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DEPARTMENT OF ECONOMICS

Factor affects fertilizer demand for smallholder farmers in North Shoa of Oromia regional state: case of Grare Jarso woreda

A RESEARCH SUBMITED TO THE DEPARTMENT OF ECONOMICS, IN PARTIAL FULFILLMENT OF THE REQUIREMENT OF BA DEGREE IN ECONOMICS

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ID NO: 167/09

June, 2019

Wolkite, Ethiopia

DECLARATION

I, Elshaday declare that this thesis entitled: *“factore affect fertilizer demand in small hold farmer in case of Grare Jarso woreda”* is outcome of my own effort and study and that all sources of materials used for the study have been appropriately acknowledged.

To the best of my knowledge, this study has not been submitted for any degree in this University or any other University. It is offered for the partial fulfillment of the Bachelor degree in economics.

By: Elshaday Kifle

Signature---

Date--

ADVISORS' APPROVAL SHEET

This is to certify that the thesis entitled *"factor affect fertilizer demand in small hold farmer in case of Grare Jarso woreda"* submitted in partial fulfillment of the requirements for the Bachelor degree in Economics, of the Department of Economics, and has been carried out by Id. No 167/09, under my/our supervision. To the best of my knowledge, is an original work and not submitted earlier for any degree either at this University or any other University.

Therefore I recommend that the student has fulfilled the requirements and hence here by can submit the thesis to the department.

Advisor: Abebe Mengesha (MSc.)

Signature:____________________

Date: June 20, 2019

Acknowledgment

First and foremost, I would like to thanks the Almighty God with his mother St. merry for endowing me the endurance and courage of going through all ups and down to reach the stage where I am now.

Next, I am also highly indebted to my family who has been with me through my academic life in general finally; I would like to forward the deepest of my appreciation and gratitude to my advisor Abebe M. (MSC) for his comment, suggestion, and useful advice for me.

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List of ACRONYMS

ADLI	Agricultural development leads industry
AGE	Age of the house hold
APSM	Agricultural product system simulation model
CCF	Concentrated complete fertilizer
CIA	Central intelligence agency
CSA	Central statistical agency
DAP	Di-ammonium phosphate
DSM	Distance to the market
EDU	Education level of house hold
FMS	Farm size hold by house hold
FRE	Fertilizer expenditure
GC	Gorgerin calendar
GDP	Growth domestic product
ICI	Imperial chemical industries
ICR	Intelligent character recognition
IMF	International monitory fund
INC	Income of the house holds
MOA	Minister of agriculture

NFIA	Netherland foreign investment agency
NFPD	Niagara Falls police department
SM	Soil moisture
USAID	United states agency for international development

ABSTRACT

The main objective of the study was to identify factor affect smallholder farmer's fertilizer demand in Grare Jarso woreda. In the study both primary and secondary data were used to investigate factor which affects fertilizer demand of smallholder farmers. Primary data was collected from 99 sample respondents selected by using simple random sampling technique from the total household of the study area. Interview was used to collected different data from sample respondents in the study area. The gathered data was analyzed by using econometrics and descriptive method. Logistic regression was employed to show factors affect the demand of fertilizer in Grare Jarso woreda. Results show there is low demand of fertilizer. Depending on the result we recommend that government have to use incentive like low price, supply fertilizer in their area, good credit access to farmers.

Key words ; logit, fertilizer demand, Grare Jarso, Oromiya

CHAPTER ONE: INTRODUCTION

1.1 Background

Fertilizer is known to be a powerful productivity enhancing input. Indeed one-third of the increase in cereal production worldwide has been attributed to fertilizer related factors (FAO, 1999). In the same vein, Anderson (1976), argue that "fertilizers contributed 55-57% of the rise in average yield per hectare" (as cited in FAO, 1999). Also, practical experiences have shown that chemical fertilizer is one of the most reliable productivity enhancing inputs available to farmers (Onwuka, and Nwachuku, 2006). However despite the vital role plays by fertilizer in agricultural production, farmers in Africa still lag behind other areas in terms of fertilizer use compares to the recommended level

Agriculture continues to be a fundamental instrument for sustainable development, poverty reduction and enhanced food security in developing countries. It is a vital development tool to reduce people suffering from extreme poverty and hunger (WB, 2010). In Africa, agriculture is a strong option for spurring growth, overcoming poverty, and enhancing food security. Agricultural productivity growth is also vital for stimulating growth in other sectors of the economy. Thus, one of the fundamental ways of improving agricultural productivity is through the introduction and use of improved agricultural technologies (WB, 2010) such as fertilizer. Yet, the rate of increase in fertilizer use has been substantially lower in Africa. Agriculture in the Ethiopian economy prominently is the largest contributor to 46.6% of Gross Domestic Production (GDP), employs 85% of the population and is the main income-generating sector for the majority of the rural population. It also serves as the main source of food and generates 80% of the foreign exchange earnings. It provides raw materials for more than 70% of the country's industries (CIA, 2013).

Fertilizers increase agricultural production and productivity that could contribute to improved national food-self-sufficiency (Kefyale, 2015) .Food self-sufficiency constitutes the corner stone of current Ethiopian agricultural policy. Along this line, the long-term development strategy of Federal Democratic Government of Ethiopia is Agricultural Development-Led Industrialization (ADLI). This ADLI strategy envisages over the short to medium term that intensification of peasant agriculture is to occur in two interdependent stages, namely: altering drastically existing agricultural practices for both crop production and livestock management and increased use of natural fertilizer and the second one is increasing considerable the use of technological inputs like chemical fertilizers, improved seeds, pesticides and small scale irrigation (NFIA, 2007). Fertilizers as improved inputs are a product of innovation and thus play an important role in sustaining food availability and food security (Bellman analysis, 2016). However, as explained below the current level of fertilizer consumption in general and in particular is very low.

The vital role that fertilizer plays in increasing crop yield per unit area is well acknowledged both nationally and at farm level. An effective use of fertilizers is an essential factor for solving problems of food security (IMF 2014). Fertilizer consumption of the peasant sector has significantly increased over the past decades. However, various reports indicate that the rate of fertilizer use in the country is quite low for reasons that are not well known. The level of fertilizer use in the country is still very low, particularly in the smallholders' sector. Fertilizer consumption levels of smallholder farmers in Ethiopia are among the lowest in Africa (USAID 1999as cited in Bellman, 2015). But still the national levels of fertilizer consumption have tended to lag behind annual targets. In Oromia region currently the consumption of fertilizer increase at slow rate, but in our study area in North shewa zone specifically in Gerar Jarso the demand of farmers to fertilizer is low for the purpose of increasing productivity of crop. My motive to conduct this research is to know the reason of the problem and to set a way how to solve it. These problems are like low productivity due to lake of fertilizer and other technology, farmer's low understanding about use of fertilizer and many and other problem. Thus, the main objective of this study is to investigate factor affect the demand of fertilizer in smallholder farmers in Gerar Jarso woreda.

1.2 Statement of the Problem

Fertilizer is important to increase production of crop, vegetable and fruit. But most of the smallholder farmers have low habit to use fertilizer; especially farmers which are found in Gerar Jarso sub woreda usually have low demand and experience to use fertilizer like other back ward place. Due to this problem the productivity of crop is not increase through a time. In addition to this, different studies which are proposed in different place indicated that there are different constraint to restrict farmers demand to use fertilizer. But in Gerar Jarso woreda before up to now there is no study conducted about demand to fertilizer and crop productivity level by using fertilizer and study conducted in other woredas is not represent this woreda because of difference in number of population, level of income and whether condition . Therefore, to identify and fill the gap and to know farmers demand to inorganic fertilizer and to create awareness about the benefit of fertilizer. We add education because we expect that it is important variable which have higher effect on demand for fertilizer but other researcher not use this variable and also we add sample size to minimize the problem of multicollinerity and other researcher use OLS regression model we use logit regression model. Because of these reason we want to conduct the study in the area of Gerar Jarso and their surroundings.

Thus, the current opinion about the constraints and problems for the slow growth rate for fertilizer consumption differ considerably from place to place and the understanding about the problem is inadequate. So researcher assessed and find out cause of farmers low demand of fertilizer as well as what is solution behind this. The study would addressing the following central questions.

Research questions

- What are factors influencing farmer's household demand for fertilizer in the study area?
- What are the effects of fertilizer on productivity of agriculture in the study area?

1.3. Objectives of the Study

1.3.1. General objective

The general objective of the study was to examine factor affecting the demand of fertilizer in smallholder farmers in Gerar Jarso woreda.

1.3.2. Specific objectives of this study were:

- To examine factors influencing farm households demand for fertilizer in the study area.
- To examine the effect of fertilizer on productivity of agriculture in the study area.

1.6 Significance of the study

The significance of the study is that it can give knowledge and understanding of the matter at the land and productive by providing information in Gerar Jarso woreda concerning use of fertilizer and may also future perspective of agricultural sector in this area. This study was attempted to generate vital information suitable for making policy and guide line to formulate policies with respect to increasing fertilizer use among smallholder farmers. The study fills the existing knowledge gap. It also use as reference for other researcher

1.4 Scope of the study

The study area was limited to Gerar Jarso woreda North shewa zone, oromia region. The study was focused on factor affect fertilizer demand in smallholder farmers.

1.5 Limitation of the study

The study was limited only in this area due to financial problem and lack of access to other essential facilities required for the study. In addition to this in the study other constraints also that face in the collection of data which are relevant to our study. In collecting data, absence of relevant and specified secondary data in the study area had its own obstacle to analysis.

