ANALYSIS OF PREFERENCE FOR ADOPTION OF LEGUME TECHNOLOGY PACKAGES: THE CASE OF CHICK PEA AND COMMONBEAN PRODUCING SMALLHOLDER FARMERS IN BORICHA AND DAMOT GALE DISTRICT, SOUTHERN REGION

M.Sc. Thesis

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Analysis of Preference for Adoption of Legume Technology Packages: the Case of Chick Pea and Common bean Producing Smallholder Farmers in Boricha and Damot Gale District, Southern Region

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MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS

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APPROVAL SHEET

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DEDICATION

I dedicate this thesis manuscript to my Husband, Egzihaye Yohannes for his love, support and dedication.

STATEMENT OF THE AUTHOR

First, I declare that this thesis is my own work and that all sources of materials used for this thesis have been duly acknowledged. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and compilation of this Thesis. Any scholarly matter that is included in the Thesis has been given recognition through citation.

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BIOGRAPHICALSKETCH

The author Dagmawit Getachew was born on the 26th of February 1988 in Wonji town of Oromiya Regional State. She attended her elementary and junior education at Wonji community school and Secondary School at Hawas secondary and preparatory School. After successful completion of the ESLCE, she joined Hawassa University in 2005 and graduated with B.Sc. in Economics on 10 July 2008. After graduation she served in Addis Ababa Water and Sewerage Authority at different position in procurement and marketing research department for about six years and now she is serving at Goal Ethiopia as a Procurement Officer. She joined Haramaya University in July 2013 to pursue her M.Sc. degree studies in Agricultural Economics.

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ACCRONYMS

CSA	Central Statistical Agency
FAOSTAT	Food and Agricultural Organization Statistics
FGD	Focus Group Discussions
FU	Farmer Union Membership
Ha	Hectare
ICRISAT	International Crops Research Institute For The Semi-Arid Tropics
IFPRI	International Food Policy and Research Institute
NGO	Non-Government Organizations
PDI	Preference for Development Intervention
PROTA	Plant Resource of Tropical Africa
SD	Standard Deviation
SNNPR	Southern Nation Nationalities and People Region
SSA	Sub-Saharan Africa
TLU	Total Livestock Units
USAID	United States Agency for International Development
WDR	World Development Report

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ABSTRACT

Understanding factors affecting farmers' preference for Legume technology adoption is vital for research projects, government agricultural bureau, farmer unions and NGOs' who are engaged in legume technology distribution to develop appropriate package that farmers are willing to adopt. This study was conducted to analyze factors affecting famers' adoption preference for chickpea and common bean legume technology in Damot Gale and Boricha District of Southern Region of Ethiopia. The study is based on, conjoint analysis, a multivariate technique used to understand consumers' preference for a technology from bundles of technology attributes and factors. The sample size used in the study was 120 for chickpea producers and 120 for common bean producers. The variables for the conjoint analysis were preference (dependent variable), seed, fertilizer, payment; fungicide, age, cooperative union membership, credit access and land size are external variables. The study has identified that regarding chickpea producer farmers in Damot Gale district the relative importance among legume technology package seed is the most important factor, fungicide is the second important factor, payment is the third and fertilizer is the last important factor. Regarding relative importance of Attribute type for common bean producers, Seed has the higher relative importance in both districts, payment is the second most important attribute for Boricha district while fungicide if for Damot Gale. Fertilizer is the least important attribute for both districts. This may indicate that farmers indeed have a preference for specific bundle of attributes for legume technology. Thus, government, research institutes, Development agents and projects need to carefully arrange attributes that have a higher preference when developing technology package.

Keywords: *Legume technology, adoption preference, and conjoint analysis.*

1. INTRODUCTION

1.1 Background of the Study

Past studies revealed that adoptions of agricultural technologies have attracted considerable attention among development economists because the majority of the population of less-developed countries derives its livelihood from agricultural production and hence new technology offers opportunity to increase production and income sustainably. Despite various extension efforts the process of adopting modern agricultural technologies is still very slow among the smallholder producers in developing countries (Mohammed and Lakew, 2013).

Among the crops produced by smallholder farmers, grain legumes contribute in major ways towards poverty reduction, improving food security, improving nutrition and health and sustaining the natural resource base. Legumes fill temporal and spatial gaps in cropping systems through rotations and intercropping, respectively. By fixing atmospheric nitrogen, they improve soils and increase the productivity of other crops. Many legumes can also be fed to livestock, allowing for value addition within farming systems. For humans, legumes offer a valuable source of dietary protein (CGIAR, 2010).Despite of their importance in human nutrition and role in sustainability of agriculture systems, grain legume yields are low and unstable across seasons and environments (FAO, 2011). With declining per capital availability of grain legumes, there is an immediate need to address their production constraints to raise productivity, quality and stability of production to ensure their increased availability to the poor at affordable price.

Legumes are often grown on more marginal land, sometimes on small areas. They are also frequently intercropped with cereals or used as short-duration rotation crops in what are largely cereal-based systems. In either of these cases, the management of legumes is often given secondary importance relative to the main cereal crop. Although cereal crops are most important in Ethiopian agriculture in providing staple diet to the population, pulses are also important components of crop production (Ali *et al.,* 2003). Accordingly, pulse

crops provide an economic advantage to small farm holdings as an alternative source of protein, cash income, and food security (Ferris and Kaganzi, 2008).

Grain legumes occupy about 13% of cultivated land in Ethiopia and their contribution to agricultural value addition is around 10%. Pulses are the third-largest export crop of Ethiopia (IFPRI, 2010a). Ethiopia ranks 6th in chickpea production, and 14th in the production of common bean. Among African countries, Ethiopia is the largest producer of both chickpea and common bean (ICRISAT, 2011). In total, the area cultivated with the selected legumes is more than 1 million ha. Production per ha is low and far below the potential production of e.g. 2.9 t/ha for Chickpea and 4 t/ha for common bean (IFPRI, 2010b, USAID, 2011).

According to N2Africa project proposal (2012), Agricultural production in most parts of sub-Saharan Africa is dominated by smallholder farming systems of low productivity. Although inclusion of legumes has the potential to improve system productivity, often less than 5-10% of cultivated land is currently planted with field legumes. Grain legumes are often included as minor intercrops in fields of cereals and other staple crops. This is because smallholder farmers operate under diverse socio-ecological constraints that limit the productivity of legumes and farmers' ability to scale up the integration of legumes into their farming systems."

The project entitled 'Putting Nitrogen Fixation to Work for Smallholder Farmers in Africa', better known as the N2Africa project, is an initiative in which legumes are used to revitalize productivity of cropping systems and to improve the wellbeing of smallholder farmers in sub-Saharan Africa. The project is working to increase farm nitrogen (N) input through Biological Nitrogen Fixation (BNF). This additional N is expected to increase the yield of grain legumes as well as companion crops, resulting to excess production which when sold is capable of increasing household income. To be able to achieve the above goal, the project is implemented following a step-wise approach, which involves selection of superior legume and rhizobia genotypes with enhanced potential for BNF; evaluation of selected legumes and rhizobia under different agronomic practices that enhance BNF;

integration and scaling up best fit agronomic technologies to smallholder farmers in different farming systems and agro-ecologies in the project impact zones (Baijukya and Vanlauwe, 2011).

Even though many studies have been conducted regarding factors affecting modern agricultural technology adoption, issues that dictate the preference of farmers' are not yet investigated. Technology adoption has been largely framed as a dichotomous centering whether farmers will adopt or not adopt certain technologies. An adoption preference among smallholder agricultural producers with different technology packages in a joint preference setting has not been investigated. In addition, the socioeconomic characteristics of farmers, like education, age or resources, have especially important effects on the earliness of adoption during the process of diffusion. However, these attributes are often less important in differentiating between adopters and non-adopters. Varietal characteristics that impede adoption are extremely important constraints, depending on the particular crop and its growing conditions (Pachio, 2014). This study is expected to provide primary information regarding farmers' legume technology adoption preference decision by analyzing preference of farmers given multiple packages which farmers consider simultaneously in their adoption preference decisions. To do this the study used a conjoint model to analyze preference for adoption of legume technology packages among smallholder farmers in Boricha and Damot Gale district, in Southern region.

1.2 Statement of the Problem

Most studies dealing with agricultural technology adoption by farmers in developing countries are based on *ex-post* analysis of intervention programs. Farmers are rarely consulted, *a priori*, about their specific circumstances, priority problems and their preference for type of intervention. The adoption behavior study comes after the costs are incurred and the technologies have been diffused. Such technological interventions often resulted in a low level of acceptance by the target group and a lower success for development programs (Feder*et al*., 1981).

There has been continued interest in studying and describing farmers' technology adoption behavior (Feder *et. al*., 1985; Marra *et al*., 2003; Knowler and Bradshaw, 2007) but no simple answer has emerged as to the determinants. A long list of explanatory variables requiring different policy interventions have been identified and suggested to explain the adoption behavior of farmers. Farmers' preferences for the type of intervention rarely appear in the explanatory variables. Prior identification of farmers' preference can help to design more acceptable and cost effective development intervention programs.

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Adoption of agricultural technology were influenced by a set of independent variables like farmer and household characteristics (such as age, gender, education level, and family size), psychological factors (such as attitudes to and perceptions of improved inputs), socio-economic factors (such as farm size, land size, number of livestock and income), institutional factors (such as credit, extension, membership in cooperatives and infrastructure like access to roads) (Seife and Caroline, 2011). However, the low rate of adoption for improved and new technologies by farmers might also be influenced by the different attributes that farmers assign in their choice for technology adoption. To this respect, adoption depends on users' judgment of the value of the technology to them. Adoption or rejection of technologies by users may reflect rational decision characteristics of the technologies under investigation. Users will reject a technology that is not relevant to their needs, not suited to their work environment and one that may interfere with other activities that are considered to be important. Farmers' subjective technology attribute needs have shown to significantly condition technology adoption decisions (Farrington and Martin, 1988; Tripp, 1989; Ashby *et al.,* 1989). Their omissions in adoption model may bias the results of the factors determining adoption decision of users (Adesina and Baidu-Forson, 1995).

Past technology adoption studies conducted in Ethiopia tried to identify factors affecting adoption of new technologies. However, they largely sees adoption as a single element that is framed as a dichotomous/ whether or not to adopt/ where a functional relationship between the probability of the adoption and a set of explanatory variables is estimated (Techane *et al*., 2006; Menale *et al.,* 2009; Alemitu, 2011; Negera and Getachew, 2014)

and also concerned with such divisible technology adoptions like improved seed, chemical fertilizer, and herbicide and pesticide adoptions solely (Techane *et al.*, 2006; Sinafikeh *et al.*, 2010; and Legese *et al.*, 2011. Feder *et al*. 1985) categorized adoption into individual and aggregate adoption. Despite these efforts, there have been no studies that addressed the adoption of legume technology using a trade-off analysis in order to understand how farmers' preference for different type of attributes determines legume technology adoption. This study was, therefore, initiated to examine factors that influence farmers' legume technology adoption preference in Damot Gale and Boricha districts of Wolaita and Sidama zone of southern region by using a conjoint model.

1.3 Research Question

This study tries to answer the following research questions:-

- What are the key factors that influence farmers' legume technology adoption preference in Damot Gale and Boricha districts?
- Which technology utility attribute types are preferred by farmers of Damot Gale and Boricha districts in their adoption decision of legume technology?

1.4 Objectives of the Study

The main objective of the study is to identify the factors that determine the farmers' preference for adoption of legume technology packages.

The Specific objectives of the study are:

- To analyze the key factors that influence farmers' legume technology adoption preference in Damot Gale and Boricha districts and
- To assess the legume technology utility attributes type that farmers prefer in their adoption decision of legume technology in Damot Gale and Boricha districts.

