
**ST. MARY'S UNIVERSITY**

**SCHOOL OF GRADUATE STUDIES**

# FACTORS AFFECTING DEMAND AND SUPPLY CHAIN OF FERTILIZER IN ETHIOPIA: EMPIRICAL EVIDENCE FROM KERSA AND MALIMA WOREDA OF OROMIA REGION, ETHIOPIA

**BY**

**DANIEL SINESHAWE**

**JANUARY 2020**

**ADDIS ABABA, ETHIOPIA**

# FACTORS AFFECTING DEMAND AND SUPPLY CHAIN OF FERTILIZER IN ETHIOPIA: EMPIRICAL EVIDENCE FROM KERSA AND MALIMA WOREDA OF OROMIA REGION, ETHIOPIA

**BY**

**DANIEL SINESHAWE**

**A THESIS SUBMITTED TO ST. MARY'S UNIVERSITY, SCHOOL OF GRADUATE STUDIES, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF DEVELOPMENT ECONOMICS**

**JANUARY 2020**

**ADDIS ABABA, ETHIOPIA**

**ST. MARY'S UNIVERSITY**
**SCHOOL OF GRADUATE STUDIES**
**INSTITUTE OF AGRICULTURE AND DEVELOPMENT STUDIES**

**BY**

**DANIEL SINESHAWE**

**APPROVED BY BOARD OF EXAMINERS**

| | |
|---|---|
| _____ | _____ |
| **Dean, Graduate Studies** | **Signature** |
| _____ | _____ |
| **Advisor** | **Signature** |
| _____ | _____ |
| **External Examiner** | **Signature** |
| _____ | _____ |
| **Internal Examiner** | **Signature** |

# DECLARATION

I, the undersigned, declare that this thesis is my original work, prepared under the guidance of Wondimagegne Chekol (PhD). All sources of materials used for the thesis have been properly acknowledged. I further confirm that the thesis has not been submitted either in part or in full to any other higher learning institution for the purpose of earning any degree.

_____ _____

Name Signature

**St. Mary's University, Addis Ababa January 2020**

# ENDORSEMENT

This thesis has been submitted to St. Mary's University, School of Graduate Studies for examination with my approval as a university advisor.

Wondimagegne chekol, (PhD) _____

Advisor Signature

**St. Mary's University, Addis Ababa** **January 2020**

# DEDICATION

All praises to the Almighty God, the most gracious, for giving me the strength and determination to complete this study. I would also like to dedicate this paper to my family, my wife and my friends for their sacrifice, encouragement and support.

# ACKNOWLEDGEMENT

Above all I would like to praise the Almighty God for His help and Protection throughout my life.

I would also like to thank my Advisor Dr. Wondimagegne Chekol for his dedication, valuable advice, continuous, precious guidance and support throughout the study of this research. He was ready and available to give me guidance, support and contributions.

My special thanks to my family, my wife and my friends, who encouraged and supported me at all times. Their love, support, encouragement, dedication, and many priceless sacrifices contributed to the successful completion of my study.

I am grateful to EABC, ESLSE, MoA and Kersa and Malema wereda office staff members who allowed me to conduct data collection smoothly in the office.

Lastly my thanks go to the members of the sample farm respondents for their time to respond my questionnaire.

# Table of Contents

DECLARATION ..... iii
ENDORSEMENT ..... iv
DEDICATION ..... v
ACKNOWLEDGEMENT ..... vi
ACRONYM ..... ix
LIST OF TABLES ..... x
LIST OF FIGURES ..... xi
LIST OF APPENDIXES ..... xii
ABSTRACT ..... xiii
CHAPTER ONE ..... 1
NTRODUCTION ..... 1
1.1. Background of the Study ..... 1
1.2. Statement of the Problem ..... 3
1.3. Research Questions ..... 5
1.4. Objective of the Study ..... 5
1.5. Significance of the Study ..... 5
1.6. Scope and Limitation of the Study ..... 5
1.7. Organization of the Thesis ..... 6
CHAPTER TWO ..... 7
LITERATURE REVIEW ..... 7
2.1. General Concepts and Definitions ..... 7
2.2. Review of Empirical Studies ..... 15
2.3. Conceptual Framework of the study ..... 20
CHAPTER THREE ..... 22
RESEARCH METHODOLOGY ..... 22
3.1. Descriptive of the Study Area ..... 22
3.2. Research Design ..... 23
3.3. Sampling Technique and Sample Size ..... 23
3.4. Methods of Data Collection ..... 24

3.5. Pre-Test ..... 24
3.6. Method of Data Analysis ..... 24
CHAPTER FOUR ..... 34
RESULT AND DISCUSSIONS ..... 34
4.1. Demographic Characteristics of Respondents ..... 34
4.2. Fertilizer Supply/Import Trend in Ethiopia (2000-2018 G.C) ..... 36
4.3. Results of the Econometric Model ..... 37
CHAPTER FIVE ..... 44
CONCLUSION AND RECOMMENDATIONS ..... 44
5.1. Conclusions ..... 44
5.2. Recommendations ..... 45
REFERENCES ..... 47
**APPENDIXES** ..... 56

# ACRONYM

| | |
|---|---|
| ADLI | Agricultural Development Led Industrialization. |
| AISE | Agricultural Input Supply Enterprise. |
| AISCO | Agricultural Input Supply Corporation. |
| ATA | Agricultural Transformation Agency |
| BOARDS | Bureau of Agricultural and Rural Development |
| CSA | Central Statistics Authority. |
| EABC | Ethiopian Agricultural Business Corporation |
| EARO | Ethiopian Agricultural Research Organization. |
| EDRI | Ethiopian Development Research Institute. |
| FCA | Federal Cooperative Agency |
| GTP | Growth and Transformation Plan |
| IFDC | International Fertilizer Development Center |
| MDGI | Millennium Development Goals Indicator |
| MOA | Ministry of Agriculture |
| QSAE | Quality and Standards Authority of Ethiopia |
| PADEP | Peasant Agricultural Development Extension Program. |

# LIST OF TABLES

Table 1: Scale Reliability (Cronbach's Alpha) ----------28
Table 2: Summary of variable ----------33
Table 3: House Head's Sex respondent----------34
Table 4: Age of household head respondents----------35
Table 5: Education level of household head respondents----------35
Table 6: Result of regression model----------38
Table 7: Result of regression ----------40

# LIST OF FIGURES

Figure 1**:** The Process (steps) of fertilizer demand estimation in Ethiopia----------12

Figure 2: Fertilizer distribution in Ethiopia and cash Flow----------14

Figure 3: Conceptual Framework----------21

Figure 4: Map of Ethiopia together with Oromiya zones and south west Shewa Zone indicating the study site Kersa and Malima *woreda*. ----------22

Figure 5: Fertilizers supply/import trend of per MT (2000-2018 G.C) ----------36

# LIST OF APPENDIXES

Appendix-1: Questionnaire and Interview Questions----------56
Appendix-2: Questioner in Oromifa----------61
Appendix-3: Tests of regressions----------64
Appendix-4: Fertilizers supply/import trend of Ethiopia per MT (2000-2018 G.C) ------66

# ABSTRACT

*The role of the agricultural sector interms of its contribution to the economy of Ethiopia is large. To accelerate the sector's growth and increase its contribution to the overall economic growth modern inputs particularly chemical fertilizers in the sector plays a great role. This study is designed to identify factors affecting demand and supply chain of fertilizer in Ethiopia as a case study in Kersa and Malima woreda in Oromiya National Regional State of Ethiopia. The researcher used both secondary and primary data. Descriptive statistics and econometric techniques were employed to analyze the data. Multiple linear regression were employed to analysis factors affecting demand and supply chain for fertilizer. Econometric estimation results depicted that estimation of demand for fertilizer purchase, storage facility and collaboration of stakeholders were negatively influenced the supply chain of fertilizer whereas distance from the village to market positively influenced supply chain of fertilizer at standard significant levels. On the other hand, price of fertilizer, farm size, access to credit, access to extension services, off-farm income, number of oxen and on time-delivery of fertilizer negatively affected the demand of fertilizer. Therefore, additional store building, computerized system of estimation of demand of fertilizer, subsidy programs on the price of fertilizer, delivering credit, assign efficient extension system and attention given for the timely distribution of fertilizer to the farmers are the most important thing to be considered in the study area.*

Key words: fertilizer, supply chain, farmers, Ethiopia

# CHAPTER ONE

# NTRODUCTION

## 1.1. Background of the Study

In Ethiopia nearly 85% of the population is directly dependent on agriculture. Agriculture, characterized mainly by smallholder farmers is the dominant economic activity of the country. The agricultural sector in Ethiopia is the principal engine of growth of the economy accounting for 83% of the labor force, 90% of exports and 45% of gross domestic product (GDP).

Despite the importance of agriculture in the economy, Agricultural production is characterized by subsistence orientation, low productivity, low level of technology and inputs, lack of infrastructures and market institutions, and extremely vulnerable to rainfall variability. The economy of Ethiopia is based largely on low productive techniques - where farm production heavily depends on traditional and backward techniques of production on fragmented lands for its success or failure (Abrhaley, 2016).

According to study of IFAD (2013) Agriculture plays a crucial role in growth and development of developing countries. One of the most important role of agricultural growth is reduction of poverty. This study argue that a 1 percent per annum increases in agricultural growth leads to a 2.7 percent increase in income of the lowest three income deciles in developing countries.

Agricultural growth, as opposed to growth in general, is typically the primary source of poverty reduction. In the contrary, a decline in agricultural growth throws many poor people into poverty. This explains some of the increase in poverty and hunger in developing countries during 2008 and 2010, when food prices increased worldwide (IFAD, 2013). Despite this strong nexus between agricultural growth and poverty reduction, the rural poor in Africa has been unable to move out of poverty because of the failure to transform their basic economic activity—agriculture —to high productivity levels (AGRA, 2013).

The key to a prolonged increase in agricultural production is to improve productivity, which can be achieved through either user of modern agricultural technologies or enhancing the efficiency of production or both (Sisay et.al, 2016).

According to Ezeh et al., (2006) Inorganic fertilizer is considered as one of the most important inputs for the achievement of increased agricultural production and productivity. As also

mentioned by Reta (2016) fertilizers in the broadest sense are products that improve the levels of available plant nutrients and/or the chemical and physical properties of soil, thereby directly or indirectly enhancing plant growth, yield, and quality. Fertilizer can significantly improve the productivity of agricultural sectors of the country. It is then important that increasing agricultural productivity is critical to stimulate the rate of economic growth of a country.

However despite the vital role plays by fertilizer in agricultural production and productivity, in Africa, the chemical fertilizer use is the lowest in the world with 14.7 kg of NPK (Nitrogen, Phosphorous, and Potassium) fertilizer per hectare of arable land in 2012 which is far behind Latin America and Caribbean with 125.9 kg, United States with 131.1 kg and European Union with 149.4 kg per hectare of arable land (The World Bank, 2015). Similarly fertilizer use in Sub Saharan Africa (SSA) is very low and inadequate to compensate for the nutrients removed in harvested crops (Yamano & Kijima, 2010). As in most SSA fertilizer use in Ethiopia is also very low (Matsumoto and Yamano, 2009)

In Ethiopia is only 30–40 percent of smallholders use fertilizer, and those who do apply on average only 37–40 kilogram per hectare (ha), significantly below recommended rates (Spielman, Alemu and Kelemwork, 2013). As mentioned by Belay, (2003) Low use of agricultural inputs keep the agricultural production and productivity low and made the country one of the food insecure nations of the world. This study also mentioned that one of the major reasons behind the poor performance and the existing structural food insecurity in the country of the Ethiopian agriculture is the poor input supply system.

A macro level analysis using the Central Statistical Authority (CSA) and the Ethiopian Rural Household Survey (ERHS) data shows that the high price of fertilizer is the major constraint for fertilizer application followed by supply shortage and late arrival of fertilizer in the country (Kefyalew, 2011).

As mentioned by different studies, Fertilizer is one of the most important agricultural input for rapid growth in agricultural productivity in Ethiopia.

## 1.2.Statement of the Problem

Fertilizer is an important dry bulk cargo imported from abroad that have greater impact on economy of the country. Since Ethiopian economy is an agrarian economy in which the livelihood of about 85% of the population directly or indirectly depends on the agricultural sector and fertilizer is a key input for productivity of the sector (Reta, 2016).

Agricultural Inputs Supply Corporation (AISCO), which was renamed as Agricultural Inputs Supply Enterprise (AISE) in 1992 and now renamed as Ethiopian Agricultural Business Corporation (EABC) is government owned enterprise that has been awarded the position of fertilizer importer every year, leaving the cooperatives with the role of fertilizer distribution. Along with this, government offices play a major role by regulating the supply, fixing marketing margins and prices, and monitoring the EABC and the cooperatives. Thus, the supply is centrally organized although it involves both state and non-state organizations (IFPRI, 2012).

EABC had its own marketing network throughout the country, which included marketing centers and service cooperatives for distributing fertilizers to the farmers. Like in many African countries, EABC controlled marketing was inefficient and expensive (ATA, 2012 –unpublished as cited Gebrerufael, 2015).

As mentioned in the studies of Reta (2016), EABC is the one and only one importer of fertilizers by holding all the ownership and risks pertaining to fertilizers imports. The main challenges the enterprise face are foreign currency problem delay in customs clearance and transit time and problem with labor force during loading and unloading of fertilizers. The enterprise use unimodal mode of shipment and using such mode together with port congestion and truck shortage become the main problem to incur higher surcharges like storage and demurrages in Djibouti port.

This complete control of fertilizer importation has been enabling the government to take an advantage of economies of scale (bargaining power in the international market and transport cost) but the long domestic supply chain and absence of competition compounded by the poor infrastructure development has led to late delivery of fertilizer to farmers (Gebrerufael, 2015).

The earlier study of Reta (2016) the lead time of fertilizers is found to be 6 months and this longer lead time has significant effect supply of fertilizers such as unavailability of fertilizers

in stock throughout the year, accumulation of surcharges while in transit, deterioration of fertilizers quality and high chance for farmers to harvest without applying fertilizers. This study also shows about 64.7 % of farmers complain with the late delivery of fertilizers as a result of supply chain of fertilizers is ineffective with respect to timely delivery.

According to studies of IFDC (2012), proved that over the last 10 years (2002-2011), total fertilizer imports have increased by more than 50 percent, from less than 370,000 MT in 2002 to almost 570,000 MT in 2011, with a spike of 627,000 MT in 2009. Fertilizer carryover stocks averaged 33 percent of imports between 2002 and 2011, with a high of 61 percent in 2002 and a low of 12 percent in 2007. These stocks, resulting from the mismatch between actual fertilizer demand and imports, accentuate the year-to-year variability in fertilizer import levels.

In Ethiopia, less than 40% of farmers use fertilizer and those who do apply rates significantly below those recommended. This low fertilizer use is primarily due to prices being two to three times higher than prices on the world markets. Reducing the price of fertilizer requires a sound understanding of the product´s supply chain (Johanes et. al., 2015).

According to CSA (2008), the national level application rates of inorganic fertilizers are very low. For example an application rate of major cereals does not exceed 57kg/ha which is far below the recommended once i.e. 200 kg per hectare.

Yet limited researches has been accomplished in the area of demand and supply chain of fertilizer in Ethiopian. Scientific study on such knowledge gap is needed and this deficiency that the study seeks to fill. Even though, limited studies were conducted in Ethiopia the currently available knowledge about the possible factors affecting demand and supply chain for fertilizer is not sufficient. Most of these studies are area specific and are limited in scope and coverage. Area specific studies provide area specific information and hence may not help much in designing a national agriculture and fertilizer policies. Issues identified as a problem in the previous studies may not exist today and new changes or problems might have been encountered in due course. Hence, the present study is hoped to provide recent empirical evidences on factors affecting demand and supply chain of fertilizer so as to suggest policy implications for future intervention strategies.

## 1.3.Research Questions

The research study were guided by the following questions

1. What are the critical determinants demand and supply chain of fertilizer in Ethiopia?
2. How trend of fertilizer supply is look like in Ethiopia?

## 1.4.Objective of the Study

### General Objective

The general objective of this study is to analysis factors affecting supply chain and demand of fertilizer in Ethiopia.

### Specific Objective

The specific objectives are:-

- To analyses factors affecting supply chain of fertilizer in Ethiopia;
- To analyses factors affecting demand for fertilizer in Ethiopia;
- To examine the trend of fertilizer supply in Ethiopia
- To identify the determinants of demand and supply chain of fertilizer

## 1.5. Significance of the Study

This study will have a significant important in solving the current issue of fertilizer supply system problem and problem of use of below recommended rate of fertilizer in the country. Further the study will also serve as a guide to further research conduct, academic work and as a self-help study material for those who might wish to firsthand knowledge about the present fertilizer supply system and demand of fertilizer in Ethiopia.