1.7 Organization of the study

The study is organized as follows፡-

In the first chapter there is the introduction part which contain background of the study, statement of the problem, objective of the study, scope of the study, significance of the study as well as limitation of the study were presented. In chapter two review of literature with its theoretical and empirical parts presented. In chapter three methodology of the study were also presented. In chapter four the result and discussion is presented and at last chapter five contains conclusion and recommendation.

CHAPTER TWO: LITERATURE REVIEWS

2.1 Overview

2.1.1. Fertilizer: Definition

Any substance that is added to soil to supply one or more plant nutrients and intended to increase plant growth is fertilizer (Robert, 2013). Fertilizers are substances, which are added to the soil to supplement the soil with those elements required in the nutrition of plants. That means, any material organic or inorganic, natural or synthetic, that furnishes to plants one or more of the chemical elements necessary for normal growth is fertilizer (Hubcap, 2012)

According to NFPD organic fertilizer means fertilizer derived from non-synthetic organic material, including sewage sludge, animal manures and plant residues produced through the process of drying, cooking, composting, chopping, grinding, fermenting or other methods and makes a declaration of nutrient value on the level. 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 (Cooke, 2010). . On the other hand, inorganic or mineral fertilizer means fertilizer produced by mineral processes or mined and derived from substance.

2.1.2 Origin and Development of Commercial Fertilizers

Archeological research has shown that man began the cultivation of crops about 10,000 to 12,000 years ago (Collings, 2011). The earliest records indicate that Egyptians, Romans Babylonians early Germans and Aryans had many manuals for farmers to improve the cultivation of crops. For instance, Colum Ella's treatise called "Husbandry" written in about 60 Gregorian Calendar (GC) contains descriptions of several agricultural practices, which were in use in the Roman Empire for many generations (Rao, 2012). The history of fertilizer has largely shaped political, economic and social circumstances in their traditional uses (Yara, 2018). In the 1730 viscount Charles (1674-1738) first studied the improving effects of the four crop rotation in Flanders (Aaron, 1984). Johann Friedrich Mayer (1719-1798) was the first to present to the world a series of experiments upon it the relation of gypsum to agriculture (Yara, 2018). Chemist Justus von Liebig (1803-1873) contributed greatly to the advancement in the understanding of plant nutrition by denounced first arguing the importance of anomia and promoting the importance of inorganic minerals. (Leigh, 2014).in 1837 Jhon Bennet Lowes an English entrepreneur began to experiment on the effects of various manures on plants growing and year or two year later the experiments were extended to crops in the field.in 1903 the Birkeland-eyde process was developed by Norwegian industrialist and scientist Kristian Birkeland along with his business partner Sam eyed based on a method used by henry Cavendish in 1784 (Rao 2012).the Nobel Pizar winning chemists carl Bosch of IG Farben and fritz Haber developed the Harbe process in 20^{th}c (classical, 2014). In 1927 Erling Johnson developed an industrial method for producing known as Odda process (classical, 2014). The English man James Fiser, Edward Packard, Tomas Hadfield and the prentice brothers each founded companies in the early 19^{th}c to create fertilizers. After world war first these businesses come under competitive pressure from naturally produced and their extraction and distribution had become economical (fisons, 2013). Intra war period 1923-1927 a more concentrated and economical fertilizer called CCF (concentrated complete fertilizer) is well known. After 1931 ICI ensure it controlled most of world supplies. Major plays in the production of fertilizer now include the Russian fertilizer company, Yara international and Astra Zeneca companies (history of Yara, 2018).

2.1.3 Economic Importance and Demand for 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, 2011). 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, chemical fertilizers are but one source of plant nutrients (Desai, 2011).As fertilizer production, distribution and consumption increase, backward and forward linkages create additional employment, which is extremely important in labour surplus countries (Mudahar, 2015).

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 (Subramanian and Nirmala, 2011).

That means fertilizer is one of the most critical inputs in farming. It can bring Profit from fertilizer use generally results from greater yield. For some crops, improvement in quality can make the use of more fertilizer profitable, but generally the pay-off comes from increased production per ha. The nature of this greater yield, known as the yield response is governed by the well-known principle of diminishing returns. But the knowledge of the maximum physical production range is needed to determine the most profitable use of fertilizer (Nelson, 2014). However, the continuous adoption and use of fertilizer depend mainly on its profitability and physical availability at the right time (Dillon and Sankhayan 2013). In general, fertilizer demand is dependent on various factors like weather condition, supply of the product, credit availability, input price, output price, knowledge and experience of the users.

2.1.4 Fertilizer Use in Ethiopia: Historical Perspectives

Ethiopia's agriculture and the paradox fundamentally historical requiring an exploration of standard as well as unconventional historical sources which is 200years of this study, its rural economy has fit the historically familiar model.

Until 2013, urea and DAP (di-ammonium phosphate) fertilizers have been the only fertilizer sources that have been in use in the Ethiopian agriculture for more than four decades. None of these are locally produced and should be supplied by imports to meet the demand (Akhilesh and yingrs, 2013. Mean fertilizer consumption in Ethiopia has risen from 132,522 MT (1995/96) to 858,825 MT (2014/15) period according to (CSA). 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). Going by the recommended usage dosages of for different crops, teef, wheat, maize and barley are the main consumers of fertilizers.

As the above data suggest, the major source of fertilizer sales in Ethiopia are urea and DAP since 1960s and there has been no change in composition of the use of fertilizers in Ethiopian agriculture until 2014/15 cropping season. The average share of urea in total use of fertilizers remains much lower than DAP; accounting for 15% of the total use of fertilizer in 1980-1999 while it was 35% between 2000-2015according to (CSA). 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. The unbalanced use of fertilizer in the sense of soil fertility (which is assessed according to the gap between recommended dose and type of fertilizer and its actual use in fields) became evident in recent years. The significant gap between the recommended dose and actual amount of fertilizer given to land is very high in case of urea. Due to unbalanced use of fertilizer; the loss in soil fertility is also significant in Ethiopia (MOA).

2.2 Theoretical literature

2.2.1Utility maximization theory

This theory assuming that farmers make adoption decisions based upon the objective of utility maximization, a farmer will adopt a technology when the utility of a new technology (Un) exceeds the utility of a traditional technology (Ut). And assume that this new technology is fertilizer. The utility derivable from a new technology is postulated to be a function of the vector of observed farm characteristics (e.g., farm size, distance to the market) and farmer characteristics (e.g., farm size, age of farmer), perceived technology characteristics (Xi) and a disturbance term having a zero mean.

Perceived technology characteristics themselves are a function of objective/or subjective characteristics of a technology, farm and farmer-specific characteristics. Farmers then weigh the consequences of adoption of a new technology against its economic, social, and technical feasibility and choose the technology (T) that promises higher utility than the traditional technology (Adesina and Zinnah, 2011). Suppose an individual household’s preference or utility of adopting a new technology, for a given vector of economic, social and physical factors (X), is denoted by UnðXÞ and the preference of adopting the traditional technology UtðXÞ; then the preference for adopting the new and old technologies can be defined as a linear relationship:

UnðXÞ ¼ XBn þ En ð1Þ

UtðXÞ ¼ XBt þ Et ð2Þ

Where Bn, Bt and En, Et are response coefficients and random disturbances associated with the adoption of new and traditional technologies, respectively. If the index of adoption is denoted by Y, it will take a value of one if the farmer is willing to adopt the new technology and zero otherwise. The probability that a given farmer will adopt the new technology can be expressed as a function of X as follows:

PðY ¼ 1Þ ¼ PðUn [UtÞ

¼ PðXBn þ En [XBt þ EtÞ

¼ P½XðBn _ BtÞ [Et _ En_

¼ PðXB[EÞ

¼ FðXBÞ ð3Þ

Where P is the probability function, B ¼ ðBn _ BtÞ a vector of unknown parameters that can be interpreted as the net influence of the vector of independent variables on adoption of the new technology, E ¼ ðEn _ EtÞ a random disturbance term and FðXBÞ is cumulative distribution function F evaluated at XB (Adesina and Zinnah, 2011).

2.2.2Production economic theory

In the approach presented here, use of the constrained profit-maximizing model in conjunction with a full specification of the production response to an added input provides valuable economic information to the decision maker. In this section the production economic theory is presented.

The traditional application of profit-maximizing behavior can be illustrated for a firm producing an output *y* which is sold at price *p*, and which purchases two inputs **X**1 and**X**2 at constant unit factor prices $\mathbf{W}_1$and $\mathbf{W}_2$ respectively (Silberberg, 2011). Assume that this firm is a farmer. The production process of the firm can be represented by the production function**,** $\mathbf{Y=}\boldsymbol{f}\mathbf{(X_1, X_2)}$.the objective function of the firm is profit (**π**), total revenue minus total cost. The assertion of this theory is that the firm maximizes the function:

$$\mathbf{\Pi=}\ \boldsymbol{pf(X_1\ X_2)}\quad W_1\ X_1\quad W_2\ X_2$$

2.2.3 Estimating crop responses theory

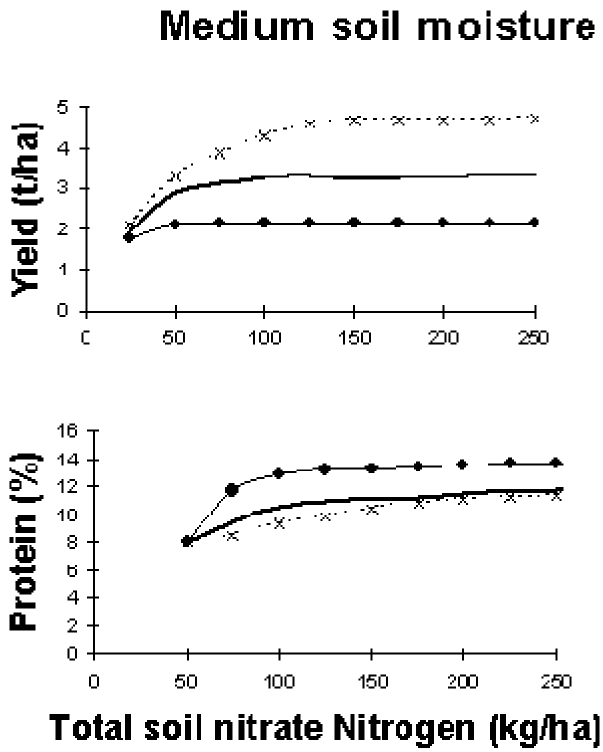
In this theory the case analyzed involves use of a crop simulation model to represent as example wheat crop responses to a single fertilizer input, N. In the case of wheat there are two crop outcomes, yield and protein, responding to the N crop input with other factors held constant. The example relates to N fertilizer use for wheat production on a Vertosol soil (Isbell, 2012) at Gunnedah in northern NSW (Farquharson 2014).

