DETERMINANTS OF ADOPTION OF IMPROVED HARICOT BEAN PRODUCTION PACKAGE IN ALABA SPECIAL WOREDA, SOUTHERN ETHIOPIA.

M. Sc. Thesis

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Haramaya University

DETERMINANTS OF ADOPTION OF IMPROVED HARICOT BEAN PRODUCTION PACKAGE IN ALABA SPECIAL WOREDA, SOUTHERN, ETHIOPIA

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By
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As Thesis Research advisor, I here by certify that I have read and evaluated this thesis prepared, under my guidance, by Rahmeto Negash, entitled **Determinants of Adoption of Improved Haricot Bean Production Package in Alaba Special Woreda, Southern Ethiopia.** I recommend that it be submitted as fulfillment of the Thesis requirement.

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_____ External Examiner	_____ Signature	_____ Date

DEDICATION

This thesis is dedicated to my Mother who sacrificed much to bring me up to this level.

STATEMENT OF AUTHOR

First, I declare that this thesis is the result of my own work and that all sources or materials used for this thesis have been duly acknowledged. This thesis is submitted in partial fulfillment of the requirements for an advanced M.Sc. degree at Haramaya University and to be made available at the University's Library under the rules of the Library. I confidently declare that this thesis has not been submitted to any other institutions anywhere for the award of any academic degree, diploma, or certificate.

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BIOGRAPHY

The author was born in SNNPR, Alaba Special Woreda in 1981. He attended his primary and high school education at Alaba Ediget primary school and Alaba comprehensive Senior Secondary School, located in the Alaba Kulito town, capital of the woreda. He then joined the then Alemaya University in September 2000 and graduated with B.Sc. degree in Agricultural Extension in July 2003.

After his graduation, he worked in Alaba Special woreda Office of Agriculture and rural development as a training expert until he joined Haramaya University for his postgraduate study in 2005.

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ABBREVIATIONS AND ACRONYMS

ANOVA	Analysis of Variance
CIMMYT	International Maize and Wheat Improvement Center
^{0}C	Degree Celsius
CSA	Central Statistical Authority
EARO	Ethiopian Agricultural Research organization
FDRE	Federal Democratic Republic of Ethiopia
GDP	Gross Domestic Product
Ha	Hectare
IAR	Institute of Agricultural Research
Kg	Kilogram
Km	Kilometer
LDCs	Less Developed Countries
LPM	Linear Probability Model
m.a.s.l	Meter Above Sea Level
Min	Minimum
Max	Maximum
MEDac	Ministry of Economic Development and Cooperation
MoARD	Ministry of agriculture and rural development.
mm	millimeter
NGOs	Non Governmental Organizations
NSRC	North Central Rural Sociology Committee
SD	Standard deviation
SNNPR	Southern Nation's Nationalities People's Region
SPSS	Statistical Package for Social Science
TLU	Total Livestock Unit
VIF	Variance Inflation Factor

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DETERMINANTS OF ADOPTION OF ADOPTION OF IMPROVED HARICOT BEAN PRODUCTION PACKAGE IN ALABA SPECIAL WOREDA, SOUTHERN ETHIOPIA

ABSTRACT

Haricot bean is considered as the main cash crop and protein source of the farmers in many low lands and mid altitude zones of Ethiopia. The country's export earning from haricot bean exceeds that of other pulses such as lentils, horse bean and chickpea. Low production and productivity, which are mainly associated with poor adoption of improved technologies and poor marketing system, were among the major problems. Adoption of improved technologies is one of the most promising ways to reduce food insecurity in Ethiopia. However, the adoption and dissemination of these technologies is constrained by various factors. To this end, the aim of this study was to empirically examine factors affecting adoption and intensity of adoption of improved haricot bean production package in the study area. Two stage sampling procedure was followed to select rural kebeles and households for the study. Four rural kebeles were selected purposively, and 160 household heads were selected randomly using probability proportional to size sampling. Structured interview schedule was developed, pre-tested and used for collecting the essential quantitative data for the study from the sampled households. Focus group discussion was used to generate qualitative data. In addition, secondary data were collected from relevant sources such as woreda office of agriculture and rural development and others. The result of the study indicated that majority of farmers in the study area preferred local variety over improved because of local market and consumption demand. Moreover, farmers' practice was found largely to deviate from research and extension recommendations. Result of the econometric model indicated that household head's attitude towards haricot bean production technology package, participation in extension event (participation in training and field visit) and access to credit were important variables which had positively and significantly influenced adoption and intensity of adoption of improved haricot bean production package. Where as, perceived relative disadvantage of technology attributes of the household head had shown negative relationship with adoption and intensity of adoption. Some farmers who previously adopted improved haricot bean varieties have discontinued planting the varieties mainly due to market problem. The overall finding of the study underlined the high importance of institutional support in the areas of extension; credit and market to enhance adoption of improved haricot bean production package. Therefore, policy and development interventions should give emphasis to improvement of such institutional support system so as to achieve wider adoption, increased productivity and income to small scale farmers.

1. INTRODUCTION

1.1. Background

Agriculture is the basis of the Ethiopian economy. It accounts for a little over 50 percent of the GDP and 90 percent of the total export revenue and employs 85 percent of the country's labor force. The average share of crop production, livestock production and forestry and other sub-sectors in the total agricultural value added is estimated to be about 60, 27, and 23 percent, respectively (MEDac,1999). Low productivity characterizes Ethiopian agriculture. The average grain yield for various crops is less than one metric ton per hectare (CSA, 2002).

The livestock sub-sector plays an important role in the Ethiopian economy. The majority of smallholder farmers depend on animals for draught power, cultivation and transport of goods. The sub-sector also makes significant contribution to the food supply in terms of meat and dairy products as well as to export in terms of hides and skins, which makes up the second major export category. However, the productivity of the sub-sector is decreasing as a result of poor management systems, shortage of feed and inadequate healthcare services.

Despite the importance of agriculture in its economy, Ethiopia has been a food deficit country since the early 1970s. A closer look at the performance of the Ethiopian agriculture reveals that over the last three decades it has been unable to produce sufficient quantity to feed the country's rapidly growing human population. Even worse, the country has experienced recurrent droughts that claimed the lives of several thousands of people. It is noteworthy that food aid has been accounting for a significant proportion of the total food supply in the country. For instance, Ethiopia received 726,640 metric tons of food aid yearly over the 1985-2000 periods (FDRE, 2002). This amounts to 10 percent of the national food grain production.

One of the principal causes of the prevailing structural food deficit in the country is the low level of utilization of output enhancing inputs. On this point, MEDac (1999) pointed out that the Ethiopian farmer continues to use low fertilizer rates which are estimated to be an average

of 7 Kg of nutrients per hectare of arable land as compared to a sub-Saharan average of 9 Kg nutrients per hectare of arable land. The world average stood at 65 Kg per hectare (ibid).

In addition to the low rate of adoption of modern agricultural inputs, the decreasing size of farms, which resulted in shorter fallow periods and even continuous cropping, contributed to the low productivity of the agricultural sector. Ethiopian agriculture is virtually small scale, subsistence-oriented and crucially dependent on rainfall. More precisely, more than 95 percent of the country's agricultural output is generated by subsistence farmers who use traditional tools and farming practices. The population pressure in rural areas has contributed to the decreasing size of farms and cultivation of impoverished soils on slopy and marginal lands that are generally highly susceptible to soil erosion and other degrading forces. In the 1999/ 2000 production year, about 69 percent of the households owned farms of less than or equal to one hectare in size whereas only 0.5 percent of the agricultural households possessed a farm size of greater than 5 hectares (CSA, 2002).

Haricot bean is considered as the main cash crop and protein source of farmers in many low lands and mid altitude zones of Ethiopia. The country's export earning from haricot bean exceeds that of other pulses such as lentils, horse bean and chickpea. For example, out of 44 million Birr export earnings from pulses and oil seeds during the 1989/90 fiscal year, the share of haricot bean was 37 million Birr or 85.5 % (IAR, 1990).

The crop is grown by subsistence farmers either as a sole crop and/or intercropped with either cereal or tree crops. Shade tolerance and early maturity contributes to haricot bean's prominent position as understorey intercrop for sorghum, maize, and coffee in the eastern zones of the country in which 85 % of all sorghum is intercropped with beans (Shimelis *et al*.1990). Therefore, these characteristics make it an ideal crop for intensification of existing farming system.

Although beans are largely grown in Ethiopia, the national average yield amounts to 0.8-0.9 t/ha under peasants farming condition (CSA, 1995). This low yield is attributed to various

constraints related to drought, lack of improved varieties, poor cultural practices, disease, and environmental degradation (IAR, 1990).

Haricot bean is an important part of human diet in Ethiopia. It is among the most important food legumes produced in the country, which has been cultivated as a field crop for a very long time (Amare, 1987). Moreover, it has been an export crop for more than 40 years (Teshome and Kirkby, 1990).

Haricot bean stands out among the pulses and is also known as "the poor man's meat" due to its high protein content, which compensates for the deficiency that could have occurred in a population with low income. Different types of haricot beans are grown in Ethiopia. These include white pea beans, grown in the central Ethiopia (Shoa) as cash crop, colored beans grown in the southern part of Ethiopia for local consumption and climbing beans grown in the north west (Metekel) and western Ethiopia (Wollega). Climbers are planted along fences and on the borders of maize fields (Zelalem, 2002).

The national agricultural research system has generated a number of improved agricultural technologies and recommendations such as crop variety, agronomic practices, crop protection measures as well as other technical advices and practices. In Alaba special woreda, improved haricot bean technologies are being promoted by government. The technologies promoted include improved varieties, recommended fertilizer rates and types, improved agronomic and weed control practices.

The adoption and intensity of use of agricultural technologies are not yet assessed in the study area. Past studies reveal that adoption of agricultural technologies has attracted considerable attention among development economists because the majority of the population of less developed countries (LDCs) derives its livelihood from agricultural production and new technologies offer opportunity to increase production and income sustainably.

This study provided primary information on the factors affecting adoption of haricot bean technologies in the study area. It will also addressed the level of adoption and constraints to

the adoption of haricot bean technology package. Adoption study also provides research, extension, development institutions and policy makers with valuable information that assists in improving the efficiency of communication among them. It can also play an important role in demonstrating the impact of research and extension efforts and in justifying continued support and funding. In addition, adoption studies can contribute to improving the efficiency of agricultural research, technology transfer, input provision and agricultural policy formulation (CIMMYT, 1993).

1.2 Statement of the problem

The major challenges facing most of developing countries such as Ethiopia is improving rural as well as 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 extensification, because there are limited opportunities for area expansion. Hence, the solution to food problem would depend on measures, which help to increase yield through intensification.

In Ethiopia, adoption of improved agricultural technologies has been a long term concern of agricultural experts, policy makers, and agricultural research and many others linked to the sector. However, evidence indicates that adoption rate of modern agricultural technologies in the country is very low (Kebede *et al.* 1990).

The adoption of agricultural innovation in developing countries attracts considerable attention because it can provide the basis for increasing production and income. Small scale farmers' decisions to adopt or reject agricultural technologies depend on their objectives and constraints as well as cost and benefit accruing to it (Million and Belay, 2004). Hence, farmers will adopt only technologies that suit their needs.

Several factors influence adoption of agricultural technologies. Studies so far conducted on major cereal crops have reported various factors influencing adoption. However, information

with regard to pulse crops in general and haricot bean production in particular is scanty. Moreover, previous studies have focused mainly on factors affecting adoption of improved variety alone.

Haricot bean technology package consisting of improved seed, seeding rate, fertilizer rate and spacing was introduced to the study area to improve the food security status. Despite such intervention adoption of improved haricot bean production package is still very low. Moreover, there is also variation among farmers in their intensity of adoption of improved haricot bean production package. However, so far there is no empirical information about the extent of adoption, various factors influencing adoption and intensity of use of the package. Therefore, this study was proposed to analyze determinants of adoption and intensity of use of haricot bean production technology package to fill the existing knowledge gap.

1.3. Objectives of the study

The general objective of this study is to identify factors influencing adoption and intensity of adoption of haricot bean technology package.

The specific objectives of this study are:

- to assess the intensity of adoption of recommended haricot bean package among the adopters, and
- to identify factors influencing adoption and intensity of adoption of improved haricot bean production package in the study area.
- to suggest policy interventions that would enhance or facilitate adoption.

1.4 Research questions

- What is the intensity of adoption of haricot bean technology package among adopters?

- What are the factors influencing adoption and intensity of adoption of haricot Bean technology packages?

1.5 Significance of the study

All development partners like extension educators, technical assistants, NGOs and other development agents involved in agricultural development must be aware and understand the factors affecting the adoption of a new technology and level of adoption of new technology in order to target and extend appropriate technologies to farmers. It is also important for policy makers to know the critical factors that could accelerate their use. This could facilitate allocation of major resources for research, extension and development programs. Hence, this study will attempt to find out factors affecting adoption of haricot bean technology package and its level of adoption by smallholder farmers' in the study area. It is expected that this study will serve as a spring board (facilitator) to undertake detailed and comprehensive studies in another woredas.

1.6 Scope and limitation

This study was undertaken in one woreda, namely Alaba special woreda which is in the SNNPR. The adoption of new technology is influenced by many factors. A factor which is found to enhance adoption of a particular technology in one locality at one time might be found to hinder it or to be irrelevant for adoption of the same technology in another locality at the same or different time for the same or different crops or the other way round. Therefore, it is difficult to identify universally defined factors either impeding or enhancing adoption of technology. This study was restricted to identification of factors influencing and assessing level of adoption of haricot bean technology package in the above mentioned woreda. In addition to the spatio-temporal issue, this study also had resource limitation (budget and time) consequently; its results will have practical validity mainly to areas having similar features with the selected woreda.

2. REVIEW OF LITERATURE

2.1 Definition of adoption

The adoption of an innovation within a social system takes place through its adoption by individuals or groups. According to Feder *et al*. (1985), adoption may be defined as the integration of an innovation into farmers' normal farming activities over an extended period of time. Dasgupta (1989) noted that adoption, however, is not a permanent behavior. This implies that an individual may decide to discontinue the use of an innovation for a variety of personal, institutional, and social reasons one of which might be the availability of another practice that is better in satisfying farmers' needs.

Feder *et al*. (1985) classified adoption as an individual (farm level) adoption and aggregate adoption. Adoption at the individual farmers' 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 diffusion process as the spread of new technology within a region. This implies that aggregate adoption is measured by the aggregate level of specific new technology with a given geographical area or within the given population.

Rogers (1983) defines the adoption process as the mental process through which individual passes from first hearing about an innovation or technology to final adoption. This indicates that adoption is not a sudden event but a process. Farmers do not accept innovations immediately; they need time to think over things before reaching a decision.

The rate of adoption is defined as the percentage of farmers who have adopted a given technology. The intensity of adoption is defined as the level of adoption of a given technology. 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 will be referred to as the intensity of adoption of the respective technologies (Nkonya *et al.,* 1997).

2.2. Theoretical Background

The study on the diffusion of agricultural innovations originated in the United States in the 1920s, by rural sociologists, when the U.S. Department of Agriculture decided to evaluate the process of their program of introducing improved farming practices among farmers. The study, which received the greatest attention among social scientists, was the one conducted by Byre Ryan and Neal Gross (1943, 8:15-20) on the diffusion of hybrid seed corn in two Iowa communities. The finding of this study showed for the first time that the adoption of innovations by farmers involved a combination of processes. The study by Ryan and Gross inspired a large volume of rural sociological research on the diffusion of agricultural innovation which grew rapidly in the 1950s and 1960s in the United States, and influenced the beginning of similar studies in the other countries (Dasgupta, 1989).

Everybody does not adopt new idea or practice at the same time. Rogers (1962) suggests that it is the time variable, which allows researchers to classify adopter categories and to plot diffusion curves. Research has generally shown that the adoption of an innovation follow a normal, bell-shaped curve when plotted, the result is an S-shaped curve. Similarly, Lionberger (1968) and Rogers (1981) indicates that ordinarily adoptions are very slow at first. After an initial slow start, they increase at an increasing rate until approximately half of the potential adopters have accepted the change. After this, acceptance continues, but at a decreasing rate. Rogers and Shoemaker (1971) also indicated that the S-shaped adopter distribution rises slowly at first when there are few adopters in a time period. Then it accelerates to a maximum when half of the individuals in the system have adopted. It then increases at a gradually rate as the few remaining individuals finally adopted.

A lot of hypotheses have been forwarded to explain the S-shaped nature of the diffusion curve. Mansfield (1961) suggested that the rate of diffusion is a function of the extent of economic merit of the innovation, the amount of investment required to adopt the innovation and degree of uncertainty associated with the innovation.

It takes time for an innovation to diffuse through a social system. It is unrealistic to expect that all farmers in a community will adopt an innovation immediately after its introduction. There is always a variation among the members of a social system in the way they respond to innovative idea or practice. While there are always a few members in a social system who are so innovative that they adopt an innovation almost immediately after they come to know about it, the majority take a long time before accepting the new idea or practice. It is the first few adopters of an innovation who influence the other members of a community to adopt the innovation (Dasgupta, 1989). Moreover, people adopt the innovation in an ordered time sequence, and they may be classified into adopter categories on the basis of when they first begin using the new idea.

Dasgupta (1989) indicates that the decision to adopt an innovation is not normally a single, instantaneous act and it involves a process. The adoption is a decision making process involving a period of time during which an individual goes through a number of mental stages before making a final decision to adopt an innovation. Lionberger (1968), and Rogers and Shoemaker (1971) indicate that innovation decision process as the mental process through which an individual passes from knowledge of innovation to a decision to adopt or reject and to confirmation of this decision.

Dasgupta (1989) also claims that all innovations do not diffuse at the same rate. An innovation, which represents only a single modification of an existing idea or practice, will obviously diffuse at a faster rate than the one, which represents a significant departure from it.

Although farmers often reject an innovation instead of adopting it, non adoption of an innovation does not necessarily mean rejection. Farmers are sometimes unable to adopt an innovation, even though they have mentally accepted it, because of economic and situational constraints (Dasgupta, 1989).

As can be seen from the foregoing discussion or theoretical concepts, there are some deep rooted reasons, which hinder or facilitate the adoption of new technology/ creates wide gap in adoption of new technology. For the long period of major attention was given to the

introduction of new innovation to different target groups in different part of the world. It was expected that the introduction of this new innovation simply would bring substantial change on the life of people and agricultural production and productivity. Different variables that negatively and/or positively associated with adoption of new technology were not well considered. Moreover, the approaches (For example, TOT) were expert oriented. The beneficiaries have not actively participated in the technology development process. The indigenous technical knowledge, which can play a vital role in improving and enhancing technological development process, was overlooked. Therefore, the question of why the adoption of technology is hindered or enhanced could be mainly related to identification of their situational factor through active participation of farmers and appreciation of indigenous technical knowledge, in addition to other major variables. And also one means of narrowing the wide adoption gap among the farmers is concentrating our attention on local community and their general environmental situations.

2.2.1. The classical five-stage adoption process

The classical five-stage adoption process model which was formulated by the North Central Rural Sociologists Committee (1961) was the dominant model until it was modified by Rogers and Shoemaker (1971). According to Campbell (1966; 459) the classical five –stage adoption process model was developed from the recognition that adoption of an innovation often is not an instantaneous act. Rather it is a process that develops over a period of time and influenced by a series of actions. The model composed of five stages namely awareness, interest, trial, evaluation and adoption.

2.2.2. The innovation decision process

Some guidelines, perhaps more useful from extension approach or strategy point of view, was evolved from propositions concerning the adoption process. The classical 5-stage concept (awareness, interest, evaluation, trial, adoption) as formulated by the North Central Rural Sociologists Committee (1961) was widely accepted in spite of valid criticism voiced, amongst others, by Campbell (1966) and later also by Rogers and Shoemaker (1971) who

then designed the innovation decision process (Duvel, 1991: 74) This model was later revised by Rogers (1983) and is presented as follows

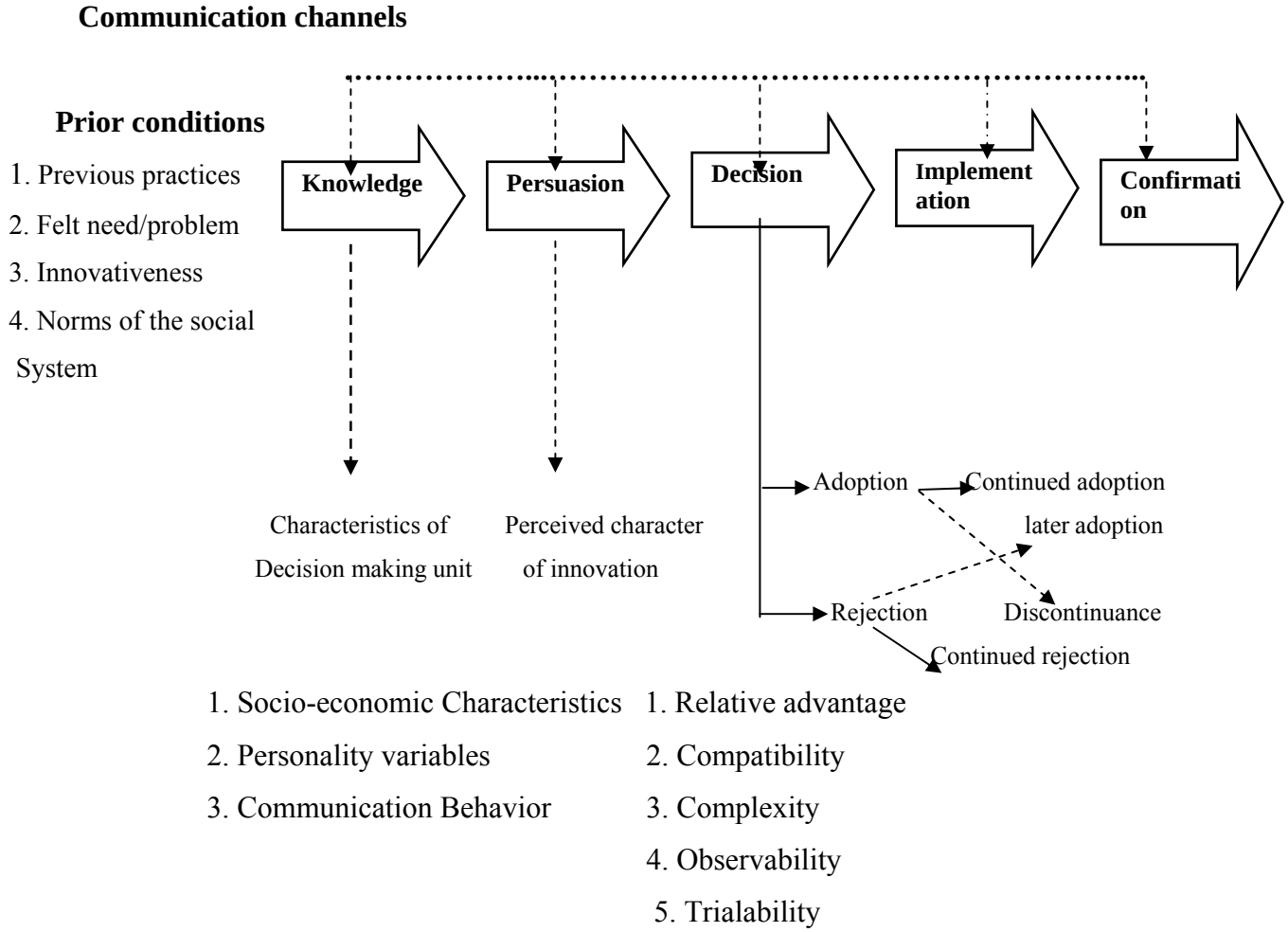

Figure 1. The Innovation Decision Process (Rogers, 1983)

The innovation decision is the process through which an individual or other decision making unit, extension organization, for example, passes from first knowledge of an innovation to forming an attitude towards the innovation, to decision to adopt or reject, to implementation of the new idea, and to the confirmation of the decision (Rogers, 1983:163). This model has five stages, the first being the knowledge stage in which the individual becomes exposed first to the new idea and develops some understanding of it. The second phase is persuasion, during which individuals either persuades them or is open to persuasion by others. At this stage too, an attitude towards the innovation evolves. The third stage is decision, when the

farmer decides to adopt or reject the new idea. The fourth stage is implementation when the individual implements the decision he made in the previous stage. Finally, there is confirmation in which the individual continues to question the wisdom of his decision once the decision to adopt the innovation has been made.