In addition to the above the study will also give some evidences to policy makers, which could be used in their decision making process.

## 1.6. Scope and Limitation of the Study

The main purpose of the study is to analyses factors affecting demand and supply chain of fertilizer in Ethiopian. In the supply chain of fertilizer there are large number of participant but this study were only includes the major actors involved in the supply chain. These are Ethiopian Agricultural Business Corporation (EABC), Ethiopian Shipping and Logistic Services

Enterprise, Ministry of Agriculture, Primary Cooperatives and farmers. To achieve the objective of the study primary and secondary data were used.

The supply chain of fertilizer involves all process starting from supplier up to final users. It touches every corner of participant's right from suppliers up to final users and a deeper investigation and data collection should be done across the supply chain actors to understand and get better solutions out of it, but it is beyond the scope of this study to address all of them. Thus, its limitations of this study are it has only addressed the sampled participants and one of woreda from Oromiya National Regional State.

### 1.7. Organization of the Thesis

The whole study is contains five chapters with different sections and sub-sections. The first chapter is an introduction under which the background of the study, statement of the problem, research questions, objectives of the study, significance of the study, scope of the study, limitation of the study and organization of the thesis is presented. The second Chapter contained the most significant theoretical and empirical studies of other writers or what other people have worked on related topics of supply chain and demand of fertilizer. Chapter three focused on research methodology while Chapter four dealt with the result and discussions part of the study. The Final, Chapter five has conclusions reached from the findings and the recommendations suggested for further research and considerations.

# CHAPTER TWO

# LITERATURE REVIEW

This chapter presents general concept, review of empirical studies, summary and conceptual framework. General concept includes various concepts and theories related to supply chain and demand of fertilizer. Review of empirical studies includes reviews conducted on supply chain and demand for fertilizer while conceptual framework describes various variables of the study.

## 2.1. General Concepts and Definitions

### 2.1.1. Definitions

**Fertilizer:** are substances, (organic or inorganic, natural or synthetic) which are added to the soil to supplement the soil with those elements required in the nutrition of plants. Inorganic fertilizers are usually simple chemical compounds made in a factory or obtained by mining, which supply plant nutrients and are not residues of plant or animal life. In general, inorganic fertilizers are chemical or synthetic materials of a concentrated nature. They contain one or more plant nutrients in easily soluble and quickly available forms (Berhanu, 2000).

**Supply chain:** is sequence of (decision making and execution) processes and (material, information and money) flow that aim to meet final customer requirements that take place within and between different stages along a continuum, from production to final consumption. The Supply chain not only includes the producer and its suppliers, but also, depending on the logistic flows, transporters, warehouses, retailers, and consumers themselves (FAO, 2007).

**Demand:** is an economic principle referring to a consumer's desire to purchase goods and services and willingness to pay a price for a specific good or service. Holding all other factors constant, an increase in the price of a good or service will decrease the quantity demanded, and vice versa.

### 2.1.2. Theoretical literature review

Conceptually, the paper approaches fertilizer from an economist’s market perspective whereby the intersection of the fertilizer demand and fertilizer supply functions determines consumption levels. In other words, consumption is the outcome of the conversion of fertilizer’s economic potential into farmers’ effective demand and the fulfillment of this demand through fertilizer supply and distribution systems (Desai 1988). In developing countries, fertilizer’s economic

potential—determined by the prevailing fertilizer responses and prices—is almost always much larger than actual use (Desai 2002).

The fertilizer demand as defined by Kelly (2001), means the quantity of fertilizer that farmers would be willing to purchase if it were available. It is the amount of fertilizer where by farmers are willing and able to buy at the prevailing price over a period of time. The quantity of fertilizer to be demanded by a particular farmer may be influenced by so many factors such as: the price of fertilizer, the farmer's income, profit from farming, the level of education of the farmer, availability of substitutes, the number of labor use on farms and the cost of the labor, the house hold size of the farmer, the farmer's experience in farming, the size of farm to be cultivated, as well as the farmers‟ contact with agricultural extension service officers.

According to Debertin (1986), the fertilizer demand function is often referred to as a "derived" demand because it is determined to a large extent by the final demand for the crop produced. In general, the demand for fertilizer depends on (a) the price of the crop(s), (b) the price of fertilizer, (c) prices of other inputs that substitute for or complement fertilizer, and (d) the parameters of the production function that describe the technical transformation of the inputs into an output (i.e., the fertilizer response function)

### 2.1.3. Origin and Development of Inorganic Fertilizers

Archeological research has shown that man began the cultivation of crops about 10,000 to 12,000 years ago the development of this art by early man was no doubt, soon followed by the application to the soil of animal manure and other materials such as bones, wood ashes, wool wastes, fish, chalk and marl. Cents and other European people are known to have used chalk or marl, wood ashes and compost some hundreds of years before Christ. The earliest records indicate that Romans and Aryans had many manuals for farmers to improve the cultivation of crops. 1842, Sir John Laws, an Englishman, developed and patented the process for making super phosphate. In the original manufacturing process, animal bones were treated with sulfuric acid, but a little later, he used mineral phosphates instead of bones. This was the beginning of inorganic (chemical) fertilizer industry in the world (Beagle, 2008 as cited by AFAP (2016)).

### 2.1.4. Economic Importance of Fertilizer

One of the major problems that have constrained the development of an economically successful agriculture in developing countries is the poor soil fertility for crop production

(Fertilizer Research, 1995). Agricultural production can, of course, be boosted by increasing inputs and/or by introducing modern agricultural technology. That means agricultural growth based on continuous increase in yield requires technological changes. If there are soil fertility constraints, it is difficult to introduce and sustain such technological changes on millions of hectares of cultivated land without growing application of plant nutrients, inorganic fertilizers are but one source of plant nutrients (Desai, 1991as cited by AFAP (2016)).

According to Mohammed et al., (1994), fertilizer use increases land productivity through yield increase and eases the nutrient constraint to multiple cropping and land development programs. In general, agricultural output can be increased through the expansion of cultivable area or through improving the productivity of available land. With the gradual closing of the land frontier, however, future increase in agricultural output has to depend on increasing the productivity of land only.

One of the crucial inputs to increase the productivity of land is fertilizer. With the introduction of high yielding varieties of various crops the possibilities of increasing farm yield and profit with intensive use of fertilizers has become financially feasible. That means fertilizer is one of the most critical inputs in farming. It can bring about a rapid increase in agricultural production even in the short run, which is the awful need of a developing country. Therefore, the provision of fertilizer is one of the essential factors, which play a great role in improving agricultural productivity (Bizualem et al., 2010).

### 2.1.5. Evolution of Fertilizer policy and Markets in Ethiopia

The history of inorganic or chemical fertilizer use in Ethiopia goes back to 37 years. Inorganic fertilizer was first introduced in Ethiopia in 1967, following a three years demonstration (1967 to 1969) on major cereal crops with Food and Agricultural Organization (FAO) assistance under Freedom from Hunger Campaign. Since then, farmers who saw the yield response warmly received fertilizer (Teshome and Getachew, 2000).

Following the introduction of fertilizer in Ethiopia in the late 1960s, fertilizer application levels remained low until the mid-1980s, when consumption increased slightly with the introduction of the Peasant Agricultural Development Program (PADEP). Since then, a series of policies continues to reshape fertilizer supply in Ethiopia (IFDC, 2012).

As expressed by Tefera et al (2012), since 1992 there have been a number of policy shifts that have shaped and re-shaped fertilizer supply in the country. These policy shifts can be grouped in to five phases: (i)complete government control(1967-1992),(ii) partial liberalization, with private sector entry and elimination of subsidies (1992-1996), (iii) competition among public, private, and regional holding companies (1997-2000), (iv) exit of private companies (2001-2006), and(v)since 2007, the exit of regional holding companies and the entry of farmers' cooperatives as the distribution channel, with AISE now called EABC as the sole fertilizer importer since 2008.

Ethiopia's fertilizer related policy evolution can be tracked tow aybackinthe1950s.The first and second five year development plans of the period 1957 to 1967 had special focus on developing the coffee industry with little support of the smallholder farming sector. The following five years development plans were also selective as they focused on developing agriculture in high potential areas of Ethiopia. With the need to expand the geographic coverage of its predecessor, the Minimum Package Program of the period 1971 to 1979 was launched. During this policy phase procurement of fertilizer was managed by the Agricultural and Industrial Development Bank (AIDB) and distribution managed by the Ministry of Agriculture and Rural Development (MoARD). Subsequently the need for intensification of this program led to the birth of Minimum Package Program II (1980-1984). This program was succeeded by the launch of the Agricultural Input Supply Corporation (AISCO) in 1984. Like its predecessors programs, the corporation had its fair share of challenges which included the lack of proper port handling facilities, red tape, high inland transport and organizational inefficiencies. All these contributed to limited efficiency in distribution of fertilizer and other agricultural inputs. In 1986 the Peasant Agricultural Development Program (PADEP) was launched with the aim of covering 8 zones, however only 3 high potential zones ended up receiving support. As was the case for most African countries during this period, Ethiopia liberalized its economy including the agriculture sector.

From the early days of field level demonstration to the collapse of central planning in 1991, fertilizer markets in Ethiopia have been controlled by the government through its input marketing agency, called Agricultural Input Supplies Corporation, later renamed as Agricultural Input Supplies Enterprise in 1992. This agency had its own marketing network throughout the country, which included marketing centers and service cooperatives for distributing fertilizers to the farmers (Rashid, S. et. al., 2013).

In the new marketing system introduced in 1992, the transitional government articulated its desire to end government monopoly as part of its overall market liberalization policies. The private-sector entry, however, was slow in the early years: Only one private company (Ethiopian Amalgamated Limited) actively participated in fertilizer marketing up until 1996. Subsequently, three other companies entered into the markets and attempted to develop their own marketing network. Around this time, a new breed of companies, owned by the regional governments, started to flourish. The first such company to enter was Ambassel Trading, a private limited company owned by the Amhara regional government. In the initial years, until 1995, Ambassel worked mainly as an agent to AISE, but it began importing in 1996 and started serving as the sole distributor and wholesaler of AISE in the Amhara region (Rashid, S. et. Al., 2013).

Inspired by Ambassel, other regional governments started launching their own companies. By 1998, companies of all four major grain-producing regions in the country were importing and distributing fertilizers alongside AISE and four private companies. However, competition among government, private, and holding companies was short lived (Byerlee et al., 2007).

By 2007 the regional state-run agencies were replaced by farmers' cooperatives, and in 2008 AISCO was renamed AISE now renamed EABC, reverting to its prior status as the sole fertilizer importer (IFDC, 2012).

### 2.1.6. Supply Chain of Fertilizer in Ethiopia

According to Simchi-Levi et al., (2000), supply chain is defined as a combinatorial system consisting of four processes namely plan, source, make and deliver, whose constituent parts include suppliers, distribution services and customers linked together. Effective management of supply chains has proven to be a very effective mechanism for providing prompt and reliable delivery services at the least cost.

Christopher (1998) also defined supply chain as "a network of connected and interdependent organizations mutually and cooperatively working together to control, manage, and improve the flow of materials and information from suppliers to end users".

Supply Chain is the group of manufacturers, suppliers, distributors, retailers and transportation, information and other logistics management service providers that are engaged in providing goods to consumers according to Chow, Heaver and Henriksson (1999) definition while Aitken

J. (2000) defined Supply chain as a network of connected and interdependent organizations mutually and co-operatively working together to control manage and improve the flow of goods and information from suppliers to end users.

Another definition by Little, A. (1999) Supply Chain as "the combined and coordinated flows of goods from origin to final destination, also the information flows that are linked with it".

According to Johanes U. et.al, (2015), there are four major functions along the supply chain of fertilizer in Ethiopia: import planning and inventory control, import execution and domestic supply of fertilizer, marketing and distribution and final use. Import planning begins with the assessment of fertilizer demand. It is a bottom- upapproach. At Kebele (sub-district level), extension workers referred as Development Agents (DA) collect farmers' requirements. Some primary cooperatives also conduct demand assessments. The estimates by the development agent and cooperatives are reconciled by the woreda (district) bureau offices and then sent to the zonal offices. The zonal offices aggregate woreda-level data and then send the estimates to the Bureau of Agriculture and Rural Development (BoARD).

Finally, the Ministry of Agriculture and Rural Development aggregates the regional estimates and comes up with the national demand estimates. The net import requirement is determined by deducting the previous year's carry-over stocks from the current year's demand of fertilizer as in Figure 1.

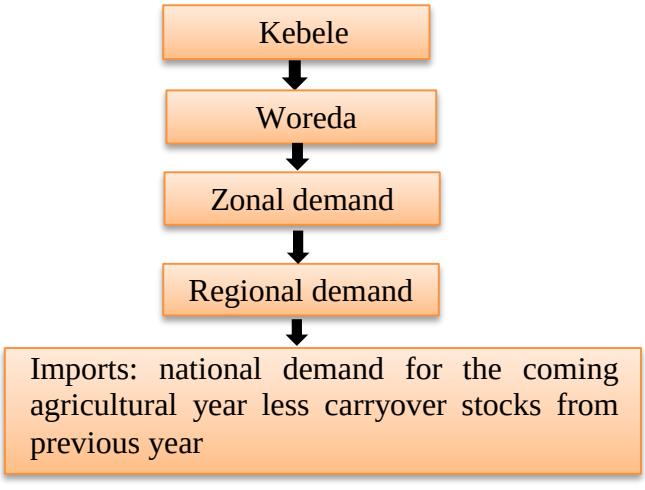


Figure **1:** The Process (steps) of fertilizer demand estimation in Ethiopia

**Source**: IFDC, 2015

Once the fertilizer estimates have been determined by MoARD and tenders approved by local financial institutions, the EABC places tenders on the international market for the supply of fertilizer for the two main planting seasons. With Ethiopia being a landlocked country, fertilizer is imported into the country through two main foreign ports, Djibouti and the Sudan ports. There are no storage facilities at the port except for a silo that can be used in emergencies to avoid demurrage costs. Product is discharged, bagged and loaded directly onto trucks, ready for distribution.

In addition to being the sole importer of fertilizer in the country, EABC is also responsible for the distribution of fertilizer to farmers through farmers' cooperative unions. EABC divides its fertilizer distribution into two main segments. For 10% of the imported fertilizer, after it has been discharged at the port, it is delivered to EABC warehouses from which fertilizer is transported to regions without union cooperatives or sold directly to large commercial farmers, investors and other regional government agencies. The remaining 90% of the imported fertilizer is distributed to the regions through cooperative unions. EABC delivers the fertilizer directly from the ports to cooperative unions' warehouses in four main regions, Amhara, Oromiya, Tigray, and the Southern Nations, Nationalities, and Peoples' Region. Fertilizer from these warehouses is then distributed to primary farmers' cooperatives, from which farmers can directly purchase fertilizer on either cash or credit basis.

The BoARD plays an active role in the marketing and distribution of fertilizers. This includes facilitating the input credit guarantee to the Commercial Bank of Ethiopia, providing transportation facilities if needed, and ensuring on-time delivery of fertilizer. The BoARD is also involved in the determination of prices and margins. The EABC determines weighted average price of fertilizer at the central warehouse level. The BoARD then adds margins (both for unions or federations and for primary cooperatives) and determines loading and unloading costs, warehouse rent, bank interest rates, and other administrative costs.

To import fertilizer through EABC, the regional governments offer credit guarantees for cooperative unions. The payments to EABC are processed through two instalments, first during opening of the letter of credit, and second, upon arrival of fertilizer at the Djibouti port. The primary cooperatives receive fertilizer on credit from unions and sell mostly in cash to smallholder farmers.

