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DETERMINANTS OF INORGANI FERTILIZER ADOPTION: IN THE CASE OF MUHOR NA AKLILWOREDA, GURAGE ZONE, SUOTH NATION NATIONALITIES AND PEOPLES REGION, ETHIOPIA

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ABREVIATION AND ACRONYM

ADLI--- Agricultural Development-Led Industrialization.

AIS-------Agricultural input supply enterprise

AISCO-----Agricultural input supply Enterprise corporation

B/C--------Because

CSA--------Central statistical agency

DAP--------Di-ammonium phosphate

GDP--------Growth domestic product

GOV.T------Government

HH----------House hold

NFIA--------National fertilizer industry agency

NPSB------- Nitrogen phosphorus boron sulfur

VIF---------Variance Inflation Factor

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ABSTRACT

Fertilizer use is crucial for raising food crop production so as to keep up with the demand from rapidly growing population. Adoption of fertilizer one of the most promising ways to reduce food insecurity in Ethiopia. However, adoptions of these fertilizer are constrained by various factors. This study examined the factors' of farmer adoption fertilizer 90 sample households) selected from 2kebeles in Muhor na Aklil woreda . were assess the determinants of inorganic fertilize adoption and examine the extent of inorganic fertilizer adoption by farm households. The research has been used both Quantitative and qualitative method of data Analysis, primary and secondary source of data for the accuracy of information A Semi structured interview method of data collection was employed to collect primary data from smallholder farmers . Sampling techniques were employed for this study was involved multi stage sampling; because three or four stages were used in the study area during conducting the research. There are different determinants determined adoptions of fertilizer. These are economic social and institutional. extension agent are institutional deter 8 identified explanatory variables 4 of them significantly determined adoption of fertilizer; such as intensity of fertilizer, education level of the household, total farm size and sex of the household head age contact. The results of the econometric model indicated that the relative influence of different variables on probability of adoption of fertilizer. Sex of the house hold, education level, total farm size and intensity of fertilizer, were affected adoption positively. As the logit model indicates sex of the household had positive and significant influence on the adoption of fertilizer at 5% significance level. Hence, sex of household head was hypothesized to increase a farmer's adoption of fertilizer. As the logit model indicates, total farm size of the households had positive and significant impact on the adoption of fertilizer at 10% significance level

Key words: Fertilizer, adoption, determinant

1 INTRODUCTION

1.1 Background

Agriculture in the Ethiopian economy prominently is the largest contributor to 50% of Gross Domestic Production (GDP), employs 80% 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 90% of the foreign exchange earnings. It provides raw materials for more than 70% of the country's industries (Teressa,2007).

Fertilizers increase agricultural production and productivity that could contribute to improved national food-self-sufficiency (Gashu, 2005). 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 considerably the use of technological inputs like chemical fertilizers, improved seeds, pesticides and small scale irrigation (N FIA, 2007). Such improved performance of the agricultural sector could be the basis of poverty alleviation, employment creation, income redistribution and raising living standards (Teressa and Heidhues, 2006). Fertilizers as improved inputs are a product of innovation and thus play an important role in sustaining food availability and food security (Koffi-Tessio, 2000).

The vital role that fertilizer plays in increasing crop yield per unit area is well acknowledged. However, as explained below the current level of fertilizer consumption in general a in particular is low in both nationally and at farm level. An effective use of fertilizers is an essential factor for solving problems of food security. Fertilizer Adoption 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 (World Bank, 2003 as cited in Teressa 2007).Despite its highest share in the country‟s economy, the performance of the

agricultural sector is very poor. The land productivity is low with an average yield of1.23 tones/ha for food grains (CSA, 2000 8b). Land scarcity has led to increasing the crop area at the expense of both fallow and grazing, with crops being grown on more marginal, steep and poorly drained land which are susceptible to erosion. Therefore, it will be necessary to open up new land for cropped area expansion in the low lands where population density is much lower.

However, this will entail a considerable amount of lead-time and investment. Hence, area expansion will be a long-term solution, and will not significantly address the problem of rising food shortage in the next few years. Therefore, increasing crop productivity is the only short-term alternative of improving food availability in Ethiopia (Mulat *et al*., 1997). Fertilizer is one of the major productivity enhancing inputs. Hence, increased and efficient use of fertilizer can be considered as a more plausible alternative in Ethiopia to bridge the wide gap of food shortage (at least in the immediate future).But There is no domestic production of inorganic fertilizer in Ethiopia. Chemical fertilizers are imported from abroad in the form of Di-Ammonium Phosphate (DAP) and Urea. Fertilizer import is mainly financed by funds obtained from Donors and Creditors. The average annual growth rate of agricultural output during 1980-1996 was 1.4% while the average annual population growth rate during the same period was 2.7% (World Bank, 1997 as cited by Bezabih, 2000). Utilization of other inputs such as improved seeds and pesticides is also at low-level. 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 (Subramaniyan and Nirmala, 2011).

1.2 Statement of the problem

The major challenge confronting most of developing countries such as Ethiopia is improving rural as well as urban food security and to stimulate underlying food system development. There is an ever increasing concern that it is becoming more and more difficult to achieve and sustain the needed increase in agricultural production based on intensification, because there are limited opportunities for area expansion). Hence, the solution to food problem would depend on measures aimed at stimulating yield which in turn is determined by sustainable growth in the use of improved technologies, mainly chemical fertilizers.

Therefore, this study was initiated to determine factors that influence fertilizer adoption by smallholder farmers. Even though some fertilizer adoption studies were conducted in Ethiopia (e.g. Bezabih, 2000; Lelissa, 1998; Teressa, 1997; Crop pen steed et al., 1999) the currently available knowledge about the possible factors affecting adoption and intensity of its use 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 hope to provide recent empirical evidences on factors influencing fertilizer adoption among smallholder farmers so as to suggest policy implications for future intervention strategies

1.3 Objectives of the Study

1.3.1 General objective

The general objective of this study is to examine determinants influencing the adoption of inorganic fertilizer by smallholder farmers in Muhor na Aklil woreda

1.3.2 Specific objectives

- To assess determinants of inorganic fertilize adoption

1.4 Research Question

- In what extent smallholder farmers have adopted fertilizer
- What are the factors that influence the adoption of inorganic fertilizer by smallholder farmer

1.5 Significance of the Study

Increasing agricultural production in the developing World has been a primary concern of National policy makers and international development agencies for many years. By now something of consensus exists about how increased production can be achieved. Improved Farming technologies, which are the results of scientific research, must be available to farmers, Along with full information on how to use the new technologies. Essential inputs such as fertilizers and improved seeds must be readily available and Sometimes capital investments must

be made (World Bank, 1987). Despite over three decades of fertilizer popularization effort in Ethiopia, the level of fertilizer use by smallholder farmers is low. In addition, there is evidence of large difference among farmers in adoption and use of fertilizer, even in a given agro- climatic zone and on a given crop, let alone among zones of the country. By studying the various factors affecting fertilizer adoption by small-holder farmers in broader areas, it is possible to formulate policies and initiate investments that most likely stimulate fertilizer demand in the future. The study also used to distinguish various factors that significantly affect smallholder farmer's fertilizer demand in study area from other factors. Furthermore, the analysis and identification of factors affecting adopt for this critical input is vitally important in the process of promoting its usage and enhancing food production as well as food security in the country. It also important to understand farmers' attitude in fertilizer use in the study area.

1.6 Scope and Limitations of the Study

This study are focused the determinant of fertilizer adoption in muhor na aklil worda level specifically. Survey on which the study were based has attempted to collect comprehensive data regarding rural households from some selected sites of the Keble of muhor na aklil . However different factors were affect it such as Time, finance and transportation costs.

1.7 Organization of the Paper

These study is composed of seven chapters the first chapter deals with introduction that contain background of study ,statement of the problem, objective of the study (general and specific objectives) significance of the study ,scope and limitation of the study ;second chapter express about review of related literature which decomposed in to the theoretical and empirical literature review; the third chapter consists of methodology that contain description of the study area, research design, sampling size and sampling techniques procedure, types and source of data, method of data collection, method of data analysis, hypothesis presentation, analysis, the fourth chapter results and discussion ,fifth chapter conclusion and recommendation sixth chapter reference, and the seventh chapter appendix.

2 LITERATURE REVIEW

2.1 Concept and Definition

Many authors have defined the term adoption at different times. Rogers (2003) defined adoption as the mental process through which an individual passes from first hearing about an innovation to final adoption. With regard to this idea, adoption process includes five stages; such as awareness, interest, evaluation, trial and adoption.

