"Supply and demand trends for fertilizer in Zimbabwe: 1930 to date": Key drivers and lessons learnt

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"Supply and demand trends for fertilizer in Zimbabwe: 1930 to date": Key drivers and lessons learnt

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Abstract

The fertilizer sector in Zimbabwe has evolved over the years in response to different policy changes based on the government's priorities on agricultural development. The industry grew from the 1930s that targeted primarily large scale commercial farmers, through the liberalization period of the mid 1990s, and recent changes that have introduced controls on the marketing system. Since 2000, following the fast track land reform program, Zimbabwe has faced food insecurity challenges that have been exacerbated by the political and economic crises. This prompted the government to adopt policies that have reduced private sector interests in fertilizer supply. In this situation where explicit fertilizer markets have been absent, relief programs have been leading in facilitating deliveries of fertilizers to poorer smallholder farmers located even in remote areas. The supply of fertilizers in Zimbabwe has been driven by government policy, finance and infrastructure while the demand has primarily been a function of farmer's capacity to acquire fertilizers, availability of water and farmers knowledge of fertilizer use. There is need for a policy shift that promotes a competitive fertilizer marketing to support a broader range of farmers in Zimbabwe leading to agricultural productivity growth. Investment in infrastructure is critical to reduce marketing costs and to boost fertilizer demand; policies that strengthen farmer's capacity to acquire fertilizers and increase their knowledge on fertilizer use complemented by technologies that promote water use efficiencies are needed.

Key words: *Fertilizer, supply and demand, policy reform, consumption trends*

Introduction

The trends in the supply of fertilizers in Zimbabwe have been driven by key factors such as government policy, market information, and infrastructure while on the demand side farmer's capacity to acquire fertilizers, availability of water (rainfall) and farmer's knowledge on fertilizer use have been key drivers. From 1930 to early 1990s the government maintained direct controls on fertilizer trading through foreign currency rationing. The demand for agricultural inputs including fertilizers increased during the period 1980 to 1987 owing to the growth in number and size of smallholder farmer's loans granted by Agricultural Finance Co-corporation and favourable weather (Rohrbach, 1989). In the 1990s the industry was liberalized (Rukuni *et al*, 2006:82). The liberalization removed price controls, subsidizes and access to foreign currency by few privileged firms. Although the fertilizer industry was in private hands, mandatory government approval of fertilizer compositions and import permit requirements still remained in place (Poulton *et al*, 2002:50). The reforms ushered in competition, but because of high entry barriers the traditional firms maintained a comparative advantage. Following the agrarian reform in 2000, the country was plunged into various problems ranging from foreign currency shortages, political instability and hyperinflation and this affected fertilizer production and consumption (FAO, 2006:25). Crop productivity dropped significantly and this was compounded by a series of droughts. The government started distributing subsidized seed and fertilizers to the resettled farmers while majority of

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the farming community continued accessing fertilizers from the private sector which was however expensive and in short supply. The government subsidized programme was affected by corruption, beauracracy and widespread defaults and it failed to stimulate increased productivity (FAO, 2006:27). Poverty and food insecurity stemming partly from low agricultural productivity persisted in the country resulting in the donor community responding by distributing relief seeds and fertilizers to the vulnerable households to boost their crop yields. Such relief programmes are still operational to date but with varying distribution channels as well as total amounts (Rohrbach *et al*. 2004:29).

To create a vibrant fertilizer industry there is need for a policy shift that promotes competitive fertilizer marketing to support a broader range of farmers in Zimbabwe leading to agricultural productivity growth. Investments in infrastructure (roads, telecommunications) are critical to reduce marketing costs. To boost fertilizer demand; policies that strengthen farmer's capacity to acquire fertilizers, increase their knowledge on fertilizer use, promote investment in agricultural research and extension, complemented by technologies that promote fertilizer water use efficiencies are needed. Capacity building of fertilizer actors and forging strategic partnerships is needed to create a dynamic fertilizer supply in the country. Recognition of fertilizer as a strategic commodity, development of regional agricultural and fertilizer policy as well as harmonization of fertilizer trade protocols in the Southern African Development Community (SADC) region stands to benefit the country's fertilizer sub-sector (Kachere, 2006:18). If subsidies are any policy options for the government, then it is imperative to link it to voucher redeemable in retail shops, involve a wide range of importers and suppliers, improve the targeting efficiency and avoid displacing the fertilizer sales through rural retailers.

The objectives of this paper are to: (a) identify the fertilizer supply and demand trends in Zimbabwe from 1930 to date, (b) identify the key drivers of fertilizer supply and demand and, (c) identify the key lessons learnt.

Conceptual Framework

We present a conceptual framework to show the current state of the fertilizer industry in Zimbabwe and how it has to be improved. Figure 1 portrays the supply and demand situation at two levels. The first level, demonstrated by supply curve (S_1), depicts a relatively inefficient fertilizer sub sector delivery system that delivers a small quantity of fertilizer (Q_1) to farmers at a relatively high price (P_1). This high cost inefficient fertilizer market is characterized by government interventions, subsidies, poor market information, poor infrastructure and constrained agribusiness finance. The industry has a lower fertilizer demand (D_1) caused by farmers inability to purchase fertilizer due to cash and credit constraints, high fertilizer prices relative to controlled producer prices and inadequate water to complement fertilizer use. The supply and demand scenario typically mirrors the current status of fertilizer marketing in Zimbabwe over the last three decades. The fertilizer industry needs rejuvenation. We hypothesize that Zimbabwe can deliver fertilizer efficiently to farmers at low cost and this can be attained by shifting the supply curve to (S_2) which delivers large quantities of fertilizer to farmers at lower prices (P_2). Increased fertilizer supply has to be matched by adequate demand for the markets to be stable and this is only achievable by removing the demand constraints, so that fertilizers demand shifts from (D_1) to (D_2).