1.5 The Scope and Limitations of the Study

This study was undertaken in Damot Gale and Boricha district of Wolaita and Sidama zone respectively, which is found in the southern region. Farmers' preference for adoption of legume technology packages 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. Therefore, it is difficult to identify universally defined factors determining preference and attitude either impeding or enhancing adoption of technology. This study was limited to assessing factor affecting Legume technology adoption preference of chickpea and common bean producing farmers in Damot Gale and Boricha districts.

1.6 Significance of the Study

Acquired information from such studies could enhance the efficiency of agricultural research, technology transfer, input provision, and agricultural policy formulation. All development partners including extension educators, technical assistants, NGOs and other development agents involved in agricultural development must be aware and understand the factors affecting farmers' adoption preference of legume technology package in order to target appropriate technologies to farmers.

The present study attempted to reveal those underlying factors which affect farmer's preference for adoption of legume technology packages in Boricha and Damot Gale districts. To this end, the findings of this study are expected to render very valuable information for further promotion of legume technology in the study area. Furthermore, farmers' technology evaluation criteria would help researchers to develop technologies appropriate to local situation and in line with the farmers' preference. The key findings from this study could help to fine tune agricultural interventions in such a way that the farmers' preference regarding legume technology can be addressed. Such information

would suggest interventions that may help to improve the efficiency of agricultural research and extension and also enables researchers and practitioners to modify and redirect their activities towards the most pressing problems.

2. LITERATURE REVIEW

2.1. Definition of Basic Concepts

2.1.1. 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).

2.1.2. Technology Adoption Preference

The term preference is used in multiple ways. Economists and behavioral decision theorists often equate preference with choice or willingness to pay (Caleb *et al.,* 2010*).*Farmers' preferences towards technology adoption are linked to the characteristics (or traits) of the technology. Farmers, according to their perceptions and preferences, choose the system for which they obtain the highest expected utility of profit. The components of farmers' profit are subjectively perceived and specific to each production context (Rahmeto, 2007).

Prior knowledge of farmers' priority problems and predisposition with respect to the usefulness of a development interventions program can also help to gear development intervention programs to the needs of farmers. This is so because farmers, who are the ultimate users of the program, take decisions to participate and adopt any development intervention in line with their utility maximization objective/preference. Alternative intervention programs are valued based on their contribution to the household welfare. Knowledge of farmers' preference for development intervention (PDI) gives an insight into the value farmers place on the different programs. These preferences can be elicited using a stated preference survey method and factors affecting these preferences can be determined econometrically (Wogayehu, 2004).

In order to explain the major adoption preference and determinants agricultural of technology adoption, mainly there are three paradigms focusing on this. These paradigms are the innovation-diffusion model, the adoption perception and the economic constraints models. The main assumption of the innovation-diffusion model is that the new technology is both technically and culturally appropriate but the problem of adoption is one of asymmetric information and very high search cost (Feder and Slade, 1984). The second paradigm, the adopters' perception paradigm, on the other hand, suggests that the perceived attributes of the technology condition adoption preference of farmers. This means that, even with full farm household information, farmers may subjectively evaluate the technology differently than scientists (Feder, 1984). Thus, understanding farmers' perceptions of a given technology is

crucial in the generation and diffusion of new technologies and farm household information dissemination.

Many determinants of technology adoption have been sought in agricultural economics literature. Farm and farmers' characteristics and the role of policies have been extensively studied (Feder and Umali, 1993). Agronomic and climatic factors reduce the adoption by limiting the selection of innovations and by constraining cropping conditions. Farmers' preferences towards technology to be adopted are linked to the characteristics (or traits) of the technology. Farmers, according to their perceptions and preferences, choose the system for which they obtain the highest expected utility or profit. The components of farmers' profit are subjectively perceived and specific to each production context.

2.1.3. Agricultural Technology Adoption

The concept of technology adoption could be better conceptualized through understanding the difference between technology adoption and diffusion, which are highly interrelated but distinct concepts. Adoption is related to private utility mechanisms (Feder*et al.,* 1985; Feder and Umali, 1993) and can be defined as "the choice to acquire and use a new invention or innovation" (Hall and Kahn, 2002), whereas "diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1983).Technology adoption is measured at one point in time while technology diffusion is the spread of a new technology across population over time (Thirtle and Ruttan, 1987).

Rogers (1962) summarized the above definition of technology diffusion using the following four core elements: (1) the technology that represents the new idea, practice, or object being defused, (2) communication channels which represent the way information about the new technology flows from change agents suppliers (extension, technology suppliers) to final users or farmer, (3) the time period over which a social system adopts a technology and (4) the social system. Overall, the technology diffusion process essentially encompasses the adoption process of several individuals or farmers over time. Further, another study by Rogers

(1995), defined the rate of adoption (speed of adoption) of a given technology. It is the relative speed with which farmers adopt technology; in this definition consideration is given to the element of a given technology to the farmers.

According to Feder *et al*. (1985), adoption can be categorized into individual or aggregate adoption. They defined individual adoption as the degree of use of a new technology in a long-run equilibrium when the farmer has full information about the new technology and its potential, whereas aggregate adoption is defined as the process of spread of a technology within a region. Further, their studies distinguished technologies that are divisible and non-divisible. Divisible technology in terms of resource allocation requires the decision process to involve area allocations as well as levels of use of the rate of application (for instance, improved seed, chemical fertilizer, and herbicide and pesticide). Whereas, technologies that are not divisible in term of resource allocation require how much resource to be allocated to the new and old technologies (for instance: mechanization, irrigation and better farm management practices such as uses of recommended agronomic practices).

The application of the concept of adoption in empirical studies, therefore, requires making distinction between technologies which are divisible and non-divisible. This is because often times the nature of the technology dictates the terms on which adoption is conceptualized and analyzed. Therefore, adoption of improved agricultural technologies such as improved variety and/or chemical fertilizer can therefore be categorized as divisible technology, defined as farmers who planted at least one improved maize variety and/or use chemical fertilizer for maize, and non-adopters are those who did not grow any of the improved maize variety and/or used chemical fertilizer in maize farming. Adoption of recommended agronomic practices such as the use of timely planting, cropping system and seed spacing are categorized as a non-divisible technology, measured in terms of the status of use by smallholder farmers for planting.

2.1.4. Stages of Technology Adoption

Rogers (1962) developed a technology adoption model, generalized the use of it in his book entitled as "*Diffusion of Innovations".* He used the model to describe how technology spread in the social system. The technology adoption model describes the adoption or acceptance of a new product or technology. The process of adoption over time is typically illustrated as a classical normal distribution or bell-curve and use the mean and standard deviation to divide the normal adopter distribution categories. The model indicates that the first group of people to use a new product or technology is called innovators, followed by early adopters. Next come the early and late majority, and the last group to eventually adopt a product are called laggards. While explaining each of the categories the study by Rogers (1962) defined as:

Innovators: These are the first individuals to adopt a given technology and hence they are willing to take risks, youngest in age, have the highest social class, have great financial liquidity, are very social and have closest contact with scientific sources and interacting with other innovators.

Early adopters: These are those groups of individuals who are typically younger in age, have a higher social status, have more financial liquidity, advanced education, and are more socially forward than late adopters, which means more discrete in adoption choices than innovators.

Early majority: Individuals in this category adopt technology after a varying degree of time. This time of adoption is significantly longer than the innovators and early adopters. Early majority tend to be slower in the adoption process, have above average social status, contact with early adopters, and seldom hold positions of opinion leadership in a system.

Late majority: Individuals in this category will adopt technology after the average member of the society. These individuals approach technology with a high degree of skepticism, and after the majority of society has adopted the technology. Late majority is typically skeptical

about technology, have below average social status, very little financial lucidity, in contact with others in late majority and the early majority, very little opinion leadership.

Laggards: Individuals in this category are the last to adopt a technology. Unlike some of the previous categories, individuals in this category show little to no opinion leadership. These individuals typically have an aversion to change-agents and tend to be advanced in age. Laggards typically tend to be focused on "traditions", likely to have lower social status, lowest financial fluidity, older of all other adopters, in contact with only family and close friends.

2.1.5. Stages of Technology Diffusion

The study by Rogers (1964) further categorized adoption decision process into five stages: (1) *Knowledge:* In this stage, an individual is first exposed to technology and hence he has some idea of how it functions; *(2) Persuasion:* This is the stage in which the individual forms a favorable or unfavorable attitude toward the technology. Due to the individualistic nature of this stage, Rogers notes that it is the most difficult stage to acquire empirical evidence; *(3) Decision:* In this stage, a person engages in activities that lead to a choice to adopt or reject the technology; *(4) Implementation:* This is a stage in which the individual puts technology into use depending on the situation; *(5) Confirmation:* During this stage, the individual evaluates the results of technology decision already made and hence made a decision to continue using the technology. This stage is both intra and interpersonal confirmation, which involve group decision about the technology adoption.

2.2. Empirical Review

2.2.1. Factors Influencing Farmers Preference for Technology Adoption

From the extensive review of the literature on technology adoption in developing countries, the various factors that influence technology adoption can be grouped into the following three broad categories (Feder *et al*., 1985): (1) factors related to the characteristics of producers; (2)

factors related to the characteristics and relative performance of the technology and (3) institutional factors. The factors related to the characteristics of producers include: education level, experience in the activity, age, sex, household size, level of wealth, farm size, labor availability, risk aversion and capacity to bear risk, etc. The factors related to the characteristics and performance of the technology include food and economic functions of the product, the perception by individuals of the characteristics, complexity and performance of the innovation or technology, its availability and that of complementary inputs, the relative profitability of its adoption compared to substitute technologies, the period of recovery of investment, the susceptibility of the technology to environmental hazards, etc. The institutional factors include availability of credit, the availability and quality of information on the technologies, accessibility of markets for products and inputs factors, the land tenure system, and the availability of adequate infrastructure these explanatory indicators vary from study to study based on their contextual applicability and specific local condition.

In Ethiopia, a number of studies examined factors affecting adoption of improved agricultural technologies in crop production. Assefa and Gezahegn (2010), Solomon *et al*. (2011) and Hassen *et al.* (2012) found that age of household head, educational status, livestock holding, non-farm income, sex, and information access plays important factors in affecting the decision of farmers to adopt improved technology. Nega and Senders (2006), and Shiferaw and Tesfaye (2005) showed the positive effect of credit on fertilizer adoption and improved maize varieties adoption, respectively.

Solomon *et al*. (2011) examined the driving forces behind farmers' decisions to adopt agricultural technologies and the causal impact of adoption on farmers' integration into output in Ethiopia. They used a Double-Hurdle model to analyze the determinants of the intensity of technology adoption conditional on overcoming seed access constraints. Results show that knowledge of existing varieties, perception about the attributes of improved varieties, household wealth (livestock and land) and availability of active labor force are major determinants for adoption of improved technologies.

According to Tadesse (2008), farmers' evaluation criteria and adoption of improved onion Production package, early maturity, good yield, large bulb size, and good bulb color were the most important traits of improved onion identified as a selection and evaluation criteria in the study area. Result of the econometric model indicated that household head's education status of the household head access credit, participation in extension event (participation in training and field day), participation cooperative society and frequency of visiting outside his/her social system were important variables which had positively and significantly influenced adoption and intensity of adoption of improved onion production package Whereas, farmers' perception towards improved onion production technology had shown negative relationship with adoption and intensity of adoption. The overall finding of the study underlined the high importance of institutional support in the areas of extension training; strengthening cooperative societies, and improving market condition to enhance adoption of improved onion production package.