The agricultural product system simulator (APSIM) model Peter (2014) was used to simulate yield and protein responses as total soil nitrate N levels varied for a range of climate scenarios. APSIM[1] is a cropping systems simulator developed for use as an analytical tool for both research workers and grain growers in the grain cropping regions of Australia. The major factors affecting production addressed by this model are climate variability, soil water characteristics, soil N fertility, and variety phenology, planting time and planting density. APSIM is a relatively complex, daily-time-step model capable of simulating soil water and N dynamics in wheat production over relatively long time spans and under crop rotations with either fixed length fallows or opportunistic sowing rules. The model uses historical climate data to simulate growth according to user-defined sowing and management rules.

For this analysis, APSIM was configured to simulate a wheat crop where soil N fertility was reset at each sowing at predetermined levels to generate results according to an experimental design. The APSIM model was run with total nitrate N available to the crop set at levels varying from 25 to 250 kg/ha, to generate crop response functions. Ninety years of daily climatic data were input to APSIM to generate distributions of results for each input level.

Two climate variability issues were accounted for in this analysis, according to the experimental design using APSIM. These were the level of soil moisture (*SM*) at sowing and in-crop rainfall (*ICR*). Soil moisture was included by running APSIM (for each N level) with *SM* reset at typical levels for each 90-year simulation, so that a separate analysis was conducted for each *SM* level. Wheat growers in the northern cropping region of Australia can readily measure the level of *SM* at sowing and this is important information in the crop farming system to determine whether to sow a crop.

For each possible *SM* level, the 90 years of APSIM output provided a distribution of crop outcomes according to *ICR*. The effects of *ICR* were estimated by recording the 10^{th}, 50^{th}, and 90^{th} percentiles (termed 'very poor', 'average' and 'very good' in-crop climate outcomes) of the distribution of crop outcomes (yield and protein content) at harvest. The resulting production responses for one particular level of *SM* are shown in Figure 1.



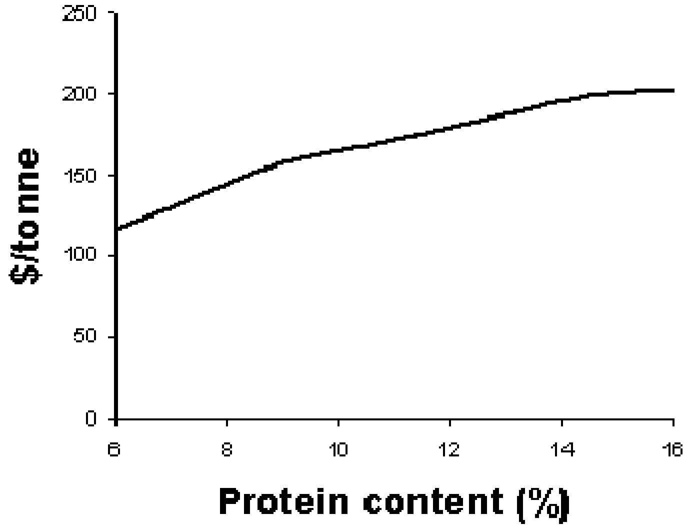
Source (farquharson, 2014)

Figure1. Predicted wheat crop responses to nitrate Nitrogen level, medium soil moisture for a Vertosol soil at Gunnedah very poor, average and very good in-crop conditions: circles, line and crosses respectively

In Figure 1 the horizontal axis represents different levels of total soil nitrate N at sowing. A medium *SM* case (124 mm of plant available soil moisture in the top metre of soil) is shown. Yield responses generally rise up to a plateau as N is increased. They also increase, and the onset of the plateau moves to the right, as climatic conditions (*ICR*) improve. In the particular district analyzed yield declines, or 'haying off', at high levels of N are not generally observed. Protein responses exhibit increasing trends with N, but protein is higher in drier than in wet seasons. For the economic analysis, the APSIM responses were smoothed with a Mitscherlich response function.

2.2.4 Enterprise profit and input demand functions theory

One way of considering the 'best' level of input according to the model objective is to use the profit functions for these N x climatic scenarios. Wheat prices depend on the protein content of the grain, an example is shown in Figure 2. Using these prices and the price of N ($1/kg) profit functions were developed as shown in Figure 3a. The flatness of economic response is quite evident



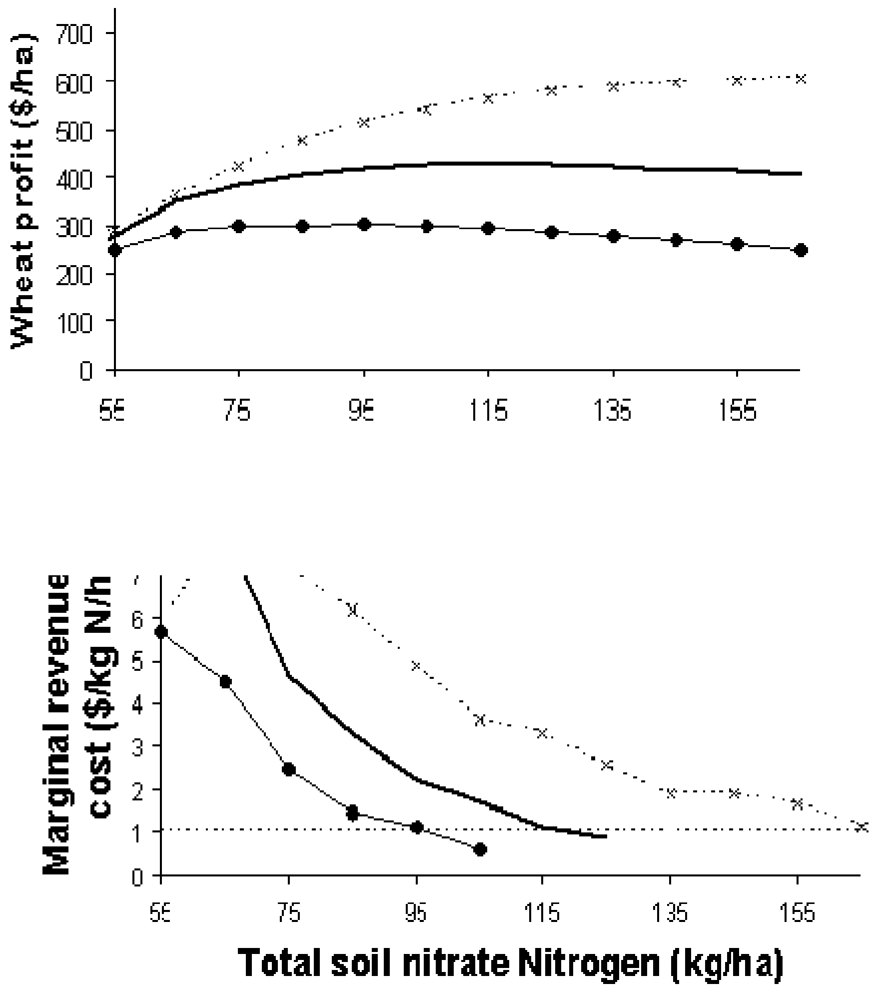
Source (panel, 2013)

Figure2. Wheat price according to protein content.

However, by considering the marginal conditions of the economic theory above, alternative information can be derived for the decision maker. Using the price schedule in Figure 2, the fertilizer input demand functions.

As expected, the demand for N used in wheat production for a particular soil type and location depends on the initial soil moisture, on the existing level of soil N, and on *ICR*. At the time of sowing, when the fertilizer decision is made, the grower can measure soil moisture and soil N level reasonably accurately and cheaply. These input demand functions show what a grower might be willing to pay for an extra unit of N given the expected wheat production responses. The flatness of economic response can be seen in these functions as they change slope near the marginal cost level.

From Figure 3b, the likely returns from investment in N inputs can be assessed. For medium soil moisture at sowing and a measured soil N level of 75 kg/ha, an extra kg/ha of N would earn $2.50, $4.60 and $7.10 for very poor, average and very good in-crop seasons. These are returns to investment of 150%, 360% and 610%, respectively. At lower (higher) levels of measured soil N the rates of return are correspondingly higher (lower).



Source (panel, 2013)

Figure3. Wheat profit responses and input demand for Nitrogen profit and marginal revenue for very poor, average and very good in-crop conditions: circles line and crosses respectively, marginal cost: dotted line.

