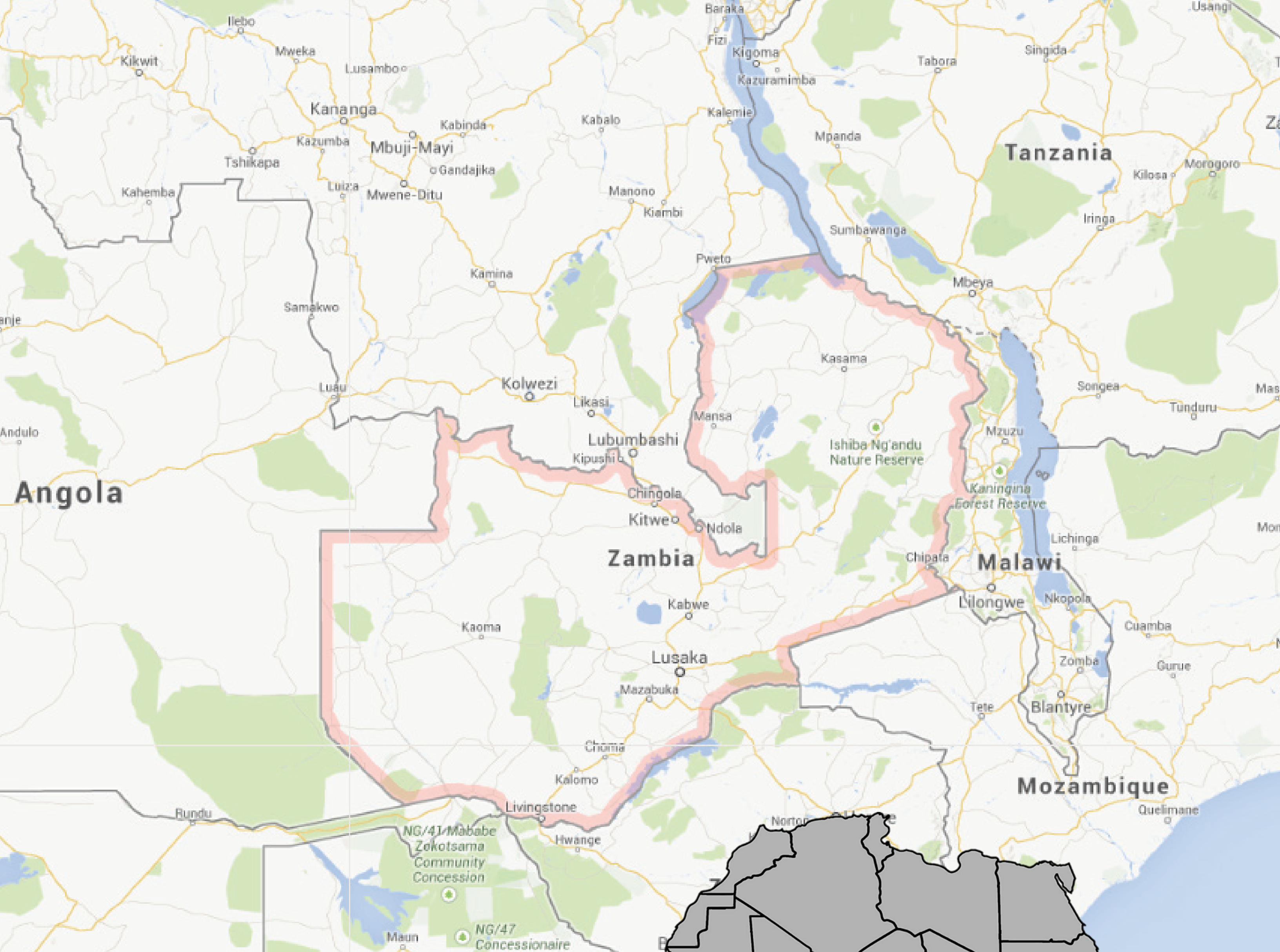

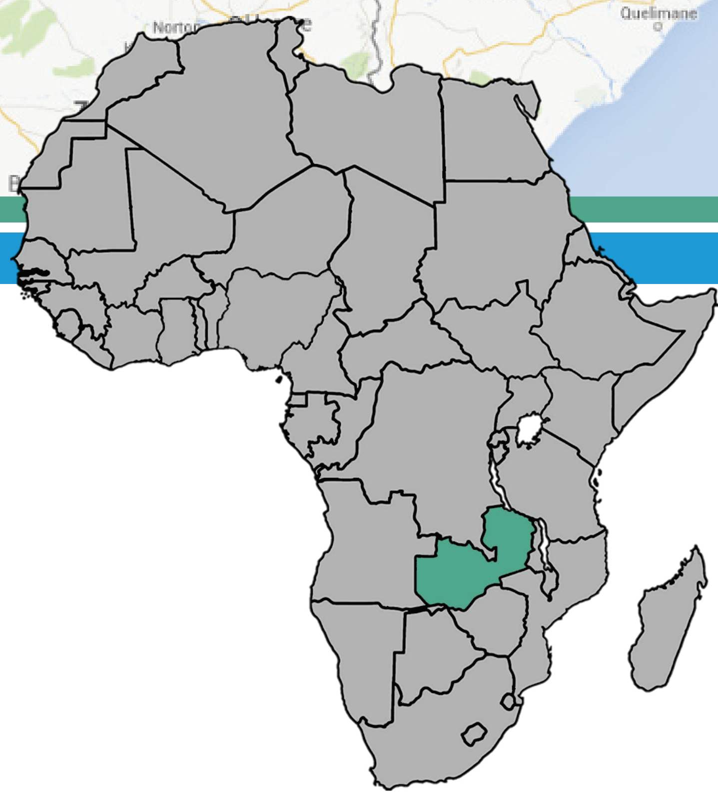

ZAMBIA FERTILIZER ASSESSMENT

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July 2013

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Acronyms

c.i.f.	cost, insurance and freight
CAADP	Comprehensive Africa Agriculture Development Program
CIP	Country Investment Plan
CSO	Central Statistics Office
DAP	diammonium phosphate
FAO	Food and Agriculture Organization of the United Nations
FISP	Fertilizer Input Support Programme
FRA	Food Reserve Agency
FSG	Food Security Group
GDP	gross domestic product
GRZ	The Government of the Republic of Zambia
ha	hectare
IAPRI	Indaba Agricultural Policy Research Institute
IFDC	International Fertilizer Development Center
ISFM	Integrated Soil Fertility Management
K	potassium
MACO	Ministry of Agriculture and Cooperatives
MSU	Michigan State University
mt	metric ton
N	nitrogen
NAP	National Agricultural Policy
NCZ	Nitrogen Chemicals of Zambia
NDP	National Development Plan
P	phosphorus
SSA	Sub-Saharan Africa
VCR	value-cost ratio
ZBS	Zambia Bureau of Statistics

Zambia Fertilizer Assessment

Executive Summary

Zambia has adopted a comprehensive strategy, utilizing the Comprehensive Africa Agriculture Development Program (CAADP) framework and related approaches, to increase agricultural productivity with the aim of raising incomes and reducing food insecurity. Commercial and subsidized fertilizer plays a significant role in the agricultural growth scenario for Zambia. Fertilizer subsidies have taken center stage in these efforts, with the objective of encouraging adoption and the intensified use of new technologies that enhance yields and hence reduce rural poverty by raising incomes. The strategic goal of raising agricultural production is predicated on accessibility to the necessary resources to achieve that outcome. A key constraint facing stakeholders in the agriculture sector is limited data and market information to make the necessary decisions towards achieving these goals. This study strives to support these efforts by estimating the gap in fertilizer use to achieve the agriculture sector growth objectives and by analyzing the existing policy constraints and possible solutions in order to close the gap in fertilizer consumption.

This study shows that, under appropriate assumptions, Zambia's fertilizer consumption must increase by 248,000 product tons – to approximately 500,000 mt – to meet the agricultural growth targets set in the CAADP country investment plan. This increased fertilizer consumption has implications for the development of each node in the fertilizer value chain in order to deal with the pressure resulting from the higher volumes of fertilizers required to achieve the agricultural targets.

The study identifies a number of constraints in the value chain, including public policies that impede private investment; poor port, road and rail infrastructure; financing constraints and storage limitations for both inputs and outputs; and inadequate capacity at the farm and agro-dealer levels. These issues must be addressed in order to raise fertilizer consumption and raise rural incomes in Zambia. Public policy influences private investments in three ways: the purchase of grain by the state-run Food Reserve Agency (FRA); implementation of the Fertilizer

Input Support Programme (FISP) fertilizer subsidy; and macro policies such as banning domestic transactions in foreign currency which raised exchange risks for private investors. The subsidy program has passed its initial planned deadline of closure and grown in volume with bureaucratic implementation procedures that entail significant leakages. The current initiative to implement a 'smart' e-voucher system is meant to make this program more efficient and competitive by involving private players, especially at the retail level, and by cutting delays in deliveries to farms. At the time of this report, the Government of the Republic of Zambia (GRZ) announced the withdrawal of the consumer subsidy on maize meal and fuel due to unsustainability and the opportunity costs involved.[1] However, the GRZ has embraced the implementation of an e-voucher subsidy system for maize growers who have limited access to fertilizers.

In addition, the state of 'hard' infrastructure is a significant part of the farm gate cost of fertilizers due to transport and related costs. Storage limitations at farm and post-farm do not augur well for market access for both farmers and traders. The current storage facilities are not sufficient to handle a bumper maize harvest.

[1] http://www.mofnp.gov.zm/images/removal%20of%20subsidies.pdf.

Zambia Fertilizer Assessment

1.0 Contribution of Agriculture to GDP

The agriculture sector accounts for a fifth of Zambia's gross domestic product (GDP) and employs more than 60 percent of the labor force, and is therefore important in reducing poverty by generating incomes and raising food security (GRZ-NAP 2004-2015). Over time, the GRZ has implemented a number of policies through various strategic plans to raise agricultural growth. In 1992, the GRZ began to liberalize the agriculture sector from a hitherto state-controlled system involving subsidies focused mostly on maize production (GRZ, 2004) to increased private sector participation in input and output markets.

The GRZ is working together with development partners to raise agricultural production within the CAADP framework, which encourages increasing expenditures on agriculture to at least 10 percent of the national public budget and achieving a growth rate of six percent per year for the sector. The government allocated 6.1 percent, 6.4 percent and 7.6 percent to agriculture for the years 2010, 2011 and 2012, respectively (GRZ-CAADP Compact, 2011), and plans to increase to 10 percent in 2013, depending on whether investment commitments are met by all partners (GRZ-Medium Term Budget Call Circular, 2010). The FISP and the FRA operations have been the main anti-poverty programs in Zambia, accounting for 60 percent of the public budget apportioned to agriculture over a period of five years[2] (Mason et al., 2011; Chiwele and Moyo, 2010). The CAADP framework is intended to strengthen, support and facilitate effective implementation of the National Agriculture Policy (NAP) of 2004 and the Vision 2030. The rationale for the collaborative partnerships is to raise investments in critical areas in order to stimulate growth by raising productivity and production among smallholder farmers in the agriculture sector, therefore reducing hunger and malnutrition as encapsulated in the above strategic plans.

[2] Due to their significant budgetary allocation, these two programs are discussed further in the following sub-section.

Some studies suggest the CAADP focus in Zambia should encourage improved technology adoption and market access, as per capita land sizes are becoming smaller and farmers are facing limited market access and poor incentives to store their produce (Jayne et al., 2011). Despite major expansion in FRA operations and fertilizer subsidy programs since 2004, there has been no major decline in rural poverty rates in Zambia (Mason et al., 2011; GRZ, 2011), although overall production volumes increased for the smallholder farmers. The increase in production, particularly for maize, is attributable to consecutive seasons of good rains, favorable grain prices for maize that encouraged area expansion and fertilizer subsidies. However, the policy environment *vis-a-vis* private sector participation, the acidity of soils that negates the benefits from fertilizer and declining per capita land ratios (poor asset base), coupled with poor infrastructure, provides dis-incentives. The rural poverty rate declined from 83 percent in 1998 to 77.3 percent in 2004, and remained relatively unchanged at 76.8 percent in 2006 (CSO, 2010).