With regard to the relationship of technological attributes with farmers' adoption decision, Rogers (1995) identified five characteristics of agricultural innovations, which are important in adoption studies. These includes 1) Relative advantage 2) Compatibility 3) Complexity 4) Trialability and 5) Observability. Rogers (1995) defines these characteristics as follows

Relative advantage: Is the degree to which an innovation is perceived as better than the idea it supersedes.

Compatibility: the degree to which the farmer perceives an innovation to be consistent with his/her cultural values and beliefs, traditional management objectives, the existing level of technology and stages of development.

Complexity: the degree to which an innovation is perceived to be complex to understand and use by farmers.

Trialability: the degree to which the innovation could easily be tried by farmer on his/her farm

Observability: the degree to which results of innovation are visible to farmers.

2.3 Haricot Bean Production and its Economic Importance in Ethiopia

The world haricot bean production is estimated to be about 17 million metric tons with an average of 26 million hectares (FAO, 1994), which makes the crop the most widely utilized of legumes. It is an important source of protein and energy in human diets in the tropical and sub-topical developing countries, particularly in the Americas and Eastern and Southern Africa (Walelign, 2002). It is produced for its green pod and dry seed which are both edible. Moreover, haricot bean is an important understorey component crop in various intercropping systems throughout the world (ibid.).

According to EARO, Low Land Pulses Research Strategy Document (2000), the central part, mainly the Rift Valley and lake areas of the country rank first in hectarage (48 percent) and

production (55 percent) of low land pulses in Ethiopia. This part is particularly important for the white pea beans that are desired for export markets. The southern part that consists of Sidamo and Gamo Gofa accounts for about 25 percent of area under low land pulses. The major types of beans in this area are red and speckled types grown for food. However, red kidney beans are also exported to countries like Pakistan, although the total volume is low relative to white pea beans. The eastern part constitutes mainly Harerghe highlands where low land pulses are dominant crops grown mainly for food. As in the southern part, farmers produce beans twice a year. Generally, colored food beans and small whites are grown in the eastern part. The western part including Wellega, Kefa and Illubabor, which accounts for 17.50 percent of land area occupied by low land pulses. The northwestern part includes Pawe and Chagnie area accounting for five percent of land area occupied by low land pulses. The northern part includes Sirinka, Kobo, Mekele and Adet areas accounting for less than five percent of the area under lowland pulses (ibid).

Haricot bean is grown predominantly in low land area (300-1100m) and some mid highland areas (1400-2000m) of the country. Nationally, area under haricot bean production is estimated at 300-500 thousand hectares (IAR, 1995; EARO, 2001). However, according to the official statistics of the country, CSA (2000), haricot bean was grown on about 166 thousand hectares of land in 1999/00, and ranked third next to horse bean and chick peas, and the average haricot bean productivity was about 8 quintal per hectare. However, the experience from experimental plots indicates that 25-30 quintal per hectare can be obtained (EARO, 2001). Haricot bean production is heterogeneous in terms of ecology, cropping system and yield (Belay et al., 1998). Haile (1990) mentioned that both production and volume of export declined in the years between 1976-87 mainly due to low production technology, fragmentation of holdings and drought. Production started to rise again since 1989. This could probably be attributed to a number of reasons including increased use of haricot bean as a substitute crop due to ill distribution and unreliability of rainfall, improved private export opportunities and emergence of larger private farms. With regard to economic importance of haricot bean, it is used as source of foreign currency, food crop, means of employment, source of cash, and plays great role in the farming system.

2.4 Empirical studies

Feder *et al.* (1985) summarized the vast amount of empirical literature on adoption and indicated that the constraints to adoption of a new technology may arise from many sources, such as lack of credit, inadequate farm size, unstable supply of complementary inputs, limited access to information, uncertainty and so on. Schultz (1995) suggested many testable hypotheses: that the probability of adoption of a new technology will depend on the difference in profitability between the new and old technologies, and the ability of the farmer to perceive the advantages and efficiently utilize the new technology.

Kebede *et al*. (1990) conducted a study on adoption of new technologies in Ethiopian agriculture in Tegulet-Bulga district, Shoa province and found that education level of farmers had positive effect on the adoption of new technologies in Ethiopian agriculture.

A study conducted by Degnet and Belay (2001) on factors influencing the adoption of high yielding maize varieties in southwestern Ethiopia underlined those factors such as age of the farmers, frequency of contact with extension workers, annual on-farm income level and farmers' knowledge of fertilizer use and its application rate significantly affected farmers adoption decision.

Wolday (1999) conducted a study to understand the major factors which dictate the use of improved seeds in Ethiopia and reported that, price of inputs, access to credits, fertilizer use, economic status of the household, size of land owned, visits of extension agents and infrastructure development are the principal determinants of the adoption of improved seed.

Teressa and Heidhues (1996) in their study on factors affecting the adoption of fertilizer in Lume area, found that extension service, number of oxen owned, access to credit and hired labor were among the important determinants of the decision to adopt fertilizer. The rate of adoption was attributed to farm size, family size, access to credit, hired labor and off farm income.

A study conducted by Chilot (1994) in Welmera and Addis Alem areas of Ethiopia showed that the adoption of improved wheat seeds is positively and significantly influenced by the wealth status of the farmers, farmers' contacts with extension agents and availability of fertilizer on time. He underlined that the distance to an extension office from a village influences the adoption of improved wheat seed negatively and significantly. He goes on arguing that the higher the incremental net benefit of the improved technology over the traditional practice, the higher the probability and rate of adoption. However, the effect of other factors like area cultivated, literacy, livestock ownership and farmer's years of experience are found to be non significant.

Study by Degnet (1999) in Mana and Kersa woreda, Ethiopia, showed that the number of oxen owned by a farmer determines maize technology adoption. The study has revealed that availability of off- farm income opportunity and wealth status of the head of household affects adoption of maize technology significantly.

Asfaw *et al*.(1997) in Bako area reported that participation of farmers in extension activities (which is represented by farmers attendance at the field days) is the only variable which is found to significantly influence the adoption of improved maize variety. The same study showed that the adoption of fertilizer technology in maize production is influenced positively and significantly by the farmers' use of credit and by the level of formal education of farm household head.

The study conducted by Lelissa (1998) on determinants of fertilizer adoption, intensity and probability of its use in Ejere district, west Shoa zone of Ethiopia has also shown that agro-climatic conditions, access to credit, extension service, oxen ownership, age of the farmer, family size, farmers' level of education, distance to fertilizer distribution center and cropping pattern are the most important determinants of fertilizer adoption and intensity of its use.

Tesfaye *et al*.(2001) conducted a study on the adoption of high yielding maize technology in major maize growing regions of Ethiopia and the results revealed that distance to the nearest

market center ,family size, livestock holding in terms of tropical livestock unit, access to credit, significantly and positively influence the adoption decision of improved maize.

Most of the work done on adoption behavior focused on only independent variables. Duvel (1991) is perhaps the only researcher who did research on the psychological aspects of technology (innovation) transfer and adoption in South Africa. He developed a "revised extension program model'' which offers a big scope for improvement in extension directly influenced by a new approach towards behavior change. In 1994 he also developed a model of technology transfer in agricultural development on the assumption that certain "intervening'' variables influence adoption behavior directly, while the influence of more independent variables only shows its effect via the intervening variables (Duvel,1994).

In a further study in 1994 he also developed a model to determine adoption behavior and found that personal and environmental factors are the independent variables, while needs, knowledge and perception are the intervening variables and adoption of practices and efficiency are the dependent variables. Non adoption of new technologies can be traced back to unwillingness (a lacking need) or incapability (related to aspects of perception and knowledge) to adopt (Duvel, 1994).

Following Duvel, Habtemariam studied the influence of intervening variables on adoption behaviors and production efficiency in Ethiopia. Adoption behaviors and production efficiency were hypothesized to be a function of personal and environmental factors, which in turn are divided into independent and intervening variables identified by Duvel (Habtemariam, 2004).

Farmers' subjective perceptions of new technologies in light of prevailing socioeconomic environment condition their adoption behavior. The concept of adopter perception can now be found in varied agricultural economics literature (Adesina and Zinah, 1993). Quantitative studies that have considered farmers' perception in context of adoption decisions have included farmers' perception of new technology. Farmers are considered to have subjective preferences for specific characteristics inherent in new technologies or innovations. These

preferences are assumed to play a significant role in technology adoption. Adoption of technologies by farmers reflects rational decision-making based up on farmer perceptions of appropriateness of the characteristics of the technology under investigation. Empirical evidence provided by Duvel (1975) on the role of perception on behavior and behavioral consequences supports the assumption that the influence of the independent variables becomes manifested in behavior via the intervening or mediating variables. Subsequent findings by Louw and Duvel (1978) have reaffirmed that the mediating function of perception together with needs and knowledge.

A large number of personal, situational and social characteristics of farmers have been found to be related to their adoption behaviour. Based on this idea, Dasgupta (1989) tried to compare the adoption behaviour of both adopters and non adopters. Adopters of farming practices tend to be middle aged, have a high rate of literacy and a higher level of formal education, operate large-sized holdings, own the land they operate, have a relatively high income and economic status, are commercial in farming orientation, have relatively high level of social participation, and tend to be cosmopolite in orientation, have relatively high level of extension contact, and belong to upper socio-economic status categories. Non adopters, on the other hand, are relatively old in age, have a low rate of literacy and level of formal education, operate smallholdings, are mostly share-croppers or small and marginal farmers, belong to low income and economic status, have a subsistence orientation to farming, have a low level of extension contact, and come from low socioeconomic status categories.

2.5. Analytical Framework

The behavioral change process involves decision-making, which implies cognitive engagement in deciding whether and how to change (Koch, 1986:19). Adoption of new innovation being the outcome of such behavioral change process involves such decision-making. Different theories of adoption and diffusion, for example the one by Rogers (1962) also indicates that adoption is a mental process of deciding on whether to adopt a given technology or not.

As it can be understood from the behavioral theories reviewed in the previous section, behavioral change such as adoption of new innovation is not an instantaneous act, rather it is a process. It involves a series of decision- making stages which implies a cognitive engagement in the process. On the other hand, adoption decision is affected by a multitude of factors including both psychological and other situational factors.

The analytical framework for this study was developed based on the theoretical models of adoption and diffusion discussed in the previous sections. In the analytical framework the different factors supposed to affect farmers' adoption behavior particularly those which contribute to the variations in adoption and intensity of adoption of improved Haricot bean production package among farmers were considered. The framework emphasized mainly on the relationship of the explanatory variables with the dependent variable.

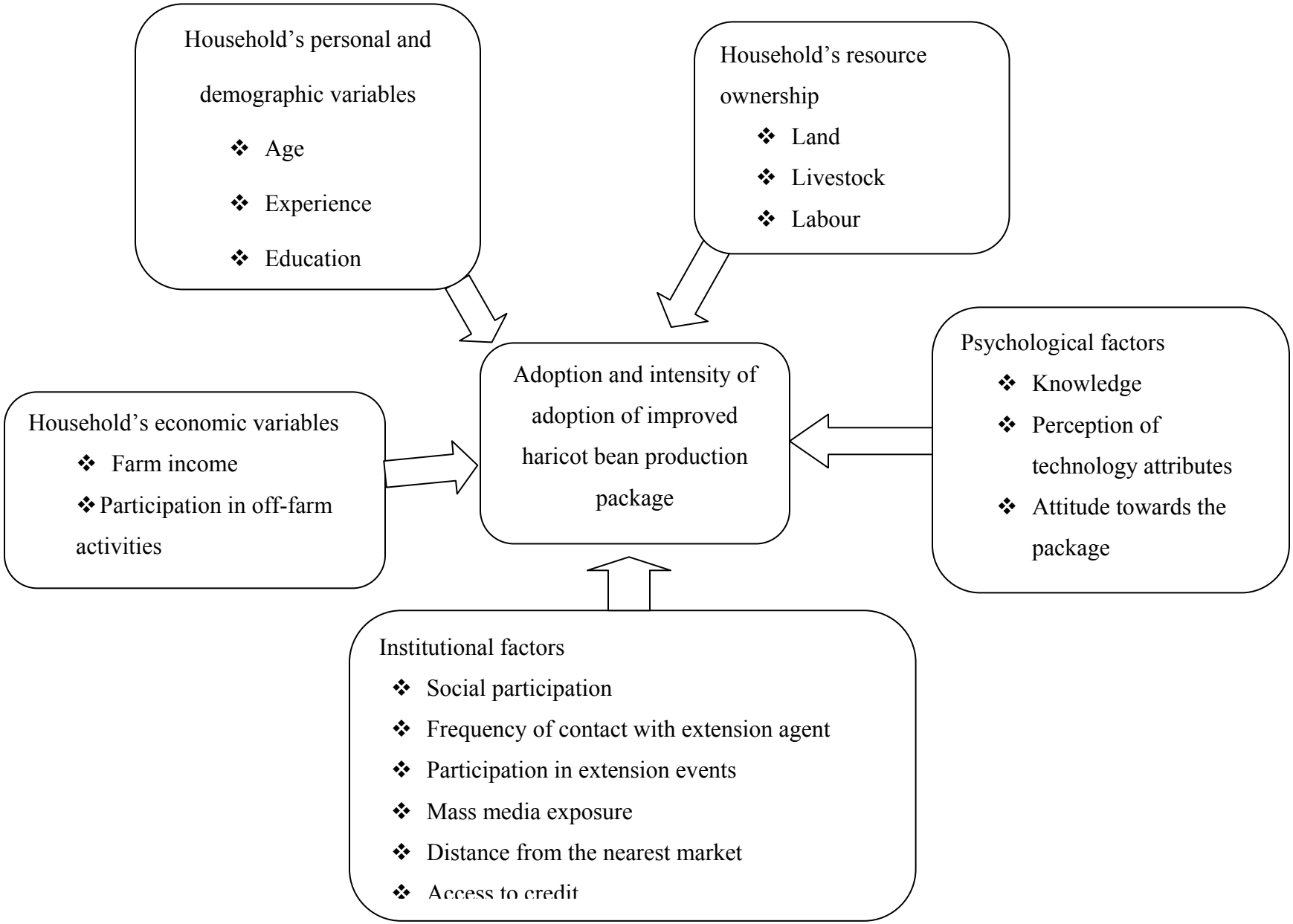

Figure 2. Analytical framework for the study.

3. RESEARCH METHODOLOGY

3.1 Description of the Study Area

Alaba woreda is located 315 km south of Addis Ababa and about 85 km southwest of the Southern Nations Nationalities and Peoples Regional (SNNPR) state capital of Awassa. The woreda is geographically located $7^0$17' N latitude and $38^0$06' E longitude. It is located west of Oromia region, north of Hadiya (Sike), east of Kembata Tembaro, south east of Silte and Hadiya zones. It is a special woreda and has a special status where the administration directly reports to the regional state. There are 73 rural kebeles and 2 sub cities. Alaba Kulito, the capital of the woreda, is believed to have been found towards the end of the 20th century (Alaba Pilot Survey, 2005).

According to the recent woreda population reports (2004/2005), the total number of rural households in 73 rural kebeles in the woreda is 35,719. Out of these, 26,698 (75 %) are men and 9,021 (25 %) are women households. The total woreda population is 210,243, out of which 104,517 (49.7 %) are male and 105,726 (50.3 %) are female. Economically active population of the woreda (15-55 years of age) is 102,176 people out of which, 55,668 are male and 46,508 are female.

Ethnically, there are about 6 major groups in the woreda, but Alaba and Gurage ethnic groups are the dominant groups constituting about 81 and 10 percent of the total population, respectively (ibid).

The altitude in the woreda ranges from 1554 to 2149 m.a.s.l, but most of the woreda is found at about 1800 m.a.s.l. Except for few hills, the woreda has agriculturally suitable land in terms of topography. Despite the recurrent drought, flood has also been a major problem in the area. The latter is induced as a result of dominantly level topography. Rainfall has been a major limiting factor in agricultural production in the area. As a result, it is one of the woredas in SNNPR where drought is observed recurrently affecting many households.

Agro ecologically, the woreda is classified as Weina Dega (dry Weina Dega). The annual rainfall varies from 857 to 1085 mm; the annual mean temperature also vary from 17^0c to 20^0c with mean value of 18^0c. The area receives a bimodal rainfall where the small rains are between March and April while the main rains are from July to September. Although, the reliability of the small rains is low, farmers in the area cultivate haricot bean in both rainy season. However, during the main rains, all crops grown in the area are planted including maize, teff, wheat, pepper, haricot bean, sorghum and millet. Rainfall during the main rains is erratic that most of the time crops fail due to uneven distribution of rainfall over the growing period. That is why the woreda faces crop failure almost every 3 years. The soils of the woreda are believed to be relatively fertile and during good rains farmers can harvest good yield even without fertilizer application. The total area of the woreda is 64,116.25 ha of which 48,337 ha (75%) are considered suitable for agriculture (Table 1).

Table 1. Land use type with its area coverage

Land use	Area coverage(ha)
Arable land	44,020.00
Grazing land	4,316.95
Forest	4,592.00
Potentially cultivable	3,644.50
Uncultivable land (hills)	28058.00
Others	4737.80
Total	64116.25

Source: Alaba special woreda rural development (2003/2004) cited in Alaba Pilot Survey.

3.2. Sampling Technique

A clear and precise identification and definition of the population of the study is an important prerequisite for research sample design. This study defines the survey population at two levels, namely at the rural kebele level and at the farm household level. Once the target population was defined, the next task was the question of taking representative samples from the population. Alaba special Woreda is selected purposively as a representative of the agriculturally potential area, and it is where the extension program was executed or where improved haricot bean varieties have been introduced in the woreda (presence of adopters and non-adopters of improved Haricot bean varieties). Moreover, this area has potential for growing haricot bean.

An important decision that has to be taken while adopting a sampling technique is about the size of the sample. Appropriate sample size depends on various factors relating to the subject under investigation like the time aspect, the cost aspect, the degree of accuracy desired, etc (Rangaswamy, 1995; Gupta and Gupta, 2002). If sample is too small, it might be difficult to achieve the objectives of analysis. But if it is too large, it may result in resource wastage when dealing with the sample. Sample error will arise because of not studying the whole population. Whenever sampling, it is usual to miss some helpful information about the population (Levin, 1989; Kothari, 1990). The higher the desired precision or the level of confidence, the larger (more costly) will be the sample (Browen and Starr, 1983). Sampling theory is of little help in arriving at a good estimate of the sample size in any particular situation (Gupta and Gupta, 2002).

A two stage sampling procedure was used to select the rural kebeles and sample households. In the first stage, four rural kebeles were selected purposively, based on distance from main market (woreda capital), relatively better haricot bean production potential of rural kebeles and improved haricot bean package promotion, from 73 rural kebeles in Alaba special woreda where haricot bean extension package program has been operational. Before selecting household heads to be included in the sample, haricot bean grower household heads of each rural kebele were identified in collaboration with kebele leaders, key informants and

development agents of the respective rural kebele. In the second stage, 160 farm household heads were selected from identified haricot bean growers using systematic random sampling technique taking into account probability proportional to size of haricot bean growers in each of four selected rural kebeles. As a result, the survey was administered and data were collected and analyzed on 160 respondents. Accordingly, the number of respondents in each rural kebele was as shown in the Table 2.

Table 2. Number of respondents in each of the selected rural kebeles.

Sl.no	PA name	Number of haricot bean grower household heads	Selected number of respondents (HHH)
1	Alemtena	267	40
2	Upper lenda	286	43
3	Gofessa	280	42
4	Kunche yaye	233	35
	Total	1066	160

3.3. Method of Data Collection

The interest of the respondents in survey work is an issue to be given top priority. Farmers will show little cooperation unless their concerns are taken care of very seriously. Therefore, in order to gain their trust, the respondents were carefully informed about the objectives of the survey and the direct and indirect benefits to them. In this regard, chair-persons of the respective rural kebeles were first approached and efforts were made to convince them of the objectives of the study. Farmers were also informed that information related to household and farm characteristics would be kept confidential.

Firstly, the interview schedule was tested at the farm level on 10 randomly selected farm households. In the light of pre-testing, essential amendments were made on such things as ordering and wording of questions and coverage of the interview schedule. Furthermore, the

pre-test enabled to know whether farmers had clearly understood the interview schedule. As a result, some questions were deleted or otherwise overlooked due to language problem but those found important were incorporated in the final version of the interview schedule.

After pre-testing and prior to the final administration of the interview schedule, enumerators were given training and briefings on the objective, contents of the interview schedule and were also acquainted with the basic techniques of data gathering and interviewing techniques and on how to approach farmers. Then using the amended structured interview schedule, primary data were collected by using personal interview technique from sampled farmers. The interview schedule was administered by using trained enumerators. In order to increase the reliability of the survey data and to reduce technical and linguistic problems at the farm level; the researcher (the author) spent much time with enumerators during all survey days. At last, to fill gaps observed during personal interviews, focused group discussions were conducted with group of farmers in each selected rural kebeles.