Using a choice experiment approach, Sinafikeh *et al*. (2010) investigated Ethiopian farmers' crop variety preferences, estimated the mean willingness to pay for each crop variety attribute, and identified household-specific and institutional factors that governed the preferences. They found that environmental adaptability and yield stability are important attributes for farmers' choice of crop varieties. Farmers are willing to forego some extra income or yield to obtain a more stable and environmentally adaptable crop variety. Among other things, household resource endowments (particularly land holdings and livestock ownership), years of farming experience, and contact with extension services are the major factors causing household heterogeneity of crop variety preferences.

Timu *et al*. (2014) examined the effect of variety attributes on adoption of improved sorghum varieties in Kenya. The results on the perception of farmers variety attributes showed that improved varieties had desirable production and marketing attributes while the local varieties were perceived to have the best consumption attributes. Evidence further indicated that the major sorghum variety attributes driving rapid adoption are taste, drought tolerance, yield, ease of cooking, and the variety's ability to fetch a price premium. Early maturity, a major focus of research was found to have no effect on the adoption decision. The findings of the

study implied that, while developing improved seed varieties, breeders should also focus on non-yield attributes like taste and ease of cooking to increase adoption and satisfy the multiple needs of the farmers.

2.3. Conceptual Framework of the Study

Most studies dealing with the agricultural technology adoption by farmers in developing countries are based on ex-post analysis of intervention programs. Farmers are rarely consulted, a priori, about their specific circumstances, priority problems and their preference for type of intervention. The adoption behavior study comes after the costs are incurred and the technologies have been diffused. Such technological interventions often resulted in a low level of acceptance by the target group and a lower success for development programs (Feder *et al.* 1981).

Farmers' adoption behavior, especially in low-income countries, is influenced by a complex set of socio-economic, demographic, technical, institutional and biophysical factors (Legesse, 1998). Based on the theoretical and empirical reviews the conceptual framework shown in Figure 1 (See also Table 2 and 3) is constructed for this study and used in the conjoint model.

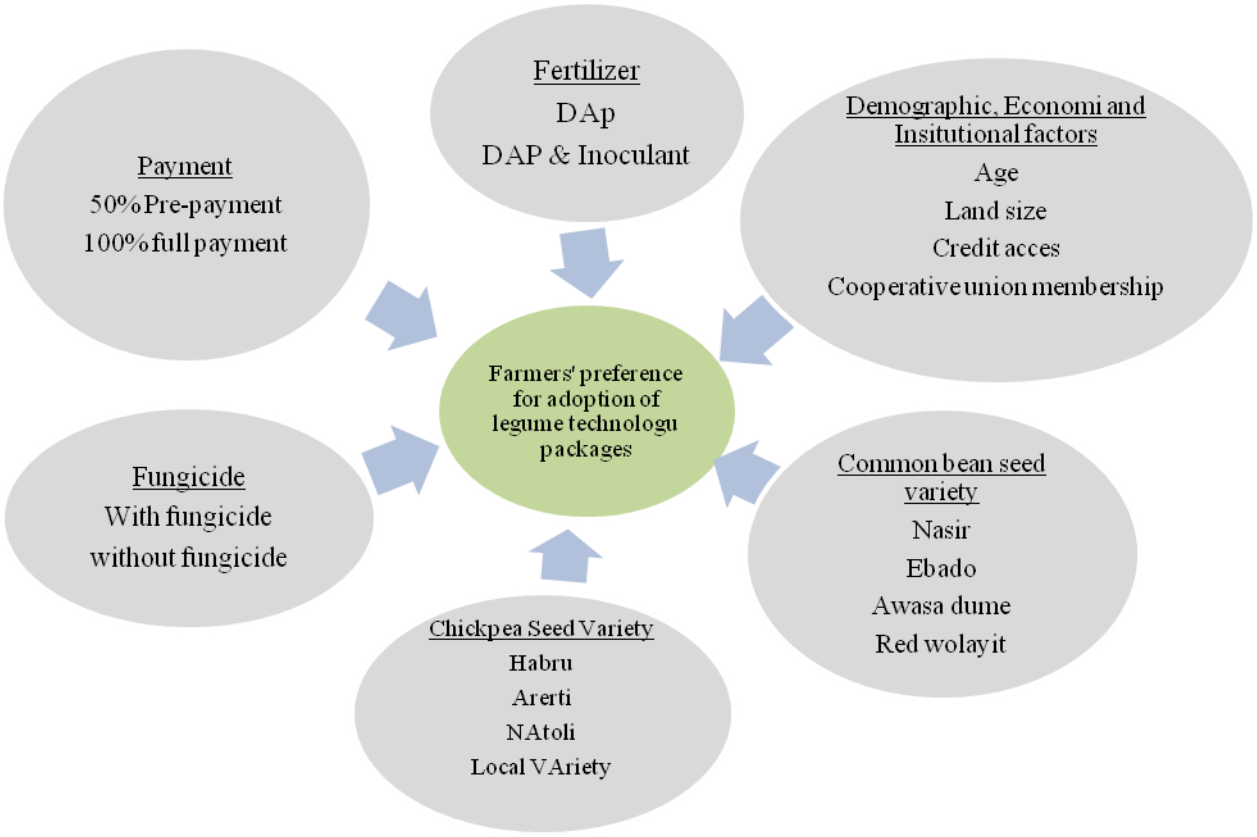

Figure 1: Conceptual Framework of the Study for Conjoint Model (Source; Own review)

3. METHODOLOGY

3.1 Description of the Study Area

The Southern Nations, Nationalities and People‘s Regional State (SNNPRS) is one of the four largest Regions in Ethiopia (out of the 9 Regions and 2 City Authorities into which the country is presently administered). It has an area of 105,887.18km^2. It is probably the most diverse region in ethnic terms, and it contains some of the most remote and wettest parts of Ethiopia with an estimated population of 16,848,011. The main economic activity in the region is agriculture (Dilayehu, 2014). The Southern Nations, Nationalities and People's Region (SNNPR) constitutes 13 Zone sub-divided in to 126 Districts, 8 special districts. The study is conducted in Damot Gale and Boricha districts. Both Districts are selected based on their legume production potential and the fact that they are target areas of the N2 Africa project which is working on putting nitrogen fixation to work for smallholder farmers in Africa.

3.1.1 Damot Gale district

The Wolaita zone is one of the thirteen zones of the Southern region(See also Figure 2). The study area Damot Gale is one of the 12 Districts in Wolaita zone. Damot Gale is bordered on the south and south-west by Sodo Zuria, on the west by Boloso Sore, on the north by the Damot Pulasa and, on the northeast by the Hadiya zone, and on the east by Damot Weydie. The administrative town is Boditi. The district is also subdivided into 31 kebele administrations. Mixed agriculture is the main economic activity of the District. According to the 2007 Ethiopian Population and Housing Census, Damot Gale district has a total population of 151,079, of whom 74,227 are men and 76,852 women; 24,133 or 15.97% of its population are urban dwellers.

3.1.2 Boricha district

Boricha district is one of the districts of Sidama zone (See also Figure 2). It is bordered by Loka Abaya in south, Dore Bafane in north, Diguna Fango in Wolaita zone in west, Siraro in West Arsi-zone in North-West and Shebedino in East. It is located at 36 kilometers from the Regional and Sidama zonal capital city, Hawassa, and 311 kilometers from capital city of Ethiopia, Addis Ababa. The area of the District is 588.05 square kilo meter.

Boricha district is agro-ecologically categorized into two: 25% is midland (Woynadega) and 75% is lowland (Kola). The altitude of the District ranges from 1,320 to 2,080m.a.s.l. The annual rainfall ranges between 27.82 to 128.58mm. It is bimodal with short rainy season from March to April which is Belg, and the long rainy season from June to the middle of August which is Kiremt. The annual temperature of the District ranges between 21.93°c and 25.56°c.

The economy of the District is mainly based on agriculture. Mixed farming system is dominant activity for rural households. The district is confined to production of rain-fed crops. The main crops produced in the study area are maize, haricot Bean, enset, coffee, potato and sweet potato. Boricha District has 42 kebeles. Out of these kebeles three are urban and the other 39 are rural kebeles. Based on the 2007 Ethiopian population and housing Census conducted by the CSA, this District has a total population of 250,260, of whom 125,524 are men and 124,736 women; 10,402 or 4.16% of its population are urban dwellers.

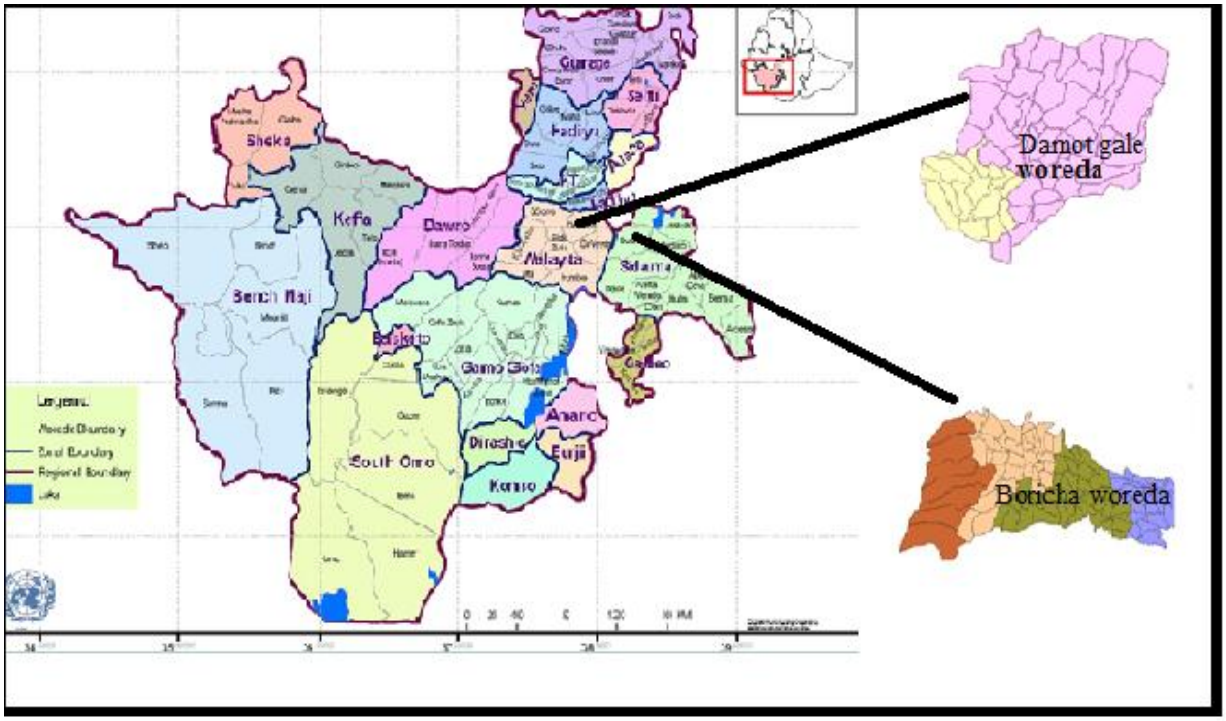

Figure 2: Map of the study area (Source: Http:// www.ethiodemographyand health.com/)

3.2 Methods of Data Collection

This study employed both qualitative and quantitative methods of data collection. Data were collected from both secondary and primary sources generated through exhaustive desk review around the issue in hand and case study and structured questionnaire. Through the desk review, the study critically evaluated the existing literature on the factors and issues related to farmers' technology adoption. Both the qualitative and quantitative techniques were employed as the methods of the data collection.

i) Qualitative method: In the qualitative method, inductive (in-depth) case study was conducted in the two research sites. The case study was based on the protocol which was designed by emphasizing the main context (ecological, social and economic) variables that may impact farmers' legume technology adoption (See Appendix 11). The case study have included interviews with: twenty individual farmers, six development experts in the study

area, four focus group discussions (FGD) with farmers where each group consisting five to eight individuals, four interviews with NGO representatives who are involved in the distribution of inputs to farmers, and four4 individual interviews with (output) traders in the area.

ii) Survey using structured questionnaire: Based on the insights of the case study, structured questionnaire (See Appendix 10) was carefully designed to conduct a survey among the randomly selected farming households. The questionnaire included the conjoint model that is to be administered on farmers regarding their preferences for the adoption of legume technology packages.