1.1 The Significance of FRA and FISP Programs in Agricultural Expenditures

The GRZ utilizes over 60 percent of its agricultural expenditures on two programs (Figure 1); the FRA that purchases maize at pan-territorial prices that are fixed above prevailing market prices and the FISP that distributes subsidized fertilizer (Mason et al., 2011). The FRA purchased between 36 and 86 percent of all marketed maize in Zambia between 2004 and 2010, which was then sold to millers at subsidized prices. By selling its maize to millers at subsidized prices, the expectation from FRA activities is that millers will, in turn, sell maize products to consumers at favorable prices and thus cushion consumers from high prices. However, findings from Mason et al. (2011) indicate that rural poverty did not change significantly despite these massive support programs, yet farmers with more land resources who were net-sellers of maize benefitted from surplus maize sales.

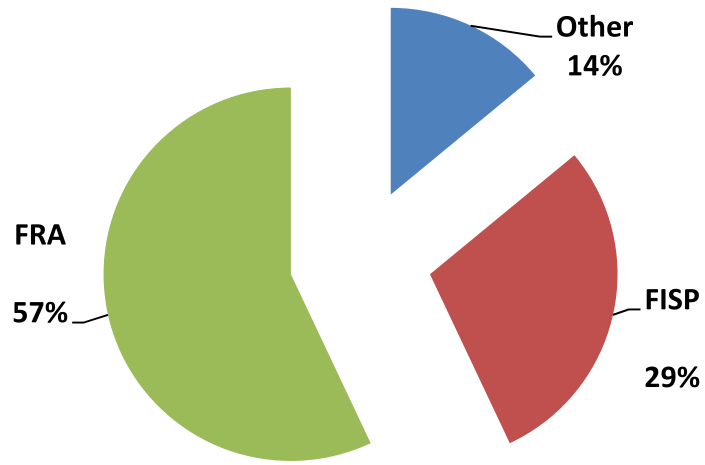

Figure 1. Public Spending in Agriculture (2010)

Source: Ministry of Finance Yellow Book. Adapted from Mason et al. (2011).

Additionally, by focusing solely on maize, the FISP program has encouraged an increase in area under maize at the expense of other crops. The FISP program is not targeted sufficiently, allowing these farmers with more land resources to benefit from the program disproportionally more than smallholder farmers. It is anticipated that the new efforts to revamp FISP by better targeting vulnerable farmers using a "smart" e-voucher system, coupled with avoiding a singular focus on maize, will increase productivity and production of other crops. The GRZ and a number of other SSA countries are re-assessing the relative merits of investing in such poverty support programs versus alternatives such as roads and other infrastructural investments.

1.2 Agricultural Investment Priorities and Targets

The CAADP framework sets the parameters for engagement by stakeholders towards fulfilling the goals of the National Development Plans (NDPs) in the development process. The GRZ-CAADP framework aims at achieving the above goals by encouraging activities in the following broad areas: private sector growth; involvement of vulnerable groups in the process of growth; promoting land and natural resources management; and streamlining services such as research, extension, training and regulatory institutions to make them effective and efficient in alignment with the CAADP Pillars. This framework envisages an agriculture sector growth of six percent, triggered by at least a 10 percent annual national budgetary allocation to the sector through the GRZ and donor support. The challenges to be met through clarification of roles and partnerships among stakeholders include low investments in the sector, low production and productivity and food insecurity.

The thrust of the national plan is to increase the contribution of agriculture to foreign exchange earnings to 10-20 percent through diversification and productivity increases, raise agricultural growth to between seven and 10 percent per annum and raise agricultural contribution to GDP to over 30 percent by 2015 in order to increase food security and reduce poverty (GRZ-NAP, 2004-2015). Table 1 shows major crops and the targeted yields based on average growth rate of seven percent over the period.

Table 1. Crop Cultivated Area, Current and Target Yields Based on Averages Over the 2005/06-2009/10 Period

Crop	Area		Yield	
	Hectares	Percent of Total	Current	Target
Maize	1,067,842	61.3%	1.54	3.04
Sorghum	37,094	2.1%	0.50	0.99
Rice	26,617	1.5%	1.19	2.34
Millet	62,829	3.6%	0.67	1.32
Sunflower	48,321	2.8%	0.40	0.78
Groundnuts	202,813	11.7%	0.50	0.99
Soybean	25,654	1.5%	0.71	1.40
Cotton	123,979	7.1%	0.76	1.50
Irish Potatoes	772	0.0%	2.39	4.71
Tobacco	9,291	0.5%	1.10	2.17
Beans	77,370	4.4%	0.79	1.56
Cowpeas	7,385	0.4%	0.38	0.75
Sweet Potatoes	50,883	2.9%	2.61	5.13
	1,740,849	100.0%		

Source: Sitko et al. (2011) and author’s calculations.

This study’s main objective is to estimate fertilizer requirements that will meet the agricultural growth targets in the national development plans under the CAADP compact agenda. These estimates will have implications for tackling existing challenges in fertilizer value chains that must adapt to meet the increased volumes of fertilizer. The study also looks at the role of policy in the private sector investments that are necessary for increased fertilizer use.

2.0 The Conceptual Approach: A Framework for Linking Inputs to Outputs

This study adopts a value chain framework as the core methodology to address the question of procuring and distributing enough fertilizer to meet the agricultural growth targets. There is an important link between input and output markets, with price signals influencing farmers' decisions to invest in fertilizers and other productivity-enhancing factors in production. An analysis of the amount of fertilizer needed and the capacity of the existing fertilizer distribution system to supply those needs requires an assessment of the value chain nodes, associated stakeholders within each node and commodity flows along two inter-linked value chains: (1) the input (fertilizer) value chain, spanning fertilizer production, trade and consumption by farmers;[3] and (2) the output value chain, spanning crop production by farmers, transformation, marketing and consumption by consumers (domestic or external). Figure 2 provides a simplified illustration of what are, in reality, complex interactions among a vast array of actors along this set of dual, integrated value chains.

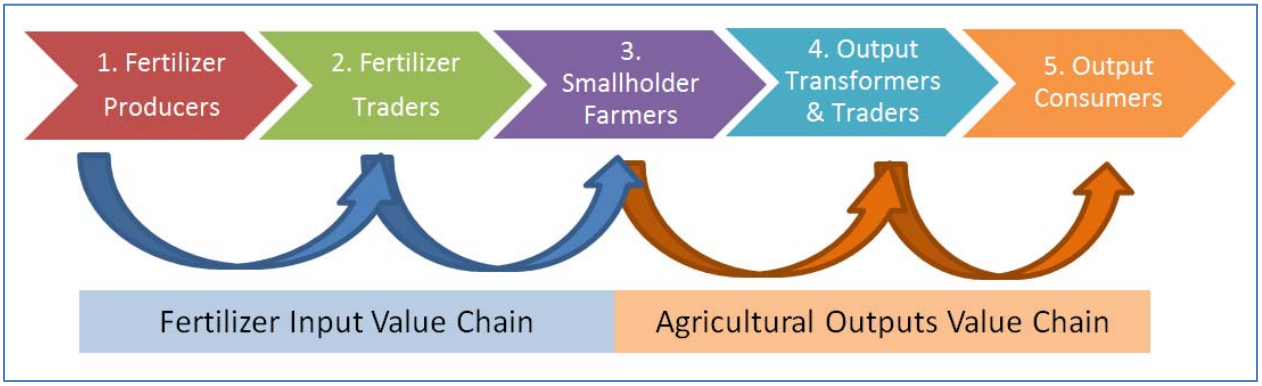

Figure 2. The Double Value Chain

For the purposes of this analysis, we begin by discussing output consumers (Node 5) and work left toward the smallholder farmer (Node 3), various types of traders (Node 2) and fertilizer

[3] Although we present the value chain for mineral fertilizers, we acknowledge the need for an integrated package that includes organic fertilizers, improved seed varieties, water and traction equipment and management skills.

producers (Node 1). To estimate the quantity of nutrients needed to meet the crop output targets and the measures required for the smooth flow of these volumes through the existing fertilizer distribution system, the following simplifying assumptions were made:

- The crop production targets accurately reflect the quantities needed to achieve the domestic contribution to national food security, agricultural growth targets, national storage and transformation capacity, people's food preferences, etc. Note that significant post-harvest losses imply that quantities at Node 5 are less than what is produced at Node 3.
- Markets will be well developed in order to absorb the increased levels of crop production. This output will either be domestically consumed or exported. The analysis also assumes that the agents involved in Node 4 have the capacity to store, process and transport and market the increased output.
- Since prices will vary depending on the levels of supply and demand, the analysis assumes that the fertilizer quantities estimated by this study will remain profitable so that farmers have the incentive to use the input. Specifically, it is assumed that, even if crop prices fall (possibly driven down by increased supply), either the price of fertilizer or the returns to fertilizer will compensate for the reduced price. Otherwise, farmers will find it unprofitable to use fertilizers.
- Given that Zambia's consumption of fertilizers is a small fraction of the world trade, this analysis assumes that Zambia is a price-taker and thus does not influence international prices.

These assumptions allow for simplification of the analysis of the output value chain and increased focus on the input value chain to address the following question: What quantities of fertilizer are required to produce (Node 3) economically viable crop outputs targeted in the national development strategy?

Next, the study assesses the capacity of the current fertilizer system (Node 2) to procure, import, store, transport and distribute that quantity to farmers (Node 3) in time for the growing season. We ask the question: What investments and policy changes will be necessary to ensure the smooth flow of increased quantities of fertilizer through the chain to smallholders?

Node 2 (fertilizer traders) in Figure 2 consists of the following key steps and players:

- Importation: Importers, bankers, shipping companies, port service providers (labor and equipment), revenue authorities, quality inspectors, transporters and blending and bagging agents.
- Wholesale distribution: Importers or independent wholesalers, bankers, quality inspectors, transporters.
- Retail distribution: Agro-dealers/stockists, financial service providers.

The study discusses possible actions by value chain participants in light of increased fertilizer use and the role of the support structure in the value or supply chain, including the effects of policy on value chain players. We examine the existing physical, human, institutional and financial capacity and identify investments and policy changes needed to ensure the right quantities of the nutrients flow on time through the supply chain to end users. Additional details on the structure of the supply chain, the data and the analysis are presented in later sections of this study.

In summary, the study assumes a positive relationship between crop production and fertilizer use, implying that a particular level of agricultural output can be achieved using some corresponding quantity of fertilizer. The study then uses value chain analysis to identify the challenges to increasing fertilizer consumption throughout the chain using simple tabular, graphic and descriptive analyses to explain the results.

3.0 Data Collection Methodology

Two methods were applied in collecting data and information for this study: (1) secondary data and (2) empirical data collection through interviews with key players in the public and private sector (Ministry of Agriculture, importers, research institutes, etc.). The study derived most of the data from existing or secondary literature or reports on fertilizer issues in Zambia authored by various organizations and research institutions, including IFDC. This exercise covered several areas, although some information was unavailable in sufficient detail:

- National country investment plan targets from country development plans and CAADP documents.
- Agricultural production data: crops, area cultivated and production.
- Fertilizer: imports, consumption, application rates per hectare (ha), percentage of farmers applying fertilizer.
- Agro-ecological data.

There is a significant amount of data that are not available from literature sources, which therefore required the study team to travel to the countries and meet with key stakeholder representatives to collect necessary information and opinions from industry players.

Some desired data were not available or accessible, including:

1. Disaggregated data on application rates per hectare by crop.
2. Percentage of farmers using fertilizer by crop and region.
3. Quantity of fertilizer products for each crop; fertilizer consumption in many SSA countries is reported at the national level and quantities are not allocated by crops or regions.
4. Soil profiles; those that do exist are outdated and not readily available in digital format.

3.1 Description of the Data: Agricultural Trends and Statistics

The following section provides information collected on area of arable land, its allocation to different activities, crop-specific areas and production and yields across different administrative units.

Zambia is a landlocked country with 290,586 square miles and borders eight countries: Botswana, Namibia and Zimbabwe to the south; Angola to the west; Tanzania and the Democratic Republic of the Congo (DRC) to the north; and Malawi and Mozambique to the east. Its shortest route to the sea is through Zimbabwe to the Beira and Nacala ports in Mozambique. The other alternative is through the northern corridor to the port of Dar es Salaam in Tanzania or through South Africa’s Durban and East London seaports. These ports are accessed from Zambia by both a road and rail system.