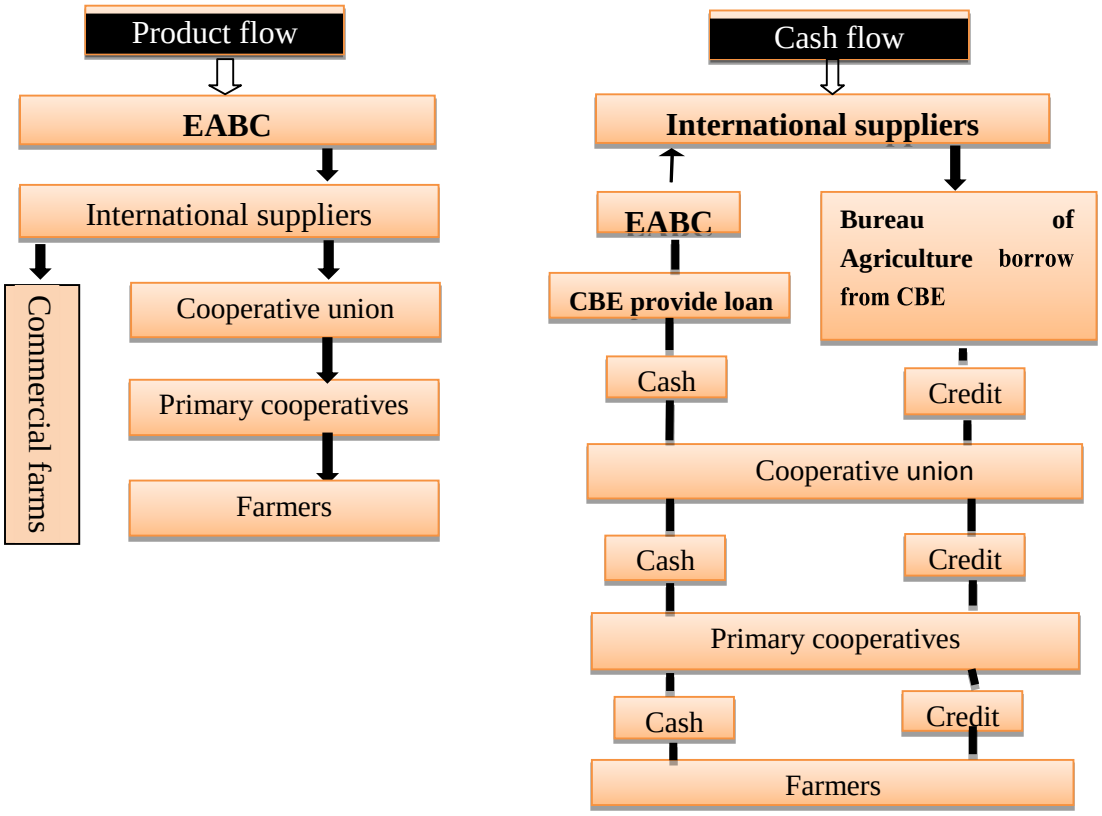


Figure 2: Fertilizer distribution in Ethiopia and cash Flow
Source: Rashid et.al, 2013

### 2.1.7. Supply Chain Performance Measures

In order to achieve an efficient supply chain, performance evaluation of the entire supply chain is very important. This means utilizing the combined resources of the supply chain members in the most efficient way possible to provide cost-effective services. Hence, overall cost-effective chain efficiency is defined as the efficiency which takes in to account the multiple performance measures related to the supply chain members, as well as the integration and coordination of the performances of those members (Mishra R., 2012). Performance Measurement is the process of quantifying the effectiveness and efficiency of actions. Supply Chain Performance (SCP) refers to the overall supply chain's activities in meeting end-customer requirements, including product availability, timely delivery, and all the required inventory and capacity in the supply chain to deliver that performance in a responsive manner.

As defined by Simchi-Levi & Kaminsky (2003) Supply chain performance as the operational excellence to deliver leading customer experience. The performance of a supply chain is influenced by both internal and external factors of the organization.

Mishra, R., (2012), indicated that supply chain performance depends on the efficiency of supply chain. In a business environment supply chain efficiency measurement is an important factor to know the supply chain better, and hence helpful for the company to take corrective measures to check the problem. Hertz (2001) stated that the common objective of any supply chain is its efficiency and effectiveness. Efficiency is an internal standard of performance while effectiveness is an external standard of fit to various groups' demands (Pfeffer & Salancik, 1978).

The concept of effectiveness according to Moller and Torren (2003) is an actor's ability to produce solutions that provide value to customers. A related, concept of effectiveness is given by Hines et al. (2000) who define effectiveness as an external standard of how well an organization meets the demand of various groups that are concerned with its activities. Supply chain effectiveness is expressed, by Gunasekaren, Patel and Tirtiro (2001), to the level to which organizations involved in delivering value to customers create customer satisfaction by delivering the right product offering at the right time at the right place.

According to Ralph (2000) established that in order to achieve the supply chain validity of outcome (effectiveness; delivering the right product offering on time, to the right groups and at the right place, all barriers to free flow of products from the supplier to user must be removed.

For the measurement of supply chain performance the efficiency or the effectiveness of an outcome of a supply chain activity is analyzed (Fugate et al., 2010). Supply chain performance can be looked at as the extent by which supply chain's activities effectively and efficiently ensure realization of organization goals and objectives.

As mentioned by Schrettle et al, (2013), a performance measure or a set of performance measures is used to determine the efficiency and effectiveness of an existing system.

## 2.2. Review of Empirical Studies

In this section related studies concerned the supply chain and demand for fertilizer were reviewed.

### 2.1.1. Factors Affecting Supply Chain of Fertilizer

Budiman (2004) found that supply fluctuation was due to capacity adjustment lead time, order processing delay and order wait time. According to the study of Camara and Heinemann, (2006) Transport, communication and storage infrastructures are vital to fertilizer availability. Further

the study argues that internal transportation costs are usually high in Africa because of poor feeder roads. A study by World Bank (2006) indicates that fertilizer is a bulky commodity with relatively low value to volume, so transport costs are a relatively large share of the farm gate prices. IFDC (2001) pointed out that for a well-functioning market, the flow fertilizer market information needs to be smooth and timely. Fertilizer dealers, farmers and policy makers should have access to fertilizer market information which composes fertilizer prices, stock availability in the national, regional and global markets.

According to the study of Moberg, Cutler & Gross, (2003) the act of information sharing in the supply chain enables accurate and faster business decision making that translates to enhanced performance of the supply chain. This sharing of supply chain information essentially enhances stakeholders total cost reduction hence improving on overall chances of optimal performance of supply chain (Gavirneni, 2006). Mentzer and Min (2004) also indicated in their study information sharing with all organizational partners is an imperative factor that enhances desirable supply chain capabilities. Moreover, exchange of information is a crucial construct that significantly affects the performance of supply chain capabilities.

The study of Chima (2007) revealed that the key element in a supply chain is transportation system, which joints the separated activities. Additionally only a good coordination between each component would bring the benefits to a maximum. Fahad, (2013) from his multiple linear regressions found that constrained infrastructure and open tender system have a positive effect on efficient supply chain management system. Reta, (2016), found the main challenges of supply of fertilizer in Ethiopia are lack of storage facility throughout the country, delay in customs clearance and transit time, truck shortage, transportation problem, delay in customs process and documentation requirement and infrastructure problems. On the other hand Gebrerufael (2015), in his study revealed that there is a weak fertilizer demand estimation system, which implies a mismatch between the annual demand estimation and the effective demand of fertilizer in Ethiopia. This study has also reviled long fertilizer supply chain and late delivery of fertilizer because of the poor infrastructure development in the Ethiopia. According to the study of DASH (n.d.), the main challenges of supply of fertilizer is the shortage of storage capacity of fertilizer, particularly in the regions with union cooperatives, as a result, there have been a number of incidents where trucks spend multiple days at warehouses unloading fertilizer due to limited warehouse space. The study further reported that Problems of inefficient

transportation planning, and the process of distribution is complicated by the time-dependent nature of fertilizer demand and use, lack of integrations and coordination among stakeholders, problem of transportation, port congestion, infrastructure, labor and warehouse shortage.

A study on fertilizer supply chain in Ethiopia by Gregory, D.et.al, (2006), revealed that the time lapse between making a decision to procure fertilizer from the international market and availability in rural areas can be from 2 to 4 months, and even up to 6 months. Similarly this study observed that constraints affecting the performance of fertilizer markets were market development constraints, lack of market information, infrastructural constraints, problem of determination of demand, problem of transport and handling, and long transport distances and very poor infrastructure.

### 2.1.2. Factors Affecting Demand for Fertilizer

Different studies regarding the factors of demand of fertilizer were conducted by different researchers in Ethiopia. Empirical studies identified numerous variables as being important to demand of fertilizer in Ethiopia.

Many studies in different African countries on the demand of fertilizer have revealed different and contradictory results. For instance, Kaliba et al., (2000) found that older heads of households were more likely to use fertilizer in Tanzania. While the work of Croppenstedt and Demeke, (1996) on fertilizer use in Sub-Saharan Africa found age of the head of the household to have insignificant effect. On the other hand Kherallah et al., (2001) found price of fertilizer had a negative effect; as economic theory would suggest, on fertilizer use in Benin. This result also indicates that household use of fertilizer decreased as its price increased and its use increased as price decreased in Benin. Another study of Sharma V. and Thaker H., (2011) using simple linear regression model estimated that price of fertilizer was negatively related with fertilizers demand in India.

Fakoya and Mato (2003) conduct a study that examines the factors affecting the use of inorganic fertilizers in Zinder state of Niger republic. The study shows that some independent variables such as: farm size, level of education, lack of credit and farming experience were significantly related to the use of inorganic fertilizers.

Moreover Olayide et.al. (2009) conduct a study on the determinants of fertilizer use in northern Nigeria. The results show that the intensity of fertilizer use increases with family labor and physical access to fertilizer, but declines with cultivated land and plot distance from homestead.

The study by Olwande, et,al, (2009) shows that age, education, credit, presence of a cash crop, distance to fertilizer market and agro ecological potentials are statistically significant in influencing the probability of adopting fertilizer.

Results from studies in Ghana among farming households revealed the insignificance influence of gender on fertilizer use (Doss and Morris, 2001). On the other hand, Holden et al., (2008) reported that female-headed households were less likely to use chemical fertilizers on their farm plots in Ethiopia. Number of oxen of households is another important factor which is supposed to determine households' level of fertilizer use. Accordingly; Holden et al., (2008) indicated that ownership of livestock in Ethiopia was associated with a lower likelihood of using chemical fertilizers. Contrary to this, Holden and Lunduka, (2011) found that households with more livestock endowment were applying significantly more fertilizer on their plots in Malawi. Brehanu (1993) has analyzed factors influencing fertilizer consumption. The study concluded that, number of oxen owned, off-farm income, farm size, timely distribution of fertilizer, and education have significantly influenced fertilizer consumption. Out of these variables farm size are inversely related to the level of fertilizer consumption.

Lelissa (1998) attempted to identify the determinants of intensity of fertilizer use in Ejere district (West Shewa, Ethiopia). According to the result of the study reported that distance from fertilizer marketing centers have negative and significant influence on the intensity of fertilizer use, while access to credit, level of education, extension service, oxen ownership, and number of family size have positive and significant influence. Teressa (1997) in his analysis on the determinants of intensity of fertilizer use in Ethiopia has shown that wealth of farm household (mainly oxen), distance from asphalted road and access to credit access have significant positive effects. However, farm size and off-farm income have negative influence. Croppenstedt et al. (1999) have also analyzed factors influencing demand for fertilizer in Ethiopia and reported that access to credit; household size and cattle ownership have a significant positive impact on fertilizer use. They also reported that formal education improves efficient allocation of

fertilizer. They further noted that farmers are price sensitive and temporary price subsidy for urea may be useful to help redress the nutrient imbalance currently observed in Ethiopia.

Another study of Holden et al., (2008) revealed that households that had off-farm activities as a secondary income source were more likely to apply chemical fertilizers in Ethiopia as compare to others. According to Nambiro E. and Okoth P. (2013), result of the study showed a positive relationship between off-farm income and use of the inorganic fertilizer which supports the hypothesis that off-farm income was used for purchasing the inorganic fertilizer. Similarly the contacts a farmer had with an extension agent in a year also had a positive and significant influence on the use of inorganic fertilizer.

The finding of knepper E. T., (2002) the regression results of the model revealed that the number of males in the household had a consistently significant impact on the quantity of fertilizer a household used. Similarly total area cropped also significant impact on the quantity of fertilizer a household used. Moreover the coefficients on the variable representing the price of fertilizer were negative in the model. The negative relationship follows economic theory that suggests that at higher prices, less fertilizer would be purchased and used.

According to Waithaka, et. al., (2007) the results show that the amount of fertilizer used on a farm increases significantly with increasing farm size and higher education levels of household head. Gender and family labor, did not influence significantly the amount of fertilizer used on a farm.

According to studies of Obisesan, et.al, (2013) the result of the study showed that the factors influencing fertilizer use intensity among the farmers in the study area was years of education, farm size, and access to credit and fertilizer price are significant factors in the use of fertilizer in the study area. Years of education of the farmer is significant at 10% and has a positive sign.

Abrhaley, (2016) study revealed that education positively and significantly affected the intensity of use of inorganic fertilizer. Ownership of livestock had the positive and significant effect on intensity of inorganic fertilizer. Similarly the coefficient of distance to near town market had the expected negative sign and significant effect on the intensity of inorganic fertilizer. While farm size, had influenced the intensity of use of inorganic fertilizer positively at less than 1% level of significance.

As revealed from the Nasrin M. and Bauer S., (2016) according to the result of the study among other variables, off-farm income and extension services showed significant impact on fertilizer use for all categories.

Using OLS regression, Ebong and Ebong (2006) undertake a study which examines the demand for fertilizer technology by the smallholder crop farmers for sustainable agricultural development in Akwa Ibom state, Nigeria. The result indicates that farm size, price of fertilizer, price of manure and farmers education to be important variables that significantly affect the demand for fertilizer in the state.

According to Gedefaw (2019), the result of the study showed that among the variables that considered in the analysis, access to extension service, availability of composting materials, sex of household head and health status of household head has significant effect on demand of fertilizer.

The ensuing research is based on a summary of the literature. As a result of review, from the researcher's knowledge none of the studies have dealt with the factors affecting supply chain and demand of fertilizers in Ethiopia and most of them evaluate the factors from the angle they were mostly interested in. The current study thus aims at filling this literature gap by investigating the factors affecting supply chain and demand of fertilizer in Ethiopia.

### 2.3.Conceptual Framework of the study

It is important to emphasize that the primary objective of this paper is to provide a realistic framework within which to study demand and supply chain of fertilizer.

A number of factors have been associated with demand and supply chain of fertilizer in different contexts and situations. The nature of association between demand and supply chain of fertilizer and these factors is not well documented through empirical research. Therefore this study were examined the factors systematically from related reviewed studies to establish the nature and extent of association with supply chain and demand of fertilizer.

There are many factors that affecting demand and supply chain of fertilizer but this study mainly includes the major factors. As a result this conceptual framework is constructed to understand how the key concepts and variables in the demand and supply chain of fertilizer analysis are interrelated and interwoven.

Accordingly to this study had eighteen independent variables that were investigated in relation to the two dependent variable. This is represented in Figure 3.

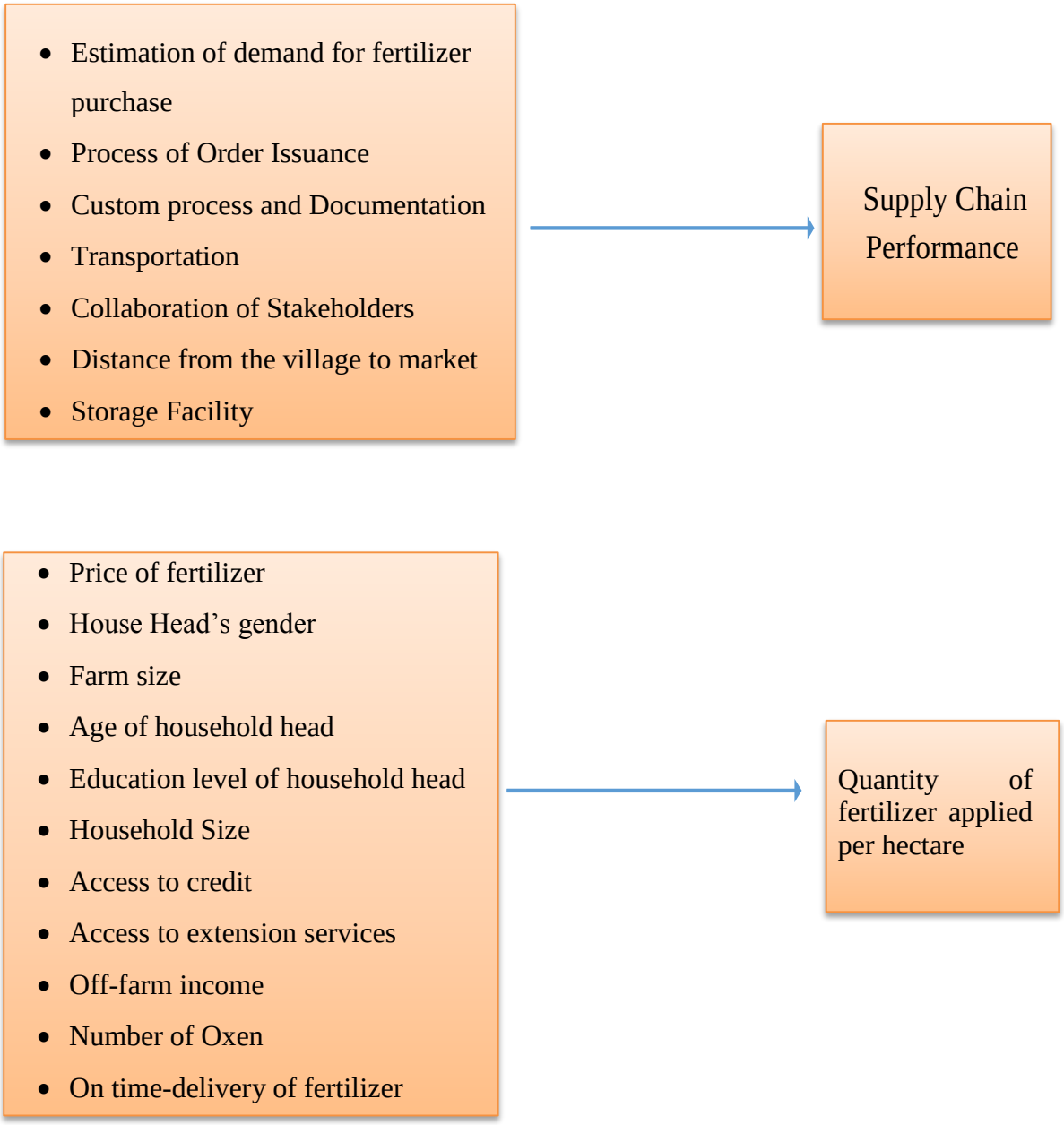


Figure 3: Conceptual Framework

Source: Own computation

# CHAPTER THREE

# RESEARCH METHODOLOGY

This chapter presents descriptive of the study area, the type of research design used, study area, sampling techniques and sample size that were used to select respondents, method of data collection, pre-test and method of data analysis.