3.3 Sampling Procedure and Sample Size Determination

A two-stage sampling procedure was employed to select chickpea and common bean producing sample farm household. A combination of purposive and random sampling technique was employed. In the first stage based on each district agriculture office information regarding potential chickpea (among twenty two potential kebeles) and common bean (among twenty three potential kebeles) producing kebeles and the fact that they are target areas of the N2 Africa project which is working on putting nitrogen fixation to work for smallholder farmers in Africa, four Kebeles namely Buge, Gacheno, Taba and Sha/shone (from Damot Gale district) and Shondololiwo, S/Chala, Qo/Heranja and H/Goro (from Boricha district) were selected purposively. At the second stage, random sampling technique was applied to obtain the sample unit based on the number of chickpea and common bean producing households in each Kebeles. The sample size for this study was determined using Yamane, 1967 formula which is a simplified formula for proportion by assuming 50 % of population proportion, a confidence level of 95%, and tolerable precision error of 0.05.

$$n = \frac{N}{1 + Ne^2}$$

Where,

n = required sample size

e = Precision error of (e = 0.05)

N= Total number of legume producers

The sample size was calculated independently for each crop and distributed for each selected Districts by using probability proportional to size which is indicated in Table 1 below.

Table 1: Sample Size

	Total no. of producers	Sample size based on probability proportion
Chickpea producers		
Boricha district	0	0
Damot Gale district	4140	120
Common bean producers:		
Boricha district	38355	80
Damot Gale district	19408	40
Total		240

3.4. Method of Data Analysis

The data was analyzed using descriptive statistics such as mean, percentage, and standard deviations to characterize the farming system of the study area. The conjoint model was used to assess the preferences of farmers for legume technology, and OLS regression was used to analyze the factors that influence farmers' preference for the adoption of legume technology packages.

3.4.1. The Conjoint Analysis

The conjoint analysis technique is chosen for this research because it relies on the premise that a person's valuation of a product is based on the utility derived from the many attributes that comprise the product as a whole (Baker, 1998). Conjoint analysis is used in a number of studies such as food items (Harrison *et al.* 1998), tourism (Marija, 2010), mobile phones

(Oyatoye, 2013), farmers wheat variety preference (Katherine, 2013) and marketing (Yared, 2015).

Conjoint analysis is a statistical technique used in market research to estimate individual preference models based on how people value different traits that make up a product (Hair *et al*. 1998). In a conjoint analysis design, a controlled set of potential products with different combinations of traits is shown to respondents and, by analyzing how they rate these products, the implicit valuation of the individual traits making up the product can be determined (Hair *et al*. 1998).

In this study, the full profile conjoint analysis method was selected for analyzing the farmers' preference for technology adoption. This method is often recommended when few (up to 10) factors are used (Green and Srinivasan, 1978; Hair *et al*., 1998). Full profile analysis remains the most common form of conjoint analysis and has the advantage that the respondent evaluates each profile holistically and in the context of all other stimuli. Full profile means evaluation of all attributes or factors at a time by ranking from most preferred product profile to least preferred product profile or by assigning scores to each product profile from lesser preference to higher reference.

Green and Wind (1975) stated that conjoint measurement is concerned with measuring the joint effect of two or more independent variables on the ordering of a dependent variable. According to Ryan and Farrar (2000), the application of conjoint analysis involves five stages; identification of attributes, assigning levels of the attributes, determining the attribute combinations, selecting the presentation method and selecting the method to be used to analyze the collected data. In the conjoint analysis, the part-worth model is the model used to express the utilities or the measure of desirability of the various attributes levels. This can be estimated with different techniques such as ordinary least square regression analysis and logistic regression. Bard *et al*. (2002) found that OLS is an appropriate estimation method in conjoint analysis. If the preference judgment is an approximately interval scale, then the part-worth can be represented by dummy variables and ordinary least-squares (OLS) regression is a means with which to estimate the part-worth (Hauser and Rao, 2002).

For this research purpose, four attributes and ten levels were identified for each crop (Chickpea and Common bean) (see Table 2 and 3). The four attributes to be evaluated were selected based on the factor analysis results from sample survey analysis by the researcher. The conjoint survey involved farmers rating hypothetical technologies or varieties that were based on combinations of the four attributes and their levels as follows.

1. Seed variety

(Habru, Arerti, Natoli and Local variety……..… for chickpea)

(Nasir, Ebado, Awassa dume and Red wolaita……...for common bean)

2. Fertilizer (DAP only and DAP and Innoculant)
3. Fungicides (with fungicide and without fungicide)
4. Payment option (50% pre-payment and 100 full payment)

Table 2: Attributes and their Levels of Chickpea

No.	Attributes	Definition of attributes and measures	Attribute level/Type
1	Seed variety	Type of chickpea seed variety	Habru Arerti Natoli Local variety
2	Fertilizer	Type of fertilizer	DAP DAP and Inoculants
3	Fungicides	Farmers' preference for fungicide availability	With fungicide With-out fungicide
4	Payment option	Payment option preferred by farmers	50% pre-payment Full payment

Table 3: Attributes and their Levels of common bean

No.	Attributes	Definition of attributes and measures	Attribute level/Type
1	Seed variety	Type of Common bean seed variety	Nasir Ebado Awassa dume Local variety/Red Wolayita
2	Fertilizer	Type of fertilizer	DAP DAP & Inoculants
3	Fungicides	Farmers preference for fungicide availability	With fungicide With-out fungicide
4	Payment option	Payment option preferred by farmers	50% pre-payment Full payment

The total number of profiles or stimuli that can be generated with the above list of attributes and attribute types (four attributes and ten levels) was 4*2*2*2= 32. But the size of profiles (32) might lead to information overload that will eventually reduce the accuracy of the respondent's preference evaluation. Moreover, respondents may not provide proper and meaningful evaluations when a large number of product profiles are presented. In order to solve this problem, fractional factorial main effect design was used to make the number of profiles manageable while keeping the orthogonality of the factors (Hair *et al*., 1998). Therefore, an orthogonal array design was created (Hair *et al*., 1998). Through the design, 8 product profiles with different combination of the Attribute types were developed. The number of profiles used for the analysis was more than the minimum requirement (Kuzmanovic *et al*., 2010) seven profiles (sum of all Attribute types - number of attributes + 1**)**. Orthogonality makes the correlation between attributes very minimum (almost zero) for the regression analysis and makes each level to appear in equal numbers (Green and Srinivasan, 1990). Five level Likert scale (1 for not preferred and 5 for most preferred) was used to capture the preference scores of each respondent for the product profiles generated from the orthogonal array design (Kambewa, 2007). A sample product profile with five levels Likert scale that was used in the survey is shown below.

Profile Number 1				
Card Number	Chickpea Seed	Fertilizer	Payment Option	Fungicide
1	Habru	DAP and & Inoculants	Full Payment	Without-Fungicide

Not Preferred Least Preferred Undecided Preferred Most Preferred

1----------2----------3----------4----------5

To measure the internal validity and predictive accuracy, holdout profiles (Kuzmanovic *et al.* 2013) were generated and incorporated in the conjoint model.

Conjoint Model Estimation

The estimation for the coefficients was done through the linear regression model to determine the utility value of each Attribute type. The basic conjoint model in this research was represented (Shalini and Msood, 2010) as:

$$U(X) = \sum_{i=1}^{m} \sum_{j=1}^{k_i} \alpha_{ij} x_{ij}$$

Where,

U (X) = Overall utility (importance) of an attribute

αij = part-worth utility of the j_{th} level of the i_{th} attribute

i= 1, 2....., m j= 1, 2……. k_i

x_{ij} = 1, if the j_{th} level of the i_{th} attribute is present

= 0, otherwise.

The coefficients for each level of the attributes were estimated using SPSS 20 conjoint statistical tool regression syntax by running both the plan and data files. The measures of each customer value (the Attribute types) are the independent (predictor) variables. The estimated betas associated with the independent variables are the preference scores for the levels. The coefficients are the utility estimates (part-worth) of the Attribute types.

In the conjoint analysis, the part worth model is the model used to express the utilities or the measure of desirability of the various attributes levels. This can be estimated with

different techniques such as ordinary least square regression analysis and logistic regression.

For this study, the Ordinary Least Square model that will be used is specified as follows.

$Y_{im}= \beta_0 + \beta_1$(Habru seed variety) + β_2(Arerti seed variety) + β_3(Natoli seed variety) + β_4(With Fungicide) + β_5(50% pre-payment) + β_6(DAP)+β_7(Age)+β_8(Land size)+β_9(Credit access)+ β_{10}(Cooperative union membership+ε_{im} ……..for chickpea producers in Damot Gale district.

$Y_{im}= \beta_0 + \beta_1$(Nasir seed variety) + β_2(Awasa dume seed variety) + β_3(Red wolaita seed variety) + β_4(With fungicide) + β_5(50% pre-payment) +β_6(DAP) + β_7(Age)+β_8(Land size)+β_9(Credit access)+ β_{10}(Cooperative union membership) +ε_{im}……for common bean producers in Damot Gale district.

$Y_{im}= \beta_0 + \beta_1$(Nasir seed variety) + β_2(Ebado seed variety) + β_3(Awasa dume seed variety) + β_4(With Fungicide) + β_5(50% pre-payment) +β_6(DAP) +β_7(Age)+β_8(Land size)+β_9(Credit access)+ β_{10}(Cooperative union membership + ε_{im}……for common bean producers in Boricha district.

Where: Y represents the rating value given by respondent on the 5-point Likert scale.

3.5. Definition of Variables and Working Hypotheses

Table 4: Definition, unit of measurement and expected effect of hypothesized variables

No.	Variable name	Definition	Measurement	Expected sign (+/-)
a) Independent Variables				
1	Seed (Chick pea)	Chickpea seed Attribute types (improved or local) that is preferred by the farmer	Dummy 1=if available in a profile, 0=if not available in a profile	
	Habru			+
	Areti			+
	Natoli			+
	Local variety			-
2	Seed (Common bean)	Common bean seed Attribute types (improved or local) that is preferred by the household head	Dummy 1=if available in a profile, 0=if not available in a profile	
	Nasir			+
	Hawasadume			+
	Ebado			+
	Red wolaita			-
3	Fertilizer	Fertilizer type that farmers' prefer to adopt	Dummy 1=DAP, 0=DAP and Inoculants	
	DAP			+
	DAP and Inoculants			+
4	Payment option	Payment option of a household head	Dummy 1=50% pre-payment, 0=100% payment	
	50% pre-payment			+
	100% pre-payment			-
5	Fungicide	Fungicide preference of household head	Dummy 1=With-fungicide, 0=Without fungicide	
	With fungicide			+
	Without fungicide			-
6	Age	Age of a house hold head	Continuous measured in years	+/-
7	Credit access	Access to credit	Dummy 1=Yes, 0=No	+
8	Land size	Total land size a HH holds in hectares	Continuous measured in hectare	+
9	Cooperative union-membership	Being a Member of a cooperative union	Dummy 1=Yes, 0=No	+

3.6. Validity and Reliability Tests

3.6.1 Validity and Reliability Tests for Conjoint Analysis

Data were examined for any extremes and missing values for the conjoint analysis. Missing values were not found. No respondent missed a variable both in chickpea and common bean producers.