3.1.1 Allocation of Arable Land and Area Under Crops

It is estimated that 58 percent (42 million ha) of Zambia's total land area can be classified as medium to high potential for agricultural production, with rainfall ranging between 800 mm to 1,400 mm annually and suitable for the production of a broad range of crops and livestock (GRZ-NAP, 2004-2015); approximately 14 percent of this land is currently being utilized.

The country consists of three broad agro-ecological zones. One region constitutes approximately 12 percent of Zambia's total land area and receives less than 800 mm of rainfall annually. This covers the south and parts of the eastern and western provinces that produce drought-resistant crops like cotton, sesame, sorghum and millet and extensive cattle rearing. The second region constitutes 42 percent of the country's total land area, receiving 800 to 1,000 mm of annual rainfall, and covers the Central, Eastern, Lusaka, Southern and Western provinces with fairly fertile and in some areas sandy soils with beef, dairy, cashew nut, cassava, cotton groundnuts, irrigated wheat, maize, millet, sunflower, soya beans, tobacco, poultry, and rice production. Around 46 percent of the country's total land area receives 1,000 mm up to 1,500 mm of rainfall annually, covered by the Copperbelt, Luapula, Northern and North Western provinces that feature mostly acidic soils and produce millet, cassava, sorghum, beans and groundnuts, coffee, sugarcane, rice and pineapples.

As indicated in Table 2, cultivated land per capita has been in decline over time for some SSA countries, including Zambia, implying that production increases are more likely to come from the use of improved technologies and intensification approaches rather than expansion in land under cultivation. The information on area under crops *vis-a-vis* available national land resources also indicate that any short- to medium-term increases in production will be driven by input intensification rather than expansion in cultivated area. There is limited land for expansion unless the less productive land areas are enhanced through soil improvement measures and irrigation infrastructure.

Table 2. Ratio of Cultivated Land to Agricultural Population for Some SSA Countries

	1960-69	1970-79	1980-89	1990-99	2000-09
Zambia	0.643	0.607	0.398	0.342	0.290
Ethiopia	0.501	0.444	0.333	0.224	0.210
Kenya	0.462	0.364	0.305	0.264	0.210
Malawi	0.580	0.466	0.357	0.304	0.300
Mozambique	0.356	0.337	0.320	0.314	0.290
Rwanda	0.212	0.213	0.195	0.186	0.170
Uganda	0.655	0.569	0.509	0.416	0.340

Note: Land to person ratio = (land cultivated to annual and permanent crops)/(population in agriculture). http://www.faostat.fao.org/. Adapted and updated from Jayne, Chapoto, Chamberlain (2011).

Table 3 shows that there is considerable emphasis or focus on maize, as this accounts for more than 60 percent of cultivated area under major crops, followed by groundnuts, cotton, beans and millet. Maize and groundnuts area cultivated has increased significantly while that for cotton has been in decline (Figures 3 and 4).

Table 3. National Area Under Select Crops ('000 ha)

	2005/06	2006/07	2007/08	2008/09	2009/10	Average	% of Total
Maize	863.5	1,039.4	1,176.2	1,078.0	1,182.2	1,067.8	61.3%
Sorghum	44.8	35.2	31.6	40.4	33.5	37.1	2.1%
Rice	12.8	23.7	29.7	31.0	35.8	26.6	1.5%
Millet	69.7	69.0	57.1	61.6	56.8	62.8	3.6%
Sunflower	43.2	34.3	39.9	70.6	53.7	48.3	2.8%
Groundnuts	157.7	184.0	189.4	215.3	267.6	202.8	11.7%
Soybean	31.7	31.5	13.6	22.6	28.9	25.7	1.5%
Cotton	177.6	106.5	148.2	102.8	84.7	124.0	7.1%
Irish Potatoes	0.8	0.7	1.1	0.6	0.7	0.8	0.0%
Tobacco	9.4	2.8	6.2	13.8	14.3	9.3	0.5%
Beans	68.3	71.6	80.6	82.7	83.7	77.4	4.4%
Cowpeas	8.0	5.2	4.7	12.8	6.3	7.4	0.4%
Sweet Potatoes	38.0	40.5	42.1	64.0	69.8	50.9	2.9%
Total	1,525.5	1,644.4	1,820.4	1,795.9	1,918.0	1,740.8	100.0%

Source: MOCA National and Provincial Reports, Sitko et al. (2011) and author's calculations.

Crop production estimates indicate that production of maize, soybeans, cotton, Irish potatoes and tobacco increased over the previous season while area planted and production for cassava, sorghum, millet, groundnuts and sweet potatoes declined in 2010/11 compared to the previous season (GRZ: MACO and CSO: 2010/2011). Total maize production in the 2010/2011 season was estimated to be 3,020,380 mt and total area planted by small- and medium-scale farmers increased to 1,311,530 ha. Area planted to maize by large-scale farmers declined to 44,324 ha though yields were higher at 5.27 mt/ha compared with small- and medium-scale farmers at 2.13 mt/ha in the 2010/2011 season.

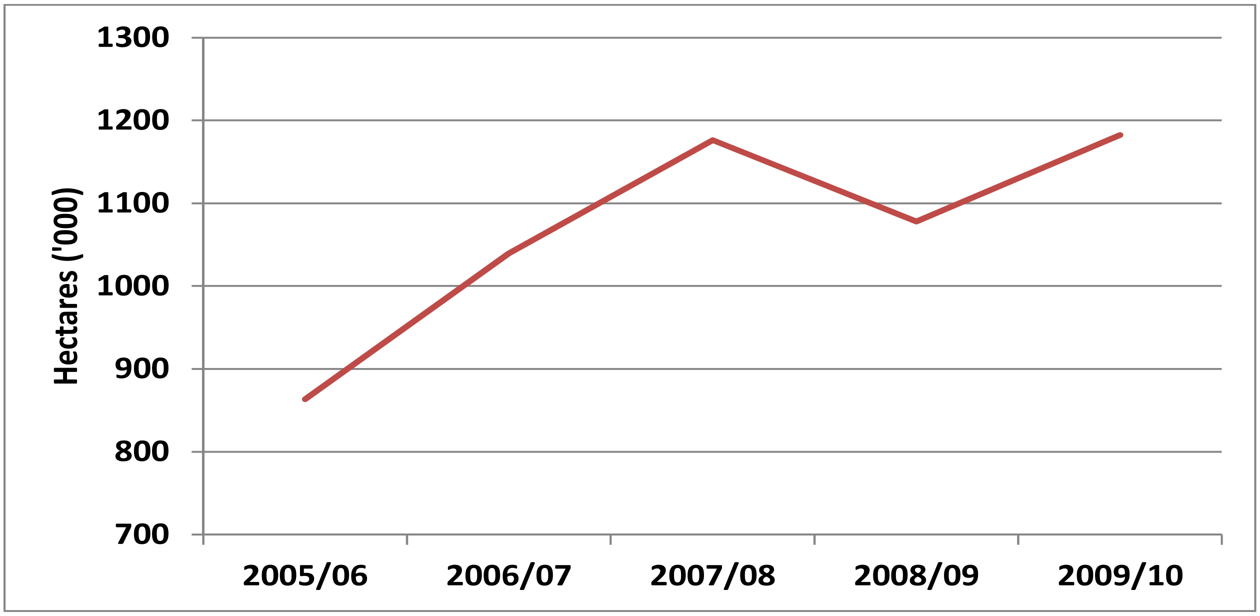

Figure 3. Area Under Maize for 2005/06-2009/10 Period

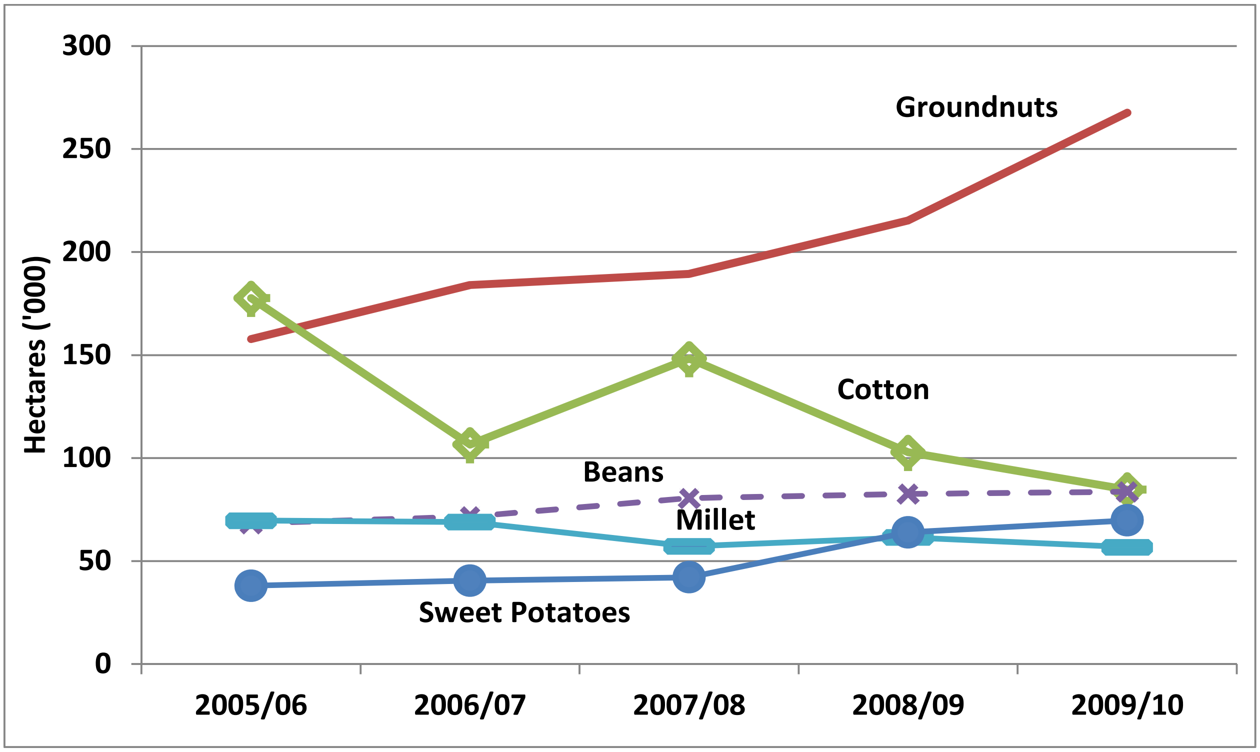

Figure 4. Area Under Other Crops for 2005/06-2009/10 Period

3.1.2 Production and Yield Trends for Crops

There has been an increase in production for most crops resulting from increased cultivated area and favorable yields during periods of good rains. Cotton area and production has been in decline, while bean area and production has been relatively flat.

