EFFECT OF FERTILIZER PRICE SUBSIDIES ON FERTILIZER USE IN KABUYEFWE LOCATION OF BUNGOMA COUNTY; KENYA

BY

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DECLARATION

The research project is my original work and has never been presented in any University for a degree course

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This research paper has been submitted for examination with my approval as a University Supervisor

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DEDICATION

This paper is Dedicated to my Wife Janet Wanjiru Mabuto for her patience, love and support, my brothers John and Peter and their families for their holding me together and support, my parents and sisters for their unceasing prayers and above all, Jehovah, my God, for His Love, Mercies, Favour as a shield.

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May our Almighty God reward you all with blessings immeasurable.

ABSTRACT

Kenya, a country in the East African region lies across the equator and covers approximately 582,366 square kilometers. Three quarters of the country lies in the arid and semi arid lands and waste lands in the north and North Eastern regions. The arid and semi arid often experience dry spells leading to prolonged drought.

As per the 2009 national census, Kenya's population was 37.7million up from an approximate 35.8 million in 2007 and was projected to reach 44,2million in 2013. The poverty level was estimated at 45.9% as at 2006

Kenya is divided into forty seven counties of which Bungoma County is the third largest with a population of 1,630,934 and a population density of 454 people per km^2. The County is one of the main producers of Maize in Kenya.

With the high poverty in the country as mentioned above, efforts to eradicate extreme poverty and hunger have been initiated though various challenges stand against the efforts; for example poor agronomic practices, low coverage of extension services and affordability of appropriate technologies like fertilizers and hybrid seeds, low value addition, adverse climate changes leading to frequent and intense droughts, floods, re-emergence of diseases and pests.

To address increased use of fertilizer which is one of the important technologies needed for increased productivity, the study used panel data of farmers from Kabuyefwe location which was part of the larger Naitiri in Bungoma County, to study the effects of fertilizer subsidy on fertilizer use. A simple regression model was employed in the study.

Results from the study indicated that the cost of fertilizer, weather patterns and availability of alternatives to fertilizer all had negative effect on fertilizer use, whereas farmer's knowledge, availlabity of fertilizer at the right time and quantity, land size and the price of the previous crop all had positive effect on use of fertilizer.

The study results further indicated that the factors considered were responsible for 89.82% of the variations in the fertilizer use. The probability (P< 0.05) realized affirmed the reliability of results generated from the study.

The study recommended the Government not to pursue further lowering of fertilizer prices through subsidies because at the price at which farmers were buying subsidized fertilizer, the cost of fertilizer was no longer a very important factor affecting fertilizer use, rather, weather patterns, land size, knowledge of farmers were of more effects to fertilizer use.

Given the various issues arising, the study recommended further studies on minimum divisible land size that will ensure high use of fertilizer and another study on advantages and disadvantages of the effects of using alternatives to fertilizer.

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LIST OF ABREVIATIONS AND ACRONYMS

MDG – Millennium Development Goals

GDP – Gross Domestic Product

NAAIAP – National Accelerated Agriculture Inputs Access Programme

NCPB – National Cereals and Produce Board

AISP – Agriculture Input Supplies Project

UNDP – United Nations Development Programme

GoK – Government of Kenya

PRSP – Poverty Reduction Strategy Paper

SSSA – Soil Science Society of America

DAP – Diammonium Phosphate

US – United States

KFA – Kenya Farmers Association

FAOSTAT – Food and Agriculture Organization Statistic

FE – Fixed Effect

FEM – Fixed Effect Model

Chapter one

1.0. INTRODUCTION

1.1. Back ground

Kenya, a country in the East African region lies across the equator and covers approximately 582,366 square kilometers. Three quarters of the country lies in the arid and semi arid lands and waste lands in the north and North Eastern regions. The arid and semi arid often experience dry spells leading to prolonged drought.

As per the 2009 national census, Kenya's population was 37.7million up from an approximate 35.8 million in 2007 and estimated at 39.5million in 2011(Economic Survey, 2012). The poverty level was estimated at 45.9% as at 2006 which was a decline from the 53.6% reported in 2000 (MDG status report for Kenya 2011). Kenya is divided into forty seven counties of which Bungoma County is the third largest with a population of 1,630,934 and a population density of 454 people per km2 (Kenya County Fact Sheets, 2011). The county is one of the main producers of Maize in Kenya.

With the high poverty in the country as mentioned above, efforts to eradicate extreme poverty and hunger have been initiated though various challenges stand against the efforts; for example poor agronomic practices, low coverage of extension services and affordability of appropriate technologies like fertilizers and hybrid seeds, low value addition, adverse climate changes leading to frequent and intense droughts, floods, re-emergence of diseases and pests.(Millennium Development Goals Status Report for Kenya 2011) Emphasis is on Agriculture because it contributes about 24% of the GDP, 75% of the industrial raw materials and 60% of export earnings and employs an estimate 3.8million Kenyans directly (First Medium Term Plan. 2008-2012)

To address affordability of appropriate technologies , various strategies have been employed including; Njaa marufuku Kenya, National Accelerated Agriculture Inputs Access Programme (NAAIAP) - which assists farmers with fertilizer and seeds, provision of subsidized fertilizer through the National Cereals and Produce Boards (NCPB) and bulk importation of fertilizer through farmers' cooperative Union as a way of boosting their production.

The other prominent program at the forefront in addressing the challenges to solving extreme poverty is the Agriculture Input Supplies Project (AISP) under Global fund Food Crisis Response Programme that was implemented between March 2009 and June 2010 to offer subsidy to farmers.

There has not been a single definition for a subsidy, however in this study we will define it as defined by (Robert K. Triest 2009) that it is   a form of assistance provided by the government to a subset of the public that lowers the cost of producing a good or the price that a consumer pays for a good.

1.2. Performance of the Agriculture sector in Kenya

The Agriculture sector performed exceptionally well in the early years of independence, however, the performance slackened dramatically over the post independence years from an average of 4.7% in the first decade to below 2% in the 90s. The decline culminated to negative growth rates of -2.4% in 2000 (UNDP 2002) and to -3.0% growth in 2002 (Economic Survey 2003). Since 2003, the sector improved over time achieving an impressive 6.7% growth in 2005 (Economic Survey 2006) before declining to record a 4.4% growth rate in 2006 and a further decline to 2.3% in 2007 due to declining prices of tea and coffee in the international markets (GOK 2007). The sector improved to a high growth of 6.3% in 2010 but again declined to 1.5 in 2011(Economic Survey 2012) before rising to a 3.8% growth in 2012 (Economic Survey 2013).

As a sector intricately linked to other sectors, its performance affects all the other linked sectors and the overall performance of the economy and the country's wellbeing.

The poor performance of the agriculture sector and particularly its declining productivity has been identified as an important determinant of poverty and food security in the country.

According to the (Poverty Reduction Strategy Paper 2000) referred to as PRSP, declining agriculture productivity has led to, unemployment, low income from cash crops, food shortages and poor nutrition which has further reduced labor productivity. Maize which is a staple food crop in Kenya has had, its production being consistently lower than consumption. Maize production decreased by about one million bags to 34.4million bags in 2011 due to unfavorable weather, delayed provision of fertilizer and certified seeds to farmers. Consequently maize imports increased by 56.4% from 229.6 thousand tones to 359.2 thousand tons in 2011. As a whole, the value of inputs sold in the sector increased by 21% from Kshs 32,422.7 million in 2010 to 39,233.9 million in 2011. Of these, the value of fertilizer purchased as a whole increased by 56.1% to Kshs 9,397.4million in 2011(Economic Survey 2012).