3.4 Definition of Variables and Hypotheses

Adoption of improved haricot bean technology package in the study area and intensity of adoption of the technology among adopters are the dependent variables.

The following explanatory variables were hypothesized to influence adoption and intensity of use of haricot bean production package in the study area.

1. Farmer's age: It is measured in number of years. Age of a farmer can generate or erode confidence on technologies. In other words, with age a farmer can become more risk averse to new technologies. However there are mixed results as to the direction of influence. It was hypothesized that younger farmers have more probability of adopting improved haricot bean technologies.

2. Experience in haricot bean farming: is measured in the number of years since a respondent started farming on his own. Experience of the farmer is likely to have a range of

influences on adoption. Experience will improve farmers' skill of haricot bean production. A more experienced grower may have a lower level of uncertainty about the technology's performance (Abadi *et al*, 1999; Chilot *et al,* 1996). Farmers with higher experience appear to have often full information and better knowledge and were able to evaluate the advantage of the technology. Hence it was hypothesized to affect adoption positively.

3. Education: Level of education was assumed to increase farmers' ability to obtain, process, and use information relevant to the adoption of improved haricot bean production package. Education is therefore expected to increase the probability of adoption of improved haricot bean production package. It is measured as a binary variable: 1, if the farmer is literate and 0, otherwise.

4. Participation in off-farm activities: Additional income earned from agricultural activities outside the farm increases the farmers' financial capacity and increases the probability of investing on new technologies (Chilot *et al,* 1996; Freeman *et al,* 1996; Van Den Ban and Hawkins, 1996; Asfew *et al,* 1997; Habtemariam, 2004). It is therefore, expected to affect adoption positively. It is treated as a dummy variable taking 1 if a household head participated in off-farm income generating activities; 0 otherwise.

5. Farm income: The farm income refers to the total annual earnings of the family from sale of agricultural produce such as sale of crop, livestock and livestock product after meeting family requirements. This is believed to be the main source of capital for purchasing agricultural inputs. Thus, those households with a relatively higher level of farm income are likely to purchase improved seeds or other essential agricultural inputs.

6. Social participation: membership and leadership in community organization assumes that farmers who have some position in rural kebeles and different cooperatives are more likely to be aware of new practices as they are easily exposed to information (Freeman *et al,* 1996; Chilot *et al,* 1996; van Den Ban and Hawkins, 1996; Asfew *et al,* 1997; Habtemariam, 2004). It is, therefore, hypothesized that those farmers who participated in some social organization as member or leader are more likely to adopt haricot bean package. The variable was measured by allocating a score of 0 if a farmer did not participate, 1 if a farmer is member of

one social organization, 2 if a farmer is committee member of one social organization and a score of 3 was given if a farmer is leader of one social organization. Total score achieved by household head from 10 listed social organizations were considered.

7. Mass media exposure: it was measured in terms of frequency of contact with different media (TV, radio, print). Mass media play the greatest role in creating awareness in shortest time possible over large area of coverage. As far as awareness is prerequisite for behavioral change its role cannot be underestimated. It is expected to have positive influence on haricot bean package adoption. Radio was the only mass media used by respondents in the study area and hence frequency of contact with radio was taken as the only variable to show mass media exposure of farmers in the study area

8. Distance from market center: it is measured in Kilometers. Distance to the nearest market and the frequency of contact that the farmer maintains with it is likely to influence adoption of the innovation. The closer they are to the nearest market, the more likely it is that the farmer will receive valuable information (Abadi, 1999; Roy et. al, 1999). Consequently distance was expected to influence adoption negatively.

9. Farm size: farm size is an indicator of wealth and social status and influence within community. Farmers with larger land size can afford the expenses on new agricultural technologies and also can bear the risk in case of failure of crop. This means that farmers who have relatively large size will be more initiated to adopt improved haricot bean technologies. And the reverse is true for small size farmers.

10. Labor availability: Labor was measured in terms of Man Equivalent. Availability of labor is likely to influence the gross margin of the innovation. A farm with larger number of workers per hectare (unit) is more likely to be in a position to try and continue using a potentially profitable innovation and it is expected to influence adoption positively.

11. Number of Livestock: Livestock is the farmers' important source of income, food and draft power for crop cultivation in Ethiopian agriculture. Hence, a household with large livestock holding can have good access for more draft. Like many other similar studies, it was

measured in terms of Tropical Livestock Unit (TLU). Livestock ownership is hypothesized to be positively related to the adoption of agricultural technologies because it serves as proxy for wealth status (Freeman *et al*, 1996; Chilot *et al*, 1996; van Den Ban and Hawkins, 1996; Asfew *et al*, 1997; Habtemariam, 2004).

12. Access to Credit: It is measured in terms of whether respondents have access to credit in terms of availability of credit sources and possibility of getting credit. Farmers who have access to credit may overcome their financial constraints and therefore buy inputs. Farmers without cash and no access to credit will find it very difficult to attain and adopt new technologies (Legesse, 1992; Teressa, 1997; Wolday, 1999; Mulugeta, 2000). It is expected that access to credit will increase the probability of adopting improved haricot bean technologies.

13. Extension services

13.1 Contacts with extension agents: This is a dummy variable, which takes a value of 1 if the household received extension service and zero, otherwise. The variable represents extension service as an important source of information, knowledge and advice to smallholder farmers in Ethiopia. Empirical results revealed that extension contact has an influence on farm households' adoption of new technology (Nkonya et al., 1997). Following this argument, extension contact was hypothesized, in this study, to influence farmers' decision to adopt improved haricot bean package positively.

13.2 Frequency of contact with extension agent(s): This refers to the number of contacts per year that the respondent made with extension agents. The effort to disseminate new agricultural technologies is within the field of communication between the change agent (extension agent) and the farmers at the grassroot level. Here, the frequency of contact between the extension agent and the farmers is hypothesized to be the potential force which accelerates the effective dissemination of adequate agricultural information to the farmers, thereby enhancing farmers' decision to adopt new crop technologies. Hence, it was hypothesized to affect adoption of haricot bean technologies positively.

13.3 Attendance in extension events

A) Attendance in field days: It is measured in terms of the number of times the farmer has participated in the field days in the last three years. Participation in field days is expected to positively influence farmers' adoption of improved haricot bean production package.

B) Attendance in training: Training is one of the means by which farmers acquire new knowledge and skill and it is measured in terms of the number of times the farmer has participated in training in the last three years. Hence, participation in training is expected to positively influence farmers' adoption behavior.

C) Participation in on-farm demonstration: It refers to the number of times the respondent has hosted demonstration with regard to haricot bean production on his farm and it is measured as the number of times the farmer has hosted demonstration on his farm in the last three years. Frequency of participation in on-farm demonstration is expected to positively influence farmers' haricot bean package adoption.

14. Knowledge: Acquaintance with the knowledge of improved technology is a precondition of technology adoption. Hence, it is possible to conclude that knowledge of improved technology will positively influence the adoption of haricot bean technologies. Knowledge scoring was made in assessing the know how of the respondents on seeding rate, fertilizer rate, post harvest loss protection measures, naming improved variety, spacing of technologies e,t,c.

15. Attitude towards haricot bean production technology: Positive attitude towards change in agricultural technology is one of the factors that can speed up the change process. Positive attitude formation is also a prerequisite for behavioral change to occur. Therefore, it was hypothesized that favorable attitude towards change in haricot bean production technology positively influences adoption of haricot bean package. This was measured using a summated rating (Likert) scale.

16. Perception of technology attributes: (Düvel, 1991) associates perceptions with the way the attributes of innovations are perceived and he distinguishes between (a) awareness of relative advantages, (b) awareness or concern of disadvantages, (c) the overall prominence or relative advantage of innovation (practice), and (d) the compatibility with situational circumstances.

In this study, weighted average of individual positive (advantages) and negative (disadvantages) were calculated and total advantage and disadvantage were calculated. This variable is then hypothesized to influence adoption positively.

Table 3. Definition of the variables and units of measurement

Dependent variables

Variable	Unit/ type	Description
Adoption	Dummy	Status of adoption 1if adopter; 0 otherwise.
Intensity of adoption	Adoption index	Extent of adoption of haricot bean technology package

Explanatory variables

Name of variable	unit	Description
1. Age of HHH	years	Age of HHH in years
2. Experience	Years	Haricot bean cultivation experience of HHH in years
3. Farm size	Hectare	Land holdings of HHH in terms of hectare
4. LAFOAVME	Man equivalent	Labor force availability in terms of man equivalent
5. NOLisTLU	TLU	Number of livestock owned by a HHH in TLu
6. TOANFAIN	Birr	Total annual farm income in Birr
7. Social participation	Score	Social participation status of HHH
8. Attitude score	Score	HHH Attitude towards improved haricot bean production package
9. FRECONEA	Number	Frequency of contact with extension agent
10. EXEVPASC	score	Attendance in extension events/training and field days.
11. Knowledge	score	Knowledge of the HHH on improved haricot bean production package.
12. Distamar	kilometer	Distance from the nearest market center
13. Mass media exposure	score	Mass media exposure
14. PEREAD	Score	Perceived relative advantage of the technology attributes
15. PEREDIAD	score	Perceived relative disadvantages of the technology attributes
16. Educ	Dummy	Educational status of household head, 0=illiterate, 1=literate
17. CREACC	Dummy	Household heads access to credit: 1if had access, 0 otherwise;
18. PAOFFAIN	Dummy	Household heads participation in off- farm income: 1 if participated, 0 otherwise;

Source: Sample survey, 2006.

3.5. Analytical Techniques

Adoption is a decision to make full use of an innovation at best appropriate course of action available (Rogers, 1983:176). For multiple practices (package), there are two options of measuring adoption; (i) adoption index: measures the extent of adoption at the time of the survey or (ii) adoption quotient: measures the degree or extent of use with reference to the optimum possible without taking time into consideration. In this study, the first option was employed. Accordingly, adoption index which shows to what extent the respondent farmer has adopted the whole set of package will be calculated using the following formula.

In order to know the intensity of adoption of improved haricot bean production package, adoption index of individual farmer was calculated as follows.

$$AI_i = \sum_{i=1}^{n} \frac{\left[\frac{AHi}{ATi} + \frac{SRAi}{SRR} + \frac{FAi}{FR}\right]}{NP}$$

Where:

AI_i= Adoption index of the i^{th} farmer

i=1, 2, 3……n, and n= total number of respondent farmers

AH_i= area under improved variety of haricot bean of the i^{th} farmer

AT_i= Total area allocated for haricot bean production (improved variety+ local, if any) of the i^{th} farmer

SRAi= Seeding rate applied per unit of area in the production of improved haricot bean of i^{th} farmer,

SRR= Seeding rate recommended for application per unit of area,

FA_i= amount of fertilizer applied per unit of area in the cultivation of improved variety of Haricot bean by i^{th} farmer,

FR= Amount of fertilizer recommended for application per unit of area in the cultivation of improved variety of Haricot bean,

NP = Number of practices

On the basis of adoption index respondent farmers were classified into three categories, viz., low, medium, and high adopter. Adoption index is thus a continuous dependent variable

which is affected by different factors to be investigated. Tobit model was used to identify factors affecting farmers' adoption and intensity of adoption of improved Haricot bean technology package.

The Tobit model

Tobit model is an extension of Probit model and it is one of the approaches dealing with the problem of censored data (Johnston and Dandiro, 1997). Some authors call such model limited dependent variable model, because of the restrictions put on the values taken by the regressand (Gujarati, 1995). Tobit model is superior over the other dichotomous regression models in that the later only attempts to explain the probability of adoption of agricultural technologies by the farm households rather than the intensity or extent of adoption. However, adoption of improved technology alone is not sufficient enough since improvement in production and productivity of farm households depends not only on adoption but also on the intensity of use of the technology. Strictly dichotomous variable often is not sufficient for examining intensity of adoption (Feder *et al*, 1985). In such cases, Tobit model, which has both discrete and continuous part, is appropriate because it handles both the probability and intensity of adoption at the same time.

Many researchers have used Tobit model to identify factors affecting adoption and intensity of adoption of improved agricultural technologies. To mention some, for instance, Nkonya *et al*. (1997) used Tobit model to identify factors affecting adoption of improved maize seed and fertilizer in Northern Tanzania. He used area planted with improved seed and area receiving fertilizer as continuous dependent variables for running Tobit model. In the same country, Kaliba *et al.* (1998) used Tobit model to study factors affecting adoption of maize production technologies particularly maize variety and used proportion of area allocated to improved maize seed as continuous dependent variable.

From adoption studies conducted in Ethiopia, Legesse (1992) and Chilot (1994) used Probit and Tobit model to identify factors affecting adoption of improved varieties, fertilizer and herbicide. Both of them used Probit model to identify factors affecting adoption of improved

variety and Tobit model to identify factors affecting intensity of fertilizer and herbicide use. On the other hand, Techane (2002) used Tobit model to identify determinants of adoption and intensity of use of fertilizer in Ethiopia. In the same line, Endrias (2003) and Getahun (2004) used Tobit model to assess factors affecting adoption and intensity of adoption of sweet potato varieties and wheat technologies respectively.

Model specification

The econometric model applied for analyzing factors influencing adoption and intensity of adoption of improved Haricot bean production package was the Tobit model shown in equation (1). This model was chosen because, it has an advantage over other adoption models (LPM, Logistic, and Probit) in that, it reveals both the probability of adoption and intensity of use of improved Haricot bean production package. Following Maddala (1992), Amemiya (1985) and Johnston and Dandiro (1997), the Tobit model for the continuous variable adoption index, can be defined as:

$AI_i^* = B_0 + B_iX_i + U_i$

$AI_i = AI_i^*$ if $B_0 + B_iX_i + U_i > 0$ ..... (1)

$= 0$ if $B_0 + B_iX_i + U_i \leq 0$

Where:

AI_i^*= is the latent variable and the solution to utility maximization problem of intensity of adoption subjected to a set of constraints per household and conditional on being above certain limit,

AI_i= is adoption index for i^{th} farmer

X_i= Vector of factors affecting adoption and intensity of adoption,

B_i= Vector of unknown parameters, and

U_i= is the error term which is normally distributed with mean 0 and variance σ^2.

The model parameters are estimated by maximizing the Tobit likelihood function of the following form (Maddala, 1997 and Amemiya, 1985).

$$L = \prod_{AI_i^*>0} \frac{1}{\sigma} f\left(\frac{AI_i - \beta_i X_i}{\sigma}\right) \prod_{AI_i^* \le 0} F\left(\frac{-\beta_i X_i}{\sigma}\right) \qquad (2)$$

Where f and F are respectively, the density function and cumulative distribution function of AI_i^*. $\prod_{AI_i \le 0}$ means the product over those i for which $AI_i^* \le 0$, and $\prod_{AI_i > 0}$ means the product over those i for which $AI_i^* > 0$.

An econometric software known as "Limdep" was employed to run the Tobit model. It may not be sensible to interpret the coefficients of a Tobit in the same way as one interprets coefficients in an uncensored linear model (Johnston and Dinardo, 1997). Hence, one has to compute the derivatives of the estimated Tobit model to predict the effects of changes in the explanatory variables.

As cited in Maddala (1997), Johnston and Dinardo (1997) and Nkonya *et al*. (1997), McDonald and Moffit (1980) proposed the following techniques to decompose the effects of explanatory variables into adoption and intensity effects. Thus change in X_i (explanatory variables) has two effects. It affects the conditional mean of AI_i^* in the positive part of the distribution, and it affects the probability that the observation will fall in that part of the distribution. Similarly, in this study, the marginal effect of explanatory variables was estimated as follows.

1. The marginal effect of an explanatory variable on the expected value of the dependent variable is:

$$\frac{\partial E(AI_i)}{\partial X_i} = F(z)\beta i \qquad (3)$$

Where, $\frac{\beta_i X_i}{\sigma}$ is denoted by z, following Maddala, (1997)

2. The Change in the probability of adopting a technology as independent variable Xi changes is:

$$\frac{\partial F(Z)}{\partial X_i} = f(z)\frac{\beta_i}{\sigma} \qquad (4)$$

3. The change in the intensity of adoption with respect to a change in an explanatory variable among adopters is:

$$\frac{\partial E(AI_i / AIi_i^* > 0)}{\partial X_i} = \beta_i \left[1 - Z \frac{f(z)}{F(z)} - \left(\frac{f(z)}{F(z)} \right)^2 \right] \qquad (5)$$

Where, F (z) is the cumulative normal distribution of Z, f(z) is the value of the derivative of the normal curve at a given point (i.e., unit normal density) and Z is the z-score for the area under normal curve, β is a vector of Tobit maximum likelihood estimates and σ is the standard error of the error term.

Before running the Tobit 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 mulit-collineality. These are: Variance Inflation Factor (VIF) for association among the continuous explanatory variables and contingency coefficients for dummy variables. In this study, variance inflation factor (VIF) and contingency coefficients were used to test multicollinearity problem for continuous and dummy variables respectively.

According to Maddala (1992), VIF can be defined as: VIF (X_i) = $\frac{1}{1 - R_i^2}$,Where R_i^2 is the squared multiple correlation coefficient between X_i and the other explanatory variables. The larger the value of VIF, the more troublesome it is. As a rule of thumb, if the VIF of a variable exceeds 10 (this will happen if R_i^2 exceeds 0.95), that variable is said to be highly collinear (Gujarati, 1995).

Similarly, contingency coefficients were computed for dummy variables using the following formula.

$$\text{C.C} = \sqrt{\frac{\chi^2}{n + \chi^2}}$$

Where, C.C is contingency coefficient, $\chi 2$ =chi-square value and n = total sample size.
For dummy variables if the value of contingency coefficient is greater than 0.75, the variable is said to be collinear (Healy, 1984 as cited in Mesfin, 2005).

4. RESULTS AND DISCUSSION

4.1. Introduction

This chapter consists of the overall findings of the study to be presented under different sections. Next to description of status of adoption and intensity of adoption of haricot bean production package, the influence of different personal, demographic, social, economic, institutional and psychological factors on adoption and intensity of adoption of improved haricot bean production package will be discussed consecutively.

Improved haricot bean production involves use of different package practices. These include use of improved variety, seeding rate, fertilizer rate, chemical application rate and spacing. After all significant improvement in production and productivity depends on the extent to which a household has applied the recommended package practices. Level of adoption of improved haricot bean production package by farmers may vary depending on socio-economic situation of the household as well as institutional environment in which the household operates.

In this study, out of five (5) haricot bean production package practices that are recommended by research system only four practices promoted by extension people were identified. These practices include variety, seeding rate, fertilizer rate and spacing. From these four practices only variety adoption, seeding and fertilizer rate were used for calculating the adoption index. Some practices were excluded because of absence and difficulty in getting reliable figure on adoption of practices among the households. In other words, because of the above reasons chemicals for disease control and spacing were excluded from adoption index calculation.

Adoption index score was calculated by adding the adoption quotient of each practice and dividing it by number of practices adopted by a farmer to know the level of adoption of each sample farm households. The adoption quotient of each practice was also calculated by taking the ratio of actual rate applied to the recommended rate, which indicates the extent to which an individual farmer has adopted the package practices.

The final adoption index of sample adopter households were categorized into three adopter groups namely low, medium and high. The non-adopter group was given a score of 0 and kept as separate category to investigate factors influencing adoption of improved haricot bean production package. This makes up 4 distinct categories across which adoption and intensity of adoption of improved haricot bean production package are assessed. The adoption index score ranges used to classify respondents into non-adopters, low, medium and high adopters were 0, 0.01-0.33, 0.34-0.66 and 0.67-1.00 respectively. The actual adoption index score ranges from 0 to1. Adoption index score of 0 point implies non-adoption of the overall improved haricot bean production package and adoption index value of 1 implies adoption according to recommendation. Chi-square and F-test were mainly used to evaluate the significance of the relationship between dependent and independent variables and test the hypothesis. Cramer's V and Pearson correlation were used to see the strength and direction of association between variables. Moreover, Tobit model was used to determine the relative influence of various explanatory variables on the dependent variable.

4.2. Current Status of Adoption and Intensity of Adoption of Improved Haricot bean Production Package

Dissemination of agricultural innovations to users is one of the priority areas that deserve attention in agricultural and rural development. The application of improved techniques, (innovations) whether it is introduced from within the social system or outside, is important for farmers to achieve increased production and productivity. According to Rogers (1983), an innovation is an idea, practice, or object that is perceived as new by an individual or another unit of adoption. A technological innovation consists of both the idea component and the object component (Rogers and Shoemaker, 1971). Both the hardware and software components of agricultural innovation are important.

New agricultural technologies/practices are usually recommended in a set or package form for use by farmers. However, for several reasons, farmers usually adopt only certain components of the package. Moreover, in most cases there is variation in intensity or level of use of a

given technology or practice. Diversity among farmers in their level of package adoption could be related to many factors: economic, social, personal, institutional and psychological. Understanding why farmers adopt one component of the package while rejecting the other as well as the underlying reasons for their variation is of a paramount importance. The result on mean adoption index scores across adoption categories is provided in Table 4.

Table 4. Distribution of respondents by level of adoption of improved haricot bean production package.

Adoption category	N	%	Adoption index Range	Mean Adoption index	SD	F	P
Non-adopters	86	53.8	0	0.00	0.00		
Low	9	5.6	0.01-0.33	0.24	0.05		
Medium	36	22.5	0.34-0.66	0.51	0.09		
High	29	18.1	0.67-1.00	0.81	0.11		
Total	160	100	0-1	0.27	0.33	1351.101***	.000

Source: Own survey data, 2006; ***= The mean difference is significant at the .01 level.

The above Table clearly indicates that the mean adoption index scores of non adopters, low, medium and high adopters groups are 0.00, 0.24, 0.51 and 0.81 respectively. One way analysis of variance revealed that there is significant mean difference (F=1351.101, P=.000) among the adoption index score of the four adoption categories at 1% significance level which indicates variation in level of adoption among sample farmers (Table 4).

A close look at the adoption index of sample households reveals that majority of the sample respondents (53.8%) had adoption index score of 0 which indicates their overall package non adoption. Of the total sampled household heads, 5.6 percent had adoption index ranging from 0.20 to 0.33 and 22.5 percent of the respondents had adoption index score ranging from 0.34 to 0.66 and 18.1 percent of them had adoption index score ranging from 0.67 to 1.00. Of the 74 adopters, 9 (12.16%) respondents fall under low adopter category and 36 (48.65 %) of them fall under medium adopters category and 29 (39.19%) respondents had adoption index score that ranges from 0.67 to 1, high adopters category. Post hoc multiple comparison test

shows the existence of significant mean difference between each adoption categories in relation to adoption index score at 5 percent probability level.