Awareness: A person first learns about a new idea, product or practice. He/ she have only general knowledge about it and know nothing of its special qualities or its usefulness;

Interest: At this stage the person is not satisfied with just knowing that the ideas exist. He/ she want more detailed information about what it's, what it will do and how it will work;

Evaluation: He/ she evaluate all the information he/ she have and decide whether the new idea is good for him/ her;

Trial: Once he/ she decide that he/ she like the idea, he/ she will give it a trial. This may be for a long period of time or on a limited scale; and

Adoption: This is the stage where he/ she firmly adopts the idea and then may even encourage others to do so.

He also defines adoption as a decision to continue use of an innovation. This definition implies that the adopter is satisfied with the innovation.

According to Dasgupta (1989, as cited in Gezahagn, 2008), define adoption as a decision to make full use of new ideas as the best course of action available. As they indicate the adoption or rejection of an innovation is a decision by an individual. If he adopts, he begins using a new idea, practice, or object and cease using the idea he was using before the innovation. The term adoption refers to the continued use by individuals or groups of a recommended idea or practice over a reasonably long period Dasgupta (1989, as cited in Gezahagn, 2008).

Colman and Young (1989, cited as Mulugeta, 2009) define adoption as it relates to the use or non-use of a particular innovation by individuals or farmers at a point in time or during an extended period of time. Adoption, therefore, presupposes that the innovation (technological change) exists and studies of the adoption process analyze the reasons or determinants of whether and when adoption takes place. In the words of Yapa and May field the adoption of an entrepreneurial innovation by an individual requires the satisfaction of at least three conditions. These are (i) the availability of sufficient information (ii) the existence of a favorable attitude towards the innovation, and (iii) the physical availability of the innovation.

Feder *et al.* (1985) defined adoption as the degree of use of a new technology in a long run equilibrium when a farmer has all of the information about the new technology and it's potential. Adoption at the farm level reflects the farmer's decision to incorporate a new technology into the production process. On the other hand, aggregate adoption is the process of spread or diffusion of a new technology within a region. Therefore, a distinction exists between adoption at the individual farm level and aggregate adoption within a targeted region. If an innovation is modified periodically, the adoption level may not reach equilibrium.

According to Hailu (2008), technologies play an important role in economic development. Adoption technology concepts describe the decision to use or not use and the spread of a given technology among economic units over a period of time. Adoption of any innovation is not a one step process as it takes time for adoption to complete. First time adopters may continue or cease to use the new technology. The duration of adoption of a technology vary among economic unit, regions and attributes of the technology itself.

The technology adoption is defined as the percentage of farmers who have adopted a given technology. On the other hand, the intensity of adoption is defined as the level of adoption of a given technological package. Put it in a different way, the number of hectares planted with improved seed also tested as (the percentage of each farm planted to improved seed) or the amount of input applied per hectare represent the intensity of adoption of the respective technologies (Nkonya *et al.*, 1997, cited as Alemitu, 2011). According to Augustine and Mulugeta (2005), the importance of adoption study is to quantify the number of technology users over time and to assess impacts or determine extension requirements that would help us in

monitoring and feedback in technology generation. It also provides further insights into the effectiveness of technology transfer.

Several authors defined adoption of technologies in different times (e.g. Dasgupta, 1989; Feder et al., 1985; Rogers, 1969). Dasgupta (1989) defined adoption as the continued use of recommended idea or practice by individuals over a reasonably long period of time. He further noted that adoptions not a permanent behavior. An individual may decide to discontinue the use of an innovation for a variety of personal, institutional or social reasons, one of which might be the availability of an idea or practice which is better in satisfying his/her need. Feder et al. (1985) also classified adoption as individual (farm level) adoption and aggregate adoption.

Final adoption at the individual farmer's level is defined as the degree of use of new technology in long-run equilibrium when the farmer has full information about the new technology and its potential. In the context of aggregate adoption behavior they defined the diffusion process as the process of spread of new technology within a region. According to Dasgupta (1989), the adoption process is conceptualized to include several mental stages through which an individual passes after first hearing about an innovation and finally deciding to adopt or reject it.

As noted by Feder et al. (1985) and Dasgupta (1989), farmers are divided, according to their tendency to adopt as innovators, early adopters, followers and laggards. The cumulative proportions of persons first adopting a practice will tend to approximate S–shaped growth curve when plotted by successive years (Dasgupta, 1989). Mansfield (1961) hypothesized that the S-shaped adoption curve is a function of the extent of economic merit associated to the new technology, the amount of initial financial requirement to adopt, accessibility to information, the degree of risks associated with the new technology. Thus, the S-shaped adoption curve implies that a small proportion of farmers adopt an innovation when it is first introduced to a social system. Through interaction with the first adopters and observing the results, a few more farmers come to know about the innovation and its usefulness and eventually adopt it. Over a period of time, a large number of farmers become familiar with the innovation and decide to adopt the practice. This is the first period which is reflected in the up word slope of the S-shaped diffusion curve. The S-shaped curve has a gentler slope until the entire village adopts the innovation (Dasgupta, 1989).

Many of the adoption studies stressed the role of communication in their attempt to explain the S-shaped pattern of aggregate diffusion over time assuming that the driving force of the diffusion process is imitation (e.g. Rogers, 1969; Mansfield, 1961; Dasgupta, 1989). Dasgupta (1989) noted that it is the first few adopters of an innovation who influence the other members of a community to adopt the innovation as they interact with them. After the innovation is adopted by a few farmers, they influence a few others who in turn offer new stimulus to the remaining ones.

Other studies (such as Benor et al. 1984; Arnon, 1987) emphasized the role of agricultural extension service in facilitating the process of communicating an information and changing the attitude of farmers. Benor et al. (1989) noted that without extension's guide, farmers often are unable to exploit completely the opportunities available to them. Even in advanced countries, it is not possible to encourage farmers to adopt new technologies and practices without farmers clearly understanding them.

According to Reardon et al. (1999), for a given household fertilizer demand is a general term that includes adoption as a subset (the distinction between zero and positive use); diffusion concerns the spread over households of adoption. They further indicated that fertilizer demand of a given farm household arises from the economic and technical relationships perceived by the farmer. The main economic relationship is that between the use of fertilizer and its profitability. The choice of level and type of fertilizer used depends on what the farmer perceives about the responsiveness of yield to fertilizer use for crop under question, controlling for other conditions such as use of other inputs, and other factors such as rainfall, managerial ability and land quality. Dasgupta (1989) also noted that, although the economic profitability is an important incentive, it is not always sufficient to induce farmers to adopt recommended farming practices. Social and cultural factors exert important influences on the adoption behavior of farmers.

A complete analytical framework for investigating adoption processes at the farm level should include farmer's decision making model determining the extent and intensity of use of the new technology at each point throughout the adoption process and a set of equations of motion describing the time pattern of parameters which affect the decision of the farmer (Feder et al., 1985). In support of the above statement Dasgupta (1989) noted that, the goal of diffusion research is to identify factors, which influence the adoption and diffusion of agricultural

innovations. The intensity of adoption of new technologies which are divisible (new seed varieties or new variable inputs) can be measured at the individual farm level in a given time period by the amount of share of farm area utilizing the technology or by per hectare quantity of input used where applicable (Feder et al., 1985). Nkonya et al. (1997) also defined the rate of adoption as the percentage of farmers who have adopted a given technology. The intensity of adoption is the level of adoption of a given technology. The amount of chemical fertilizer applied per hectare will be referred to as the intensity of adoption of fertilizer.

2.2 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, 2005). 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, G (2011).

However, most of the growth in agricultural production in less developed countries over the last forty years has been due to area expansion and not to yield increase. Consequently, grazing land and considerable forestland have been put under cultivation and has resulted in environmental degradation. Promotion of fertilizer usage, including the use of governmental subsidies, can be expected to have multiple benefits: growth in agricultural output, increased national food security, increased income in the rural sector, maintenance of soil fertility and structure and the limitation of soil erosion and deforestation as the pressure to utilize more fragile ecosystems is reduced (Mohammed *et al.*, 2004).

Similarly, fertilizer use increases land productivity through yield increase and eases the nutrient constraint to multiple cropping and land development programs. As a result, it relaxes the land constraint. Since the yield increase is proportionately more than the corresponding incremental labor applied, fertilizer use increases labor productivity. As fertilizer production, distribution and

consumption increase, backward and forward linkages create additional employment, which is extremely important in labor surplus countries (Mudahar, 2008).

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 (Subramaniyan and Nirmala, 2011).

