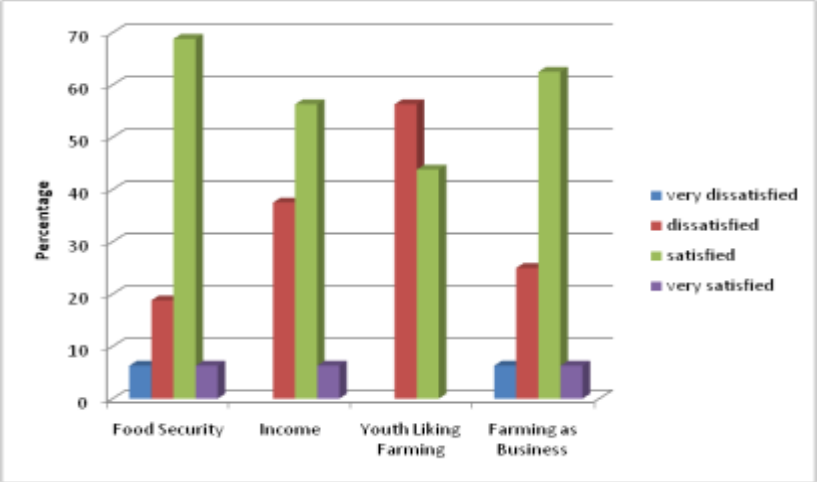
Source: Authors' calculation based on field survey data

Figure 6.14: MOFA staff's satisfaction on provision of land, inputs and services to farmers on the block farms (% of staff)



Source: Authors' calculation based on field survey data

Figure 6.15: MOFA staff's satisfaction on achieving objectives of the block farms program (% of staff)



Source: Authors' calculation based on field survey data.

Analysis of the block farm's potential economic welfare returns

As in the other programs, the economic welfare impact of the Block Farm is assessed using the economic surplus method as we do across all the four programs. Details of the approach and underlying data and assumptions are provided in Annex A. Here we focus more on the results.

As in the other programs, a number of key assumptions were superimposed on the analysis. One important observation from the field surveys is the special case of Block Farms in accessing high value inputs such as mechanization, improved seeds, fertilizer, chemicals and access to input

credit and output markets. It is special because the program is intended to not only 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 on the perception of agriculture as a profitable and viable commercial livelihood, especially among the youth. As such, we do not expect the Block farms to expand very much, imposing instead a steady growth rate in area coverage of about 10% per year until 2020. The program is therefore less likely to have a big dent on national production levels.

The growth in BF acreage leads to increasing program costs in 2011 GHS values. Based on our assumptions for both direct and indirect costs in Annex A, results in Table 6.5 below shows a more than doubling in total costs by 2020—from GHS 15.9 million in 2010 (of which GHS 3.6 million and GHS 12.3 are direct and indirect costs, respectively) to GHS 39.1 million by 2020 (of which GHS 9.8 million and GHS 29.3 are direct and indirect costs, respectively).

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

The total net worth to society of the BF program is quite positive, 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, and GHS 75.2 million if we assume a higher own-price elasticity of demand (-0.7). This is assuming domestic are not affected so long as there is sufficient markets to export any excess supply.

Overall, the effect on domestic maize prices under the condition of no trade is small given the programs 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 1.5.

Table 6.5: **Summary of results of economic analysis of the block farms program**

Scenario	A			B		
Elasticity of demand (ed)	-0.4			-0.7		
	2010	2020	*Growth*	2010	2020	*Growth*
Yield without program (kg/ha)	1,714	1,893	*1.0*			
Yield with program, Y (kg/ha)	2,200	2,546	*1.5*			
Adoption rate, t (%)	2.9	7.6	*9.7*			
Unit production cost (2011 GHc/ha)	320	448	*3.4*			
Resulting production and price changes:						
National production without any programs (1000 MT)	1,669	2,247	*3.0*	1,669	2,247	*3.0*
National production with BF program (1000 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 (1000 ha)	129.3	353.7	*10.3*			
Total cost of BF 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 Inv. 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 (2011 GHs, million):		83.6			75.2	
B-C 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 (2011 GHS, million):		57.3			69.1	
B-C Ratio:		1.3			1.4	

Source: Authors calculations.

Notes: Values under the column headed growth are annual percentage growth rates.

Lessons and challenges of the program

Here too we asked both farmers and MOFA staff about their experiences with the block farms program so far. We captured these as lessons and success on one hand and challenges, opportunities and changes needed on the other hand—see Tables 6.6 and 6.7 for details based on the responses by farmers and MOFA staff, respectively. Both farmers and MOFA staff attest to the success of the program in terms of using greater amounts of inputs and mechanizations services as well as adopting recommended practices promoted by extension, which together has led to greater productivity (output per unit area) and production. Farmers appreciate MOFA staff more now because they deliver the technologies that they promote and then work more closely with them on adopting the recommendations. Similarly, MOFA staff, particularly the AEAs, is

now more excited about their work because they are observing the positive outcomes in terms of the greater productivity and production.

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

Table 6.6: Farmers' perspectives of lessons and challenges of the block farms program

Lessons and successes	Challenges and recommended changes
• Group learning and participation is helpful • Inputs are always assured • We now use more fertilizer • We get quality seeds • Modernization of our farming is occurring • Increase in yield due to adoption of new technology • Increase income levels through increased acreages and production • There is increase in food production which is enhancing or increasing food security and employment • No borrowing of money anymore	• Early delivery of inputs is very much needed, especially fertilizer • Improve access to land • Increase farm acreages • 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 group guarantee for recovery in order to apply group/peer pressure and enforce recovery; to avoid losing our block farm

Source: focus group surveys.

Table 6.7: MOFA staff's perspectives of lessons and challenges of the block farms program

Lessons and successes	Challenges and recommended changes
• Good intervention/support for the whole value chain; and technology adoption is faster and higher now • BFP has made MOFA active to reach out to the farmers more now than before. • BFP has improved the level of appreciation of Agricultural Extension Agents (AEAs)	• Ploughing of the block farms happens too late and there is late supply of the inputs such as certified seeds, fertilizers, etc. • The nature of land fragmentation due to land tenure system makes monitoring difficult. Where government land is limited for the BFP, farmers should be allowed to use their lands to be able

• Food security is improving. Farmers were producing an average of 4 maxi bags of maize per acre but this has increased to 10 bags per acre • Some farmers were able to obtain as high as 68 maxi bags of paddy rice from only 4 acres using the Jasmine variety of rice • Some farmers assessed the value of the BFP against other programmes and opted out of those programmes to join the BFP • Farmers for the first time have access to inputs as credit without interest, and along with that there is technology transfer; making it a unique package • In some cases, after paying 85% to 100% of the recoveries, farmers still made a lot of money and bought building materials and motorbikes (this was also confirmed by the farmers in some districts such as Yendi, Tamale and Ejura-Sekyedumase) • Some block farm participants increased their acreages from 20 to 60 (at Savelugu-Nanton for example) and were able to buy their own tractors • BFP is also reviving the communal spirit, making farmers more business-oriented and the group formation of block farms enhances extension delivery • There is reduction in social vices and even the poorer youth are now able to go into farming	expand and make use of the acquired technologies and other inputs • Tractor ploughing services are not well done. It should not be given to a few operators; as the few cannot reach out to many farmers at the same time • AEAs have more monitoring and outreach work but no increase in support to be able to do this effectively: (i) T&T has been the same for over 3 years; (ii) Tools (protective dresses, moisture meters, GPS instruments, etc) for the AEAs are also lacking • Investment recovery is very challenging, so there should be more sensitization on paying back during the block farm group formation stage. Farmers manage to harvest before the knowledge of the AEAs, etc. • With increased output, there is lack of maize shelling machines (farmers have also requested this in the chart above) • Political influence, which also increases default rate • Inadequacy of staffing to match increased block farm work load • Diversion of inputs from the block farms (to own farms or to sell) • Prices of farmers' produce at the time of harvest is too low to cover farming costs

Source: focus group surveys.

Cost recovery and financial analysis

From the preceding discussion, an area of major concern is the level of recoveries 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, 3 bags in the case 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 6.8. Except in the Ashanti region, recovering

were up to only a quarter of expectation. Therefore, the area of cost recoveries calls for further intensification of efforts. The economic cost-benefit analysis (i.e. accounting for indirect costs and externalities) is dealt with in chapter 8.

Table 6.8: Expenditures made on and recovered from the block farms in 2009 (GHS)

Region	Expenditures expected to be recovered	Expenditures recovered	Balance outstanding	Expenditures recovered (%)
Upper East	212,458	39,693	174,447	18.7
Upper West*	189,049	120,663	116,280	-
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	-	-	-
Total	2,637,193	-	-	-

Source: MOFA (various documents on summary of block farms production and recoveries in 2009)
*Information provided did not match up.

A Special case: Ejura block farms in the Ejura-Sekyedumase district

The number of participants or farmers on a block farm in the communities that were surveyed ranged from 8 to 100, which is typical of the cases in most parts of Ghana. In the Ejura-Sekyedumase district, however, we found a case one block farm in Ejura with 1,000 participants. This is attributed to the defunct government owned Ejura Farms Company Limited, making available to those previously employed block farmers and many others large tracks of land, extensive tractor services, warehousing and storage facilities, within a vibrant farmers market with large numbers of international customers from the West Africa sub region.