4.2.1 Adoption of improved haricot bean varieties

Improvement in production and productivity of a given crop depends, among other things, on presence and use of better and improved varieties. In line with this objective, a lot of efforts have been made by the research system to generate improved varieties of haricot bean and as a result, many varieties have been released. Among the released white haricot bean varieties Mexican, Awash one and Awash melka varieties were introduced to the study area. These three varieties were introduced to the farming community through MoARD.

Regardless of such intervention, however, adoption of improved haricot bean varieties in the study area is still low. Adoption of improved haricot bean variety alone is not enough to bring significant change in production and productivity at household level. The level of adoption of a variety influences the amount of yield obtained by farmers. In the study area, the intensity of variety adoption which is measured as area covered by improved variety of haricot bean was found to vary among grower sample households. The result on intensity of variety adoption is furnished in the Table 5.

Table 5. Mean % of land under improved variety in total for haricot bean cultivation

Variety adoption category	N	%	Mean % of land	SD	F	P
Non adopters	110	68.8	0 %	0.00		
Low	16	10.0	24 %	0.09		
Medium	17	10.6	48 %	0.04		
High	17	10.6	100 %	0.00		
Total	160	100	18 %	0.32	5853.349***	0.000

Source: own survey data, 2006; ***= the mean difference is significant at the .01 level.

As indicated in Table 5, the average area covered by improved variety across each adoption category was 0 for non-adopters and 0.24, 0.48 and 1.00 for low, medium and high variety

adopters groups. It means that low, medium and high adopters categories covered 24 %, 48 % and 100 % of haricot bean land with improved haricot bean variety (See Appendix Table 3). Mean difference test was conducted using ANOVA and it showed that there was significant mean difference among the adoption categories (F=5853.349, p=0.000) in relation to intensity of adoption of improved haricot bean variety at 1 % significance level. Post hoc multiple comparison test result illustrated that the variability is observed between each categories at 5 percent probability level.

Farmers have their own variety preference criteria, which in most cases are not considered by research and extension personnel. Majority of the respondents including improved variety adopters (94.4 %) preferred local variety for its consumption and local market demand and compatibility of the crop to agro-climatic condition of the area, time of maturity (season of food deficit), yield advantage if cultivated in the same manner as that of improved variety (it means that attention paid in cultivation of improved variety is relatively higher in terms of using spacing and fertilizer application but its yield is lower), better market price and disease resistance as mentioned by sample haricot bean grower farmers during focused group discussion.

Understanding farmers' technology preference criteria is an important issue in technology generation and dissemination process. In most cases, technologies fail to be adopted by users due to mismatch in preference criteria between technology promoters and end users (farmers). In general, sample respondents have selected most preferred attributes, which can be used for selecting among varieties of haricot bean. This suggests the need to give emphasis to participatory research which considers farmers' technology preference criteria, needs and priorities.

Farmers in the study area have high interest in cultivating the traditional red haricot bean variety because of local consumption demand particularly during food deficit season, when this red bean is harvested, certainty on market and also better suitability of seed to the agro-ecology of the area. Farmers' lack of interest in improved variety was expressed by selling

improved variety collected from office of agriculture and rural development. The supply push extension approach of the area can be manifested by stored and undistributed improved seed. Hence, efforts of the government and other organization should be geared towards need of farmers at least by introducing improved seed of red variety and its other accessories. This demand driven approach will make effort of all actors involved in the system beneficial and fruitful.

Table 6.Distribution of respondents in relation to area under local and improved variety and average yield

	Area under local variety in ha	Average yield in quintal per hectare for local seed	Area under improved variety in ha for variety adopters	Average yield in quintal per hectare for improved variety	Total annual harvest from local variety in quintal	Total annual harvest in quintal from improved variety
N	160	160	50	50	160	50
Mean	0.6715	4.8374	0.25	5.82	3.1180	1.50
SD	0.48118	2.27673	0.10	1.88	2.33863	0.75
Minimum	0.13	0.66	0.13	2.00	.25	0.50
Maximum	3.00	12.00	0.50	8.00	14.00	4.00

Source: own survey data, 2007.

The above Table shows that average area under local variety is 0.67 ha with standard deviation of 0.48. Moreover, the minimum and maximum area under local variety were 0.13 ha and 3.00 ha respectively. The average yield in quintal per hectare, its standard deviation, minimum and maximum from local variety were 4.83 quintal per hectare, 2.28, 0.66 quintal per hectare and 12 quintal per hectare respectively. The average area under improved variety for variety adopters', standard deviation, minimum and maximum area were 0.25, 0.10, 0.13 and 0.50 respectively. The average yield for variety adopters was 5.82 with standard deviation of 1.88 and theirs minimum and maximum yield was 2 and 8 quintal per hectare respectively. The average yield of the area is by far less than the national average which is 8 and extremely

lower than that of research managed plots which is 28 quintal per hectare. Moreover, total harvest average for local and improved variety was 3.12 and 1.50 respectively

4.2.2. Seeding rate

Use of proper seeding rate is one of the most important practices in improved haricot bean production. Excessive or under utilization of seed will result in poor production performance. Usually research recommends specified level of seeding rate for a given variety or crop with a given range of seed viability. Extension also advices farmers based on this research recommendation. The recommended seeding rate of improved haricot bean variety is 100kg per ha. Farmers' adoption of the recommended seeding rate however depends among several things on the appropriateness of the recommended rate itself, availability of quality seeds, uncertainty in its germination percentage and other household related socio-economic problems (knowledge/awareness level).The result of average seeding rate across adoption categories is indicated in Table 7.

Table 7. Average seeding rate applied per hectare of land by sample households

Seeding rate adoption category	N	%	Average seed rate Kg/ha	SD	F	P- value
Non adopters	110	68.8	0.00	0.00		
Low	8	5.0	26.00	0.03		
Medium	39	24.4	49.00	0.02		
High	3	1.88	100.00	0.00		
Total	160	100	15.00	0.24	21021.603 ***	.000

Source: Own survey data, 2006; ***= the mean difference is significant at the .01 level.

Farmers in the study area were found to use varying seeding rates of improved haricot bean variety ranging from seed use index score of 0 to 1 (i.e. from 0 kg to 100 kg improved seed per ha), the maximum being according to recommendation by the research system. Concerning variability in the amount of seed applied per hectare of land among sample respondents, majority of farmers 110 (68.8 %) applied 0 kg of improved seed of haricot bean and 8 (5.0%) farmers on average applied 26kg of improved seed per hectare of land, 39

(24.4%) respondents on average used 49 kg of improved seed per hectare of land and 3 (1.88) on average farmers applied 100kg of seed per hectare of land, which is according to recommendation. The average seeding rate was 15 kg for sample household. There was significant variation among seed adoption categories in terms of their seeding rate. This is evident from results of one-way ANOVA which indicated the presence of significant mean difference in seeding rate applied between seed adoption categories (F= 21021.603, P=.000) at 1% significance level (Table 7). To see where the variability lies, post hoc test result was used and it showed that significant mean difference was observed between each category at 5% probability level.

4.2.3. Fertilizer application rate

Haricot bean production, like any other crop, requires use of different inputs. Fertilizer application is one of the most important practices that need to be adopted by haricot bean growers. Moreover, proper application of the recommended rate (100 kg/ha) is important to obtain the required yield. As far as fertilizer use is concerned, farmers in the area use varying fertilizer rate, which is below the recommendation. The average fertilizer application rate is shown in the Table 8.

Table 8. Average fertilizer rate applied (in Kg/ha) by adoption categories

Adoption category	N	%	Mean	SD	F	P-value
Non adopters	88	55.0	0.00	0.00		
Low	12	7.5	23.00	0.06		
Medium	20	12.5	47.00	0.08		
High	40	25.0	97.00	0.07		
Total	160	100.0	32.00	0.41	3946.251***	0.000

Source: Own survey data, 2007; ***= the mean difference is significant at the .01 level.

The average rate of fertilizer applied for haricot bean production by sample grower households during the 2005/06 production year was 32 kg/ha. The mean fertilizer rates of non-adopters, low, medium and high adopters were 0 kg, 23 kg, 47 kg and 97 kg per hectare

of land. Fertilizer application rate of sample respondents vary across adoption categories. Analysis of mean variance indicated that there was significant mean difference between adoption categories (F= 3946.251, P= 0.000) in relation to fertilizer application rate at 1 % probability level (Table 8). In addition to this multiple comparison post hoc tests result indicated that the mean difference lies between each adoption categories at 5% level of significance.

A close look at Appendix Table 6 also shows that out of package adopters (74 farmers) only 72 farmers were found using fertilizer. From 72 farmers who used fertilizer for haricot bean cultivation 19 respondents (26.39%) applied below half of the recommendation, 11 respondents (15.28 percent) used half of the recommendation and 8 respondents (11.11 percent) applied fertilizer rate of 66kg to 88kg per hectare of land and 34 respondents (47.22 percent) used according to recommendation.

Respondent farmers have mentioned different reasons for their use of such low fertilizer rates. In the first place, they were claiming lack of financial capacity and unavailability of fertilizer at the right time was mentioned in the second place. In their view, the amount of fertilizer to be applied per hectare of land depends on attention paid to land preparation and fertility status of land. This has an implication for research indicating the need to revisit the previous research recommendation by conducting further site-specific fertilizer trials. Lack of soil moisture and lack of irrigation facilities may also result in low fertilizer use.

4.2.4 Chemical application

Majority of respondents (72.5%) reported the existence of disease problem in the study area. According to respondents, although they tried to contact concerned officials in the woreda office of agriculture and rural development, they did not succeed in solving their problem. Even though they are well aware of the problem, they do not know solution to such problem and they are eager to know and apply modern crop protection measures to avoid crop loss. The rest 44 (27.5%) reported absence of disease problem (Table 9).

Table 9. Disease occurrence report by the respondents

Disease occurrence	Frequency	Percent
Yes	116	72.5
No	44	27.5
Total	160	100.0

Source: own survey data, 2007.

Table 10. Distribution of respondents by measure used when disease strike

Measure taken to avoid disease problem	Frequency	Percent
No disease	44	27.5
Indigenous measures/ash/	19	11.9
Nothing	97	60.6
Total	160	100.0

Source: own survey data, 2007.

4.2.5. Spacing

Appropriate plant spacing is important because overcrowded sowing would result in slow and stunted growth and eventually in poor yield. The research recommended spacing for improved haricot bean production is 10 to 15 cm between plants and 40 cm between rows.

Because of the irregularity of farmers' practices of spacing across plots and the absence of variation among farmers' spacing practice it was not taken into account in the calculation of adoption index.

Respondent farmers have mentioned different reasons for not using the recommended spacing. According to the majority, spacing requires additional labor and skill and because of this it is difficult for them to manage. In addition to this, farmers in the study area prefer broadcasting seeds during sowing in order to avoid risk of germination failure and with the assumption that denser plantation has better yield advantage than sparse plantation. This

indicates the complexity of the practice for farmers' management. Here it should be noted that complexity is one of the technological characteristics that affect technology adoption.

4.3. Influence of Independent Variables on Adoption and Intensity of Adoption of Improved Haricot bean Production Package

According to van Den Ban and Hawkins (1996), adoption is a decision to apply new innovation. Several factors influence farmers' adoption decision. Different researchers group these factors under different major categories depending on the purpose of their study and list of relevant variables to be considered. In this study, the independent variables thought to have relationship with adoption of improved haricot bean production package are grouped as household's personal and demographic variables, household's resource ownership, household's economic variables, institutional and psychological factors. The relationship of these variables with adoption and intensity of adoption of improved haricot bean production package is discussed in the following sections.

4.3.1 Household personal and demographic variables

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, with age a farmer can become more risk averse to new technologies and are expected to be less responsive to newly introduced agricultural technologies. Therefore, in this study, it is hypothesized that the farmer's age and adoption of the given crop technology are inversely correlated.

Table 11. Relationship between age with adoption of improved haricot bean production package.

Variable	Mean for adoption category				Mean of				
	Non	Low	Medium	High	total	SD	F	p	r
Age	39.90	31.89	39.47	38.55	39.11	11.72	1.309NS	0.273	-0.020
Family size					7.01	2.88			

Source: Own survey data, 2007. NS=Not significant.

As indicated in Table 11, the mean age of sample households was 39.11 years with standard deviation of 11.72. The maximum age for the sample farmers was 72 years while the minimum was 15 years. Result of mean test using one-way ANOVA indicated that there was no significant mean difference (F=1.309, P=0.273) among adoption categories, implying the absence of significant relationship of age with adoption and intensity of adoption of improved Haricot bean production package. This is evident from the non-significant mean difference in average age among adoption categories. The mean age of non adopters, low, medium and high adopters were found to be 39.90, 31.89, 39.47 and 38.55 years respectively. Although it is weak, the correlation coefficient shows the existence of negative association between age and adoption and intensity of use of improved haricot bean production package.

The studies of Dereje (2006) and Abrhaley (2007) on assessment of farmers' evaluation criteria and adoption of improved bread wheat varieties in Akaki and farmers' perception and adoption of integrated striga management technology in Tahtay adiabo woreda, respectively also reported absence of statistically significant mean age difference between adopters and non adopter groups.

Family size

Large family size may be an indicator for availability of labor provided that there are more people within the age range of active labor force. Availability of labor in the household is again one of the important resources in pulse production in general and haricot bean production in particular. Based on this assumption, the variable was hypothesized to have

positive and significant relationship with adoption and intensity of adoption of haricot bean production package.

In this study, the average family size of the sample households was 7.01 persons with standard deviation of 2.88. The maximum family size was 17 while the minimum was 2 persons. The average family size of the study area is relatively higher as compared to that of the nation which is 6 persons implying the need for strengthening family planning programs to strike the balance of population growth with the level of economic development. The effect of family size on adoption is captured in the other variable dealing with household's labor availability.

Experience of the household head

Farmers with higher experience in haricot bean production appear to have often full information and better knowledge and supposed to evaluate the advantage of the technology. Hence it was hypothesized to affect adoption positively. The survey result of farmers experience on haricot bean cultivation is furnished in Table 12.

Table 12. Distribution of respondent households and their mean experience in haricot bean farming in years

Adoption category	N	Mean	SD	Min	Max	F	P	r
Non Adopter	86	8.24	9.18	2	50			
low	9	8.78	5.56	3	20			
Medium	36	8.92	7.18	2	33			
High	29	9.90	8.75	1	40			
Total	160	8.73	8.47	1	50	0.280NS	0.840	0.065

Source: Own survey data, 2007. NS=Not significant

With respect to the respondents' farming experience, the most experienced farmer in the sample had 50 years whereas the least experienced farmer had one year of experience in

haricot bean farming. On average, the sampled respondents had 8.73 years of experience in haricot bean cultivation. The average years of haricot bean cultivation experience of household heads for non adopters, low adopters, medium and high adopters were 8.24, 8.78, 8.92 and 9.90 respectively. One way analysis of variance ANOVA (F=.280, P=.840) for comparison of the average haricot bean farming experience of adoption categories shows that there is no statistically significant mean difference between adoption categories. The result of this study is in complete agreement with the findings of Chilot (1994).

Educational status of household heads

Level of education was assumed to increase farmers' ability to obtain, process, and use information relevant to the adoption of improved haricot bean production package. Education is therefore expected to increase the probability of adoption of improved haricot bean production package. It is measured as a binary variable: 1, if the farmer is literate and 0, otherwise. The result on educational status of household heads is provided in Table 13.

Table 13. Educational status of sample household heads

Educational status of HHHs	Adoption categories								Total	
	Non Adopter		low		Medium		High			
	n	%	n	%	n	%	n	%	n	%
Illiterate	45	52.3	4	44.4	14	38.9	8	27.6	71	44.4
Literate	41	47.7	5	55.6	22	61.1	21	72.4	89	55.6
Total	86	100.0	9	100.0	36	100.0	29	100.0	160	100.0

Source: own survey data, 2007. $\chi^2 = 5.953$, Cramer's V= .193, df = 3, P= 0.114

The distribution of total sample respondents in terms of literacy level has shown that 44.4% were illiterate and 55.6 % were literate. The literacy level was argued to have positive impact on the adoption of new technologies.

The result of this study shows that the proportion of literate farmers in the non-adopters category was 47.7 % and in that of low, medium and high adopters groups were 55.6 %, 61.1 %, and 72.4 % respectively (Table 13). The Chi-square statistics (χ^2= 5.953NS) of household heads indicates statistically insignificant difference in the educational status among adoption categories.

The finding of this study is inconsistent with many of the previously conducted studies. For example, Itana, 1985; Chilot *et al*., 1996; Kansana, 1996; Asfaw *et al*., 1997; Mwanga *et al*., 1998 and Tesfaye *et al*., 2001 have reported positive and significant relationship of education with adoption. Similarly, Nkonya *et al*., 1997 reported positive relationship of education with adoption and intensity of adoption of improved maize seed indicating that each additional year of education increases the probability and intensity of adoption by 5%.

4.3.2 Household resource ownership

Total land holding

Land is perhaps the single most important resource, as it is a base for any economic activity especially in rural and agricultural sector. Farm size influences households' decision to adopt or not to adopt new technologies. It also influences scale of technology use. Hence, land holding was hypothesized to have positive and significant relationship with adoption and intensity of adoption. The result on land holding of household heads in the study area is given in Table 14.

Table 14. Relationship between total landholding with adoption of improved haricot bean production package

Variable	Adoption category							
	Non	Low	Medium	High	Total	F	p	r
Total land holding (ha)	2.18	1.97	2.31	2.32	2.22	0.465 NS	0.707	0.053

Source: Own survey data, 2007, NS= non significant mean difference.

In this study, the average land holding of sample population was found to be 2.22 ha with standard deviation of 0.97 ha. This figure is a bit larger than the national figure, which is 1.5 ha implying relatively better holding in the area. The maximum land size owned by sample households was 5.88 ha while the minimum is 0.08 ha. The average land holding for non adopter group was 2.18 ha while that of low, medium and high adopter group was 1.97, 2.31, and 2.32 ha, respectively. The results of one way ANOVA with value of F= 0.465 and P= 0.707 shows that there was statistically insignificant mean difference among adoption categories. Regarding the direction of relationship, result of bivariate correlation analysis revealed the presence of positive and weak association (r= 0.053) between land holding and household's adoption of improved Haricot bean production package (Table 14). The result of this study confirms the earlier findings of Getahun (2004) and Mesfin (2005).

Livestock holding

In rural context, livestock holding is an important indicator of household's wealth position. The number of livestock owned by a farmer was hypothesized to be positively related to the adoption of improved haricot bean production technology. Livestock is the farmers' important source of income, food and draught power for crop cultivation in Ethiopian agriculture. Hence, a household with large livestock holding can have good access for more draught and it is one of the main cash sources to purchase inputs. The survey result on livestock holding of sampled households is presented in Table 15.

Table 15. Livestock holding of sampled households in terms of TLU.

Adoption categories	N	Mean	SD	Min	Max	F	P	r
Non Adopter	86	5.07	3.78	0.013	17.34			
low	9	6.15	3.20	2.70	14.02			
Medium	36	6.73	4.25	0.44	16.62			
High	29	7.31	6.80	1.33	38.21			
Total	160	5.91	4.60	0.013	38.21	2.297 *	0.080	0.218***

Source: Own survey data, 2007, *** and * represents 1 % and 10 % significance level.

Result of this study indicates, the livestock holding of sample population ranges from 0.013 to 38.21 TLU implying the existence of large variation among the households in livestock ownership. The average livestock holding of the sample population was 5.91 TLU with standard deviation of 4.60 TLU. It was observed that non adopters of improved haricot bean production package had livestock holding of 5.07 TLU and low, medium and high adopters categories had 6.15, 6.73 and 7.31 TLU respectively. Test of mean difference using one-way ANOVA showed that there was significant mean difference (F= 2.297, p= 0.080) among adoption categories at 10 % significance level (Table 15). This clearly shows the significant role of livestock holding in adoption and intensity of adoption of improved haricot bean production package. Moreover, result of bivariate correlation also confirmed the positive and significant relationship (r=0.218, p=0.006) of livestock holding with adoption of improved haricot bean production package at 1% significance level.

Regarding relationship of livestock holding with adoption, many adoption studies so far conducted have also reported similar results. To mention some, for instance, Kidane (2001), Birhanu (2002); Techane (2002); Endrias (2003); Degnet *et al.* (2001), Yishak (2005), have found that livestock holding has positive influence on adoption of improved agricultural technologies.

Labor availability

A household with large working labor force will be in a position to manage the labor-intensive agricultural activities. Moreover, large working labor force in a family means, the household may not need to hire more additional labor and the money saved due to use of own labor force could be used for purchasing other crop production inputs. This will increase household's possibility to adopt improved haricot bean production package. Therefore, it was hypothesized to have positive relationship with adoption and intensity of adoption of haricot bean production package.

Table 16. Distribution of respondents in relation to labor shortage and its solution in haricot bean cultivation

labor shortage problem	Frequency	Percent	Solution to labor shortage problem	Frequency	Percent
No	88	55.0	No problem	88	55.0
Yes	72	45.0	Hiring	13	8.1
Total	160	100.0	Asking for cooperation	44	27.5
			Both hiring and cooperation	15	9.4
			total	160	100

Source: own survey data, 2007.

The above Table reveals that 45 % of the respondents reported facing labor shortage during weeding and harvesting. Moreover, it also shows that 8.1 %, 27.5 % and 9.4 % of respondents reported using hiring, asking cooperation and both hiring and cooperation respectively as solution to labor shortage problem. The survey result on labor availability across adoption categories is given in Table 17.

Farmers in focused group discussion explained the role played by women in haricot bean cultivation as very crucial. According to farmers of the study area, women role is not restricted to biological, labour and social reproduction; they are also involved in productive role of farming activities. In relation to haricot bean production they play role in the whole production process except ploughing. Although they were found to participate in different activities of production process such as sowing, weeding, cultivation, harvest, transport, storage and preparation of threshing field, the nature of participation is not full time because of biological reproduction of child birth and lactation and labor reproduction which involves the daily regeneration of the labor force through cooking, cleaning, washing, nursing and so on. Making female farmers targets in extension, therefore, makes sense for agricultural and rural development.

Table 17.Relationship between labor availability in terms of man equivalent with adoption of improved haricot bean production package.

Adoption Category	N	Mean	SD	F	p	r
Non Adopter	86	3.29	1.46			
Low	9	2.71	0 .74			
Medium	36	3.04	1.39			
High	29	3.41	1.75			
Total	160	3.22	1.47	0.766 NS	0.515	0.012

Source: Own survey data, 2007. NS=Not Significant

The man equivalent (ME) was calculated for the sample respondents (See Appendix Table 1). The average labor availability in terms of man equivalent for sample household was 3.22 with standard deviation of 1.47.The average number of available labor force in terms of man equivalent for non-adopters, low, medium and high adopters were 3.29, 2.71, 3.04 and 3.41 with standard deviations of 1.46, 0.74, 1.39, 1.75 respectively (Table 17). The size of labor force in the household is expected a priori to contribute for variation on adoption decision of haricot bean technology. However, in this study, significant difference was not observed with regard to the size of labor force between adoption categories. This is evident from the result of one way ANOVA (F= 0.766 and P= 0.515) which shows absence of significant mean difference between adoption categories, non, low, medium, high adoption. The result of this study confirms the earlier findings of Getahun (2004) and Yishak (2005).