2.3 Empirical Review

Different studies regarding technology adoption in general and fertilizer in particular are conducted in different countries (including Ethiopia) by different researchers (e.g. Bezabih, 2000; Mulugeta, 1995). Nkonya *et al.*, (1997) used Tobit model to analyze factors affecting adoption of fertilizer and improved maize seed in Northern. They concluded that adopting both technologies together provides synergistic benefits as improved seeds varieties have larger responses to fertilizer. They also noted that the amount of fertilizer applied per hectare was significantly and positively influenced by the number of hectares planted with improved maize seeds, while it is negatively influenced by farm size. Other explanatory variables such as education, off-farm income, age, visits by extension agents, family labor availability were not highly significant in explaining nitrogen fertilizer adoption.

Green *et al.*, (1993) also employed Logistic model and analyzed factors affecting fertilizer adoption in Malawi. Their findings have shown that type of crop grown (maize or tobacco), farming system, improved variety, off-farm employment opportunities and regular labor availability were the main factors influencing fertilizer adoption.

The decision to adopt fertilizer is determined by a number of factors. The most important of which are the response rate of fertilizer application (increment in output from a given increment in fertilizer use), the cost of fertilizer at the farm gate (including the transaction cost associated with obtaining it) and the output price. The response rate itself depends on the use of complementary inputs. The cost of fertilizer is affected by supply conditions, infrastructure, credit availability, transaction cost associated with obtaining fertilizer and the extent of risk and uncertainty (Amare, 2001).

As indicated in the same source, the adoption of fertilizer use is primarily related to farmers' access to all-weather road, credit and the total value of produced crops. Farmers with access to all-weather roads are more likely to adopt fertilizers and use higher quantities. Although the response of cereals to fertilizer is rather low, it is conservatively estimated that for each quintals of fertilizer supplied at least three quintals of cereals have to be moved out of region. Therefore, access to an all-weather road is indispensable. Since the credit market is under-developed, adoption of fertilizer use is also determined by the farm household cash flow, which is in part explained by the total produced crop value. Other sources of cash income to the farm household that could potentially be used for the purchase of fertilizer include cattle sales, off-farm employment and receipt of remittances from relatives employed in urban areas. (Amare, 2001).

Barker and Hayami (2006) used a simple demand-supply model to analyze the Philippines rice economy and underlined the importance of fertilizer subsidy. They reported that subsidizing modern inputs such as fertilizer was more beneficial than supporting production prices. They also noted that the increase in government budget due to fertilizer subsidy expansion could be compensated for by the increase in export tax revenue. The fertilizer price subsidy ranging from very low level to over 50.0% provides an incentive for more rapid adoption of fertilizer than would occur in its absence.

The study by Tesfai (2005) carried-out in the Chilalo Agricultural Development Unit (CADU) area of Ethiopia showed that the probability of adoption of improved varieties and fertilizer increased with farm size, availability of cash for dawn payment, membership in local association and literacy level. However, he emphasized that the influence of literacy level and participation in local associations was not as strong as the influences of farm size and extension services. He also reported that extension contact as measured by distance from an extension center was negatively related to adoption of improved varieties and fertilizer. The negative coefficient associated with extension contact or distance from extension centers indicates that the probability of farmers using improved varieties and fertilizer decreases as the distance between the extension center and the farm increases (as the number of extension contacts decreases).

A study by Yohannes *et al.,* (1990) using a logit model, reported that debt has a negative effect on the adoption of fertilizer and pesticides. Other factors like farm size, family size, education,

exposure to outside information and experience as represented by age have a positive effect on the probability of fertilizer and pesticide adoption. Teressa (2007) using a logit model for fertilizer adoption and a simultaneous equation for the intensity of fertilizer use found that extension service, oxen, labour, access to credit and off-farm income were the major variables contributing to fertilizer adoption and intensity. On the other hand, variables like distance from asphalt road,to an all-weather road is indispensable. Since the credit market is under-developed, adoption of fertilizer use is also determined by the farm household cash flow, which is in part explained by the total produced crop value. Other sources of cash income to the farm household that could potentially be used for the purchase of fertilizer include cattle sales, off-farm employment and receipt of remittances from relatives employed in urban areas. (Amare, 2001).

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Teressa (2007) using a logit model for fertilizer adoption and a simultaneous equation for the intensity of fertilizer use found that extension service, oxen, labour, access to credit and off-farm income were the major variables contributing to fertilizer adoption and intensity. On the other hand, variables like distance from asphalt road, sick persons in the households, dependency ratio, and availability of family labour, age, education and sex were statistically insignificant. Land holding with negative coefficient becomes significant implying that farmers who own large farmland may use fallowing to fertilize the soil. Regarding fertilizer intensity, farm size and off-farm incomes have a negative coefficient, while oxen, access to credit, distance from asphalt road and fertilizer-crop price ratio has positive coefficients and all are significant. Other factors like availability of farm labour, hired labour, household's health condition and household characteristics were found statistically insignificant.He pointed-out that agro-climatic conditions, land tenure con dition, access to credit, extension service, oxen ownership, age of the farmer, family size, farmer's level of education, manure, ratio of price of crops to fertilizer cost, distance to fertilizer distribution center and cropping pattern are the most important determinants of fertilizer adoption and intensity of its use.

Anthieu and Verga (2008 as cited in Lelissa, 2008) reported that lack of knowledge about correct crop fertilization, low level of the extension service, unfavourable price ratio (fertilizer/farm produce) and shortage of credit are the most important determinants of fertilizer use in the context of developing countries. According to FAO (2004), the demand for fertilizer is basically determined, among others, by the size of the area cultivated, the number of years the farmers have been using fertilizers, the physical availability of fertilizers, the possession of at least one pair of oxen and the ratio of produce price to the cost of fertilizer.

The study conducted by Croppenstedt *et al* (2009) reported that household size, and cattle ownership also have a large impact on fertilizer use. Wealth as proxies by cattle ownership relaxes the credit constraint and increases the household ability to bear risk. Likewise, land size is positively correlated with the amount of fertilizer bought. Regarding literacy, for four or more

years of education increases in the probability of wanting fertilizer as well as the higher intensity of its use is driven by a real education effect. The authors explained that the stagnation in the demand for fertilizer, with the decline in demand due to the price increase partly offset by increased credit availability and possibly the declining soil fertility. The removal of subsidy is negatively correlated. Lowering the cost of fertilizer is important, but one can expect that in the long-run investments in irrigation, and land improvement that increase water-retention will be needed to increase the use of fertilizer in Ethiopia Employed. probit model to study determinants of fertilizer adoption in Ethiopia: the case of major cereal producing area. He reported that access to hired labour, access to extension services, area of land planted with improved seed and access to input credit have positive and significant influence on adoption and intensity of fertilizer use. Whereas off-farm income, illness of household head and proportion of steep slope lands have negative and significant influence on adoption and intensity of fertilizer use.

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' adoption 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' adoption for fertilizer and to tackle (minimize) the impact of major socio-economic variables, which have negatively influenced their adoption for fertilizer.

3 RESEARCH METHDOLGY

3.1 Description of the Study Area

Gurage Zone is one of the zones found in the Ethiopian Southern Nations, Nationalities and Peoples Region (SNNPR). It is located in the western part of central Ethiopia; it is bordered on the south by Hadiya on the west, north and east by Oromia Region, Yem on southwest and on the southeast by Silte Zone. Its land area is estimated as 593,200 hectares. The zone is divided in to 13 woredas and two town administrations. These are Abeshgie, Cheha, Enemor-Ener, Endegagn, Kebena, Ezha, Geta, Muhur-aklil, Mareko, Kokir, Gummer, Meskan, Sodo Woreda and Butajira and Wolkite town administrations.

The total population of the zone is estimated to be 1,622328 (Guraghe Zone Finance and Economic Development Department, 2015 population projection) having distribution of 789101 males and 833226 females with percentages of 48.6 and 51.4, respectively. The current labour forces the population of the zone are 28538 male population are 12966 and the female population are 15572.The unemployed population are 15721 and male population 5512 and female population are 10209 and the employed population 12817and male 7454 and female population are 5363. The majority of the population (90%) lives in rural areas leading an agricultural life.

The nature of topography in the zone exhibits three categories. These are the mountainous high land (represented by the Guraghe Mountain chain, dividing the zone east to west, having an elevation of 3600 m), the plateau flat lands and the low stretching area (the western fringe of the rift valley and the Wabe-Gibe valley having an elevation of 1000 m).

The zone is divided in to three agro ecological zones namely ‘Dega’ or highland climate (31.6%), mid highland climate or ‘woina-dega’ (65.3%) and lowland or ‘kolla’ climate (3.1%). Most of the areas lie in the mid highland division. The distribution of rainfall and temperature mainly follows this pattern. The annual average rainfall ranges from 200 MM/annum - 1,400 MM/annum. The highest and lowest temperature record is 320c and 7 0c respectively. The study will conducted at Muhur-Aklil woreda south westren part of Guraghe zone of SNNPR. The woreda having thirty kebele where both crops and livestock production are interdependent farm enterprises and have comparable importance.