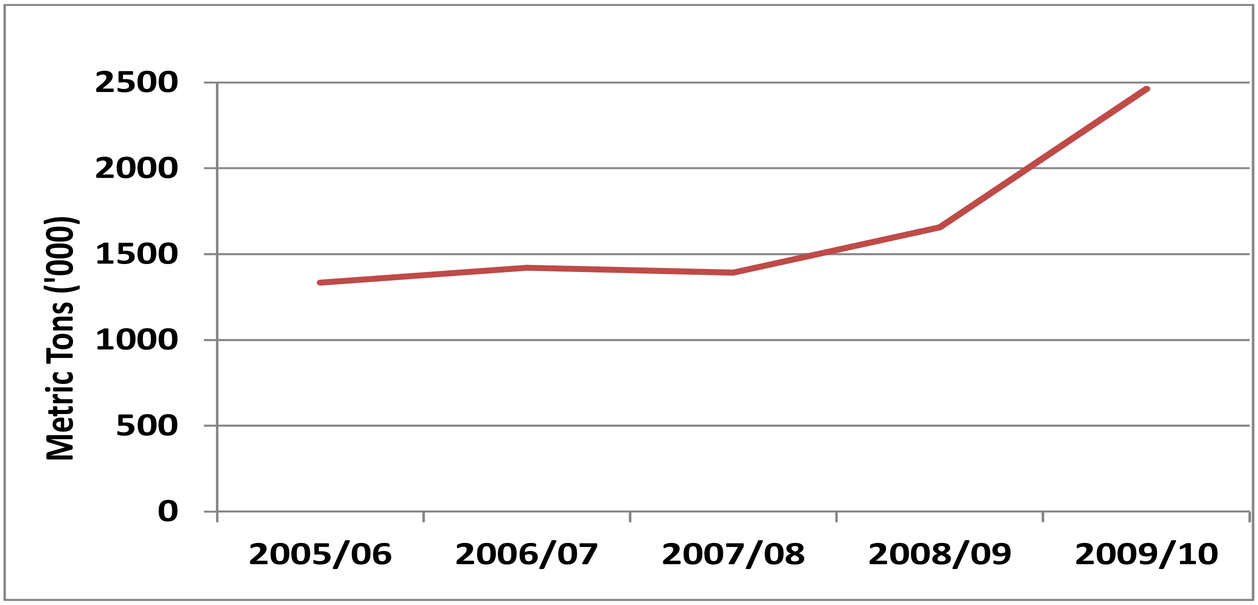

Figure 5. National Production of Maize for 2005/06-2009/10 Period

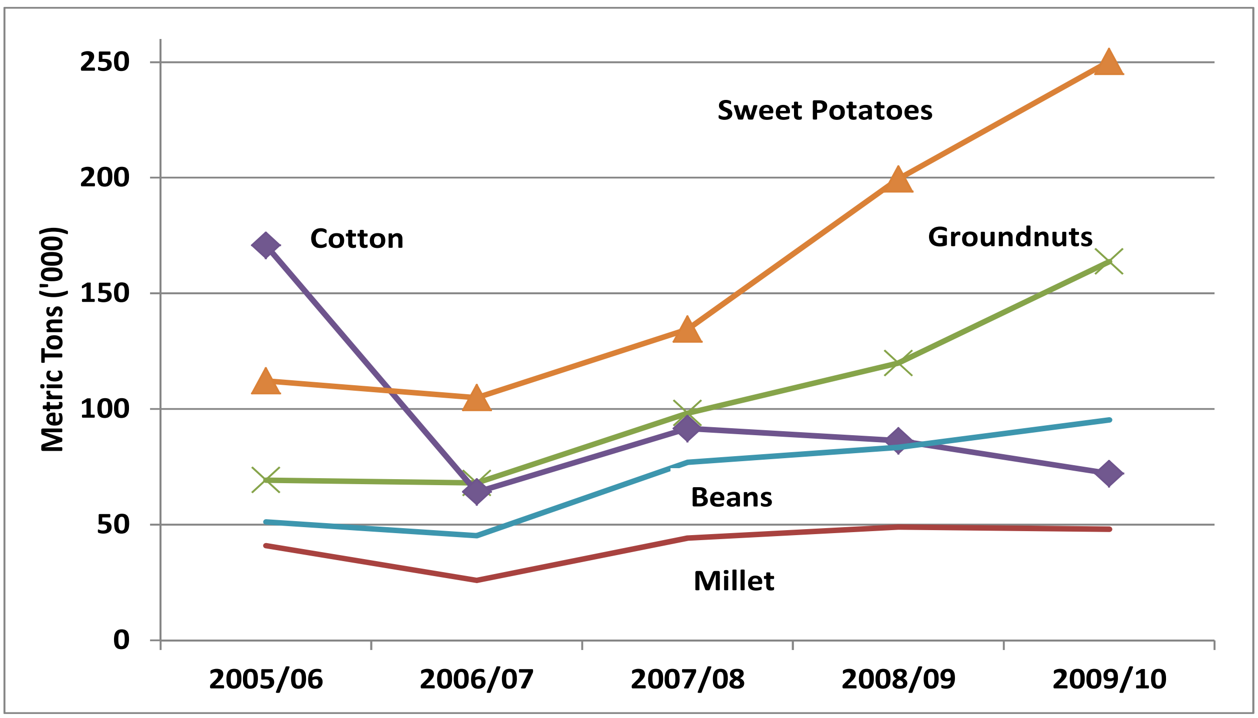

Figure 6. National Production of Other Crops for 2005/06-2009/10 Period

In general, apart from cotton, which had decreased production, crops have experienced an average positive growth over this period (Figure 5 and 6).

Typically, crop yields produced by smallholder farms are comparatively lower than for commercial farms. Recent trends indicate upward movement for maize and sweet potatoes, while those for millet, beans and cotton remain fairly consistent (Figure 7 and 8).

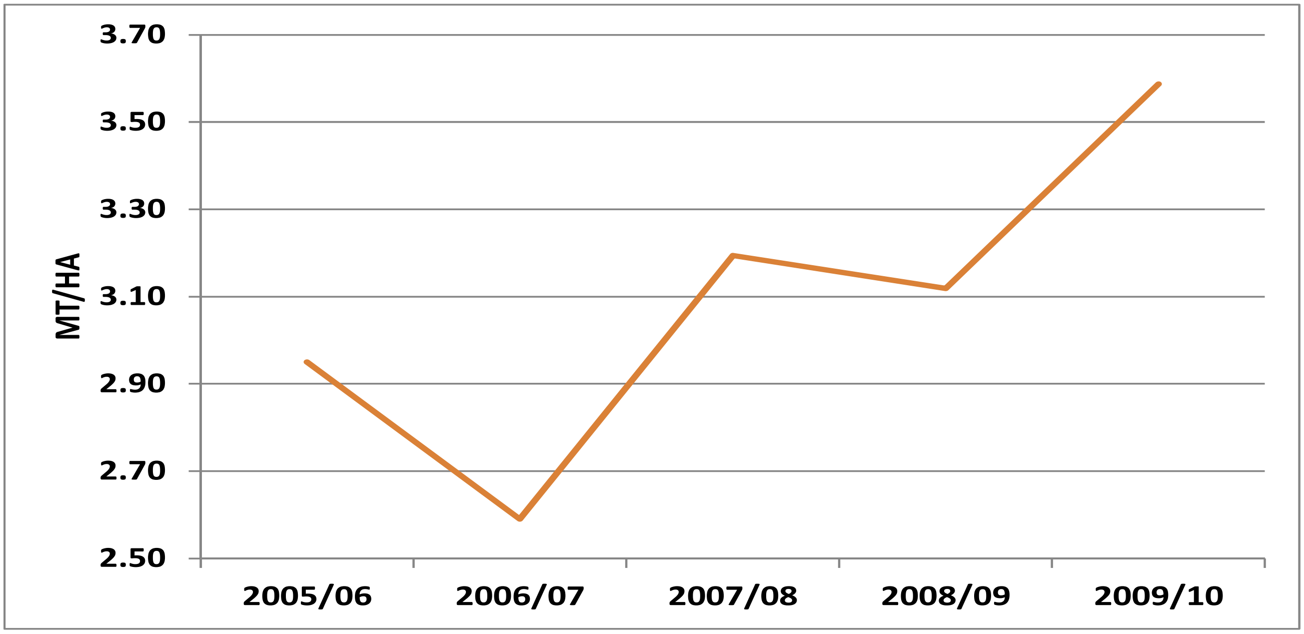

Figure 7. Average Yields for Sweet Potatoes for 2005/06-2009/10 Period

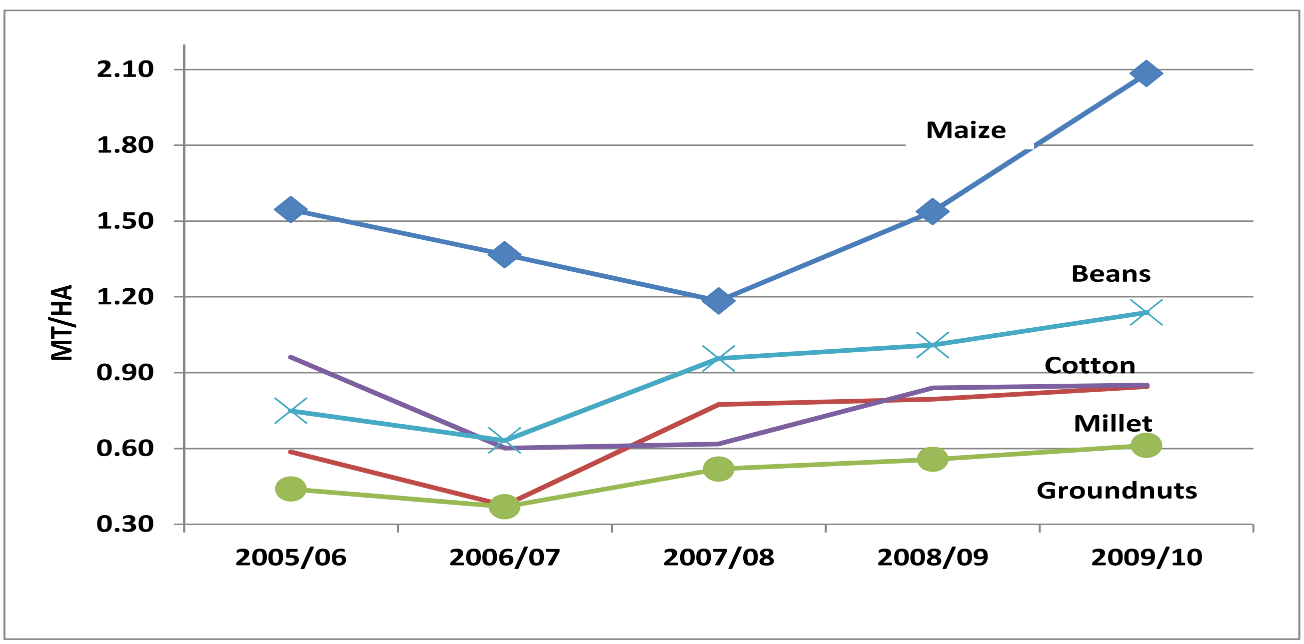

Figure 8. Average Yields for Other Crops for 2005/06-2009/10 Period

Yield potentials have not been met, in part due to insufficient rains, declining soil fertility and market conditions. Figure 9 exhibits the distribution of maize yields across different provinces in Zambia with the northern and central regions having relatively higher yields compared with the southern and western provinces of the country, mostly due to better rainfall and other agro-ecological conditions.

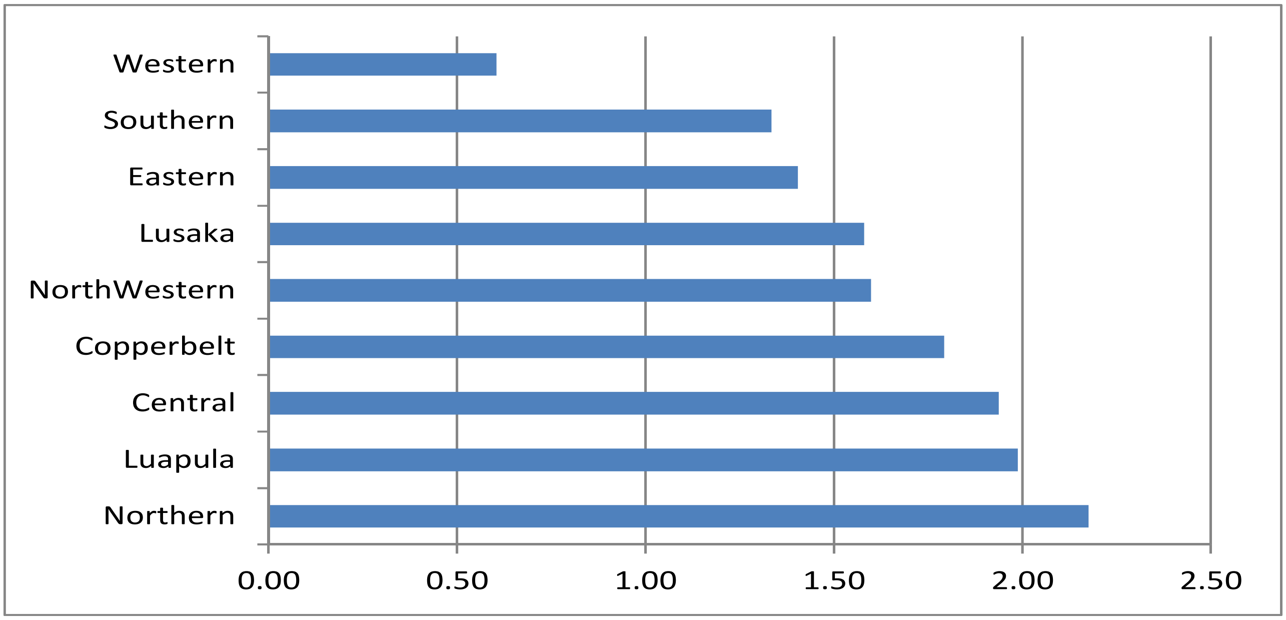

Figure 9. Average Yields (mt/ha) for Maize for Different Provinces – 2005/06-2009/10

4.0 Zambia's Fertilizer Market

4.1 Overview of Fertilizer Production and Consumption Patterns

FAO data indicate that SSA produces 0.1 percent of the world's fertilizer nutrients, consumes 0.9 percent, accounts for 2.2 percent of imports and 0.2 percent of global exports. The small share of the global market is a reflection of decreasing soil fertility, low application rates, unfavorable input-output price ratios and constraints to input and output market development (Gregory and Bumb, 2006; Ariga and Jayne, 2009). Like most SSA countries, Zambia depends on the international markets for its fertilizers, as local production is very limited and dependent on a state-run plant (Nitrogen Chemicals of Zambia [NCZ]) that is in need of major repairs/upgrades. There is some local blending by Greenbelt Ltd. and others. There has been considerable interest, with some efforts by several governments in SSA to encourage local or regional manufacturing in hopes of improving accessibility and productivity, while saving on foreign exchange and avoiding international price fluctuations. However, efforts in this area have not been successful due to a combination of factors, including the lack of detailed feasibility studies, resource limitations, insufficient regional demand to warrant investments and competition from relatively cheaper products from the Middle East and other sources (Gregory and Bumb, 2006).