Operational definition of a block farm

The conceptual notion of a block farm as having several farmers on a large tract of a single piece of land was not always observed. The existing land tenure system does not allow easy procurement of large tract of farmland owned by a single entity. The case of Ejura is unique. What we observed as block farms were often a collection of small pieces of land owned by different entities. In many cases, neighboring farmers (with farms bordering each other) had gotten together to form a block farm. We also observed cases where the farms were not even close to each other, i.e. 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. Cost recovery also becomes more difficult. 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 by the program for interested participants, it will be difficult to involve new farmers and particularly those without land of their own, including the youth.

Thus, 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 (Porter 1996) and where a cluster is defined as "a geographical proximate group or geographic concentration of interconnected companies, or firms in related industries in particular fields that compete but also cooperate and are linked by commonalities and complementarities" better describes how the 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 The 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 sub-sectors 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 the block farm program, i.e. economies of scale and low unit cost of input and service delivery, is largely preserved.

Conclusions and recommendations

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

- There is keen interest in the block farms program 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 has greater productivity, production, and incomes. Therefore, farmers need to be encouraged to pay back, else it is difficult to see how the government can sustain the program. Similarly, it is difficult to see how farmers too will be able to buy and pay for such inputs and services on their own.
- The youth are not a strong focus of the program as it was conceived of for initiating the programme. Because they are inexperienced, the youth tend to be a risky venture in terms of being able to properly manage the farm and inputs and services given in order to meet expectations, given the pressure AEAs and district MOFA staff face in delivering results and recoveries.
- Another area needing attention is the increased demand for post-harvest technologies and services as a result of the greater productivity and production of particularly maize.
- To keep the enthusiasm of MOFA ground staff going, there is need to beef up logistical support, particularly transportation and protective gear, for AEAs in delivering their

increased work load. These could be included in the cost of the inputs and services given to farmers.

- The positive economic returns of the program primarily capture the gains from productivity improvement on the block farm as well as it effects on total economic welfare as consumers benefit from stable supply and prices, and producers benefit from lower per unit costs of production. Benefits also come from the fact that the program enjoys significant input subsidies for fertilizer, credit and extension. The primary issue, therefore, as in the fertilizer subsidy program, is the fiscal sustainability of the program. So 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).

7. Agricultural Mechanization Services Enterprise Centers (AMSECs) Program

Background

The Agricultural Mechanization Services Enterprise Centers (AMSECs) program is one of the major ones 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 to purchase agricultural machinery and set 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 the commercial banks. Ultimately, the support to the private sector is to enable farmers and agro-processors have widespread access to mechanization services at affordable prices and to make 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 utilized. As such farm power for the majority of farmers relied overwhelmingly on human muscle power and they were 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 reduces and limits 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 twelve 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 one AMSEC set up there. The idea is to raise the low number of tractor to farmer ratio estimated at 1:1800 and reduce the high number of aged tractors, estimated average age of more than 15 years. The expected outputs are:

a. Timely access to mechanized services, via one AMSEC per district
b. Efficient utilization of agricultural machinery
c. Reduction in drudgery and tedium associated with agriculture
d. Increased production and yield
e. Rural employment generation
f. Reduction in post-harvest losses

At the time of the study, five thousand 30-50 KW 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, with the bulk of them (31 percent) located in the Northern region, followed by the Brong-Ahafo (15 percent), Eastern (12 percent) and Upper West regions (11 percent) (see Table 7.1). The remainder were somewhat distributed equally across the other regions, except the Western region which had only one reported AMSEC established at the time of the study.

Table 7.1: Regional distribution of AMSECs

Region	Number	% 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: www.mofa.gov.gh
Note: This does not include other mechanization centers (or non-AMSECs).

This chapter evaluates the AMSEC program with the view to shape policy for government in respect of change in strategy and improvement in implementation of the program. The specific assessment questions were presented in the introductory chapter.

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 Fronteh (2010), a farmer using only hand hoes can prepare about 0.5 ha only for planting per season. Therefore, the underlying assumption is that by providing low-interest credit and subsidized machinery and implements to mechanization service providers, there will be more and cheaper services available to all farmers so that more farmers can then purchase these services and expand their area cultivated. They can now adopt more modern inputs (e.g. fertilizer, pesticides) and practices (e.g. row planting, specific spacing) that are also mechanized. By reducing the unit cost of production and raising productivity, incomes to farmers will increase, which in turn will impact their consumption and food and nutrition security positively. As discussed in the other chapters, the fulfillment of this chain of outputs and outcomes depends on other multiple 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 initiative) as well as making other agricultural inputs like certified seed, fertilizer and pesticides easily accessible (as envisioned with the fertilizer subsidy and block farms program) is important. Farmers' characteristics, including their endowments of human, physical, financial and social capital are also important. There are important feedback links underlying the relationship between the AMSEC program and the outcomes, which are represented by the dotted paths.

In addition to secondary data that were obtained from various sources, different stakeholders along the value chain (AMSEC and non-AMASEC service providers, tractor operators, farmers, tractor mechanics, tractor spare-parts dealers, traditional and local authorities, and experts working in the food and agricultural sector) were interviewed to obtain relevant information to carry out the analysis. Details on sources of secondary data and instruments used are presented in the annex to this chapter.

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 when a proposal was finally prepared for the piloting of the concept in four locations: Kasoa, Asutuare, Nkoranza and Walewale. Nothing happened until October 2007 when 12 AMSECs were piloted at 12 locations in 8 regions of the country. The number of AMSECs was expanded to 69 in 2009, 84 in 2010, and then to 88 by August 2011 (see Table A7.1 in the annex to this chapter for a full list of the centers).

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. Qualified applicant should be a registered company showing ability to payback in addition to technical requirements for operating a mechanization center. Prospective awardees are provided with an allocation letter which 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 5 tractors and accompanying basic implements including plough, harrow and trailer. Table 7.2 summarizes the total number and brands/types of machineries 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 7.2: 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, MOFA.
Note: no machinery and implements were given in 2008.

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, 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 (i.e. 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 AMSEC centers acquired machinery and equipment on their own, i.e. 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, 6 planters, 4 combine harvesters, 13 maize shellers, 5 rice mills, and several other machines and equipment (Table 7.3). Inventory of the machines and equipment owned by the non-AMSECs surveyed (88 in total) as shown in Table 7.3 indicate 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 sprayer and rice millers as shown in Table 7.3. The inventories in Tables 7.2 and 7.3 suggest that the most common machines and implements for land preparation and carting (tractors, disc plough, 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 7.3: Number of own-purchased machinery and equipment by AMSEC and non-AMSEC, 2008 to 2010

Type of machinery/equipment	AMSEC (48 centers)	Non-AMSEC (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: For the AMSECs, this does not include machines and equipment obtained through the government's credit facility.

Assessment of mechanization services provided

As Table 7.4 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 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 the AMSECs being better equipped in terms of the number of 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.

The mode of payment for services rendered is important in farming business as farmers may not have cash to pay for services. As Table 7.5 shows, a combination of cash, credit and in-kind payment were very 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 farmed and area on average than non-AMSEC did to the extent that farmers who could not pay with cash risked not being served by a non-AMSEC provider.

Table 7.4: Average number of farmers and area served by AMSEC and non-AMSEC, 2008-2010

	AMSEC (N=48)	Non-AMSEC (N=88)	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: *, **, and *** means statistical significance at 10, 5 and 1 percent level, respectively.

Table 7.5: Mode of payment for services by AMSEC and non-AMSEC (% of total)

Mode of payment	AMSEC (N=48)	Non-AMSEC (N=88)
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

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 that gave good or excellent rating was higher, and a larger proportion of AMSEC operators gave a poor rating (Table 7.6). These perceptions are consistent with the results in Table 7.7, which shows that although AMSEC operators had newer machinery and equipment, they experienced equal or more frequent breakdowns and worked a smaller number of months in a year. Regarding tractors for example, the average age for AMSEC and non-AMSEC was 2.7 and 5.3 years, respectively; AMSEC tractors worked about 4 months in a year while those of non-AMSECs 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 7.6: Perception of performance of machineries and equipment (% of providers)

	AMSEC				Non-AMSEC			
	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

Table 7.7: Performance of farm machineries and equipment

	AMSEC			Non-AMSEC		
	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

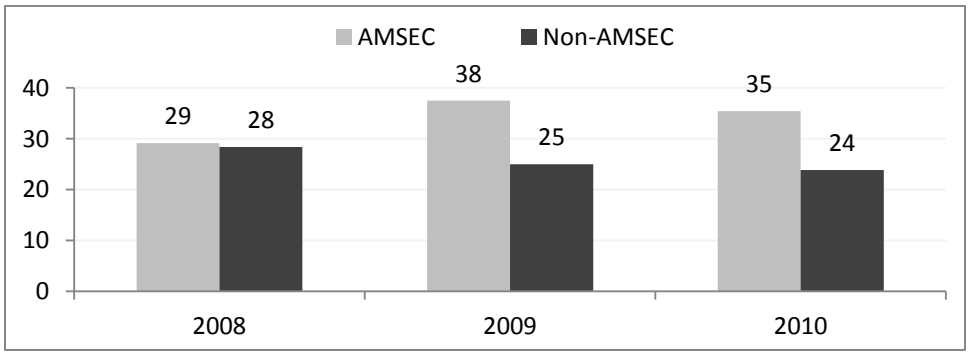
Source: Field survey of service providers

Could this be an issue of quality of the machines and implements or the way they are handled? According to some farmers, the new tractors (as they refer to AMSEC) are operated by the same old operators of other private tractor service providers in the district and often work haphazardly and hurriedly so that they can attend to another client. The tractor operators admitted that they at times have to rush with their work in other to meet the targets set for them by their managers or tractor owners. There was an instant where an AMSEC 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 ploughing late into the night just to exceed the target, which is risky. Many of the operators interviewed placed some of the faults on the managers and owners. They revealed that some of the tractor owners do not adhere to the routine servicing of timely change of oil and filters; however, they admit that some of the structural defects on the tractor are due to their negligence and partly to the farmers who fail to notify them of stumps in their farms.