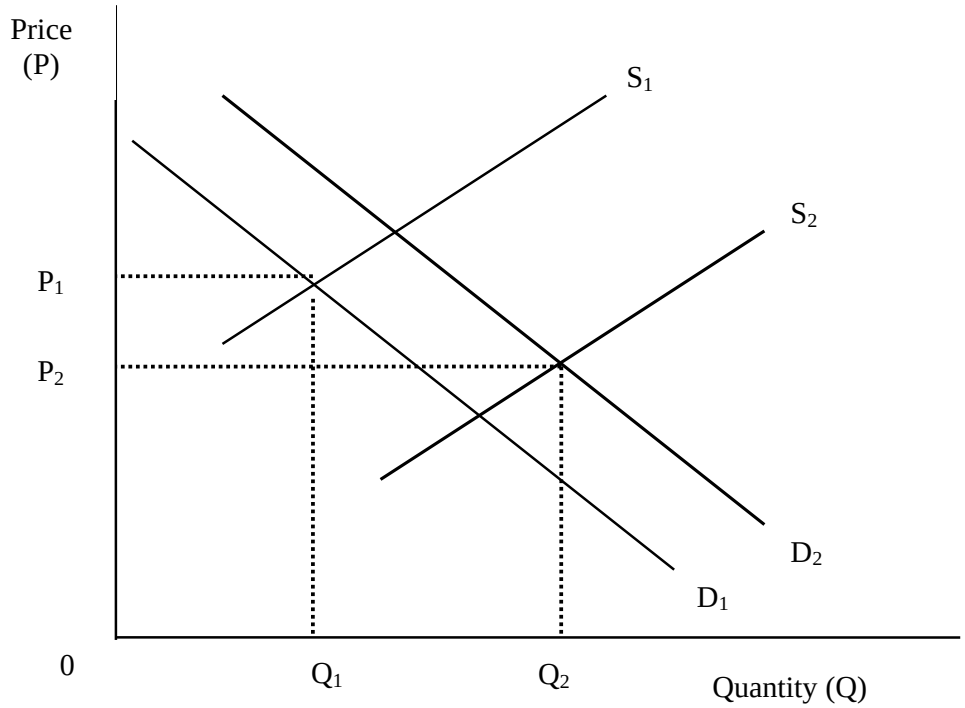

Figure 1: The conceptual framework, shifting supply and demand curve to the right

Source: Adapted and extended from Gregory and Bumb, 2006: 28

Major developments in the fertilizer industry since 1930

The fertilizer industry has been conditioned by a series of policy developments occurring since 1930s (Table 1). Prior to 1980, the agricultural policies were directed to large scale commercial farming sector and thereafter the country adopted a dual agrarian system (large scale and smallholder farming sector) and policies were enacted to cater for the two sectors.

Table 1: Developments in the fertilizer industry since 1930

Time	Major developments in the industry
1930	Fison Albatros formed to market fertilizers and chemical products. The African Explosives and Chemical Industries of South Africa formed a subsidiary to manufacture fertilizers and other chemicals in Harare using imported raw materials
1939	Rhodesia Plough and Marketing Company (later called Zimbabwe Phosphate Industries) succeeded the subsidiary of African Explosives and Chemical Industries and manufactured sulphuric acid, super phosphates, stock feeds, and water treating chemicals
1952	The Fertilizers, Farm Feeds and Remedies Act was enacted to regulate and support the growing fertilizer industry powered by expansion of the large scale commercial agriculture
1965	The Fertilizers, Farm Feeds and Remedies Act were amended. The United Nations imposed sanctions on the country following the Unilateral Declaration of Independence by the Smith Government
1969	Sable Chemicals was established to seal off mandatory sanctions (restrictions on importation of raw materials and finished products) on the country imposed in 1965
1970	Windmill, an American fertilizer company was acquired by the local consortium of Cotton Growers Association, Zimbabwe Tobacco Association, Commercial Grain Producers' Association and the Farmers Cooperatives
1971	The Rhodesia Chemical Industries later called Zimbabwe Fertilizer Company Limited (ZFC) after 1980 was formed as a result of a merger of the fertilizer and crop chemical interests of African Explosives and Chemical Industries, Albatros Fisons and Pest Control Limited of Central Africa. It manufactured fertilizers, disinfectants, animal dips, pesticides and herbicides
1972	The Rhodesian Plough and Marketing Company later called Zimbabwe Phosphate Industries (Zimphos) after 1980 started utilizing phosphate rock concentrates from Dorowa mine and iron pyrite from Iron Duke Mine. Fertilizer Regulations Act was enacted to regulate and maintain quality control to prevent adulterations of the products. All fertilizer and agro-chemical companies were compelled to register their products through the Ministry of Agriculture
1980s	The government controlled fertilizer production and trade through the allocation of foreign exchange and interventions in domestic trade. The government promoted the use of hybrid maize seed, fertilizers, pesticides and farm equipment by smallholder farmers as well as marketing depots were set up in communal areas to promote smallholder farming. The agricultural input priority committee was established by the Ministry of Agriculture to provide estimates of national fertilizer requirements, and other inputs to enable proper forecasting of foreign currency requirements for fertilizer imports. Agricultural Finance Corporation, provided credit to rural farmers to purchase fertilizer and other relevant inputs
Early 1990	The International Monitoring Fund (IMF) and the World Bank encouraged the Government of Zimbabwe to embark on an Economic Structural Adjustment Program (ESAP), aimed at improving efficiency in the economy through widespread removal of state controls on the markets. ESAP ushered in competition in the seed and fertilizer industry. Seven companies entered the fertilizer market as agents and sold fertilizer or related products. These were: Agricura, Cyanamid, Technical Services, Sprayquip, Graniteside Chemicals, Agrevo and Milborrow. Ciba-Geigy, Hoeschst, Bayer, BASF, and Rhone-Poulenc, subsidiaries of multinationals also sold fertilizers directly to smallholders and commercial farmers, thus improving the performance of the fertilizer supply system
Late 1990s	Following liberalization, government support to agricultural credit unions, such as the Agricultural Finance Corporation declined. Cooperative unions that normally mobilized input support to smallholder farmers across the country were equally affected and their share of trade sales dropped from 52% to 1% between 1985 and 1994. ZFC attempted to open smaller fertilizer depots to serve rural farmers but the initiative proved not viable owing to seasonal demand and these were closed. CARE and African Center for Fertilizer Development initiated an agro dealer project in five districts of Masvingo and Midlands provinces in order to improve fertilizer access to local smallholder farmers in 1997. The operation of these agro dealers were severely affected by the economic crisis that affected the country since 2000
1992 to 1998	The government ran the free crop pack program from 1992-1997, following the 1991/92-drought season. It targeted the drought affected smallholder households and sought to help them achieve food security. The free crop pack consisted of seeds, fertilizer (50kg each of Ammonium Nitrate and Compound D). Though the program boosted maize production in the smallholder farming sector, the government stopped it in 1998, because it was drawing heavily on the fiscal budget

Source: Various sources; Rohrbach *et al*. 2004; Rukuni *et al*. 2006:280; Rusike and Sukume, 2006;

The fertilizer sub sector post 2000

Figure 2 shows that fertilizer in Zimbabwe is supplied through a mixture of domestic production and imports (commercial and aid imports). On the domestic market, Sable Chemicals and Zimphos have comparative advantages in the production of ammonium nitrate and phosphate fertilizers respectively and they supply them to ZFC and Windmill in proportions to their market shares (FAO, 2006) and this have in the past benefited Sable and

Zimphos because they reduced inventory costs, and ZFC and Windmill had guaranteed raw material supply. The donor community have been actively providing relief fertilizer to vulnerable smallholder farmers since 2000, following food insecurity problems stemming from chaotic agrarian reform, series of droughts and political instability. To support the agrarian reform programme, the Government started distributing subsidized fertilizer to newly resettled and smallholder farmers through state agencies (e.g. Grain Marketing Board (GMB). The programme was however plunged by bureaucracy, corruption and arbitrages by the recipient farmers. On the other hand a few Non Governmental Organizations have been pilot testing fertilizer distributions through retail shops.