Estimates of the profitability of maize in 1988/89 by the Ministry of Agriculture (GRZ, 1989) showed a VCR of 5.2, which was well above the threshold of 2. The high VCR indicated that using fertilizer on maize in the late 1980s was a profitable activity. The profitability index depends on the relative prices of grain and fertilizer and factors like rainfall that may contribute to the productivity of fertilizer indirectly. This attractive estimate might have been influenced by low fertilizer prices from significant subsidy support by the GRZ and donors. During this period, the fertilizer pricing policy was uniform throughout the country with a subsidy rate of 50 percent. This scenario was not conducive for development of private sector markets or encouraging efficiency in fertilizer markets.

Table 4. Total Fertilizer Consumed, 1995/96-2007/08

	GRZ Channels	Commercial	Total Fertilizer	GRZ Share of
1995/96	61,141	69,000	130,141	47%
1996/97	65,577	108,000	173,577	38%
1997/98	15,000	81,900	96,900	15%
1998/99	43,028	65,912	108,940	39%
1999/00	24,825	118,925	143,750	17%
2000/01	23,975	81,307	105,282	23%
2001/02	29,580	58,141	87,721	34%
2002/03	54,120	74,485	128,605	42%
2003/04	76,927	111,850	188,777	41%
2004/05	54,094	129,295	183,389	29%
2005/06	57,130	148,486	205,616	28%
2007/08	50,000	121,126	171,126	29%

Source: Xu *et al.* (2009). Note that data for 2006/07 is missing.

There has been a general increase in fertilizer consumption driven mostly by state subsidies, which currently account for more than 50 percent of the national consumption. Table 4 and Figure 10 show this slight upward trend in national fertilizer consumption during this period.

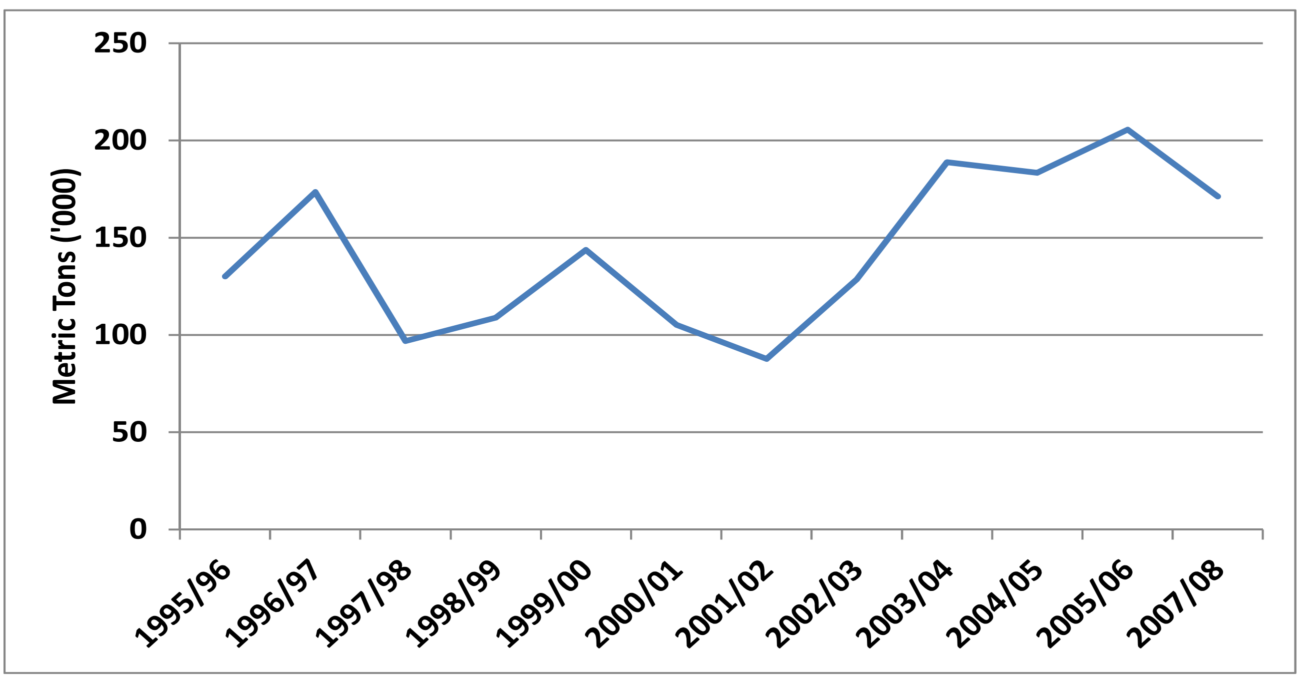

Figure 10. Trend in Total Fertilizer Consumption

4.2 Major Players in the Fertilizer Supply Chains in Zambia and Role of Subsidy

Though the market is a mix of public and private sector players, the state influences a number of processes along the value chain through the implementation of the Fertilizer Input Support Programme, or FISP.

4.2.1 Importation

Current national fertilizer consumption is estimated at 250,000-300,000 mt, of which approximately 200,000 mt is imported under the FISP, a subsidy program that focuses mainly on maize farmers. Estimates by some importers put the potential fertilizer consumption at 500,000 mt if the right policy environment were to prevail and farmers were to receive appropriate extension advice. The focus on maize has influenced crop mix in the country and influenced some farmers in unproductive areas to grow maize in order to receive the subsidy. The government is now encouraging diversification into export crops that can provide much-needed foreign currency. The subsidy consists of four bags of basal and top-dressing sold at a subsidized price of K50,000 (equivalent to US $9.09 at current exchange rates [July, 2013]), which is a small fraction of the commercial private market prices. This large subsidy influences the investment decisions of the private sector.

The number of importers who are also involved in wholesaling and distribution in Zambia is estimated at 13 and includes the following: Nitrogen Chemical of Zambia (government manufacturing plant near Lusaka), Greenbelt Ltd. (also trades and blends in Tanzania and Mozambique), Zambia Fertilizers Ltd. (does blends also), Bridgeways Commodities, Pro-vet, Nyiombo (Zambia-based), Omnia Ltd., Louis Dreyfus and Export Trading Group (ETG). Most of these companies are headquartered in South Africa. Some of the factors that limit entry include the small size of the market considering the competition from subsidies, financial requirements and logistics and management constraints in handling bulky products. A 20,000-mt cargo of DAP at current free on board (f.o.b.) prices will cost US $12 million to purchase at the source. Considering the capitalization of most SSA firms, this is a major hurdle without links to relatively cheaper international sources of finance.

The system works in the following manner. The FISP implementation agency decides on the amount of subsidy then asks for tenders from the importers. Bids are then selected based on a number of criteria that include prices. The tender process begins in March-April and takes about three months to award the tender to select importers (the validation period, June-August); it requires another three months to transport the product to Zambia (September-November). Apart from prices, the tender conditions also require tenderers to have some volume available in inventory during the tender period, which implies readiness to absorb some storage costs. The distribution of 200,000 mt of fertilizer across the country requires sufficient time and resources. This implies that it takes four to six weeks to supply these quantities across the country. This would be equivalent to about 300 trucks moving 15 tons of fertilizer each day during these final weeks – a huge task that, even if well planned, can lead to delays in fertilizer reaching the farms.

Usually, two companies receive the tender to supply fertilizers under FISP, while the losing bidders import fertilizers that they sell under competitive commercial market conditions parallel to the subsidy program. The major suppliers include Omnia, Greenbelt, Nyiombo and ETG. Nyiombo and Omnia dominate the government subsidy program, winning tenders most of the seasons. Greenbelt supplies sugar plantations, while Omnia dominates large farm sales. The FISP fertilizers are basically D-Compound (10-20-10) for basal and urea for top dressing across the country.

In addition, to keep the NCZ plant running, the FISP allocates some 30,000 mt to NCZ to blend and/or produce some of the products. NCZ, a state plant with 120,000 mt capacity for D-Compound, also uses imported raw materials to blend products in competition with private companies. Its monopoly was broken in 1991 with liberalization of the sector, which brought stiff competition; NCZ only barely survives, mostly due to state financing. It was allocated 33,000 mt of D-Compound to manufacture, but this level of output is becoming increasingly difficult to meet, as the plant has not been upgraded and some equipment requires replacement. Its allocation of FISP fertilizer has been in decline over the years. As a result, it operates sporadically, and currently the ammonia plant is completely shut down. The plant faces low capacity utilization, competition from the private sector that offers lower prices and government controls that offer less flexibility to fix problems. The NCZ is no longer blending. There is no economic reason to keep NCZ running since sufficient resources to maintain its operations have not been identified and most inputs are sourced outside the country. Thus, the plant is at a competitive disadvantage.

The commercial importers target large farmers and smallholders through their own distribution networks. Table 5 gives a rough idea of where commercial sales play a relatively significant role compared with subsidized fertilizer. The subsidy program has a substantial focus on maize-growing areas, crowding out commercial sales in some provinces (Table 5).

Table 5. Distribution by Province of FISP and Commercial Fertilizer Sales (2007/08) in MT

Region	FISP	Commercial	Total	% FISP
Western	1,156	111	1,267	91%
North Western	2,490	571	3,061	81%
Luapula	2,390	618	3,008	79%
Northern	6,836	4,292	11,128	61%
Eastern	9,240	10,187	19,427	48%
Southern	8,854	18,850	27,704	32%
Central	8,274	18,850	27,124	31%
Copperbelt	6,180	18,495	24,675	25%
Lusaka	3,100	49,152	52,252	6%
Total Zambia	48,520	121,126	169,646	43%

Source: World Bank (December 2009), adapted by authors.

Some of these importers also buy farm produce and process it for local and export markets. Maize, soybeans and groundnuts are the main crops that these firms process and package for local and international markets. This is one way that these companies are enabling farmers to access markets, which supports the purchases of inputs like fertilizers. It also spreads their risk across a wider enterprise mix.

4.2.2 Zambia's Domestic Fertilizer Value Chains

Some key supply chains for fertilizer in Zambia are depicted in Figure 11. The diagram focuses on domestic participants and does not include international players (manufacturers, shippers and others). There are basically two systems, commercial and subsidy, one consisting of importers who strictly handle commercial imports and the another dealing in both commercial and subsidy fertilizers (due to winning the tender bids); the NCZ manufacturing facility does not bid for supply tenders but is nevertheless contracted to supply D-Compound and other fertilizers using raw materials imported through local firms. To summarize, importers handle commercial and subsidy fertilizers and may also be contracted by NCZ to supply raw materials from international sources.