The government of Kenya uses both incentives and supportive measures to encourage agricultural production. The incentive structure comprise of marketing incentives where the government tries to ensure farmers receive prompt payment for their produce. Other incentives include exchange rate and fiscal policies where the government tries to restrict tendency to tax the agriculture sector though with the exception of the export crops. Services to support farmers include provision of subsidized fertilizer, agro-chemicals and quality seeds so as to improve farming practices. However the level of support services provided is not sufficient considering the importance of agriculture sector to the economy verses the proportion of resource allocation to the sector which for example was on the general decline since mid 1980s (GOK 2007).

The Maputo Declaration in 2003 by Heads of Government called for increased resource allocation to the agricultural sector to 10 per cent of national expenditure by the year 2010 as noted in the (Public Expenditure Review 2012). The review reports that Kenya's progress towards that target has been slow though in the recent years it has increased considerably and was estimated at 4.3 per cent in 2012. The high increase in the allocation was due to the Economic Stimulus Programme which supported several sub-sectors in the sector. In terms of actual expenditure, the sector performance was reported as fair because the overall absorption of the allocated funds averaged 84.6 percent (Comprehensive Public Expenditure Review 2013).

1.3. Crop Productivity:-

The yield of a crop is determined by the nutrients in the soil, a deficiency of these nutrients therefore results to limited yields. Plants require different amounts of nutrients differently, thus the deficient nutrients are the ones that most often limit yield. The yield level can therefore be increased by increasing the amount of the limiting nutrients. When this is done, the yield increases to a level where another deficient nutrient's limiting effects sets in. The most important negative social externality of soil-fertility depletion is its link to lower employment and increased poverty (SSSA Special Publication Number 51, 1997).

Many agriculture experts see the use of modern inputs, in particular fertilizer as the key to increased agricultural productivity. Pointing to the strong relationship between fertilizer use and high yields in test plots.

Nutrients can be added in organic or inorganic form. The various organic fertilizers include manure, night soils, compost plant materials and sewage sludge. On the other hand inorganic fertilizers (chemicals/artificial or mineral fertilizers) are produced as fertilizer that contains only one nutrient (nitrogen, potassium or phosphorous) and compound or mixed fertilizers which contain more than one of these three nutrients.

In Kenya as in other sub-Saharan countries, the majority of the soils that are important for crop production have low chemical soil fertility. The nutrients that limit growth of crops in Kenya are Nitrogen (N) Phosphorous (P) and Potash (K). Since these nutrients are continuously removed from the soils through leaching, harvesting, surface runoff etc, they need to be replenished in an efficient way so as to avoid undue loss of soil fertility. Adding organic fertilizer is considered a better way of replenishing the soil fertility since they add new organic matter into the soils.

On average, the nutrition content of chemical fertilizer we buy in Kenya is approximately 50% nitrogen, 44% phosphorous and 5% potash.
The major crops needing much nitrogen are tea, coffee, and sugar cane while maize, wheat and barley account for 60% phosphorous use. Potash is mainly used on tea coffee and tobacco.

1.4.   World fertilizer situation

World fertilizer prices continued to rise over the years, and soared in 2007. The most affected was Diammonium Phosphate (DAP) whose US Gulf price increased from US$ 252 per ton in January 2007 to US$ 752 by January 2008, almost tripling within a year (Republic of Kenya, 2008). The over 200% rise in the World price of fertilizer over those two years has been attributed to rising demand for grain for production of biofuel in the US and other countries including Brazil. Other factors include higher energy and freight costs and increased demand for grain for animal feeds.   Moreover, phosphate fertilizers have been most affected due to limited supplies as there are only a few producers of the commodity world-wide because of limited sources of raw materials mainly found in United States, Morocco and along the Baltic Sea.

1.5.   Regional fertilizer Situation

In 2000, the Zambian government instituted the Food Security Pack which distributed seeds and fertilizer to households. The Tanzanian state returned to subsidizing fertilizer in 2003 and since 2008, has employed a voucher-based scheme. In 2006, Kenya, which had been touted as a country that successfully developed the private agricultural input markets through effective implementation of liberalization policies, also launched a fertilizer subsidy program. In 2008, the government of Ghana instituted a national voucher-based fertilizer subsidy after having been absent from active participation in the sector since liberalization in 1991(Banful, Afua 2011).

Malawi's removal of fertilizer subsidies led to a famine, however when the country reinstated a two-thirds subsidy on fertilizer, there was an agricultural boom which was attributed to the restoration of the fertilizer subsidies (Dugger, 2007).

1.6.   Policies in the fertilizer industry in Kenya

Government policy on input had operated under free market conditions during the colonial era. But after independence, the Kenya Farmers' Association (KFA) and a few private companies were responsible for all imports. Prices were set in line with a joint proposal that the importers submitted to the government for review.   This resulted in an oligopoly situation where importation and distribution of fertilizer was controlled and a situation in which the importers colluded in the setting of prices of inputs especially for fertilizers. The government eventually legislated against oligopoly with the subsequent introduction of wholesale and retail margins for

the distribution of fertilizers. It further controlled the fertilizer market by imposing import quarters, setting prices and establishing controls on distribution and marketing margins.

From 1980, the government's focus shifted from controls towards a liberalized state ideology emphasizing reduced state interventions in the economy and free market operations. The government in 1989 eliminated price controls on fertilizers. The period after 1993 was characterized by a focus on decontrol and removal of obstacles in the marketing and distribution system. Foreign exchange controls and import licensing were eliminated by 1994 leading to the full liberalization of the fertilizer market. These led to the fertilizer market being dominated by the private sector and the period recorded increased fertilizer use. The government, however, still intervenes in the inputs market through import duties and taxes where fertilizers and heavy agricultural machinery are exempt and fertilizer price subsidies are offered to farmers. As indicated in the First Medium Term Plan (2008-2012), the government aims to continue encouraging farmers by implementing the first phase of the planned three-tie fertilizer cost reduction proposals.

1.7. Annual fertilizers prices in Kenya (2006-2010)

The retail prices of fertilizers took a dramatic trend in 2008. The price of Di-ammonium phosphate (DAP), for example increased by a dramatic 93% from Kshs.2,333 per 50 kg bag in 2007 to Kshs.4,500 per bag by March 2008. This was attributed to sustained increases of fertilizer prices in the World Market since January 2007. *(Economic Review of Agriculture 2008)*

Table1: Average Retail Fertilizer price 2006-2010 (selected fertilizers)

Fertilizer Type	2006	2007	2008	2009	2010
DAP	1,700	2233	4500	3092	2712
CAN	1,350	1450	2350	2067	1954
UREA	1,450	1,683	2550	2167	2100

Source: compiled from Economic Review of Agriculture (2008and2011)

As shown in table 1, there was a sharp increase in prices especially for DAP in 2008 before gradually adopting a downward trend but not to the levels before 2008.

The sharp rise in fertilizer prices triggered unprecedented consequences in local food production and food security. The prices of DAP fertilizer which is mainly used for planting increased resulting to decreased usage. Overall, the high cost of inputs resulted to low application of fertilizer and certified seeds thereby affecting agricultural productivity (First Medium Term Plan (2008-2012).

1.8. Problem Statement

A major objective of Kenya's agricultural policy is to promote food security (Republic of Kenya 2008). Due to increasing population and diminishing agricultural land however, there is imbalance between national food supply and demand. The average production of maize which is the main staple food crop relied on for food security in Kenya for example, averaged 30 million bags in a good year and dropped to 18 million bags in drought years against local demand of 36 million bags (Republic of Kenya 2008).

To increase yields, many different studies including Duflo, Kremer, and Robinson, (2008) have been carried out to confirm the effect of fertilizer use on increasing yields, also various studies have been done to confirm the effect of credit availability to influencing fertilizer use.