3.1.1 Location and Size

Muhur-Aklil is one of the thirteen woreda and two administrative zonal town namely Wolkite and Butagera of Gurage zone in South Nation Nationality and Peoples Region (SNNPR) and lies between 7o 53' 0'' to 8o 20'0'' N Latitudes and 37o53' 0'' to 38 o17' 0''E Longitudes. It is found at a road distance of about 346 km from Awassa (the capital city of SNNPR), 208km from Addis Abeba, and 58km from Wolkite (the capital city of Gurage zone).

The woreda having an area of 421 square km. It is divided in to 29 peasant associations (Kebele administration) and one town administration and name of a town is Hawariat. The woreda also bounded by Ezha woreda on south, Kokir gedebano guazer woreda on north, Kebena woreda on west and Meskan woreda on the east.

3.1.2 Topography

The elevation of Muhur-Aklil woreda ranges between 1501-3500 meter above sea level. The relief features includes 7%,8%,10%,and 75% of the woreda is mountain ,escarpment ,plain and plateaus land respectively. The woreda is divided in to two main traditional agro-climatic zones that mean cool mid-altitude (Amharic Dega) and moist mid-altitude(amharic Woyna-Dega).The main economic activity in the district is agriculture. It is predominantly mixed farming which is predominantly subsistence mixed crop with livestock. The dominant crops grown in the surrounding communities are enset, Teff, barley,Maize, potato, chat and coffee (MAWARDO, 2012).

3.2 Research Design

We were used a cross sectional study design, because we were used descriptive data analysis and standardized question to collect data. And also, we do not use longitudinal method due to shortage of time that means longitudinal method take more time but cross sectional method takes less time and we are also ask and pass system of data collection method. To obtain primary data from the community and secondary data from woreda administrative body and the selected kebeles of the woreda.

3.2.1 Type And Source of Data Collection

3.2.1.1 Primary Data

Primary data were collected by formally through that was fitted out through face to face and direct interview of respondents. Qualitative data were gathered informally through contacted participants of the study area, type of activities of the people in the study area and their behavior. It was helped providing information for specific purpose of addressing the problem at hand and necessary information for the study.

3.2.1.2 Secondary Data

Secondary data was gathered through reviewing documents, and reports. It is the main source of information and these data are available. Secondary data indicated the past present performance of farmers‟ fertilizer adoption.

3.3 Sampling Technique and Sample Size

Sampling techniques we were employed for this study were involved multi stage sampling; because four stages were used in the study area during conducting the research i.e., in first stages we were selected Gurage zone purposefully , in second stages we were select Muhur-aklil woreda purposefully because Muhur-aklil woreda less to produce cash crops such as Teff and also the people commercialize their product as compared to other kebele due to this they are use fertilizer in order to specialize Teff product (output), in third stage we were select keels randomly because most of kebele use fertilizer but mode of adopting it could be different as compared with peoples who adopt and demanded the fertilizer and lastly we were select hhs as sample respondents by systematic random sampling because as we know we already select the woreda and kebele purposefully after that we were be take the respondents in random sampling . while conducting the research: from (13) kebele two Kebeles are selected purposively. Thus two kebeles (Wukiye and Yebejeyeche), randomly selected the interview respondents. From the total household (male 470, female20 total 490; male 372,female 60 total 432) Wukiye and Yebejeyeche respectively of the two Kebele's (922). In order to take a total sample size relevant to target study we were apply Yamane formula (1967) of $n = N/1+N (e)^2$. In addition to this, we are going to use proportionate sampling that was enable us in taking samples from each sub strata' which are to be selected from the target population.

N= N1+N2

N= 490+432

N=922

n=N/1+N (e^2)

n=922/1+922(0.1^2)

n=922/1+922(0.01)

n= 90.215 ≈90

(e)=10% or 0.1

Where: N=target population

n=sample size

e=error

Then we have to apply proportionate sampling to obtain how many respondents are selected from each stratum by using formulas:

nh1 = n(Nh1)/N

nh1=90(490)/922

nh1=47.8≈48

nh2 = n(Nh2)/N

nh2=90(422)/922

nh2=42

Where: nh =sample size for stratum h,

Nh is the numbers of house holds for stratum h

N =total numbers of household and n=total sample size.

Nh1 numbers of household in kebele 1(wukiye) and

Nh2 were the numbers of household in kebele 2

So that, nh1=48, and nh2=42, are the sample size of the strata of the two kebeles wukiye and Yebejeyeche respectively.

3.4 Data Analysis Methods and Interpretation

Following the completion of the data collection, qualitative and quantitative data was coded and entered into (STATA) version 13 computer programs for analysis. In this study two types of data analysis, namely descriptive statistics and econometric methods were employed for data analysis. Descriptive analyses were used because of its simplicity and clarity to draw inferences. Bar graph, Regression, frequency and tables were used for the analysis of the data.

3.4.1 Quantitative Data Analysis

Secondary data were gathered through reviewing documents, and reports. It is the main source of information and these data are available. Secondary data indicated the past present performance of farmers‟ fertilizer adoption. Data obtained from interview and direct observation.

3.4.2 Qualitative Data Analysis

Data gathered informally were analyzed through concepts of explanation and elaborate description of ideas and opinions of respondents.

3.4.3 Descriptive analysis

Descriptive statistics such as means, and percent, were used to characterize the agricultural system of the study area and occurrence for the adopter and non-adopter of farmers for inorganic fertilizer in study district.

3.4.4 Econometric Model

Model Specification

There are several tools that can be used in the analysis of farm technology adoption. They include frequency tables, contingency tables, correlation analysis, linear regression, and binomial choice models. There are various approaches for the study of qualitative response models. They are the linear probability models, logit model, probit model, and the Tobit model (Gujarati, 2004). In these models, the dependent variable takes on values which are dummy in nature such as adopting a practice or not adopting the practice. Therefore, in models where the dependent variable is qualitative, the objective is to find the probability of something happening, such as adoption of fertilizer. Hence, qualitative response regression models are often called probability

models (Mandela, 1992; Gujarati, 2004). The econometric model was employed to analyze the data on farmers' adoption. Empirical evidence suggests that neither Logit nor Probit have superiority over the other. The choice becomes a matter of preference (Gujarati, 2004). Therefore, the logit model was used for this study because of its **computational and mathematic**), the logit model can be specified as follows:

If Pi is the probability of adopting fertilizer and Xi is the socioeconomic factor influencing the adoption?

$Pi = EY = 1Xi = \beta 1 + \beta 2Xi$ (1)-- ----Equation (1) can be represented as:

$Pi = EY = 1\,Xi = 11 + e - (\beta 1 + \beta 2Xi)(2)$

If Zi is equal to $\beta 1 + \beta 2$ ----------equation (2) can be written as:

$Pi = 11 + e - Zi = eZ1 +$,and this represents logistic distribution function. (3)

If Pi is the probability of adopting fertilizer then $(1 - Pi)$ is the probability of not adopting fertilizer which is:

$1 - Pi = 11 + eZi$ (4)

Therefore, $Pi1 - Pi = 1 + eZi1 + e - Zi = eZi$ is odds ratio in favor of adopting the fertilizer (5)

Taking the natural logarithm of equation (5), gives

$Li = lnPi1 - Pi = Zi = \beta 1 + \beta 2Xi$

Where Li is the log of the odds ratio and it is called the *logit*.

To estimate the logit model, equation (6) can be written as:

$Li = lnPi1 - Pi = \beta 1 + \beta 2Xi$ where ui is stochastic error term. (7)

The variables that were used in the model Table 3 included the dependent variable (adoption of fertilizer which assumed values of 0 and 1). A household was considered adopter if it used fertilizer in 2015/16 cropping season. The independent variables that were assumed to affect adoption of fertilizer were age and educational level of household head, total land size, income, access to credit services, intensity of fertilizer, access to extension services, and sex of the household.

Before running the binary Logit model all the hypothesized explanatory variables were checked for the existence of multi-collinearity problem. There are two measures that are often suggested to test the existence of multi-collinearity. These are: Variance Inflation Factor (VIF) for association among the continuous explanatory variables and contingency coefficients for dummy variables. In this study, a variance inflation factor (VIF) was used to test multi-collinearity problem for continuous and dummy variables respectively.