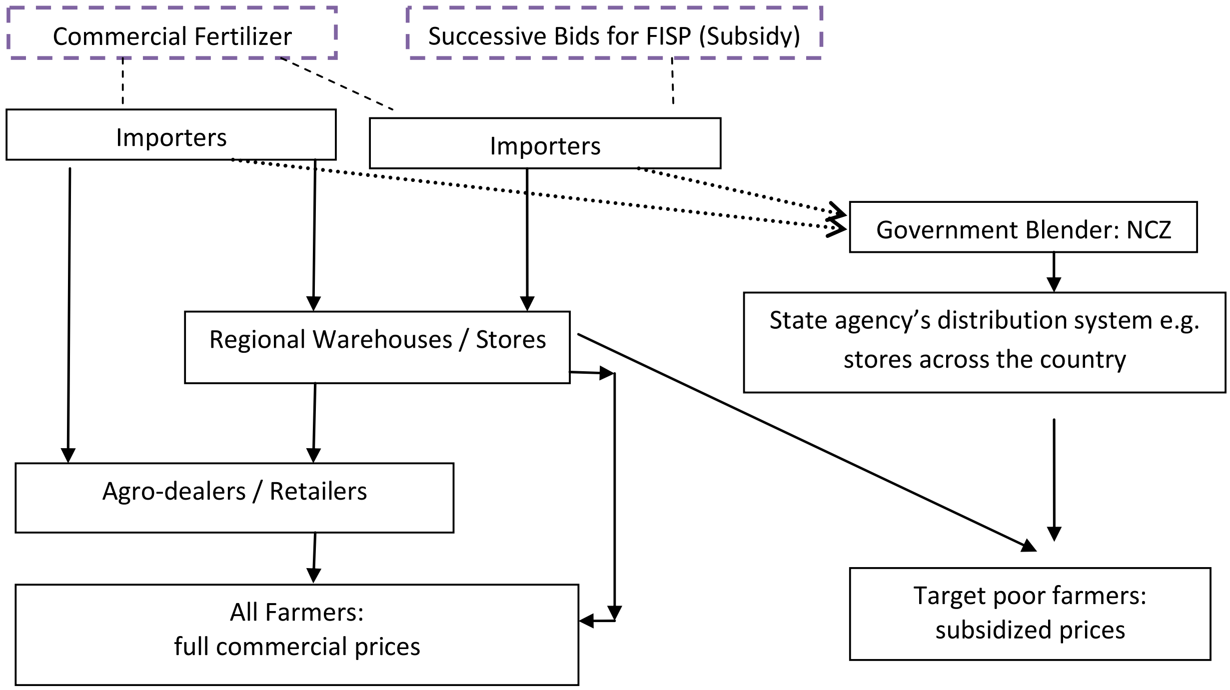

Figure 11. Key Domestic Value Chains for Zambian Fertilizer

Source: Authors using information collected from field interviews.

The subsidy chain is the most widespread, consisting of importers and NCZ through state agencies, regional warehouses and storage facilities to agro-dealers and ultimately farmers. This is the value chain that the government uses to implement its targeted subsidy program through warehouse stores across the country. Those importers who do not win bids for FISP subsidy fertilizers are involved in commercial fertilizer procurement in competition with importers who win the tenders and participate in commercial trade as well.

Although in some seasons the government does not meet import target quantities or experiences delays in delivery of imports, farmers still prefer waiting to purchase the cheaper fertilizer before they resort to purchasing it from the private sector at higher market prices.

4.3 A Breakdown of International and Domestic Fertilizer Distribution Costs

In pursuing ways to raise fertilizer consumption in Zambia, it is important to analyze domestic costs of distributing fertilizer from the port to the farm gate. This provides information that will guide decisions on specific areas to be targeted in order to mitigate costs so that retail prices are reduced. The supply chain costs consist of three major items (transport, transaction costs and trade margins). Of these three categories, transport costs generate the most interest; it is important to note that estimating business margins and transaction costs is challenging due to difficulty in getting reliable information and data on the individual elements (confidentiality and the difficulty of measurement). For this study, we use an estimate of margins from interviews with importers as a percentage of costs.

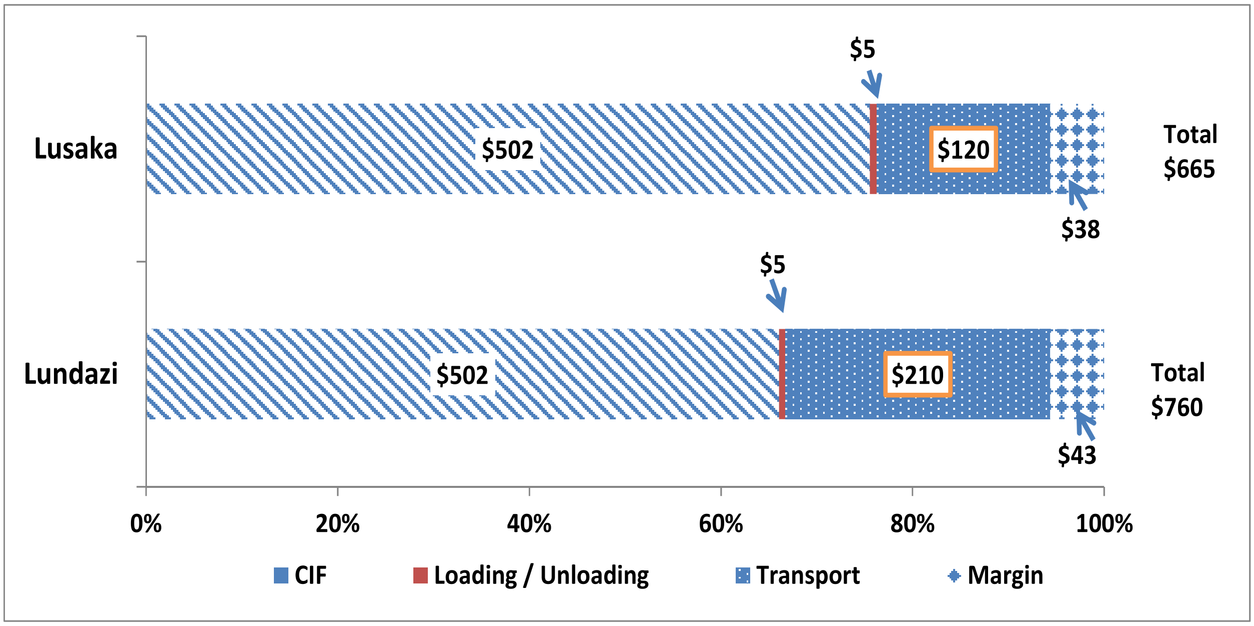

Figure 12. Total Cost Build-Up for D-Compound Fertilizer (10-20-10)

Source: Authors' calculations. Note that individual costs in US $ are inserted, while the axis shows the relative percentages of costs as proportion of the total.

Figures 12 and 13 illustrate the key costs from the port of Beira (Mozambique) to two locations in Zambia (the capital city of Lusaka and inland city of Lundazi). Lusaka is 2,000 km from Beira, and Lundazi is 770 km from Lusaka. Transport costs, margins and loading/unloading costs contribute 26 percent, 10 percent and 0.6 percent, respectively, of the farm gate price of US $760/mt at rural Lundazi. The balance consists of international costs.

In contrast, Figure 13 excludes the international freight, insurance and product costs (CIF) and analyzes only the distribution of domestic costs that can be influenced by policy or other public-private efforts geared toward reducing such costs. The contributions of these individual costs are compared with the total domestic costs. For instance, domestic transport costs account for between 74 and 81 percent of domestic costs of moving fertilizer from the port to these locations within Zambia. Total domestic costs amount to US $258 at Lundazi, where the farm gate price is $760/mt.

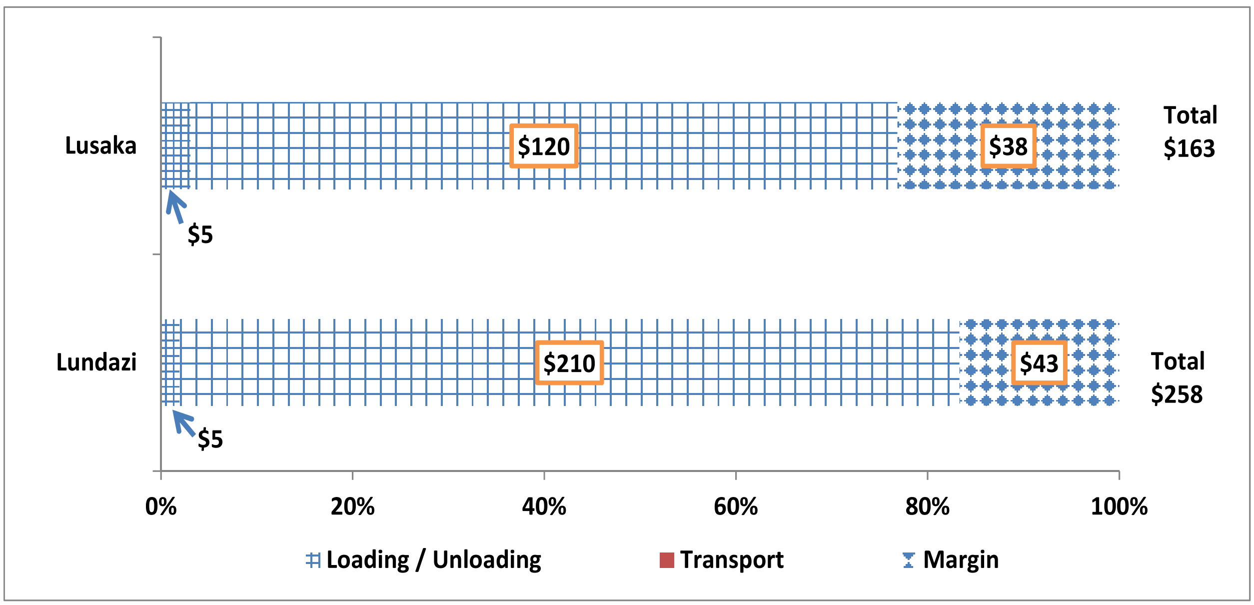

Figure 13. Domestic Fertilizer Costs for Zambia

Source: Authors' calculations. Note that individual costs in US $ are inserted, while the axis shows the relative percentages of costs as proportion of the total.

Inland transport costs add significantly to the cost of fertilizer. The margins are 'gross' (i.e., the internal costs incurred by the businesses related to the fertilizer activity, including labor, capital and overhead, are part of these margins); therefore, the 'net' margins are lower than that which is reflected here, depending on the respective costs for these firms.

Clearly, these costs create a challenge to improving the flow of fertilizers to farmers at attractive prices. Efforts toward increasing fertilizer consumption in Zambia will require designing ways to improve the efficiency of transport. The following sections examine ways to gain such efficiencies by tackling domestic infrastructure constraints, particularly in light of estimates of increased fertilizer required for reaching CAADP targets.

4.4 The Distribution of Fertilizer Use at the Farm Level

Table 6 shows the distribution of the subsidy across different farm sizes. Though the bulk of FISP fertilizer goes to farmers with less than five hectares, the proportion of farmers with more than five hectares who receive subsidy fertilizer is higher than that for smallholders. The data show that the fertilizer subsidy does not necessarily reach those with fewer resources, which brings into question the implementation strategy to avoid possible leakages and rent-seeking behavior.

Table 6. FISP Fertilizer by Farm Size Category (2010/11 Crop Season)

Area Under Crops	% Farm HHs	% Receiving FISP Fertilizer	kg FISP/HH
0-0.99 ha	39.6%	14%	24
1-1.99 ha	33.1%	31%	69
2-4.99 ha	23.5%	45%	140
5-9.99 ha	3.3%	59%	310
10-20 ha	0.5%	53%	346
Total	100.0%	29%	77

Source: MACO/CSO Crop Forecast Surveys, 2010/11 in Mason et al. (2011).

Figure 14 shows the percentage of smallholder farmers using fertilizer in the different provinces. On average, less than 30 percent of smallholders use fertilizers, though there is heterogeneity across provinces.