In Kenya, poor credit and poor input supply abound and as a result, fertilizer use is low owing to its high price attributed to high cost of transportation and poor distribution systems. Fertilizer use in Kenya is about a third of the level used in India and a quarter of the level used in Indonesia (Republic of Kenya 2004).

Governments all over the world variously put out a hand to assist their citizens in market situations so as to improve their lives or encourage them to engage in certain undertakings e.g. to increase use of fertilizer, etc. The government hand could be in the form of subsidies, state aid etc though this would be against the economists stand for an invisible hand of the market being allowed to work out.

After phasing out fertilizer subsidy programs in the 1990s, several African countries have re-introduced fertilizer subsidies as a means to boost grain yields and rural incomes. A strand of the development literature has further fueled the resolve to revive the case for fertilizer subsidy

programs by asserting that they can help poor farmers break out of a low input/low output poverty trap and kick-start growth processes that can sustainably raise their incomes and assets even after they stop participating in the programs (Dorward et al., 2008).

In Kenya, the queue on subsidies is being followed down to counties. Bungoma County integrated Development Plan (2013-2017) states that efforts of National, County Governments and development partners should be harnessed to enable farmer's access and use modern agricultural technologies, subsidized farm inputs, light agricultural machineries and Value addition technologies.

However, proponents of fertilizer price subsidies need to have a strong basis for pursuing fertilizer price subsidies to influencing fertilizer use contrary to advice against fertilizer price subsidies; given that only a few studies have been done in this area.

1.9. Research Question

Arising from the research statement, this research seeks solutions to the following questions in Bungoma County;

1. What factors influence fertilizer use in Kabuyefwe location?
2. Does fertilizer price subsidy influence fertilizer use in Kabuyefwe Location?

1.10. Objectives of the study

The overall objective of this study is to investigate the effect of fertilizer price subsidies on fertilizer use in Kabuyefwe Location, Bungoma County The specific objectives are:-

1. To identify factors that influence fertilizer use
2. To estimate the effect of fertilizer price subsidies on fertilizer use.
3. To draw conclusions and give policy recommendation based on (1 and 2) above.

1.11. Significance of the Study

Food security is paramount to the well being of any nation and Kenya having Agriculture as its main stay, needs to increase her food production. The benefits of fertilizer use technology have

been communicated variously and efforts to increase fertilizer use are a concern for the government of Kenya.

The study is therefore an attempt to generate vital information to supplement the studies that have already been done on increase of fertilizer use to ensure increased food productivity and the effects of fertilizer subsidies. It will confirm to policy makers the significance of fertilizer price subsidies in increasing fertilizer consumption given the identified factors particular to the location of study and so help bridge the information gap as to where they should direct their effort in trying the increase fertilizer use to realize increased food productivity and poverty reduction.

1.12. Organization of the rest of the paper

The first chapter of this study covered the general background of the agricultural sector and its role in the development of the Kenyan economy. Chapter two is on the review of literature on increase of fertilizer use. Methodology which entails model specifications, estimation procedure and hypothesis testing is outlined in chapter three.

Chapter Two

2.0. Literature Review

2.1. Theoretical Literature review

Farming is as much business as anything else and a farmer is motivated by considerations of value cost ratio (profitability) and risk elements when investing in fertilizer. The use of fertilizer is therefore worthwhile if it results to the value of additional crop produced exceeding the total cost to the farmer for purchasing and applying the fertilizer. Indeed Zerfu and Larson, (2010) note that once a farmer uses fertilizer, the level of fertilizer use is mainly driven by the input/output price ratio. However, fertilizer use is low in sub Saharan Africa hence a calling for efforts to increase it.

Zoe' D et al (2012) pointed out that as is the situation in Sub-Saharan Africa where input or output markets do not work, there arises a case to justify use of subsidies. They noted that African farmers may not use fertilizer at optimal levels because they do not understand the benefits from fertilizer use or may not be in a position to use fertilizer because they are unable to buy the fertilizer or have no physical access to fertilizer. These are the conditions which make fertilizer subsidies to be economically justified in addressing the market failures and other dis-incentives faced by the farmers they noted. To maximize the economic efficiency of subsidies therefore, the subsidies should be targeted to only the households faced by the above mentioned conditions which are a result of market failures. They argued that for raising the level of efficient fertilizer use, there are two main entry points, these are increasing the marginal benefit of fertilizer use by promoting technology adoption and another is by increasing the affordability of fertilizer by reducing input prices. Fertilizer subsidies, they noted reduce farmers' perceived risks arising from lack of knowledge on benefits of fertilizers by making fertilizer available and at an affordable price and in small quantities on a temporary basis. The temporary basis for subsidies allow the poor or constrained farmers increase their profitability by adopting fertilizer use though at reduced perceived risk but also avoids causing the farmers to create reliance on the subsidy as a longtime mitigating factor for the perceived risk. This is on the basis that once farmers try higher fertilizer levels, and the results are higher yields, then they will be convinced that

fertilizer use is necessary to achieve high yields, and so the removal of subsidies will not affect further fertilizer adoption. However, they noted, there is no single policy instrument that can increase fertilizer use because there are a myriad of reasons as to why farmers are not using fertilizers. Indeed fertilizer subsidies only tackle the price constraint, and in a temporary manner if there is no rent-seeking behavior by fertilizer dealers, but then price might not be the only bottleneck preventing widespread fertilizer use. In their view, understanding the various bottlenecks and identifying the market failures that causes them is paramount to evaluating the adequacy of fertilizer price subsidy programs at influencing fertilizer use. They however noted that this understanding is limited due to large information gaps on the results of the programmes because rigorous impact evaluations are lacking and even basic information on the design and immediate results of those programmes is sometimes hard to find.

Crawford et al (2005) analyzed in their paper arguments for and against subsidies, they categorized arguments for fertilizer subsidies into three as financial arguments, economic arguments and non-economic arguments. Under financial arguments, they placed the arguments that subsidies would greatly reduce the input output price ratios by raising the net income of farmers closer to profit-maximizing fertilizer use levels by offsetting the higher fertilizer prices that may be caused by high transport costs or limited market development when the product prices have not risen or been raised correspondingly or output prices have been held down to benefit urban consumers and also by offsetting the effects of limited availability or high cost of credit. Under the economic arguments they presented that subsidies encourage fertilizer use or optimal use when that is constrained by market distortions that increase input costs or reduce output prices relative to their free-market equilibrium levels, when there is lack of knowledge of the benefits that accrue from fertilizer use or when there is risk aversion by farmers which discourages them from adopting new technology or engaging in cash investments that carry financial risk and weak or missing financial markets in rural areas. Subsidies introduced to encourage fertilizer use amongst farmers with lack of knowledge and that are risk averse must be temporary and removed once the farmers have had experience with fertilizer. Under the non-economic arguments they noted that the basis for fertilizer subsidies is for example to offset the unfair competition resulting from subsidies on agriculture in developed countries and to encourage use of inorganic fertilizers to address the problem of soil nutrient depletion. On the

overall, they noted that the argument for subsidies is attractive because subsidies are politically attractive, they seem easy to implement, and the problems they are intended to address remain compelling at both the national and international levels. On the other hand, the arguments against fertilizer price subsidies were that they distort resource allocation at the farm level to the extent that they encourage excessive use of fertilizer, inefficient substitution of scarce resources for abundant ones or substitution of crops towards those that use the subsidized fertilizer and neglecting good land use practices such as use of organic matter or minimum tillage. Further, they noted that fertilizer subsidies are very hard to target and would generally benefit relatively well-off farmers or would encourage rent-seeking behavior which may cause the fertilizer to leak even across national borders or would usually stifle the operations in the private sector by crowding it out especially when no targeting is done. The failure to target would allow the able farmers to access the subsidized fertilizer and being rational, they would merely substitute the commercially available fertilizer with the subsidized ones. Further, subsidies are costly to administer, are financially unsustainable as they easily create a hard to end dependency, and are an inferior policy choice relative to other alternatives available for they do not address some of the major problems that cause low fertilizer use like low supply and poor credit availability. Lastly, they noted that there is really no sufficient technical and economic knowledge to allow one to rightly judge whether the costs of fertilizer subsidies would be outweighed by the social benefits obtained from increased fertilizer use.