Variance inflation factor

According to Maddala (1992), VIF can be defined as:

$VIF\ (Xi) = 1/1\text{-}R^2$

Where, R2 is the squared multiple correlation coefficient between Xi and the other explanatory variables. The larger the value of VIF, the more troublesome, as a rule of thumb, if the VIF of a variable exceeds 10 (this will happen if Ri^2 exceeds 0.95), that variable is said to be highly collinear (Gujarati, 1995).

3.5 Hypothesis and Definition of Variables

Dependent Variable (Adoption of Fertilizer)

Hypothesis is temporary assuming the effect of independent variable on dependent variable. In the course of identifying factors influencing farmer's decision to use fertilizer, the main task is to analyze which factor influence how and by how much. Therefore, in the following section potential variables those are supposed to influence adoption.

The Independent (explanatory) Variables

Farmers' decision to used fertilizer given period of time is hypothesized to be influence by a Combine effect of various factors such as household characteristics, socio-economic and. Such as Intensity of fertilizer, Access to credit, Sex, income, Education, Access to Extension Service.

Age of the Household Head

Age is one of the demographic factors that is useful to describe households and provide indication about the age structure of the sample and the population. In traditional societies, age serves as an important indicator of the individual's position in the society. Older farmers will be in a position to experience much with their traditional farming practices, but they older and older (above65) stop adopting fertilizer.

Sex of the households (SEXHH): this is a dummy variable, which takes a value of one if the household head is male and zero, if female. Literature indicate that female-headed households have less access to improved technologies, land, and extension services as compared to male headed households (Green &Nongoma, 1993). If the household head is male, he has enough time compared to female headed to get more information about commercialization of Teff. This variable is expected to have indeterminate effect on fertilizer adoption.

Access to credit (ACCCREDIT); this is a dummy variable which refers to the access to credit received and utilized by farmers from different organizations like micro finance institution, cooperatives and other institutions operating in the area. credit makes traditional agriculture more productive through the purchase of farm equipment and other agricultural inputs, and technological developments. Credit can also be used as an instrument for market stability. Rural farmers can build their bargaining power by establishing storage facilities and providing transport system acquired through credit. Therefore, this variable is expected to have a positive relation to the level of fertilizer adoption.

Education level of the Household Head (EDUHH): It is as Categorized (year or grade) variable and measured in years of schooling of the household head. Formal education is hypothesized to have positive influence on the level of fertilizer adoption. observed that education and visits by an extension agent had significant and positive effect on quantity of fertilizer applied. But an expected to the extantion contact had negative effect on adoption of fertilizer.

Access to Extension contact (ACCEXC). : This variable is treated as a Categorized (week) variable and measured by number of visits made by the extension agents to sample households. Extension visits will help to reinforce the message and enhance the accuracy of implementation of the technology packages. More frequent visits, using different extension teaching methods like

attending demonstrations, field day, and participation on on-farm trials can help the farmers to adopt a new technology. However, all farmers may not have equal access to extension services. If the farmers get better extension services, they are expected to adopt inorganic fertilizer production technologies than others.

Intensity of fertilizer (IFZR): it is a dummy variable and measure in Kilogram. It refers the availability of fertilizer to producers. If fertilizer is available in the right amount and time it will be increase production. This variable is expected positive relation to the adoption of fertilizer.

Total Land size (TLASI): The total land Continuous (ha);used for production is measured in terms of number of hectares the house hold owns and it is expected to affect the household extent of fertilizer adoption positively because, a producer who owns a large area of land for production than a producer who own less area of land and under the same input utilization condition can produce more produce

1.Independent variable	type's of variables	Description	Hypothesized sign/ effect
Age	Categorized (age group)	Age of household (1=15-30;2=30-65 and above 65)	+,-
Intensity of fertilizer	Dummy	availability (=0,if no; = 1,if yes)	+
Sex	Dummy	Sex of house hold(0=female1=male	+
Education	Categorized (year)	Education status of household (1. Illiterate 2. Read and write 3. 1-4 grade, 4. 5-8 grade, 5. 9-12 grade and 6. Above grade 12)	+
Marital status	Categorized	marital status (1 =married; 2=unmarried;3 windowed and 4 divorced	+,
Access to credit	Dummy	access of credit (0=if no; 1= if yes)	+
Land	Continuous (ha)	Total farm land of the Household in number	+
Access to extension	Categorized (week)	Access to extension service (1=once per week;2=twice perweek;3=every three weeks and 4=once per month	-
2.dependentvariable	Adoption of fertilizer		

Table 1 Effects of independent variable on dependent

4 RESULT AND DESCUTION

This chapter summarizes the major findings of the study. Both descriptive statistics and econometric analysis were used to analyze the primary data. Descriptive statistics were employed to describe the socio-demographic characteristics of sample farmers. Econometric analysis was used to identify the intensity of adoption of fertilizer in the study area.

4.1 Descriptive Results

This study was intended to identify factors affecting adoption of fertilizer in the study area muhur na aklil District as well as to know the effect of hypothesized independent variables on the dependent variables. In this section of analyses descriptive statistics such as mean, standard deviation and, percentage odds ratio was employed.

4.1.1 Economic factors

Economy of farmers is one of most factors of fertilizer adoption. B/c fertilizers come/donated from as import and it needs money to buy. Under this, categories include income, access to credit, and land size..

Income

Income of the household develops the capacity to increase fertilizer adoption. Income go together with other determinants, b/c if no land for production no fertilizer adoption. From determinant per adopter Reason farmers become non-adopter are cost of fertilizers are higher and higher from time to time with have less income or the cost not income based.

Access to credit.

The major option for increased adoption of fertilizer is to overcome the income/ capital constraint through increased credit provision. Increased access to credit sources can help farmers surmount short-run liquidity constraints and increase fertilizer adoption. Credit considerations are of indirect concern as well because explicit and implicit interest rates determine the future value of money, and when interest rates are high, they can make modest immediate income seem

more attractive than even large future returns. As the table 2 below shows 43 farmers or 47.78% of the farmers get access to credit from banks such as OMO , commercial banks and others. As we observed even the farmers get access to credit interest rate is high, and not enough to adopt b/c cost of fertilizer is high know. Non access to credit (52.22%) farmers said that, access need grants and not give for poor's.

Land: Land is the basic determinant for fertilizers adoption. If the farmers have no land, they cannot adopt. Land holding was hypothesized to have relationship with adoption and intensity of adoption.

Table 2 Descriptive statistics of income, credit access and land size of the household

income of hh	**non adopt**		**adopt**		**Total**	
	No	%	No	%	no	%
less than 1000	6	6.67	9	10	15	16.67
less than 2000	12	13.33	19	21.11	31	34.44
less than 3000	7	7.78	15	16.67	22	24.45
above 4000	6	6.67	16	17.78	22	24.45
Total	31	34.45	59	65.56	90	100
access of cradit						
No	16	17.78	31	34.44	47	52.22
Yes	15	16.67	28	31.11	43	47.78
Total	31	34.45	59	65.55	90	100
total land size						
1	1	1.11	0	0	1	2.11
2	8	8.89	9	10	17	18.89
3	9	10	7	7.78	16	17.78
4	8	8.89	17	18.89	25	27.78
5	3	3.33	9	10	12	13.33
6	1	1.11	12	13.33	13	14.11
8	0	0	5	5.56	5	5.56
9	1	1.11	0	0	1	1.11
Total	31	34.44	59	65.6	90	100

Source: Owen Survey result, 2019

4.1.2 Social Determinants

Age of the household head

Age is one of the demographic factors that is useful to describe households and provide indication about the age structure of the sample and the population. In traditional societies, age serves as an important indicator of the individual's position in the society. Older farmers will be in a position to experience much with their traditional farming practices, but they became older and older stop adopting fertilizer. According to the data the minimum age is 16& maximum age is 70 so age less than 15 is not participating in farming activities and non-adopter. As we see maximum age of respondent is 70 above this are non-adopters. Therefore, adoption is depends on active and productive age group such as the age 15-65 as we know they called productive age group.

Educational status of household

.Education plays an important role by helping decision makers to think critically and use information sources efficiently Producers with more education are more accessible to and be aware of more sources of information and more efficient in practicing and evaluating innovations as compared to their counterpart of uneducated producers. It is very important for the farmers to understand and interpret the information coming from any direction to them. Farmers' education is also pivotal for the effective work of extension personnel because if the farmer has better education status he/she can has a capability to understand and interpret easily the information transferred to them from Level of education was assumed to increase farmers‟ ability to obtain, process, and use information relevant to the adoption of fertilizer.