4.3.3 Household economic variables

Farm income

The farm income refers to the total annual earnings of the family from sale of agricultural produce after meeting family requirements. This is believed to be the main source of capital for purchasing agricultural inputs. Thus, those households with a relatively higher level of farm income are likely to purchase improved seeds or other essential agricultural inputs. In this study the household farm cash income was estimated based on the sales of crops and

livestock and livestock products. Accordingly the average annual income from sale of crop for sample households was 1606.68 and mean income from sale of livestock and livestock products for sample respondents was 475.06.This implies that the average income from sale of crop is by far greater than the average income from sale of livestock and livestock products. The major cash income for sample households in the study area is from sale of crop. The average annual income from haricot bean cultivation is presented in Table 18.

Table 18. Average annual income from haricot bean (in Birr)

N	160
Mean	290.1938
Std. Deviation	347.40045
Minimum	0.00
Maximum	2100.00

Source: own survey data, 2007.

The above Table indicates the average cash income from haricot bean cultivation after consumption and it was 290.19 birr with standard deviation of 347.40. The average annual income from haricot bean production accounts 18.06 percent of annual income from crop sale. The Table also indicates the minimum and maximum income per household head after fulfilling family requirements and it was 0.00 and 2100. The result of mean annual income across adoption categories is provided in the following Table 19.

Table 19. Mean annual farm income across adoption categories (in Birr)

Adoption category	N	Mean	SD	Min	Max	F	P	r
Non Adopter	86	1732.82	2194.08	0.00	17259.00			
low	9	1427.56	694.55	280.00	2563.00			
Medium	36	2523.41	2240.48	300.00	9460.00			
High	29	2771.22	3256.09	570.00	18200.00			
Total	160	2081.74	2406.40	0.00	18200.00	2.063NS	0.107	0.194**

Source: survey date, 2007. ** represents significant at 5 percent probability level.

As provided in Table 19 above the average on-farm income for sample households was birr 2081.74, whereas the mean farm income for non-adopters was Birr 1732.82 and that of low, medium and high adopters mean on-farm income was 1427.56, 2523.41 and 2771.22, respectively. One way analysis of variance (F= 2.063 and p=0.107) was conducted based on farm income of household heads and the test result showed insignificant mean difference between adoption categories in relation to farm cash income after fulfilling family requirement and bivariate correlation test result (r=0.194) reveals that the existence of positive and significant relation between adoption index of household heads and annual farm income. The result of this study is inconsistent with research findings carried out by Kidane (2001), Degnet and Belay (2001).

Participation in off-farm activities: during slack periods many farmers can earn additional income by engaging in various off-farm activities. This is believed to raise their financial position to acquire new inputs. Therefore, in this study, it is hypothesized that there is a positive correlation between participation in off-farm activities and the level of adoption of new crop technologies. It is a dummy variable and takes value of 1 if a household head participated in the activities, 0 otherwise.

Table 20. Relationship between participation in off-farm and adoption (%)

Variable response		Adoption category				Total	χ^2-value
		Non	Low	Medium	High		
Off-farm	Yes	19.8	22.2	25	24.1	21.9	
Activity	No	80.2	77.8	75	75.9	78.1	
Engagement (%)	Total	100 (86)	100 (9)	100 (36)	100 (29)	100 (160)	0.517NS

Source: Own Survey data, 2007; Cramer's V= 0.057, df=3 p=0.915, NS= non Significant

Out of the total households interviewed 21.9% had participated in off-farm activities. Among the households who participated in off-farm activities, adopters accounted about 51.43 % while non-adopters accounted 48.57% with insignificant difference in terms of percentage. Unlike priori expectation, participation in off-farm activities had insignificant relationship

(χ^2=0.517, df= 3, p= 0.915, Cramer's V= 0.057) with adoption of improved haricot bean production package (Table 20). The result of this study confirms the findings of Mesfin (2005).

In the study area, petty trading, daily labor activities on safety net program, house making, income from horse drawn cart and pepper trading were found to be some of the off-farm activities in which sample households were participating.

4.3.4 Institutional factors

Farmers make decisions within a broader environment or context (Tesfaye, 2003:68). Institutional factors are part of such broader environment, which affects farmers' adoption decision of agricultural technologies. Institutional factors in the context of this study include support provided by various institutions and organizations to enhance the use of improved haricot bean technologies such as social organization, extension and credit services.

Social participation

Participation in social organization is expected to have an indirect influence on the adoption behavior of farmers. It links the individual to the larger society and exposes him to a variety of ideas. This exposure makes him positively predisposed towards innovative ideas and practices. The social participation scores of the farmers were calculated on the basis of scores given for their membership status, score of zero was given for non participant, score of 1 was given for those who are members only, 2 was given for those who are committee members, and score of 3 was given for those who are leaders of organization. To see each farmer's level of social participation in local organizations, 10 organizations were included in the interview schedule. A farmer's maximum total score to achieve accordingly was 30. The mean score for adoption categories is presented in Table 21.

Table 21. Relationship between total score achieved in social participation and adoption and intensity of adoption of haricot bean production package

Adoption category	N	Mean	SD	Min	Max	F	P	r
Non Adopter	86	2.20	1.69	0	9			
low	9	2.11	1.17	1	4			
Medium	36	2.67	1.51	1	6			
High	29	4.10	2.74	1	11			
Total	160	2.64	1.98	0	11	7.799***	0.000	0.313***

Source: Own survey data, 2007, *** represents 1 % significance level.

The above table indicates that the average score for sample households was 2.64. While the mean score of social participation for non adopters, low adopters, medium and high adopters was 2.20, 2.11, 2.67 and 4.10, respectively. The results of one way ANOVA (F=7.799 and P=0.000) reveals statistically significant mean difference between adoption categories in relation to social participation score at 1% probability level. Further analysis using post hoc test shows the existence of significant mean difference between high adopters Vs non adopters, low and medium adopter categories at 5% probability level. This result reaffirms previous findings of Dasgupta (1989) and Dereje (2006).

Contact with extension information sources

Contact with development agent

Extension is supposed to have a direct influence on the adoption behavior of farmers. When there is contact with extension agent, the greater is the possibilities of farmers being influenced to adopt agricultural innovations. The village level worker is one of the most important sources of information on agricultural innovations to farmers, especially those who are earlier adopters. Later adopters, however, tend to rely more for information on relatives, friends, and neighbors who have already tried out the innovation and adopted. The result on sampled farmers contact with extension agent is presented in Table 22.

Table 22. Relationship between contact with extension agent and adoption and intensity of adoption of haricot bean production package.

Information source/ Development agent	Adoption categories								Total	
	Non Adopter		low		Medium		High			
	n	%	n	%	n	%	n	%	n	%
Yes	35	40.7	5	55.6	29	80.6	24	82.8	93	58.1
No	51	59.3	4	44.4	7	19.4	5	17.2	67	41.9
Total	86	100.0	9	100.0	36	100.0	29	100.0	160	100.0

Source: Own survey data, 2007. χ^2=25.4278***, df=3, Cramer's v=0.399, p=0.000

Of the total 160 sample respondents 93 (58.1 percent) farmers reported having contact with development agents and 67 (41.9 percent) farmers reported having no contact with development agents (Table 22). This (41.9 percent) has a serious implication with respect to management of development agents (existing monitoring and evaluation, reward and punishment), particularly having at least two development agents per each rural kebele.

The Table also indicates that 40.7, 55.6, 80.6 and 82.8 percent of non adopters, low adopters, medium and high adopters had contact with extension agent respectively. Whereas 59.3, 44.4, 19.4 and 17.2 percent of non adopters, low, medium and high adopters had no contact with development agent. This implies that larger proportion (78.38%) of adopters have contact with development agent while smaller proportion (40.70%) of non adopters have contact with development agent. The chi-square result (χ^2=25.427 and P=0.000) shows statistically significant difference between adoption categories with respect to farmers contact with extension agent. This agrees with priori expectation and confirms the study carried out by (Nkonya *et al*., 1997).

Frequency of contact with extension agent

This refers to the number of contacts per year that the respondent made with extension agents. The effort to disseminate new agricultural technologies is within the field of communication between the change agent (extension agent) and the farmers at the grassroot level. Here, the frequency of contact between the extension agent and the farmers is hypothesized to be the

potential force which accelerates the effective dissemination of adequate agricultural information to the farmers, thereby enhancing farmers' decision to adopt new crop technologies.

Table 23. Adoption categories and score for frequency of contact with extension agent

Adoption category	N	Mean	SD	Min	Max	F	P	r
Non Adopter	86	0.98	1.43	0	4			
low	9	1.67	1.73	0	4			
Medium	36	1.61	1.29	0	4			
High	29	2.14	1.48	0	4			
Total	160	1.37	1.49	0	4	5.444***	0.001	0.300***

Source: Own survey data, 2007. ***=significant at 1 %.

The score for frequency of contact with extension agent was calculated on the basis of scores given for the frequency of contact farmers have with extension agent, score of zero was given for having no contact with extension agent, score of 1 was given for those who have contact once in a year, 2 was given for those who have monthly contact with extension agent, and score of 3 was given for those who have bi-weekly contact with the agents and a score of 4 given for those having weekly contact with the agent. Accordingly, the maximum score to be achieved by a farmer was 4. Table 23 shows that the average score of sample respondents was 1.37 with standard deviation of 1.49. Test of mean variance using one-way ANOVA showed that there was significant mean difference (F=5.444, p=0.001) between adoption categories at 1% significance level in relation to score achieved for frequency of contact with extension agent. Further analysis using post hoc test result indicates statistically significant mean difference lying between non adopters with high adopter categories. Moreover, result of bivariate correlation also confirmed the positive and significant relationship (r=0.300, p=0.000) of frequency contact with extension agent and adoption of improved haricot bean technology package at 1% significance level. This result is in complete agreement with the finding reported by Kidane (2001), Girmachew (2005), Abrhaley (2007).

Attending extension events

Attending field visit, training and demonstration

The result on farmers' attendance in different extension events in relation to haricot bean production is furnished in Table 24.

Table 24. Farmers' participation in different extension events

Farmers attendance in different extension event		Frequency	Percent
Attendance of HHH in field visit	Yes	6	3.8
	No	154	96.3
	Total	160	100.0
Attendance in training	Yes	21	13.1
	No	139	86.9
	Total	160	100.0
Attending demonstration	Yes	0	0
	No	160	100
	Total	160	100

Source: survey data; 2007.

Table 24 indicates that only 3.8 percent of sampled farmers have attended field visit on improved haricot bean production technology package and majority of the farmers (96.3%) did not attend in field visit.

Training is an important aspect to improve farmers' performance. It equips farmers with new knowledge and skill, which help them to perform new practice properly. If a farmer has no skill and know-how about certain technology, he/she may have less probability of adoption. The skill acquired through training helps to carry out a new technology effectively and efficiently. If farmers are well trained in new practice, they may not need outside support later. They can properly implement the recommendation. Concerning farmers' presence at

training programs, out of total 160 farmers interviewed only 13.1 % of them were found to attend and the rest 86.9 % did not attend in the program.

Undertaking field trial on ones farm is very important because it helps other farmers to observe the productivity and yield of new technology practically. This situation may facilitate the adoption process. In other words attending demonstration is an important means, which create concrete awareness among the target group on the practice. It is also a means of passing information to initiate farmers to try and then adopt the better practice into their farm. The study revealed that no farmer was found who attended demonstration of improved haricot bean production technology package. This is because woreda office of agriculture and rural development did not arrange demonstration.

Attending extension events and its influence on adoption

Attending extension events was measured by giving scores to respondent farmers' participation in the two extension events namely training and field visit. Demonstration was not taken into account in scoring because of the absence of participation in demonstration. Farmers' attendance was valued out of the total score of 3 which was assigned for each event. Accordingly, total attendance in extension events constitutes a total score of 6. A farmer who had attended three times in each extension event was given maximum score of 3, while those who attended twice in an event was given score of 2, those who attended once in the extension event were given score of 1 and those of farmers who did not attend the events were given with a score of 0. Finally, respondent farmers' total attendance in extension events was taken as a sum of a score for each event. The result on mean score achieved from attendance in extension events across adoption categories is provided in Table 25.

Table 25. Mean score for attending extension events by adoption categories

Adoption category	N	Mean	SD	Min	Max	F	P	r
Non Adopter	86	0.09	0.66	0	6			
low	9	0.44	1.01	0	3			
Medium	36	0.33	0.83	0	4			
High	29	0.59	0.98	0	4			
Total	160	0.26	0.80	0	6	3.223**	0.024	0.206***

Source: Own survey data, 2007. **and *** = significant at 5% and 1 % probability level.

The average attendance score of the sample households was 0.26. The maximum attendance score was 6 while the minimum is 0. Mean Score for attendance in extension events was 0.09 for non-adopters and 0.44, 0.33 and 0.59 for low, medium and high adopter categories, respectively. Statistical test for variability in mean score using one way analysis of variance indicates that there was significant mean difference in attendance score (F= 3.223, p= 0.024) among adoption categories (Table 25). Post hoc multiple comparison test result indicates that the variability was observed between non adopters and high adopters categories at 5% probability level.

Bivariate correlation analysis also showed that there was positive and significant relationship (r=0.206, p=0.009) between attendance in extension events and adoption of improved haricot bean production package at 1% significance level (Table 25). This means that an increase in farmers' level of participation in extension events like training will increase adoption and intensity of adoption of improved haricot bean production package. Therefore, extension has to give emphasis to such means of transferring agricultural information to farmers.

The result of this study is in agreement with the findings of many authors. For instance, Tesfaye *et al*., (2001) reported that attendance of on-farm demonstration and training contributed positively to farmers' adoption decision. In the same line, Asfaw *et al*. (1997) and Yishak (2005) in their studies of determinants of adoption of improved maize technology in Ethiopia and Damote Gale wereda found that farmers' presence in demonstration had positive and significant relationship with adoption. Taha (2007) also reported same result.

Table 26. Distribution of respondents in relation to frequency of contact with different agricultural information sources

Frequency of contact	Frequency of contact with model farmers		Frequency of contact with follower farmers		Frequency of contact with PA leaders		Frequency of contact with NGOs		Frequency of contact with Neighbors		Frequency of contact with input suppliers		Frequency of contact with Agricultural professionals	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Never	113	70.6	104	65.0	51	31.9	155	96.9	10	6.3	122	76.3	92	57.5
Once in a year	8	5.0	7	4.4	12	7.5	3	1.9	11	6.9	32	20.0	14	8.8
Monthly	14	8.8	18	11.3	39	24.4	2	1.3	1	.6	4	2.5	31	19.4
Weekly	22	13.8	28	17.5	46	28.8	0	0	16	10.0	1	0.6	22	13.8
Daily	3	1.9	3	1.9	12	7.5	0	0	122	76.3	1	0.6	1	0.6
Total	160	100	160	100	160	100	160	100.	160	100	160	100.	160	100

Source: own survey data, 2007

Farmers contact in relation to agricultural matters decreases as one goes from neighbors, PA leaders, Agricultural professionals, follower farmers, model farmers, input suppliers and NGOs. In other words, 6.3 %, 31.9 %, 57.5 %, 65 %, 70.6 %, 76.3 % and 96.9 % of the farmers reported having no contact with neighbors, PA leaders, Agricultural professionals, follower farmers, model farmers, input suppliers and NGos respectively. Farmers daily contact on agricultural matters is higher among themselves followed by PA leaders. From this we can derive that farmers' communication is higher among themselves irrespective of being model or follower farmer. It can be said that focusing on relatively innovative or progressive farmers of the study area would not necessarily mean other farmers would benefit almost automatically.

Mass media exposure

The adoption process of agricultural technologies depends primarily on access to information and on the willingness and ability of farmers to use information channels available to them. The role of information in decision-making process is to reduce risks and uncertainties to enable farm households to make right decision on adoption of improved agricultural technologies. Mass media play the greatest role in provision of information in shortest possible time over large area of coverage. However, as compared to other communication channels, its effect on behavioral change is weak as it is limited to awareness creation than skill development. But, as far as awareness is pre-requisite for behavioral change, still its role cannot be underestimated. Hence, mass media exposure was expected to positively influence adoption and intensity of adoption of improved haricot bean production package. The survey result on mass media exposure of sample respondents is provided in Table 27.

Table 27. Distribution of respondents with respect to radio listening habit

Frequency of contact with radio	Frequency	Percent
Never	66	41.3
Monthly	6	3.8
Weekly	44	27.5
Daily	44	27.5
Total	160	100.0

Source: survey data, 2007.

Concerning radio listening habit of respondents in the study area, 41.3 % of them did not listen radio programs whereas 3.8 %, 27.5 % and 27.5 % of the respondents have monthly, weekly and daily radio listening habit (Table 27). Surprisingly, majority of radio listeners in the study area do not pay attention to agricultural programs. Lack of attention to agricultural radio program may be attributed to unfamiliarity of the language and also lack of awareness on the importance of the program. It could also be attributed to lack of favorable attitude towards the program. Farmers mass media exposure across adoption categories is given in Table 28.

Table 28. Distribution of respondents in relation to mass media exposure

Frequency of contact with radio	N	Mean	SD	Min	Max	F	P	r
Non Adopter	86	2.01	1.81	0	4			
low	9	1.22	1.86	0	4			
Medium	36	1.83	1.73	0	4			
High	29	2.41	1.50	0	4			
Total	160	2.00	1.75	0	4	1.257 NS	0.291	0.065

Source: survey data, 2007. NS= non significant

In this study, respondent farmers' exposure to mass media was measured on five-point scale and total mass media exposure constituted a total score of 4. As shown in Table 28, mass media contact had positive and insignificant correlation (r=0.065, p=0.417) with adoption of

improved haricot bean production package. Mean difference test using one way analysis of variance /ANOVA/ also indicated there was insignificant mean difference (F= 1.257, p= 0.291) between adoption categories. The result of this study is consistent with the findings of Kidane (2001) Getahun (2004). This could be due to the fact that agricultural radio programs were not given top priority by farmers of study area rather the priority was for other non agricultural programs.

Distance to market centers

Markets are communication centers both for producers, consumers and traders. In this study, it is hypothesized that the distance between the respondent's residence and the nearest market place (measured in kilo meters) is negatively correlated with the decision to adopt newly introduced crop varieties. The result on mean distance traveled by respondents across each adoption categories is presented in the Table 29.

Table 29. Average distance of the respondents from the nearest market center in kilometers

Adoption category	N	Mean	DS	Min	Max	F	p	r
Non Adopter	86	7.19	3.12	4.00	20.00			
low	9	6.39	2.20	5.00	10.00			
Medium	36	6.19	2.00	2.50	10.00			
High	29	7.45	2.87	5.00	17.00			
Total	160	6.97	2.83	2.50	20.00	1.488NS	0.220	-0.025

Source: own survey data, 2007. NS= non significant

Regarding the distance taken to travel from home to the nearest market place, sample farmers reported that they had to travel an average of 6.97 km with standard deviation of 2.83 km. For sample respondents the minimum and the maximum distance that a farmer had to travel to access market center were 2.5km and 20km respectively. Mean distance traveled to the nearest market centers by non-adopters, low adopters, medium and high adopters was 7.19 km, 6.39km, 6.19 and 7.45 km respectively (Table 29).

Results of one way analysis of variance /ANOVA/ (F=1.488 and P=0.220) reveals that there is no statistically significant mean difference among adoption categories. Moreover, the bivariate correlation confirms the existence of negative and insignificant association between distance and adoption of haricot bean technology. The result of this study is inconsistent with the findings of many other researchers who reported that market distance is negatively and significantly associated with adoption of crop technologies Mahdi (2005), Mesfin (2005), Yishak (2005), Tesfaye (2006) which were conducted in different parts of the Ethiopia.

Quality of inputs

Quality of input delivered by an institution will have its own impact on adoption of agricultural technologies and production and productivity of crops. With this understanding, data on problems of input delivered by office of agriculture and rural development and purchased from market were collected and summarized as follows.

Table 30. Problem of input delivered by office of agriculture and rural development

Problems of improved seed of HB	Frequency	Percent	Problems of fertilizer	Frequency	Percent
Delay	93	58.1	Scarcity	15	9.4
Low quality	48	30.0	Delay	81	50.6
Expensive	12	7.5	Low quality	17	10.6
Down payment	7	4.4	Expensive	37	23.1
Total	160	100.0	Down payment	10	6.3
			Total	160	100.0

Source: own survey data, 2007.

Table 30 shows that majority of respondents 93 (58.1 %) and 48 (30 %) reported delay and poor quality (poor in terms of germination and color) delivery of improved haricot bean variety as problems of inputs from rural development office. Furthermore, the Table also provides majority of respondents 81 (50.6 %) and 37 (23.1 %) reported delay and

expensiveness of fertilizer as problems of inputs from rural development office. This implies importance of time, quality and price in input delivery.

Table 31. Problems of inputs purchased from market

Problems of local haricot bean seed purchased from market	Frequency	Percent	Problems of fertilizer purchased from market	Frequency	Percent
Low quality	55	34.4	Scarcity	1	0.6
Expensive	105	65.6	Delay	1	0.6
Total	160	100.0	Low quality	31	19.4
			Expensive	127	79.4
			Total	160	100.0

Source: own survey data, 2007.

The above Table clearly indicates that 105 (65 %) and 127 (79.4 %) respondents reported expensiveness of local seed and fertilizer purchased from market, respectively. Moreover, it also provides information on low quality of local seed and fertilizer purchased from market as reported by 55 (34.4 %) and 31 (19.4 %) respondents concerning local seed and fertilizer, respectively.

Data on to whom they sell was collected to see whether they have changed to whom they sell in the last two to three years and the finding is summarized in the Table 32.

Table 32. Distribution of respondents in relation to change in produce procuring agent

Changed your sale in the last 2-3 years	Frequency	Percent
No	141	88.1
yes	19	11.9
Total	160	100.0

Source: own survey data, 2007.

It can easily be seen from the Table 32 that 141 reported no change to whom they sale produce and only 19 respondents reported changing to whom they sale. Those who changed explained the existence of increase in price and alleviation of problem of cheating in kg when sold to consumers than traders.

Data on haricot bean price trend in the last 3 to 4 years and its effect on haricot bean cultivation is given in the Table 33.