Banful, (2011) noted that there is a disadvantage that relates to the political economy of subsidies which can undermine their impact even where they would be well designed and economically efficient. That is that fertilizer subsidy programmes create opportunities for entrenched rent-seeking behavior by official towards distributors/retailers and also create opportunities for political interference for personal and/or political gains. This is because granting of subsidies may be strongly tied to political support in that through them, politicians are presented with an opportunity to establish and maintain political and electoral support through clientelistic networks.

A. Dorward (2009) On the thought that a major constraint identified as leading to low use of fertilizer is credit availability, he argued that fertilizer subsidies will be useful only if in the

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absence of complementary financial services allowing farmers to access credit to finance the significant costs of purchasing fertilizer, subsidies will lead to sufficiently large enough reductions in fertilizer prices that will lead to increased access to fertilizers by poorer farmers. If subsidies lead to smaller reductions in fertilizer prices which do not make them affordable by poorer farmers then they are likely to mainly benefit less poor farmers whose use of unsubsidized fertilizer is less constrained by lack of knowledge of how to use fertilizers or by inability to finance their purchase. He however further noted that even when subsidies are sufficiently large enough there are possibilities of inefficiencies. This is because whereas the economically efficient use of inputs will be at a point where marginal value product equals marginal factor cost which gets lowered by a subsidy, if there are farmers with information on the benefits of increased use of inputs and have access to subsidized inputs, then they will apply much more of the inputs beyond the optimal level to get higher productivity. The problem is that this higher productivity will have a higher Marginal Factor Cost above the Marginal Value Product meaning the production is non-profiting. Furthermore, this extra subsidy use will simply be going to farmers who would already be using fertilizer and need no subsidies. Given that usually only a small proportion of the subsidy actually helps rise the input use he suggested that efficiency in subsidy programmes can be improved by targeting them to farmers who would otherwise use very little or no inputs and again those who would substantially increase the input use once it is subsidized. The combination of these two conditions he noted, would ensure subsidized input use but not beyond the economically efficient level. He however cautioned that indeed targeting criteria or methods would be constrained by the political concerns and implementation practicalities because subsidies are associated with political, economic, welfare and equity issues.

J Ricker et al (2009). Proposed that when other factors like soil quality, seed and management ability have been controlled, farmers should all be on the same production function, and as pointed out by Ellis (1992) offering fertilizer to farmers at a subsidized rate lowers the input output price ratio such that we would expect this price change to cause farmers to apply more fertilizer and move up the production function since the input/output price ratio gets flatter once the subsidy is implemented, a farmer who is at a higher point before the subsidy will thus receive

a lower yield response from fertilizer subsidy as he/she moves up the production function as compared to one at a lower point. According to this scenario the overall effect of subsidized fertilizer depends on the quantity of fertilizer farmer's use before the subsidy. They pointed out that the goal of fertilizer subsidy programs as articulated by many African governments is to improve farmers' incomes and national food security by increasing food production. To achieve these goals, the subsidy must raise total fertilizer use. They noted that the degree to which a subsidy program raises total fertilizer use depends on the extent to which it crowds out farmers' purchase of commercial fertilizer. This means if subsidized fertilizer substitutes the commercially acquired fertilizer, then there might not be change in total fertilizer use. However, if the subsidized fertilizer compliments the commercially sold fertilizer, then there will be an increase in total fertilizer use.

Soil Science Society of America (1997) reported that in as much as subsidy programs may have various objectives, their design and implementation should be "smart" in the sense that they should result to increased agricultural productivity and food security that exceed what could be achieved by investing the resources in other areas and should not crowd out commercial transactions or undermine investment in fertilizer distribution by suppliers and agro-dealers as noted by (Isaac et al, 2008). On the other hand, Economist and food policy analysts recommend that despite the lack of credit availability for influencing fertilizer use, input subsidies and particularly fertilizer subsidies should be eliminated entirely because they are a common technique used to increase the profitability of intensive agriculture while keeping food prices artificially low. Further, the report notes that according to Steve et al. (2010) the orthodox economic advice is that subsidies on private goods should be avoided since they are often costly, difficult to sustain without cutting spending on other valuable public goods, they distort resource allocation and are inefficient and often inequitable as a way of transferring resources, and they tend to distort the intensity of use of inputs from their economically optimal levels resulting to significant waste. It notes that, the use of manure to increase soil fertility is an alternative already available to most smallholder farmers who get it from cattle enclosures.

2.2. Empirical Literature Review

Heady et al (1965) In their study on solving farm problems in the united states of America estimated that use of fertilizer contributed 45% of the average annual increase in yields for all crops for several decades in the country whereas of the remaining share, 6% came as a result of irrigation, 10% as a result of introduction of hybrid maize and 39% came as a result of use of improved seeds, improved cropping practices and other innovations.

Duflo, Kremer, and Robinson, (2008) carried out a study in Busia region of Western Kenya where fertilizer use is low. They investigated reasons for low adoption of fertilizer but specifically the lack of information and savings difficulties. Their findings however suggested that simple interventions that affect neither the cost of, nor the payoff to fertilizer could substantially increase fertilizer use. Particularly, they noted that offering farmers the option to buy fertilizer at the full market price but with free delivery immediately after the harvest leads to an increase of at least 33% in the proportion of farmers using fertilizer; this effect was comparable to that of a 50% reduction in the price of fertilizer due to a fertilizer subsidy. The finding thus was inconsistent with the idea that low adoption to fertilizer use was due to low returns or credit constraints. This thus suggested that there may be a role for non–fully rational behavior in explaining production decisions. However, on the effect of fertilizer use to production, the study showed that when fertilizer is used in limited quantities, it on average generates returns of 36% over a season, which translates to 70% on an annualized basis even without other changes in agricultural practices.

Ammani et al (2010) using a multiple regression model did a study on effects of liberalization of the fertilizer sector in Nigeria given that there existed dual fertilizer distribution channels. On finding that there was a decrease in total maize production after the Government liberalized the fertilizer sector in 1997, they concluded that the maize production reduced as a result of a decrease in fertilizer use during that period. This thus points to liberalization having left farmers to the market forces which resulted to reduced use of fertilizer by farmers.

Chaudhry et al (1976) used time series data for the period 1962 – 1974 to estimate the demand function for nitrogen fertilizer in Pakistan. The study regressed fertilizer demand as dependent variable on the price of fertilizer, revenue per cropped area and a trend variable representing technology and institutional charges as the independent variables. The study found that revenue per cropped areas, price and trend variable to be the important factors in determining the total fertilizer use in Pakistan.