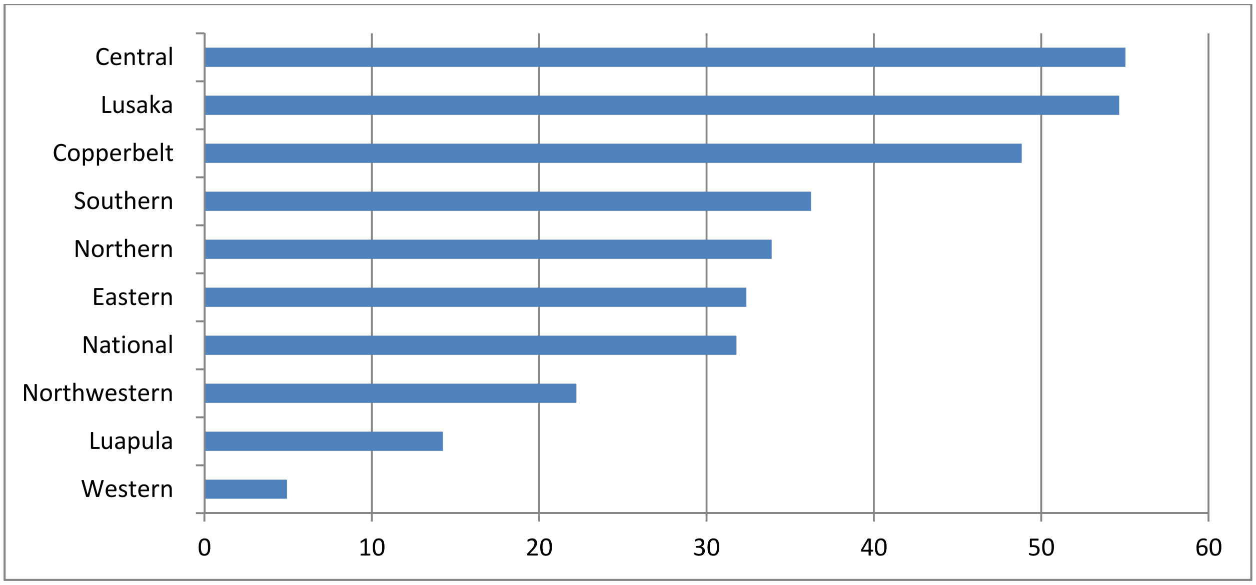

Figure 14. Percentage of Smallholders Using Fertilizer (Average 2006/07-2009/10)

Source: Adapted from Sitko et al. (2011).

4.5 Anticipated Changes to the Implementation of the Subsidy Program: e-Voucher Program

Currently, fertilizer subsidy prices are fixed pan-territorially and so do not encourage arbitrage, particularly for remote areas not served well by roads. Sometimes shortages in supply are caused by government procurement procedures that are bureaucratic and lead to late delivery, which contributes to poor yields; the situation is made worse by poor agro-dealer networks in Zambia. FISP handles a significant portion of total consumption nationwide, therefore the private sector is confined to supplying larger farmers or those farmers that the subsidy program does not reach. The GRZ has crowded out the private sector by distributing over 200,000 mt of the fertilizer requirements.

The FISP fertilizer subsidy program begins with the government floating a tender to which the importers make bids. In this 'open' tender, two to four bidders are selected to import primarily D-Compound fertilizers, which are then distributed as indicated in Figure 11. At the local level, the subsidy recipient pays the discounted fertilizer price at the bank, gets a deposit slip and then goes to a local MOCA office to get a letter allowing them to receive fertilizer from the nearest importer warehouse or store. Transport to the farms is provided by the government. Transporters of fertilizer from warehouses to farms are hired through a bidding process.

There are plans to introduce an e-voucher system[4] in order to widen import choices, as the private sector will supply what farmers demand rather than the current system under which farmers only choose from what the government has to offer through the subsidy program (typically D-Compound and urea). The planned e-voucher system will target 10 provinces with approximately 900,000 farmers and run parallel to the existing system in order to compare and choose the relevant system to scale up.

Some agro-dealers have been trained and linked to banks for efficient transactions. The e-voucher will be distributed to recipients who will now have a wider competitive choice; they will be able to purchase their fertilizer from stores in the private sector. The current subsidy system only allows recipients of coupons to buy from government stores or appointed dealers. Farmers now can shop for a better deal on both price and quality.

However, a problem with the e-voucher is rent seeking, where those with the connections and means can access FISP fertilizer at a subsidized price of US $10 per 50-kg bag and then sell the product at higher prices ranging up to about US $30. The government covers a substantial portion of the price, including providing transport from the stores to the farm gate. The FISP price has no relationship to the market price of fertilizer. The original plan was to phase out the subsidy by reducing the amount of subsidy per bag over time as a percentage of the market price, but this plan was not implemented. The sustainability of the subsidy program is not assured because it is a substantial part of the government budget. In addition, concerns about the efficiency of subsidy programs in SSA are raising funding questions among development partners.

[4] At the time of this report, the GRZ has indicated that this system is going to be implemented. At the same time, the GRZ has withdrawn consumer maize meal subsidy, citing unsustainability of the program and the need to look at alternative uses for these funds (http://www.mofnp.gov.zm/images/removal%20of%20subsidies.pdf).

5.0 Estimating Fertilizer Requirements

As indicated in the framework for linking inputs to outputs outlined in Section 2, the ideal way to estimate fertilizer requirements is to account for both market and agronomic relationships between inputs and agricultural commodities. However, in the absence of complete data sets such as production and fertilizer use by crop for each agricultural region over time, updated soil profiles and expected prices of inputs and outputs, the analysis is based on agronomic data. These estimates are intended to identify the basic issues that emerge as the public and private sector lay out the priorities underlying a realistic program for meeting the CAADP targets. We assume that as the process unfolds, these results will provide the basis for further discussions and analysis.

To provide a robust and reasonable range of estimates for the quantities of fertilizer required to achieve the CAADP targets, we first analyze the gap between current and target production levels (Table 7Table 7Table 7).

Table 7. Yield and Production Differences Between Current and CAADP Targets

		Yield		Total Production		
	Area	Current	CAADP Target	Current	CAADP Target	Gap (CAADP *less* Current)
	(‘000 ha)	(mt /ha)		(‘000 mt)		
Maize	1,068	1.54	3.04	1,649	3,243	1,594
Sorghum	37	0.50	0.99	19	37	18
Rice	27	1.19	2.34	32	62	31
Millet	63	0.67	1.32	42	83	41
Sunflower	48	0.40	0.78	19	38	19
Groundnuts	203	0.50	0.99	102	200	98
Soybean	26	0.71	1.40	18	36	18
Cotton	124	0.76	1.50	94	186	91
Irish Potatoes	1	2.39	4.71	2	4	2
Tobacco	9	1.10	2.17	10	20	10
Beans	77	0.79	1.56	61	121	59
Cowpeas	7	0.38	0.75	3	6	3
Sweet Potatoes	51	2.61	5.13	133	261	128

Source: MOCA and authors’ calculations. The maize gap is estimated at 1.6 million mt.

Table 7~~Table 7~~Table 7 reveals the gaps between the CAADP targets and current production and sets the stage for the discussion below. These CAADP targets are discussed in Zambia's national country development plan for the period 2004-2015.

5.1 The Nutrient Use Estimates for Maize and Other Crops

We construct estimates of fertilizer requirements for crop targets based on nutrient removal rates. This method estimates fertilizer requirements based on nutrients removed by harvested crops, adjusted to reflect fertilizer use efficiency. The approach assumes good management practices on the part of farmers, and that fertilizer application is designed to maintain rather than to build soil fertility levels. Nutrient levels contained in the incremental harvested crops were estimated then adjusted by efficiency factors for N, P and K.

Table 8 shows the results utilizing the nutrient removal method. The analysis indicates that incremental nutrient removal associated with the increased output of targeted crops would total 60,000 mt of nutrients.

Table 8. Using Nutrient Removal Factors to Estimate Fertilizer Requirements

	Incremental Production	Nutrient Removal			Incremental Nutrient Removal
		N	P_2O_5	K_2O	
	('000 mt)	(lb/mt of Production)			('000 mt Nutrient)
Maize	1,594	31.2	13.6	7.9	38.17
Sorghum	18	36.6	14.9	9.1	0.50
Rice	31	27.1	12.8	10.7	0.70
Millet	41	42.3	15.9	9.7	1.26
Sunflower	19	63.9	29.0	18.0	0.94
Groundnuts	98	87.4	16.5	13.8	5.25
Soybean	18	130.1	30.5	36.8	1.58
Cotton	91	54.3	23.7	32.2	4.56
Irish Potatoes	2	7.7	3.3	12.3	0.02
Tobacco	10	61.7	11.0	114.6	0.84
Beans	59	81.9	23.3	36.0	3.80
Cowpeas	3	60.0	15.0	30.0	0.13
Sweet Potatoes	128	11.5	5.1	22.0	2.25
Totals					60

Note: Numbers may not add due to rounding.

Source: Data from MOCA and authors' calculations using representative nutrient removal factors.

Table 9 adjusts the nutrient removal figures to reflect fertilizer use efficiency. This refers to the actual nutrient utilization by a crop per unit of nutrient applied. In this analysis, we used efficiency factors of 50, 35 and 70 percent for N, P and K, respectively. This calculation shows that the incremental nutrient volume required to be applied to the targeted crops will total approximately 125,205 mt, which is equivalent to 247,824 mt of urea, DAP and potash combined.

Table 9. Incremental Nutrient and Product Requirements for Target and Major Crops

Crop Categories	Nutrient Tons	Product Tons
CAADP Target Crops	125,205	247,824

Sources: Authors' estimates based on nutrient removal factors. The product conversions are to equivalent tons of urea, DAP and MOP.

These results point to the need for a significant increase in Zambia's fertilizer utilization in order to meet crop production targets. The analysis shows an increase of approximately 248,000 product tons in order to meet production targets. The country will therefore need to essentially double fertilizer consumption from the current level of about 250,000 mt in order to achieve the targeted crop production levels.

6.0 Key Challenges in Fertilizer Value Chains

6.1. Dealing with Challenges in Fertilizer Value Chains to Meet Agricultural Growth Targets

In the following sections, we discuss the challenges across the fertilizer value chain and possible responses to mitigate or eliminate them so that fertilizer consumption increases to meet the agriculture sector goals set in national development plans.

6.1.1 Inadequate Port, Rail and Road Infrastructure: High Port and Transport Costs

A number of studies conclude that a major impediment to international trade in SSA is the state of the ports (JICA, 2009). The port capacities have not been modernized or expanded to meet the increased flow of goods, which increases pressure on existing facilities. The time from which the ship docks until the goods reach Lusaka or other hinterland locations can span more than 20 days.

The slow clearance at these ports is not just a reflection of the volume of containers that are handled at the port, but also the inadequacy of existing facilities. On arrival at port, vessels must be allocated a berth, which may take several days. Once berthed, offloading averages 1,500 mt/day. At these rates, a 20,000 mt cargo ship will take almost two weeks to have its cargo offloaded. Assuming that there is increased vessel traffic, this may require more than two weeks. Demurrage costs begin to accrue after 10 days, so these delays lead to increased financial costs and the risk of not meeting deliveries at various destinations.

The poor condition of the road and rail systems used for inland transport hampers product movement out of the ports. The rail network is generally poor and in some areas is nonexistent, which leaves the road network as the main mode of transport in this region. Most of the road infrastructure is also in a poor state, adding to costs for truck maintenance and increasing haul times. Zambia receives most of its imports through Beira, Dar es Salaam and South African ports, implying long haulage distances along mostly poor roads.

Road transport costs are exacerbated by numerous roadblocks and weighbridges which, along with poor infrastructure and other non-tariff barriers, have been identified as leading causes of high marketing costs (JICA, 2009).

Delays in clearing through the ports and road systems are problems that increase the cost of fertilizer and also affect general business competitiveness by raising costs of goods relative to other regions in the world. Without improvements in these areas, the increased demand will overwhelm the system and raise costs for businesses and farm gate prices.