## 3.1. Descriptive of the Study Area

This study was conducted *at Kersa and Malima woreda, South West Shewa Zone of* Oromia regional state. The *woreda* is located at 60 Km south west of Addis Ababa. It is bordered on the south west by Southern Nations, Nationalities and Peoples Region, on the east by East Shewa Zone on the south by Sodo Dachi on the North East Alemgena, and on the north west by Tole *Woreda*s. Administratively the woreda is divided into thirty one (31) rural Kebeles and one (1) town administration. The major town in Kersa and Malima is Leman. The study area is characterized by tropical and warm to cold humid temperate climates. In this area majority of the farmers produce cereal crops and most of the farmers having a long fertilizer use history.

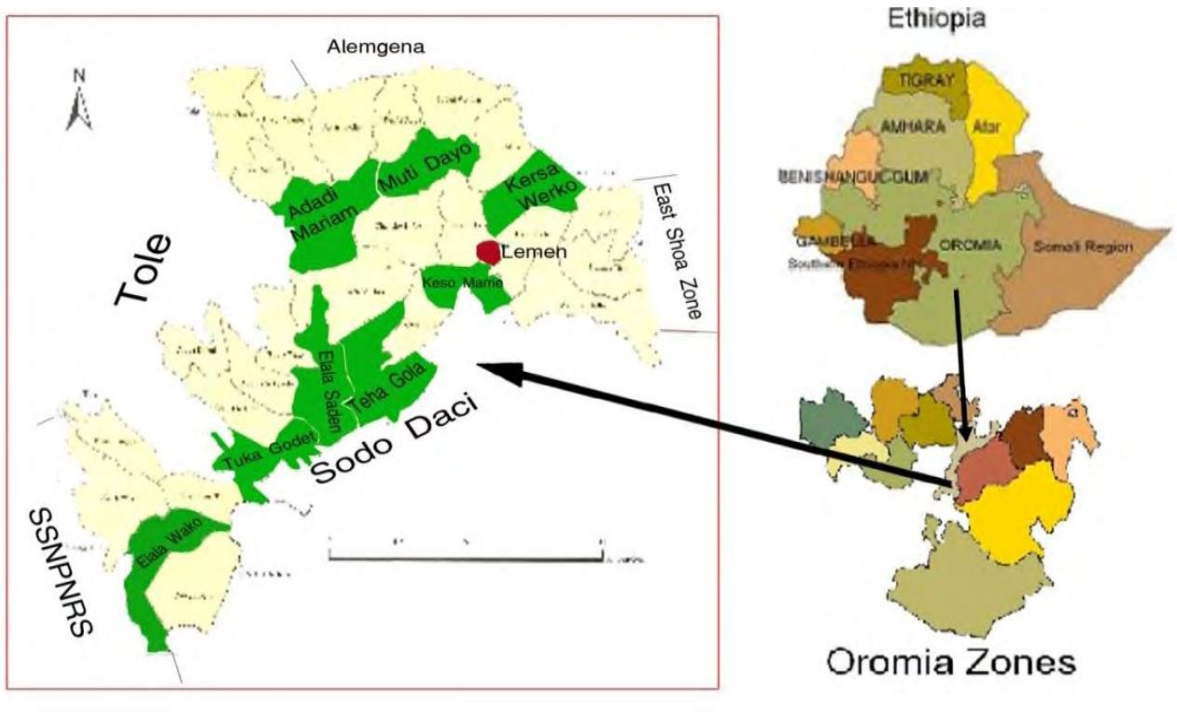


Fig.4: Map of Ethiopia together with Oromiya zones and south west Shewa Zone indicating the study site Kersa and Malima *woreda*

### 3.2. Research Design

The researcher used both qualitative and quantities researcher approach. This mixed research is an approach that combines or associates both qualitative and quantitative research methods that enables mutual collaboration of each other via the use of multiple sources of collecting data. Qualitative approaches enables collection of data form of words rather than numbers. It provides verbal descriptions rather than numerical. Qualitative methods can be also used to gain more in depth information that difficult to convey quantitatively. Quantitative approach strives for precision by focusing on items that can be counted into predetermined categories and subjected to statistical analysis.

### 3.3. Sampling Technique and Sample Size

Samples were selected from major participants of supply chain of fertilizer and users of fertilizer. These were managers, team leader and concerned employees involved in supply chain of fertilizer in Ethiopia (including EABC, Ethiopian Shipping and Logistic Services Enterprise, Ministry of Agriculture), Primary Cooperatives and farmers in the wereda.

There were 31 kebles in the wereda. Out of these 4 Kebles were selected. The total target population were 2,330. Then samples were selected from this target population. The sample size was determined based on the following formula given by Slovin's sampling formula.

$$n = \frac{N}{1 + (e)^2}$$

Where, n = sample size,

N = population size = 2,330

e = sampling error/ a margin of error = 6%.

$$n = \frac{2{,}330}{1 + 2{,}330(0.06)^2}$$

$$= 248$$

According to the formula out of the total target population 248 representative were selected randomly. However, households with inappropriate filled questionnaire and missed data were dropped and the data set to 207 representatives were analyzed.

### 3.4. Methods of Data Collection

Both quantitative and qualitative data types were used in the study. In order to generate these data types, both secondary and primary data sources were used. Secondary data collected from related articles, journals, books, reports, publications and records of Ministry of Agriculture, Ethiopian Agricultural Business Corporation, Ethiopian Central Statistical Agency, and Oromia region agricultural office.

The primary data was gathered through distributing the questionnaires to managers, team leaders and concerned employees of Ethiopian Agricultural Business Corporation, Ministry of Agriculture, Ethiopian shipping and Logistics Services Enterprise, primary cooperatives and farmers. The primary data that gathered from the representative of Wreda was through distributing questionnaire that converted to Oromifa language.

### 3.5. Pre-Test

Before conducting the main survey, a pre-testing (pilot study) conducted to validate the instrument. A pre-testing study provides an opportunity for the researcher to determine whether the respondents has any difficulty understanding the questionnaire moreover the pre-test affords an opportunity to check whether there are any ambiguous or biased questions. The pre-testing study was held on 24 farmers selected on a convenience basis and 17 schedules work responded fully which was good response rate (71%) and slight changes made on schedule after conducting pre-test.

### 3.6. Method of Data Analysis

Two types of data analysis, namely descriptive statistics and econometric models were used for analysis.

#### 3.6.1. Descriptive Analysis

Descriptive statistics were used to provide a summary statistics related to variables of interest. In this section of analyses descriptive statistics such as trends, percentage, mean and standard deviation were used. In addition to this, descriptive tools such as tables, and chart were used to present data.

#### 3.6.2. Econometric Analysis

In the econometric analysis multiple linear regression were used to analysis determinant factors.

### 3.6.2.1. Factors Affecting Supply Chain of Fertilizer

Supply Chain takes a system approach to viewing the Supply Chain as a single entity. This means that the partnership concept is extended in to a stakeholder effort to manage the flow of goods from suppliers to the ultimate customer. Each stakeholder in a Supply Chain directly or indirectly affects the performance of Supply Chain members, as well as the overall performance of the Supply Chain. In this study supply chain performance were used as a dependent variable.

In the findings of factors affecting supply chain performance of fertilizer the questionnaire were developed in five scales (likert scale) ranging from five to one; where 5 represents Strongly agree, 4 represent agree, 3 represent neither agree nor disagree, 2 represent disagree, and 1 represent strongly disagrees.

**I. The Model Specified**

In this case multiple linear regression model were used to analyses the data. Multiple linear regression analysis is the study of how a dependent variable Y is related to two or more independent variables. If we are studying the dependence of one variable on more than one explanatory variable, multiple linear regressions is the right model (Gujarati, 2003).

The multiple linear regressions model specified as:-

$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_2 X_{3i} + \ldots + \beta_k X_{ki} + U_i$…….(1)

Where Y = the dependent variable.

$X_i$ = vector of the independent variable (I = 1, 2,...n).

$U_i$ = the error term

$\beta$ = is a (Kx1) vector of unknown parameter to be estimated.

$SCP = \beta_1 + \beta_2 EDP + \beta_3 POI + \beta_4 CPD + \beta_5 TP + \beta_6 CS + \beta_7 DM + \beta_8 SF + \varepsilon_i$

Where:

$\beta$ = Constant

SCP = Supply Chain Performance

EDP =Estimation of demand for fertilizer purchase

POI = Process of Order Issuance

CPD = Custom process and Documentation

TP = Transportation

CS = Collaboration of Stakeholders

DM = Distance from the village to market

SF = Storage Facility

$\varepsilon_i$ = An error term

**II.Definition of variables and Hypotheses**

**Supply Chain performance (SCP):** It is a variable that represents the dependent variable.

The explanatory variables of importance in this study are those variables, which are thought to have influence on supply chain performance of fertilizer. The independent variables that are expected or hypothesized to have association with supply chain performance were selected based on theoretical perspective and available literature. The major explanatory variables that are influencing and affecting supply chain performance of fertilizer and their associated hypotheses of the research study are presented below.

**Estimation of demand for fertilizer purchase (EDP):** This is the process of need assessment/estimating the amount of fertilizer that would be purchased/import for the next agricultural year. According to the study of Johanes et.al., (2015), there are four major functions along the supply chain of fertilizer in Ethiopia, they are: import planning and inventory control, Import execution and domestic supply of fertilizer, Marketing and distribution and Final use. Import planning begins with the assessment of fertilizer demand. It is a bottom- up approach. At sub-district level, extension workers referred as Development Agents (DA) collect farmers' requirements, which are then gradually aggregated at district, zone and region levels by the respective Bureaus of Agriculture (BoA). The final aggregation at national level is carried out by the Agricultural Inputs Marketing Directorate of the Ministry of Agriculture (AIMD/MoA). According to Word bank, (2011) since the market does not play a role in assessing demand and responding to it the amount of fertilizer imported depends on an estimation of demand by the Government for the coming season.

**Process of Order Issuance (POI):** It is a process that includes prepares the tender documents, invitation of international fertilizer supplier, open bids and evaluate, announcement of winner of international fertilizer supplier and finally issuance of purchase order to supplier.

**Custom process and Documentation (CPD):** It includes Contractual agreement with supplier**,** LC preparation and selection of Inspection Company.

**Transportation (TP):** This is the transport or distribution of fertilizer from port to regional cooperatives and to EABC store according to their need assessment. Transportation factors, such as the availability of a road network, play an important role in the performance of supply chain (Chakravarty, 2011). Indeed, the existence of a well-developed road infrastructure, for example, facilitate the logistical operations, while a poor road network tends to disrupt and slow down the distribution of relief items. According to World Bank, (2006) as in most countries, transporting fertilizer via trucks over the road is the main mode of transportation in Ethiopia. Ethiopia is a landlocked country and inherently suffers from let delivery and high transportation costs from the ports and this is usually transmitted to farmers in form of higher prices for imported fertilizer. Inefficient transportation systems, road conditions results for let delivery of fertilizer and high transportation costs all add to high fertilizer distribution costs in Ethiopia.

**Collaboration of Stakeholders (CS):** this deals about the collaboration between all participants in the supply chain of fertilizer. It defines as to work with another person or group in order to achieve or done something. According to Cohen (2004, p. 139) definition "The means by which companies within the supply chain work together toward mutual objectives through the sharing of ideas, information, knowledge, risks and rewards". As Minear, (2002) explained the supply network is huge and complicated with numerous players (government, and suppliers), and it is hard to coordinate all of them along with all the items that need to be delivered. As along with that the vast geographical spread of country and different number of climates simultaneously at different places at one point of time there is a high need of collaboration among the participants (De block et al., 2012). It is only through collaboration and information sharing between each other that they would be able to achieve the required degree of synchronized activity. The act of information sharing in the supply chain enables accurate and faster business decision making that translates to enhanced performance of the supply chain. (Moberg, Cutler & Gross, 2003).

**Distance from the Village to Market (DM)**: This is deals the distance from study area to fertilizer market. The longer is the distance of the market, the lesser is the probability of buying and using fertilizer. Hence, a negative relation is expected. The poor condition of rural areas adds significantly to the transportation cost of supplying inputs, especially fertilizers, in rural areas. Cost of distribution to more remote areas are high, affecting the price farmers have to pay for fertilizer.

**Storage Facility (SF):** It is substantial component of supply chain operations that refers to the activities involving storage of fertilizer on a large-scale in a systematic and orderly manner and making them available conveniently when needed. In other words, it means holding or preserving fertilizer in huge quantities from the time of their purchase till their actual use or sale. The first criterion of effectiveness in fertilizer distribution is that the product be available in adequate quantities when and where it is needed. This depends on the existence of suitable storage facilities. According to kassu kubayo seko, (2009) Existence of storage facilities at farmers' disposal would have an advantage for input suppliers to damp and timely deliver agricultural inputs. The presence of storage for agricultural inputs at farmers' disposal may encourage farmers to demand it timely.

**Reliability**

Reliability is the extent to which research findings would be the same if the research were to be repeated at a later date, or with a different sample of subjects. In other words, the reliability of a measure indicates the extent to which the measure is without bias (error free) and hence offers consistent measurement across time and across the various items in the instrument. It helps to assess the goodness of measure, and indicates accuracy in measurement.

This research used consistency reliability that is the Cronbach's alpha by using SPSS and has been used to identify the validity of items used in survey. This measure indicates the consistency of a multiple item scale. Alpha is typically used when you have several Likert type items that are summed to make a composite score or sum mated scale.

According to McGraw and Wong (1996) the alpha of a scale should be greater than 0.70 for items to be used together as a scale. Supply chain performance were assessed with Cronbach's Alpha and the reliability values are confirmed that the overall reliability test result was 0.778 which greater than 0.7. As per result in Table 1 all the variables were reliability.

Table 1: Scale Reliability (Cronbach's Alpha)

| Cronbach's Alpha | N of Items |
|---|---|
| 0.778 | 8 |

Source: (SPSS Output, 2019)

### III. Validity

Bolarinwa O. (2017) the researchers always wish to know if the measurement tool employed actually measures the intended research concept or construct (is it valid? or true measures?) Validity expresses the degree to which a measurement measures what it purports to measure. Several varieties have been described, including face validity, construct validity, content validity and criterion validity (which could be concurrent and predictive validity). This study addressed content validity.

According to Bolarinwa O. (2017), Content validity pertains to the degree to which the instrument fully assesses or measures the construct of interest. The development of a content valid instrument is typically achieved by a rational analysis of the instrument by raters (experts) familiar with the construct of interest or experts on the research subject. Specifically, raters will review all of the questionnaire items for readability, clarity and comprehensiveness and come to some level of agreement as to which items should be included in the final questionnaire. The rating could be a dichotomous where the rater indicates whether an item is 'favorable' (which is assign a score of +1) or 'unfavorable' (which is assign score of +0). Different ratings have been proposed and developed. These could be in Likert scaling or absolute number ratings. Item rating and scale level rating have been proposed for content validity. The item-rated content validity indices (CVI) are usually denoted as I-CVI. While the scale-level CVI termed S-CVI will be calculated from I-CVI. S-CVI means the level of agreement between raters. Proposed a S-CVI of = 0.78 as significant level for inclusion of an item into the study. So based on this criteria the researcher checked the validity.