To test the reliability (internal consistency) for multi-items of the research instrument Croanbach's alpha was computed and from the reliability statistics table (See Table 5) the obtained Cronbach's Alpha value of 0.824, 0.783 and 0.732 for chickpea and common bean producers in Damot Gale district and common bean producers in Boricha district respectively in which all is > 0.700. Based on Cronbach's Alpha values it can be concluded that this research instrument has high level of reliability (internal consistency).

Table 5: Reliability statistics of conjoint analysis

	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Chickpea Damot Gale	0.824	0.819	12
Common bean Damot Gale	0.783	0.753	12
Common bean Boricha	0.732	0.739	12

To test the validity of the conjoint model Pearson's and Kendall's tau correlation coefficient (Green and Srinivasan, 1990) was examined which provides measures of correlation between the observed and estimated preference. Pearson correlation result for chickpea and common bean producers in Damot Gale district and common bean producers in Boricha district shows 0.988, 0.995 and 1.000 consecutively. For the internal validity Kendall's tau was examined and the result was 0.714, 1.000 and 1.000 for Chickpea and common bean producers in Damot Gale district and common bean producers in Boricha district shows 0.988, 0.995 and 1.000 consecutively. The (See Table 6) also provides

Kendall's tau just for holdout (i.e, 0.333, 0.333 and 0.913 for chickpea and common bean producers in Damot Gale district and common bean producers in Boricha district shows 0.988, 0.995 and 1.000 consecutively). The holdouts should always produce lower correlation coefficients than both the Pearson's correlation coefficient and the Kendall't tau test (see Table 4) which reveal that the model is fit and have the ability to predict the outcomes (Green and Srinivasan, 1990).

Table 6: Correlations of conjoint analysis

	Chickpea Damot Gale		**Common bean Damot Gale**		**Common bean Boricha**	
	Value	Sig.	Value	Sig.	Value	Sig.
Pearson's R	0.988	0.000	0.995	0.000	1.000	0.000
Kendall's tau	0.714	0.007	1.000	0.000	1.000	0.000
Kendall's tau for Holdouts	0.333	0.248	0.333	0.248	0.913	0.035

Source: Own Survey, 2016

Error terms are identically distributed (See Appendix 5) in both consumer groups, so there is no heteroskedasticity problem for the data. The Durbin Watson test was done and all the values found are within the range between 1.25 and 2.75 (Shalini and Msood, 2010), so there is no autocorrelation in all regression models (See Table 7).

Table 7: Durbin Watson test for autocorrelation

Regression	Durbin-Watson test
Common bean producers	
Common bean producers in Boricha district	1.798
Common bean producers in Damot Gale district	1.736
Chickpea producers in Damot Gale district	1.645

Source: Own Survey, 2016

The data was also tested for multi-coliniarity. As a rule of thumb if VIF result is lower than 10, multi-coliniarity is not a series problem (Gujarati, 2004). The mean VIF value of correlation among predictors (See Table 8) show there is no multi-coliniarity on the data. The highest VIF value is for variable Hawassa dume for common Bean producers in both districts and for all chickpea seed varieties in Damot Gale district (See Appendix Table 5).

Table 8: Mean VIF result

No.	Description	Mean VIF
1	Common bean Producers In Boricha district	1.142
2	Common bean Producers In Damot Gale district	1.384
3	Chickpea Producers In Damot Gale district	1.25

Source: Own Survey, 2016

3.7. Ethical Considerations

During the sample survey, the data collection, before entering to the premises of the individuals' farm households' permission from the owners' farm households, and other responsible persons was solicited and the sole objective of the data collection purpose was explained. Ethical considerations as have also been taken into account during data analysis, interpretation and presentation.

4. RESULT AND DISCUSSION

This chapter presents the major findings of the study. It has three main sections. The first section deals with descriptive statistics of the sample households. The second section presents factors affecting farmers' preference for adoption of legume technology packages. The third section presents results of conjoint analyses which contains the relative importance and part worth utilities of attributes and attribute types.

4.1. Socio-demographic and economic Background of Chickpea Producing Farmers

4.1.1. Demographic Structure

Age of households ranges from 20 to 60 years. The average age is 43.13. in both Districts majority of the respondents age range falls between 41 to 50 years of age.

Table 9: Demographic Structure

Socioeconomic Characteristic			
Indicators	Percentage		
	Chickpea producers	Common bean producers	
		Damot Gale district	Boricha district
Age			
20 to 30	2.5	7.5	11.25
31 to 40	34.17	45	40
41 to 50	57.5	42.5	45
Above 51	5.83	7.5	3.75
Total	100	100	100

Source: Own Survey, 2016

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.

4.1.2 Livestock and land ownership

Land is the most important resource, as it is a base for any economic activity especially in rural and agricultural sector. And also is one of the scarce factors of production whose supply is considered fixed. Land holding was very small averaging from 0.68 to 0.75 hectare per household. The minimum and maximum land holdings were found to be from 0.125 hectare and 1.25 hectare, respectively.

The minimum and maximum land size under chickpea or common bean crop is 0.125 and 0.75 respectively whereas the average land size under chickpea or common bean crop is 0.28 and 0.33 respectively. This may mean that respondents assign smaller proportion of their land either to chickpea or common bean crop cultivation.

4.1.3 Legume/ Common Bean Production Practices

In Damot Gale district there are four types of chickpea crop varieties produced; Habru, Arerti, Natoli and the local variety. Among the respondents 97.5% of were found to planting improved chickpea producer and the rest 2.5% produces the local variety. Among this 97.5%, 84.2% produces Habru variety, 10% produces Arerti variety and the rest 3.3% produces Natoli variety. In the same district among the respondents 62.50% use improved common bean variety whereas the rest 37.50% are local variety users. There are also four common bean varieties; Nasir (42.50%), Hawasa dume (20%) and Red Wolaita /the local variety (37.50 %) (See appendix table 3).In Boricha district 55% of the respondents are improved seed users and 5% uses local variety. There are also four types of common bean variety among improved seed users; 17.50% uses Nasir, 32.50% uses Hawasa dume, 5% uses Ebado and 45% uses Red wolaita (See Appendix Table 2).

4.1.4 Chemical fertilizer, inoculants and weed and pest control measures

Two kinds of Chemical fertilizer are used by the farmers; DAP and NPS. The majority (90%) of the respondents apply chemical fertilizer to their farm lands. This implies most of the farmers use chemical fertilizer.

With regard to Inoculants application; there is a better inoculants application by chickpea producers 86.7%. In Borichas common bean producers only 22.5% are inoculants users 22.5%. Regarding weed and pest control measures only 6.3% of the farmers apply herbicide on their farm. 36.7% of chickpea producers apply fungicide to their common bean fields. 86.7% of chickpea producer respondents are the maximum pesticides users followed by 52.5% of common bean producers in Damot Gale district whereas only 6.3% of the respondents apply pesticide and 6.3% of common bean producers in Boricha district apply pesticide which is minimum scale. In focus group discussion farmers in Damot Gale district has been raising a rust problem which explains their pesticide use (see appendix table 3).

4.1.5 Credit access, development agent visit and Farm union membership

Access to credit is one way of improving farmers' access to new production technology. Among respondents Damot Gale farmers both chickpea and common bean producers have a better credit access 91.7 % and 90% respectively whereas in Boricha district only 21.25% of the respondents have access to credit. 78.75% do not have access to credit in Boricha district (See appendix table 4).

In Damot Gale district more than 97% of the respondents have development agents assistance whereas in Boricha district only 77.5% of the respondents have access the rest 22.5% do not have development agents assistance (See appendix table 4).

In Damot Gale there is one farm union; Damota wolaita farm union and in Boricha district there are two unions; Sidama Elito farmer union and Kayo common bean multiplier union.

3.7% of respondents in Boricha district are found to be the minimum farmer union member followed by 30% and 39.2% of common bean and chickpea producers in Damot Gale district

4.2 Factors Affecting Farmers' Preference for Adoption of Legume Technology Packages

4.2.1. Demographic, Economic and Institutional Variables Affecting Farmers' Adoption Preference for Legume Technology

Regarding Common Bean producers in Damot Gale District the regression analysis shows that, out of the four socio-economic variables age of HH (β=0.023, p= 0.005) and credit access have significant relationship with technology adoption preference. With respect to age, the regression result shows that age has a positive influence on adoption preference (See Table 10). Mostly it is assumed that as farmer age increases the probability of adoption is expected to decrease because as the farmer's age increases, it is expected that the farmer becomes conservative (Techane *et al.* 2006). Contrary to this the result shows positive relationship between age and adoption preference. The reason could be that older farmers have gained knowledge and experience over time and are better able to evaluate technology information than younger farmers (Mignouna *et al*, 2011; Kariyasa and Dewi 2011). Credit access (β=-0.104 p= 0.012) is negatively and significantly related to adoption preference of legume technology (See Table 10). During sample survey focus group discussion farmers stated problem of problem of loan repayment which might be due to knowledge gap of credit use. In Boricha district all the four socio-economic variables were found insignificant to technology adoption preference.

In case of Chickpea producers in Damot Gale district among the four socio-economic variables; age (β=0.011, p=0.036), credit access (β=0.557, p=0.000) and cooperative union membership (β=0.271, p=0.000) positively and significantly affects adoption preference of legume technology (See table 11). However, land holding in hectare (β=-0.335, p=0.028) negatively affects legume technology adoption preference (See table 11). The result goes in agreement with Etoundi and Dia (2008) study which pointed out that increasing the area

diminishes the probability of adopting the improved maize variety. The reason was that a big sown area with maize requires much manpower and huge resources. This may mean that Farmers without cash and no access to credit will find it very difficult to attain and adopt new technologies and farmer union member farmer farmers will have the exposure and access to agricultural technologies.

4.2.2 Regression Results of the Conjoint Profiles

Based on the regression result regarding common bean producers in Boricha district among seed Attribute types Awassa Dume seed variety (β=1.200, p=0.000), DAP (β=0.428, p=0.000) and 50% pre-payment (β=1.350, p=0.000) positively influences adoption preference while Fungicide (β=-.359, p=.000) negatively influences preference for adoption legume technology (See Table 10).

Table 10: Regression results of factors influencing adoption preferences for Common Bean legume technology

	Common Bean Producers							
	Boricha District				Damot Gale District			
Variables	Coefficient	S.E.	t-value	P-value	Coefficients	S.E.	t-value	P-value
Constant	2.246***	0.332	6.760	0.000	1.031***	0.336	3.063	0.002
Nasir	0.188	0.128	1.468	0.142	1.412***	0.136	10.386	0.000
Ebado	0.019	0.128	0.147	0.883				
Awassa dume	1.200***	0.140	8.579	0.000	1.175***	0.149	7.887	0.000
Red wolaita					1.150***	0.136	8.456	0.000
DAP	0.428***	0.095	4.521	0.000	0.181*	0.101	1.797	0.073
50% Payment	1.350***	0.114	11.820	0.000	0.525	0.122	4.316	0.000
Fungicide	-0.359***	0.095	-3.795	0.000	0.181	0.101	1.797	0.073
Land size	0.176	0.122	1.441	0.150	-0.142	-0.180	-0.787	0.432
Age	-0.009	0.008	-1.161	0.246	0.023***	0.008	2.828	0.005
Credit access	-0.124	0.114	-1.079	0.281	-0.104**	0.117	-0.890	0.012
Cooperative-union Membership	-0.203	0.240	-0.847	0.397	0.274	0.108	2.535	0.218
F-statistics, (df)	F(10 629), 16.696				**F-statistics (df)**	F(10 309), 16.677		
R^2 (Adj. R^2)	0.410 (0.397)				**R^2 (Adj. R^2)**	0.351 (0.330)		

Source: Own Survey, 2016

*Note: ***, **, and * are significant at 1%, 5% and 10% (two-tailed), respectively*

Regarding common bean producers in Damot Gale the regression analysis shows that among seed Attribute types Nasir (β=1.412, p=0.000), Awassa dume (β=1.175, p=0.00) and Red Wolaita (β=1.150, p=0.000) positively and significantly affects farmers adoption preference, this means that farmers prefer both all three varieties (Awassa dume, Nasir and Red Wolaita) however Nasir variety is the most preferred variety and this result goes in agreement with the findings of Alemitu (2011) who stated in her study of factors affecting adoption of haricot Bean improved seed variety (See Table 10). DAP (β=0.181, p<0.1), 50% pre-payment (β=0.525, p=0.000) and fungicide (β=0.181 p<0.1), also positively affects adoption preference.