Jacob et al (2009) did a panel data study in Malawi on the effect of subsidized fertilizer on the demand of Commercial fertilizer purchased. They used a double huddle model to address the corner solutions. The double hurdle model accounts for the possibility that factors influencing fertilizer market participation and factors influencing quantity of fertilizer purchased may be different. For example, fixed costs may affect a farmer's decision to participate in the market but they may not affect the quantity purchased. However, to obtain consistent estimates in the model, the independent variables must be independent of unobserved heterogeneity *in* non-linear models. They empirically estimated factors influencing participation in commercial fertilizer markets and the amount of fertilizer purchased.
They found that when a subsidy is introduced, subsidized fertilizer use increases while
Commercial fertilizer use decreases. However, the total fertilizer use is seen to increase

Idachabe et al (1976) estimated demand functions for pesticides in the cocoa zones in Nigeria. He used quantity of pesticide used on the farm as the dependent variable and pesticide price, expected cocoa price for the season, income position of the farmer and a vector of other variables influencing farm consumption of pesticides as the independent variables. The study found price of fertilizer to be significant in influencing pesticides consumption and so recommended pesticides subsidy. In the distributed leg model that they used, the adjustment coefficient for pesticide price was higher for cocoa producer prices both in the long run and short run. They concluded that for large scale adoption of a new input, more emphasis should be given to input subsides rather than support crop prices. The study concentrated mainly on economic factors as the major determinants of demand for inputs ignoring the non-economic factors which may affect inputs demand.

Zoe' D et al (2012) in their paper on Fertilizer subsidies in Sub Saharan Africa, refer to the 1990s where the Sasakawa Global Initiative implemented a series of pilot programmes aimed at promoting crop productivity in Africa by providing fertilizer, improved crop varieties and crop management information to more than three million farmers through extension demonstration plots. The programme sought to promote rapid adoption of new seed/fertilizer technologies by providing free credit for inputs, which would be bought from the private sector, together with extension efforts on closely supervised, half-hectare demonstration maize plots cultivated by individual small-scale farmers in high-potential agro-ecological zones on their own land. The programme initially targeted less poor and more educated farmers. The support was then withdrawn after one or two years and farmers expected to continue using the new technologies due to their superior performance. Results showed consistent yield increases both during the programme and afterwards. Further, in yet another analysis using Food and Agriculture Organization Statistical (FAOSTAT) data for aggregated yield trends for selected countries in Africa, they made a Comparison between the increase of yields for targeted crops before and after the fertilizer subsidy was introduced and the increase for the same crops and the same period in the countries where no subsidy was in place. As regards the West Africa, for most of the analyzed crops, they found that yield increases after the introduction of the fertilizer subsidy were higher than increases in countries where no subsidy was in place, indicating a clear positive effect of the subsidy

Subramaniyan et al (1991) in an analysis of fertilizer demand in India, used time series data for the period 1967 to 1986 to estimate the demand function for fertilizer in India. The study used fertilizer consumption as the dependent variable while the independent variables were relative price of fertilizer, percentage area planted with high yielding varieties, percentage area irrigated, a measure of land intensity, trend variable and the weather. The study found the relative price of fertilizers to be an important factor influencing its demand and recommended a fertilizer subsidy so as to increase affordability of fertilizer hence increase its demand.

Rabbi (1986) in a study on fertilizer subsidy in India used a multiple regression analysis, linear form and the log linear and found that a unit increase in fertilizer usage would increase production by 12-27 units, wherefrom he concluded that any attempt to increase farm gate price

of fertilizer by reducing subsidies could impact negatively on the output of food grains. Further, he pointed out that in 1983, the US paid a total subsidy of $18.7 billion to farmers to compensate them not to put to production a total of thirty one million hectares of farm land, thus subsidies were not peculiar to India.

Hayami and Barker (1976) in their study on Price Support versus Input Subsidy for Food Self-Sufficiency in Developing Countries, they evaluated the policies on output price support and input subsidy, using a simple demand-supply model to the Philippine rice economy. The results demonstrated a possibility that a subsidy applied to modern inputs, such as fertilizer, that are being used below optimum can be more beneficial than supporting product prices. They concluded that fertilizer subsidies could lead to welfare gains to the society but that they need to be focused on as a short run issue where once farmers attain optimal fertilizer use, then the subsidies should be phased out and in so doing, causing no major drops in fertilizer use or yields.

Clement and Schwartz (1999) in their study on problems of defining and measuring government subsidies, they analyzed international trends in government subsidy expenditure for a 16-year period from 1975 to 1990, using general government subsidy data from the United Nations System of National Accounts for sixty countries. They noted that subsidies were a major instrument of Government expenditure policy on a domestic level hence they affect domestic resource allocation decisions, income distribution and reduce the flexibility of the economy and affect international level by causing distortions in the international resource allocation by affecting competitiveness, thus they impose a substantial burden on the economy. The aim of the study was to look for ways to improving the cost-effectiveness of subsidy programs. Therefore on the options for reform, they emphasized that attention should be focused on increasing transparency, enhancing cost effectiveness, limiting duration, strengthening cost control, and selecting a pragmatic approach to subsidy policies. For transparency, they noted that subsidies should be provided in cash, and directly from the government budget, because any other forms other than cash or by institutions outside of the central government would results to transparency suffering.

David Kwach (2011) did a study on Effects of fertilizer input subsidy on maize production in Kenya. Using cross section data from farmers in wareng district and applying a production

function he regressed the yield against the various factors influencing it and found that fertilizer input subsidy had a positive effect on the production of maize and increased yield by 14.3% per acre when effect from all other factors had been controlled. However, he also found that the fertilizer subsidy was not the most important factor to increased maize production but farmers' access to credit. He recommended that policy should focus on increasing the amount of fertilizer input subsidy but not as the only way to increase maize productivity but also initiate programms to shift from rain-fed agriculture to irrigated systems and embrace proper crop husbandry.

2.3. Overview of the Literature review

From literature review, fertilizer use is taunted as the most significant input in maize production and can increase yields by up to 45%. However, its use is low in sub-Saharan Africa owing to its unavailability and high price that results from among others, high transportation costs. Poor farmers who are the majority are thus unable to access it given that they cannot afford it nor access credit that is paramount in their acquiring the fertilizer or because of poor distribution channels of the fertilizer.

On the basis of the difficulties faced by poor farmers, a case for fertilizer subsidies has revived in Africa as a way of encouraging increased fertilizer use among farmers. This is because fertilizer subsidies are thought to be easy to implement, are politically attractive, they address issues generally accepted as pertinent to farmers who are the majority and are capable of increasing house hold incomes and pooling the poor out of poverty.

Other arguments in support of subsidies are generally that they help encourage farmers who are risk averse to investing in perceived high risk financial investments like purchasing of fertilizer or are ignorant of benefits that accrue from fertilizer use. However, these subsidies should be on a temporary term so as to avoid farmers developing dependencies on them.

There are however also arguments against the use of fertilizer subsidies; the orthodox economic advice is that subsidies distort resource allocation, are inefficient in resource distribution and are wasteful. Other arguments are that subsidies are costly and difficult to sustain, are susceptible to

political interference and encourage rent seeking behavior among officials responsible for distribution them and this could results to leaking.

Despite studies having been carried out on the effects of subsidies, these studies have largely been concerned with the effects to yield, or to commercial fertilizer or to households income among others but not specifically on how strong the effects of fertilizer price subsidies are to fertilizer use, therefore there still exists information gap in this area on effects of fertilizer price subsidies on fertilizer use.

Chapter Three

3.0. METHODOLOGY

3.1. Theoretical Framework

From the literature and economic theory it is evident that there are many factors that influence the use of fertilizer. Fertilizer being an input, its demand is indeed a derived demand.

According to Quddus et al (2008), the utilization of fertilizer is depended upon the profit maximizing condition and the production function which they presented as.