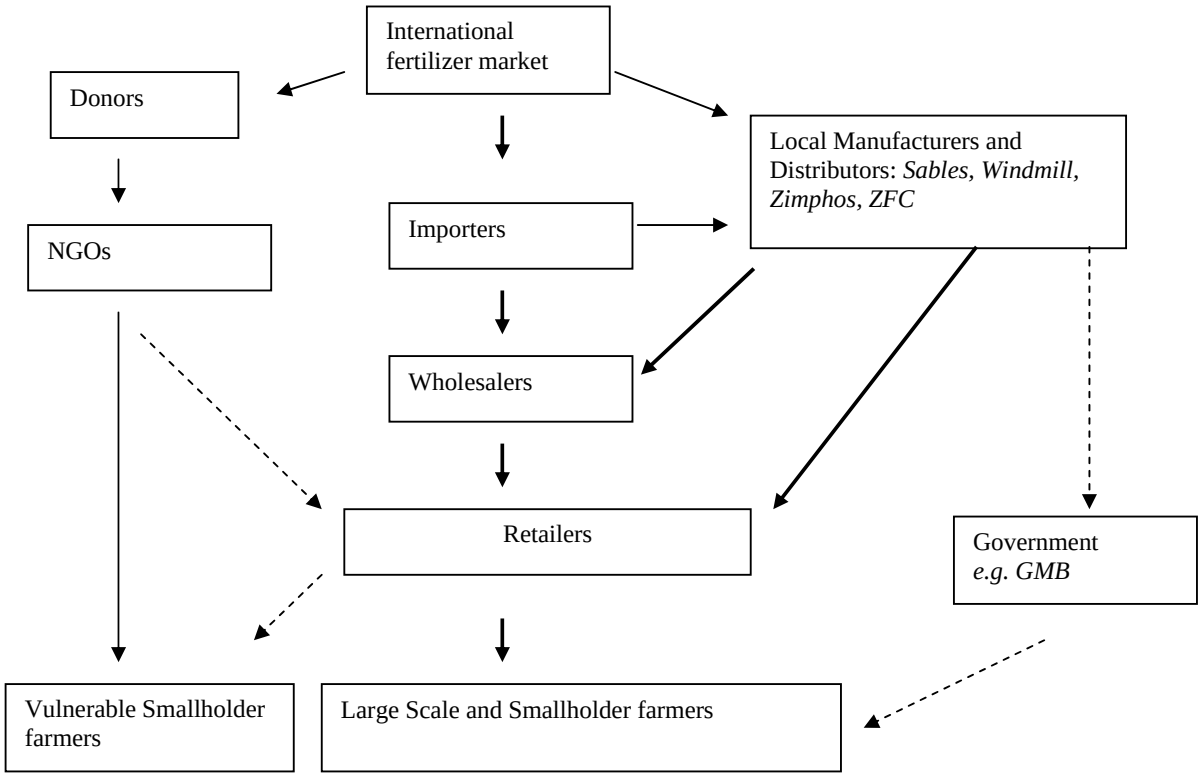

Figure 2: The current fertilizer sub sector in Zimbabwe
Source: Compiled by author based on FAO, 2006; Rukuni *et al*, 2006; Kachere, 2002.

The major fertilizer types in Zimbabwe

The common fertilizers types used in Zimbabwe are (a) straight fertilizers (e.g. ammonium nitrate, urea, sodium nitrate, ammonium sulphate, calcium nitrate, single and double triple phosphates, potassium chloride and potassium sulphate), (b) compound fertilizers (e.g. compound A and D) and (c) blends (e.g. tobacco blend, maize blends). The fertilizers are supplied in granular form and in bags. In developing countries, including Zimbabwe liquid fertilizers are only confined to specialized drip irrigation for high value crops (FAO, 2006: 21). The major fertilizer types used in Zimbabwe differentiated by crop are shown in Table 2.

Table 2: Major fertilizer types differentiated by crops where used

Main crop	Main fertilizer type(s) used
Tobacco	Compound A, B, C, S, V, Tobacco blend
Maize	Compound D, AN, Urea, Maize blend
Coffee, Fruit trees	Compound J, Coffee blend
Groundnuts	Phosphates, Gypsum
Wheat	Compound D,
Horticultural crops	Compound C, D, Vegetable blend, AN

Source: FAO, 2006:23

Fertilizer production and consumption

In order to understand the fertilizer trends in Zimbabwe; we traced nitrogen, phosphate and potash fertilizer production, consumption and imports for the period 1961-2007. These are the most important fertilizer type used in the country (FAO, 2006: 21). Data for these fertilizers is available at http://www.fertilizer.org/ifa/ifadata/search.

Nitrogen

Nitrogen fertilizer production in the country has been characterized by fluctuating trends (Figure 3). In 1969 nitrogen fertilizer production were 23 thousand tonnes and this rose sharply to around 60 thousand tonnes in 1971. Production levels fell down during the period 1977-1979 and Desai and Ghandi (1990:121) attributed this to the widespread droughts, deteriorating terms of trade and civil unrest. The period of stagnation was followed by a period of extremely rapid growth which restored fertilizer production above 60 thousand tonnes in early 1980s. This growth was facilitated by good weather, better support services and fast post war recovery in the country (Rukuni *et al*, 2006:228).

Following this there was however a period of stagnation and this is partly associated with the drought of 1984 and foreign currency constraints due to debt crisis (Desai and Ghandi, 1990:126). The drought of 1992 may have also been behind the drop in production levels. Production levels dropped again sharply from 1999 and never recovered till today. The drop coincided with the chaotic implementation of the land reform programme and the macro economic challenges the country started to face like foreign currency shortages, power and fuel shortages. As a result fertilizer companies failed to finance production and import raw materials and spare parts. The performance of fertilizer supply systems varied depending on climatic, economic and political factors. Nitrogen fertilizer imports fell sharply from 47 thousand tonnes in 1966 to 10 thousand tonnes in 1971. This was as a result of sanctions imposed on the country in 1965. Imports were high during the period 1980 – 83 and this was powered by the maize revolution in the country during the 1980s (Byerlee and Eicher, 1997:31). The period where consumption was exceedingly higher than local production, the demand for nitrogen fertilizer imports grew.