Education is therefore expected to increase the probability of adoption of fertilizer. From total non-adopters 34.45% were 17.78% were illiterates, 5.56% read and write, 8.89% 1-4 grade. 22.22% 5-8 grade and 0% were 9-12 grade. In the case of adopters, from the total 65.55% adopters were 33.33% illiterate, 22.22% were read and write, 15.56% were 1-4 grades, 14.44% were 5-8grade and 10% were 9-12 grade. The proportion (percentage) of illiterate adopters and non-adopters(0.19%) was smaller than that of literate adopters and non-adopters(3.13%) as indicated in the Table 4. In this study the literacy was extended from religious to attending regular school education. To see the relationship, the p value was conducted. The result of p value shows that there is a significant difference in adoption between adopters and non-adopters due to education at 1% significant level in the study area as indicated in table 4 below.

Marital status of household

Marital status were one of the determinant of households to adopt fertilizer.. As the table 4 indicate, from the total 34.45% of non-adopter farmers; 6.67%, 12.22%, 7.78% and 7.78% and In the case of adopter, 65.55%, 42.22%, 10%, 4.44% and 8.89% were married, unmarried, windowed and divorced respectively. In this study almost married householders were adopter. This is because; when persons become married they live permanent life, think more and adopt new things.

Table 3 Descriptive statistics age, education level, and marital status of household

	non adopt		adopt		Total	
age of household	**No**	**%**	**no**	**%**	**no**	**total**
16-30	8	8.89	22	24.44	30	33.33
31-64	15	16.67	20	22.22	35	38.89
abev65	8	8.89	17	18.89	15	27.78
Total	31	34.45	59	65.55	90	100
education level						
Illiterate	16	17.78	3	3.33	19	21.11
read and write	5	5.56	20	22.22	25	27.78
1-4 grade	8	8.89	14	15.56	22	24.45
5-8 grade	2	2.22	13	14.44	15	16.66
9-12 grade	0	0	9	10	9	10
Total	31	34.45	59	65.55	90	100
marital status of hh						
Married	6	6.67	38	42.22	44	48.89
unmarried	11	12.22	9	10	20	22.22
windowed	7	7.78	4	4.44	11	12.22
Divorced	7	7.78	8	8.89	15	22.78
Total	31	34.45	59	65.55	90	100

Source: Owen Survey result, 2019

4.1.3 Institutional factors

Institutional factors deal with the extent or degree to which institutions influence fertilizer adoption. Institutions include all the services to agricultural development, extension activities, input distribution and information dissemination.

Activities Given by DA This refers to the number of contacts extension agent to farmers educate farmers fertilizer use, improve seed use, manure use &land use practice in addition to this, how to use & when to use, create awareness& give training. Frequent contacts enhance the exposure of farmers about fertilizer adoption. From those activities training most effective one.100% trainers are adopters. Extensions agents give information which use manure other ways adopt fertilizer, how much amount adds to crop, and stage of crop add fertilize.

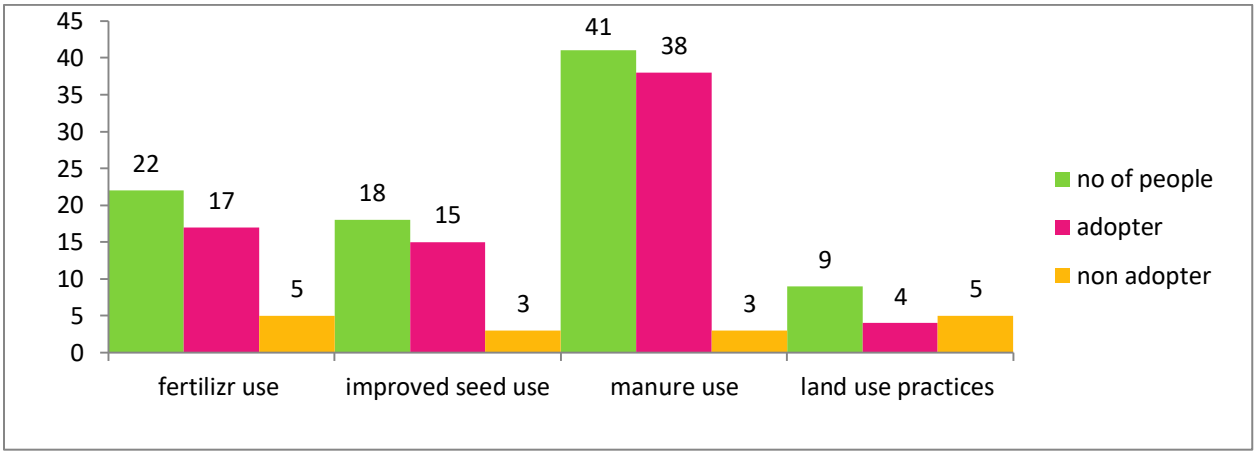


Figure 1 Advice of extension worker for farmer

Rate of Farmer's Adoption

Farmers" adoption rate depends on farmers" knowledge, extension activities, experience on farming, type of production (chat, coffee), age, land size and type of land (fertile, non fertile). Farmers that are rate of adoption rise b/c of increase production yield, decrease soil fertility and to get more profit. However, famers rate no change are non-adopter and they lake land, coffee grower, chat grower, and their land are fertile. So performance of adopter farmer is increase form time to time. From the graph adopters rate are rising, but non-adopters are no change. Farmers that have more money adoption rate are increase. However, poor farmers" adoption rates are decrease and stop when they become poorer and poorer. Reason farmers rate increases are land

adopt fertilizer and cannot grow without fertilizer. The numbers listed on the figure 2 are exact value the graph 59adopter and 31non-adopter.

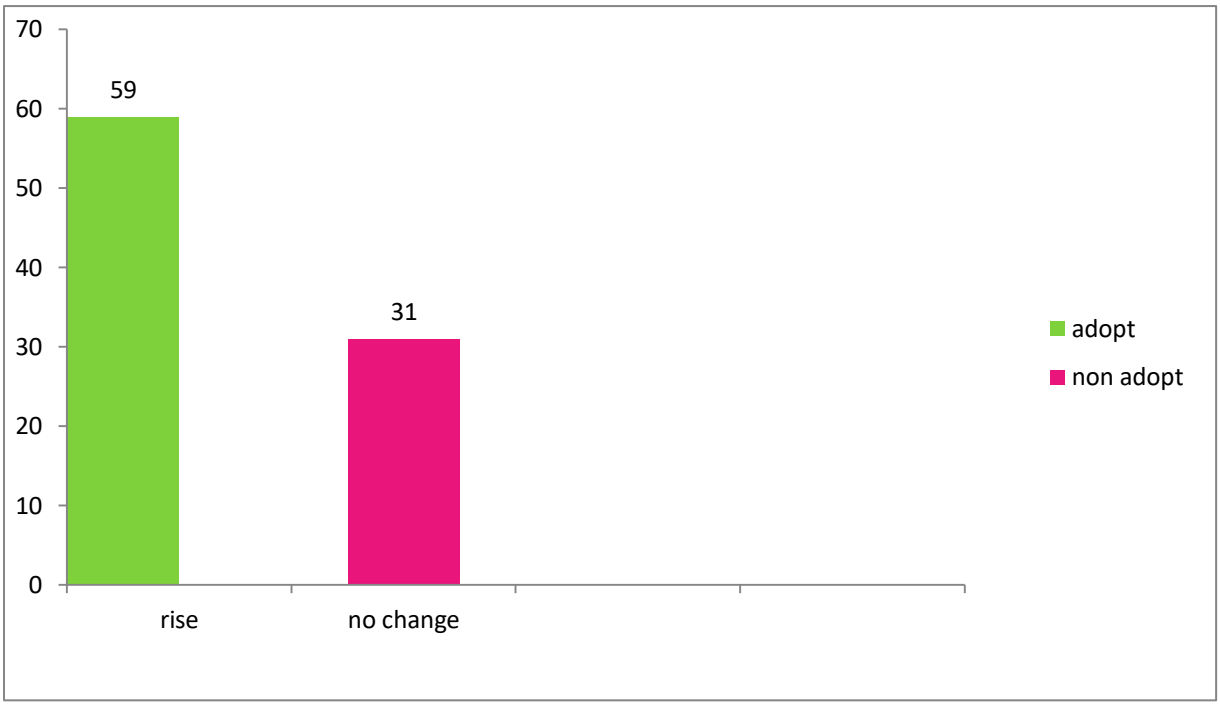


Figure 2 rate of adoption of fertilizer of the farmers

Advantages of Farmers Live Around Cultivation Area

Farmers live in different parts. They live in near farmland, medium distance, and far from cultivated land. Each have its own advantage and disadvantage on fertilizes adoption. The advantage that gate the farmer are easy application fertilizer to land, reduce labor force, and easy to manage. However, far farmlands are time killed for application fertilizer on land, increase labor force, and cannot manage easily.