#### 3.6.2.2. Factors Affecting Demand for Fertilizer

### I. The Model Specified

Before giving a description of the methods used in data analysis, the term "fertilizer use" needs clarification. The term is used in this study to mean the total amount of chemical fertilizer in kilograms the farmer use per hectare for the last cropping year.

Research on the determinants of demand for an innovation such as fertilizer draws heavily from the adoption-diffusion framework on one hand, and from factor demand on the other. This study used the factor demand framework to analyses the main factors of demand of fertilizer (intensity of use) rather than adoption-diffusion framework.

Demand of inorganic fertilizers per unit area is continuous variable. Therefore multiple linear regression were used for analysis.

The model to be estimated in this study was in the following form:-

$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_2 X_{3i} + \ldots + \beta_k X_{ki} + U_i$……(1)

Where Y = the dependent variable.

$X_i$ = vector of the independent variable (i = 1, 2,...n).

$U_i$ = the error term

$\beta$ = is a (Kx1) vector of unknown parameter to be estimated.

$QFA = \beta_1 + \beta_2 PF + \beta_3 HHG + \beta_4 FZ + \beta_5 AHH + \beta_6 ELH + \beta_7 HZ + \beta_8 AC + \beta_9 AES + \beta_{10} OFI + \beta_{11} NOX + \beta_{12} ODF + \varepsilon_i$

Where:

$\beta$ = Constant

QFA = Quantity of fertilizer applied

PF = Price of fertilizer

HHS = Household Head's sex

FZ = Farm size

AHH = Age of household head

ELH = Education level of household head

HZ = Household Size

AC = Access to credit

AES = Access to extension services

OFI = Off-farm income

NOX = Number of Oxen

ODF = On time-delivery of fertilizer

$\varepsilon_i$ = An error term with the usual stochastic assumptions.

## II. Definition of Variables and Hypotheses

A brief description of the variables in the specific regression model used is as follows:

**The dependent variable**: Quantity of fertilizer applied per hectares (QFA).

The dependent variable retained here is the quantity of chemical fertilizer applied by farmers in kilogram per hectare.

The Independent variables of importance in this study are those variables, which are thought to have influence on demand of fertilizer. The independent variables that are expected or hypothesized to have association with demand of fertilizer are selected based on available literature and scientific research done somewhere else. The major independent variables that are influencing and affecting demand of fertilizer and their associated hypotheses of the research study are presented below.

**Price of fertilizer (**PF**):** It is a dummy variable, it takes a value of one if price is affordable and zero if price is not affordable. Most studies of fertilizer use usually ignore market prices, so the first analysis parallels these standard methods including market price in the analysis. According to the study of Hagos and Holden, (2002) indicated that the most serious constraint faced by farmers for not using fertilizer is high fertilizer prices. Most farmers feel that the fertilizer prices are so high and they fear that this will contribute to their indebtedness. Therefore, this variable was hypothesized to negatively influence demand of fertilizer.

**Household Head's Sex (HHS)**: dummy variable representing the sex of head of household. It takes the value of one if the household head is male and is zero for female-headed households. Male-headed households are theorized to use fertilizer more readily than female-headed households. As indicated in the study of Gedefaw, (2019) that male-headed households were more likely to use organic fertilizers than female-headed household head.

**Farm size (FZ)** in Hectares: households with larger farm size are expected to use fertilizer more than smaller ones. As mentioned by Waithaka et. al., (2007) the amount of fertilizer used on a farm increases significantly with increasing farm size. It was therefore expected that farm size could positively influence demand of fertilizer.

**Age of household head (AHH)** in years: Older farmers may accumulate more wealth than younger ones so as to finance fertilizer purchase. Moreover, this variable can be considered as a proxy for experience in using fertilizer. Farmers who have experience demanding higher rate of fertilizer. The result of Olwande et.al, (2009) shows that age has significant influence on use of fertilizer. Therefore, this variable was hypothesized to positively influence demand of fertilizer.

**Education level of household head (ELH)**: Education is generally believed to have the effect of widening the mental horizon of a person and preparing him to be receptive new ideas.

Farmers with ability to read and write are expected to have an advantage in obtaining information and understand the benefit of fertilizer use. Some empirical studies have demonstrated that literacy is the important factor influencing demand of fertilizer (Fakoya and Mato, 2003, Waithaka et. al., (2007) and Obisesan et.al, 2013). For example study of Waithaka et. al., (2007) show that the amount of fertilizer used on a farm increases significantly with higher education levels of household head. Literate farmers are therefore expected to use more fertilizer than the illiterate one. Therefore, education was hypothesized to positively influence demand of fertilizer.

**Household Size (HZ):** number of families of any age in the household. It is indirectly represents family labor available for agricultural activities. Larger household sizes increase the labor availability for household tasks. In the study of Olayide et.al., (2009) revealed that intensity of fertilizer use increases with family labor. It is expected to have a positive effect on the demand of fertilizer.

**Access to credit (AC):** This is a dummy variable, which takes a value 1 if the farm household has access to input credit for fertilizer and 0 otherwise. Availability of credit to purchase fertilizer on the other hand improve the farmers' cash position and hence their ability to purchase fertilizer. It was noted that the farmers who get cash credit do not use it to purchase fertilizer and thus only the credit got in the form of fertilizer is considered here. Different studies have shown that access to credit plays a significant role in enhancing the use of chemical fertilizer (Obisesan, et.al, 2013 and Fakoya and Mato 2003). In this study it was hypothesized that access to credit would have positive influence on demand of fertilizer.

**Access to extension services (AES):** this is a dummy variable, which takes a value 1 if the household received extension service and 0 otherwise. Extension service is one form of farmer learning and enhances the ability to acquire and use information required for production. It is assumed that the more of these services a farmer has, the more likely he is to know of the benefits of fertilizers and hence use more fertilizer. The study of Gedefaw, (2019) expressed that farmers who have access to extension service have applied more organic fertilizer compared with those who did not have access. Therefore, it was hypothesized that this variable positively influences intensity demand of fertilizer.

**Off-farm income** (OFI) it is a dummy variable which takes a value 1 if involved in off-farm activities, 0 otherwise. It is believed that off-farm income can have a positive impact on rural households' total income or wealth. When households income increase, their risk taking behavior also increase; this may lead to utilizing higher amount of fertilizer iuse. The study of Holden et al., (2008) revealed that households that had off-farm activities as a secondary income source were more likely to apply chemical fertilizers as compare to others. Thus, a positive relation is expected.

**Number of Oxen (NOX)**: it is the total number of oxen the household had. Since ox is the major means of production in the country. Traditionally a pair of draught oxen is required to plough a field. Because of oxen shortage, the farmers may not timely accomplish his /her agricultural activities. The untimely accomplishment of farming operation in turn may attribute to the less demand (or not at all) of fertilizer. Thus it was hypothesized that this variable will influence demand of fertilizer positively.

**On time-delivery of fertilizer (ODF):** it is a dummy variable which takes a value 1 if there is a timely availability of fertilizer, 0 otherwise. This refers to timely availability of sufficient amount of fertilizer in the area, which may be explained by poor delivery time may act as an impediment to demand of fertilizer. As mentioned in the study of Olayide et.al., (2009) the intensity of fertilizer use increases with physical access to fertilizer.

Table 2: Summary of variable

| Sr.no. | variable | Code of the variable | Expected sign |
|---|---|---|---|
| 1 | Price of fertilizer | PF | -ve |
| 2 | Household Head's sex | HHS | ± ve |
| 3 | Farm size | FZ | +ve |
| 4 | Age of household head | AHH | ± ve |
| 5 | Education level of household head | ELH | +ve |
| 6 | Household Size | HZ | +ve |
| 7 | Access to credit | AC | +ve |
| 8 | Access to extension services | AES | +ve |
| 9 | Off-farm income | OFI | +ve |
| 10 | Number of Oxen | NOX | +ve |
| 11 | On time-delivery of fertilizer | ODF | +ve |

# CHAPTER FOUR

# RESULT AND DISCUSSIONS

This chapter deals with the empirical findings and discussion of the results obtained from descriptive and econometric analysis. It has three major parts. In the first part demographic Characteristics of respondents are presented and discussed. In the second part trends of supply of fertilizer in Ethiopia were analyzed. Finally the factors affecting demand and supply chain of fertilizer are presented and discussed.

## 4.1. Demographic Characteristics of Respondents

In this study, it was conducted and analyzed the profile of the respondents but it is not the foremost objective or destination of this research. Nevertheless, it is a vital instrument towards the major findings and an indicator for the collective data quality. That is because the study is based on perception of the respondents and understanding the profile of the respondents is good information to comprehend about the research findings. Consequently, each demographic profile of the respondents which has been included in the survey was presented below based on response from respondents.

### 4.1.1. Sex

Table 3: House Head's Sex respondent

| Gender Representative | Number of Respondents | Percent |
|---|---|---|
| Male | 181 | 87.4 |
| Female | 26 | 12.6 |
| Total | 207 | 100.0 |

Source: its own survey, 2019

As shown in table 3, Out of the 207 observations used in this study, 181 (87.4%) were male headed households while the remaining 26 (12.6%) were female headed households.

### 4.1.2. Age

Age is presented in survey in different (four) groups for choice of respondents. The choices were below 30 years, between 30 and 40 years, between 40 and 50 years, and above 50 years. The result was presented in the table 3 below.

Table 4: Age of household head respondents

| Age Category | Number of Respondents | Percent |
|---|---|---|
| Below 30 years | 47 | 22.7 |
| 30 - 39 years | 77 | 37.2 |
| 40 - 49 years | 63 | 30.4 |
| 50 year and above | 20 | 9.7 |
| Total | 207 | 100.0 |

Source: its own survey, 2019

As indicated in Table 4, the majority of the respondents 77 (37.2 %) were between 30 to 39 years then 63 (30.4%) of respondents were between 40 to 49 years, followed by 47 (22.7%) of respondents were below 30 years while the rest 20 (9.7%) of respondents were 50 years and above.

### 4.1.3. Educational Level

Education level is among those profiles relatively more important and a clue for the respondent's familiarity for the subject matter. Because education level shows information and knowledge, it is indispensable for a good perception.

Table 5: Education level of household head respondents

| Education Level | Number of Respondents | Percent |
|---|---|---|
| Illiterate | 74 | 35.7 |
| 1-6 Grade | 87 | 42.0 |
| 7- 12 Grade | 46 | 22.2 |
| Total | 207 | 100.0 |

Source: its own survey, 2019

As indicated in table 5, 74 (35.7%) of respondents were illiterate, 87 (42%) of respondents were between grade 1 to 6 while 46 (22.2%) of respondents were between grade 7 to 12.

### 4.2. Fertilizer Supply/Import Trend in Ethiopia (2000-2018 G.C)

Until 2013, urea and DAP (di-ammonium phosphate) fertilizers have been the only fertilizer sources that have been in supply and use in the Ethiopian agriculture. But after 2013 new fertilizer such as NPS, NPSB, NPSZnB, NPSZn, NPSCU and Potash had been available in the country. None of these are locally produced and should be supplied by imports to meet the demand. In this trend analysis only the total amount of supply/import were used for the analysis. Supply of fertilizer assessed in terms of total fertilizer imported were analyzed.

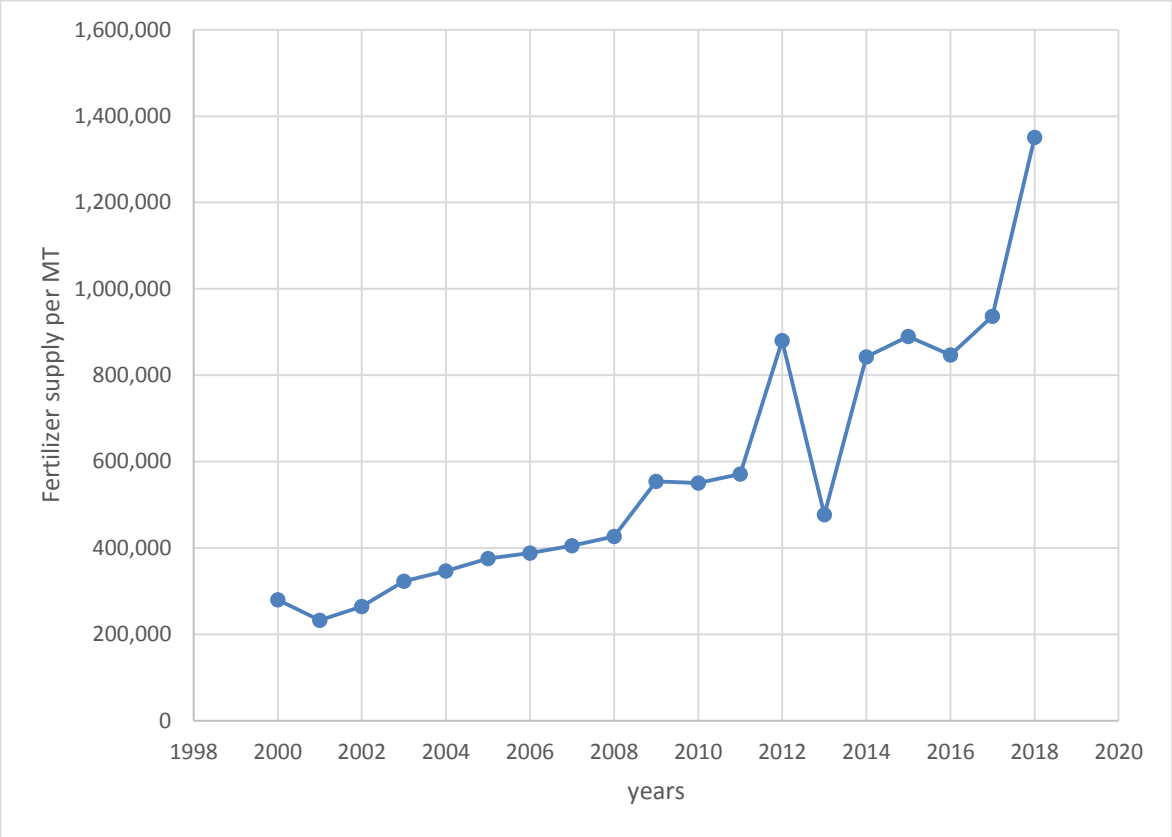


Figure 5 Fertilizers supply/import trend of per MT (2000-2018 G.C)

As it clearly shown in figure 5, the import of fertilizers in Ethiopia has 17% declined from year 2000 to 2001 but then after volume of imports steadily increased up to year 2009. In year 2010 there was 1% decrease of imports of fertilizer. In year 2011 and 2012 there has been an increase of imports but in year 2013sharply declined by 46%. In years 2014 and 2015 there has been an increase of import. In year 2016 import of fertilizer has decreased by 5%. In years 2017 and 2018 the fertilizer imports increased significantly.

In general, fertilizer imports in Ethiopia has increased on an average of 12% throughout the period under consideration; a big drop (-46%) was recorded in between year 2012 and 2013, and a maximum growth (77%) has attained in between year 2013 and 2014.

According to IFDC, (2015) Even though the amount of fertilizer imported increases every year, Ethiopian farmers still lag far behind other developing countries in fertilizer use. The average intensity of fertilizer use in the country (which is roughly less than 40 kilograms per hectare) remains much lower than elsewhere (e.g., 54 kg/ha in Latin America, 80 kg/ha in South Asia, and 87 kg/ha in Southeast Asia). The scenario fairly suggests that there was no much effort to improve the fertilizer use in the country that has a variable agro-ecology and soil conditions.

### 4.3. Results of the Econometric Model

In this section the results of econometric models is discussed. In view of this, efforts were made to include variables found relevant to the models in order to estimate the effects of the hypothesized explanatory variables.

#### 4.3.1.Factors Affecting Supply Chain of Fertilizer

Supply Chain takes a system approach to viewing the Supply Chain as a single entity. Each stakeholder in a Supply Chain directly or indirectly affects the performance of other Supply Chain members, as well as the overall performance of the Supply Chain.

For this study the questionnaire were developed in five scales (likert scale) ranging from five to one; where 5 represents Strongly agree, 4 represent agree, 3 represent neither agree nor disagree, 2 represent disagree, and 1 represent strongly disagrees.