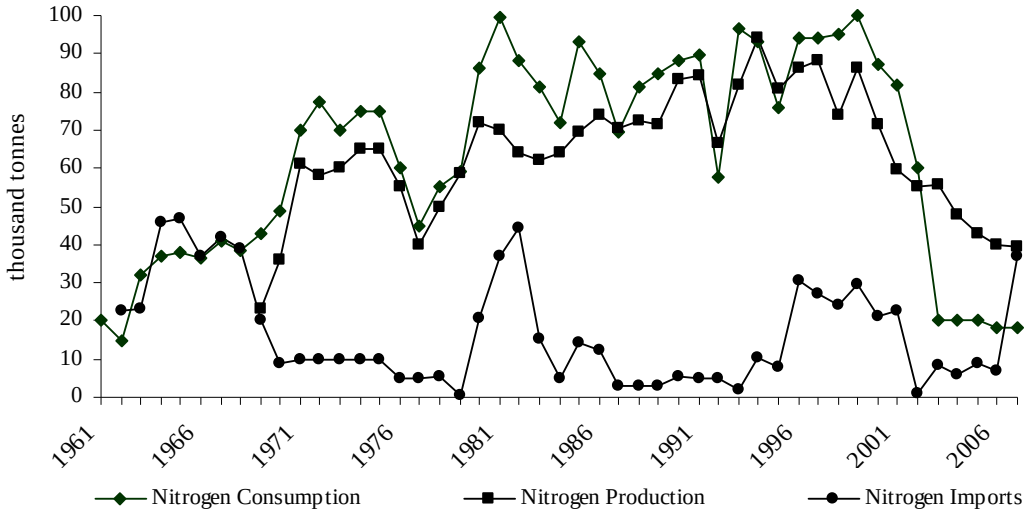

Figure 3: Trends in Nitrogen Production, Consumption and Imports ('000 tonnes nutrients) for the period 1961 to 2007

Source: computed from IFA data (2010)

Nitrogen fertilizer consumption rose significantly to above 60 thousand tonnes for the period 1971-75, followed by a drastic drop in 1977 (Figure 3). Consumption rose again sharply and reached a peak of 100 thousand tonnes in 1981 and this was partly due to an increase in smallholder maize production driven by extension, research and conducive credit policies (Rukuni and Eicher, 1994).

From Table 3, nitrogen consumption for the period 1980 to 1993 i.e. the period before the Economic Structural Adjustment Programme (ESAP) was higher than for the periods 1966 to 1979 and 1994 to 2007 (Paired samples t-test, $P < 0.05$). During the drought of 1992, consumption levels fell by about 50% compared to 1991. From 2000 onwards fertilizer consumption maintained a declining trend and this is associated with widespread poverty stemming from disruptions in the farming sector due to agrarian reform and recurrent droughts (FAO, 2006). Jayne *et al*, (2003) noted that the quantity of fertilizer applied per hectare of arable and permanent crops (kg/ha) in Zimbabwe changed from 56.84 (1980-89) to 49.38 (1990-95) and then 51.91 (1996-2000). This shows that fertilizer use decreased by 11% in the period 1996-2000 when compared to the period 1980-89.

Table 3 Differences in nitrogen consumption in Zimbabwe differentiated by reform period

Pair of reform period [x/]	**N**	**Mean consumption '000 tons**	**Mean difference (a-b)**	**t-value**
Pre-ESAP (a) and Post ESAP (b)	14	84 63	21	2.18**
Pre Independence (a) and Pre ESAP (b)	14	57 84	-27	- 5.13**

** Paired samples t-test significant at 5% level of error probability.
[x/] Pre Independence (1966 to 1979), PreESAP (1980 to 1993) and Post ESAP (1994 to 2007)

Source: Calculated from FAOSTAT.

Maize production variability before 1980 was low showing a coefficient of variation (CV) of 0.29 compared to that of 0.4 realised after 1980. The highest productions were recorded in 1981 and 1985 while the lowest production was confined to the drought year of 1992. The period of low maize production coincided with the drought (Figure 4).

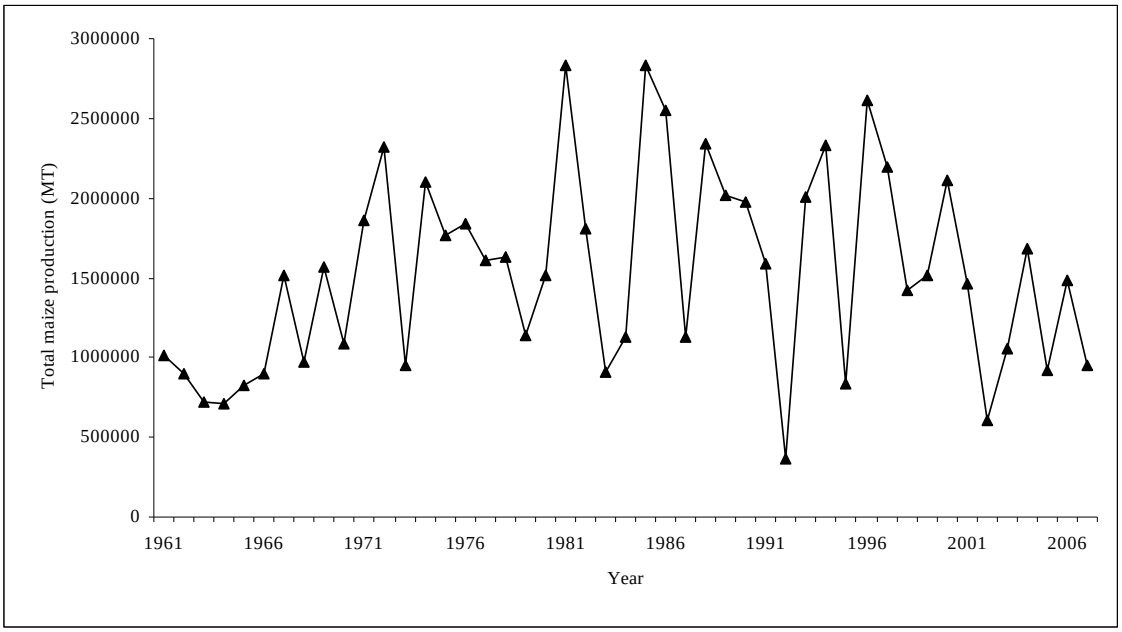

Figure 4: Total maize production (MT) in Zimbabwe for the period 1961 to 2007

Source: Calculated from FAOSTAT 2010

Phosphate

Figure 5 shows trends in phosphate production, consumption and imports. Phosphate demand tends to equal phosphate production with exceptions of the periods, 1979-1984 and 1996–2001. During this time period consumption exceeded production and the balance was supplied through imports which also rose during these time periods. Phosphates imports were only confined to few years. Zimphos produces 50 000 tonnes of phosphorous per year and this usually meets the national requirements.