4.2 Results of Econometrics Model

In the previous section, we have deal mostly with description of the sample household farmers and Identification of these factors alone is however not enough unless the relative influence of each factor is known for priority based intervention. In this section, binary logit econometric model was used to see the relative influence of different variables on adoption and status of adoption of fertilizer.

4.2.1 Factors influencing adoption

Variance Inflation Factor (VIF) and Contingency coefficients (CC) were computed to check association between continuous and discrete variables,. The VIF values shown in indicate that all the continuous explanatory variables have no serious multi collinearity problem as shown in (Appendix table 4.).

A total of 8 explanatory variables were included into the econometric model out of which four variables were found to significantly influence adoption of fertilizer; such as sex of household head, Education level of the household head, Intensity of fertilizer and farm size. Education level of house hold head and Intensity of fertilizer had a positive and a highly significant (at less than 1% significance level) in influencing the probability of adoption of fertilizer. It was hypothesized that had it had a positive impact on the adoption of fertilizer.

As the logit model indicates sex of the household had positive and significant influence on the adoption of fertilizer at 5% significance level. Hence, sex of household head was hypothesized to increase a farmer's adoption of fertilizer. As the logit model indicates, total farm size of the households had positive and significant impact on the adoption of fertilizer at 10% significance level as shown below in the table 4.

Table 4 Binary logit model results of explanatory variables

adoption	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]	*Odds Ratio*
sex	1.377724	.6317821	2.18	0.029**	.1394541	2.615995	*3.965866*
age	.1333047	.3508993	0.38	0.704	-.5544453	.8210547	*1.142598*
edu	.9934113	.297785	3.34	0.001*	.4097634	1.577059	*2.700431*
acccri	.2747396	.5907566	0.47	0.642	-.8831221	1.432601	*1.316188*
accex	-.3000058	.2851783	1.05	0.293	-.8589451	.2589334	*.7408139*
ifrz	2.001895	.6265546	3.20	0.001*	.7738707	3.22992	*7.403073*
tlsi	.3652834	.1983425	1.84	0.066***	-.0234608	.7540276	*1.440922*
income	.1669173	.2938748	0.57	0.570	-.4090667	.7429013	*1.181657*
_cons	-5.000504	1.892157	2.64	0.008	-8.709064	-1.291944	*.0067346*

*Source: model output *,**,*** represents 1%, 5% and 10% level of significance respectively*

4.2.2 Effects of changes in explanatory variables

Sex of household head: - For a male the odds of being adopted fertilizer are *3.965866* times as larger as the odds for a female being adopted This is because; most of the time male has high opportunity to get information about the Fertilizer and Fertilizer related activities for improving productivity than female in different mechanisms**.**

Education level of household:-For one unit increase in education level of the household increases, the odds of being adopted fertilizer increase by *2.700431* and approximate to 2.7.

Intensity of fertilizer (IFZR): for one unit increase the supply of fertilizer increase, the odds of being adopted fertilizer increase by *7.403073*. Because, if is available in the right amount and time it would be increase production as well as improve food security. This is in turn increases to the adoption of fertilizer by farmer.

Farm size: -for a hectare of farm size of the head of the household increases, the odds of being adopted fertilizer increase by *1.440922* ≈ 1.44. This is because, as the total land holding increases by the house hold head, the use of inputs for the farming activities increases too.

5 CONCULUSION AND RECOMANDATION

5.1 Conclusion

There are different determinants affect adoptions of fertilizer among farmers. From these determinants economic (income, access to credit, and land), social (age of household, education level and marital status and institutional (extension activity). House holed income has positive effect on adoption of fertilizer. When house holed have more money they adopt more than which have not. I.e. rich farmers adopt more than poor farmers. Access to credit has positive effect on adoption of fertilizer. When house holed have gene access to credit they adopt more than which have not. Age of people have an effect on adoption of fertilizers. When age increase they have knowledge and adopt more. Productive groups adopter but nonproductive group (young and olds) are non-adopter. Sex of farmers has positive effect on adoption. Males‟ adopter more than females. B/c of males performs farm activities‟ and social determination of an area. Education of farmer is positive effect on adoption from (table 2&3 above.

Education is crucial idea in identifying benefit and disadvantage for adoption. When farmers educate, they know about the technology's benefit and risk. Farmers Level of education increases ability to obtain, process, and use information relevant to the adoption of fertilizer. Education is therefore expected to increase the probability of adoption of fertilizer.Marital status were one of the determinant of households to adopt fertilizer.. In this study almost married householders were adopter. The logit analysis of factors affecting the adoption of fertilizer that sex of the household, farm size and education level of the household are positively influenced the probability of adoption of fertilizer.

Intensity of fertilizer (ifzr): were as show the logit model it have positively significance on fertilizer adopotion.for one unit increase the supply of fertilizer increase Because, if is available in the right amount and time it would be increase production as well as improve food security.

5.2 Recommendation

More attention of further studies and development efforts needs to be paid to technologies that require few assets. Decision makers also need to recognize technologies that build on fewer assets which the poor farmers already have are more likely to be adopted fertilizers. As the logit model indicates sex of the household had positive and significant influence on the adoption of fertilizer at 5% significance level. Hence, sex of household head was hypothesized to increase a farmer's adoption of fertilizer. As the logit model indicates, total farm size of the households had positive and significant impact on the adoption of fertilizer at 10% significance level as shown below in the table 4.There is a gape b/n male and female on adoption of fertilizer, concerned bends see such things and create avoiding discrimination of females on farms. Farmers have land problem, and government attention on teaching wise use of land. b/c land is created only once.

Educating is very important. Education level of the house hold head was found to have a positive relationship with the adoption and intensity of use of intercity of fertilizer. Providing information system to fill the gap, facilitating training of farmers. So gov,t facilitates farmers to learn. Education level of the house hold head was found to have a positive relationship with the adoption and intensity of use of. Suitable strategies for better education are another important issue that should get proper attention. Agricultural information and extension communication are powerful and crucial to achieve better adoption improved agricultural innovations like fertilizer and in this case. Appropriate and timely information should reach to the intended farmers group to achieve better adoption of improved agricultural technologies.

Ethiopia’s food insecurity problem that was caused mainly by rapid population growth and low productivity could be solved only through high investment in agriculture technology and expansion of modern fertilizer. which could exploit the maximum yield on existing cultivated land. The possibility of expanding cultivable land is almost exhausted. Hence, the cultivated land size on the farmer’s adoption decision is significant; there is a need to minimize constraints that hinder farmers from adopting the fertilizer. These include developing the awareness about the agricultural technology to farmers and providing appropriate training to farmers and agricultural development agents.

Researchers‟ give attentions on easily production of fertilizers at less cost to increase adopter level.

6 REFERRENCE

Amare Moges (2001), On-Farm Economic Analysis of Fertilizer Use in Wheat and 'teff' Production in East Gojam: The case of Machakel Woreda. M. Sc. Thesis, Unpublished Alemaya University, Alemaya

Augustine.L and Mulugeta.M. 2005. Modeling Agricultural technology adoption using the soft ware STATA, training manual presented at a training course organized by CIMMYTALP Harare Zimbabwe.

Gujarati N. 2003. Basic Econometrics .Fourth edition .United States of Military Academy, West Point.

Bank, 1995.national fertilizer project, staff appraisal report number 13722, Ethiopia

Barker, R. and Hayami Y. (2006), "Price Support versus Input Subsidy for Food self sufficiency in Developing Countries." *American Journal of Agricultural Economics*, November 1976, pp. 617-628 mentCleaver, K. M. (2006), "A Strategy to Develop Agriculture in Sub-Saharan Africa and a Focus for the World Bank "World Bank Technical Paper No. 203.

BenorD Hassison. , J, O 1997, Agricultural extension. The training and visiting of system, World Bank, Washington D.C., USA.

Bezabih Emana, 2000, the role of new Varieties and chemical fertilizer under risk the, case of small holders in eastern Oromia, Ethiopia PhD, Dissertation University of Hanover, and shaker very long Germany.

Bezabih Emana. 2001. Determinants of Multiple Technology Adoption: Defining Adopters and Empirical analysis. *Eth. Journal of Agricultural Economics*. 5(1&2): 23-39

CSA (Central Statistical Authority). 2008. Agricultural sample survey 2007/2008. Report on area and production for major crops (Private peasant holding, main season). Statistical Bulletin A.A, Ethiopia

Chilot Yirga .Shapiro ,B.I. and Mulat Demeke 1996 ,factors influencing adoption of new wheat technologies on Wolmera and Addis Alem Areas of Ethiopia ;, Ethiopia Journal of Agricultural Economics.