Training and maintenance

Looking at the proportion of service providers that received training (Figure 7.1), the proportion of AMSEC service operators that received training was much higher (29-38 percent) than their non-AMSEC counterparts (24-28 percent). Although this does not match up with the previous observation of AMSEC machinery experiencing more frequent breakdowns, the proportion of all providers receiving training is quite low; contributing to the overall frequent breakdowns. When they breakdown, 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 the important areas identified for training includes basic knowledge of mechanization and safety use of the machineries, 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. Regarding mechanics and maintenance, discussions with dealers and mechanics revealed that training for most of the mechanics has been limited to the unstructured apprenticeship, 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 the Massey Ferguson and Ford tractors, which are owned more by the non-AMSECs.

Figure 7.1: Percent of service providers that received training



Source: Field survey of service providers

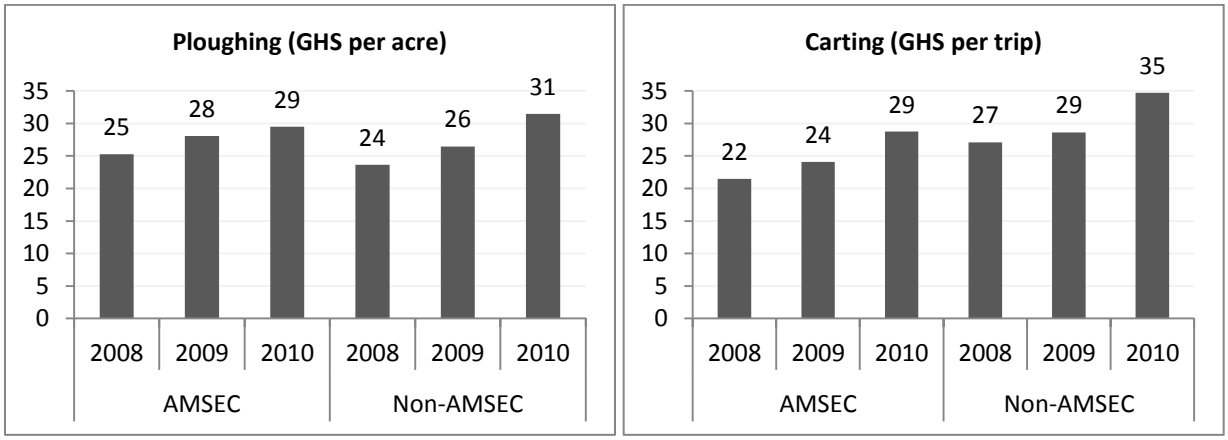
Effect of AMSEC on the mechanization services market

Rental charges of mechanization services

To get a good sense of the prices charged for mechanization services, we asked both service providers and farmers the charges were for different services. In general, we find very little differences in the prices quoted separately by providers and by farmers. Example for ploughing and carting services are shown Figures 7.2 and 7.3 for service providers and farmers, respectively. In general, AMSECs charged slightly higher prices in 2008, i.e. on entering the

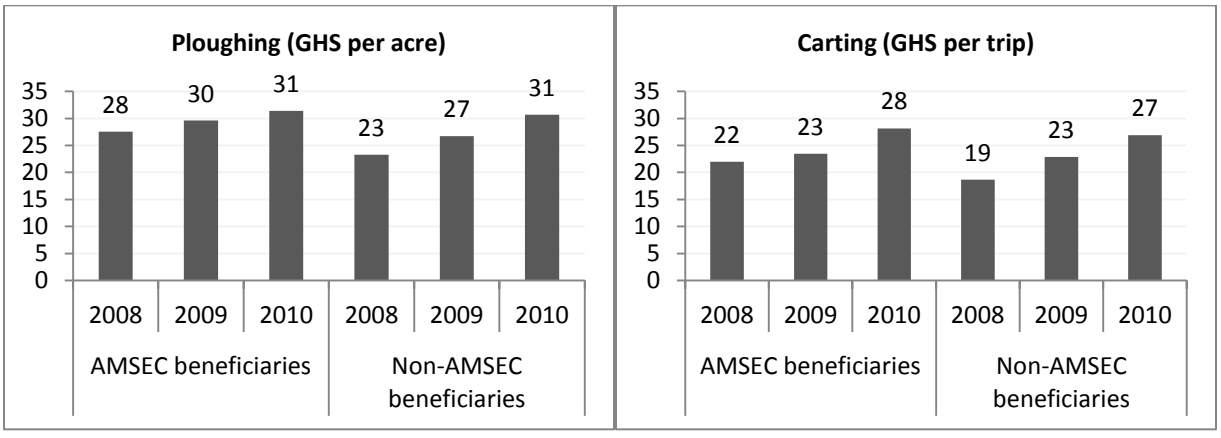
market, which is surprising but could be rationalized based on their newer machinery and potentially higher quality services. However, the price gap closed over time, with non-AMSECs increasing their prices at a faster rate by 15 percent year for ploughing compared to 7 percent in the case of prices charged by AMSECs. The same pattern is observed across many of the services provided (see the Annex to this chapter for details). Thus, it seems that the AMSEC program may have contributed to raising prices.

Figure 7.2: Average prices charged by service providers for ploughing and carting, 2008-2010



Source: Field survey of service providers

Figure 7.3: Average prices paid by farmers for ploughing and carting, 2008-2010



Source: Field survey of farmers

Notes: AMSEC beneficiaries means farmers that used services of AMSECs, and non-AMSEC beneficiaries means farmers that solely used the services of non-AMSECs.

Marketing strategies

This section discussed strategies used by AMSECs in attracting clients, compared with those used by non-AMSECs (see Table 7.8). Most of the service providers used meet-the-competition

pricing, with some AMSECs using some promotional pricing, which is expected being 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 9 percent of AMSECs. Personal contacts were relied on by 75 percent of AMSECs and all of the non-AMSECs to advertise their services. The remaining AMSECs (25 percent) used radio or television. This is not surprising due to high cost involved in advertising and publicity.

Table 7.8: Marketing strategies used by AMSECs and non-AMSECs (percent 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	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 contacts	66	88
Direct contact of institutions and organizations	9	12

Source: Field survey of service providers

Barriers to entry and exit

Both AMSECs and non-AMSECs considered capital cost of machinery and access to operators and maintenance as the key factors inhibiting entry into the market (Table 7.9). 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 rating. 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 7.9: Perception of barriers to entry (percent of providers)

Barrier factor	AMSEC				Non-AMSEC			
	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: zero, low, high and very high represent the level of severity the factor is perceived to be a barrier.

In terms of 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 (Table 7.10). 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 60 percent or more of the providers rating these to of zero or low importance.

Table 7.10: Perception of barriers to exit (percent of providers)

Barrier factor	AMSEC				Non-AMSEC			
	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: zero, low, high and very high represent the level of severity the factor is perceived to be a barrier.

Effect of AMSEC on use of mechanization services by farmers

We surveyed farmers to assess the effect of AMSEC on their use of mechanization services and unit cost production. To better get a sense of this, we demarcated the sample of farmers into: (i) 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; (ii) 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 (iii) 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-AMSEC, then we would expect outcomes to greater for the AMSEC beneficiaries, followed by those using services form both AMSECs and non-AMSECs, and then non-AMSEC beneficiaries, other factors remaining unchanged. Before looking at the results, we first 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 7.11, it is clear that while 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 non-farm activities, membership in farmer's organizations, and farm size. In terms of gender 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. Regarding education attainment, there 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 non-farm employment, about 44 percent, compared to 26 and 30 percent of the non-AMSEC and other group, respectively. Those using services of both AMSECs and non-AMSECs had more of them as members of FBOs (65 percent) than the AMSEC beneficiaries (52 percent) and the 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 while 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. While 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 7.11: Characteristics of AMSEC and non-AMSEC beneficiaries

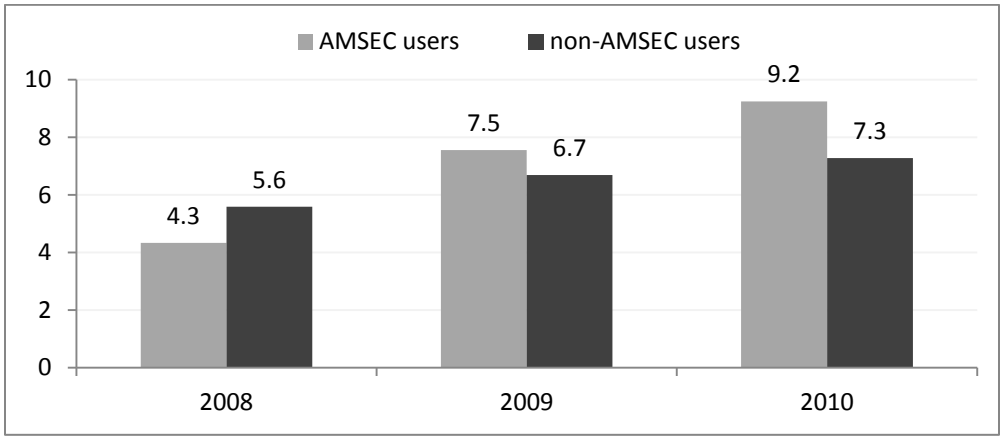
Variable	AMSEC	Non-AMSEC	Both
Household-level characteristics			
Gender (% of farmers that are males)	61.5	72.3	92.1
Age (years)	45.2	43.9	41.5
Education level (percent of farmers)			
None	40.4	34.2	33.3
Primary	5.8	12.9	14.3
JSS/Middle	34.6	34.2	30.2
Secondary	3.8	9.7	11.1
Vocational/Technical	7.7	4.5	7.9
Tertiary	7.7	4.5	3.2
Farming experience (number of years)	18.5	19.1	17.8
Membership in FBO (% of farmers)	51.9	44.5	65.1
Non-farm 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 it			
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

Effect of AMSEC on acreage mechanized

Figure 7.4 shows the average area mechanized for different groups from 2008 to 2010. Although the average are 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 to surpass 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 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 relieve 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 also highlight the importance of complementary program in enhancing the impact. We will discuss program interaction effects in the next chapter.