Table 33. Trend in the price of haricot bean in the last 3 to 4 years and effect on its cultivation

Trend in price	Frequency	Percent	How does price trend compare with other crop?	Frequency	Percent
Decreasing	0	0	it attracts farmers towards		
Stagnant	2	1.3	cultivation of HB	158	98.8
Increasing	158	98.8	it does not attract farmers	2	1.3
Total	160	100.0	Total	160	100.0

Source: own survey result, 2007

Table 33 reveals that 158 (98.8 %) respondents reported increasing trend on haricot bean market price particularly for the local variety and again the same percent of the respondent farmers reported as it attracts farmers towards its cultivation. This implies crop's potential for its future expansion.

Table 34. Distribution of respondents in relation to the perception they have towards price and production risk in haricot bean cultivation

Response category	Is there price risk?		Is there production risk in haricot bean production?		Which risk is more significant?		
	Frequency	Percent	Frequency	Percent		Frequency	Percent
Yes	160	100.0	160	100	Price	7	4.4
No	0	0	0	0	Production	153	95.6

Source: own survey data, 2007.

The above table shows 100 % respondents perceive the existence of price and production risk in haricot bean cultivation. The price risk is particularly important to improved variety and the production risk is attached to railfall failure, disease occurrence and perception on decreasing yield of teff, which is sown immediately after harvesting of haricot bean yield during belge season. Moreover, the production risk was perceived as more significant by 153 (95.6 %) respondents and price risk was perceived as more important by 7 (4.4 %) respondents. Majority of the respondents perceived production risk as more significant than price because of the probability of completely losing the crop due to rainfall failure and disease.

Access to credit

Access to credit is one way of improving farmers' access to new production technology. Farmers' ability to purchase inputs such as improved seed and fertilizer is particularly important. The formal sources of credit in Ethiopia are office of agriculture, Service Cooperatives and Ethiopian Development Bank. Farmers who have access to credit can minimize their financial constraints and buy inputs more readily. Thus, it is expected that access to credit can increase the probability of adopting improved haricot bean technologies. The result on credit accessibility of the respondents is summarized and presented in Table 35.

Table 35.Access to credit across adoption categories

Availability of credit	Adoption categories								Total	
	Non Adopter		Low		Medium		High			
	n	%	n	%	n	%	n	%	n	%
Yes	8	9.3	1	11.1	23	63.9	18	62.1	50	31.3
No	78	90.7	8	88.9	13	36.1	11	37.9	110	68.8
Total	86	100.0	9	100.0	36	100.	29	100.	160	100.0

Source: own survey data, 2007. χ^2=51.652***, df= 3, Cramer's V= 0.568, p=0.000.

***= significant at 1 percent probability level.

In the study area, inputs were available on credit basis to farmers from the office of agriculture and rural development in the cropping season. Regarding credit access of respondent farmers in the study area 31.3 percent reported having access to credit while the remaining 68.8 percent reported lack of access to credit for the purchase of improved haricot bean technologies. With respect to credit accessibility response of farmers in the adoption categories 9.3 % of non-adopters and 11.1 % of low-adopters, 63.9 % of medium and 62.1 % of high adopters used credit for improved haricot bean technologies (Table 35).

Timeliness of production loan from institutional sources was expected to influence the adoption decisions of the farmers. It is believed that timely access to institutional credit would alleviate the problem of cash constraint for timely usage of seasonal inputs thereby encourages farmers to adopt improved agricultural inputs which in turn raise agricultural productivity. The result of this study shows statistically significant difference between adoption categories in relation to access to credit at less than 1% percent probability level ($\chi 2=51.652$, $p=0.000$). The result confirms priori expectation and also findings of previous research (Legesse, 1992; Teressa, 1997; Wolday, 1999; Mulugeta, 2000).

4.3.5. Psychological factors

Knowledge

In order to measure the farmers' level of knowledge about the cultivation of improved haricot bean, suitable question were framed to invoke responses from the farmers and teacher made type achievement tests were used. In this study knowledge of technology was hypothesized to influence adoption of improved haricot bean technologies positively. During the survey, farmers' knowledge of improved haricot bean technology was evaluated by asking respondents to give their answer for the stated question like naming three improved varieties, which are introduced to the area, name a chemical that can be used to treat seed, amount of chemical that can be used to treat one kg of seed, seed rate per timad of land, fertilizer rate per timad of land, time of fertilizer application, spacing etc, and responses were recorded for each respondent and the result is indicated in Table 36.

Table 36.Mean score achieved from knowledge test by adoption category

Adoption category	N	Mean	SD	Min	Max	F	P	r
Non Adopter	86	3.83	2.11	0	8			
low	9	4.11	2.21	2	9			
Medium	36	5.61	1.36	2	8			
High	29	6.07	1.58	3	9			
Total	160	4.65	2.11	0	9	14.394***	0.000	0.426***

Source own survey data 2007, *** represents 1% level of significance**.**

As it has been clearly indicated in Table 36, the average score of knowledge on haricot bean production technology was 4.65 for all respondents and was found to be 3.83, 4.11, 5.61, and 6.07 for non adopters, low adopters, medium and high adopters of haricot bean technologies respectively. As one way ANOVA analysis illustrates mean difference was found to be significant at less than 1% level (F=14.394, p=0.000) implying that knowledge of technology can affect adoption of haricot bean technologies positively and supported the hypothesis. Post hoc test results showed that significant mean difference was observed between non adopters' vs medium and high adopter categories at 5% probability level. Moreover, bivariate correlation result shows the existence of positive and significant relation between adoption and knowledge on improved haricot bean production package. This is due to the fact that the more farmers became knowledgeable on a given technology and its application, the more confident they will be and the lower the probability of failure. The result confirms the finding by Legesse (1992), Getachew (1993) and Degnet and Belay (2001).

Farmers' perception of haricot bean technology package

A). Farmers' perception of improved haricot bean varieties

Technologies are viable only when farmers use them. No matter how well the new technologies work on research stations, if farmers do not have them for use, their development would be in vain (Snadera *et al*., 1989 cited in Oldele and Fawole, 2007). But

more trouble will it have been if the farmers' perception of the technologies is not only low but also wrong (Oldele and Fawole, 2007).

Based on this ground, farmers' perception of haricot bean technologies has been considered in this study. With regard to the assessment of perception, an index which identifies how well certain attributes of improved varieties meet farmers' preference over the local variety on five point scale was used. Accordingly, the ratings such as very low (1), low (2), medium (3), high (4), and very high (5) were used to measure the respondents perception to the technologies and the larger value (5) indicates how farmer perceives the characteristics being presented for evaluation is being embodied and 4, 3, 2, and 1 in a decreasing manner. A value less than three indicates how the farmer perceives the characteristics under evaluation as poor or negatively. The result on farmers' perception of haricot bean technology package is given in Table 37.

Table 37: Distribution of sample households per technology attributes rating (IHBV)

No.	Attributes of IHBV	No. of respondents	Distribution of respondents per perception category (%)					average score	
			Very low	Low	Medium	High	Very high	Mean	SD
1	Perception of yield potential of the variety	160	31.3	30	6.3	21.3	11.3	2.51	1.410
2	Perception of early maturity	160	0	3.1	34.4	38.1	24.4	3.84	0.831
3	Perception of grain quality	160	33.1	43.1	16.9	3.1	3.8	2.01	0.984
4	Perception of disease resistance	160	11.3	66.3	14.4	8.1	0	2.19	0.740
5	Perception of pest resistance	160	26.9	50.6	14.4	7.5	0.6	2.04	0.878
6	Perception of logging resistance	160	20.0	60.0	11.9	6.3	1.9	2.10	0.856
7	Perception of long harvesting time	160	14.4	53.1	26.3	5.6	0.6	2.25	0.793
8	Perception of world market demand	160	15.0	55.6	10.6	15.6	3.1	2.36	1.019
9	Perception of profitability	160	46.9	24.4	16.3	9.4	3.1	1.97	1.138

Source: own survey data, 2007.

According to the survey result shown in Table 37, the varieties were supported by farmers for certain attributes such as early maturity while some of the attributes like yield potential, grain quality, disease resistance, pest resistance, water logged condition resistance, long harvesting time, world market demand and profitability were given the least scores of 2.51, 2.01, 2.19, 2.04, 2.10, 2.25, 2.36 and 1.97 respectively.

Low ratings of yield potential of improved variety could be due to poor management of plots. This is evident from low seed and fertilizer rate and inappropriate spacing applied by majority of sampled farmers which can be evidenced from data collected on seeding rate, fertilizer rate and spacing. According to farmers in Lenda rural kebele, it can also be due to incompatibility

of technology to agro-ecology of the area. This implies the need to conduct further research and site specific trial on the performance of technology in the study area.

The low ratings on grain quality, disease and pest resistance, long harvesting time, world market demand and profitability could be due to distribution of poor quality seed in terms of germination, low disease and pest resistance compared to local variety, it shatters when it dries too much, lack of good local market and high cost of production compared to local variety respectively.

Relative disadvantages of improved haricot bean variety

Perception on storability, regular fresh seed requirement, high seed purchase price, unavailability of seed at the right time and quality seed availability, local consumption demand and local market demand related attributes were assessed to get farmers' view on relative disadvantages of improved haricot bean variety (see Table 38).

Table 38: Distribution of sample households per technology attributes rating (IHBV)

No.	Disadvantages associated with the use of IHBV	Sample HHHs	Distribution of respondents per perception category (%)					score	
			Very low	Low	Medium	High	Very high	Mean	SD
1	Low storability	160	3.8	12.5	8.1	65.0	10.6	3.66	0.958
2	Regular fresh seed requirement	160	3.1	11.3	15.0	54.4	16.3	3.69	0.978
3	High seed purchase price	160	0.6	1.3	15.0	68.1	15.0	3.96	0.638
4	Unavailability of seed at the right time and quality	160	0.6	3.1	5.0	70.6	20.6	4.08	0.659
5	Low local consumption demand	160	7.5	10.6	15.6	53.8	12.5	3.53	1.081
6	Low market demand	160	1.9	5.0	3.8	54.4	35.0	4.16	0.858

Source: own survey data 2007.

The result presented in Table 38 reveals that low market demand, unavailability of seed at the right time and with right quality, high seed purchase price, regular fresh seed requirement, low storability, low local consumption demand with an average score of 4.16, 4.08, 3.96, 3.69, 3.66 and 3.53 were some of the disadvantages associated with the variety respectively.

Regarding the quality of improved seed distributed in 2005/2006 production year, farmers in focused group discussion reported the distribution of poor quality seed in terms of its poor germination percentage and poor color, which does not conform to the demand of the market.

Hence, it can be concluded that the local variety of haricot bean was perceived to be suitable for local market demand, availability of seed at the right time, low cost of obtaining the seed and local consumption demand. This confirms the statement of Ashby and Sperling (1992; cited in Makokha, *et al,* 1999). According to them, farmers are considered to have subjective preference for specific characteristics inherent in new technologies and hence need to be given due concern by researchers.

Accordingly, with reference to the study area, some of the characteristics which are perceived highly important by farmers such as early maturity, yield, disease resistance, compatibility to local agro-ecology, suitability to local consumption demand and more importantly quality seed production that satisfies world market demand and timely delivery of improved seed (input) need to get due consideration in further haricot bean improvement, breeding and extension programs.

B). Farmers' perception of fertilizer

As far as the relative advantages and disadvantages of fertilizer are concerned, same procedures with that of variety were followed in obtaining farmers' judgment on certain identified attributes (Table 39).

Table 39: Perception of relative advantages and disadvantages of fertilizer application according to recommendation.

No.	Relative advantages of fertilizer	N	Distribution of respondents per score perception category (%)						
			Very low	Low	Medium	High	Very high	Mean	SD
1	Increase production	160	0	4.4	5.6	49.4	40.6	4.26	0.756
2	Increase efficiency of fertilizer use	160	0.6	0.6	7.5	56.3	35.0	4.24	0.671
3	Facilitates maturity	160	0.6	0.6	6.3	52.5	40.0	4.31	0.673
4	Dark green looking stand	160	0.0	0.6	3.8	60.6	35.0	4.30	0.570
5	Helps in estimating cost of production	160	3.8	5.6	25.6	53.1	11.9	3.64	0.901
6	Improves soil's fertility	160	0	0	4.4	50.6	45.0	4.41	0.575
	Disadvantages								
1	High price/cost	160	0.6	4.4	7.5	58.1	29.4	4.11	0.769
2	Bureaucratic procedures	160	1.3	6.3	17.5	55.6	19.4	3.86	0.846
3	Absence of quality fertilizer	160	0.6	5.0	5.6	65.0	23.8	4.06	0.741
4	No fertilizer distribution if there is previous default in the kebele	160	0	2.5	1.3	51.9	44.4	4.38	0.643

Source: own survey data 2007.

The calculated survey result revealed that (Table 39) farmers' perception of relative advantages of fertilizer use was found to be positive for all listed attributes such as improve soil fertility, facilitate maturity, dark and green stand, increased production, increase efficiency of fertilizer use and help in estimating cost of production in order of their rank taking average mean score of 4.41, 4.31, 4.30, 4.26, 4.24 and 3.64, respectively. Whereas No fertilizer distribution if there is previous default in the kebele, High fertilizer price, followed by unavailability of quality fertilizer and bureaucratic input administration procedures are

disadvantages associated with the use of fertilizer with an average mean score of 4.38, 4.11, 4.06 and 3.86 respectively.

C) Farmers perception of spacing

Appropriate plant spacing is important because overcrowded sowing would result in slow and stunted growth and eventually in poor yield. The result on farmers perception of plant spacing is presented in Table 40.

Table 40: Perception of relative advantages and disadvantages of spacing.

No.	Relative advantages of spacing	N	Distribution of respondents per perception category (%)					score	
			Very low	Low	Medium	High	Very high	Mean	SD
1	Ease of weeding	160	0	0.6	5.0	52.5	41.9	4.36	0.608
2	Vigor stand	160	0	0	5.0	57.5	37.5	4.33	0.567
3	Good light interception	160	0	0.6	11.3	55.0	33.1	4.21	0.655
4	Improves fertilizer use efficiency	160	0	0.6	5.6	53.1	40.6	4.34	0.613
5	Convenience of field inspection	160	0.6	0	15.6	53.8	30.0	4.13	0.707
6	Increases yield	160	1.3	3.8	6.3	44.4	44.4	4.27	0.837
7	Improves seed use efficiency	160	0.6	0	1.3	38.1	60.0	4.57	0.589
8	Saves time during weeding	160	0.6	0.6	7.5	66.3	25.0	4.14	0.623
9	Improves quality of grain	160	0	0.6	30.6	36.3	32.5	4.01	0.813
	Disadvantages								
1	Wastage of farm land	160	5.0	31.3	8.1	34.4	21.3	3.36	1.261
2	Skill requirement	160	2.5	5.6	12.5	65.6	13.8	3.83	0.828
3	Labor requirement	160	0	3.1	15.6	62.5	18.8	3.97	0.686

Source: own survey data 2007.

The calculated survey result revealed that (Table 40) farmers' perception of relative advantages of spacing was found to be high for all listed attributes such as increase in seed use efficiency, ease of weeding, improves fertilizer use efficiency, vigor stand, increases yield, good light interception, saves time during weeding, convenience of field inspection and improves quality of grain in order of their rank taking average mean score of 4.57, 4.36, 4.34, 4.33, 4.27, 4.21, 4.14, 4.13, 4.01, respectively. On the contrary, wastage of farm land, skill and labor requirements are perceived to be relative disadvantages of spacing with an average mean score of 3.36, 3.83 and 3.97, respectively.

d). Total perception of the package

Total perception score for relative advantages of the package (improved seed, fertilizer and spacing) for whole respondents was 13,565. This number was divided by 160 to get the average total score for a household head in the sample and it was found to be 84.78. Finally this number was again divided by the total attributes (24) of the technology listed to be rated by an interviewee. The resulting figure was 3.53, which is a bit larger than the median score (3), implying slightly positive perception towards technology package i.e. improved seed, fertilizer and spacing. This figure masks the very negative perception farmers have towards improved haricot bean variety; hence care should be taken so as not to forget or misguided by this figure, which is the result of high influence of fertilizer and spacing relative advantage ratings of the respondents.

In order to summarize the discussion on perception of sample households and examine its influence on adoption of the over all haricot bean technologies (variety and fertilizer), it was important to calculate the total perception score of the technologies with regard to the relative advantages and disadvantages of improved haricot bean production technologies. Efforts were made to see the association between adoption of haricot bean technologies and farmers' perception on relative advantages of technology attributes and the result is provided in Table 41.

Table 41.Total perception score on advantages of technology attributes

Adoption categories	N	Mean	SD	Min	Max	F	P	r
Non Adopter	86	83.72	8.14	66	101			
low	9	87.22	10.45	77	108			
Medium	36	86.06	8.23	70	99			
High	29	85.59	7.53	75	99			
Total	160	84.78	8.20	66	108	1.131NS	0.338	0.127

Source: survey data, 2007. NS= non significant

Non- adopters mean perception scores on advantages of technology attributes was 83.72 and that of low, medium and high adopters' categories were 87.22, 86.06 and 85.59, respectively. The ANOVA result shows the absence of significant mean difference (F=1.131, P=0.338) between adoption categories in relation to perceived relative advantages of the package (see Table 41). This might indicate that all respondents have relatively similar awareness level and perception on the positive attributes of the haricot bean technologies. Similarly, the result of correlation analysis shows that the relationship between adoption of the technologies and perceived relative advantages were found to be positive.

E) Total perception score for relative disadvantage of the package

Total perception score for relative disadvantages of the package (improved seed, fertilizer and spacing) for whole respondents was 7231. This number was divided by 160 to get the average total relative disadvantage score for a household head in the sample and it was found to be 45.19. Finally this number was again divided by the total attributes/items (13) of the technology listed to be rated by an interviewee. The resulting figure was 3.48, which is a bit larger than the median score (3), implying perception about the disadvantages of haricot bean technology package i.e. improved seed, fertilizer and spacing. The result on mean scores achieved across adoption categories on perception of relative disadvantages of the package is furnished in the Table 42.

Table 42. Total perception score on disadvantages of technology attributes

Adoption categories	N	Mean	SD	Min	Max	F	P	r
Non Adopter	86	51.79	3.93	39	60			
low	9	49.00	3.20	45	56			
Medium	36	50.00	4.13	40	58			
High	29	48.52	4.01	39	56			
Total	160	50.64	4.14	39	60	6.038***	0.001	-0.303***

Source: survey data, 2007. *** represents 1 % significance level.

As can be seen from Table 42, the mean perception scores on disadvantages of technology attributes for non-adopters, low, medium and high adopters' categories were 51.79, 49.00, 50.00 and 48.52 respectively. One way analysis of variance was conducted to see whether difference exists between adoption categories in terms of the perception on relative disadvantage of haricot bean technology package. Accordingly, the ANOVA result shows the existence of significant difference between adoption categories at 1 percent probability level. Multiple comparison post hoc test result was also computed to see where the variability lies and it was found that significant mean difference was observed between categories of non adopters with high adopters at 5% probability level. This indicates that adopters have low score on relative disadvantage which means that they did not perceive the package as highly disadvantageous compared to non adopters, who perceived it as disadvantageous. Similarly, the result of correlation analysis shows that the relationship between adoption of haricot bean technologies and perceived relative disadvantage was found to be negative and significant. The result of this study is in agreement with research conducted by Adesina and Zinnah (1993) who gave due attention to technology specific factors in addition to the farm and farmer specific variable in the adoption decision process. The research was employed to analyze the determinants of adoption decisions of improved mangrove swamp rice varieties in Sierra Leon. A Tobit model was used to test the hypothesis that farmers' perceptions of technology-specific characteristics significantly condition technology adoption decisions. In the analysis, the authors reported that none of the farm and farmer specific factors was significant in explaining the adoption decisions of the improved varieties. Rather, farmer

perceptions of the technology specific traits of these varieties have been the major factors conditioning adoption behavior.

Household head's attitude towards haricot bean production technology

Attitude of farmers towards improved haricot bean production technology was measured with help of five point likert scale. In this scale, for favorable statements, the scores are allotted on the following basis: strongly agrees (SA), 5; agree (A), 4; neutral, 3; disagrees, 2; and strongly disagrees (SD), 1. On the contrary, for unfavorable statements the scoring was reversed. Its reliability and validity were found to be significantly positive.

Attitude towards package or part of the package determine the intensive use of a technology and innovation in any given social setting. Individual's attitude is the determinant factor in the adoption and intensity of adoption decision of agricultural technologies and innovations. The result on mean score of attitude towards haricot bean production package is given in Table 43.

Table 43. Mean score achieved by adoption categories from attitude towards haricot bean technology package

Adoption category	N	Mean	SD	Min	Max	F	P	r
Non Adopter	86	13.45	2.92	6	21			
low	9	17.78	3.53	11	21			
Medium	36	16.83	3.05	8	23			
High	29	17.03	3.55	10	24			
Total	160	15.11	3.56	6	24	17.797***	0.000	0.432***

Source: Survey data, 2007. ***= significant at 1 percent probability level.

The highest and lowest attitude scores for sample respondents were found to be 24 and 6 respectively. The highest attitude score of non adopters, low adopters, medium and high adopters were 21, 21, 23 and 24 respectively (Table 43).The mean attitude score for non adopters was 13.45 and that of low adopters, medium and high adopters were 17.78, 16.83

and 17.03 respectively out of an obtainable potential score of 32. Mean score comparison using one way ANOVA shows significant mean difference between adoption categories in their attitude towards improved haricot bean production technology package. In this study, the relation between adoption categories and attitude of sample respondents towards haricot bean technology package was found to be positive and significant at 1 percent probability level (Table 43). A further analysis using multiple comparison post hoc tests revealed the existence of significant mean difference between non adopters and adopter categories at 5 percent probability level. The result of this study goes along with findings of Ibrahim; 2006, and Mekonen; 2007.

4.4. Summary of Results of Descriptive Analysis

Before passing to the econometric part of the analysis it is important to summarize the results of the descriptive statistics. In general, 18 explanatory variables were considered out of which 8 of them had shown significant association with adoption of improved haricot bean production technology. Summary of the overall findings is presented in tables 44 and 45.