2.3 Empirical Studies on Demand for Fertilizer

The review presented in this sub-section indicates the logical reasoning forwarded by different researchers about the demand for fertilizer and/or the adoption of fertilizer by farm households by embodying factors including socio-cultural, political, physical, environmental, and economic and nature of the technology in question. The following are empirical studies on the program from different countries.

Funk and Downey (1981) analyzed Indiana farmers, focusing on fertilizer product/service needs, buying behavior, attitudes, preferences of farmers, and the manner in which this information could be used to develop product, price, promotion, and distribution policies for manufacturers and dealers. One hundred fifty central Indiana farmers from 12 counties were surveyed. Major findings were as follows: local fertilizer dealers, other farmers, and family members are the most widely used influence groups; most dealer contacts are initiated by farmers, not fertilizer dealers.

Shakirulla (2006) studied the nature and extent of adoption of fertilizer among small, medium and large farmers in Union Council Palosi, District, and Peshawar. The results revealed that the fertilizers were used by 78.75 per cent of the farmers, while 2.25 per cent did not use them. Majority of the farmers (41.25 per cent) started using fertilizer 6-15 years ago for different pests. The per annum average cost of fertilizer purchase was significantly higher at 1 per cent level for large farmers than medium and small farmers. And when there land sizes increase the farmer use less fertilizer. This shows that the larger farms applied more fertilizer.

Liu Yu (2009) empirical study tested the major factors which affect fertilizer application amount using econometric models and micro-level data from Jianghan plain in Hubei province by year 2006. The results demonstrate that housemaster's education level, family's management scale, land fragmentation are major factors affecting farmer's decision-making process. When farmers have consciousness of scientific fertilization, higher agricultural labor proportion, farther land distance, longer production period could decrease fertilizer application amount. In the field of agricultural public policy, training for technical generalization is helpful in reducing fertilizer consumption. and government have to supply fertilizer in surrounding to farmers resident.

Marika Krausova and Afua Branoah Banful (2010), comment that knowledge of the characteristics and size of the agricultural input sector of a country is critical for policymakers to design appropriate interventions that not only foster growth in the sector, but also support the agricultural development goals of the country. In 2009, the International Food Policy Research

Institute and the International Fertilizer Development Center jointly conducted a census of agricultural input dealers in Ghana to fill a critical data gap on the nature of the country's agricultural input sector. This paper presents a detailed description of the sector's structure, market practices, and supply chain. It also assesses the sector's response to recently implemented fertilizer subsidies, and findings show that, despite the government's goal of making the subsidy program supportive of the private market, the majority of fertilizer retailers were excluded from participating. And they dell about the income and proportion of income farmers spent on fertilizer.

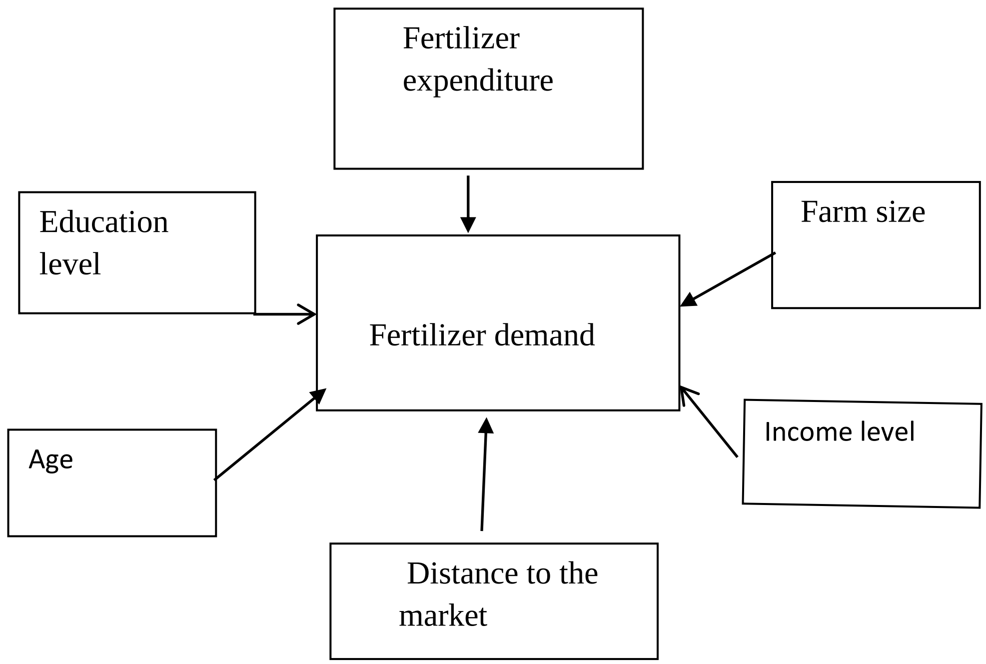
In Ethiopia studies like Lelissa (2012), reported that based on Mali and Burkina Faso case, sufficient rainfall, availability of subsidised credit for inorganic fertilizer, agro-ecological conditions, profitability, institutional environment, access to input market and liquidity and guaranteed

When measured in terms of quantity imported fertilizer use in Ethiopian has increased from 250000tons of product in 1995to 400000tons of products in 2011.The growth of total fertilizer consumption was More rapid than average for sub Saharan Africa over period (Crawford, 2010).

Higher price for crop production affect the adoption of improved technologies. He noted that the input-tied credit system and the delivery of inputs through village associations have led to the wide diffusion of new technologies including high levels of inorganic fertilizer. He further suggested that government policyholder should gear towards the ease of financial and input market constraints through the formation of rural financial institutions and the promotion of infrastructure investments**.** In summary, different studies conducted by different researchers using different Models were reviewed to see the influence of different socio-economic variables on farmers demand for fertilizer in different areas. From this review, we note that farm households' demand for fertilizer vary mainly due to farmers' difference in perceptions about benefits and risks associated to fertilizer use, variations in farmers' access to information, resource endowments and the socio-economic conditions of the farmers' in general. Therefore, undertaking studies on farm households' demand for fertilizer in different localities help the policy makers and other development workers to design and implement an appropriate policies to encourage the smallholder farmers' demand for fertilizer and to tackle (minimize) the impact of major socio-economic variable

2.3. Conceptual Framework

This conceptual frame work is telling as how independent variables like fertilizer expenditure, farm size, income level of farmer, and distance from the market, age and education level can determine the dependent variable fertilizer demand



Source: own computation (2019), determinant of fertilizer demand in small holder farmer.

CHAPTER THREE:-RESEARCH METHODOLOGY

3.1 Description of study area

This study was undertaken in Gerar Jarso woreda, found Oromia regional state located at the north showa zone. It is far away 115 km from Adiss Abeba city. The area was bordered in eastern by Amhara region, in western by Degem, northern by kuro kebele and in southern by Yaya Gulelena and Debrelibanos. The total population living in this sub woreda is, 67,312 of these 34,467 are males and 32,845 are females. None of its population was urban dwellers

The study area was categorized dega agro climatic zone and it accounts an elevation of about 1400-2782 above sea level. The total amount of land of the area was 2400 hect, from this farm land has 1100 hect, land covered by forest 60hect and grazing land 100 hect.

The major economic activity of the area is mixed farming system mainly crop production and livestock raring. The most commonly cultivated annual crop in the area is white 180 hectare, teef 600 hectare, vegetables 40 hectare and chickpea plantation 140 hectare and others.

3.2. Source of data

Different types of data were collected for this study through the use of various way of data collection for the achievement of the objective the study from different source. This study uses both primary and secondary data sources. The primary data was collected from sample of respondents. The secondary data was collected from experts (natural resource expert), books, statically reports and official documents.

3.3 Sampling procedure

The sampling technique plays a great role for accuracy and validity of information. The technique that used to select the sample in the study area is simple random sampling because it gives equal chance to the households selected as a sample, it is usually unbiased by researcher judgment. In order to gather data and other information’s relevant to the study easily and to draw representativeness.

3.4 Sample size

The size of the sample depends up on the precision desires and it is very simple to do and there is no single rule that can be used to determine sample size. But the larger sample is much more likely to be representative of the population. So in these cases, the total population of the study area is 67,312 from which 34,467 are males and 32,845 are females. From the total population there were about 7025 households. But the study only takes 99 households by using Yamane formula. From the total household presented in the study area as a sample by simple random sampling method. Sample size was limited to this in the study because of time and finance shortage.

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

$n=7025/1_{+7025(0.01)}$ =99.

3.5 Methods of data collection

Primary method of data collection was including collecting information through the use of experiment, questionnaire, interview and observation. In addition to this the secondary method of data collection involves gathering data from annual report, published and unpublished documents. But in the study interview was used to collect primary data from sample respondents. Because interview is important to collect data from literate and illiterate farmers. On the other hand secondary data were collected from the review of secondary source like books and internets were more important.

3.6 Methods of Data Analysis

For data analysis, researcher was use descriptive statistics and econometric model is important for the study. Descriptive statistics such as mean, standard deviation and the like used besides econometric model.by using logistic model.

3.6.1Descriptive Analysis

Descriptive analysis is used to reduce the data in to a summary format by tabulation and measure of central tendency. Moreover; variance was used to describe the general characteristics of farmers who have various habits to purchase fertilizer. Qualitative data that obtained from different method of data collection was presented by using frequency and tables. But quantitative data was presented in mean and standard deviation in the study.

3.7. Model specification

The study was tries to apply econometrics in order to analyze the functional relationship between farm household's demand for fertilizer and various factors that affect it. In order to analyze the correlates of farm household's demand for fertilizer a logistic regression model was employed with the dependent variable being the dichotomous of whether the farm household demand for fertilizer (1) and not demand (0). The explanatory variable considered (Age of the household, farm size, income, education level, distance to market, fertilizer expenditure).