Figure 7.4: Average acreage mechanized by AMSEC and non-AMSEC users



Source: Field survey of farmers

Effectiveness and efficiency of delivery of mechanization services

Availability of mechanization services

Major of AMSEC beneficiaries (about 62 percent) were satisfied or very satisfied with the availability of tractor services, and many more, about 87 percent, said had availability had improved in the last three years (Table 7.12). Not relatively as many of 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, while

about 49 percent thought there has been no change in the availability in the last three years. Those using services of both AMSEC and non-AMSEC were also nearly as positive as the AMSEC beneficiaries. Although the farmers and other stakeholders in the value chain in general claim that the availability of tractor services is now, it is still very difficult accessing it since the demand is much higher than the supply. In some of the communities that cultivate irrigated rice, they said some of the newer tractors that are two-wheel drive are not able to enter their fields when the ground is wet. This touches on some of the quality issues discussed next.

Table 7.12: Perception of availability of tractor services (percent of farmers reporting)

	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 between 2008 and 2010 in availability			
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

Quality of mechanization services

The majority of AMSEC beneficiaries felt the quality of different services was good and it has improved in the last three years, as the examples for ploughing and carting services show in Table 7.13. In the case of ploughing for example, all the AMSEC beneficiaries thought it good or very good. Here too those using services of both AMSEC and non-AMSEC were also nearly as positive as the AMSEC beneficiaries. Other mechanization services including harrowing, shelling, ridging and tilling are not reviewed, because a very small proportion of framers across the board engage in them.

Table 7.13: Perception of quality of mechanization services (percent of farmers reporting)

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

Source: Field survey of farmers

Notes: data n non-AMSEC users is being rechecked

Farmers' constraints on use of mechanized services

Looking at the constraints faced by farmers in utilization of mechanization services, Table 7.14 shows that there are several factors that limit farmers' use of mechanization services 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 opportunity cost of investment were not considered to be constraining factors.

Table 7.14: Perception of factors constraining use of mechanization (percent of farmers reporting)

Factor	AMSEC users					Non-AMSEC users					Both				
	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 foregone 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 on 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.

Pricing, profits, and efficiency performance of service providers

To understand the financial performance of service providers and their efficiency of carrying out their operations, we asked how 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 7.15 for details of the results. Majority of both AMSECs and non-AMSECs said service fees changes only once a year, indicating stability in the market. Regarding profits, 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 in relative terms, with 22 percent of the AMSECs saying they were about a quarter, while 10 and 12 percent of them said they were one-half and three-quarters, respectively.

Table 7.15: Opinion about price, profit and efficiency performance of service providers (percent of providers reporting)

	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

Analysis of potential economic returns of the AMSEC program

For the economic analysis of the program's potential impact on national welfare, we take the same approach as in all the other programs. Details of data and assumptions are in Annex A. Here we only present the results in Table 7.16 below.

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.

Table 7.16: **Summary of results of economic analysis of AMSEC Program**

Scenario	A			B		
Elasticity of demand (ed)		-0.4			-0.7	
	2010	2020	*Growth*	2010	2020	*Growth*
Yield without program (kg/ha)	1,714	1,893	*1.0*			
Yield with program, Y (kg/ha)	1,900	2,143	*1.2*			
Adoption rate, t (%)	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, Q (1000 MT)	1,669	2,247	*3.0*	1,669	2,247	*3.0*
National production with AMSEC program (1000 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 (1000 ha)	19.8	122.6	*20.0*			
Total cost of AMSEC program, CP (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 (NB = B – C), million 2011 GHS	1.5	23.4	*31.8*	1.5	22.9	*31.6*
Discounted Net Worth (2011 GHs, million)		49.1			48.3	
B-C Ratio		4.3			4.3	
Program Net Worth (with AMSEC and at autarky):						
Net Economic Benefits (NB = B – C), million 2011 GHS	1.5	21.8	*31.0*	1.5	22.5	*31.3*
Discounted Net Worth (2011 GHS, million)		46.9			47.9	
B-C Ratio		4.2			4.2	

Source: Authors calculations.

Note: Values under the column headed growth are annual percentage growth rates.

Results show high positive returns, with benefit cost rations of about 4.3. 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 very minimal, -0.2 percent to -0.6 percent per year, given very small contribution of output

growth from mechanization to national output (about 0.4 percent in 2010 and 2.4 percent); growth in national production increase from 3 to 3.2 percent per year.

The high economic return of the program is likely too high 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 from the surveys above.

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 of 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 7.17). Recovery rates of the loans given in 2009 and 2010 actually surpass the target, suggesting that administration of the program has improved over time in terms of having an effective recovery system.

Table 7.17: Repayment of AMSEC credit facility

	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, MOFA.

Notes: expected recovery 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

The study revealed that there was lack of skilled tractor operators and mechanics. Basically, most of the tractor operators were not formerly or properly trained, but just picked the skill by observing and practicing what their masters (most of who were also not formally trained) were doing. Another worrying issue is the difficulty with 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, Framtrac, 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 gear box parts of the Farmtrac), only being less rare 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 the tractor and implement spare parts is prior to the main farming season in March and this continues to 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 ploughing and dealing with mechanical faults deep into or close to the end of the season, respectively.

Limited scope of mechanization services

Ploughing, harrowing and caring 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 to total mechanization in order to drive down the unit cost of operation and reduce drudgery further. Other services are in the area of making of ridges for the cultivation of root crops and vegetables and de-stumping. The demand for these services is growing rapidly because of high cost of hired labor and limited family labor as most farmers are increasingly sending their children to school. Interestingly, using hired for any operation costs the same and sometimes more than using tractor services; Using hired labor also takes a longer time and quality of the work done is poor.

Potential impact of mechanization on the environment

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

Conclusions and recommendations

- Against the background of high capital cost of machinery and implements deterring entry into the mechanization services market, the AMSEC program has contributed to improving the 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 21 percent per year increase in the area mechanized. Because, the demand for

mechanization far outstrips the demand, the program has not crowded out private-sector investments in the market as indicated by both investors and framers, 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, mechanics and spare parts for the newer brand of tractors imported via the program. Poorly prepared fields with stumps have contributed greatly to most of the damages to all brands of tractors.

- Expanding and deepening the training offered by AESD using GSAE (see annex to this chapter for details) is inevitable, particularly when different brands of tractors than what is 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 in order to operate it well. Such training should encompass education and sensitization on the environmental degradation issues associated with ploughing along the slopes rather than across it, as well as stronger links with R&D.
- Until the time when use of very expensive bulldozers for proper land preparation become 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.

Appendix to chapter 7

Annex A7.1: Specific problems associated with some of the tractors and implements

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 due to dirt and this can be associated with delay in changing of the filters.
- Kingpin damage is 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.
- Most of the plough disc hub bearings were breaking down often and this has to be replaced with hubs for Massey Ferguson disc ploughs.
- Frequent leakage of hydraulic oil along the pipes, has been the result of obstacles entangling the pipes and pulling them apart during field work and also 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.
- Replacement of broken crankshaft bearings on some of the Farmtrac brands

In addition to the above, specific brands have unique problems.

Farmtrac 60

- Frequent dent of oil sump due mainly to obstacles (especially stumps) in the field.
- Frequent change of the steering bushings in the steering pot due to wear.
- There are problems associated with the gears in the gear box these are often due to wear.
- Ford 4000 parts could be used for some aspects of the Farmtrac engines. From the gear box down to the hydraulic lifts cannot be got from anywhere except the supplier of Farmtrac.

Farmtrac 70

- The bolts on the base plate of the gear box often slacks and drops 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 gear box, the lower links are attached to the base plate whiles in Farmtrac 60, Farmtrac 80 and all the other tractors, the lower links are attached to either the main housing of the gear box or the back axle of the tractor.
- The gear box parts are very difficult to get for replacement. Currently some of the mechanics depend on scrap dealers for some of the gears.
- The Ford 4000 engine parts also serves some purposes as in Farmtrac 60.

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

- The Perkins engine model has its parts interchangeably with Massey Ferguson engine parts.

- The fuel pump on the Farmtrac 80 with the Siemens engine is very difficult to find on the open market.
- The MF188 parts are compatible with some parts of the Farmtrac 80 with the Perkins engine.

John Deere

- There is frequent problem with the clutch disc plates which often needs adjustments or replacement due to wear.
- The position of the hydraulic filters is low and it breaks easily together with the hose because it entangles obstacles in the field during land preparation.
- Breakdown of the injection pump due to delay in change of fuel filters. This could be serviced by changing the injector nozzles.
- Poorly fabricated disc plough and harrow. None could be used for field work and also cannot be repaired because of a fundamental engineering problem of poor quality material used.