CSA/central statistical Authority).1992 Agricultural sample survey; report on farm management practice/ private peasant holding, meher season) statistical bulletin 3

Dasgupta, s, 1989, Diffusion of Agricultural innovations in village India Wilery eastern limited 1998, national fertilizer bench mark survey, private peasant holding both seasons

Desai, G. (2011), "Issues and Themes in Growth of Fertilizer Use in India: An Agenda for Further Research and Future Policies." *Journal of the Indian Society of Agricultural Statistics*, 43(1)

Croppenstedt, A. and Mulat Demeke (2003),*Determinants of Adoption and Levels of Demand for Fertilizer for Cereal Growing Farmers in Ethiopia.* Working Paper Series Wps/96-3. Center for the Study of African Economics, University of Oxford, England

Desai, G. (2011), "Issues and Themes in Growth of Fertilizer Use in India: An Agenda for Further Research and Future Policies." *Journal of the Indian Society of Agricultural Statistics*, 43(1)

Green D.A G and Ngongola, D.H 1993 factors affecting fertilizer adoption in less developed countries, an application of multivariate logistic analysis in Malawi, "journal of agricultural economics Htt://en.wilkpedia.org/wik/man

Gujarati N. 2004. Basic Econometrics .Fourth edition .United States of Military Academy, West Point.

Fertilizer Research (2005), "An International Journal Covering All Aspects of Fertilizers and Soil Fertility Management." Kluwer Academic Publishers, 41 (3)

Hailu beyene. 2008. Adoption of improved teff and wheat production in crop livestock mixed system in northern and western shewa zones of Ethiopia Ph. D. Thesis University of

Pretoria

Lyju Kuruvilla, Author of the book "The World of Bonsai" (2010-present)

Maddalla, G.S. 1992. Introduction to Econometrics: 2nd ed. Business Economics: University of Florida and Ohio state University, Mac Milan publishing Company, and New York.

Mohamedet.al.(2004) The Vertisols of Ethiopia, their characteristics, classification and management

Mulat Demeke, Ali said and Jayne, T.S.1997, promoting fertilizer use in Ethiopia, Addis Ababa, Ethiopia.

Mulugeta Mekuria, 1995. Technology development and transfer in Ethiopian agriculture

NFIA, 2009.field assessment report on marketing, national fertilizer industry agency (unpublished)

Rogers, E.M. 2003. Diffusion of new Innovations. New York, New York Free Press.

Rogers. E, 1969. Modernization among peasant, the impacts of communication, New York.

Sumbramanian and Nimala (2011), . Fractionation of soil phosphorus. *Soil Science* 84: 13

Teressa Adugna (2007), "Factors Influencing the Adoption and Intensity of Use of

Teressa Adugna (2007), "Factors Influencing the Adoption and Intensity of Use of Fertilizer: The Case of Lume Woreda, Central Ethiopia." *Quarterly Journal of International Agriculture*, 36 (2)

Teressa Adugna and F. Heidhues (2006), " A Simultaneous-Equation Approach to the Analysis of Factors Influencing the Adoption of Agricultural Innovations: The Case Of Inorganic Fertilizer." a paper presented on international symposium on Food Security a Innovations: Successes and Lessons Learned, March 11-13, 1996, University of Hohenheuim, Stuttgart, Germany.

Teressa Adugna, 2007. "Factors influencing the adoption and intensity of use of fertilizer; the case of Lume district, central Ethiopia quarterly journal of agricultural economics.

Tesfai Tekle (2005), “Application of Multivariate Probit Analysis to Adoption Model of New Agricultural Practices.” *Ethiopian Journal of Development Research.* 2: 43-56.

Teshome Lakew and Getachew Bekele (2000), “National Fertilizer Industry Agency, Fertilizer Marketing.” A Paper Presented to the Regional Workshop.

World Nkonya, ET.Schroeder, T. and Norman, D, 1997. “Factors affecting adoption of improved maize seed and fertilizer in northern Tanzania.” Journal of agricultural economics.

Yohanneset.al.(1990),

Phosphorus status of some Ethiopian soils. I. Sorption characteristics. *Plant and Soil* 102:261266.

7 APPENDIX

7.1 APPENDIX 1: Questionnaire

A questionnaire Developed for Determinates of Adoption of inorganic fertilizer by Smallholder Farmers in Wukiye and Yebejeyeche District, Garage Zone, SNNAP Region, Ethiopia.

Demographic Characteristics of stallholder Farmer

1. Sex of household's head: A. Male B. Female
2. Age _____yrs?
3. Marital status of the farmer A. Married B. Unmarried C. Widowed D. Divorced
4. Educational level A. Illiterate B. Read and write C. 1-4 grade D. 5-8 grade
   E. 9-12 grade F. Above grade 12
5. How does your demand to fertilizer for the purpose of crop production?

   A. High B. medium C. Low D. very low

Intensity of fertilizer

6. Which constraints do you face to use large amount fertilizer?

A. not available B. high price of fertilizer C.lack of credit D.weather not good E. low income

7. How many times you use fertilizer in one cropping season?

8. Is there are enough supply of fertilizer? A. Yes B. no

(I).If, No what is the reason----------?

9. In which tendency to adopt inorganic fertilizer belong to you are?

A. innovators B. early adopters C. followers D. laggards

Access to credit

10. Have you ever-got credit to purchase inorganic fertilizer? A. Yes B. No

.a. If yes, 1. When---------- (year) 2. Source----------

3. Rate of interest---------- (present per year)

b. If no, what are your sources of finance for purchase inorganic fertilizer?

A. Crop sales B. Livestock sales C. Off-farm activities D. Others (specify) _____

Total land size

11. Land size and ownership:

Land size_____(timad) Cultivated_____-(timad)
Uncultivable_____(timad)

12. Do you have any problems in getting credit? A. Yes B. No

13. If yes, what is the nature of your credit problems? (Rank or prioritize them)

A. Bank loans not available B. Do not have required collateral

C. Loans from informal sources not available D. Repayment terms are unfavorable

E. Interest rates are too high F. Others (specify)_____

14. Was collateral required to obtain credit? A. Yes B. No

15. If yes, what was the collateral? A. Land B. Animal C. Future income D. Building

Extension contact

16. How many Extension worker are there in your kebele ----------?

17. How many times contact with extension agents? A. Once per week B. Twice per week

C. Every three weeks D. Once per month E. Others_____

18. Usual type of visit by extension worker? 1. Individual-------- 2. Group----------

19. Types of extension messages given by the agents?

A. Fertilizer use B Improved seed use D. Manure use E. Land use practices F. Use of credit

Market

7.2 Appendix 2

Logistic regression — Number of obs = 90; LR chi2(8) = 42.45; Prob > chi2 = 0.0000; Log likelihood = -36.727631; Pseudo R2 = 0.3663

adoption	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
sex	1.377724	.6317821	2.18	0.029	.1394541	2.615995
age	.1333047	.3508993	0.38	0.704	-.5544453	.8210547
edu	.9934113	.297785	3.34	0.001	.4097634	1.577059
acccri	.2747396	.5907566	0.47	0.642	-.8831221	1.432601
accex	-.3000058	.2851783	-1.05	0.293	-.8589451	.2589334
ifrz	2.001895	.6265546	3.20	0.001	.7738707	3.22992
tlsi	.3652834	.1983425	1.84	0.066	-.0234608	.7540276
income	.1669173	.2938748	0.57	0.570	-.4090667	.7429013
_cons	-5.000504	1.892157	-2.64	0.008	-8.709064	-1.291944

7.3 Appendix 3

Logistic regression — Number of obs = 90; LR chi2(8) = 42.45; Prob > chi2 = 0.0000; Log likelihood = -36.727631; Pseudo R2 = 0.3663

adoption	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
sex	3.965866	2.505563	2.18	0.029	1.149646	13.68082
age	1.142598	.4009369	0.38	0.704	.5743908	2.272896
edu	2.700431	.8041479	3.34	0.001	1.506461	4.8407
acccri	1.316188	.7775467	0.47	0.642	.4134899	4.189583
accex	.7408139	.2112641	-1.05	0.293	.4236087	1.295547
ifrz	7.403073	4.63843	3.20	0.001	2.168142	25.27763
tlsi	1.440922	.2857962	1.84	0.066	.9768122	2.125544
income	1.181657	.347259	0.57	0.570	.6642699	2.102025
_cons	.0067346	.0127428	-2.64	0.008	.0001651	.2747362

7.4 APPENDIX 4

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. estat vif
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Variable	VIF	1/VIF
income	1.07	0.937547
edu	1.06	0.945698
marsta	1.06	0.946394
age	1.03	0.966347
accex	1.01	0.994620
Mean VIF	1.04	