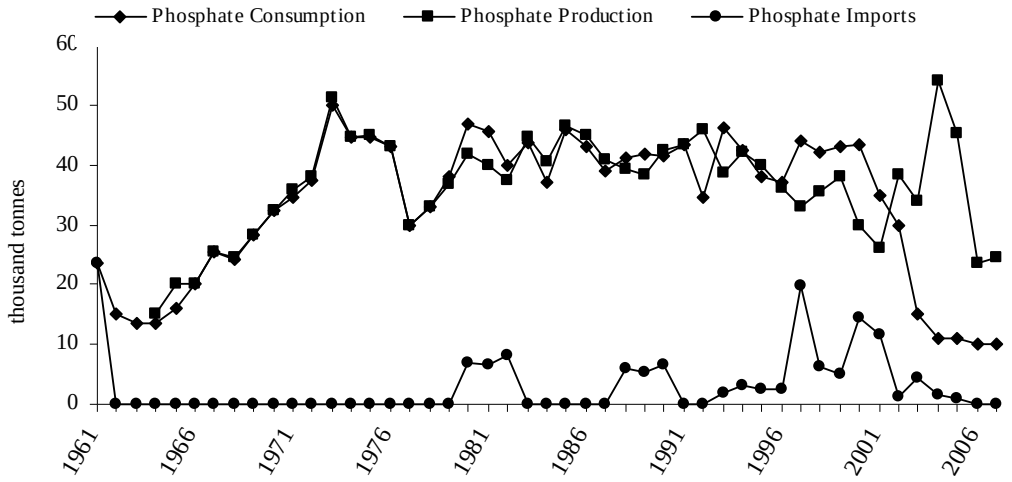

Figure 5: Trends in Phosphate Production, Consumption and Imports ('000 tonnes nutrients) for the period 1961 to 2007

Source: computed from IFA data (2010)

Potash

There is no potash production in Zimbabwe and as a result all potash requirements are imported. From 1961 to 2007, potash consumption requirements were adequately satisfied by imports with the exception of the period 1967 to 1972 where consumption requirements were slightly above imports, causing nutrient shortfalls (Kachere, 2006:9).

Fertilizer use by crop

Figure 6 shows the proportions of fertilizers used on each crop before 2000. Maize accounted for almost half of the fertilizer used in the country, followed by tobacco and wheat. Maize accounted for 90% of the fertilizer use in the smallholder farming sector while in the large scale farming sector it accounted for a third of the fertilizer consumption (FAO, 2006:33 Mapfumo and Giller, 2001:12). Maize is the staple crop and has a high nitrogen response rate and this may partly explaining the widespread application of the fertilizer on the crop in the country (Byerlee and Eicher, 1997:33). Soybeans and horticultural crops consumed the least fertilizer of 3% each while other crops like groundnuts, small grain, and other field crops accounted for a total of 12% of the fertilizer used.

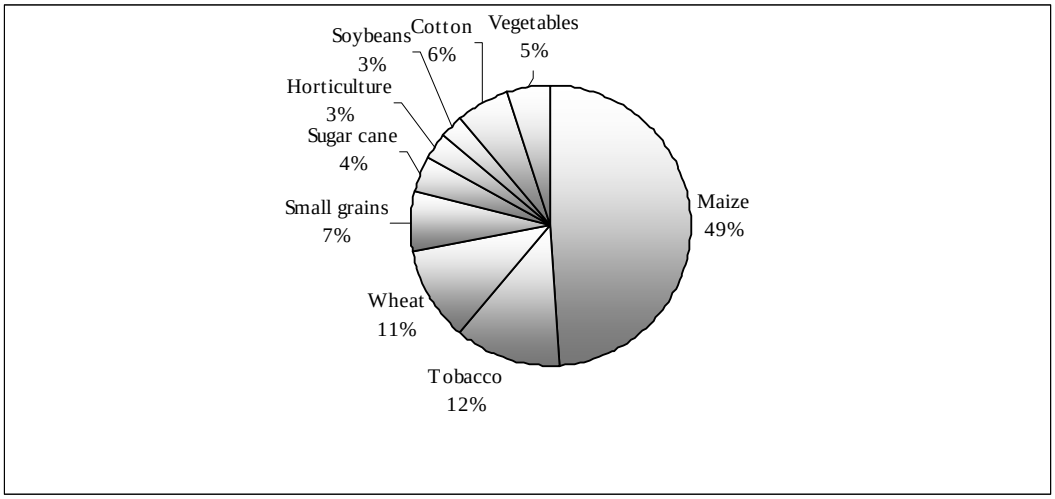

Figure 6: Proportion of fertilizer use by smallholder farmers before 2000

Source: Adapted from FAO, 2006:33

Drivers of fertilizer supply

The pillars that drive the performance of fertilizer markets in Africa have been categorically highlighted by Gregory and Bumb (2006:21) and Camara and Heinemann (2006:16) as: policy, human capital, finance, market information, regulation and infrastructure. The extend to which these drivers apply to Zimbabwe is analyzed below:

Policy

A conducive and stable policy climate is essential for promoting private sector-based input markets. A distorted policy environment characterized by price and non price distortions (e.g. price controls and import tariffs) sends wrong signals, lowers private sector investments and keep transaction costs high (Gregory and Bumb, 2006:19). Before 1990 the Government of Zimbabwe controlled input production through multiple mechanisms, despite that the majority of marketing activities were in the hands of private traders. The government has intermittently controlled the prices of fertilizers on the premises of protecting the consumers but this has in turn discouraged private sector development. Rukuni *et al,* (2006:294), Poulton *e tal*, (2006:50) and Townsend (1999) argued that these controls limited farmers choice of fertilizers and they noted that only 13 compound fertilizers and 8 single nutrient fertilizers were on the market from 1970 to 1990s. The introduction of ESAP brought about significant reforms in the provision of fertilizer inputs that saw the removal of controlled prices and subsidized fertilizers. The policy reforms experienced by the fertilizer industry in Zimbabwe are highlighted in Table 4. Townsend (1999:110) noted that between 1990 and 1997, fertilizer producers in Zimbabwe were protected by fertilizer import taxes that ranged from 0-5 percent and a 10% surcharge on finished products which compete with domestic production. These duties, taxes and tarrifs acted as disincentive to competitive importation of fertilizers.