Mahindra

- Frequent wear associated with the cam follower. Currently, these are fabricated because there are no spares available with the supplier's representative.
- Frequent problems associated with the gear box and which often requires the change of gears which have got damaged or worn.
- There is also frequent bearing wear problems associated with the steer.
- The clutches wear often. This type of clutch was found to match with the MF135 clutch, however, other mechanics have adopted the Benz truck clutch which last longer.
- Some seals on the hydraulic pump often break.
- Complaints of broken drive shaft
- Engine overhaul is also common.

Yukon

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

Shakti power tiller

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

Annex A7.2: Suppliers of farm machinery and implements

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

Foundry and Agricultural Machinery Company Limited

The total number of Farmtrac tractors sold to MOFA from 2003 to date is 1,481 set (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 also 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 got 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 model. The tractors received were all manufactured and assembled in India. All the parts can be got from the main supplier through 5 satellite centers at strategic points in the country that are manned by the following staffs.

Foston Ghana Limited

The company started sales of the 605 and 705 series tractors in Ghana in 2008 and have so far sold out 262 tractors with ploughs, harrows and trailers to MOFA. The tractors received were all manufactured and assembled in India. The spare parts could only be got from the supplier's representative in Kumasi. Currently, there are no spare parts distribution or sales point in any part of the country apart from Kumasi.

Yukon

The company has sold out 262 tractors with ploughs, harrows and trailers to MOFA. The tractors received were all manufactured and assembled in the Czech Republic. All the spare parts of the tractor could only be got from the supplier's representative in Accra. Currently, there are no spare parts distribution or sales point in any part of the country apart from Accra.

Annex A7.23: Main source of spare parts on the open market

Name of shop or mechanic	Location	Mobile number	Types of spare parts
Mechanical Lloyd	Accra /Kumasi	0322026882	Engine, engine parts
Tractor & Equipment Mantrac	Kumasi/Accra		Engine, transmission
Japan motors	Accra /Tamale		Engine, hydraulics
AGPS	Accra, Tudu	0302667873	Engine, engine parts, bearing, liners, pistons, connecting rods, engine valves, hydraulic system
AGPS	Kumasi, Adum	0322024486	Engine, engine parts, bearing,

			liners, pistons, connecting rods, engine valves, hydraulic system
Alex Nkrumah Enterprise	Kumasi, Magazine	0322026882 0244589781	Engine parts, filters, gears, hydraulic parts
A Nigerian Company (spare parts dealer)	Nigeria, Abuja	0243569703	Liner, pistons, bearings
Scrap Dealer	Tamale	0244589781	Input shaft, gears

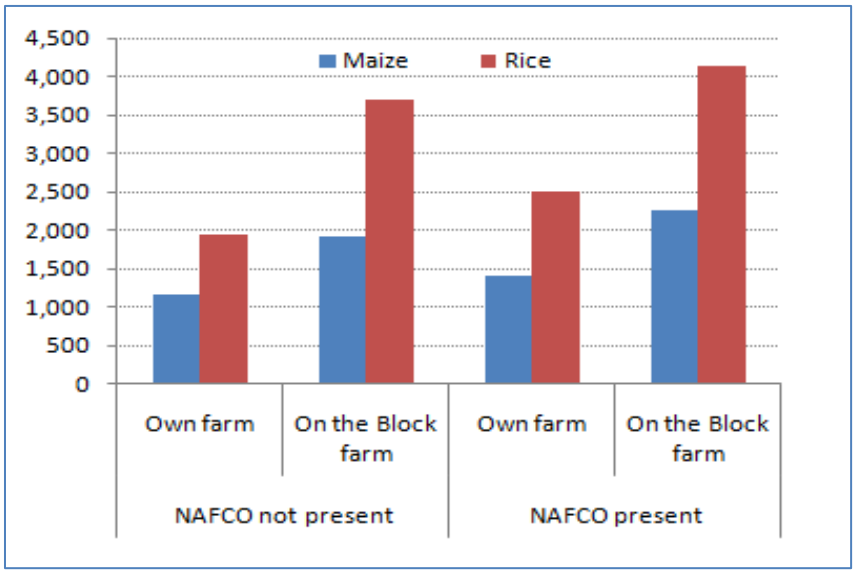
8. Program interaction effects and economic cost-benefit analysis

Program interaction effects

As we discussed in the methodology chapter, the nature of implementation of the programs give rise to potential interaction effects. For example, the NAFCO Buffer stock scheme has been linked to the block farms program. The key commodities, maize, rice and soya beans, that it deals with are the same key commodities grown on the Block farms. Thus, the natural intention is to help mop up the harvested output of the block farm—details of how this works, as well as challenges emerging from such links, is discussed in more detail in the block farms evaluation chapter. Here we discuss some of the resulting effects on yields, and thus performance of the block farms vis-à-vis a combination of the different programs, i.e. where there is a NAFCO warehouse and where there is not, with and using and without using fertilizer as well as with and without an AMSEC.

Evidently, the presence of NAFCO among the block farms being established around the country results in higher yields being reported by farmers on these farms. From Figure 8.2, the presence of NAFCO is associated with higher average yields than when there is not a NAFCO, again whether on or off the block farm. On the block farms example, the average rice yield reported with a NAFCO present is about 4.1 mt per ha 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 ha compared to 1.5 where NAFCO is absent. The same pattern is observed for average maize yields.

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

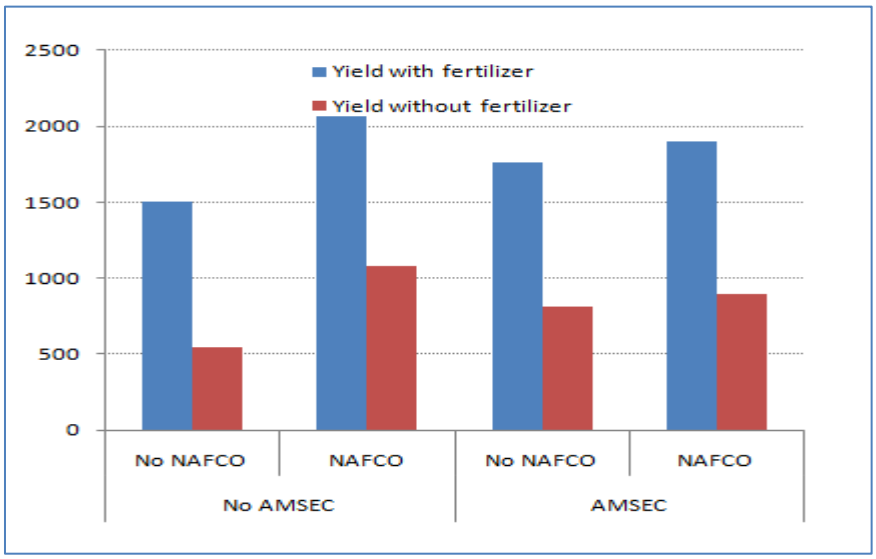


Source: Field survey of farmers

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 introductory 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.

The same pattern is observed in the presence of NAFCO with or without fertilizer use. From 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 higher yields and output for purchases. But even more importantly, 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 short duration of the NAFCO program since its inception. It's also quite possible that NAFCO may have been initially operating in areas with already higher productivity.

Figure 8.2: Average maize yields with and without fertilizer across with and without NAFCO and AMSEC.



Source: Field survey of farmers

Economic cost-benefit analysis across 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 3 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 fertilizer program showed us in Chapter 4 to have a significant effect on lowering domestic prices to levels well below the current NAFCO floor price of GHS 0.55, under the assumption of no trade.

To simulate the combined effect of all programs, we begin by looking into the 3 programs focused on increasing productivity through greater use of fertilizers, mechanization and credit via the Block Farming structure. Table 8.1 below summarizes the results. Details on the assumptions and the extent to which programs costs are calculated are provided in Appendix A.

Table 8.1: Summary of results of economic analysis of AMSEC, Fertilizer Subsidy, and Block Farms programs without NAFCO

Scenario	A			B		
Elasticity of demand (ed)		-0.4			-0.7	
	2010	2020	*Growth*	2010	2020	*Growth*
Yield without program (kg/ha)	1,714	1,893	*1.0*			
Yield with program, Y (kg/ha)	2,200	2,546	*1.5*			
Adoption rate, t (%)	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 (1000 MT)	1,669	2,247	*3.0*	1,669	2,247	*3.0*
National production with all 3 program (1000 MT)	1,817	2,850	*4.6*	1,734	2,510	*3.8*
Share of all 3 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 3 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 3 programs (million 2011 GHS)	55.3	177.7	*13.0*			
Direct Costs of 3 Programs (million 2011 GHS)	41.8	144.1	*13.9*			
Indirect costs of 3 programs (million 2011 GHS)	13.5	33.7	*10.0*			
Total cost of 3 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 (NB = B – C), million 2011 GHS	18.6	157.8	*21.8*	15.6	125.7	*20.9*
Discounted Net Worth (2011 GHs, million)		430.5			358.4	
B-C Ratio		1.7			1.5	
Program Net Worth (with programs and at autarky):						
Net Economic Benefits (NB = B – C), million 2011 GHS	2.7	-67.3	-	12.4	74.9	*0.2*
Discounted Net Worth (2011 GHS, million):		-30.6			252.1	
B-C Ratio:		1.0			1.4	

Source: Authors calculations.

Notes: Values under the column headed growth are annual percentage growth rates.