$Y = AF\ L\ \mu_0$ – production function ---------------- (i)

$= P_1Y - P_2F - P_3L$ - Profit identity ----------------- (ii)

Where:-

Y = Output

F = Fertilizer

L = Labour

$=$ Profit

P_1 = Price of output

P_2 = Price of fertilizer

P_3 = Price of labour or any other input

By using profit maximizing conditions with respect to fertilizer and then labour and combining the two with the production function and solving for 'F' they obtained,

$LogF = ((logA + log\ [P_2/\ P_1]\ (\ -1) +\ \ log\ (\mu_1 - \mu_2) - logP_3/P_1 + log\ \mu_0 - log\ \mu_1))/1 -\ -\ $ -------- (iii)

Where equation (iii) indicates that any demand function for fertilizer must incorporate product price, price of fertilizer and other input technological shift and random distribution term.

Further, basic economic theory is that quantity demanded is equal to quantity supplied i.e. $Qd = Qs$ for a particular commodity in a market at the equilibrium level.

The side for quantity demanded is given as

$Qd = f\ (P_1 \ldots Pn; a)$

Where:-

Qd = Quantity demanded

$D_1\ (P_1 \ldots Pn; a)$ = Demand function

In which:-

P_1…. P_n = price of the commodity, price of substitutes, price of complements

a = A factor affecting the economy

D_1 = Multiplier.

Given that the law of demand states that all else being equal, quantity demanded of a good is inversely related to its price, inclusion of other factors that affect demand would lead to the following basic equation for demand:-

$Q = $ - P_i. -- (iv)

Where:-

Q - Demand

  - Other factors that influence demand.

P_i - Own price, price of substitutes, complements etc.

Drawing from the above theoretical framework, in this study, the general model is specified as:

$Q_{it} = X_{it} + i + u_{it}$ or $= X_{it} + i + u_{it} + it,$ ----------------------- (v)

Where

– Q_{it} is the dependent variable (amount of fertilizer demanded) for individual i in year t

–   is the coefficient for independent variable (IV),

– X_{it} is a vector of independent variable (factors affecting Q) for individual I in year t.

– i ($i=1$….n) is the unknown intercept for each entity (n- entity specific- intercepts)

 - u_{it} is the between entity error term-

- it *is* the within entity error term

3.2.   Model Specification

Using panel data, the study considers that increased fertilizer demand/use is a function of income of farmers, price of fertilizer, price of the preceding produce, farmers' knowledge, fertilizer availability at the right time and quantity, weather patterns, availability of alternatives to fertilizer and lastly size of land.

The study uses a simple regression model to determine the effect of each of the identified factors on the quantity of fertilizer demanded.

The specific model is as follows;

$$Qi_t = {}_{0i} + {}_1X_{1t} + {}_2X_2i + {}_3X_3\,it + {}_4X_4t + {}_5X_5i + {}_6X_6it + {}_7X_7it + {}_8X_{8it} + Ui_t + it, \text{------- (vi)}$$

Where:

Qi_t = fertilizer consumption of individual i in year t

${}_{0i}$ = is the unknown intercept for each entity

X_1 = Price subsidy

X_2 = Farmers knowledge

X_3 = Fertilizer availability.

X_4 = Weather patterns

X_5 = Size of land

X_6 = income of a farmer

X_7 = Manure

X_8 = Price of preceding produce

Uit = Between entity error term representing unobserved time invariant variables that may affect fertilizer purchases such as soil quality and community infrastructure for individual i in time t

it = within entity error term representing unobservable factors(personal characteristics) for individual i in time t that may affect fertilizer use.

Table 2:   Operational Definition of Variables

	Description	**measurement**	**Expectation**
${}_1X_{1t}$	Price Subsidy received as a whole by farmer i at time t based on a 50kg bag of fertilizer.	Continuous	Positive because the more the subsidy, the higher the fertilizer consumption.
${}_2X_2i$	Farmer i's knowledge based on education attained.	Dummy 1 if farmer has post primary education or received Specific training on right use of fertilizer 0 if otherwise	Positive because information/knowledge increases fertilizer use

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$_3X_3$ it	Fertilizer availability to farmer i at time t.	Dummy 1 if fertilizer was available at the right time 0 if otherwise	Positive because fertilizer availability encourages fertilizer consumption
$_4X_4$t	Weather patterns at time t	Dummy 1 for good rains 0 if otherwise	Positive because good rains would encourage more fertilizer use
$_5X_5$i	Size of land for farmer i	Ordinal (from small to big)	Positive because bigger land size encourage more fertilizer use
$_6X_6$it	income of a farmer i at time t	Continuous	Positive because higher income allows for higher fertilizer use
$_7X_7$it	Manure availability for farmer i at time t	Continuous	Negative because the more the use of manure, the less the use of fertilizer. It acts as a substitute to fertilizer.
$_8X_8$t	Price of preceding produce for farmer i at time t	continuous	Positive because if higher, it motivates use of fertilizer in the succeeding year.

3.3.   Estimation Techniques

On the general, usually two methods are considered when dealing with panel data. These are fixed effect and Random effect methods. The choice of method depends on whether E (XitVi) = 0 or E (XitVi)   0. The Hausman's specification test provides guidance on weather error components are E (XitVi)   0. Michael P. Murray (2005)

E (XitVi) = 0 means characteristics   not observed are not correlated with the variables included in the model.

Fixed Effect Method

We use fixed-effects (FE) whenever we are only interested in analyzing the impact of variables that vary over time. We assume that something within the individual may impact or bias the predictor or outcome variables and we need to control for this, we further assume that those time-invariant characteristics are unique to the individual and should not be correlated with other individual characteristics. Each entity is different therefore the entity's error term and the constant (which captures individual characteristics) should not be correlated with the others. The method discards all variation between individuals and uses only variation over time within an individual. Under an assumption of strict exogeneity, the fixed effects estimator can be

considered unbiased (Wooldridge, 2002). This implies that all explanatory variables are uncorrelated with all unobservable factors in the residual. Fixed Effects is not efficient if

E (XitVi) = 0 i.e when explanatory are not correlated to unobserved heterogeneity.

The main problem *for the fixed effects model* (FEM) is that the estimator cannot be used to investigate time-invariant causes to the dependent variables.

The following general equation is employed in fixed effect model

$$Y_{it} = 1X_{it} + i + u_{it} \text{--- (vii)}$$

Random effect

Random effects models assume the variation across entities is uncorrelated with the predictor or independent variables included in the model. i.e. E(XitVi) = 0 . The model is used when differences across entities have some influence on the dependent variable.

The equation for Random Effect Model is;

$$Y_{it} = X_{it} + + u_{it} + it \text{--- (viii)}$$

The crucial distinction between fixed and random effects is whether the unobserved individual effect embodies elements that are correlated with the regressors in the model, not whether these effects are stochastic or not.

3.4. Diagnostic Tests

The diagnostic test to be conducted shall be to carry out the Hausman's specification test to establish the existence of correlation between explanatory variables and unobserved heterogeneity so as to choose the right method for use as a model.

3.5. Hypothesis testing

The approach is to consider that the null hypothesis is the preferred model which is random effects vs. the alternative model which is fixed effects (Green, 2008). Here we shall basically tests whether the unique errors (u_i) are correlated with the regressors, the null hypothesis is that

they are not, i.e E (XitVi) = 0   Hence we use the Random effect and vice versa. Use of Fixed effect Method in the absence of autocorrelation will render our results less accurate

3.6.   Data and Sources of Data

Panel data for 2009 to 2013 for farmers from Kabuyefwe Location in Bungoma County was used. A list of farmers was obtained from the chief's office and by random sampling a list of sixty six farmers out of one thousand six hundred was developed for interviewing The cost at which farmers obtained subsidized fertilizer per bag for various years was obtained from the farmers and collaborated in general by the National Cereals Produce Boards (NCPB) stores at Nzoia and similarly commercial fertilizer prices were obtained from local retail traders and collaborated in general by farmers.