Table 11: Regression results of factors influencing adoption preferences for Chickpea legume technology

CHICKPEA PRODUCERS				
Variables	**Coefficients**	**S.E**	**t.-value**	**P-value**
Constant	0.369	0.298	1.240	0.215
Habru	1.663***	0.081	20.479	0.000
Arerti	1.129***	0.081	13.910	0.000
Natoli	0.308***	0.081	3.798	0.000
DAP	0.038	0.057	.653	0.514
50% Pre-Payment	0.433***	0.057	7.549	0.000
With Fungicide	0.429***	0.057	7.476	0.000
Age	0.011**	0.005	2.103	0.036
Land holding (ha)	-0.342**	0.144	-2.378	0.018
Credit access	0.557***	0.105	5.285	0.000
Cooperative membership	0.271***	0.062	4.385	0.000
F-statistics (df)	F(10, 949), 69.861			
R^2 (Adj. R^2)	0.424 (0.418)			

Source: Own Survey, 2016
*Note: *** and ** are significant at 1%, and 5% (two-tailed), respectively*

In case of chickpea producers in Damot Gale district all legume technology Attribute types except DAP significantly affects adoption preference. With respect to Seed Attribute types Habru seed variety (β=1.663, p=0.000), Arerti seed variety (β=1.129, p=0.000) and Natoli seed variety (β=0.308, p=0.000) significantly and positively affects adoption preference for legume technology (See table 11). Habru seed variety is the most preferred and Natoli seed variety is the least preferred seed attribute. This may mean that improved chickpea varieties positively affect farmers' preferences. In other words, chickpea producing farmers prefer chickpea legume technology package with improved seed varieties of Habru, Arerti and Natoli in that order. 50% pre-payment (β=0.433, p=0.000) and fungicide (β=0.429 p<0.1), also positively affects adoption preference.

4.3. Conjoint Analysis Results

4.3.1. Chickpea Producers

4.3.1.1. Utility Estimate of Attribute type

Table 12 shows a direct relationship between seed Attribute type Habru and Arerti, this means that Habru and Arerti corresponds to higher utility where as Natoli and Local variety of chickpea are inversely related to utility, meaning Natoli and Local variety of chickpea corresponds to lower utility value. There is a direct relationship between fertilizer Attribute type DAP and utility, DAP corresponds to higher utility level where as there is inverse relationship between DAP and Inoculants and utility which means DAP and Inoculants corresponds to lower utility value.

Table 12: Utility estimate of Attribute type

Utility values			
Attribute	**Attribute types**	**Chickpea producers**	
		Utility Estimate	Std. Error
Seed	Habru	0.901	0.189
	Arerti	0.309	0.189
	Natoli	-0.453	0.189
	Local Variety	-0.757	0.189
Fertilizer	DAP	0.011	0.109
	DAP & Inoculants	-0.011	0.109
Payment	50 % Pre-Payment	0.199	0.109
	100% Pre-Payment	-0.199	0.109
Fungicide	With Fungicide	0.197	0.109
	Without Fungicide	-0.197	0.109
Constant		2.841	0.109

Source: Own Survey, 2016

There is a direct relationship between payment Attribute type 50 percent pre-payment and utility, meaning 50 percent pre-payment corresponds to higher preference (utility level) where as there is inverse relationship between 100 percent payment and utility which means 100 percent payment corresponds to less preferred (lower utility value).There is also a direct relationship between fungicide Attribute types with fungicide and utility, it corresponds to higher utility level where as there is inverse relationship between no-fungicide and utility which means no-fungicide corresponds to lower utility value.

Since the utilities are all expressed in a common unit, they can be added together to give the total utility of any combination. For instance a chickpea legume technology package's preferences score (utility score) of a profile number 7 with: seed Attribute type Habru; fertilizer Attribute type DAP; payment Attribute type of 50 percent pre payment and with fungicide is:

0.901+0.011+0.199+0.197 (Constant) = 1.308

The range of the utility values (highest to lowest) for each factor (attribute) provides a measure of how important the factor was to overall preference (See Table 12). Factors with greater utility ranges play a more significant role than those with smaller ranges (Gaurav and Anurag, 2015). According to this study, seed and fungicide have a greater utility ranges, and hence they are more important than fertilizer and payment for chickpea producing households preference for chickpea legume technology.

The relative importance of each factor known as an importance score or value is computed to identify which factor or product attribute is more important to farmers. The values are computed by taking the utility range for each factor separately and dividing by the sum of the utility ranges for all factors. The values thus represent percentages and have the property that they sum to 100. The calculations are done separately for each subject, and the results are then averaged over all of the subjects (See Table 12).

Table 13: Relative importance of attributes

Relative importance values of chickpea attributes	
Attributes	**Relative importance**
Seed	60.14
Fertilizer	9.47
Payment	14.65
Fungicide	15.74
Total	100.00

Source: Own Survey, 2016

Seed (Table 13**)** has the higher relative importance (60.14%). Considering the seed Attribute types (Table 10), Habru chickpea variety give more utility value to preference of

a chickpea legume technology (0.901), Arerti chickpea variety is the second most important variety (0.309). Local variety of chickpea (-0.757) have the least utility value whereas Natoli chickpea variety is the second least preferred variety (utility value).

Fungicide (Table 13) is the second most important attribute (15.74%). From the fungicide Attribute types (Table 10); farmers prefer (higher utility value) chickpea technology package which have fungicide (0.197) whereas chickpea technology package with no fungicide has been least preferred (lower utility value) by farmers (-0.197).

Payment (Table 13) is the third important attribute (14.65%). From the payment Attribute types **(**Table 12) 50 percent pre-payment give more utility value (0.199) than payment attribute of 100 percent payment (-0.199) for chickpea producing farm households.

Fertilizer (Table 13) is the least important attribute (9.47%). From fertilizer Attribute types DAP has a positive utility (0.011) and DAP and Inoculants (-0.011) has a negative value; which indicates that DAP is more preferable than DAP and Inoculants **(**Table 10). By computing the utility values of each Attribute types the total utility of the legume technology profiles scored by respondents were computed (Table 12).

As it is shown on the table (Table 12) the product profile number 6 (local variety of chickpea DAP, 100 percent payment and no fungicide) has got the least preference (utility value) from all the profiles. Profile 11 is the second least preferred. Whereas the product profile number 7 (Habru seed variety, DAP, 50 percent pre-payment and with fungicide) has got the highest utility value from all the profiles. Profile 10 is the second and profile 9, 1, and 2 has got the next highest utility value. In all the least profiles the seed variety level is local variety and in all the most preferred profiles the seed variety is Habru chickpea variety. Therefore we can argue that seed is more important than other attributes.

Table 14: Total utility score and rank of profiles

Profile Number	Chickpea producing HH	
	Total utility score	Rank
1	0.494	4
2	0.318	5
3	-0.466	9
4	-0.372	7
5	-0.440	8
6	-1.142	12
7	1.308	1
8	0.300	6
9	0.716	3
10	0.910	2
11	-0.770	11
12	-0.744	10

Source: Own Survey, 2016

4.3.2 Common Bean Producers

4.3.1.2. Utility estimate of Attribute type

Table 15 shows in Boricha district there is a positive relationship between seed Attribute type Nasir and Ebado with preference, this means that Nasir and Ebado corresponds to higher utility whereas in Damot Gale district there is a positive relationship between all seed attributes and utility except Hawasa dume seed attribute meaning in Damot Gale district Nasir, Red Wolaita and Ebado corresponds to higher utility level. In both districts Hawasa dume is inversely related to preference meaning Hawasa dume seed attribute of common bean corresponds to lower utility value but in Boricha district seed attribute Red Wolaita is also inversely related to preference (utility). Based on sample survey interviews with farmers, Ebado variety is characterized by higher selling price and from (Table 14) one can understand that payment is the second important attribute preferred by Boricha district farmers so in conclusion in Boricha district payment is a big constraint of farmers in adopting legume technology.

Table 15: Utility value

Attributes	Attribute type	Boricha district		Damot Gale district	
		Utility Estimate	Std. Error	Utility Estimate	Std. Error
Seed	Nasir	0.003	.000	0.544	0.097
	Hawasa Dume	-0.166	.000	-0.869	0.097
	Ebado	0.347	.000	0.044	0.097
	Red Wolaita	-0.184	.000	0.281	0.097
Fertilizer	DAP	0.044	.000	0.025	0.056
	DAP &Inoculants	-0.044	.000	-0.025	0.056
Payment	50% Pre-Payment	0.559	.000	0.200	0.036
	100% Pre-Payment	-0.559	.000	-0.200	0.036
Fungicide	With Fungicide	-0.009	.000	0.156	0.051
	Without Fungicide	0.009	.000	-0.156	0.051
Constant		2.866	.000	3.194	0.051

Source: Own Survey, 2016

Regarding fertilizer, in both districts there is a direct relationship between fertilizer attribute type DAP and utility, DAP corresponds to higher utility level where as there is negative relationship between DAP & Inoculants and utility which means DAP & Inoculants corresponds to lower utility value.

There is a direct relationship between payment Attribute type 50 percent pre-payment and utility, meaning 50 percent pre-payment corresponds to higher preference (utility level) where as there is inverse relationship between 100 percent payment and utility which means 100 percent payment corresponds to less preferred (lower utility value).

In both districts there is a direct relationship between fungicide attribute types a legume technology with fungicide and utility, it corresponds to higher utility level where as there is negative relationship between a legume technology with no-fungicide and utility which means no-fungicide corresponds to lower utility value. Since the utilities are all expressed in a common unit, they can be added together to give the total utility of any combination. For instance a common bean legume technology package's preferences score (utility score) of a profile number 10 with: seed Attribute type Nasir, fertilizer attributes types DAP; payment Attribute type of 100 percent pre-payment and with fungicide is:

0.003+0.044-0.559+0.009(constant) = -0.503……Boricha district

0.544+0.025-0.200+0.156 (Constant) = 0.525…….Damot Gale district

The same profile (profile number 10) in between the two districts gives different preference (utility level) of a common bean technology package. The range of the utility values (highest to lowest) for each factor (attribute) provides a measure of how important the factor was to overall preference.

Table 16: Relative importance of attributes

	Relative importance	
Attributes	Damot Gale district	Boricha district
Seed	60.53	38.16
Fertilizer	9.78	15.05
Payment	13.02	33.35
Fungicide	16.67	13.44
	100.00	100.00

Source: Own Survey, 2016

The relative importance of each factor known as an importance score or value is computed to identify which factor or product attribute is more important to farmers. The calculations are done separately for each subject, and the results are then averaged over all of the subjects (Table 16).