Why we choose logit model than other model

We can use logit model when our dependent variable is dichotomous variable. We choose logit rather than other model because it is the most appropriate for the title with dichotomous dependent variable. The output of logit model is more informative than others. Propit model can also use for this title but according to Jone (2015) logit has the advantage of generating coefficients that can be transformed into the familiar odds ratio by exponentiating the coefficient. The liogit model not only gives a measure of how relevant a predictor is (coefficient size) but also its direction of association (Bernardo, 2017).

Logit model is appropriate when we assume the random components of response variables follow binomial distribution & when most variables have categorical responses. Put differently, it is suited when the dependent variable is dichotomous and of the type that have a yes or no response. The form of the Logit model following Gujarati (2004) is:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_k X_k + \varepsilon \quad .... (1)$$

$\beta_i X_1 \; run from \beta_1 X_{1t} to \beta_k X_K$

Where,

Ý = Probability of a household demand for fertilizer

α = Intercept (constant) term

β_k =Coefficients of the predictors estimated using the maximum likelihood method

X_i= Predictors (independent variables)

ε = Random effect (error term)

Aggregating the value yields

Ý = $\alpha + \sum_{k=1}^{k} \beta_k X_k + \varepsilon$ …………………………… (2)

In practice Y is unobserved, and ε is symmetrically distributed with zero mean and has cumulative distribution function (CDF) defined as F (ε). What we observe is a dummy variable y, a realization of a binomial process defined by

y= $\begin{Bmatrix} 1 if y > o \\ 0 othewise \end{Bmatrix}$ ……………… (3)

From equation (2) leaving the constant term and rewriting the model yields

Prob(Y=1) = Prob $\left(\sum_{k=1}^{k} \beta_k X_k + \varepsilon > 0 \right)$

= Prob $\left(\varepsilon > -\sum_{k=1}^{k} \beta_k X_k \right)$

$$= 1-F\left(-\sum_{k=1}^{k}\beta_k X_k\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \quad (4)$$

The Logit model usually takes two forms. It may be expressed in terms of Logit or in terms of event probability. When expressed in Logit form, the model is specified as

$$\text{Log}\left[\frac{P(y=1)}{1-P(y=1)}\right]=\sum_{K=1}^{K}\beta_K X_K \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

Using equation 4 and 5 can be transformed into a specification of the Logit model of event probability by replacing the general CDF, F, with a specific CDF, L representing the Logistic distribution

$$\Pr ob(y=1)=1-L\left[\sum_{k=1}^{k}\beta_k X_k\right]=L\left[\sum_{k=1}^{k}\beta_k X_k\right]=\frac{e^{\sum_{k=1}^{k}\beta_k X_k}}{1+e^{\sum_{k=1}^{k}\beta_k X_K}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

The above equation represents the probability of an event occurring. For a non-event, the probability is just 1 minus the event probability.

$$\Pr ob(y=0)=\left[-\sum_{k=1}^{k}\beta_k X_k\right]=L\left[\sum_{k=1}^{k}\beta_k X_k\right]=\frac{e^{-\sum_{k=1}^{k}\beta_k X_k}}{1+e^{-\sum_{k=1}^{k}\beta_k X_k}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

On the light of the above explanation, we can develop our household fertilizer demand as follows

UP=*f* (AGE, FMS, INC, EDU, FRE, DSM,)

The list of variables with their definition is given below

AGE= age of the house hold

FMS=farm size hold by house hold

INC=income of the household

EDU=education level of household

FRE=fertilizer expenditure

DSM=distance to the market

Description of Explanatory Variables

Age of household (AGE):-

It refers to the number of years since the time of birth that the house hold has completed at a time of survey. Older farmer are reject new technologies. That means they are more reluctant to use new technologies. On contrary, younger farmers are often expected to be more knowledgeable about new event and likely to bear risk due to their longer plan horizon. They are eager to assess the advantage associated with new technology (Mdahar 2015).there for it hypothesized age of house hold increased would have a negative impact on farmers demand for fertilizer.

Farm size (FMS)

Ii refers to the total land holding of the house hold. What is more important is that farmer with large farm size has better chance to earn more income that in turn enable him/ her to purchased fertilizer. In other word, farmer with large farm size is relatively wealthier that farmers with small size. According to Ellis(2015) the larger farm area implies more resources and greater capacity to invest in farmland, purchase inputs like fertilizer, improved seeds and the like as well as it increase readiness to take risk. But according to area l studied farmer perceptions about their large land holding were low demand of fertilizer because their perceptions is large land produce large agricultural productions. Hence variables hypothesized to have negative relationship with demand of fertilizer.

Income of the household (INC)

It refers to the total amounts of money that the farmer earns from on farm income activities annually. It is the sum of current market value of output obtained from crop production, income from the sales of livestock and it's by product income from sales of chat plant. Therefore, it is hypothesized that there is positive relationship between total on farm income and Farmer demand for fertilizer.

Education level of household (EDU)

It refers to the education level of the farmers. Uneducated farmer are reject new technologies on other hand if the farmers are educated the acceptance level of new technology will be high.so, it hypothesize education level of household increase will have positive effect impact on farmer demand for fertilizer.

Fertilizer expenditure (FRE)

This refers the total payments to purchase fertilizer in the cropping season. When fertilizer expenditure increases because of high demand, small holder farmers demand to fertilizer increase and vice versa. It is hypothesized that this variables has positive influence on demand for fertilizer.

Distance from Farmers Residence to Fertilizer Marketing Center (DSM)

This refers that the closer the farmer residence to market center, the more he/she is exposed to information about the cost and benefits of the technology under the study. Again the longer the distance is, the farmer spend more of their time on fertilizer purchasing and this in turn share more time of agricultural activities (lelisa, 2008)More over the farmers boring to go far distance to purchase fertilizer. Slit is hypothesized that this variable affected farmers demand for fertilizer negatively.

Table3.1The expected sign and magnitude of explanatory variables

Variables	Short form of variable name	Expected sign	Category of the variables
Age of household	AGE	−ve	Continues
Farm size	FMS	−ve	Continues
Income of household	INC	+ve	Continues
Education level of household	EDU	+ve	Dummy
Fertilizer expenditure	FRE	+ve	Continues
Distance to the market	DSM	–ve	Continues

3.8 Some testing tools

Multicollinearity

One of the assumptions of the classical linear regression model (CLRM)is that there is no Multicolinerity among the repressor's included in the regression model. The term Multicolinerity refers to the situation where there is either an exact or an approximately exact linear relationship among the x variables. The variance inflation factor (VIF)is the test of Multi colinearity. Some authors therefore use the VIF as an indicator of Multicolinerity. As a rule of thumb the larges the value of VIF or if the value of the variable exceed 10 the more will be the degree of linearity of the variable with the other repressor. On the other hand if the VIF is less than 10 the greater the evidence that variable is not collinear with other repressor (Gujarati, 2004).

Hetrocedasticity test.

When the problem of hetrocedasticity exists in the model, the variance the dependent variable (Y) and the variance of the residual term (Ui) of the model is not uniform (not constant). The major sources of hetrocedasticity are model misspecification bias, omission of the relevant variables from the model and the wrong mathematical form of the model. If this problem exists in the model our conclusion would be misleading. Therefore, the researcher was employed the brush-pagan test to detect the problem. Accordingly, in the B. pagan test the prob (chi2) have to be greater than level of significance (5%)to say the model is free from the problem of hetrocedasticity. (Gujarati, 2004)

Odd ratio test

Odd ratio test is the major test for logistic regression model. It’s because in this model we didn’t interpret the coefficient directly like other models. Odd ratio shows the change in odd for every unit increase predicted variable.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introductions

This chapter summarizes the major findings of the study. Both descriptive statistics and econometrics analysis were used to analyze the primary and secondary data. Descriptive statistics were employed to describe information about current situation of factors that affect Fertilizer demand and their different socio-economic status such as income, age, and farm size. Econometrics analysis was used to identify the factors affect fertilizer demand in small hold farmers. Fertilizer is expected to improve productivity in the short run and in the long term economic and social security of their household via wealth creation, increasing of income and the others. To understand those, the data is collected by direct contribution of questionnaires and interview to those empower in small hold farmers as well as secondary data available to achieve with general and specific objective.

4.2 DESCRIPTIVE ANALYSIS

4.2.1 Household Characteristics

Sex and marital status of Household Heads

Of the total 99 sample respondents, female farmers accounted for only 15 while the rest of 84 were male farmers. From this 76.66percent of farmers were married but the rest of 23.33 percent farmers were unmarried.

Table 4.1 sex and marital status of sample respondents

	Characteristic	Frequency	Percent
Sex of the AHH head	Female	15	15.15
	Male	84	84.85
	Total	99	100
marital status of the AHH head	Married	75	75.76
	Unmarried	24	24.24
	total	99	100

Source, sample survey 2011E.C

4.2.2 Farm Characteristics

Age the household heads

The average age of the sample farmers was 44 years. The age of the sample respondents taken by simple random sampling ranges from 24 to 78 years. In addition to this the age of sample respondent's standard deviation was 16 year. What we consider from this is more population in in Grare Jarso woreda is young. It implies that farmers are in working age.

Farm size

As indicated in table (2) the average farm size of 99 sample respondents' taken randomly were 3.37 hect. In the study area sample respondents' have minimum farm size 0.5 hect. And maximum sample responders have 14 hect. According to the data collected the farm land distribution is not equitable in sample respondents. In the study area standard deviation of sample respondents farm size was 2.42 hect. From this data we see that there is high deference land size between farmers but highly farmers have small size of land. When the land owners have large land size they loss control over it and their willingness to use fertilizer is decrease.