6.1.2 Farm-Level, Demand-Pull Constraints

Three farm-level issues are of particular interest in their influence on demand for fertilizers (i.e., as fertilizer demand-pull factors). Soil fertility is low and in decline due to insufficient use of nutrients (organic and inorganic fertilizers), particularly for smallholder farmers. For farmers to use best management technologies, it is important that these technologies are relevant to the environment that exists on these farms, so encouraging soil testing and use of appropriate fertilizers and their blends will be a crucial step. The planned e-voucher system may alleviate this problem by increasing competition and choice of fertilizer products at the retail level. Studies indicate that the current FISP implementation process is not effective, as it results in late fertilizer deliveries, has crowded out the private sector to some level, involves leakages, is not well targeted and is not sustainable, as it consumes a significant proportion of the budget allocated to agriculture (Chiwele and Moyo, 2011). If the planned e-voucher system is implemented with the envisaged 'smart' structures in place, there will more private sector participation at the retail level, which will allow farmers to choose not only the type of fertilizer that fits their requirements but also the right quality and at the right time. This will help deal with the problem of high acidity of soils in Zambia.

There is inadequate on-farm storage for most smallholders, forcing farmers to sell their produce at harvest when prices are considerably lower. This implies that most smallholder farmers do not store their produce to take advantage of higher prices later in the season. In addition, farm storage is closely linked to efficient output markets, which will drive the demand for inputs. If farmers are not able to sell their produce at favorable prices, then it is less likely for them to adopt or use improved technologies. Warehouse receipt systems and interlinked input-output arrangements between famers and agricultural output processors are examples of ways to solve this problem.

6.1.3 Challenges That Cut Across the Supply Chain (and Participants)

6.1.3.1 Macro Policies: Exchange and Interest Rates

Issues associated with access to finance by farmers, retailers and importers are not new. Smallholder farmers have poor access to sources of capital to purchase improved technologies such as fertilizer in Zambia. This has led to government intervention in the form of fertilizer subsidies, along with training and extension efforts, to expose farmers to the benefits of fertilizer use. Since these farmers sell their crops immediately after harvest (when prices are low) to meet various needs, when the next planting season comes, they often lack the funds to buy fertilizers and hybrid seed. Those selling to government agencies in the hope of getting better prices must wait an inordinate amount of time for payments, therefore incurring additional hidden costs; this latter situation leads some farmers to sell to private buyers who pay promptly, though their prices may be lower than government agencies' prices. Prompt payments by FRA for maize purchases and implementation of activities that help develop demand for fertilizers as explained herein may provide opportunities for improving farm incomes. This capital constraint is associated with the financial institutions' view of agricultural investments as being a *relatively greater risk* compared with manufacturing and services. Access to credit is further limited by *high costs*, with interest rates as high as 30 percent, combined with *poor knowledge* by farmers on how formal credit arrangements work and constraints involved with *land policy and tenure*, preventing the use of land as collateral.

For the large importers, the finance situation is considerably different. They face a rigid foreign exchange regime at home but better financing options internationally. They have access to international finance through their multinational linkages unlike the smaller dealers, wholesalers and retailers who find collateral and high interest rates to be a major challenge. Nevertheless, domestic policies (exchange and interest rate regimes) should be designed to encourage increased private sector investments. The current exchange rate policy that demands foreign currency be converted to the Zambian Kwacha and all domestic transactions be done in local currency has created a risky situation for international traders who must convert currencies at rates that are not favorable; they also find it difficult to hedge under such inflexible conditions.

6.1.3.2 Human Capital Development and Access to Information

Adoption of new technology requires training on its use and information on the benefits accruing from investment in the technology. A large proportion of smallholder farmers have no knowledge of how to use fertilizer and the benefits that accrue from its use. Even though some import firms, ministry of agriculture and development partner organizations are assisting in training some agro-dealers on fertilizers, this is still miniscule and requires extensive scaling. For fertilizer use to increase significantly, more training through demonstration farms and other fora will be an important ingredient in increasing adoption by farmers that are not using fertilizer; this will also encourage farmers who are using fertilizer at suboptimal levels to increase their application rates.

6.1.3.3 Legal and Regulatory Framework

There is no formal policy dealing with fertilizer quality in Zambia. Though fertilizers are inspected by the ZBS at the border of entry, results often do not reach importers at all, which defeats the purposes of such inspections. The limited choices of fertilizers do not allow farmers to choose appropriate products for their crops and soil conditions. D-Compound and urea are the main fertilizers imported and used widely in the country across different crops and agro-ecological conditions. This has been a legacy from the previous government control system involving the NCZ manufacturing plant and the subsidy program that maintained the status quo.

7.0 Conclusions and Recommendations

The broader objectives of Zambia's agricultural policies are to increase productivity, raise rural incomes and reduce rural poverty in a sustainable manner, with fertilizer as the key input. Fertilizer policy is influenced by the actions of the FISP and FRA, two programs that work in tandem to supply fertilizer and market maize grain. Together, they account for a significant portion of the public budget allocated to agriculture. The actions of these two programs/agencies have worked to almost exclusively encourage maize production through intensification and extensification in order to take advantage of high output prices and subsidized fertilizer.

However, the relatively high producer prices offered by FRA accrue to few farmers that produce enough to sell to the market, and these high prices do not benefit the majority of consumers (FRA acts as a price setter in the maize market, generally raising maize prices throughout the market). Therefore to improve food security, it is important that there is an overall increase in production, which will lower prices for consumers who constitute the majority of the population. On the input side, FISP has issues delivering fertilizer to farmers; the system involves leakages, late delivery to farms and crowds out private investments – all at a huge cost that is not sustainable unless there is significant donor support.

To meet the CAADP agricultural goals for Zambia, this study estimates a substantial increase in fertilizer consumption. For the current fertilizer market value chain to accommodate increased volumes of fertilizers to meet the growth in agricultural production as per country investment plans, a number of issues must be addressed including:

- ***The status of 'hard' infrastructure: Poor port, rail and road facilities*** and inefficient operations add to the cost of fertilizer. Though Zambia cannot influence port operations, because the ports are controlled by other countries, the domestic cost of moving fertilizer from the port to farms is a significant portion of total farm gate prices. There is a need to increase the efficiency of current rail and road operations, which may require a regional approach. Efforts by regional governments to quantify and prioritize investment in this area are warranted.
- ***Training of farmers/dealers and input-output market development*** **–** Estimates show that fertilizer imports must double in order to meet the growth targets for the agriculture sector. The current fertilizer adoption rate is around 30 percent of households. It is crucial that farmers who are not using fertilizer learn the benefits of using fertilizer and how to use the input effectively; at the same time, those already using fertilizer must be informed and encouraged to strive for maximum economic yield. Just as important will be the development of a viable output market for the increased production. Farmers will not incur costs to increase production if they do not have access to a market for their surplus production. These simultaneous efforts to create demand at the farm level and to develop the input and output markets are the only ways that the increase in fertilizer requirements can be achieved and sustained. It is encouraging to see that a number of fertilizer suppliers are responding to the needs of the sector by investing in processing plants for agricultural produce; more investments in this area will add value and encourage farmers to increase production, particularly if they are linked to such firms.
- ***Farm storage or warehouse receipt system*** **–** Most smallholder farmers sell their produce immediately after harvest when prices are at their lowest. Farmers do this to meet immediate needs and also because they lack alternatives due to poor storage facilities at the farms. Post-harvest losses can be as high as 30 percent of the output. These two actions create immediate problems: (1) farmers miss higher prices later in the season, which would be possible with storage; and (2) the low prices for output may lower the chances of these farmers buying

fertilizers in the future. Taking advantage of relatively higher post-harvest output prices can encourage input adoption by farmers. Encouraging financing mechanisms that link output and input markets in a peer-group situation in which suppliers deliver inputs on credit and deduct their cost from the sale of output from farmers can also be useful. For instance, a warehouse receipt system can provide farmers with the option of using their produce as collateral for input credit.

- ***Policy and ad-hoc state intervention*** – There is general agreement, even by private sector businesses, that temporary and targeted subsidies can help increase the number of farmers using fertilizers, which can be beneficial for businesses as well. However, intervention negatively affects business when the rules for state intervention are not clearly communicated and consistent, sending the wrong signals through the market. The amount of fertilizers, the timing of imports and distribution, the prices to farmers and all relevant aspects of government subsidy operations should be transparent and strictly adhered to. In addition, subsidies should be "smart" (i.e., targeted to those who need them the most), utilizing rather than disrupting the private sector system – and they should be temporary. Examples from Africa show that prolonged subsidies are a burden to taxpayers and also disruptive to private investments and can quickly become unsustainable. A smart subsidy program that raises competition among suppliers and leads to a wider set of fertilizer products that meet different soil and crop requirements while offering farmers a choice of sellers, and products should be pursued in place of a blanket subsidy that distorts markets.
- ***A regional perspective in fertilizer marketing and trade*** is therefore necessary for the region, with each country carving out a more viable fertilizer market. It is important to remove all constraints that hinder the development of a vibrant private sector-driven fertilizer industry. Moreover, well-facilitated fertilizer trade within the region is likely to result in reduced distribution costs and ultimately spur growth in fertilizer demand. Other challenges are created by the differences in fertilizer regulations and legislation in the region, including different tariffs and taxes and inadequate enforcement capacity. Addressing these issues will enhance the realization of economies-of-scale and efficiency gains to stakeholders.

8.0 References

Ariga J.M and Jayne T.S. 2009. Private Sector Responses to Public Investments and Policy Reforms: The Case of Fertilizer and Maize Market Development in Kenya. IFPRI Discussion Paper 00921. This paper has been prepared for the project on Millions Fed: Proven Successes in Agricultural Development (www.ifpri.org/millionsfed).

Chapoto A. and Jayne T.S. 2011. Zambian Farmers' Access to Maize Markets. Working Paper No. 57, Food Security Research Project, Lusaka, Zambia.

Chiwele D.K. and Moyo F. 2011. Study on the Implementation and Management of the Farmer Input Support Programme: Zambia Case Study. NEPAD Coordinating and Planning Authority

Gregory, D.I. and Bumb B.L. 2006. "Factors Affecting Supply of Fertilizer in Sub-Saharan Africa." Agriculture and Rural Development, Discussion Paper 24, World Bank, Washington, DC.

GRZ. 1989. A New Fertilizer Marketing System for Zambia. Ministry of Agriculture, Planning Division. Lusaka, Zambia

GRZ. 2011. Zambia Comprehensive Africa Agriculture Development Programme Compact. To support the Successful Implementation of the National Agricultural Policy and the Vision 2030 through National Development Plans

GRZ. 2010. Medium Term Budget Call Circular.

GRZ. 1991. Fertilizer Situation and Markets in Zambia. Ministry of Agriculture.

JICA. 2009. The Research on the Cross-Border Transport Infrastructure: Phase 3. Japan International Cooperation Agency.

Kuteya A.N and Jayne T.S. 2012. Is the Government of Zambia's Subsidy to Maize Millers Benefiting Consumers? Working Paper 67. Indaba Agricultural Policy Research Institute (IAPRI)

GRZ. 2011. 2010/2011 Preliminary Crop Forecast Survey Report. MOCA and the CSO.

GRZ. 2004. National Agricultural Policy (2004-2015). Ministry Of Agriculture and Co-Operatives.

Jayne T.S., Burke W., Shipekesa A., Chapoto A. and Mason N. 2011. Zambia's Maize Policy Challenges: Issues and Options for CAADP. Meeting of Agricultural Cooperating Partners in Zambia. FAO/Lusaka.

Jayne T.S., Chapoto A. and Chamberlin J. 2011. Strengthening Staple Food Markets In Eastern And Southern Africa: Toward An Integrated Approach For CAADP Investment Plans. Policy Synthesis for Cooperating USAID Offices and Country Missions. http://fsg.afre.msu.edu/

Mason N.M., Burke W.J., Shipekesa A. and Jayne T.S. 2011. The 2011 Surplus in Smallholder Maize Production in Zambia: Drivers, Beneficiaries, & Implications for Agricultural & Poverty Reduction Policies. *Working Paper No. 58 Draft, Food Security Research Project. Lusaka, Zambia*

Sitko N.J., Chapoto A., Kabwe S., Tembo S., Hichaambwa M., Lubinda R., Chiwawa H., Mataa M., Heck S. and Nthan D. 2011. Technical Compendium: Descriptive Agricultural Statistics and Analysis for Zambia in Support of the USAID Mission's Feed the Future Strategic Review. Working Paper No. 52, Food Security Research Project, Lusaka, Zambia.

Xu Z., Guan Z., Jayne T.S. and Black, R. 2009. Factors Influencing the Profitability of Fertilizer Use on Maize in Zambia. Agricultural Economics: Volume 40, Issue: 4, Blackwell Publishing Inc., Pages: 437-446