Table 4 Summary of Impact of Reforms on the Zimbabwe Fertilizer Industry.

Pre-Reform Controls before 1990	Situation Early 1996
• access to foreign exchange • import permits required, • mandatory government approval of fertilizer composition • price controlled • parastatal offer subsidized fertilizer	• removed • No change • No change • Removed • Removed
Effects	Effects
• Limited access to farmers technology • Few dealers, fertilizer not always available to small farmers • Limited choice of nutrients and farmers not able to match nutrients with soil deficiencies	• Change in industry structure; formerly a protected public/private duopoly with reform, ten new companies entered in 1995 and 1996 • Technology transfer; new entrants offer soil tests, made to order fertilizers high analysis fertilizers, old companies respond with similar services, 260 new fertilizer products were registered between 1991-96 • Prices; competition is building; trading margin still high, • Quantity; no significant change; fluctuations in use dominated by austerity, drought and free fertilizer programs.

Source: Adapted from Townsend (1999:112)

The agrarian reform program adopted by the government in 2000 was followed by a series of agricultural policy changes, targeted at supporting the resettled farmers. The government again intervened in fertilizer trading by introducing price controls and compelling fertilizer suppliers to channel fertilizer through state agencies to pursue social and equity goals. The government efforts were however compromised by bureaucracy, corruption and arbitrages by the recipient farmers (FAO, 2006:26).

In Zimbabwe, and the Southern Africa Development Corporation (SADC) the performance of the fertilizer sector also stems from lack of fertilizer regional policy framework. There is a general failure to recognize fertilizer as a strategic commodity and there lacks a policy framework to define and create an efficient and cost effective procurement system that promotes domestic production and simplify cross border distributions of fertilizers (Kachere, 2006:12). New Partnership for Africa' Development (NEPAD) has at least ushered in new hope for recognition of fertilizers as an essential commodity as it aims to raise awareness of fertilizer consumption to boost food security.

Infrastructure

Transport, communication and storage infrastructures are vital to fertilizer availability. Internal transportation costs are usually high in Africa because of poor feeder roads and acts as a disincentive to private dealers to expand to remote areas (Camara and Heinemann, 2006:16; Byerlee and Eicher, 1997:37). Zimbabwe is a landlocked country and inherently suffers from high transportation costs from the ports and this is usually transmitted to farmers in form of higher prices for imported fertilizer. Fertilizer is a bulky commodity with relatively low value to volume, so transport costs are a relatively large share of the farm gate prices (World Bank, 2006). In Zimbabwe roads, telecommunications and postal services are in poor state, and in some areas there are no roads. This is a deterrent to farmers and at the same time discourages private sector investments in the fertilizers trade in rural areas. In

1992, ZFC established depots in smallholder areas to improve availability of fertilizer. However, the company closed these depots following viability problems because of seasonal demand and high transport costs (Rusike and Sukume, 2006). Mashingaidze (2004) noted that Zimphos was struggling to meet its phosphate production capacity of 150 000 tonnes/year owing to railway transportation constraints which affected the shipment of raw materials from Dorowa Mine. The non-existence of strategic buffer stocks that might cater for periods when there are shortfalls in the domestic production or fertilizer imports due to foreign currency shortages and international price fluctuations remains a key barrier to fertilizer supply in the SADC region (Kachere, 2006:14).

Other factors

For a well functioning market, the flow of information needs to be smooth and timely. Fertilizer manufacturers, dealers, farmers and policy makers should have access to information about fertilizer prices, stock and availability in national, regional and global markets (IFDC, 2001). In Zimbabwe the majority of fertilizer players lack adequate market information and this is compounded by stringent cross border regulations (Kachere, 2006:14).

Enactment and enforcement of laws and regulations dealing with quality control, registration, packaging and labelling are important in the fertilizer industry. Yet in many African countries these are non-existent or ineffective (Gregory and Bumb, 2006:22). Continuous procedural changes discourage fertilizer trade as it is usually accompanied by high transaction cost. Another factor affecting fertilizer supply if finance. In Zimbabwe limited access to finance resulting from high interest rates, underdeveloped financial structures, stringent collateral requirements and the risk averse attitudes of commercial banks towards agriculture and agribusiness makes it difficult for fertilizer importers, wholesalers and dealers to purchase fertilizers and raw materials timely to meet the farming needs as well as importing equipment and machinery for refurbishing production plants (FAO, 2006:26).

Drivers of fertilizer demand

The demand for fertilizer is influenced by farmer's capacity to invest in fertilizer use, commodity and fertilizer prices, profitability of fertilizer use, crop yield response to fertilizers and availability of complementary inputs (Kelly, 2006:12; Camara and Heinemann, 2006:12). Even if fertilizer use is profitable farmers may be unable to purchase it because they lack cash, cannot obtain credit, or cannot obtain fertilizer locally (Kelly *et al*, 1998; Byerlee and Eicher, 1997). The majority of smallholder farmers in Zimbabwe lack the necessary finance to purchase adequate fertilizers. In the period immediately after independence in 1980, the availability of subsidized credit drove maize yields and in turn drove fertilizer demand (Rukuni and Eicher, 1994). From 1981 to 1986 fertilizer purchases increased fourfold to reach a peak of 127 thousand tonnes because smallholder farmers had access to short term loans from Agricultural Finance Corporation. However, sales began to decline after the 1986/87 season because of reduced seasonal loans to smallholders following high default rates (Rugube, 2003). In Zimbabwe fertilizers have been traditionally sold in 50kg packs making them unaffordable to resource poor farmers (FAO, 2006). ICRISAT have been pilot testing the demand of smaller fertilizer packs in semi-arid areas of Zimbabwe and the results have been overwhelming supporting that Fertilizer companies need to rethink and consider smaller fertilizer packs. Such evidence has been complemented by yield gains from fertilizer micro dosing and conservation agriculture technologies.