Fertilizer expenditure

As indicated in the table(2) ,respondents reported in the study area their expenditure to purchase common type of fertilizers like DAP and UREA for a hectare ranges (300-7800) br. Due to the increase of fertilizer price respondents' didn't purchase large amount fertilizer through a time. In which different data collected from 99 sample respondent signifies that the mean and standards deviation of fertilizer expenditure was 1528.33 and 980.02 respectively.

Education level

It refers to the education level of the farmers. Uneducated farmer are reject new technologies on other hand if the farmers are educated the acceptance level of new technology will be high.so, fertilizer is one of new technology its effectiveness and willingness to use is highly affected by education level of the user. From the respondent 38 respondent are educated and 61 of respondents are not. Its standard deviation is 0.4862.with maximum value 1 and minimum value 0. From this data we can see that more farmers in sample area are not educated so to increase the use of technology like fertilizer we have to increase the level of education.

Income of household

Crop and livestock production are the major sources of income for sample respondents in the study. In the study, the average total on farm income of respondents' was 6087.44 br annually. Sample farmers income ranges from 1900-20500 br and its standard deviation 3194.95 br. Farmers taken as respondent in the study reported that the total on farm income gets from the sale of crop livestock and livestock product was very low because of lack of quality and consumer preference, (based on table, 2)

The survey conducted in the study area revealed that of majority of people received income from on farm activities and other part people would get income from non on farm activities (off farm activities). As respondents revealed off farm income was got from trade and others off-farm activities like working as daily laborer's on the field of others by migrating to other areas.

Distance from Farmers Residence to Fertilizer Marketing Center

As sample respondents revealed that distance from farmer's residence to marketing center have great effect on farmers demand to fertilizer when road infrastructure is not adequate, transportation cost is high. The average distance from farmers' residence to marketing center was 4.86 km. According to the survey in the study area the minimum and maximum distance from farmer residence to fertilizers marketing center were 0.5 km and 60km respectively. In addition to this the standard deviation of distance from farmer residence to marketing center was 7.4 km. what we can see from this is distance of fertilizer market is not the seam which means in some areas it good in some areas its very far so government have to distribute market efficiently.

	Number	Minimum	Maximum	Mean	Std Deviation
AGE	99	24	78	44.75	12.72
FMS	99	0.5	14	3.37	2.42
INC	99	19000	20500	6087.44	3194.95
EDU	99	0	1	0.3737	0.486
FRE	99	300	7800	1891.82	1674.67
DSM	99	0.5	60	4.8	7.4

Table 4.2 descriptive statics for continuous variable through the use of sample respondents

Source, survey 2011 E.C

4.2.3 Challenge in fertilizer distribution

As sample respondents reported in the study area there are various problems in the distribution of fertilizer in to in farmers' residence. Some of problem face on smallholder farmers is like absence of road infrastructure, transportation service lack car, lorry and other transport service.

Most of respondent in the study explained the major constraint in the distribution of fertilizer the geographical location of the study area the price of fertilizer is also other problem in

Supply of fertilizer: As respondents in the study area reported sometimes shortage of fertilizer supply happened. The data collected in the study were indicated that shortage of fertilizer in the cropping season especially occurs in June and July and August.

4.3 Econometrics analysis

In econometric analysis we use logistic regression model accordingly, this study has carried out: odd ratio test, Marginal effect, Classification tests.

Table 4.3: logit regression model result

FDD	Coef.	Std.err	Z	p>z	[95% conf. interval]	
AGE	-0314731	.0610178	-0.52	0.606	-.1510659	.0881197
FMS	-1.527281	.6425987	-2.38	0.017	-2.786755	-.2678147
INC	.0018406	.0006922	2.66	0.008	.0004839	.0031972
EDU	1.010649	2.796657	0.36	0.718	-4.470669	6.491996
FRE	.004227	.0015024	2.81	0.005	.0012824	.0071716
DSM	-.1894559	.3382602	-0.56	0.575	-.8524337	.4735219
_cons	-9.345022	4.347998	-2.15	0.032	-17.86697	-.8231023
Prob> chi2	0.000000					
Pseudo R^2	0.8482					

As we can understand from this regression table age farmer (AGE), farm size (FMS) and distance from Residence to Fertilizer Marketing Center (DSM) have negative effect on demand for fertilizer. On-Farm Income (INC), education level (EDU) and fertilizer expenditure (FRE) has negative effect on demand for fertilizer.

The regression result of the model shows that the study is over all statistically significant at

95% confidence level and 5% margin error indicated by the p-value (i.e. prob>chi2= 0.0000<0.05).

Even though the model as a whole is statistically significant not all variables, are independently statistically significant. According to the result farm size (FMS),at 0.17 income (INC) at 0.008 and fertilizer expenditure (FRE) at 0.005 are statistically significant at 95% of level of significance because their Respective p value (p>lzl) are less than five percent (that is p>lzl<0.05). But age (AGE), at 0.606 educations (EDU) at 0.718 and distance from the market (DSM) at 0.575 are statistically insignificant because their p values are greater than 5% at 95% level of significant.

4.3.1 Odd ratio result

Table 4.4 Logistic regression of odd ratio result

FDD	Odd ratio	Std.err	Z	p>z	[95% conf. interval]	
AGE	.969017	.0591273	-0.52	0.606	.8597911	1.092119
FMS	.2171244	.1395238	-2.38	0.017	.0616208	.7650495
INC	1.001842	.0006834	2.66	0.008	1.000484	1.003202
EDU	2.747383	7.683488	0.36	0.718	.0114393	659.8394
FRE	1.004236	.0015087	2.81	0.005	1.001283	1.007197
DSM	.8274092	.2798796	-0.56	0.575	.426376	1.605639
_cons	.0000874	.00038	-2.15	0.032	1.74e-08	.4390674
Prob.> chi2	0.000					
Pseudo R^2	0.8482					

If farmers fertilizer expenditure increases, then the log of odd ratio in favor of willingness to demand fertilizer increase by 1.0042 units, significant at the level of significant 5% level of significance , p>lzl=0.005 citrus paribus. The positive relationship can be explained by the factor that as fertilizer expenditure become more and more positive, the probability of farmers demand for fertilizer increases.as other researchers Marika and Afua Branoan (2010) of international fertilizer development center researcher says that as the proportion of income farmer spent to buy fertilizer the demand for fertilizer also increase. This means there is positive relation between fertilizer expenditure and fertilizer demand. This result sports our result which shows positive relation.

If income of farmer increase, then the log of odd ratio in favor of willing to demand fertilizer increases by 1.0018 unit, significant at 1% level significance, p>lzl=0.008 citrus paribus. The positive relationship of the variables by the factor can be explained as the income of the farmer increase the probability of the farmer to demand fertilizer increases. As Marika and Afua Branoan (2010) and Lelissa (2011) report say one of the main problems of farmers in developing countries to adopt new technology like fertilizer is financial problem. They suggest that to solve this problem government have to raise on-farm income. Increase of income of farmer leads to increase demand for fertilize. Income and fertilizer demand are positively related as our result shows.

If farm size is increased, then the log of odd ratio in favor of willing to buy fertilizer decreases by 0.21 units, significant at 1% level of significance, p>lzl=0.017 citrus paribus. The negative relationship explained by the farm size increase their willingness to by fertilizer is decrease because of human capital didn't utilizing all recourse effectively. As study's done Shakirulla (2006) in union council Palasi distinct and Firaol (2011) says farmer with small farm land use fertilizer more than who have large farm land. farmer who have large size land can't control their land because of lace of labor force, when farmer have large land size they compare them self to those which have small land they think they get enough income when they compere to small land size and there interest of using technology like fertilizer decreases. This researchers result support our result negative relation between fertilizer demand and farm size

If education level increases the log odd ratio of willingness to demand fertilizer increase by 2.74 unit, education is insignificant at 5% level of significant ,p>lzl=0.718. The positive relation explained by when education level of farmer increase their demand for fertilizer also increase. Even if our literatures didn't use education as there variable it is very important variable which can be supported by other theories and we can see the effect of education in our day to day activities. Educated peoples have much ability and willingness to accept and use new technology and can be effective easily. It's the same when we came to fertilize and other technology adoption in rural areas educated farmer have high demand for fertilize compared to uneducated farmers.

If age increases the log odd ratio of willingness to demand fertilizer decrease by 0.96 unit, age is insignificant at 5% level of significant, p>lzl=0.606. The negative relation explained by, age of farmer increase their demand for fertilizer decrease. Many researchers like Liu Yu,(2009), Funk and Duwney (1981), Lelissa (2011) says age have negative relation with fertilizer demand. When age increases the ability of farmers to accept technology decreases because old farmer in developing countries are mostly uneducated and they afraid to take risks than young farmers.

If distance of fertilizer market from farmers resident increase the odd ratio of willingness to demand decrease by 0.82 unit, distance is insignificant at 5% level of significance, p>lzl= 0.575. the negative relation explained by, distance from market. Researchers like Liu Yu (2009) stated that government have to supply fertilizer surrounding to farmers resident. This shows farmers if the market far from farmers living area it have negative effect on fertilizer demand. this shows our result which show negative relation between fertilizer demand and distance of fertilizer market from farmer resident is effective.