In order to assess the determinant factors (independent variable) and supply chain performance (dependent variable), multiple linear regression model were conducted for scale typed questionnaire. The collected data were presented and analyzed using STATA (version 14) and SPSS (version 20) statistical software.

Prior to the estimation of the model parameters the most important diagnostic tests were conducted. The variance inflation factor (VIF) values were ranging between 1.16 and 2.81 and the mean VIF value was 1.49 (Appendix 3). These results indicated the absence of serious multicollinearity problem among the independent variables. The Heteroscedasticity tests were

performed and there was no heteroscedasticity problem (Appendix 3). Similarly, omitted variable test result also showed that there was no specification error (Appendix 3).

Table 6: Result of Regression Model

| Variables | Coef. | t-ratio | p-value |
|---|---|---|---|
| Estimation of demand for fertilizer purchase | -0.135 | -1.784 | .076* |
| Storage Facility | -0.172 | -2.028 | .044* |
| Custom process and Documentation | -0.040 | -.560 | .576 |
| Transportation | -0.105 | -1.271 | .205 |
| Collaboration of Stakeholders | -0.197 | -2.509 | .013** |
| Distance from the village to market | -1.175 | 8.439 | .000*** |
| Process of Order Issuance | -0.026 | -.366 | .715 |
| Constant | 1.487 | 2.780 | .006*** |
| F- statistics | 17.22 | | |
| R- squared | 0.756 | | |
| Adjusted $R^2$ | 0.735 | | |

***, ** and * Represents level of significance at 1%, 5% and 10% respectively
Source: model result

F test is used to test the overall significance of the estimated multiple regression model or test of goodness of the model. If computed F value is greater than the critical F value or alternatively, if the p value of F obtained sufficiently low, the model is significant. As shown in the table 6 the value of F is 17.22 which is greater than the critical F value, it shows the model is significant. Coefficient of multiple determinations (R Squared) is used to check goodness of fit for the regression model. As indicated in the table 6 the adjusted R Squared is 0.74, which indicates the explanatory variables in the model have accounted for over 74 percent variation in supply chain performance of fertilizer, hence the model best fits when predicting supply chain performance.

Estimated result of regression function on table 6 shows that, out of 7 explanatory variables considered in the model, only 4 (Estimation of demand for fertilizer purchase, Storage Facility, Collaboration of Stakeholders and Distance from the village to market) variables were found to be significantly influencing supply chain performance of fertilizer at 1%, 5% and 10% levels of significance. The remaining 3 (Custom process and Documentation, Transportation and Process of Order Issuance) variables were found have no significant effect on supply chain performance.

**Estimation of Demand for Fertilizer Purchase (EDP):** The results have shown that Estimation of demand for fertilizer purchase was negatively influencing supply chain performance of fertilizer (significant at 10% level). This implies that for every unit increase in time of estimation of demand for fertilizer purchase supply chain performance of fertilizer decrease by 0.135 unit. This indicates that process of fertilizer estimation takes longer time, so this affects efficiency of performance of supply chain of fertilizer. This is similar with the finding of Gebrerufael (2015) who revealed that fertilizer demand estimation system negatively affects supply chain performance of fertilizer.

**Storage Facility (SF):** It found negatively influencing performance of supply chain performance of fertilizer at 10% level of significance. For every unit of shortage of storage facility supply chain performance of fertilizer decreased by 0.172 unit. This implies that, existence of storage facilities at farmers' disposal would have an advantage for fertilizer suppliers to damp and timely delivery of fertilizer, but farmers are subjected to high transport cost and lack of timely delivery of fertilizer due to shortage of storage facility. This study is similar with the study of DASH (n.d.), who argued that the main challenges of supply of fertilizer is the shortage of storage capacity of fertilizer, particularly in the regions with union cooperatives, as a result, there have been a number of incidents where trucks spend multiple days at warehouses unloading fertilizer due to limited warehouse space. This result also in line with Reta (2013) who indicated that the main challenges of supply of fertilizer is lack of storage facility.

**Collaboration of Stakeholders (CS):** These had found negatively determining the supply chain performance of fertilizer at 5% level of significance. The result of the study shows that, if there is no well collaboration between stakeholders supply chain performance of fertilizer decreased by 0.197 unit. This indicated that there were absence of well coordination between stakeholders along supply chain of fertilizer. Due to this supply chain performance of fertilizer were inefficient. This finding is consistent with Mentzer and Min (2004).

**Distance from the Village to Market (DM)**: The results have shown negatively influencing supply chain performance of fertilizer (significant at 10% level). This implies that, an increase in unit of distance from fertilizer market cause a decrease in 1.175 unit of supply chain performance of fertilizer. This indicates that, those who are far from the market may not have a chance to get agricultural inputs timely comparing to the nearby farmers. This result is similar with Camara and Heinemann (2006).

### 4.3.2.Factors Affecting Demand for Fertilizer

The demand of fertilizer is affected by various, demographic, socioeconomic and institutional factors. In view of this, efforts were made to include variables found relevant to the model in order to estimate the effects of the hypothesized explanatory variables on level of demand of fertilizer by farmers. Multiple linear regression model were employed to identify the significant factors affecting demand for fertilizer by using STATA software version 14 and SPSS software version 20.

For the parameter estimates to be efficient, test of assumptions of OLS were performed using appropriate test statistics. The four most important diagnostic tests multicollinearity, heteroscedasticity, normality and omitted variable were conducted.

The variance inflation factor (VIF) values were ranging between 1.05 and 3.35 and the mean VIF value was 1.55 (Appendix 3). These results indicated the absence of serious multicollinearity problem among the independent variables. The Heteroscedasticity tests were performed and there was no heteroscedasticity problem (Appendix 3). Similarly, omitted variable test result also showed that there was no specification error (Appendix 3).

Table 7: Result of Regression Model

| Variables | Coef. | t-Ratio | p-value |
|---|---|---|---|
| Price of fertilizer | -0.199 | -2.23 | 0.027** |
| Household Head's sex | 0.094 | 0.75 | 0.455 |
| Farm size | 1.150 | 22.38 | 0.000*** |
| Age of household head | 0.061 | 1.25 | 0.214 |
| Education level of household head | -0.087 | -1.54 | 0.125 |
| Household Size | -0.009 | -0.32 | 0.749 |
| Access to credit | 0.307 | 2.85 | 0.005*** |
| Access to extension services | 0.281 | 2.67 | 0.008*** |
| Off-farm income | 0.248 | 2.57 | 0.011** |
| Number of Oxen | 0.168 | 3.38 | 0.001*** |
| On time-delivery of fertilizer | 0.257 | 3.04 | 0.003*** |
| constant | -0.465 | -1.69 | 0.092* |
| F- statistics | 237.53 | | |
| R- squared | 0.931 | | |
| Adjusted $R^2$ | 0.927 | | |

***, ** and * Represents level of significance at 1%, 5% and 10% respectively

Source: model result

F test is used to test the overall significance of the estimated multiple regression model or test of goodness of the model. If computed F value is greater than the critical F value or alternatively, if the p value of F obtained sufficiently low, the model is significant. As shown in the table 7 the value of F is 237.53 which is greater than the critical F value, it shows the model is significant. Coefficient of multiple determinations (R Squared) is used to check goodness of fit for the regression model. As shown in the result the adjusted R Squared is 0.93. It indicates that explanatory variables in the model have accounted for over 93 percent variation in the demand of fertilizer, hence the model best fits when predicting demand of fertilizer.

Estimates of the parameters of the variables expected to determine the demand of fertilizer are displayed on Table 7. A total of 11 explanatory variables were considered in the econometric model out of which 7 variables (Price of fertilizer, Farm size, Access to credit, Access to extension services, Off-farm income, Number of Oxen and On time-delivery of fertilizer) were found to significantly influence demand of fertilizer. The remaining 4 variables (Household Head's sex, Age of household head, Education level of household head and Household Size) were found have no significant effect on demand of fertilizer.

**Price of fertilizer**: As expected, price of fertilizer had found negatively determining the demand of fertilizer at 5% level of significance. The result shows that the perception of high price of fertilizer by farmers reduced demand of fertilizer by 0.199 kg/ha. This implies that farmer's demand of fertilizer decreased as its price increased and its demand increased as price decreased. This finding is consistent with Kherallah et al., (2001), Ebong and Ebong (2006) and Sharma V. and Thaker H., (2011), revealed that price of fertilizer was negatively related with fertilizers demand.

**Farm size (FSZ):** Farm size had found positively determining the demand of fertilizer at 1% level of significance. A one hectare increased in farm size increased the demand of fertilizer by 1.15 Kg/ha. This implies that farmers with larger farms size use more fertilizer than those with smaller farms sizes. The result was in conformity with the earlier studies of Waithaka et. al., (2007), Obisesan et.al, (2013), Abrhaley, (2016) and Fakoya and Mato (2003) who found that farm size influenced demand of fertilizer positively and significantly. They explain that the amount of fertilizer used on a farm increases significantly with increasing farm size.

**Access to credit (AC):** Access to credit had found positively determining the demand of fertilizer at 1% level of significance. Based on the study access to credit increases the demand of fertilizer by 0.307 Kg/ha. This indicate that availability of credit improve the farmers cash position and hence their ability to purchase more fertilizer. This finding is similar with the result of Olwande, et,al, (2009) and Obisesan, et.al, (2013) who have indicated that access to credit have significant positive effects on demand of fertilizer.

**Access to extension services (AES):** As expected, extension was positively influencing the demand of fertilizer at 1% significant level. An access to extension services increase demand of fertilizer by 0.281 Kg/ha. This indicate that extension workers effort may also play its own role for this positive outcome. Extension service as a source of information regarding the benefit of fertilizer use, its application rate, etc., has a strong influence on the farmer's demand of fertilizer. This result coincide with Nasrin M. and Bauer S., (2016) and Gedefaw (2019) who have reported significant and positive relationship of access to extension services and demand of fertilizer.

**Off-farm income (OFI):** Off-farm income had found positively determining the demand of fertilizer at 5% level of significance. The result shows that farmers who earn income from off-farm activity demand 0.248 Kg/ha more than those who did not have access to off-farm income. This may due to the fact that farmers who had cash from these sources demanded more fertilizers. This finding is similar with Nambiro E. and Okoth P. (2013) and Nasrin M. and Bauer S., (2016) who found that off-farm income influenced demand of fertilizer positively and significantly. They explain that farmers with an additional source of income will be willing to take risk in demanding of more fertilizer.

**Number of Oxen (NOX):** Oxen ownership is another factor, which was positively related to the dependent variable at 1% significant level. The result of the study shows that each additional unit of oxen increases the demand of fertilizer by 0.168 kg/ha. The implication is that oxen are important sources of cash income in rural area, which can be used for purchasing more fertilizer. In addition, ox is the major means of production in the agricultural sector of the area. Hence, having more oxen may mean being able to plough the land at the appropriate time than waiting for hired oxen. As a result, farmers having more oxen can plough their land at the right time and extract higher yield which could be an incentive and source of income for demanding more

fertilizer. Similar result was reported by Lunduka, (2011) and Abrhaley, (2016) who argued that number of oxen influenced demand of fertilizer positively and significantly.

**On time-delivery of fertilizer** (ODF)**:** the result show that it is significant at 1% and has a positive sign. The result of the study shows that on time-delivery of fertilizer increases the demand of fertilizer by 0.257 kg/ha. It is believed on time delivery of fertilizer has helped the farmers demanding of more fertilizer. Similar result was reported by Olayide et.al., (2009) who found that on time-delivery of fertilizer influenced demand of fertilizer positively and significantly.

# CHAPTER FIVE
# CONCLUSION AND RECOMMENDATIONS

## 5.1.Conclusions

The agricultural sector of Ethiopia is well known for its being traditional and use of backward. Different studies and practical observation argued that the application of modern agricultural inputs and practices can contribute a lot for productivity enhancement of the sector of agriculture. The fate of the sector in terms of increasing its contribution to the overall growth of the economy and securing food self-sufficiency depends on the development and application of appropriate farm inputs especially chemical fertilizer.

Today, there is a general consensus that fertilizer is considered as one of the most important inputs for the achievement of increased agricultural production and productivity in Ethiopia. Optimal fertilizer utilization is a key important thing for increasing agricultural production and productivity in Ethiopia, and it will have an impact on alleviating the poverty and food insecurity issues for many smallholder producers.

This study has investigated to identify factors affecting demand and supply chain of fertilizer in Ethiopia. This study were conducted in Kersa and Malima woreda of Oromiya Regional State of Ethiopia. In this study multiple linear regression model were used to analyses factors affecting demand and supply chain of fertilizer.

In the case of supply chain of fertilizer, the multiple linear regression econometric results has verified that out of 7 explanatory variables considered in the model, only four (Estimation of demand for fertilizer purchase, Storage Facility, Collaboration of Stakeholders and Distance from the village to market) variables were found to be significantly influencing supply chain performance of fertilizer. The remaining 3 (Custom process and Documentation, Transportation and Process of Order Issuance) variables were found have no significant effect on supply chain performance of fertilizer.

The second, and most significant, contribution of this paper was to econometrically test how the various factors influence a household's demand for fertilizer using multiple linear regression model. A total of 11 explanatory variables were considered in the econometric model out of which 7 variables (Price of fertilizer, Farm size, Access to credit, Access to extension services, Off-farm income, Number of Oxen and On time-delivery of fertilizer) were found to significantly influence demand of fertilizer. The remaining 4 variables

(Household Head's sex, Age of household head, Education level of household head and Household Size) were found have no significant effect on use of fertilizer.

## 5.2.**Recommendations**

The researcher recommends the following measures so as to be considered in the future intervention strategies

### 5.2.1. Factors affecting supply chain of fertilizer

The result of the econometric model showed that Estimation of demand for fertilizer purchase is a very important variable that negatively influenced supply chain of fertilizer. This implies that the method of estimation takes longer time duration. Therefore, the researcher recommends that traditional way of estimation of demand of fertilizer should be replaced by computerized system.

Another very important variable that negatively influenced supply chain of fertilizer is storage facility. This indicates the shortage of store facilities in the study area. This makes shortage of fertilizer stock at the time of need. Therefore additional stores should be built in order to alleviate this problem.

Moreover, to make the supply chain of fertilizers well integrated, all the stakeholders, importers, retailers, logistics service providers, regulatory and financial institutions and final users have to be in the same page about need, challenges and mitigating mechanisms. Those stakeholders all together have to involve in supply chain plan of fertilizers for effective and efficient supply chain performance.

### 5.2.2. Factors affecting demand for fertilizer

The result of the study showed that Price of fertilizer is one of the most significant factor variable that negatively influenced demand for fertilizer. The result of the study suggested that, the government is concerned with access to fertilizers by poor farmers who cannot afford market prices, then a smart subsidy system can be designed that targets such vulnerable groups. Such subsidy programs need to be carefully designed and clearly articulated to all players and with clear exit strategies.

Inaccessibility of credit is found to be serious problem to demand of fertilizer in the area. Hence, it is recommended to improving the efficiency of credit system, timely and sufficient amount of delivering credit to farmers who engaged on crop production has to be considered so as to improve consumption of fertilizer by farmers.

The result of the econometric model showed that access to extension service is a very important variable that positively influenced the demand fertilizer. Hence, it is recommended to assign efficient extension system, updating the extension agent's knowledge and skills about the benefit and utilization of fertilizer.

The other important variable that negatively influenced demand of fertilizer were on time-delivery of fertilizer. Timely distribution of fertilizer according to the demand of fertilizer is crucial to boost up production and productivity of farmers. Therefore, the oromiya agricultural office has to give attention for the timely distribution of fertilizer to the farmers.

# REFERENCES


Abu-Suleiman, A., Boardman, B., & Priest, J. (2004). A framework for an integrated Supply Chain Performance Management System. Industrial Engineering Research Conference. Houston: TX. Refereed Research Article and Presentation.

Abrhaley Tsehaye, (2016) the analysis of fertilizer use and agricultural productivity: case of la'ilay maychew woreda, tigray, Ethiopia. International conference on the Ethiopian economy, organized by EEA addis abeba, Ethiopia.

Africa Agriculture Status Report: Focus on Staple Crops. Nairobi, Kenya: Alliance for a Green Revolution in Africa (AGRA) (2013). Livestock Production and Marketing. ESSP II Working Paper.

African Fertilizer and Agribusiness Partnership (AFAP) (2016): A Review of National Fertilizer Regulatory Authorities in Ethiopia. Newark. USA.

Africa Agriculture Status Report: Focus on Staple Crops. Nairobi, Kenya: Alliance for a Green Revolution in Africa (AGRA). 2013. Livestock Production and Marketing. ESSP II Working Paper.

AISE (2013). Unpublished data. Agricultural Inputs Supply Enterprise Archives (AISE), Addis Ababa, Ethiopia.