Seed (Table 16) has the higher relative importance (60.53% and 38.16%) in both Boricha and Damot Gale district respectively. Considering the seed attribute types (table 15), Ebado common bean variety (Table16) give more utility value in Boricha district (0.347), whereas Nasir gives highest utility in Damot Gale district (0.544) which is also supported by Alemitu (2011) study which states that based on its different attributes Nasir variety ranks first which also contradicts with the finding in Boricha district which is Nasir ranks second for Boricha district whereas (0.003) which indicates farmers preference can be defined as a factor of different technological, social and economic variables. Red Wolaita is the second preferred attribute type for Damot Gale district (0.281). Red Wolaita and Hawasa dume common bean variety is the least important variety (-0.184 and -0.869) in both Boricha and Damot Gale district respectively.

Fungicide (Table 16) is the second most important attribute (16.67%) for Damot Gale district. From the fungicide attribute types (Table16); farmers prefer (higher utility value) common bean technology package which have fungicide (0.156) whereas common bean technology package with no fungicide has been least preferred (lower utility value) by farmers (-0.156). Payment (Table16) is the second important attribute (33.35%) for Boricha district. From the

payment attribute types (Table16) 50 percent pre-payment give more utility value (0.559) than payment attribute of 100 percent payment (-0.559) for common bean producing farm households.

Payment (Table 16) is the third important attribute (13.02%) for Damot Gale district. From the payment attribute types **(**Table 16) 50 percent pre-payment give more utility value (0.200) than payment attribute of 100 percent payment (-0.200) for common bean producing farm households. Fertilizer is the third important attribute for Boricha district (15.05%). From fertilizer attribute types DAP has a positive utility (0.044) and DAP and Inoculants (-0.044) has a negative value; which indicates that DAP is more preferable than DAP and Inoculants (Table 16).

Fungicide (Table 16) is the least preferred attribute (13.44%) for Boricha district. From the Fungicide attribute types ((Table 16); farmers prefer (higher utility value) common bean technology package which no-fungicide (0.009) whereas common bean technology package with fungicide has been least preferred (lower utility value) by farmers (-0.009). Fertilizer (Table 16) is the least important attribute (9.78%) for Damot Gale district. From fertilizer attribute types paper DAP has a positive utility (0.025) and DAP and Inoculants (-0.025) has a negative value; which indicates that DAP is more preferable than DAP and Inoculants (Table 16).

By computing the utility values of each attribute types the total utility of the product profiles scored by respondents were computed for both districts common bean producing farmers (Table 16).

Table 17: Total utility score and rank of profiles

	Common Bean Producing HH			
	Boricha district		Damot Gale district	
Profile number	Total utility score	Rank	Total utility score	Rank
1	-0.59	9	0.16	7
2	-0.18	7	0.03	9
3	-0.78	11	-0.94	12
4	0.34	6	0.3	5
5	0.45	4	-0.8	11
6	-0.69	10	-0.05	10
7	0.6	3	0.93	1
8	0.87	2	0.06	8
9	0.94	1	0.42	3
10	-0.52	8	0.53	2
11	-0.8	12	0.21	6
12	0.43	5	0.35	4

Source: Own Survey, 2016

As it is shown on Table 17 for Boricha district the product profile number 12 (Red Wolaita variety of common bean, DAP and Inoculants, 100 percent payment and with fungicide) has got the least preference (utility value) from all the profiles. Profile 3 is the second least preferred. Whereas the product profile number 9 (Ebado seed variety, DAP, 50 percent pre-payment and with fungicide) has got the highest utility value from all the profiles. Profile 8 is the second and profile 7, 5, and 12 has got the next highest utility value. In all the least profiles the seed variety level is Red Wolaita and Hawasa dume variety and also payment is 100 percent. In all the most preferred profiles the seed variety is Ebado and Nasir common bean variety and 50 percent pre-payment. Therefore seed and payment are the first and second most important attribute than the other attributes.

From Table 17 the product profile number 7 (Nasir variety of common bean DAP, 50 percent pre-payment and with fungicide) has got the highest preference (utility value) from all the profiles. Profile 10 is the second most preferred profile. Profile 10 is the second and profile 9, 12, and 4 has got the next highest utility value. Whereas the product profile number 3

(Hawasa dume seed variety, DAP and Inoculants, 100 percent payment and with fungicide) has got the least utility value from all the profiles. In the most preferred profiles the seed variety level is Nasir. Therefore we can argue that seed is more important than other attributes.

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

The main theme of this study was to identify the factors and attributes that determine the farmers' preference for legume technology adoption. The study was conducted in Damot Gale and Boricha District, which is located in Wolaita and Sidama Zone of Southern Ethiopia respectively. In these areas, Common Bean and Chickpea (Damot Gale) is an important crop, which serves as a source of food and cash. A total of 240 sample households (120 Chickpea producers and 120 Common Bean producers) were selected from 4 kebeles of the each District were interviewed using structured interview schedule.

Qualitative data were collected using interviews with: 20 individual farmers, 6 development experts in the study area, 4 focus group discussions (FGD) with farmers where each group consisting 5 to 8 individuals, 4 interviews with NGO representatives who are involved in the distribution of inputs to farmers, and 4 individual interviews with (output) traders in the area.

The data analysis was done with the help of employing SPSS 20; The Conjoint analysis techniques was used to assess farmers' preference in their adoption decisions for legume technology packages in the study area and To analyze the key factors that influence farmers' legume technology preference in the study area. But measuring the impact of factors on consumers' preference is difficult. This is mainly because customers evaluate products not only from perspective of one factor rather from bundle of attributes and there is always trade off among attribute and their levels.

The major factors identified in this study that affect farmers' preference for legume technology packages are seed, fertilizer, payment and fungicides. The study has identified that regarding Chickpea producer farmers in Damot Gale District the relative importance among legume technology package seed is the most important factor, fungicide is the second important factor payment is the third and fertilizer is the last important factor. While measuring the combined effect of Chickpea legume technology package a package which is composed of Habru seed variety, DAP, 50 percent pre-payment and with fungicide is the most

preferred package whereas a package of local variety of Chickpea DAP, 100 percent payment and no fungicide) has got the least preferred. Habru and Arerti, fertilizer, fungicide and 50% pre-payment are directly related to preference whereas Natoli and Local variety, DAP and inoculants, no fungicide and 100 % pre-payment are inversely related to preference.

Regarding relative importance of Attribute type for Common Bean producers, Seed has the higher relative importance in both Districts, payment is the second most important attribute for Boricha District while fungicide if for Damot Gale District. Fertilizer is the least important attribute for both Districts. While measuring the combined effect of Common Bean legume technology package a package which is composed of (Ebado seed variety, DAP, 50 percent pre-payment and with fungicide) has got the highest utility in Boricha District and (Nasir variety of Common Bean DAP, 50 percent pre-payment and with fungicide) has got the highest preference) in Damot Gale District. In Boricha District Nasir and Ebado, DAP, 50 percent pre-payment and fungicide are positively related to preference whereas Hawasa dume and Red Wolaita, DAP and Inoculants, 100 percent payment and no fungicide are negatively related to preference. In Damot Gale District Nasir, Ebado and Red Wolaita, DAP, 50 percent pre-payment and fungicide are positively related to preference whereas Hawasa dume and Red Wolaita, DAP and Inoculants, 100 percent payment and no fungicide are negatively related to preference.

Regarding Common Bean producers in Damot Gale District the regression analysis shows that, out of the four socio-economic variables age of HH and credit access has significant relationship with technology adoption preference. With respect to age, the regression result shows that age has a positive influence on adoption preference. Credit access is negatively and significantly related to adoption preference of legume technology. In Boricha district all the four socio-economic variables were found insignificant to technology adoption preference. In case of Chickpea producers in Damot Gale district among the four socio-economic variables; Age, Credit access and Cooperative union membership positively and significantly affects adoption preference of legume technology. However, land holding in hectare negatively affects legume technology adoption preference.

5.2. Recommendation

These results have important implications for contextual variety development, Legume technology package development and targeted diffusion of improved varieties in Ethiopia. The findings of this research help agricultural bureau, NGOs and input suppliers in identifying the major factors and attributes of legume technology that influence farmers preference for legume technology.

The following are the major recommendations based on this study.

First, amongst the alternative Common Bean legume technology package profiles in Damot Gale District profile 7 which is composed of Nasir seed variety, DAP, 50 percent pre-payment and with fungicide is the most preferred. Whereas in Boricha District profile nine 9 which is composed of Ebado seed variety, DAP, 50 percent payment and with fungicide. Among the alternative Chickpea legume technology package profiles Chickpea producers in Damot Gale District most prefer profile 7 which is composed of Habru seed variety, DAP, 50 percent payment and with fungicide. From the result one can understand the subjective preference of farmers which need to be addressed in that order. The cultural background of farmers, ecological conditions, available technologies and manpower, and manyother factors constitute a context within which farmers decide to adopt an innovation so, differences need to be noted. For a better adoption a legume technology package should include farmers preferred attribute traits of the technology.

Second, based on result of relative importance of attributes for, seed is the most important factor that affects farmer's preference for legume technology package for both Chickpea and Common Bean producers in both Districts. Habru, Nasir and Ebado seed variety of Chickpea and Common Bean is the most preferred in Damot Gale and Boricha District respectively; therefore seed multipliers should focus on these seed variety supply. Agricultural research centers developing improved seed should enhance such seeds to resist rust there by reducing cost of fungicides.

Third, fungicide is the second most important factor in Damot Gale District and the third important factor in Boricha District; this might be due to the occurrence of rust that farmers stated during focus group discussion in Damot Gale District specially related to Chickpea Producers. So seed multipliers and agricultural bureau researchers should focus on enhancing seed attribute to be resistance to rust. Until then farmers should be able to get supply of fungicide in order to save their produce from loss.

Fourth, payment is the third important factor in Damot Gale District and the second important factor in Boricha District, so in both Districts there is a need for financial support. Ebado seed variety has been found to be the most preferred by farmers in Boricha District which might be due to the higher price of Ebado seed variety), during focus group discussion farmers stated loss of produce due to no rainfall (this means no capital for future production); therefore there is a serious need for finance in Boricha District but there was also knowledge gap of how to use credit service. Farmers should get awareness about the financial repayment methods or creating a partnership between financial institutes for credit access, the farmer and marketers (farmer unions) so that farmers get market and better price for their produce so that they can benefit and also repay their loan.

Fifth, fertilizer is the fourth important factor for both Chickpea and Common Bean producers in Damot Gale Ditstrict and is the third important factor in Boricha District, this might be because fertilizer is mostly supplied by government agricultural bureau and there is no problem of supply except payment problem. From the conjoint profiles, the most preferred profiles are composed of DAP whereas DAP and Inoculants combined has a negative relation with preference. However DAP and Inoculants are more productive than DAP alone. So to promote adoption of Inoculants there is a need for more farm demonstration for the farmer to observe the difference in productivity.

Lastly, for chickpea producers in Damot Gale District, Provision of facilitations to farmers who are non-members of cooperative unions that Cooperative union members are entitled and credit access may enhance the adoption of legume technology. Whereas regarding Common

Bean producers in Damot Gale District Credit is negatively related to legume technology adoption preference so, this calls for policy implications which are:

Further study of distinguishing between credits constrained and credit unconstrained farmers in order to explain the reason for the negative relationship of credit with legume technology package adoption preference.

There is a need for a longitudinal study to confirm consistency of the factors across multiple years. Such longitudinal data could give conclusive findings for generalization of broader future technology intervention. In general, the results might indicate that technology preference by smallholder farmers need to be considered in terms of packages where farmers might evaluate several attributes jointly for their adoption decision.