3.7.   Estimation method

The data was regressed by simple linear regression method with an acceptable margin of error of ten at a ninety percent confidence level.

STATA statistical software for analysis was used to carry out the data description and analysis and tabular formats used to present results of the study variables.

3.8.   Data Limitation

The study used both primary and secondary data to obtain the necessary information. However, data for some variables was falling outside of the recall period for some interviewees and since they had no written records, they gave estimates. There is also a possibility that wrong information was given especially as relates to individual incomes and the amount of fertilizer used per acre. Despite some of these shortcomings, the data used was good enough for use to make indicative inferences.

Chapter Four

4.0. Findings and Interpretations

4.1. Summary Statistics

Summary statistics of the main variables included in the model and the consequent analysis including the descriptive statistics on the variables is as below.

Table 3:   Descriptive statistics

Variable	Obs	Mean	Std Dev	Min	Max	kurtosis	skewness
Fert	330	7.9	3.994753	0	20	2.901612	-0.00944
X_1(cost)	330	3500	708.1806	2500	4500	1.7	0
X_2(Edu)	330	0.878788	0.3268693	0	1	6.387931	-2.32119
X_3(avail)	330	0.993939	0.0777315	0	1	163.0061	-12.7282
X_4(weth)	330	0.6	0.4906419	0	1	1.166667	-0.40825
X_5(land)	330	4.398485	1.730602	0.5	10	2.78534	0.224827
X_6(inco)	330	78136.36	32634.05	10000	220000	5.814154	0.878317
X_7(manu)	330	0.078788	0.2698165	0	1	10.77783	3.126953
X_8(cropp)	330	2801.061	204.0407	2000	3100	4.742812	-1.11106

Source: Researcher's survey data 2014.

As per the statistics in table 4.1, there were a total of 330 observations made by the researcher on each variable; each farmer used an average of 7.9 bags of fertilizer. The highest use by any farmer was 20 bags of fertilizer while the least use by any farmer was no use of fertilizer. Further, land put to use for maize production which was the crop under consideration averaged approximately 4.4 acres. The farmer using the least land used 0.5 acres whereas the farmer using the most land acreage used 10 acres. The cost of fertilizer averaged Ksh. 3500/= per bag with the highest price being Ksh.4500/= per bag and the lowest price being Ksh.2500/= per bag which was reached in 2013 due to government subsidy. Income of farmers averaged Ksh. 78,136/= per year with the least income to any farmer being Ksh. 10,000/= per year and the highest amount earned by any particular farmer being Ksh. 220,000/= in a particular year.

Farmers sold their crops at an average price of Ksh.2801.06/= per bag over the period, however price was as low as Kshs. 2000/= per bag in 2009 and as high as Ksh.3100/= per bag there after.

4.2. Regression Results

A presentation of a robust regression results of the effects of covariates in the model on the quantity of fertilizer.

Table 4: A regression of effects of factors on quantity of fertilizer

variable	parameter/coefficient	Significance P value
constant	-4.216805	0.191
X_1(cost)	-0.0002682	0.125
X_2(Education)	0.4759958	0.139
X_3(availability)	1.970881	0.129
X_4(wether)	-0.0880717	0.592
X_5(land)	1.677153	0.000
X_6(income)	0.0000161	0.000
X_7(manure)	-2.670214	0.000
X_8(crop price)	0.0008227	0.306

R- Squared (R^2) = 0.8982

F(8, 321)   = 614.05

Prob > F   = 0.0000

Root MSE   = 1.2904

The model explaining the effects of various factors on quantity of fertilizer was given by

Qi_t = -4.25 + -0.0003X_{1t} + 0.476X_2i+ 1.971X_3 it + -0.0881X_4t+ 1.6772X_5i+ 0.0000161X_6it + - 2.670X_7it+ 0.00082X_8it + ui_t + it, -- (ix)

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The result indicate R-squared of 0.8982 meaning 89.92% of variations in the quantity of fertilizer used can be explained by income of farmers, cost of fertilizer, price of the preceding produce, farmers' knowledge, fertilizer availability at the right time and quantity, weather patterns, availability of alternatives to fertilizer and lastly size of land.

The result is affirmed by an F- statistic of 61.41 against a lower value of 0.05 level of significance and a probability of zero which allows a rejection of a hypothesis of possible insignificant regression result i.e

$$H_0: \quad _1 = 0 \text{ verses } H_a: \quad _1 \quad 0 \text{ for all } i = 1 \ldots, k.$$

Further, the regression results show that the cost of fertilizer still has a negative effect on the use of fertilizer albeit a very small one. Knowledge of farmers which was captured by the level of schooling attained or training on the use of fertilizer had a significantly positive effect on the use of fertilizer, similarly, positive effect on the use of fertilizer was realized from availability of fertilizer, size of land, income of the farmer and price of the previous crop price. On the other hand, the cost of fertilizer as earlier mentioned, weather, which was measured as rainfall received and availability of alternatives to fertilizer which was captured as use of manure all had negative effects on the use of fertilizer.

Chapter Five

5.0. Conclusions and Recommendations

5.1. Summary

The researcher aimed at establishing the effects of fertilizer price subsidies on fertilizer use in Kenya based on a study conducted in Kabuyefwe Location which was part of the lager Naitiri Location of Bungoma County. The conclusions and recommendations are based on theoretical and practical considerations, research limitations, suggestions for further research and policy implications.

5.2. Discussions and Conclusions

The study investigated the effects of other variables on the use of fertilizer other than the input subsidy, the consideration for these other factors was for control purposes given that fertilizer use is not only affected by fertilizer subsidy but rather by several other factors also.

The effect of the following factors was therefore put into consideration, cost of fertilizer, price of the preceding produce, farmers' knowledge, fertilizer availability at the right time and quantity, weather patterns, availability of alternatives to fertilizer and size of land.

Cost of fertilizer, availability of alternatives to fertilizer and weather patterns were found to have negative effects on fertilizer use. Of these three, availability of alternatives had the highest negative effect on fertilizer use followed by the weather patterns. It is interesting to note that the cost of fertilizer had the least effect on fertilizer use in this study. The results were backed by a low probability (p= 0.000< 0.05) implying that the result did not happen by chance but are consistent. Given that fertilizer input subsidy reduced the cost of fertilizer; we infer that the input subsidy indeed helps counter the negative effect imposed on fertilizer use by the cost.

Given that fertilizer use (an input) strongly contributes to productivity, yet this study finds that the cost of fertilizer is not the most important factor affecting fertilizer use, then the study indeed contrasts the findings of Owour (2009) who found that the most important determinant of

productivity was cost of inputs like fertilizer. The results partly confirm Kwach (2011) who found fertilizer subsidy which is related to fertilizer cost in this study not to be the most important factor. However, the studies might not be strongly comparable since Kwach (2011) had different objectives and not exactly the same factors (variables) but for the few that were similar e.g land and education, they were found very important factors just as they are found to be very important in this study. It is however very important to still note that the cost might have been found to be not most important in this study because the subsidy had already countered the effects of cost by lowering it to a level of insignificant effect.

On the other hand, the following factors had a positive effect on the use of fertilizer; fertilizer availability at the right time and quantity, land size, knowledge of farmer, preceding crop price and income respectively.