Not surprisingly, the combined cost of all three programs—Fertilizer Subsidy, Block Farming and MASEC—increases significantly as a share of the projected total MOFA budget to 2020, from an estimated 25 percent in 2010 to about half the budget by 2020. The bulk of the cost is carried by the fertilizer subsidy, by itself accounting for 35 percent of the MOFA budget in 2020, and the other 15 percent by the Block Farming and AMSEC programs combined.

One key result is the effect of the 3 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 -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 export excess grain to, the picture changes. Both assumptions on demand elasticities result in very positive economic returns across all three programs—valued at GHS 430 million (B-C ratio of 1.7) and GHS 358 (B-C ratio of 1.5), respectively.

Aside from trade, the NAFCO program could also assert its goal to stabilizing domestic prices. Table 8.2 below 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 4 programs combined easily making up close to 90 percent of the projected MOFA budget by 2020, this from an estimated 35 percent in 2010.

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. Total costs across all 4 programs rise to 35 percent of MOFA budget by 2020 instead. The overall net-worth value of all 4 programs is GHS 403 million across the ten 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.

In summary, therefore, there is a real advantage to promoting greater access for trade with regional maize markets. This is likely to results in much higher economic returns and a lower burden on the fiscal cost 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 also exhibited higher yields. Although yet to be validated, it is possible that 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.

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

Scenario	A			B		
Elasticity of demand (ed)		-0.4			-0.7	
	2011*	2020	*Growth*	2011*	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, CP (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 3 program (1000 MT)	1,892	2,850	*4.6*	1,794	2,510	*3.8*
Supply in domestic markets, less stocks (1000 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 3 programs, autarky (2011 GHS/kg)	0.42	0.18	*-7.8*	0.52	0.46	*-1.3*
Maize prices with all 4 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 4 programs (million 2011 GHS)	72.2	327.9	*17.8*	58.9	190.8	*13.8*
Direct Costs of all 4 Programs (million 2011 GHS)	56.9	280.6	*18.9*	44.8	156.0	*14.6*
Indirect costs of all 4 programs (million 2011 GHS)	15.3	47.3	*13.1*	14.1	34.9	*10.6*
Total cost of 4 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 (NB = B – C), million 2011 GHS	14.3	7.6	*-15.9*	23.9	112.7	*-32.1*
Discounted Net Worth (2011 GHS, million):		132.0			301.3	
B-C Ratio:		1.1			1.4	
Program Net Worth (with programs and at autarky):						
Net Economic Benefits (NB = B – C), million 2011 GHS	71.6	100.5	*-15.6*	37.4	131.8	*-39.6*
Discounted Net Worth (2011 GHS, million):		605.1			414.2	
B-C Ratio:		1.6			1.6	

Source: Authors calculations.

Notes: Values under 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' concept more excess production in order to maintain a floor price of GHS 0.55 per kg. 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 (i.e. removed from the domestic market). * While we report 2011 year, 2010 remains the base year.

Table 8.3: Summary of results of economic analysis of AMSEC, Fertilizer Subsidy, and Block Farms programs with NAFCO (with gradual increase in stock).

Scenario		A			B	
Elasticity of demand (ed)		-0.4			-0.7	
	2010	2020	*Growth*	2010	2020	*Growth*
Volume of Stocks handled annually	12.0	28.4	*10.0*			
Total cost of NAFCO program, CP (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 3 program (1000 MT)	1,892	2,850	*4.6*	1,794	2,510	*3.8*
Supply in domestic markets, less stocks (1000 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 3 programs, autarky (2011 GHS/kg)	0.42	0.18	*-7.8*	0.52	0.46	*-1.3*
Maize prices with al 4 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 for all 4 programs (million 2011 GHS)	56.8	180.2	*13.5*			
Direct Costs of all 4 Programs (million 2011 GHS)	42.9	146.3	*14.4*			
Indirect costs of all 4 programs (million 2011 GHS)	13.9	33.9	*10.4*			
Total cost of 4 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 (NB = B – C), million 2011 GHS	29.7	155.4	*20.5*	25.9	123.3	*19.3*
Discounted Net Worth (2011 GHS, million):		401.3			329.1	
B-C Ratio:		1.6			1.5	
Program Net Worth (with programs and at autarky):						
Net Economic Benefits (NB = B – C), million 2011 GHS	3.0	-74.9	-	14.5	59.3	*17.7*
Discounted Net Worth (2011 GHS, million):		-100.2			162.2	
B-C Ratio:		0.9			1.2	

Source: Authors calculations.

Note Values under the column headed growth are annual percentage growth rates.

9. Conclusions and Implications

This study assessed four major subsidy and credit facilitation initiatives implemented by the Ministry of Food and Agriculture (MOFA) to guide government policy and improve their performance. The four initiatives are: (1) subsidization of agricultural mechanization services via support to the establishment and operation of Agricultural Mechanization Service Centers (AMSEC); (2) subsidization of fertilizers via the National Fertilizer Subsidy Programme; (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 the National Food Buffer Stock Company (NAFCO).

Based on the literature, program-specific impact pathways were conceptualized to guide the empirical approach, including indicators, sampling, and data collection and analysis. The information used were obtained from two main sources: (1) existing program documents and data; and (2) interviews with implementing actors, knowledgeable experts, farmers, and other stakeholders along the entire value chain using structured and semi-structured instruments, considering with/without and before/after program to the extent possible.

For the fertilizer subsidy program, we find that there has been increase in application of fertilizers due to the subsidy programme, and that farmers who applied fertilizer on their farms obtained not only higher yields, which is expected, but a positive net income than those who did not use any. 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 delays supply and distribution of the fertilizers, place limitations on the potential benefits of the program. To forestall delays in the fertilizer importation and distribution, it is recommended that government starts the negotiations with the importers early so that the fertilizers are in stock in the regions and districts prior to the planting season.

Regarding the NAFCO program, the evidence shows that there was stabilization of maize price in 2010 compared to preceding years', for which there are some lessons to be learned, although data limitations limited our ability to distill the role of NAFCO in this stabilization in order to inform the government and NAFCO on how to strategize to sustain or improve upon it. We found NAFCO to be financially viable under current conditions projected in the immediate future. 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 it 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 that 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 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 seem to have also exhibited higher yields in response.

The block farms program 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. For the government to sustain the program, farmers need to be encouraged to pay back. Contrary to expectation, we find that the youth have not been a strong focus of the program as it was conceived, because, being relatively inexperienced, the youth are considered a riskier venture in terms of being able to properly manage the farm and inputs and services given to obtain decent yields and be able to pay back.

Given the high capital cost of machinery and implements which deters entry into the mechanization services market, the AMSEC program has contributed to improving the 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 services far outstrips the demand, 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 than those operated by non-AMSEC agents, about 17-64 percent more, which is due to lack of skilled operators, mechanics and spare parts for the newer brand of tractors imported via the program. Therefore, expanding and deepening the training offered by the agricultural engineering services directorate (AESD) of MOFA is inevitable.

We found substantial interaction effects among the four different 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 prices and permits them to make higher purchases of inputs. Thus, the roles of the AMSEC, fertilizer and block farms programs seem to be inherently linked to the success of the NAFCO program by ensuring higher yields and outputs. While NAFCO could achieve its goals of stabilizing prices and produce positive economic returns, it would result in rapidly increasingly costs atht would become unbearable for the government, easily making up about 90 percent of the MoFA budget by 2020, this from an estimated 35 percent in 2010.

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. Total

costs across all 4 programs rise to 35 percent of MOFA budget by 2020 instead. The overall net-worth value of all 4 programs is GHS 403 million across the ten 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.

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APPENDIX A: Economic Efficiency Approach

Program Costing and Economic Surplus Method for Impact Evaluation

Background

Considering all four programs were recently launched, we use a simple economic surplus method to estimate future economic costs and benefits associated with them, and therefore, an economic impact assessment. The principal goal for this ex-ante type analysis is to compare a situation with and without the program as opposed to comparing before and after. The economic surplus method can be considered as a partial equilibrium and single commodity analysis. For our study, we focus on the principal crop that benefits the most across all 4 programs - maize.
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 (e.g. a program designed to increase yields), equilibrium quantities and prices also change with important implication on overall economic welfare.

One critical advantage for using the economic surplus approach is that it requires less data except for sufficient information on the flow of production and program costs, assumptions on supply and demand behavior over time, and flow of benefits. For production cost, detailed information on 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 (e.g. administrative costs) should be used. On the benefit side, initial output prices are critical to help project out any price changes over time which have important implications on production incentives, and therefore, overall supply.

On the demand side, as for supply, prices also influence quantities consumed since at a higher prices, consumers generally demand less depending on the type of commodity and income levels. For example, if maize is easily substitutable with cassava, rising maize prices would simply shift demand to a lower priced cassava product. In this case, demand would fall and put a downward pressure on prices as markets become saturated with fewer buyers. Eventually, the lower price brings buyers back and stabilizes prices. In the event that is a critical staple, most buyers would still be forced to buy at the higher price – providing incentives for producers to expand output until a new temporary equilibrium is reached.

What is important is that for some particular commodity market, we can observe the price (P), quantity supplied (Qs) and demanded (Qd), which help describe the economic situation facing both producers and consumers at some point in time. 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 difference between what consumers would have paid for each unit of output they consumed or produced, respectively.

If an individual program shifts the supply curve out from an initial equilibrium point, by expanding production for example, some additional economic surplus is gained as prices fall for consumers (hence mostly a consumer surplus gain). A good example is the fertilizer subsidy program which increases yields and overall output, and thus ultimately lowering prices as supply shifts out and consumers pay less for each unit of output. On the other hand, if a program reduces production or supply such that less quantity of output is valued at the same price as before, as in the case when NAFCO buys up more stock at higher prices to store. Overall economic surplus may still increase as producers gain from increased prices per unit of output.