Aitken, J., Supply Chain Integration within the Context of a Supplier Association, Cranfield University, Ph.D. thesis, 1998.

ATA (2013). Proposal for revised input credit system. http://www.ata.gov.et, accessed on June 16, 2013. AISE (2013). Unpublished data. Addis Ababa, Ethiopia: Agricultural Inputs Supply Enterprise Archives.

Barbier, E.B. (2000). The economic linkages between rural poverty and land degradation: some evidence from Africa. Agric. Ecosyst. Environ. 82, 355-370.

Belay, K. (2003). Agricultural Extension in Ethiopia: the Case of Participatory Demonstration and Training extension System, J. Soc. Dev. Afr., 18(1): 49-84.

Bezabih Emana .2000. The Role of New Varities and Chemical Fertilizer Under Risk: The Case of Smallholders in Eastern Oromia, Ethiopia. Ph.D Dissertation, University of Hannover, Shaker Verlung, Germany. Croppenstedt, A.,

Bolarinwa O. A., (2017): Questionnaires Used in Social and Health Science Researches.

University of Ilorin. Ilorin, Nigeria

Bonger, T., G. Ayele, and T. Kumsa. 2004. Agricultural Extension, Adoption and Diffusion in Ethiopia. Ethiopian Development Research Institute (EDRI) Research Report 1. Addis Ababa: EDRI.

Byerlee, D., D. Spielman, D. Alemu, and M. Gautham. 2007. Policies to Promote Cereal Intensification in Ethiopia: A Review of Evidence and Experience. Discussion Paper 707. Washington, DC: International Food Policy Research Institute.

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

Charan., P, Shankar., R, Baisya, R.K. (2008).Analysis of interactions among the variables of supply chain performance measurement system implementation, Business Process Management Journal, 14(4), 512 - 529.

Chen, I. J., & Paulraj, A. (2004). "Towards a theory of supply chain management: the constructs and measurements", Journal of Operations Management, Vol.22, pp 119-126.

Chima, A. (2007).Supply chain management issues in the oil and gas industry, Journal of Business and Economics Research, Vol.5, No.6, pp 27-36.

Chopra, S., and Meindl, P. (2010), "Supply chain management: Strategy, planning, and operation", Prentice Hall, Boston et al.

Chow, D., Heaver, T., & Henriksson, L. (1999). Logistics performance: Definition and measurement. International Journal of Physical Distribution & Logistics Management, 24(1), 17–28.

Christopher, M. (1998). Logistics and Supply Chain Management, 2nd ed., London: Pitman Publishing.

Croppenstedt, A., Demeke, M. & Economies, C. F. T. S. O. A. 1996. Determinants of adoption and levels of demand for fertiliser for cereal growing farmers in Ethiopia, CSAE Pub.

CSA (Central Statistics Authority), (2008) Statistical Abstract, Addis Ababa, Ethiopia

DASH (n.) Supply Chain for Fertilizer Distribution in Ethiopia. Harvard University's. http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-ofuse#LAA

Debertin, D. 1986. Agricultural Production Economics. New York: McMillan Publishing Company.

De Blok,C.,Meijboom,B.,Luijkx,K.,Schols.,J.(2012)The human dimension of Modular care provision: opportunities for personalization and customization, International Journal of Production Economics.

Dercon, S., Christiaensen, L. (2011). Consumption risk, technology adoption and poverty traps: evidence from Ethiopia. J. Dev. Econ. 96, 159-173.

Desai, G. 2002. Key Issues in Achieving Sustainable Rapid Growth of Fertilizer Use in Rwanda. Consulting Report. Bethesda, MD: Abt Associates.

Desai, G., and V. Gandhi. 1988. "Fertilizer Consumption in Sub-Saharan Africa: An Analysis of Growth and Profile of Use." Paper presented at the IFPRI/IFDC workshop on Fertilizer Policy in Tropical Africa, 5–7 April, Lome, Togo.

Dorosh, P., and S. Rashid, eds. 2013. Food and Agricultural Policy in Ethiopia: Progress and Policy Challenges. Philadelphia: University of Pennsylvania Press.

DSA (Development Studies Associates). 2006. Study on Improving the Efficiency of Input Markets. Addis Ababa: Ministry of Agriculture and Rural Development, Federal Democratic Republic of Ethiopia.

Dyckman, B. (2009). Integrating Supply Chain Finance into the Payables Process. Journal of Payments Strategy & Systems, 3(4), 311-319.

Ebong, V.O., & Ebong, M.V. (2006). Demand for Fertiliser Technology by Smallholder Crop Farmers for Sustainable Agricultural Development in Akwa Ibom State, Nigeria. International journal of Agriculture & Biology 1560-8530/2006/08-06-728-731 Retrieved July 16, 2011 from http://www.fspublishers.org

Embaye kidanu (2010), analysis of butter supply chain: the case of atsbiwenberta and alamata woredas, tigray, ethiopia Haramaya University

Fahad b. f.a, (2013) factors affecting supply chain management by oil companies in kenya. Administration of kenyatta university. kenya.

Fakoya, E.O., & Mato, Y. (2003). Factors Affecting the Use of Inorganic Based Fertilisers by Farmers in Zinder State of Niger Republic SET Series A(2003) 3(1),7-13.

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.

FAO (Food and Agricultural Organization). 2007. Agro-Industrial Supply Chain Management: Concepts and Applications. Agricultural Management, Marketing and Finance Occasional Paper. Food and Agriculture Organization, Rome, Italy.

Fiala, P. (2005). Information Sharing in Supply Chains. Omega, 33(5), 419-423.

Gebrerufael G. (2015). Chemical Fertilizer Marketing and Uptake in Ethiopia: Evidence from Ada`a District of Oromia Regional State. Addis Ababa, Ethiopia. Addis Ababa University.

Gregory, D.I., Bumb, B. (2006). Factors affecting supply of fertilizer in Sub-Saharan Africa. Agriculture & Rural Development Discussion paper 24. Washington, DC: World Bank Press, p. 81.

Gujarati, N. 2006. Basic Econometrics, Third Edition, McGraw Hill Book Company, New York

Gunasekaran, A., Patel, C. & Tittiroglu, E. (2001). "Performance Measures and Metrics in a Supply Chain Environment," International Journal of Operations and Production Management, 2(1-2), 71–87.

Holden, S. & Lunduka, R. (2011). Do Fertilizer Subsidies Crowd Out Organic Manures? The Case of Malawi. Department of Economics and Resource Management. Norwegian University of Life Sciences, As, Norway.

Holden, S. T., Otsuka, K., & Place, F. M. 2008. The Emergence of Land Market in Africa: Impacts on Poverty, Equity, and Efficiency. Washington DC, Resource for the Future (RFF) publisher.

Howard, J., Crawford, E., Kelly, V., Demeke, M., Jeje, J.J. (2003). Promoting high-input maize technologies in Africa: the Sasakawa-Global 2000 experience in Ethiopia and Mozambique. Food Policy 28, 335-348.

IFDC. (2012). Ethiopia Fertilizer Assessment. Alabama 35662, USA. http://www.ifdc.org//

IFAD, (2013). The importance of scaling up for agricultural and rural development: A success story from Peru, Rome, Italy, IFAD Occasional Paper

IFPRI. (2012). Fertilizer in Ethiopia: Policies, Value Chain, and Profitability. Addis-Ababa,

Ethiopia: International Food and Policy Research Institute Press, p. 66.

Isaac M., Kizito M., Conrad M., Patrick N., (2010) "Supply and demand trends for fertilizer in Zimbabwe: Contributed Paper presented at the Joint 3rd African Association of Agricultural Economists (AAAE) and 48 th Agricultural Economists Association of South Africa (AEASA) Conference, Cape Town, South Africa.

Janvier A. M., 2012: A New Introduction to Supply Chains and Supply Chain Management: Definitions and Theories Perspective: China Published. Shanghai.

Gavirneni, S. (2006). Price Fluctuations, information Sharing, and Supply Chain Performance. European Journal of Operational Research, 174(3), 1651-1663.

Gedefaw Abebe (2019). Factors affecting use of organic fertilizer among smallholder farmers in Sekela district of Amhara region. Bonga University. Ethiopia.

Gerald E. S., (2016) factors affecting the performance of supply chain financing in kenya: a case study of commercial bank of Africa. United States international university Kenya.

Johanes U.I. Agbahey, Harald G. & Workneh N. (2015), Fertilizer supply chain in Ethiopia: structure, performance and policy analysis, Africa focus journal, Volume 28, pp. 81-101.

Kaliba, A. R. M., Verkuijl, H. & Mwangi, W. 2000. Factors affecting adoption of improved maize seeds and use of inorganic fertilizer for maize production in the intermediate and lowland zones of Tanzania. Journal of Agricultural and Applied Economics, 32, 35-48.

kassu kubayo seko, (2009) analysis of agricultural input supply system: the case of dale woreda, southern nations, nationalities and peoples' region. haramaya university

Keebler, J., Manrodt, K., Durtsche, D., and Ledyard, D. (1999), "Keeping Score: Measuring the value of logistics in the supply chain". Council of Logistics Management, Chicago.

Kefyalew, E. (2010). Fertilizer Consumption and Agricultural Productivity in Ethiopia, Addis Ababa, Ethiopia, Ethiopian Development Research Institute, Working 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.A., Mpyisi, E., Murekezi, A., & Neven, D. (2001). Fertiliser Consumption in

Rwanda. A Paper Prepared for the Policy Workshop on Fertiliser use and Marketing, 2001. Retrieved July 16, 2011 from http://aec.msu.edu/\/rwanda

Knepper, E. T. 2002. Factors Affecting the Use of Fertilizer by Small-and Medium-sized Farming Households in Zambia, 1997 to 2000. Michigan State University.

Kohls, Richard L. and Joseph N. Uhl, 1985. Marketing of agricultural products. 6th edition. Macmillan publishing company, New York.

Lambert D.M., Cooper C.M., 2000. Issues in supply chain management. Industrial Marketing Management 29, 65–83.

Lambert, D., and Pohlen, T. (2001), "Supply Chain Metrics. International Journal of Logistics Management", Vol. 12 No. 1, pp. 1-19.

Lai, K., Ngai, E. W. T. & Cheng, T. C. E. (2002). "Measures for Evaluating Supply Chain Performance in Transport Logistics," Journal of Transportation Research: Part E, 38(6), 439-456.

Lelissa Chalchissa Argeta. 1998. The Determinants of Adoption, Intensity and Profitability of Fertilizer use: the case of Ejere District, West Showa. M.Sc. Thesis. Addis Ababa University, Ethiopia. PP. 1-90.

Lalwani, C.S., Disney, S.M., & Naim, M.M. (2006). Assessing the sensitivity to uncertainty in distribution network design: International Journal of Physical Distribution &Logistics Management, 36 (1), pp.68-79.

Leong, G.K., Tan, K.C. & Wisner, J.D. (2009). Principles of Supply Chain Management: A Balanced Approach. Cengage Learning

Little, A. (1999). A European Supply Chain (SC) survey. [Online] Available: http://www.adlittle.be/insights/studies/pdf/european_supply_chain_survey.pdf. (July 15, 2011).

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.

Ministry of Agriculture (2011). Ethiopia`s Agricultural Sector Policy and Investment Framework (2010- 2020). MOFED (2010). Growth and Transformation Plan (GTP)

Mishra, R.K. (2012). Measuring Supply Chain Efficiency: a dea approach. Journal of

Operations and Supply Chain Management 5 (1), pp 45 – 68

Moberg, C. R., Cutler, B. D., & Gross, A. (2003). Identifying antecedents of information exchange within supply chains. International Journal of Physical Distribution and Logistics Management, 32(9), 755-770.

Morgan, C. (2004), "Structure, speed and salience: performance measurement in the supply chain", Business Process Management Journal, Vol. 10 No. 5, pp. 522-536.

Moser CM, Barrett CB (2003). The Disappointing Adoption Dynamics of a Yield-Increasing, Low-External Input Technology: The Case of SRI in Madagascar. Agric. Syst. 76:1085-1100.

Nambiro E. and Okoth P. (2013), what factors influence the adoption of inorganic fertilizer by maize farmers? A case of Kakamega District, Western Kenya academic journals http://www..Org/SRE

Nasrin M. and Bauer S., (2016) Factors affecting fertilizer use intensity among farm size groups: Perception about fertilizer subsidy policy in Bangladesh. Justus-Liebig University, Giessen, Germany, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh: Conference on International Research on Food Security, Natural Resource Management and Rural Development organized by the University of Natural Resources and Life Sciences (BOKU Vienna), Austria.

Neely, A., Gregory, M. & Platts, K. (1995). "Performance Measurement Systems Design: A Literature Review and Research Agenda," International Journal of Operations and Productions Management, 15(4), 80-116.

Obisesan A. A., Akinlade R.J, and Fajimi F.O., (2013). Determinants of fertilizer use among smallholder food crop farmers in Ondo State, Nigeria. American Journal of Research Communication, 1(7): 254-260} www.usa-journals.com, ISSN: 2325-4076

Olayide, O.E., Alene, A.D., & Ikpi, A. (2009). Determinants of Fertiliser Use in Northern Nigeria. Pakistan Journal of Social Sciences 6(2), 91-98.

Olwande, J., Sikei, G., & Mathenge, M. (2009). Agricultural Technology Adoption: A Panel Analysis of Smallholder Farmers` Fertiliser Use in Kenya. A Paper Presented at the 83rd Annual Conference of the Agricultural Economics Society Dublin.

Polson, R. A. & Spencer, D. S. C.1991. The technology adoption process in subsistence agriculture: the case of cassava in southwestern Nigeria. Agricultural Systems, 36, 65-78.

Ramesh, A., Banwet, D.K., and Shankar. R. (2010).Modelling the barriers of supply chain collaboration, Journal of Modelling in Management, 5 (2), 176-193.

Rashid, S., Nigus S., Minot N., and Gezahengn A. (2013). Fertilizer in Ethiopia: An Assessment of Policies, Value Chain, and Profitability. Addis Ababa, Ethiopia, IFPRI Discussion Paper.

Reta H. (2016): Analysis of Supply Chain of Fertilizers in Ethiopia. Addis Ababa, Ethiopia. School of Commerce of Addis Ababa University

Saad, M. and Patel, B. "An investigation of supply chain performance measurement in the Indian automotive sector". Benchmarking: An International Journal, Vol.13 No.1/2, pp. 36-53, 2006.

Schrettle, S., Hinz, A., Rathje, M.S., Friedli, T. (2013). Turning sustainability into action: Explaining firms' sustainability efforts and their impact on firm performance. International Journal of Production Economics.

Shah, N.K., Li, Z., and Ierapetritou, M.G., (2011). Petroleum refining operations: Key issues, advances, and opportunities, Industrial and Engineering Chemistry Research, Vol. 50, pp 1161-1170.

Sharma V. P. and Thaker H. (2011). Demand for Fertilizer in India: Determinants and Outlook for 2020: Indian Institute of Management. India.

Simchi-Levi, D., P. Kaminsky and E. Simchi-Levi. (2003). Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies. New York, NY: McGraw-Hill

Sisay, D., Jema, H., Goshu, D., & Abdi, K. E. 2016. Agricultural technology adoption, crop diversification and efficiency of maize dominated farming system in Jimma Zone, South-western Ethiopia (Doctoral Dissertation), Haramaya University, Ethiopia

Spielman D. J., Dawit, K. and Dawit, A. (2011). Seed, Fertilizer, and Agricultural Extension in Ethiopia. Addis Ababa, Ethiopia, ESSP Working paper.

Supply Chain for Fertilizer Distribution in Ethiopia. Harvard University's http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-ofuse#LAA

Sweeney, E. (2005). Managing the Supply Chain: The Role of Information and Communications Technology (ICT) as a Key Enabler of the Process. Business Ireland, Summer Issue, p.105-109.

Tefera, N., Ayele, G., Abate, G. T., & Rashid, S. (2012). Fertilizer in Ethiopia: Policies, Value Chain, and Profitability. International Food Policy Research Institute.

Teressa Adugna. (1997). "Factors Influencing the Adoption and Intensity of Use of Fertilizer: The Case of Lume district, Central Ethiopia." Quarterly Journal of International Agriculture. 36: 173-187.

Yamano, T.Y., Kijima, Y.K. (2010). Market Access, Soil Fertility, and Income Market Access, Soil Fertility, and Income in East Africa in East Africa. GRIPS Discussion Paper 10-22. Tokyo, Japan: GRIPS Press, p. 29

Vanlauwe, B., Wendt, J., Giller, K.E., Corbeels, M., Gerard, B., Nolte, C. (2014). A fourth principle is required to define Conservation Agriculture in Sub-Saharan Africa: The appropriate use of fertilizer to enhance crop productivity. Field Crops Res. 155, 10-13.