It is of interest that income of a farmer is the least important factor determining a farmer's use of fertilizer given that with a casual eye we see farmers with high incomes using more fertilizer. Indeed income has a very minimal effect compared to availability of fertilizer for use and land size,

5.3. Policy Implications and Recommendations

Fertilizer costs have a negative effect on fertilizer use, given that fertilizer subsidy reduces the cost of fertilizer, it follows that the subsidy counters the negative effect hence is an important contribution to fertilizer use. However, as noted by previous studies, the subsidy programmes must be targeted to avoid wastage. The government should not keep pursuing increase of fertilizer price subsidies because as shown from the results, at lower levels, price of fertilizer is not the most important determinant of fertilizer use. Efforts should therefore be directed at such factors like availability of fertilizer at the right time and quantity which was shown to have a strong effect on the use of fertilizer. In this regard, the Government can put in plans that will encourage improvement of distribution channels which would definitely ensure sustained availability of fertilizer to farmers at the right time and quantity. These may have to do with providing the subsidy amount rather than the subsidized fertilizer which gets distributed by the government. This approach may better encourage development of distribution channels as it

allows private persons to engage in distribution yet at the same time allowing farmers to buy at the low costs as a result of subsidy amounts (money) availed.

Size of land under use also had a very strong positive effect on fertilizer use, as such the small holdings should be discouraged and a policy for encouraging large-scale farming encouraged as this would have less administrative costs hence maximize the overall benefits to farmers due to fertilizer use. Equally, minimum size one can hold can be legislated so as to avoid the tendency of individuals subdividing agriculture land to non productive sizes.

Given that weather patterns are found to be negatively related to fertilizer use, it will be prudent to adopt policies that encourage irrigated farming rather than reliance on rain fed agriculture. This may call for efforts by the government to avail adequate water to farmers. Research on how to practice farming under control environment should be pursued so as to avoid being too subjected to natural weather issues.

The government should also pursue efforts to enable farmers to acquire knowledge on fertilizer use, this will encourage optimal use. Extension services may need to be pursued more aggressively.

Given that both price of preceding crop and income have positive effects, this should not be relegated. The government needs to put in place structures that will allow farmers to get competitive prices for their produce. This could be in the form of encouraging formation of farmers marketing cooperatives and development of alternative livelihoods so that farmers do not sale their produce at throw away prices because they have no otherwise.

Further, alternatives to fertilizer are also seen to strongly, negatively affect fertilizer use, however, any government policy concerning them must be carefully considered given increased productivity that is attributable to alternatives to fertilizer and also the health benefits that are associated with this fertilizer alternatives.

5.4. Areas for further Study

As noted in the recommendations above, there is a need to set minimum Agriculture land holding size. These must be backed by proper research to establish the size of land that will be optimal for fertilizer users.

The use of alternatives to fertilizer and in particular manure which was considered in the study is seen to negatively influence fertilizer use, but indeed any legislation or policy to direct the use of this should be well researched given that the substitution of e.g. fertilizer for manure might not necessarily become disadvantageous depending on purpose, quantity and quality applied.

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ANNEX 1

Introduction letter

August 2014

Dear Respondent

REF: EFFECT OF FERTILIZER PRICE SUBSIDIES ON FERTILIZER USE IN KABUYEFWE LOCATION OF BUNGOMA COUNTY; KENYA

My name is Andrew Welime, an Economics Masters student from the University of Nairobi. I am carrying out a research on the above subject to fulfill a requirement for the masters degree course am undertaking, I therefore humbly request that you allow me to ask you a few questions for which your answers will help me finalize the research.

The research covers a period of five years up to 2013; therefore each question refers to a particular year within that period.

All information obtained from you shall be treated with utmost confidentiality and the results from the research will be for the purpose of fulfilling my course requirements and to avail valuable information to policy makers on how they can encourage farmers to increase fertilizer use for increased maize production.

Thank you in advance for your time and cooperation

Andrew Welime

072352614

Questionnaire

EFFECT OF FERTILIZER PRICE SUBSIDIES ON FERTILIZER USE IN KABUYEFWE LOCATION OF BUNGOMA COUNTY; KENYA

SN [   ] Date ……………

Background information

1. **Name of interviewer……………………………………………….**

2. **Address of Residence……………………………Contact …………………..**
   Note: Please request for answers to the following questions in the language best understood by the interviewee and help him/her record the answers legibly or tick appropriately.

3. **Farmer information**

   3.1.   Division …………………………………

   3.2.   Location ………………………………..

   3.3.   Name of Sub location………………………………

   3.4.   Name of Village ……………………………………….

4. **Demographic characteristics**

   4.1.   Sex   Male [ ]   Female [ ]

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4.2.   Age   …………. Years

4.3.   Duration as a farmer ……………….. years

5.0.   Improved technology

5.1. In each of the following years, please tick on what you used to increase

productivity of your maize farm. Please use the space provided to say what you

used most if both were used.

2009		2010		2011		2012		2013	
Fertilizer	Manure	Fertilizer	Manure	Fertilizer	Manure	Fertilizer	Manure	Fertilizer	Manure

5.2. If you used fertilizer, according to you. How accessible and adequate was

fertilizer in each of the years you used it.

2009		2010		2011		2012		2013	
Good	Not good	Good	Not good	Good	Not good	Good	Not good	Good	Not good

5.3. How much was the cost of a   bag of fertilizer in each of the years

Fertilizer type	2009	2010	2011	2012	2013
DAP					

5.4. How many bags of the fertilizer did you use in each of the years?

2009	2010	2011	2012	2013

5.5. What was the size of land in acres that you used the fertilizer on in each of the

years.

2009	2010	2011	2012	2013

6.0. Perceptions

6.1. Over this period, Please tick on what best describes how the rains were in each of

the years

2009		2010		2011		2012		2013	
Good	Not good	Good	Not good	Good	Not good	Good	Not good	Good	Not good

7.0. Education and Training

7.1. What highest level of education have you reached?

[Primary]   or   [Post primary]

7.2. Have you ever received any training/ information on the type and quantity of

fertilizer to use for your crops for best production?

[Yes]   or   [No]

7.3. When was the training received for the first time if the answer is yes in question

7.2 above?

8.0. **What was the sale price of a 90kg bag of maize in each of the following years**

2008	2009	2010	2011	2012

9.0. **Income**

9.1. What level of income on average did you realize in each of the years of focus?

2009	2010	2011	2012	2013

Thank you very much for your time and cooperation

Annex 2: Raw Analysis

Table 1: Regression of Fertilizer quantity used

regress yfetiliz x1cost x2edu x3avail x4weth x5land x6inco x7manu x8cropp, vce(robust) level(90)

```
Linear regression                           Number of obs =    330
                                            F( 8,  321) =  614.05
                                            Prob > F      = 0.0000
                                            R-squared     = 0.8982
                                            Root MSE      = 1.2904


--------------------------------------------------------------------------------
             |            Robust
    yfetiliz |    Coef.   Std. Err.     t    P>|t|    [90% Conf. Interval]
-------------+------------------------------------------------------------------
      x1cost | -.0002682   .0001742   -1.54   0.125    -.0005557    .0000192
       x2edu |  .4759958   .3210131    1.48   0.139    -.0535521    1.005544
      x3avail|  1.970881   1.296598    1.52   0.129    -.1680048    4.109767
      x4weth | -.0880717   .1639723   -0.54   0.592    -.3585628    .1824193
      x5land |  1.677153   .0572482   29.30   0.000     1.582716    1.771591
      x6inco |  .0000161   3.22e-06    5.01   0.000     .0000108    .0000214
      x7manu | -2.670214   .5059342   -5.28   0.000     -3.50481   -1.835618
     x8cropp |  .0008227   .0008021    1.03   0.306    -.0005005    .0021458
       _cons | -4.216805   3.219705   -1.31   0.191    -9.528076    1.094467
--------------------------------------------------------------------------------
```