The demand for an input is derived demand. In general, an increase in price of a crop increases fertilizer demand (World Bank, 2006). The relative output to fertilizer price ratio

conditions fertilizer use, which explains why fertilizer use is concentrated on profitable crops such as cotton, maize and tobacco in Zimbabwe. The profitability of fertilizer use is a function of technical constraints (e.g. poor soils, low crop fertilizer response, complementary packages) and economic factors (high fertilizer costs, low producer prices) (Camara and Heinemann, 2006:12). Kelly *et al* (1998) highlighted that the expansion of market infrastructure reduced marketing costs and increased profitability, thereby promoting smallholder use of fertilizer in Zimbabwe in the 1980s. Commodity prices are also influenced by the strength of demand for a crop, policies, transport, market information and seasonal variability in supply and demand (Yanggen *et al*, 1998). Fertilizer was affordable in Zimbabwe in the 1980s because producer prices were high in relation to the fertilizer prices (FAO, 2006). Turning to input prices, an increase in the price of fertilizer results in a reduction in the quantity of fertilizer demanded. According to the Zimbabwe Farmers' Union (2002), smallholder farmers reduced their fertilizer procurement following the Structural Adjustment Program in 1990 as a result of the increase in the prices of fertilizer and other inputs.

Farmer's perceptions about the potential impact of fertilizer on yields affect their demand. Their understanding is influenced by the quantity and quality of information on fertilizer (application rates, price and availability) and access to extension, farm trials and improved crop technologies. The availability of fertilizer complements like water (irrigation or rainfall), seed, and farm labour have an impact on the use of fertilizer. Water and fertilizers are complements in crop production because water reduces the risk of fertilizer use (Kelly, 2006; Camara and Heinemann, 2006:12). This explains why fertilizer use falls during periods of droughts e.g. the 1992 drought period saw nitrogen fertilizer consumption dropping (Rukuni *e tal*, 2006).

Fertilizer use in semi-arid areas of Zimbabwe is limited with Scoones *e tal*, (1996) arguing that between 75 and 90% of cropped lands are not fertilized during any cropping season. Rusike *et al* (2004) acknowledge that less that 5% of the smallholder farmers in Southern Zimbabwe commonly use fertilizers. Scoones *e tal*, (1996) and Mapfumo and Giller (2001:42) attribute this to lack of knowledge about the proper usage of fertilizer, cultural and traditional beliefs that fertilizers burn crops. Farmer knowledge on how to use the fertilizer is therefore a vital ingredient in shaping fertilizer use.

Recommendations

The government of Zimbabwe can transform the inefficient and high cost fertilizer industry to an efficient low cost industry where increased supply is matched to demand at lower transaction costs (i.e., shifting the supply and demand curve upward and to the right in Figure 1), by attending to the following recommendations:

Policy reforms

Policy reforms are vital to stimulate private investment in and commercial financing of agricultural input and output sector. Relevant policy options include: trade policies that promote free flow of goods, macroeconomic policies that facilitate access to foreign exchange, tax policies that do not place heavy tax burden on agricultural inputs like fertilizers, policies that promote competition by facilitating entry and exit of firms, and land tenure policies that increase farmer's access to credit. A comprehensive fertilizer policy has to be articulated and integrated into the whole policy framework. The development of appropriate and coordinated regional agricultural development policies and harmonization of

fertilizer trade protocols to ensure that adequate fertilizer is produced and distributed across border will stand to benefit the country and SADC. The scope of reducing cost through joint procurement (pooling orders and jointly chartering vessels), joint investment and regional market expansion need to be tested.

Investment in Infrastructure

The government has to invest in transport, communication and storage infrastructures to reduce fertilizer costs, increase farmers share of output prices, and reliability of service (both timeliness of delivery and maintenance of product quality).

Regulatory and Institutional Reforms

Regulatory and institutional reforms are needed to ensure smooth commercial exchanges at all levels of the value chain. Particular attention is needed in: the development and implementation of quality controls, enactment and enforcement of contract laws and prevention of excessive consolidation of market power.

Strengthening of agricultural research and extension services

The government and the private sector has to fund and support agricultural research to produce seeds that respond to fertilizer; determine and disseminate fertilizer use recommendations that are appropriate for different areas (as opposed to one blanket recommendation for an entire country).

Capacity building

Capacity building is vital to improve the knowledge and skills of farmers and commercial fertilizer players. Training to improve farmer knowledge on fertilizer use should be emphasised and strengthened. Market and price information for fertilizers should be readily accessed by the fertilizer industry (manufacturers, private traders and government trading agencies and farmers). Capacity building can be achieved through public education systems, training programmes that target farmers and traders needs and through development of a vibrant Information Communication and Technology system (e.g. internet). This develops adequate human capital to drive the fertilizer manufacturing business and to spearhead a vibrant fertilizer entrepreneurial climate capable of promoting a competitive fertilizer industry.

Improvements in the agricultural resource base

Are needed to help improve the quality of the soil and water resources to increase crop responses to fertilizer and reduce the risk of crop loss. These “public goods” investments such as irrigation, soil conservation and erosion control although often considered outside the scope of fertilizer marketing policy, nevertheless strongly affect the demand for fertilizer. Repackaging into smaller packs that are affordable is also a vital policy option. Experiences from applying fertilizers in smaller quantities within the conservation farming are giving evidence of high yield payoffs even to the vulnerable communities (Twomlow *et al*, 2006).

Strategic Partnerships

Strategic partnerships are needed to for the success of the strategies mentioned above. Key partnerships need to be forged between government, the private sector, farmers, financial institutions, local and international development partners, and research, training and extension institutions. Partnerships that build trust attract the needed investments and create confidence in the industry.

The future of fertilizer subsidies

Following sharp increases in the world food and fertilizer prices in 2007 and 2008, issues of fertilizer subsidies have been proposed as the options for government and donors to respond to the crisis (Minde *et al*, 2008:1). We then ask the question: Are subsidies a viable option for Zimbabwe? If the government pursues this strategy what ought to be done to ensure their effectiveness? We provide the following guidelines on how to maximize effectiveness of the subsidies to meet food security, alleviate poverty and hunger. These are based on evidences from Kenya, Malawi and Zambia highlighted by Minde *et al*, (2008:3) and which we believe can be replicated to Zimbabwe.

a. *Use input vouchers that can be redeemed at local retail stores rather than direct distribution* in order to maintain the capacity of private sector input delivery system. This notion is also shared by Rohrbach *et al*, (2004), who highlighted that direct input distributions have undermined the trading capacities of local retailers in Zimbabwe.

b. *Involve a wide range of fertilizer importers, wholesalers, and retailers in the input voucher scheme*. Providing tenders to few firms to import fertilizers can squeeze out other firms resulting in a concentrated and uncompetitive input market. The system should allow farmers to redeem coupons at existing retail stores to promote additional investments in remote areas where it is most needed.

c. *Consider the objectives of the targeting, cost of implementation, time requirements and displacement of commercial sales by subsidized inputs*. If the subsidy program objective is to increase total output, then the inputs need to reach farmers who can use them efficiently and on a large enough area to generate significant gains in total output. Evidence indicates that a high proportion of non-poor farmers are able to acquire fertilizer through markets. Thus spending scarce government resources to provide them with discounted fertilizer will largely substitute subsidized fertilizer for commercial fertilizer, adding relatively little to overall fertilizer use or crop output. In some cases, small farmers may also use fertilizer more efficiently than larger farmers. If the subsidy program objective is to alleviate poverty, or to overcome liquidity constraints for poor farmers who would otherwise be unable to purchase fertilizer, then it must be possible to identify poor farmers, and socially acceptable to channel vouchers to them, at a reasonable cost. Providing crop production support to relatively asset-poor households also contributes importantly to equity and social protection objectives.