Table 44: Summary of Results of Continuous Explanatory Variables

Variable	Mean across adoption categories				F- value
	Non	Low	Medium	High	
Age of HHH	39.90	31.89	39.47	38.55	1.309NS
Experience	8.24	8.78	8.92	9.90	.280NS
Farmsize	2.18	1.97	2.31	2.32	.465 NS
LAFOAVME	3.29	2.71	3.04	3.41	.766 NS
NOLisTLU	5.07	6.15	6.73	7.31	3.428*
TOANFAIN	1732.82	1427.56	2523.41	2771.22	2.063NS
Social participation	2.20	2.11	2.67	4.10	7.799***
Attitudescore	13.45	17.78	16.83	17.03	17.797***
FRECONEA	0.98	1.67	1.61	2.14	5.444***
EXEVPASC	0.09	0.44	0.33	0.59	3.223**
Knowledge	3.83	4.11	5.61	6.07	14.394***
Distamar	7.19	6.39	6.19	7.45	1.488NS
Mass media exposure	2.01	1.22	1.83	2.41	1.257 NS
PEREAD	83.72	87.22	86.06	85.59	1.131NS
PEREDIAD	51.79	49.00	48.52	50.64	6.038***

Source: own survey data, 2007. ***, **, * significant at 1, 5 and 10 % probability level respectively. NS= Not significant

Table 45: Summary of Results of Dummy Explanatory Variables

Variable		Proportion across adoption categories				χ^2-value
		Non	Low	Medium	High	
Education	Illiterate	52.3	44.4	38.9	27.6	χ^2=5.953NS
	Literate	47.7	55.6	61.1	72.4	
	yes	9.3	11.1	63.9	62.1	51.652***
CREACC	No	90.7	88.9	36.1	37.9	
	Yes	19.8	22.2%	25%	24.1%	.517NS
PAOFFAIN	No	80.2	77.8%	75%	75.9%	

***= Significant at 1 % probability level .

4.5. Results of the Econometric Model

In the previous section**,** we have dealt mainly with description of the sample population and test of the existence of association between the dependent and explanatory variables to identify factors affecting adoption of improved haricot bean production package. 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, Tobit econometric model was used to see the relative influence of different personal, demographic, socio-economic, institutional and psychological variables on adoption and intensity of adoption of improved haricot bean production package. List of variables included in the model are presented below.

Out of the total hypothesized variables, 8 of them which were found to affect the probability and intensity of use of improved haricot bean production package significantly were promoted for further analysis using the Tobit model. These are number of livestock owned in tropical livestock unit, social participation, attitude of the household head towards haricot bean production package, frequency of contact with extension agent(s), attendance in extension events (attendance in training and field visit in relation to haricot bean production), knowledge level of the household head on improved haricot bean production package, perceived relative disadvantages of technology attributes and access to credit. Others which failed to discriminate between adopters and non adopters were excluded from further considerations as it has been done by Legesse *et al*., (2001) and Endrias, (2003).

Before running the Tobit model all the hypothesized explanatory variables were checked for the existence of multi-colinearity problem. VIF (variance inflation factor) was used for testing the association between the hypothesized continuous variables and the value of VIF can be computed using the formula,

$$\text{VIF}\ (x_i) = \frac{1}{1 - R_i^2}$$

Where, R_i^2 was the squared multiple correlation coefficient between X_i and the other explanatory variables. A statistical package known as SPSS was employed to compute the

VIF values. To avoid the problem of multicollinearity, it is essential to exclude the variables with the high VIF value (10), which will happen when R^2 exceeds 0.9.

The VIF values displayed in Table 46 show that all the continuous explanatory variables have no serious multi-colinearity problem.

Similarly, there might also be an association between dummy variables. In order to test multicollinearity problem between discrete variables, contingency coefficient which is χ^2-chi-square based measure of association was computed. The values of contingency coefficient ranges between 0 and 1, with zero indicating no association between the variables and values close to 1 indicating high degree of association. The association is said to be high when the value is greater than 0.75.

$$C.C = \sqrt{\frac{\chi^2}{n + \chi^2}}$$

Where: C.C = Contingency coefficient, n= sample size, χ^2 =Chi-square value.

The values of the contingency coefficients were also low (Table 47). Based on the above test result, significantly influencing both hypothesized continuous and dummy variables were included into the model.

One of the assumptions in regression analysis is that the errors u_i have a common variance σ^2. If the errors do not have a constant variance we say they are heteroscedastic (Maddala, 1992). In the general linear model, OLS estimates are consistent but not efficient when the disturbances are heteroscedastic. In the case of the limited dependent variable models (such as Tobit), the estimate of the corresponding regression coefficient is upward biased in the presence of heteroscedasticity. But nothing can be said about the other coefficients and the direction of the bias. It is more practicable to make some reasonable assumptions about the nature of heteroscedasticity and estimate the model than just to say that Maximum Likelihood estimates are inconsistent if heteroscedasticity is ignored (Maddala, 1997).

In this study, heteroscedasticity was tested for some suspected variables by running, heteroscedatic Tobit using econometric software (Limdep). Attitude towards haricot bean technology package, perception on technology attributes, attendance in extension events and knowledge level of household heads on haricot bean production technology package were assumed as the possible sources of heteroscedasticity. It was found none of these variables were statistically significant for heteoroscedasticity. As a result no significant variable was dropped and all significant variables were included in to the tobit model.

Table 46. Multicollinearity test result for continuous variables (n=160)

Variable	Collinearity Statistics	
	Tolerance	VIF
(Constant)		
1. Age of farmer in years	0.673	1.487
2. Experience of farmer in haricot bean farming in years	0.785	1.274
3. Total score achieved in Social participation	0.711	1.406
4. Farm size of a HHH	0.745	1.342
5. Labor force availability in terms of man-equivalent	0.687	1.455
6. Number of livestock in TLU	0.410	2.440
7. Total annual farm income of HHH	0.433	2.307
8. Distance from the nearest market center in kilometers	0.849	1.179
9. Knowledge score	0.848	1.179
10. Attitude score	0.734	1.362
11. Frequency of contact with extension agent	0.616	1.625
12. Attendance in extension events	0.852	1.174
13. Mass media exposure	0.871	1.149
14. Perception score on advantages of technology attributes	0.883	1.133
15. Perception score on disadvantages of technology attributes	0.802	1.247

Source: survey data, 2007.

Table 47. Contingency coefficient for dummy variables

Variables	Educ	Paoffinc	CREacc
1. Educ	1		
2. Paoffinc	0.204	1	
3. CREacc	0 .188	0.002	1

Source: Computation from field survey data

4.5.1. Determinants of adoption and intensity of adoption of improved haricot bean production package.

Estimates of the parameters of the variables expected to determine the adoption and intensity of adoption of improved haricot bean production package are displayed in Table 48. A total of 8 explanatory variables were included into the econometric model out of which five variables were found to significantly influence adoption and intensity of adoption of improved haricot bean production package. These are knowledge level of household head on the improved package, attitude towards haricot bean technology package, perceived relative disadvantage of technology attributes by a household head, participation in extension event (participation in training and field visit) and access to credit.

Table 48. Maximum Likelihood Estimates of Tobit Model

Variables	Estimated Coefficients	Standard Error	t-ratio	P-value
Constant	0.21762852	0.58852899	0.370	0.7115
TOTSSOPA	0.03117162	0.02131251	1.463	0.1436
NOLISTLU	0.01249309	0.00846556	1.476	0.1400
Access to credit	0.24402791	0.09289772	2.627***	0.0086
FreqCONTEA	0.00317876	0.03147997	0.101	0.9196
TSAKNOTE	0.09326040	0.02336635	3.991***	0.0001
TOTSAATT	0.04465469	0.01284417	3.477***	0.0005
TOPSDITA	-0.03088595	0.01025906	-3.011***	0.0026
SCPAEXEV	0.09040216	0.05028834	1.798*	0.0722
Sigma	0.41534874	0.03791454	10.955***	0.0000

Loglikelihood function= -80.25172

ANOVA based fit measure = 0.341598

P=.000

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

Access to credit: As the tobit model result indicates, the variable access to credit had positive and significant influence on the likelihood of adoption of improved haricot bean technology at 1% significance level. From this result it can be stated that those farmers who have access to formal credit, from agricultural Office are more probable to adopt improved haricot bean technology than those who have no access to formal credit. In the study area, access to credit is determined by availability of cash on hand. As indicated in the descriptive part, the agricultural Office that distributes improved seed and fertilizer on credit requires a down payment to provide credit. In this case, only those farmers who possess cash on hand can benefit from formal credit. On the other hand, farmers who have no cash on hand will be devoid of the opportunity. Earlier study also reveals that credit is one of factors that affect the probability of adoption of improved varieties and the quantity of fertilizer farmers apply (Legesse, 1992; Tesfaye and Shiferaw, 2001).

The other important variable hypothesized in this study was **knowledge** and it was found to influence the probability of adoption and intensity of use of haricot bean production package positively and significantly at less than 1% probability level. This is in agreement with findings by Legesse (1992), Getachew (1993) and Mulgeta (2000). Haricot bean technology knowledge gives farmers more confidence and minimizes possibilities of failure. During the survey, it was observed that majority of respondent farmers do not know the appropriate seed and fertilizer rate, spacing, characteristics of the new technologies etc. So, this calls for due attention to improve farmers' knowledge besides to other package promotion.

Attitude towards haricot bean production technology package: Positive attitude towards haricot bean production technology package is one of the factors that can speed up the change process. Attitude formation is also a prerequisite for behavioral change to occur. Therefore, it was hypothesized that attitude towards change positively influences adoption of haricot package. The result of tobit model shows that attitude towards haricot bean production is again positively and significantly related with adoption of the package at less than 1 percent probability level. The above finding implies that those individuals who have unfavorable attitude towards haricot bean production technology package usually create resistance to accept new ideas and innovations thereby retard the processes of change towards which interventions in rural development are geared. This implies need to change negative attitude held by non adopters of haricot bean technology package. The result of this study goes along with findings of Ibrahim (2006) and Mekonen (2007).

Perceived disadvantages of technology attributes: improved haricot bean package adoption can be influenced by both positive (perceived relative advantages) and negative (perceived relative disadvantages) attributes. In this research too both positive (perceived relative advantages) and negative (perceived relative disadvantages) attributes was used to see the influence of perception about attributes on haricot bean production package adoption.

Model result shows that perception about negative attributes were found to be negatively and significantly related with haricot bean package adoption at less than 1 percent probability level. The direction of influence is also in line with the hypothesis.

Attending extension events: attendance in extension events is the other means through which farmers get information about improved technologies. These events include extension arrangements such as training and field visits. In this study, attendance of farmers in these events was considered as one aggregate variable. Result of the finding indicated attendance in extension events was positively and significantly related to adoption of improved haricot bean production package at 10% significance level. The implication is that emphasis has to be given to farmers' training and participation in field visit to enhance adoption of improved haricot bean production package.

The result of this study goes along with the findings of many authors. For instance, Tesfaye *et al*. (2001) reported that participation in on-farm demonstration and attendance of training contributed positively to farmers' adoption decision. In the same line, Yishak (2005) in his study of determinants of adoption of improved maize technology in Damote Gale wereda found that farmers' participation in demonstration had positive and significant relationship with adoption.

4.5.2. Effects of changes in the significant explanatory variables on probability of adoption and intensity of adoption of improved haricot bean production package

All variables that were found to influence the adoption and intensity of use of haricot bean production technologies might not have similar contribution in influencing the decision of farm household. Hence, using a decomposition procedure suggested by McDonald and Moffitt (1980), the results of Tobit model was used to assess the effects of changes in the explanatory variables into adoption and intensity of use and the result is presented in Table 49.

Table 49.Marginal Effects of determinant variables

Variables	Change in the probability of use	Change in intensity of use	Total change
ONE	0.05732	0.21763	0.21763
CREACC	0.06427	0.24403	0.24403
TSAKNOTE	0.02456	0.09326	0.09326
TOTSAATT	0.01176	0.04465	0.04465
TOPSDITA	-0.00813	-0.03089	-0.03089
SCPAEXEV	0.02381	0.09040	0.09040

Source: survey data model output.

The results computed indicate that the estimated increase in the probability of adoption and intensity of use of improved haricot bean production package resulting from having access to credit is 6.4 % and 24.4 % respectively (cetirus paribus)which were very large as compared to the changes resulting from other significant variables.

A change in improved haricot bean production knowledge brings about 2.5 % increases of probability of adoption and 9.3 % of intensity of use of the haricot bean production package by the adopters (other factors kept constant).

The marginal effect result also shows that the estimated increase in the probability and intensity of use of improved haricot bean production package resulting from having better attitude towards improved haricot bean production package is 1.2 % and 4.5 % respectively (cetirus paribus).

The estimated influence of perceived relative disadvantage of haricot bean technology attribute is negative (in agreement with the hypothesis) and results in a reduction of probability of adoption and intensity of use of improved haricot bean production package by about 0.8 % and 3.1 % respectively (other factors kept constant).

An increase in attendance in extension events increases probability of adoption and intensity of use of improved haricot bean production package by 2.4 % and 9.1 % respectively (cetirus

paribus). This implies the need to give emphasis to strengthening institutional supports to improve farmers' access to extension services and their participation in extension to enhance adoption of improved haricot bean production package.

Reason for Discontinuing Use of Improved haricot bean Varieties

A decision to discontinue a practice is either to cease using an idea in order to adopt a better idea, which supersedes it or to cease using an idea as a result of dissatisfaction with its performance (Rogers, 1983, and Ray, 2001). Francis and Branan (1987) also mentioned that the most fundamental has been the favorable price being offered for the variety, that is, if the price declines for the variety farmers may discontinue. The other most important factors for sustainable use of technologies are the supply of improved seeds and chemical fertilizers. For instance, Chambers *et al.* (1989) stated that a productive agriculture requires a constantly changing mix of techniques and inputs. Seeds degenerate, insect pests spread and develop resistance to pesticides, market prices fluctuate, new inputs appear and old ones become expensive, agricultural and trading laws change.

In this study the result obtained was similar to the view of Rogers (1983) and Ray (2001) Francis and Branan (1987). In this study some discontinuers during focused group discussion explained some reasons for discontinuance. These include institutional problem of failure to keep the promise to collect produce after harvest. The office of agriculture and rural development promised to collect the produce at the rate of 385 birr per quintal, but the cooperative collected it at a rate of 160 birr per quintal without any readiness and faced loss. As a result of this the office has lost credibility and farmers have developed uncertainty on market condition. Lack of attractive market price and unavailability of improved seed in the next cropping season were also additional reasons for discontinuation. Unavailability of seed in the next cropping season was again due to fear of rejection due to inability to keep the promise of previous season harvest. In general market risks, fear of risks related to climatic conditions (especially, shortage of rain), the late availability of inputs, financial constraint to purchase improved seeds and fertilizers were some of the reasons for discontinuance and market problem being the main among them.

5. SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Summary

This study was conducted in Alaba special woreda, which is located in the Southern part of Ethiopia about 315 km away from Addis Ababa. In this area, haricot bean is an important crop, which serves as source of both food and cash. New technologies that include improved varieties and fertilizer have been introduced by governmental organization. However, factors that affect adoption and intensity of adoption of improved haricot bean production technology package are not well understood.

This study was conducted in order to identify factors influencing of adoption and intensity of use of haricot bean production technology package by farmers in the area. The study tried to investigate the status of adoption and factors influencing farmers' adoption behavior. Improved haricot bean production package considered in this study includes use of improved variety, seeding and fertilizer rate. After all adoption of these package practices is very important for farmers to achieve the intended production and productivity, but most of the time is not considered in adoption studies.

The package of practices considered in this study was found to be practiced by improved haricot bean growers, but there was variation among the grower households in the level of adoption or use of these practices. On the other hand, for various reasons farmers' practices were found to deviate from the rate recommended by the research. As mentioned by sample respondents the reasons for deviation ranges from the financial capacity of farmers to other household, technological and institutional related factors.

Variation in adoption among the sample households was assessed in view of various factors theoretically known to influence farmers' adoption behavior of new technologies. These variables were categorized as household personal and demographic, socio-economic, institutional and psychological factors. Result of descriptive statistics using one –way ANOVA, chi-square and bivariate correlation tests indicated that some of the variables

hypothesized to influence farmers' adoption behavior were significantly related with adoption and intensity of adoption of improved haricot bean production package.

From household's economic and wealth related variables which were hypothesized to influence adoption and intensity of use of improved haricot bean production package livestock holding was found to be positively and significantly related with adoption and intensity of adoption.

Concerning institutional variables, participation in social organization, frequency of contact with extension agent, attendance in extension events, access to and use of credit were found to have positive and significant relationship with adoption and intensity of adoption of improved haricot bean production package.

Moreover, among psychological factors, attitude towards the package and knowledge level of household head were found to be positively and significantly related with adoption and intensity of adoption whereas perceived relative disadvantages of technology attributes was negatively and significantly associated with adoption and intensity of use of package, which is similar to priori expectation.

Improved haricot bean production is relatively a complex activity compared to its traditional practices as it involves use of different package practices such as seeding rate, fertilizer rate, chemical application rate and spacing. Due to this farmers need to get information and close advices on technical use of the recommended practices. Other institutional supports such as farmers' participation in social organization and provision of credit services were also found to be very crucial to enhance adoption of improved haricot bean production package.

On the other hand, results of the econometric model indicated the relative influence of different variables on adoption and intensity of adoption of improved haricot bean production package. A total of eight (8) significant explanatory variables were included in the model of which five (5) of them had shown significant relationship with adoption of improved haricot bean production package. Accordingly, access to credit, knowledge level of household head

on the improved package, attitude towards haricot bean technology package and attendance in extension event (attendance in training and field visit) were found to have positive and significant influence on adoption and intensity of adoption of improved haricot bean production package. Contrary to this, perceived relative disadvantage of technology attributes by a household head had shown negative and significant relationship with adoption and intensity of adoption of improved haricot bean production package.

5.2. Conclusion and Policy Recommendations

Haricot bean contribution to households' nutrition, income and food security is very high. It also provides job opportunities for youth and the landless poor and for merchants and poor urban dwellers who are engaged in its processing activities. Regardless of its contribution, however, the emphasis given nationally to the sector is relatively low compared to other food crops. As a result of this, institutional support provided to this sector, such as credit service, research and extension was not to the expected level. These factors together with several household personal, demographic and socio-economic factors greatly affected the adoption of improved haricot bean production technologies and consequently production and productivity of the sector. Based on the research findings of this study, the following points are recommended to improve farmers' adoption of improved haricot bean production package so as to enhance its production and productivity.

One of the major bottle necks to the development of improved haricot bean production in the study area is marketing problem. The lack of local market demand and low selling price farmers are currently receiving makes the demand for promising market and good marketing conduct a priority issue that needs immediate solution.

Non-adoption and variation in level of adoption among households was found to be influenced among other things by number of livestock owned by household head. As a result of this, less number of livestock owner farmers could not adopt improved haricot bean production package. Therefore, making effort to improve the existing livestock in the study

area through improved livestock management approach has to be considered as a central and core component of any development intervention in the sector.

Improved haricot bean production involves the use of different practices which require knowledge and skill of application and management. Knowledge on improved haricot bean production was found to have a strong relation with adoption of improved haricot bean production package as it enhances ability to acquire and use information required for production. Therefore, due emphasis has to be given towards strengthening farmers knowledge on improved haricot bean production by arranging demonstration and farmers' training.

Farmers' deviation from recommended package practices was found partly due to poor extension service and also lack of financial capacity of farmers to apply fertilizer according to recommendation. Therefore, extension service provision has to be strengthened so as to improve farmers' access to information and extension advices. Moreover, improving credit access and revisiting of the existing bureaucratic input administration procedure is also crucial. Furthermore, revisiting again previous research recommendations is highly important.

Lack of better quality seeds in terms of germination and color was another critical problem in haricot bean production. Respondent farmers reported the problem of poor quality of improved haricot bean seeds and fertilizer as their major problems. Poor qualities of seeds have greatly exposed farmers to production failure as well as high production expenses. Therefore, strengthening of seed quality control mechanisms should be given due attention both in the areas of policy and development intervention.

Result of this study also indicated that there was significant difference in adoption and level of adoption among farmers with high and low participation in social organization. Hence, we need to encourage establishment and strengthening of social organization to enhance adoption of improved haricot bean production package.

If our intention is to help farmers improve productivity and make them successful in market, we should start from the scratch that we should remove fear of market uncertainty from farmers mind by arranging produce procuring agent, which really keep its promise and purchase any time when farmers want to sell. Moreover, we need to verify the performance of technology by conducting site specific on-farm trials and demonstrate method of application as well as result of technology output to farmers of the study area.

Farmers cultivate improved variety not for home consumption but for sale. So it is crucial to search for variety that has high demand on market (small size according to merchants) and also better in its quality, having high germination percentage and good color. Farmers in the area also reported the distribution of poor quality fertilizer. Hence, controlling quality of inputs is again important for crop productivity improvement.

In addition to this as discussed in the descriptive part of the study larger numbers of farmers have reported the existence of disease problem in the study area, hence farmers should get training on how to avoid disease problem and avail materials required for crop protection based on their needs.

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7. APPENDICES:

7.1 Tables in the Appendix

Table1: Conversion factor used to compute man equivalent (Labour Force)

Age group (years)	Male	Female
Less than 10	0.0	0.0
10-13	0.2	0.2
14-16	0.5	0.4
17-50	1.0	0.8
Greater than 50	0.7	0.5

Source: Stork, *et al.,* 1991.

Table 2: Conversion factors used to estimate tropical livestock unit

Animal Category	TTLU	Animal Category	TTLU
Calf	0.25	Donkey (young)	0.35
Weaned Calf	0.34	Camel	1.25
Heifer	0.75	Sheep & Goats (adult)	0.13
Cow and Ox	1.00	Sheep & Goats (young)	0.06
Horse	1.10	Chicken	0.013
Donkey (adult)	0.70		

Source: Stork, *et al.,* 1991.

Table 3: Proportion of land covered with improved seed in total land allocated for haricot bean production

% of land under improved variety from total land for haricot bean	Frequency	Percent	Cumulative Percent
0.00	110	68.8	68.8
0.06	1	0.6	69.4
0.08	1	0.6	70.0
0.17	1	0.6	70.6
0.18	1	0.6	71.3
0.20	4	2.5	73.8
0.25	2	1.3	75.0
0.33	6	3.8	78.8
0.40	2	1.3	80.0
0.43	1	0.6	80.6
0.50	14	8.8	89.4
1.00	17	10.6	100.0
Total	160	100.0	

Source: own survey data, 2007.

Table 4: Distribution of sample respondents based on their seed use index.

Seed use adoption index	Frequency	Percent	Cumulative Percent
0.00	110	68.8	68.8
0.20	1	0.6	69.4
0.24	1	0.6	70.0
0.25	4	2.5	72.5
0.30	2	1.3	73.8
0.40	1	0.6	74.4
0.42	1	0.6	75.0
0.48	1	0.6	75.6
0.50	36	22.5	98.1
1.00	3	1.9	100.0
Total	160	100.0	

Source: own survey data, 2007.