Table4.5 Comparison of the model results and expected result

Variable	Expected sign	Result Sign
AGE	- ve	-ve
FMS	-ve	-ve
INC	+ve	+ve
EDU	+ve	+ve
FRE	+ve	+ve
DSM	-ve	-ve

4.3.2 Marginal effect result

Table 4.6 result of marginal effect

Pr(FDD) Y=0.94012619							
Variable	dy/dx	Std. err	Z	p>z	[95% c.r.]		X
AGE	-.0017716	.00407	-0.44	0.663	-.009749	.006206	44.7576
FMS	-.0859692	.11057	-0.78	0.437	-.302678	.13074	3.37121
INC	.0001036	.00013	0.77	0.443	-.000161	.000368	6087.44
EDU	.0.0523032	.14621	0.36	0.721	-.234263	.33887	.3737373
FRE	.0002379	.0003	0.80	0.423	-.000344	.00082	1891.82
DSM	-.0106643	.03071	-0.35	0.728	-.07785	.049521	4.86869

If farmers have high income, then the probability of to demand fertilizer increases by0.01%, significant at 5% level of significance, citreous paribus. Income has a positive marginal effect, showing increase in income have positive impact towards fertilizer demand

If farm size is get larger, then the probability of demand for fertilizer decreases by 8.5%, statistically significant at 5% level of significance, citreous paribus. Farm size has a negative effect on fertilizer demand showing that as the farm size increase the probability of demand for fertilizer decreases.

If farmers fertilizer expenditure increase, then the probability of to demand fertilizer increases by0.023%, which is statistically significant at the 5% level of significance citreous paribus. Fertilizer expenditure has a positive marginal effect, showing increase in fertilizer expenditure have positive impact towards fertilizer demand

When farmers age increase the probability to demand fertilizer decrease by 0.17%, age is statistically insignificant at the 5% level of significant. age has a negative marginal effect, showing increase in age have positive impact on fertilizer demand.

If farmers level of education increase the probability to demand fertilizer increase by 5.2%, which is statistically insignificant at 5% level of significance. Education level has a positive marginal effect which shows increases in level of education have positive impact on fertilizer demand.

If the distance of fertilizer market from farmers resident increase the probability to demand fertilizer decrease by 10%, which is statistically insignificant at 5% level of significance. Of fertilizer market from farmers resident has negative marginal effect, which shows increase distance have negative impact on fertilizer demand.

4.3.3 Test for good fitness and Classification

The model of the study was good fitness because the prob >ch2 is greater than 5% level of significance which is 0.9315.In the study ch2 indicates the amount how much the independent variable explain the dependent variable jointly. In the study pesudo R^2 was 0.84 and it refers that 84.8 % change in fertilizer demand was due to change of independent variable and 15.6%change of fertilizer demand was due to other factors than the independent variable which is error term. So the model fit the good fitness. In classification we have the true prediction and false prediction. Our data is correctly classified by 95.96% which means high correct prediction.

4.4 Diagnostic tests

4.4.1 Test for Multicollinarity

Before running the Logit, the hypothesized explanatory variables were tested for the existence of multicollinearity problem that is the situation where the explanatory variables are highly intercorelated (Maddala, 1983). The term multicollinarity refers to the existence of perfect or exact linear relationship among some or all explanatory variables. If the explanatory variables are multicollinear, although BLUE, the OLS estimator have large variances and covariance's making precise estimation difficult. Because of this the confidence intervals tend to be much wider leading to the acceptance of the "zero null hypothesis" (i.e. the true population coefficient is zero) more readily, which in turn leads to conclude significant variables as insignificant. Hence to detect multicollinarity problem the variance inflation factor (VIF) or the detection tolerance for multicollinarity test is employed.

Table 4.7 VIF result

variable	VIF	1/VIF
FS	8.98	0.1111372
FER	6.62	0.150965
AGE	3.84	0.260417
LS	2.97	0.336288
EDU	1.73	0.576898
IRRG	1.11	0.903983
Mean	4.21	

if the result of the test is less than 10 there is no multicollinerity problem but if the result is greater than 10 there is multicollinerity problem. As we see the result of vif is less than 10 which means there is no serious multicollinerity problem.

And also we can test correlation by using corr. If the result is less than 0.8 there is no high correlation problem between variables and if the value is greater than 0.8 there is correlation problem the solution for this is transformation.in the result there is correlation problem between fertilizer expenditure (FRE) and on-farm income and we solve the problem by transforming.

4.4.2 Test for Heterocekedasticy

When heteroskedasticy assumption is violated, the variance of the estimates of OLS is no longer minimum (it becomes larger). This makes the acceptance region of hypothesis testing wider than what it should be, making some explanatory variables insignificant while they are actually significant. Therefore, hypothesis testing with heterocekedastic error terms will be misleading although the estimates are linear and unbiased. The test result is as follows.

hettest

Breusch-Pagan / Cook-Weisberg test for heterocekedasticity

Ho: Constant variance

Variables: fitted values of FDD

chi2(1) = 2.13

Prob > chi2 = 0.1449

Depending on the test result we fail to reject Ho which says constant variance or homoscedasticity at 1%, 5% and 10% level of significance implying that there is no hetroskedasticity problem in the model. We fail to reject Ho because prob> chi^2 = 0.1449, which is greater than all level of significance.

CHAPTER FIVE: - CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The major objective of the study was to analyses factor affect fertilizer demand in small hold farmers in case of Grare Jarso woreda.

To achieve the stated objective of the study both descriptive and econometric analysis was employed. From the descriptive and econometric analysis results there are various factors which affect smallholder farmer fertilizer demand in the study area. Some of the variables which have effect on farmers demand to fertilizer like are total on farm income, age of house hold, farm size of farmers land , fertilizer expenditure, education level of farmer, distance from the market other variables. Before making an econometric estimation the variable were tested by using different testing method

Before testing logit model test diagnostic tests like multicolinerity and hertrocedactiy. When we test multicollinerity to say there is no colinearity problem the result has to be less than 10, our model fit this criteria. When we test hetrocedactiy to soy there is no problem our result has to be greater than 5% level of significant, our model shows 14% level of significant which is greater than 5%. Then we regress by using logit model from this test we get 0.8482 pusido R^2.three variable FMS, FRE, INC is statistically significant at 5% level of significance, AGE, EDU, DSM are statistically insignificant at 5% level of significance. In case we didn't interpret the coefficients directly in logit model then we tests odd ratio of logistic regression model to interpret the result. Odd ratio shows the change in odd for every unit increase predicted variable. Variables FMS, AGE, DSM have negative effect FRE, EDU and INC has positive effect. Lastly we run marginal effect and classification testes. Marginal effect shows the probability of increase or decrease in fertilizer demand when the dependent variable increase by 1 unit. Classification tests the true and false prediction of the data. Our data is correctly classified by 95.96% which means high correct prediction.

Total on farm income get from crop, and livestock sale have positive impact and it is significant. Income has major impact on farmers demand to use fertilizer. Farmers get high income from crop, and livestock sale; have great demand to use fertilizer and other agricultural technologies than farmer which have low income. But, on the other hand when fertilizer expenditure increases because of high price, farmers demand to use fertilizer was directly decline.

Distance from fertilize market have a negative effect As the study indicate either closer or far from the marketing center of fertilizer had effect on smallholder farmers demand to fertilizer. Because when the market is far transportation problem comes as we know rural areas infrastructure is low so rods and other transportation mechanisms are low and costly so, farmer prefer not to buy or to buy small amount of fertilizer.

Age of house hold is also effect on demand of fertilizer as the study indicate, because old farmers would reject more use ability of fertilizer. They are more likely to reject the new technology by assuming that training is as much as difficult and worried of low yield as well as large land holding farmers not sure about new technology they said that it yield loss due to large technology is larger field. In contrary younger farmers was more knowledgeable about use and importance of fertilizer and new technology’s in crop production.

The farm sizes of farmer also have negative effect on fertilizer demand. when the farm land get larger This situation occur when smallholder farmers thinks when farm size increase the product get from that farm land also increase. As that time their feeling to use fertilizer is low, because they assume the product is increase only as the farm size increase. But when their farm size is small, their demand to use fertilizer is increase to increase the product get from the farm land. Because farmers assume the product get from small farm size is small, during this time farmers demand to use fertilizer is increase to get more product. The other case in which smallholder farmer demand to fertilizer decrease, as farm size increase when farmers didn’t have enough money to purchase appropriate amount of fertilizer for that farm size

Fertilizer expenditure is positively related to fertilizer expenditure an increase this refers the total payments to purchase fertilizer in the cropping season. When fertilizer expenditure increases because of high demand, small holder farmers demand to fertilizer increase and vice versa. It is hypothesized that this variables has positive influence on demand for fertilizer.

Education have positive effect and insignificant. Farmer witch have access to education accept new technology like fertilizer than farmer not educated

5.2 RECOMMENDATION

As the study show there are various problems which affect fertilizer demand of smallholder farmers to increase the production of crops. So, to reduce this problem the following were important:

Fertilizer price subsidy: This should be very important to increase fertilizer demand of farmers because when there is fertilizer price subsidy, farmer's willingness to purchase fertilizer also increase in high rate. As the data indicated in the study area the severe factor to limit farmers demand to use fertilizer was its high price. So price subsidy was important for the study area to increase low demand of fertilizer in smallholder farmers.

Encourage farmers to produce more exportable goods: production of exportable crop helps farmers to resist the increase in price when the price is high to purchase enough amount of fertilizer for their farm size.