References

Byerlee D, Eicher C.K (1997) Africa's Emerging Maize Revolution. Lynne Rienner Publishers, Inc USA

Camara O, Heinemann E (2006) *Overview of Fertilizer Situation in Africa*. Background Paper Prepared for the African Fertilizer Summit, 9 – 13 June 2006, Abuja, Nigeria

Desai G. M, Ghandi V (1990) Fertilizer Consumption in Sub-Saharan Africa: An Analysis of Growth and Profile of Use. IFPRI/ IFDC Discussion Paper. International Food Policy Research Institute, Washington, D.C.

FAO (2006) Fertilizer use by crop in Zimbabwe. Food and Agriculture Organization of the United Nations. Land and Plant Nutrition Management Service Land and Water Development Division. Rome 2006.

FAOSTAT. www.faostat.fao.org, Accessed 25 January 2010

Gregory D.I, Bumb B.L (2006) Factors affecting Supply of *Fertilizer In Sub-Saharan Africa.* Agriculture and Rural Development Discussion Paper 24 World Bank, Washington DC.

International Fertilizer Association (IFA) website: http://www.fertilizer.org/ifa/ifadata/search, accessed on 3 February 2010

IFDC (2001) A strategic framework for African Agricultural Input Supply System. Technical Bulletin IFDC T-65. Internbational Fertilizer Development Center. Muscle Shoals

Jayne T.S, Kelly V, Crawford E (2003) Fertilizer consumption trends in Sub-Saharan Africa: Food Security, Policy Synthesis 69, Department of Agricultural Economics, Michigan State University, Lansing, Michigan

Kachere, M.S. (2006) Fertilizer Industry in the Southern African Development Community (SADC), Region, current situation, opportunities, challenges and constraints Paper prepared for Presentation at the 12th International Arab Fertilizer Association (AFA) Annual conference, Cairo, 6-8 February 2006

Kachere, M.S. (2002) Fertilizer supply chain management in Zimbabwe: trends in fertilizer production and consumption 1990–2002. Zimbabwe Chemplex Internal Discussion Paper.

Kelly V (2006) Factors affecting Demand for *Fertilizer In Sub-Saharan Africa.* Agriculture and Rural Development Discussion Paper 23, World Bank, Washington DC.

Kelly V, Reardon T, Yanggen D, Naseem A. (1998) *Fertilizer In Sub-Saharan Africa: Breaking The Vicious Circle Of High Prices And Low Demand*, Policy Synthesis 32, Department of Agricultural Economics, Michigan State University, Lansing, Michigan

Mapfumo, P. and Giller, K.E. (2001) Soil fertility management strategies and practices by smallholder farmers in semi-arid areas of Zimbabwe. ICRISAT with permission from FAO.

Mashingaidze, T.A. (2004) An analysis of ZIMPHOS capacity to meet demand for phosphates and related products for the next 20 years, based on forecast demand for fertilizers and alum. ZIMPHOS Internal Paper.

Minde I, Jayne T.S, Crawford E, Ariga J, Govereh J (2008) *Promoting Fertilizer Use in Africa: Current Issues and Empirical Evidence from Malawi, Zambia and Kenya*, Policy Synthesis 83, Department of Agricultural Economics, Michigan State University, Lansing, Michigan

Poulton C, Davies R, Matshe I, Urey I (2002) A Review of Zimbabwes Agricultural Economic Policies: 1980-2000. ADU Working Paper 02/01. Department of Agricultural Sciences, Imperial College Wye, Kent, United Kingdom

Rohrbach (1989) The Economics of Smallholder Maize Production in Zimbabwe: Implications for Food Security. MSU International Development Paper No. 11. Department of Agricultural Economics, Michigan State University, Lansing, Michigan

Rohrbach D, Charters R, Nyagweta J. (2004) Guidelines for Agricultural Relief Programs in Zimbabwe. ICRISAT Box 776, Bulawayo, Zimbabwe

Rukuni M, Eicher C.K (eds). (1994) *Zimbabwe Agricultural Revolution*. Harare: University of Zimbabwe Publications.

Rukuni M, Tawonezvi P, Eicher C, Munyukwi-Hungwe M and Matondi P. (2006) Zimbabwe's Agricultural Revolution Revised. University of Zimbabwe Publications, Harare, Zimbabwe

Rusike, J. And Sukume, C. (2006) Agricultural input supply. In Zimbabwe' Agricultural Revolution. University of Zimbabwe publications: Harare, Zimbabwe.

Scoones *e tal*, (1996) Hazards and Opportunities: Farming livelihoods in Dryland Africa: Lessons from Zimbabwe. Zed Books Ltd. London

Townsend R.F (1999) Agricultural Incentives In Sub-Saharan Africa: Policy Challenges. World Bank Technical Paper No.444. World Bank, Washington DC.

Twomlow S, Rohrbach D, Rusike J, Mupangwa W, Dimes J, Ncube B (2006) Spreading the Word on Fertilizer in Zimbabwe. Global Theme on Agroecosystems Report No. 24. PO Box 776, Bulawayo, Zimbabwe: International Crops Research Institute for the Semi-Arid Tropics. 16pp

World Bank. (2006) Promoting increased Fertiliser Use in Africa: Lessons Learned and Good Practice Guidelines. Africa Fertiliser Strategy Assessment ESW Technical Report. Discussion Draft. June 2006. Africa Region. World Bank, Washington DC.

Yanggen D, Kelly V, Reardon T, Naseem A (1998) *Incentives for Fertilizer Use in Sub-Saharan Africa: A Review of Empirical Evidence on Fertilizer Yield Response and Profitability*, IDWP 70, Department of Agricultural Economics, Michigan State University, Lansing, Michigan

Zimbabwe Farmers' Union. (2002) Issues and concerns of farmers regarding the supply and costs of fertilizer. Paper presented at the SADC Regional Consultation on Fertilizer Procurement and Distribution, Harare.

Zimbabwe Fertilizer Company (1999) Product price and information bulletin. Harare