The goal of the fertilizer, Block farming, and AMSEC programs is to ultimately reduce production costs. As such, the economic surplus or net welfare gains will depend on whether the gain to consumers would be greater than the loss to producers from any reduced prices that result from a shift in output. If either of the programs represents a very small share of the total supply in the market place, such differences may be too small to affect any significant welfare gains at the national level.

Data and assumptions

To undertake the analysis, certain data is needed, such as costs and benefits. We therefore begin by providing estimate of total program costs, inclusive of both direct and indirect costs. Together with some assumptions on future growth in expenditures over time, this provides a good basis for estimating a flow of program costs that we can compare against a flow of net social benefits in the economic analysis later on.

1. *Assumptions of future growth*

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

Table A.1: Assumptions and projections of key economic indicators, resources, and commodities, 2010 to 2011 (constant 2011 GHS)

	Growth (%)	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
Ag 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).
Note: Shares based on IFPRI's public expenditure database and Benin et al. (2008).

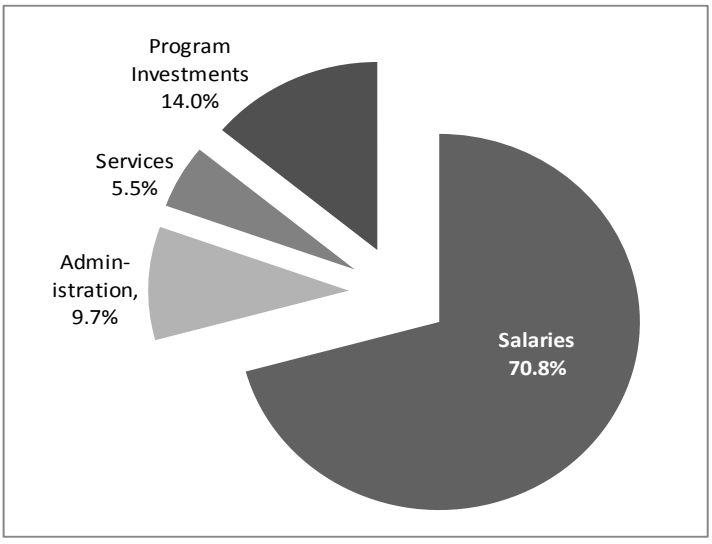
2. Analysis of program costs and share of MOFA's total budget

Estimates of program costs are needed for undertaking the benefit-cost analysis. Additionally, comparing these with estimates of MOFA's budget over time can help determine the extent to which any of the programs are fiscally possible. The costs are projected out to 2020 using information on the goals of all 4 programs, a number of assumptions on the future growth of overall government expenditures, and projections of overall economic and agricultural sector performance. Sources of data come from various sources: primary data from surveys conducted under each program, MOFA, bureau of statistics, FAO, and World Bank. Past studies on public expenditures in Ghana are also relied on heavily.

Table A.1 provides a summary of key growth economic indicators, inflation, and growth in public budgetary expenditures. The data on expenditures relies on the work done by Benin et al. (2008). We chose to maintain a MOFA budget ratio to total agricultural GDP to be 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 was available.

A breakdown of MOFA's budget draws on the breakdown observed in previous years, especially from 2005. Salaries make up the bulk of the budget, estimated at GHS 143 million out of a total MOFA budget of GHS 225 million in 2010, which is about 71 percent of the total budget (see Figure A.1). Indirect costs for each of the programs are assumed to be drawn from salaries while direct costs come out of the investments line item. Agriculture sector budget projected from 2010 to 2020 are shown in Table A.2, while those for the four programs are shown in Tables A.3 and A.4. We now turn to the program coverage and cost estimates of each program.

Figure A.1: Assumed distribution of MOFA Budget based on past shares



Source: Ministry of Finance, Government of Ghana (2005)

Table A.2: Breakdown of MOFA expenditures, 2010-2020

	Annual growth rate	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 Ag	*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
		Percent 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 Ag GDP		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
		Break down 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).

Fertilizer subsidy

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 in 2010. The costs of the subsidies are calculated based on the per metric 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 (see Tables A.3 and A.4). For example, with a total cost of GHS 36.8 million in 2011 constant prices (GHS 32 million in 2010 prices), indirect costs are estimated to be about GHS 1.1 million in 2011 and rises to GHS 4 million in 2020 (see Table A.3).

NAFCO

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 over 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, well above its current storage capacity. Costs are therefore expected to rise faster under this scenario.

Any increase in stocking levels implies higher costs in managing the associated activities of buying and selling throughout the period, as well as maintaining the stock itself. To estimate such a cost, we borrowed the previous work of Rashid and Lemma (2011) in which they estimate a unit cost for maintain and managing stocks in Ethiopia (about $34.84/MT). We adjust this upwards to $52.26/MT to account 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 on salaries. Altogether, costs are quite conservative, rising from GHS 1.2 million to GHS 12.1 million per year by 2010, a growth of about 29 percent per year is anticipated, reflecting the gradual increasing capacity for handling greater stock volumes (150,000 MT by 2020).

Block Farm program

On the costs of the program, direct costs 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 in

Table A.3: Estimating total costs of 4 programs – direct and indirect costs (Constant 2011 GHs, million)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Direct Costs											
Fertilizer	36.8	36.3	43.4	49.9	57.4	65.9	75.7	87.0	100.0	114.9	132.0
Block Farming	4.1	4.1	4.0	3.8	3.6	3.5	3.3	3.2	3.1	2.9	2.8
NAFCO	18.2	0.9	1.0	1.1	1.3	1.4	1.5	1.7	1.8	2.0	2.2
AMSEC	1.5	5.1	5.3	5.6	5.8	6.1	6.3	6.6	6.9	7.2	7.6
Total of 4 Programs	60.5	46.5	53.8	60.4	68.1	76.8	86.9	98.5	111.8	127.1	144.6
Indirect Costs											
Fertilizer	1.1	1.1	1.3	1.5	1.7	2.0	2.3	2.6	3.0	3.4	4.0
Block Farming	12.3	12.4	11.9	11.4	10.9	10.5	10.0	9.6	9.2	8.8	8.4
NAFCO	1.8	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
AMSEC	0.1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4
Total of 4 Programs	15.3	13.9	13.6	13.3	13.1	12.9	12.8	12.7	12.7	12.8	13.0
Total:											
Fertilizer	37.9	37.4	44.7	51.4	59.1	67.9	78.0	89.6	103.0	118.3	136.0
Block Farming	16.4	16.6	15.9	15.2	14.6	13.9	13.4	12.8	12.2	11.7	11.2
NAFCO	20.0	1.0	1.1	1.3	1.4	1.5	1.7	1.8	2.0	2.2	2.4
AMSEC	1.5	5.4	5.6	5.8	6.1	6.4	6.7	7.0	7.3	7.6	7.9
Total of 4 Programs	75.9	60.4	67.4	73.7	81.1	89.7	99.7	111.2	124.5	139.9	157.6

Source: See Table A.1

Note: Important assumption here is that direct program costs are assumed to come out of the 'investments' portion of the MoFA 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 Farm for instance.

Table A.4: Assumption for program indirect costs to MOFA

Program	Ratio of indirect to total direct program costs	Indirect programs costs as a share of MoFA salaries (%)	
	2011 – 2020	2011	2020
Fertilizer	0.03	0.7	1.8
Block Farming	3.00	8.3	3.8
NAFCO	0.10	0.1	0.1
AMSEC	0.05	0.2	0.2

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

in-kind payments from block farm or BF 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 111 are typically recovered. Future direct cost projections are ultimately determined by these unit costs, depending on the total acreage under BFs.

For indirect costs, we assume these to much higher than direct costs. This is because among all the programs, the BF is the most intensive with regard to MOFA's administrative oversight and the level of effort being provided by extension. As such, we assume this part of total cost to be highest for the BF in comparison with the other 3 programs and 3 times its own direct costs less recoveries (Table A.4). This is a government sponsored and administered program, and therefore, potentially comes at a high cost to MOFA. From Table 6.5 below, total costs are expected to more than double by 2020 as the acreage under BFs grows by 10 percent per year—from GHS 15.9 million in 2010 (of which GHS 3.6 million and GHS 12.3 are direct and indirect costs, respectively) to GHS 39.1 million by 2020 (of which GHS 9.8 million and GHS 29.3 are direct and indirect costs, respectively).