Table 5. Seed use index among adopters

Seed use adoption index	Frequency	Percent	Mean	SD
0.20	1	2		
0.24	1	2		
0.25	4	8		
0.30	2	4		
0.40	1	2	0.4868	0.15944
0.42	1	2		
0.48	1	2		
0.50	36	72		
1.00	3	6		
Total	50	100		

Source: own survey data, 2007.

Table 6. Distribution of respondents in relation to adoption score for fertilizer use

Adoption score for fertilizer use	Frequency	Percent	Mean	SD
0.00	88	55.0	.3189	.41146
0.12	1	0.6		
0.20	6	3.8		
0.24	2	1.3		
0.30	1	0.6		
0.32	2	1.3		
0.34	2	1.3		
0.35	1	0.6		
0.40	3	1.9		
0.42	1	0.6		
0.50	11	6.9		
0.60	1	0.6		
0.66	1	0.6		
0.80	5	3.1		
0.88	1	0.6		
1.00	34	21.3		
Total	160	100.0		

Source: own survey data, 2007

7.2 The Interview Schedule

Title: Determinants of Adoption of Haricot Bean Technology Package in Alaba Special Woreda, Southern Ethiopia

Instruction

- Introduce your self and get introduced with the respondent
- Tell to the respondent about the purpose of the study
- Check that all questions are asked and responses are filled accordingly

General information

Date of interview……

Name of the respondent: ----------

PA: ----------

Village: ----------

Name of the Interviewer: ----------Sign. ----------

1. **Household personal characteristics**

Religion _____

Ethnicity _____

1.1 Household demographic characteristics

No	Name of the HH members	**Relationship	Sex	Age	*Education

* Education of HH head 1) Illiterate2) Read and write 3) 1-4grades 4) 5-8 grades 5)9-10

** Family relationship 1) Husband 2) Wife 3) Son 4) Daughter 5) Relative

1.2 Household head experience in haricot bean farming in years ----------

2. Social participation

In which of the following organization are you member and leader?

Organization	Non-participant (0)	Member (Tick) (1)	Committee member (Tick) (2)	Leader (Tick) (3)	Frequency of participation in activities		
					Never (0)	Sometimes (1)	Always (2)
Idir							
Iqub							
Religious club							
Irrigation association							
Marketing cooperative							
Union							
PA leader							
School council							
PA council							
Saving and credit group							

3. Household resources ownership

3.1 Land ownership in 1998E.c

Land allocation	Land size (in timad.)
Cropped land	
Grazing land	
Forest land	
Fallow and degraded land	
Homestead + others	
Total	

3.2 Livestock ownership

Category	Total	Remark
Local Cows		
Crossbred cows		
Oxen		
Local Heifers		
Crossbred heifers		
Calves		
Bulls		
Goats		
Sheep		
Poultry		
Donkey		
Horse		
Others		
Grand total		

3.3 House type and number of houses

House type	Number	Estimated cost of each house	Purpose
Grass roofed			
Corrugated iron sheet			

4. Crop Production

4.1 Crop production by the household in 1998E.C

Crop grown	Area coverage(ha)	Average yield/ha	Total annual harvest(qt)
Maize			
Teff			
Wheat			
Red Haricot bean			
White Haricot bean			
Pepper			
Cabbage			
Tomato			
sorghum			
Millet			
Chat			
Others (Specify)			

*Purpose 1) For purchasing farm inputs2) For settling debts3) For buying clothes for family

4) To buy food grains 5) Others (Specify) ----------

5. Socio-economic characteristics of the household

5.1 Household labor availability

Age category	Number(#)		*Activities participated in	Nature of participation		Other job for part-time participant
	Male	Female		Full time	Part-time	
Children<10 years						
Children 10-13 years						
Children 14-16years						
17-50 years						
>50years						

* Haricot bean production activities include:

1) Land preparation 2) sowing 3) Weeding 4) Cultivation 5) Harvest

6) Transportation 7) Storage 8) Marketing 9) others (specify)

5.2 Do you face labor shortage problem in haricot bean production? 1) Yes 2) No

5.3 If yes, how do you solve labor shortage problem?

1) By hiring 2) Asking for cooperation (Debo/Jigi) 3) All 4) Others (Specify) -------

5.4 Household's annual farm income from sale of crops /1998 E.c/

Commodity	Annual harvest	consumed	sold	Unit price	Total price
Maize					
Tef					
Wheat					
Red Haricot bean					
White Haricot bean					
pepper					
Cabbage					
sorghum					
Millet					
onion					
Sugarcane					
potato					
Chat					
Others					
Total income					

5.5 Income from sale of livestock/1998E.C/

Animal type	Number sold	Unit price	Total sale price	Purpose
Oxen				
Cows				
heifers				
Bull				
Calves				
Goats				
Sheep				
Donkey				
Horse				
Poultry				
Hide				
Others				
Total income				

5.6 Income from sale of livestock products/1998E.C/

Product type	Amount collected per year	Consumed	Sold	Unit price	Total revenue	Purpose
Milk						
cheese						
Butter						
Egg						

5.6 Household's participation in off-farm activities in 1998E.C.

1) Yes 0) No

6. Access to and utilization of farm inputs for haricot bean production

6.1 Which agricultural inputs do you use for haricot bean production and what are the sources?

Type of input	Specific name	Source(tick)		
		Market	OoARD	Others(Specify)
Improved seed of haricot bean				
Local seed of haricot bean				
Fertilizer				
Chemicals				
Others(Specify)				

6.2 Quantity of inputs purchased /used for haricot bean production and their price in 1998E.C

Type of inputs	Specific name	Quantity purchased/used	Unit price(Birr)	Total cost
Improved seed of haricot bean				
Local seed of haricot bean				
Fertilizer	DAP			
	Urea			
Chemicals	Herbicide			
	Fungicide			
	Insecticide			
Others (Specify)				

6.3 Can you purchase the required amount of inputs as you need (Availability)?

1) Yes 2) No

6.4 If, No please rate the availability on the following five-point scale

Inputs	Availability Rating				
	Very scarce(1)	Scarce(2)	Not as required(3)	Available(4)	Very much available(5)
Improved seed of haricot bean					
Local seed of haricot bean					
Fertilizer					
Chemicals					
Others9Specify)					

6.5 Can you get the required inputs on time? 1) Yes 2) No

6.6 If No, please rate the timely availability of the inputs on the following five point scale

Inputs	Rating of timely availability				
	Never on time(1)	Rarely on time(2)	Some times on time(3)	Mostly on time(4)	Always on time(5)
Improved seed of haricot bean					
Local seed of haricot bean					
Fertilizer					
Chemicals					

6.7 Do you get the inputs to the required quality? 1) Yes 2) No

6.8 If No, please rate the quality of the inputs available on the following five point scale?

Inputs	Quality Rating				
	Very poor(1)	Poor(2)	Moderate(3)	Good(4)	Very good(5)
Improved seed of haricot bean					
Fertilizer					
Chemicals					
Others(specify)					

6.9 Which of the following problems do you think are there with inputs provided by rural development office?

Inputs	Problems (tick)					Remark
	Scarcity	Not timely	Low Quality	Expensive	Down payment	
Improved seed of haricot bean						
Fertilizer						
Others(Specify)						

6.10 Which of the following problems do you think are there with inputs purchased from market?

Inputs	Problems (tick)				Remark
	Not available	Not timely available	Quality problem	Expensive	
Fertilizer					
Others(Specify)					

6.11 How much does the timeliness of availability of inputs affect your level of input adoption? (Tick)

No effect(1)	Affected less(2)	Some what affected(3)	High effect(4)	Very high effect(5)

6.12 Have you obtained credit for haricot bean production in the last five years?

1) Yes 2) No

6.13 If yes, from where you get and how much did you get?

Source----------

Amount (in Birr) ----------

6.14 For what purpose did you use the credit?

1) For purchasing fertilizer 2) For purchasing improved seeds 3) For purchasing chemicals 4) For other purpose (Specify) ----------

7. Market related variables

7.1 Market centers accessible to you

Name of the market	Distance	Mode of transport	Transport cost	Commodities sold at the market place

7.2 What was the average market price of haricot bean last year?

Type of haricot bean	Price at		*To whom you sell at farm gate	*To whom you sell at Market
	Farm gate	Market		
local				
improved				
Others(specify)				

*To whom 1) to whole saller 2) to retailer 3) to direct consumers

7.3. Have you changed to whom you sell in the last 2-3 years? 1=yes 0=No

7.4 if yes, is there change? 1=yes 0=No

7.5. What was the change? _____

7.6. What is the trend in price in the last 3-4 years?

1) Decreasing 2) stagnant 3) increasing

7.7 In that light, how does it compare with alternative crops that you can grow?

7.8 In your view how do you see the selling price of haricot bean?

Haricot bean type	Price condition					Remarks
	Very Poor(1)	Poor(2)	Moderate	Good(4)	Very good(5)	
Local						
Improved						

7.9 In your view how do you see the prices of inputs used for haricot bean production in relation to the income generated by haricot bean produced/sale?

Inputs	Price condition	

	Very expensive(1)	Expensive(2)	moderate	Less expensive(4)	Not expensive(5)	Remarks
Improved variety						
Fertilizer						
Chemicals						
Labor						
Others (Specify)						

7.10. Do you get market price information on haricot bean?

1) Yes 2) No

7.11 If yes, what are your sources of information and how often do you get access to it?

Sources of information	How often?					Which source you prefer and why?
	Never	Once in a year	Twice in a year	quarterly	weekly	
DA						
Traders						
Neighbor farmers						
Others(Specify)						

7.7 What do you think are the major marketing problems with regard to haricot bean marketing particularly improved variety? ----------

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8. Sources of agricultural information on haricot bean production for farmers and frequency of contact/ use

8.1 Do you get advisory services from extension agents? 1) Yes 2) No

8.2 How frequently do the extension agents visit you?

0) never 1) Annually 2) Monthly 3) bi-weekly 4) Weekly

8.3) when does extension agent visit you? a) Land preparation b) During input provision c) During sowing d) whenever disease/ pest occur

E) During credit collection F) others (Specify)

8.3 Do you visit extension agent? 1) Yes 2) No

8.4 If yes, when do you visit?

1) During sowing for technical advice 2) During input provision to obtain inputs

3) It depends (any time when there is technical problem)

8.5 What are your other sources of information and how often you use/ have contact with them?

Other sources	How often you contact/use them					*Means of information exchange
	Never (0)	Once in a year (1)	Monthly (2)	Weekly (3)	Daily (4)	
Researchers						
Contact farmers						
Fellow farmers						
PA leaders						
NGO						
Cooperative						
Neighbors/ Friends						
Input dealers						
Agricultural professionals						

*Means of information exchange: 1) Demonstration 2) Field day/visit 3) Training 4) Written materials (leaflets, manuals, and so on) 5) Others (Specify) ----------

8.6 When have you first heard of improved variety of haricot bean? _____

8.7 from who/ which source? _____

8.8 Which improved variety of haricot bean have you first grown?

1) Awash melka 2) Awash-1 3) Mexican 4) others (specify) _____

8.9. Why did you choose to try this particular variety first? _____

8.10 Which improved varieties of haricot bean you have grown so far and when you have grown them?

Variety	Year first grown	Duration of use	*Reason for stopping using	Variety currently being used
Awash Melka				
Red Wolaita				
Awash-1				
Mexican				
Others(Specify)				

* Reason for stopping

1) Availability of better variety 2) Unavailability of seeds 3) High seed purchase price

4) Low yield in my field 5) disease and pest problem 6) Others (Specify) ----------

8.11 Have you participated in field day/ visit in the last five years? 1) Yes 2) No

8.12 If yes, how many times and who arranged for you?

No of times----------

Who arranged for you? 1) OoARD 2) Research 3) NGO 4) Others (Specify) ----------

8.13 Have you ever received training in haricot bean production in the last five years?

1) Yes 0) No

8.14 If yes, how many times and who arranged for you?

No of times----------

Who arranged for you? 1) OoARD 2) Research 3) NGO 4) Others (Specify) ----------

8.15 Have you hosted demonstration in the last five years? 1) Yes 2) No

8.16 If yes, how many times and with whom you conducted demonstration?

No of times----------

With whom you conducted demonstration? 1) OoARD 2) Research 3) NGO 4) Others (Specify) ----------

8.17 Indicate your access to and frequency of use of the following media materials?

Mass media	How often you use them				
	Never(0)	Rarely(1)	Occasionally(2)	Often(3)	Very often(4)
Radio					
Television					
Leaflets					
Pamphlets					
Manuals					
Others					

8.18 Rank your sources of information based on Accessibility, timeliness, reliability of their information

Sources of information	Rank accessibility	Rank timeliness	Rank reliability	Remark
Extension agent				
Researcher				
NGO				
Contact farmers				
Mass media				
Neighbors/friends				
Input dealers				
Follower farmers				
Agricultural professionals				
Others (specify)				

9. Intensity of adoption of different haricot bean production package components

9.1 did you encounter disease problem in haricot bean cultivation in 1998/99e.c production season? 1) Yes 0) No

9.2 If yes, what kind of measure did you take?

1) Local 2) improved 3) Nothing

9.3 If you did not apply improved method of disease control what is your reason? _____

9.4) did you come across weed problem in 1998/99 E.c haricot bean cultivation?

1) Yes 0) No

9.5 If yes, how did you solve this problem? 1) Using chemical 2) hand weeding

9.6 in the last three years production season what kind of haricot bean varieties did you use?

1) Local 2) improved 3) both

9.7) which method of sowing you used in haricot bean cultivation?

1) Spacing 2) Broadcasting 3) Both

9.8 If your answer is spacing, to which variety you used this method?

1) Local 2) improved 3) Both

9.9 did you apply fertilizer in haricot bean cultivation? 1) Yes 0) No

9.10 If your answer is yes, to which variety you applied fertilizer?

1) Local 2) improved 3)both

9.11 If your answer is yes, which kind of fertilizer you used? 1) DAP 2) Urea 3) both

9.12 if you did not apply fertilizer in haricot bean production, what is your reason ?

Type of fertilizer not applied yet _____

Reason for not applying _____

9.13 Area Coverage by improved variety of haricot bean in 1998E.C

Subjects	Area coverage(timad)
Total area allocated for haricot bean	
Area covered with improved haricot bean variety(s)	

9.14 Intensity of adoption of haricot bean production package components by 1998E.C

Sl. No	Package components	quantity used per timad./frequency per one harvest season	
		Traditional variety	High yielding variety
1	Fertilizer		
	Urea		
	DAP		
2	Plant protection measure used		
2.1	herbicide		
2.2	pesticides		
2.3	fungicides		

2.4	Hand weeding		
3	Seed rate for HYV		
4	Inter row spacing		
5	Intra row spacing		

10. Knowledge of improved haricot bean cultivation

Sl.No	Practices	Answer boxes	remark
1	Name of the three recommended HYV	1._____ 2._____ 3._____	
2	Give name of any one chemical for seed treatment	1._____	
3	Give the quantity chemical that can be used for /Kgs seed treatment		
4	Seed rate per timad of land		
5	Recommended fertilizer dose		
	(a) Give the quantity required for Urea for one timad		
	(b) Give the quantity required for Dap for one timad		
6	Give any one herbicide for controlling weed		
	Give the quantity for one timad		
7	Name any one fungicide		
	Give the quantity for one timad		
8	Spacing		
	(a) Row spacing		
	(b) Plant spacing		
9	Give four method that can be used to reduce post harvest loss	1	
		2	
		3	
		4	

11. Perception about the advantage and compatibility of the different components of haricot bean production package

11.1 What is the advantage (superiority) of the following components of haricot bean production package over the local practices?

Package	Advantage over the local practices	

components	Highly inferior(1)	Slightly inferior(2)	equal(3)	Superior(4)	Highly superior(5)	*Reasons
Improved seed						
Fertilizer						
Chemical						
Weeding						
Inter raw spacing						
Intra raw spacing						
Others						

*** Reasons for less superiority** 1) Not much yield difference 2) Consumes more time 3) Requires more labor 4) Others (Specify) ----------

11.2 How do you see the compatibility of the recommended rate of the different haricot bean production package components with your socio-economic circumstances?

Package components	Compatibility with socio-economic circumstances					*Reasons
	Not compatible (1)	Less compatible (2)	Undecided (3)	Compatible (4)	Highly compatible (5)	
Improved seed						
Fertilizer						
Chemical						
Weeding						
Inter raw spacing						
Intra raw spacing						
Others						

*** Reasons for less compatibility** 1) Financially costly 2) Not better than the local rate/ practices 3) Consumes more time 4) Requires more labor 5) requires more technical knowledge 6) Others (Specify) ---

11.3 Is there price risk in production of haricot bean? 1) Yes 2) No

11.4 If yes, indicate the degree of risk on the following five point scale

Price risk	Very low(1)	Low(2)	moderate(3)	High(4)	Very high(5)

11.5 is there production risk in haricot bean cultivation? 1. yes 0=no

11.6 Which risk is more significant in haricot bean production? 1) price 2) production

11.7 How do you perceive the investment cost (production cost) of haricot bean compared to the return or compared to other crop?

Production cost	Very low(1)	Low(2)	Undecided(3)	High(4)	Very high(5)

11.8. Attitudes towards haricot bean technology package

Sl. No	Statements	Ratings				
		SA	A	UD	D	SD
1	HBTP helps to improve the yield					
2	HBTP consumes a lot of labor					
3	HBTP demands careful management practices					
4	Unless the package is fully applied, I will not get the expected yield					
5	HBTP requires high overhead cost per farmer					
6	HBTP is insensitive to local circumstances					
7	Only Small number of farmers benefit from it					
8	Failure in input delivery characterize the package program					

12. Variety preference criteria

12.1 Which improved haricot bean variety you prefer and why?

Variety name	Preference rank	*Reason for preference (can be more than one)
Awash Melka		

Red Wolaita		
Awash-1		
Mexican		
Others(specify)		

* preference criteria

1) Grain size 2) Grain color 3) early maturity 4) Market demand 5) Price advantage 6) Storability 7) Yield advantage 8) others _____

12.2 What parameters do you consider important to select among different improved varieties of haricot bean? Put them in order of importance.

Parameters	Rank
Yield advantage	
Grain size	
Grain color	
Time of maturity	
Market demand	
Price advantage	
Storability	
Seed production	
Others(specify)	

13. Generally what are the major problems in improved haricot bean production? _____

Perception of technology attributes

14.1 Rate the following if they are advantages of improved variety of haricot bean?

Sl. No	List of advantages	Ratings				
		Very low(1)	Low (2)	Medium(3)	High (4)	Veryhigh(5)
1	High productivity/yield advantage					
2	Early maturity					
3	Quality grain					
4	Disease resistance					
5	Insect pest resistance					

6	Resistance to lodging					
7	Long harvest time					
8	World market demand					
9	profitability					

14.2 take five most important advantages of improved seed and rank them in order of importance

1st ----------

2nd ----------

3rd ----------

4th ----------

5th ----------

14.3 Rate the following if they are disadvantages of improved variety of haricot bean?

Sl. No	List of disadvantages	Ratings				
		Very low(1)	Low (2)	Medium(3)	High (4)	Veryhigh(5)
1	Low storability					
2	Regular need for fresh seeds					
3	High seed cost					
4	Seed unavailability (at right time, quality , place and type)					
5	Low local consumption demand					
6	Low market demand					

14.4 Rate the following if they are advantages of applications of row planting?

Sl. No	List of advantages	Ratings				
		Very low(1)	Low (2)	Medium(3)	High (4)	Veryhigh(5)
1	Ease of weeding					
2	Vigor of stand					
3	Good light interception					
4	Improve efficiency of fertilizer use					
5	Convenience for field inspection					
6	Ease of shilshalo					
7	Provision for intercropping					

8	Increases yield					
9	Help to save seed					
10	Saves time of weeding					
11	Good quality grain					

14.5 take five most important advantages of row planting and rank them in order of importance

1st ----------
2nd ----------
3rd ----------
4th ----------
5th ----------

14.6 Rate the following if they are disadvantages of applications of row planting?

Sl. No	List of disadvantages	Ratings				
		Very low(1)	Low (2)	Medium(3)	High (4)	Very high(5)
1	Waste f land					
	incompatibility					
2	Requires skills					
3	Requires labor					

14.7 take three most important disadvantages of row planting and rank them in order of importance

1st ----------
2nd ----------
3rd ----------

14.8 Rate the following if they are advantages of using recommended type and rate of fertilizer?

Sl. No	List of advantages	Ratings				
		Very low(1)	Low (2)	Medium(3)	High (4)	Very high(5)
1	High grain yield					
2	Facilitates maturity					
3	Dark green looking stand					
4	Helps to estimate cost of production					
5	Improves fertilizer use efficiency					
6	Improves soil ferility					

14.9 take four most important advantages of using recommended type and rate of fertilizer and rank them in order of importance

1st ----------
2nd ----------
3rd ----------
4th ----------

14.10 Rate the following if they are disadvantages of using recommended type and rate of fertilizer?

Sl. No	List of disadvantages	Ratings				
		Very low(1)	Low (2)	Medium(3)	High (4)	Very high(5)
1	High cost					
2	Bureaucratic input and credit administration					
3	Seed unavailability (at right time, quality , place and type)					
4	Inability to get fertilizer if there is previous default by the kebele					

14.11 take four most important disadvantages of using recommended type and rate of fertilizer and rank them in order of importance

1st ----------
2nd ----------
3rd ----------
4th ----------

14.12. Rate the following if they are advantages of spot applications of fertilizer?

Sl. No	List of advantages	Ratings				
		Very low(1)	Low (2)	Medium(3)	High (4)	Very high(5)
1	Economic use of fertilizer and seed					
2	Increase fertilizer use efficiency by the plant					

14.13 Rate the following if they are disadvantages of spot applications of fertilizer?

Sl. No	List of disadvantages	Ratings				
		Veryhigh(5)	High (4)	Medium(3)	Low (2)	Very low(1)
1	Laborious					
2	It requires time					

Checklist used for conducting focused group discussion.

As you probably know, agriculture office is trying to popularize an improved variety of haricot bean, which should significantly increase yields. The office is also providing interested farmers with seed and fertilizers, which are necessary for the cultivation of the improved variety. However, most of the farmers are not using it .why?

Why are so few farmers using the new haricot bean variety?

Is the improved variety profitable to farmers?

Do the farmers experienced difficulty in procuring the needed inputs? Do they need credit?

What are the general impressions about the improved variety?

Do the people like the taste of the new variety of haricot bean?

Can you get good quality production inputs of haricot bean?

How do you see the recommended seeding and fertilizer application rate?

Did farmers in this area faced disease problem in haricot bean production?

Which method of sowing did you use in haricot bean production and why?

Which one of the variety (local or improved) you prefer in haricot bean cultivation and why?

Please indicate problems encountered in the process of haricot bean production, storage and marketing? And mention solution to these problems?

What is the role of women in haricot bean cultivation?

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