Expand infrastructure and market access: To change low level of smallholder farmer fertilizer demand, expansion of infrastructure should be very important. Because infrastructure like access of road expand smallholder farmers easily transport their product to the market to get income which is important to purchase fertilizer. In addition to this expansion of road infrastructure allows simple transportation system of fertilizer. When market was accessible for different farm product, it creates different farm outputs sold at proper price and it is also used for to reduce the perish ability fresh products. So market access should be important to smallholder farmers because it have a significant effect to increase fertilizer demand through improving on farm income. Generally the following recommendations are given. Attention should be given to intensive farming in order to increase productivity per unit area through provisions of agricultural inputs means fertilizer. The government and other concerned bodies should give attention to promote: income generation activities, provision of training to use fertilizer and other methods to increase productivity by using input fertilizer.

5.3 Areas for Further Study

Future researchers ought to investigate that factors affect fertilizer to be productive For instance, there is need to investigate the effectiveness and quality of fertilizer, how to reduce the cost of distribution and production, corruption when government on distribution.

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APPENDIX

Appendix 1

Questionnaires

I'm conducting senior essay about the factors that affect fertilizer demand in case of Grare Jarso woreda. Dear respondent, the success of this paper depending on the scenery and frankness of your response. I assure you that information you provide will be kept confidential and used only for the intended purpose. So I kindly request cooperation in responding for the questionnaires below. Thanking you!

PART 1 PERSOAL BACKGROUD QUSTIONS

1) Farmer's Name----------------------------------
2) Sex
   A) Male   B)Female
3) Age
4) Marital status of the farmer
   A) Married
   B) Un married
   C) Others (specify) -----------
5) Education level
   A) Illiterate
   B) Primary education (1-8)
   C) Secondary education (9-12)
   D) College or university
6) The total number of year spent on farming ……………………………………….

PART 2 Farm characteristics

1) How much is your total farm land in hectares?
   A) Land size___________________(hec)
   B) Cultivated_____________________-(hect)

C) Plantation_____________________(hect)

D) Grazing _______________________(hect)

E) Others_________________________(hect)

2) Mention main sources of your income and how much

1…..........

2............

3..........

3) How much of your income spent to buy fertilizer …………………………………

4) Do you have interest buying fertilizer?

A) Yes B) No

5) If your answer is yes why you need fertilizer ……………………….............

6) How was your demand to fertilizer for the purpose of crop production?

A) High B) Medium C) low D) None

7) What is the reason, if it is

A) high-----------

B) medium-----------

C) low-----------

D) None…………………..

8) How far fertilizer marketing center to your farm place? ....

9) Dose Distance from fertilizer market has impact on your need

A) Yes B) No

10) If your answer is yes what types of effect..

11) Where did you get the money to buy fertilizer

A) By own my self
B) Borrowing from traditional creditors
C) Getting credit from financial institutions

D) Other

11) What was the price of fertilizer during this season – 2008?

Type of fertilizer	Fertilizer bag size	Cost of fertilizer
DAP		
Urea		

12) Which constraints do you face to use large amount fertilizer?

A) availability

B) high price of fertilizer

C) lack of credit

D) weather not good

E) low on farm income

F) Other specify......................…..................…......

Appendix 2

```
. logit FDD AGE FMS INC EDU FRE DSM

Iteration 0:   log likelihood = -68.009196
Iteration 1:   log likelihood = -23.045578
Iteration 2:   log likelihood = -14.252892
Iteration 3:   log likelihood = -10.567083
Iteration 4:   log likelihood =  -10.32588
Iteration 5:   log likelihood = -10.322406
Iteration 6:   log likelihood = -10.322406

Logistic regression                               Number of obs   =         99
                                                  LR chi2(6)      =     115.37
                                                  Prob > chi2     =     0.0000
Log likelihood = -10.322406                       Pseudo R2       =     0.8482
```

FDD	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
AGE	-.0314731	.0610178	-0.52	0.606	-.1510659	.0881197
FMS	-1.527285	.6425987	-2.38	0.017	-2.786755	-.2678147
INC	.0018406	.0006922	2.66	0.008	.0004839	.0031972
EDU	1.010649	2.796657	0.36	0.718	-4.470699	6.491996
FRE	.004227	.0015024	2.81	0.005	.0012824	.0071716
DSM	-.1894559	.3382602	-0.56	0.575	-.8524337	.4735219
_cons	-9.345022	4.347998	-2.15	0.032	-17.86694	-.8231023

```
Note: 0 failures and 12 successes completely determined.
```

```
. des

Contains data
  obs:            99
 vars:             7
 size:         2,277
```

variable name	storage type	display format	value label	variable label
AGE	byte	%10.0g		AGE
FMS	double	%10.0g		FMS
INC	int	%10.0g		INC
EDU	byte	%10.0g		EDU
FRE	int	%10.0g		FRE
DSM	double	%10.0g		DSM
FDD	byte	%10.0g		FDD

```
Sorted by:
     Note:  dataset has changed since last saved

. sum
```

Variable	Obs	Mean	Std. Dev.	Min	Max
AGE	99	44.75758	12.72158	24	78
FMS	99	3.371212	2.425251	.5	14
INC	99	6087.444	3194.953	1900	20500
EDU	99	.3737374	.4862572	0	1
FRE	99	1891.818	1674.669	300	7800
DSM	99	4.868687	7.472428	.5	60
FDD	99	.4444444	.4994328	0	1

```
. vif
```

Variable	VIF	1/VIF
INC	8.98	0.111372
FRE	6.62	0.150965
EDU	3.84	0.260417
FMS	2.97	0.336288
AGE	1.73	0.576898
DSM	1.11	0.903983
Mean VIF	4.21	

```
. corr
(obs=99)

             |      AGE      FMS      INC      EDU      FRE      DSM      FDD   plogit residu
> al
-------------+------------------------------------------------------------------------------
> --
         AGE |   1.0000
         FMS |  -0.0998   1.0000
         INC |  -0.3704   0.7170   1.0000
         EDU |  -0.6417   0.2056   0.6677   1.0000
         FRE |  -0.4368   0.6107   0.9085   0.7174   1.0000
         DSM |  -0.0131  -0.0899  -0.2086  -0.0404  -0.1789   1.0000
         FDD |  -0.5032   0.2668   0.6877   0.7797   0.7047  -0.2665   1.0000
      plogit |  -0.5362   0.2842   0.7327   0.8307   0.7508  -0.2840   0.9438   1.0000
    residual |  -0.5362   0.2842   0.7327   0.8307   0.7508  -0.2840   0.9438   1.0000   1.0(
> 00
```

```
. ladder FRE

Transformation         formula                chi2(2)       P(chi2)
-------------------------------------------------------------------
cubic                  FRE^3                        .         0.000
square                 FRE^2                    51.06         0.000
identity               FRE                      23.35         0.000
square root            sqrt(FRE)                11.21         0.004
log                    log(FRE)                  7.00         0.030
1/(square root)        1/sqrt(FRE)               2.46         0.293
inverse                1/FRE                    19.43         0.000
1/square               1/(FRE^2)                60.19         0.000
1/cubic                1/(FRE^3)                    .         0.000

. predict
```

```
. logistic FDD AGE FMS INC EDU FRE DSM

Logistic regression                               Number of obs   =         99
                                                  LR chi2(6)      =     115.37
                                                  Prob > chi2     =     0.0000
Log likelihood = -10.322406                       Pseudo R2       =     0.8482

------------------------------------------------------------------------------
         FDD | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         AGE |    .969017   .0591273    -0.52   0.606     .8597911    1.092119
         FMS |   .2171244   .1395238    -2.38   0.017     .0616208    .7650495
         INC |   1.001842   .0006934     2.66   0.008     1.000484    1.003202
         EDU |   2.747383   7.683488     0.36   0.718     .0114393    659.8394
         FRE |   1.004236   .0015087     2.81   0.005     1.001283    1.007197
         DSM |   .8274092   .2798796    -0.56   0.575      .426376    1.605639
       _cons |   .0000874     .00038    -2.15   0.032     1.74e-08    .4390674
------------------------------------------------------------------------------
Note: 0 failures and 12 successes completely determined.


. mfx

Marginal effects after logistic
      y  = Pr(FDD) (predict)
         =  .94012619
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
     AGE |  -.0017716      .00407   -0.44   0.663  -.009749  .006206   44.7576
     FMS |  -.0859692      .11057   -0.78   0.437  -.302678   .13074   3.37121
     INC |   .0001036      .00013    0.77   0.443  -.000161  .000368   6087.44
    EDU* |   .0523032      .14621    0.36   0.721  -.234263   .33887   .373737
     FRE |   .0002379       .0003    0.80   0.423  -.000344   .00082   1891.82
     DSM |  -.0106643      .03071   -0.35   0.728   -.07085  .049521   4.86869
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

```
. estat classification

Logistic model for FDD

              -------- True --------
Classified |         D            ~D  |      Total
-----------+--------------------------+-----------
     +     |        42             2  |         44
     -     |         2            53  |         55
-----------+--------------------------+-----------
   Total   |        44            55  |         99

Classified + if predicted Pr(D) >= .5
True D defined as FDD != 0
--------------------------------------------------
Sensitivity                     Pr( +| D)   95.45%
Specificity                     Pr( -|~D)   96.36%
Positive predictive value       Pr( D| +)   95.45%
Negative predictive value       Pr(~D| -)   96.36%
--------------------------------------------------
False + rate for true ~D        Pr( +|~D)    3.64%
False - rate for true D         Pr( -| D)    4.55%
False + rate for classified +   Pr(~D| +)    4.55%
False - rate for classified -   Pr( D| -)    3.64%
--------------------------------------------------
Correctly classified                        95.96%
--------------------------------------------------


. estat gof

Logistic model for FDD, goodness-of-fit test

       number of observations =        99
 number of covariate patterns =        99
             Pearson chi2(92) =        72.69
                  Prob > chi2 =         0.9315
```