Waithaka Michael M., Thornton Philip K., Shepherd Keith D. and Ndiwa Nicholas N., (2007) Factors affecting the use of fertilizers and manure by smallholders: the case of Vihiga, western Kenya. Kenya https://www.researchgate.net/publication/ 225716403

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

World Bank (2007). World Development Report 2008: Agriculture for Development. Washington, DC.

World Bank, (2011) the estimation of demand for fertilizer imports. Project performance assessment report. Ethiopia fertilizer support project under the Ethiopia emergency food crisis response program and the global food crisis response program

Zerfu, D., Larson, D. (2010). Incomplete markets and fertilizer use: evidence from Ethiopia. World Bank Policy Res. Work. Pap.

# APPENDIXES

## Appendix-1

### Questionnaire and Interview Questions

My name is Daniel Sineshaw, I am conducting a research entitled 'Factors affecting supply chain and demand of fertilizer in Ethiopia in partial fulfillment of the requirement for the award of Master of Arts Degree. This questionnaire is designed and given to you to collect data about your knowledge, attitude and beliefs about supply chain and demand of fertilizer practices. The information you provide is pertinent for successfully accomplishing the research.

Here, I promise you that your response will be kept absolutely confidential and used only for the consumptions of this paper. I really appreciate your genuine response for this questionnaire

**I. General Instruction**

- No need to write your name
- After carefully reading each Question, indicate your response by ticking the box which is relevant for you.
- To open-ended questions, please write your response on the space provided.

If you have any questions or enquiries; please contact via 0911997433 or danysine1@gmail.com.

Please use (√) mark

**II. GENERAL INFORMATION**

**1. GENDER**

1 = Male ☐ 2 = Female ☐

**2. AGE**

1 = Below 30 years ☐ 2 = 30 - 39 years ☐

3 = 40 - 49 years ☐ 4 = 50 year and above ☐

**3. EDUCATIONAL LEVEL**

1 = Illiterate ☐ 2 = 1-6 Grade ☐

3 = 7- 12 Grade ☐ 4 = Diploma and above ☐

## III. Factors Affecting Supply Chain of Fertilizer

This section aims at determining factors affecting supply chain of fertilizer in Ethiopia. Please indicate your agreement using the following likert scale by ticking (√) on each listed in the table below.

*Strongly disagree = 1, Disagree = 2, Neither Agree nor Disagree = 3, Agree = 4, Strongly Agree = 5*

| No | Variable | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1 | Do you agree that estimation of demand for fertilizer purchase is time taking process and a factor for the delay of fertilizer supply in Ethiopia? | | | | | |
| 2 | Do you agree that Process of order issuance is long process and a factor for the delay of fertilizer supply in Ethiopia? | | | | | |
| 3 | Do you agree that custom process and documentation is longtime taking process and consider it as a factor for the delay of fertilizer supply in Ethiopia? | | | | | |
| 4 | Do you agree that transportation is a factor for the delay of fertilizer supply in Ethiopia? | | | | | |
| 5 | Do you agree that there is lack of collaboration among the major participant of supply chain of fertilizer and consider it as a factor for the delay of fertilizer supply in Ethiopia? | | | | | |
| 6 | Do you agree that distance from the village to fertilizer market as critical factor for the delay of fertilizer supply in Ethiopia? | | | | | |
| 7 | Do you agree that storage facility as critical factor for the delay of fertilizer supply in Ethiopia? | | | | | |
| 8 | Do you think that supply chain of fertilizer in Ethiopia is not perform efficiently and effectively? | | | | | |

9. What other factors affecting supply chain of fertilizer.

_____

10. What is/are your suggestion to improve the supply chain of fertilizers in Ethiopia?

_____

## IV. Factors Affecting demand for Fertilizer in Ethiopia.

1. Total hectare of farm land……..
2. Number of House Holds ……..
3. How many oxen do you have…….
4. Do you use fertilizer? 1. Yes.....0. No.....
5. Have you taken fertilizer in the last cropping year? 1. Yes.....0. No.....
6. If your answer for question number 5 is yes, how many hectares did you applied fertilizer …….
7. If your answer for question number 5 is yes, how many kilograms did you use …….

| No | Items | Yes | No |
|---|---|---|---|
| 8. | Was the price of a fertilizer really affordable? | | |
| 9. | Have you got any agricultural credit last cropping year in the form of Fertilizer? | | |
| 10. | Did you get an advice from extension agents in the last cropping year? | | |
| 11. | Did you involved in off-farm activities in the last cropping year? | | |
| 12. | Was fertilizer delivered in the right quantity and in the right time in the last cropping year? | | |

***Thank For Your Time and Responses***

**Interview Questions for EABC (Ethiopian Agricultural Business Corporation)**

1. What is the role of your company in fertilizers supply chain in Ethiopia?
2. How your organization does select fertilizers supplier?
3. What are the main stakeholders involved in supply chain of fertilizers in Ethiopia?
4. What is/are your suggestion to improve the supply chain of fertilizers in Ethiopia?

**Interview Questions for ESLSE (Ethiopian Shipping and Logistics Services Enterprise)**

1. What is the role of your company in fertilizers supply chain in Ethiopia?
2. What is/are your suggestion to improve the supply chain of fertilizers in Ethiopia?

**Appendix-2 Questioner in Oromifa**

**SI'AANTI MEERII YUNIVERSIITII**

**KOLLEJII BIIZINESII FI IKkOONOMIKSII**

**MUUMME BARNOOTA DEVELOOPIMETAAL IKkOONOMIKSII**

Maqaan koo Daani'el Sinishaaw jedhama, ani Si'aanti Meerii yuniversiitiitti barataa developimentaal ikkoonomiksii yeroon ta'u Maastersii YKN Digrii lamataa argachuuf qoranno mata dureen isaa 'Factors affecting supply chain and demand of fertilizer in Ethiopia" jedhu irratti aanaa keessan keessatti raawwachuuf karoorfadheera. Qorannoo kanas geggeessuuf gaaffileen armaan gaditti qophaa'ani isiniif dgiyaatan odeefanno waliigalaa, yaadaa fi amantaa isin dhiyeessi fi barbaadamummaa xaa'oo irratti qabdan funaanuun qorachuuf kan oolu ta'a. Kanaafuu odeefannoon isin naaf kennitan galmaan ga'uu qorannoo koof iddoo guddaa qaba.

**Hubachiisa**: Deebiin isin naaf kennitan qoranno kana duwwaaf waan ooluuf yaada keessan hunda amanamummaa fi of eegannoo cimaan akkan itti fayadamu waadaan gala.

**Deedii fi yaada kennitaniif jalqaba galatoomaa!**

**V. Qajeelfama waliigalaa**

- Maqaa barreessuun hin barbaachisu
- Erga gaaffilee obsaan dubbistanii booda, deebii keessan saanduqa qophaa'e keessatti mallattoo (√) galchuun agarsiisaa.
- Gaaffiilee banaa ta'aniif bakka duwaa qophhan irratti yaada keessan barreessaa.

***Yaada fi gaaffi qabdan hundaaf; lakkoofsa Bilbilaa 09 11 99 74 33 ykn***

***E-mail=****danysine1@gmail.com.*

**VI. Odeefannoo waliigalaa**

**4. Saala**

1 = Dhiira ☐ 2 = Dhalaa ☐

**5. Umurii**

1 = waggaa 30 gadi ☐ 2 = waggaa 30 - 39 ☐

3 = waggaa 40 - 49 ☐ 4 = waggaa 50 ol ☐

**6. Sadarkaa barnootaa**

1 = kan hin baratne ☐ 2 = kutaa 1-6 ☐

3 = kutaa 7- 12 ☐ 4 = Diploomaa fi iaa ol ☐

## VII. Wantoota adeemsa dhiyyeessii xaa'oo gufachiisan

Kutaan Kun kan xiyyeefatu Itoophiyaa keessatti Wantoota adeemsa dhiyyeessii xaa'oo gufachiisan addaan baasee baruuf kan gargaaru dha. Yaada qabdan likert scale armaan gadii qophaa'e irratti mallatto (√) gochuun agarsiisaa

Gonkuma *walii hin galu = 1, walii hin galu = 2, yaada hin qabu = 3, waliin gala = 4, sirrittan walii gala = 5*

| Lakk | Gaaffilee | Likerti iskeelii | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 1 | Tilmaamni adeemsa gaaffii bittaa xaa'oo sassaabuu yeroo fudhata jettanii yaaduu, kunis ammo xaa'oo yeroon dhiyessuu dhabuuf sababa akka ta'e itti amantaa? | | | | | |
| 2 | Tamsaasni xaa'oo yeroo ni fudhataa, kunis ammo itoophiyaa kessatti xaa'oo yeroon dhiyessuu dhabuuf sababa akka ta'e itti amantaa? | | | | | |
| 3 | Adeemsi gumuruk fi dokumenteeshinii kan yeroo dheeraa fudhatu akka ta'ee fi kunis ammo xaa'oo yeroon dhiyessuu dhabuuf sababa akka ta'e itti amantaa? | | | | | |
| 4 | Geejjibni yeroon dhiyessuu dhabuu xaa'oof sababa ta'a jettee itti amantaa? | | | | | |
| 5 | Hirmaattota adeemsa xaa'oo dhiyeessuu keessatti rakkoon walii galtee ni mul'ata jettee yaaddaa? Kunis ammo xaa'oo yeroon dhiyeessuuf gufuu ta'a jettee ni yaaddaa? | | | | | |
| 6 | Fageenyi ganda keessanni fi bakki itti xaa'oon rabsamu gidduu jiru xaa'oo yeroon argachuu irratti sabab guddaa ta'a jettee ni yaaddaa? | | | | | |
| 7 | Dhiyeessiin xaa'oo itoophiyaa keessa jiru rakkoon mana kuusa xaa'oo yeroon dhiyeessuu irratti sababa to'a jettee amantaa? | | | | | |
| 8 | Adeemsi xaa'oo dhiyeessuu keessa darbu ga'insa fi seeraan hin dhiyaatu jettee ni yaaddaa? | | | | | |

9. Adeemsa xaa'oo dhiyeessuu keessa Rakkooleen jiran maalfaa ta'a jettee ni yaadda?

_____

10. Rakkooleen Adeemsa xaa'oo dhiyeessuu keessa jiran furuuf maaltu mala jettee yaadda?

## VIII.Rakkoolee fedhii xaa’oo itoophiyaa keessaa miidhan

13. Baay’ina lafa qotamuu hektaaraan meeqa qabdu ……..
14. Baay’ina abbaa warraa meeqa?……..
15. Sangaa meeqa qabdu?…….
16. Xaa’oo ni fayyadamtuu? 1. Eeyyee ☐ 2. Lakkii ☐
17. Bara oomishaa darbe xaa’oo fayyadamtaniittuu? 1. Eeyyee ☐ 2. Lakkii ☐
18. Deebiin gaaffii 5ffaa eeyyee yoo ta’e, hektaara meeqa irratti xaa’oo fayyadamtan? …….
19. Deebiin gaaffii 5ffaa eeyyee yoo ta’e, kiloograama meeqa xaa’oo fayyadamtan? …….

| ***Lakk*** | ***Gaaffilee*** | ***Eeyee*** | ***Lakkii*** |
|---|---|---|---|
| 20. | Gattiin xaa’oo ittiin argatan madaalawaa dha jettee yaaddaa? | | |
| 21. | Bara darbe liqaa qonnaa bifa xaa’oon argatan qabduu? | | |
| 22. | Bara darbe gorsa exteenshii qonnaa irraa argatan qabduu? | | |
| 23. | Bara darbe hojii qonnaan alaa hojjechuu irratti hirmaataniittuu? | | |
| 24. | Bara darbe xaa’oon amma barbaadanii fi yeroo barbaadanitii isin ga’eeraa? | | |

***Yeroo fi deebii kennitaniif Galatoom***

**Appendix-3: Test of regrations**

**Test of Multiple Regression Model for factors affecting supply chain of fertilizer**

**Test of multicoliniarity**

estat vif

| Variable | VIF | 1/VIF |
|---|---|---|
| dm | 2.81 | 0.356082 |
| poi | 1.38 | 0.722693 |
| cpd | 1.34 | 0.748193 |
| sf | 1.32 | 0.758535 |
| edp | 1.24 | 0.805147 |
| cs | 1.20 | 0.830890 |
| tp | 1.16 | 0.859430 |
| Mean VIF | 1.49 | |

**The Heteroscedasticity tests**

. estat hettest

| Breusch-Pagan / Cook-Weisberg test for heteroskedasticity |
|---|
| Ho: Constant variance |
| Variables: fitted values of SCP |
| chi2(1) = 19.79 |
| Prob > chi2 = 0.1583 |

ovtest

Ramsey RESET test using powers of the fitted values of scp
Ho: model has no omitted variables
F(3, 215) = 10.11
Prob > F = 0.1164

Shapiro-Wilk W test for normal data

| Variable | W | V | z | Prob>z |
|---|---|---|---|---|
| SCP | 0.99465 | 0.888 | -0.275 | 0.60824 |
| EDP | 0.98547 | 2.412 | 2.038 | 0.16077 |
| SF | 0.97923 | 3.448 | 2.866 | 0.16208 |
| CPD | 0.99211 | 1.309 | 0.624 | 0.26639 |
| TP | 0.98281 | 2.853 | 2.427 | 0.17762 |
| CS | 0.98370 | 2.706 | 2.305 | 0.16060 |
| DM | 0.99888 | 0.186 | -3.888 | 0.99995 |
| POI | 0.99906 | 0.156 | -4.308 | 0.99999 |

**Test of Multiple Regression Model for factors affecting demand for fertilizer**

Test of multicoliniarity

| Variable | VIF | 1/VIF |
|---|---|---|
| FZ | 3.27 | 0.306144 |
| NOX | 3.11 | 0.321305 |
| HZ | 1.47 | 0.682484 |
| AHH | 1.35 | 0.743325 |
| AES | 1.28 | 0.783792 |
| ODF | 1.13 | 0.883679 |
| ELH | 1.13 | 0.884322 |
| HHG | 1.12 | 0.896408 |
| OFI | 1.07 | 0.931994 |
| AC | 1.05 | 0.951092 |
| PF | 1.05 | 0.952321 |
| Mean VIF | 1.55 | |

**The Heteroscedasticity tests**

. estat hettest

| Breusch-Pagan / Cook-Weisberg test for heteroskedasticity |
|---|
| Ho: Constant variance |
| Variables: fitted values of qfa |
| chi2(1) = 15.33 |
| Prob > chi2 = 0.1621 |

estat ovtest

Ramsey RESET test using powers of the fitted values of qfa

Ho: model has no omitted variables

F(3, 192) = 2.30

Prob > F = 0.1783

Shapiro-Wilk W test for normal data

| Variable | W | V | z | Prob>z |
|---|---|---|---|---|
| qfa | 0.96213 | 5.822 | 4.060 | 0.18112 |
| pf | 0.96345 | 2.991 | 5.016 | 0.15060 |
| hhg | 0.97128 | 9.027 | 5.071 | 0.19520 |
| fz | 0.96683 | 5.099 | 3.755 | 0.19009 |
| ahh | 0.99513 | 0.749 | -0.667 | 0.74749 |
| elh | 0.99731 | 0.414 | -2.032 | 0.97890 |
| hz | 0.98902 | 1.688 | 1.207 | 0.12379 |
| ac | 0.96396 | 1.689 | 5.667 | 0.18401 |
| aes | 0.97053 | 4.531 | 3.482 | 0.17025 |
| ofi | 0.99654 | 0.532 | -1.456 | 0.92732 |
| nox | 0.98158 | 2.831 | 2.398 | 0.15823 |
| odf | 0.99703 | 0.456 | -1.809 | 0.96479 |

**Appendix- 4**

Fertilizers supply/import trend of Ethiopia per MT (2000-2018 G.C)

| Year | Total supply/imported |
|---|---|
| 2000 | 279,602 |
| 2001 | 232,270 |
| 2002 | 264,349 |
| 2003 | 322,942 |
| 2004 | 346,554 |
| 2005 | 375,717 |
| 2006 | 388,141 |
| 2007 | 404,756 |
| 2008 | 426,676 |
| 2009 | 553,885 |
| 2010 | 550,575 |
| 2011 | 571,000 |
| 2012 | 880,000 |
| 2013 | 477,000 |
| 2014 | 842,350 |
| 2015 | 889,985 |
| 2016 | 846,811 |
| 2017 | 936,430 |
| 2018 | 1,350,621 |

Source: EABC and Ministry of Agriculture