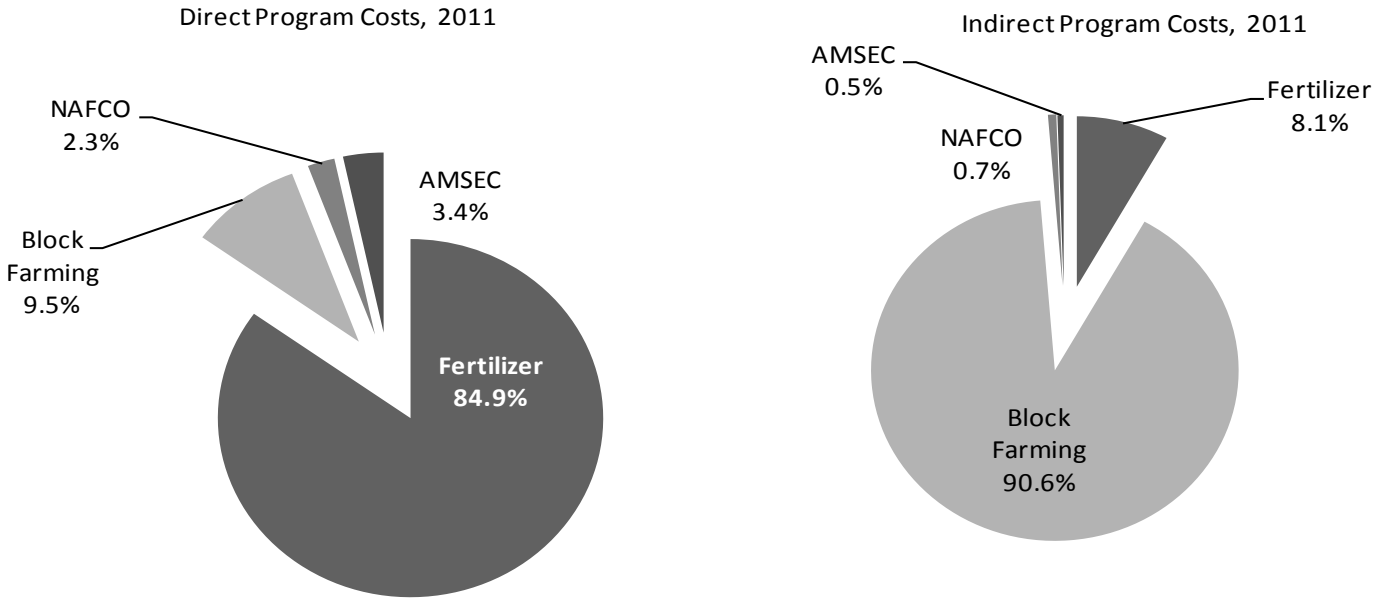
AMSEC

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 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. Indirect costs are assumed to be about 0.05 times the direct costs (Table A.4).

Comparing across all four programs

Figure A.3 and Table A.6 provide an overall summary of the programs costs compare across each other and when projected to 2020. Not surprisingly, based on our assumption and structure of the programs, the fertilizer subsidy would make up almost 90 percent of the direct program costs by 2020. Block farming on the other end rises in in indirect costs by 2020, making up over 60 percent of this. For NAFCO, committing to a floor price with all 4 programs in place begins to cost as much as the fertilizer subsidy, while also replacing the Block Farm for indirect costs.

Figure A.2: Comparing across programs direct and indirect program costs in 2011 (percent share of total across 4 programs)



Source: Authors' calculations

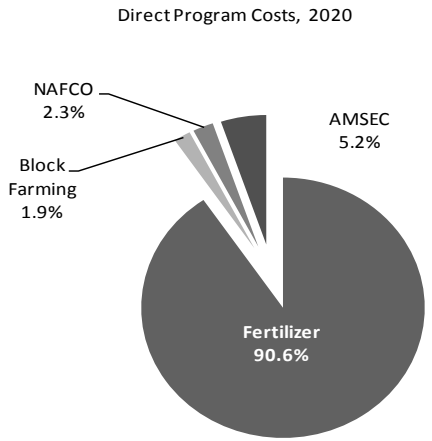
Table A.5: Estimating total costs of NAFCO programs – direct and indirect costs with or without committing to Floor price (Constant 2011 GHs, million)

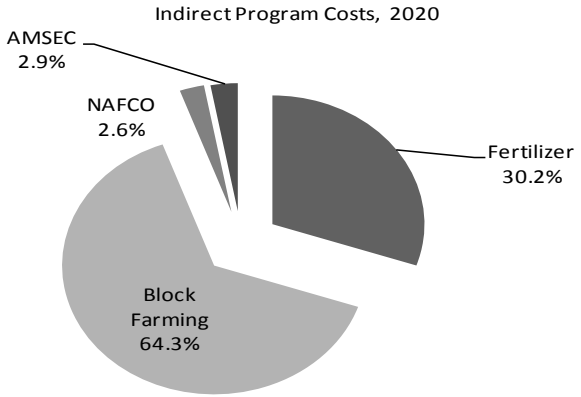
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
				a) Committing to Floor price							
Direct Costs											
NAFCO	18.2	14.9	18.0	21.9	26.9	33.3	42.0	53.8	70.6	95.8	136.5
Total of 4 Programs	60.5	60.5	71.3	82.4	95.6	111.4	130.7	154.8	185.6	226.8	285.9
Indirect Costs											
NAFCO	1.8	1.5	1.8	2.2	2.7	3.3	4.2	5.4	7.1	9.6	13.7
Total of 4 Programs	15.3	15.3	17.1	19.0	21.3	23.8	26.8	30.4	34.6	40.0	47.3
Total:											
NAFCO	20.0	16.4	19.8	24.1	29.6	36.7	46.2	59.2	77.7	105.4	150.2
Total of 4 Programs	75.9	75.7	88.4	101.4	116.8	135.2	157.5	185.1	220.2	266.9	333.2
				a) Gradual increase in stock							
Direct Costs											
NAFCO	18.2	0.9	1.0	1.1	1.3	1.4	1.5	1.7	1.8	2.0	2.2
Total of 4 Programs	60.5	46.5	53.8	60.4	68.1	76.8	86.9	98.5	111.8	127.1	144.6
Indirect Costs											
NAFCO	1.8	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Total of 4 Programs	15.3	13.9	13.6	13.3	13.1	12.9	12.8	12.7	12.7	12.8	13.0
Total:											
NAFCO	20.0	1.0	1.1	1.3	1.4	1.5	1.7	1.8	2.0	2.2	2.4
Total of 4 Programs	75.9	60.4	67.4	73.7	81.1	89.7	99.7	111.2	124.5	139.9	157.6

Source: See Table A.3

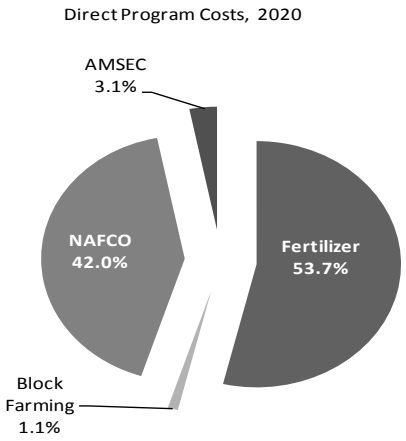
Figure A.3: Comparing across programs direct and indirect program costs in 2020 (percent share of total across 4 programs)

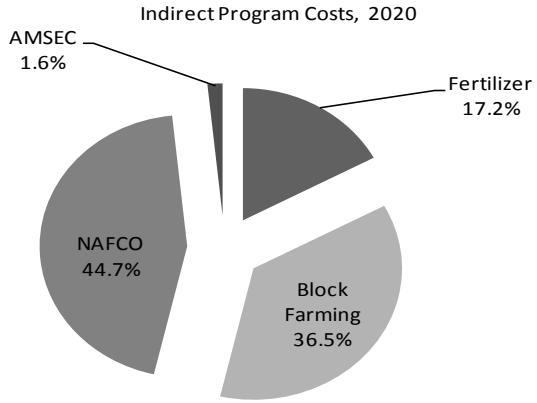
a) When NAFCO gradually increases its stock capacity (30% per year)





b) When NAFCO commits to floor price





Source: Authors' calculations

Table A.6: Estimating total program costs (direct and indirect) as a share of MoFA Budget

Program	2011 (%)	2020 (%)
Fertilizer	15.7	35.3
Block Farming	7.0	2.9
NAFCO	0.4	0.6
AMSEC	2.3	2.1
All 4 Programs	25.4	40.9
Direct Costs as share of Development Spending	88.2	130.2
Indirect Costs as share of MoFA salaries	9.2	5.8

Source: Authors' calculations using data from Table 3.

Note: The shares result from individual program assumptions based on expected growth of activities and coverage to 2020 in program investments and indirect costs.

Table A.7: Assumptions of future growth across all 4 programs

MOFA Programs Coverage	Annual growth (%)*	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Fertilizer (total, 1000 MT)	*10.0*	43	73	91	100	110	121	134	147	162	178	196	215	237
Block Farming (total area, 1000 ha)	*10.0*	-	12	129	150	165	182	200	220	242	266	292	322	354
NAFCO[1] (total volume, 1000 MT)	*10.3*	-	-	11	12	13	15	16	18	19	21	23	26	28
NAFCO[2] (total volume, 1000 MT)	*42.7*	-	-	11	190	230	279	343	425	535	686	901	1,222	1,742
AMSEC (total area, 1000 ha)	*20.0*	2	29	66	79	95	114	137	164	197	237	284	341	409
Per unit (kg/ha or ratios)														
Fertilizer (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
Block Farming (% 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	2.7	3.0	3.2	3.6	3.9	4.3	4.7	5.1	5.6	6.1
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: * Numbers with asterisks indicate a target assumption. For the Fertilizer Subsidy program, we assume the amount subsidized each year will grow at about 10 percent per year. For Block farming we restrict growth to about 10 % per year, gowing beyond the targeted goal of 150,000 hectares. For NAFCO, we offer two alternatives: NAFCO[1] assumes gradual increase in stocks that grow 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 other 3 programs.

Table A.8: Breakdown of fertilizer quantities imported, subsidized and prices, 2010-2020

Quantities	Annual Growth (%)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
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 (1000 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 break down (2011 GHs/kg)*	Share of domestic price (%)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
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 & 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 & 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**
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 Funtes, Johnson and Bumb (2010).

Appendix B: Survey Instruments