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7. APPENDICES

LIST OF APPENDIX TABLES

Appendix Table 1: Livestock land ownership

	Minimum	Maximum	Mean	SD
Total land size				
Common bean producers Bboricha district)	0.125	1.5	0.68	0.380
Common bean producers (Damot gale district)	0.5	2	0.75	0.291
Chickpea producers (Damot gale district)	0.38	1.25	0.69	0.203
Land under crop				
Common bean producers (Boricha district)	0.125	0.75	0.33	0.181
Common bean producers (Damot Gale district)	0.125	0.75	0.31	0.169
Chickpea producers (Damot Gale district)	0.125	0.75	0.28	0.120
Livestock no(TLU)				
Common bean producers (Boricha district)	0.7	5.73	2.39	1.277
Common bean producers (Damot Gale district)	0.96	4.9	2.77	1.031
Chickpea producers (Damot Gale district)	0.96	5.25	2.71	0.843

Source: Own Survey, 2016

Appendix Table 2: Varieties under Production

Improved seed use		Percentage		
		Common bean Boricha district	Common bean Damot Gale district	Chickpea Damot Gale district
Improved seed users		55%	62.50%	97.50%
Improved seed non-users/ Local seed users		45%	37.50%	2.50%
Total		100%	100%	100%
Type of improved seed				
Common bean variety	Chickpea variety	Common bean Boricha district	Common bean Damot Gale district	Chickpea Damot Gale district
Nasir	Habru	17.50%	42.50%	84.20%
Hawasa Dume	Arerti	32.50%	20%	10%
Ebado	Local variety	5%		2.50%
Red Wolaita/ local variety	Natoli	45%	37.50%	3.30%
Total		100%	100%	100%

Source: Own Survey, 2016

Appendix Table 3: Chemical fertilizer, Inoculants and Weed and Pest control Measures

	Percentage		
Chemical fertilizer use	Common bean Boricha district	Common bean Damot Gale district	Chickpea Damot Gale district
Chemical fertilizer users	90%	100%	98.30%
Chemical fertilizer non-users	10%	0	1.70%
Type of chemical fertilizer			
DAP	58.8	25	25.80%
NPS	31.2	75	72.50%
Non	10%	0	1.70%
Inoculants use			
Inoculants users	22.5	60	86.70%
Inoculants non-users	77.5	40	13.30%
Weed and Pest control methods use			
Herbicide			
Users	6.3	0	1.7
Non-users	93.7	100	98.3
Fungicide			
Users	7.5	25	36.7
Non-users	92.5	75	63.3
Pesticide			
Users	6.3	52.5	86.7
Non-users	93.7	47.5	13.3

Source: Own Survey, 2016

Appendix Table 4: Access to credit, Development agents visit and Farm union membership

	Chickpea producers Damot Gale district	Common bean producers Damot Gale district	Common Bean producers Boricha district
Credit Access			
Yes	91.7	90	21.25
No	8.3	10	78.75
Total	100	100	100

	Chickpea producers Damot Gale district	Common bean producers Damot Gale district	Common Bean producers Boricha district
Development Agent Visit			
Yes	100	97.5	77.5
No	0	2.5	22.5
Total	100	100	100

Farmer Union Membership

	Chickpea producers Damot Gale district	Common bean producers Damot Gale district	Common Bean producers Boricha district
Member Farmers	39.2	30	3.7
Non-Member Farmers	60.8	70	96.3
Total	100	100	100

Source: Own Survey, 2016

Appendix Table 5: Correlation test for Common Bean and Chickpea producers

Common bean producers					Chickpea producers		
Boricha district			Damot Gale district				
			Common bean				
Variables	Tolerance	VIF	Tolerance	VIF	Variables	Tolerance	VIF
Constant							
Nasri	0.667	1.500	0.667	1.500	Habru	.667	1.500
Awassa dume	0.556	1.800	0.556	1.800	Arerti	.667	1.500
Ebado	0.667	1.500	-	-	Natoli	.667	1.500
Red wolaita	-	-	0.667	1.500	-	-	-
DAP	0.909	1.100	0.909	1.100	DAP	1.000	1.000
50% pre-payment	0.667	1.500	0.667	1.500	50% pre-payment	1.000	1.000
With Fungicide	0.909	1.100	0.909	1.100	With Fungicide	1.000	1.000
Land holding (ha)	0.967	1.035	0.859	1.164	Land holding (ha)	.980	1.020
Age	0.917	1.091	0.837	1.195	Age of HH	.983	1.017
Credit access	0.929	1.076	0.906	1.103	Credit access	.971	1.030
Cooperative union membership	0.982	1.018	0.942	1.062	Cooperative union membership	.961	1.040

Source: Own Survey, 2016

Appendix 6: Survey Questionnaire

Analysis of Preference for the Adoption of Legume Technology: The Case of Chickpea and Common bean Producing Smallholder Farmers in Boricha and Damot Gale District of Southern Region.

M.Sc. Thesis Research

Survey Questioner

Prepared by Dagmawit Getachew (MSc. Student, Haramaya University)

Questionnaire No. .....

District .....

Dear respondent

I am Dagmawit Getachew from Haramaya University. I am conducting a research on the above title Analysis of Legume Technology Adoption: The case of chickpea and common bean producing smallholder farmers in Boricha and Damot Gale district of southern region to better understand farmers' technology package preference. This survey questionnaire is meant only for research purposes. Your response will be confidentially used for this purpose only. Thank you for your participation in this survey.

Part I. Background questions:

1. Age _____
2. Gender:
   a. Male ☐ b. Female ☐
3. Education status:

a) No formal education ☐
b) Elementary (1-6 years) ☐
c) High School (7-12 years) ☐
d) Secondary and above ☐
e) If others please specify_____

4. Family size of a household:_____
5. Number of household members under 14 years,_____
6. Livestock ownership:

No.	Type of livestock	Amount in number
1	Oxen	
2	Cow	
3	Donkey	
4	Horse	
5	Sheep	
6	Goat	
7	Chicken	

7. Are you a member to any cooperative in your area?
   a) Yes_____
   b) No_____

8. How much arable land do you have access to in 'TIMAD'?_____
9. How much did you cultivate last season in 'TIMAD'? _____
10. What is the ownership structure of your farmland?
    a) Personal land_____Timad
    b) rented land _____Timad
11. Did you plant Chickpea last season?
    Yes: ☐
    No: ☐
12. What is the size of your land in 'TIMAD' devoted forproduction of Chickpea last season? _____
13. How many different fields of Chickpea did you cultivate last season?_____

If more than one: The following questions apply to you main Chickpea field

14. Do you use improved seed?
    Yes: ☐
    No: ☐
15. If yes to Q 14, please state name of Planted variety

Chickpea variety:_____

16. What is the main source of seed of the Chickpea you planted last season?

f) Own seeds……

g) Other farmer…….

h) Government agriculture bureau ….

i) Local market…….

j) NGO, name……..

k) Farmers' union, name…….

17. If No to Q 14, why?
    a. Economic problem
    b. Lack of access to improved seed
    c. The local variety was more productive
    d. If other, please specify:_____

18. How many quintals of chickpea have you harvested per 'Timad' last season from the main field?

    Chickpea:_____

19. How was the production amount chickpea per your main field?
    a. Good
    b. Average
    c. bad

20. Did you plant common bean last season?

    Yes:

    No:

21. What is the size of your land in 'TIMAD' devoted for production of common bean last season? _____

22. How many different fields of common bean did you cultivate last season?_____

If more than one: The following questions apply to you main chickpea field

23. Did you use improved seed?

    Yes:

    No:

24. If yes to Q 23, please state name of Planted variety

    Common bean variety:_____

25. What is the main source of seed of common bean you planted last season?

    a. Own seeds……
    b. Other farmer…….
    c. c. Government agriculture bureau ….
    d. Local market…….
    e. NGO, name
    f. Farmers' union, name

26. If No to Q 23, why?

    a. Economic problem
    b. Lack of access to improved seed
    c. The local variety was more productive
    d. If other, please specify:_____

27. How many quintals of common bean have you harvested per 'Timad' last season?

    Common bean: _____

28. How was the production amount common bean per your main field?

    a. Good
    b. Average
    c. bad

29. Have you used Fertilizer in last season for chickpea cultivation on your main field?

    a. Yes:
    b. No:

30. Have you used Fertilizer in last season for common bean cultivation on your main field?

    a. Yes:
    b. No:

31. Which Fertilizer do you use?

    a. Green manure
    b. Animal manure
    c. Leaving residuals

d. DAP
e. NPS
f. If other, please specify _____

32. What is the main source of Fertilizer you used last season?
    a. Own farm..……
    b. Government agriculture bureau ….
    c. Local market…….
    d. NGO, name
    e. Farmers' union, name
    f. Other, name _____
33. Have you used Inoculants (bio fertilizer) in last season common bean cultivation on your main field?
    a. Yes:
    b. No:
34. Have you used Inoculants (bio fertilizer) in last season chickpea cultivation on your main field?
    a. Yes:
    b. No:
35. What is the main source of Inoculants (bio fertilizer) you used last season?
    a. Government agriculture bureau ….
    b. Local market…….
    c. NGO, name
    d. Farmers' union, name
    e. Other, name
36. Is anyone in your family working off-farm?
    a. Yes
    b. No
37. If Yes to Q 26; Please specify the major sources of Income for the household:
    a. Farm Income
    b. Off-farm employment income
    c. Trade

d. Other specify:

38. Did you use Pesticides in last season cultivation?
    a. Yes
    b. No
39. Did you use Fungicides in last season cultivation?
    a. Yes
    b. No
40. Did you use Herbicides in last season cultivation?
    a. Yes
    b. No
41. Do you get development agent assistance?
    a. Yes
    b. No
42. If yes to Q 42, how often?
    a. Once in a month
    b. Twice in a month
    c. Three times a month
    d. If other, please specify_____
43. Do you have a Credit access?
    a. Yes
    b. No
44. If yes to Q 44. Please specify the type of credit access_____

_____

45. Have you ever taken a credit (or loan in birr from any individual or institution?

    a) Yes_____ b) No_____

46. If yes to Q. 46, what is the amount of credit or loan in birr_____?
47. In the last successive three years, was there any environmental/agricultural problem?
    a. Yes
    b. No
48. If yes to Q 48, what was the problem
    a. Shortage of rainfall

b. Rust

c. If other, please specify

49. What kind of planting technique do you use?

a. broadcasting

b. Spacing/planting by row

c. Ridges

50. Please specify your choice for Q 50?

a. Less effort need_____

b. Lack of awareness_____

c. Seed saving_____

d. Higher crop yield_____

e. Facilitates weeding_____

f. If other, please specify_____

51. Actual use of Legume Technology

Measurement Instruments	**Measurement scale**				
How many times do you use improved variety seed?	1	2	3	4	5
How many times do you use Fertilizer (DAP)?	1	2	3	4	5
How many times do you use inoculants (bio fertilizer)?	1	2	3	4	5

Scale: 1----------2----------3----------4----------5

Not at all Once Twice For Last 3 Years All The Times

Part III. Conjoint analysis questions

We will show you 12 cards describing different Chickpea legume technology package. Please rate each card based on your preference on a scale from 1 to 5; 1 being least preferred and 5 being most preferred.

Profile Number 1

Card Number	Chickpea Seed	Fertilizer	Payment Option	Fungicide
1	Habru	DAP & Inoculant	Full Payment	Without-Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 2

Card Number	Chickpea Seed	Fertilizer	Payment Option	Fungicide
2	Arerti	DAP	Full Payment	With Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 3

Card Number	Chickpea Seed	Fertilizer	Payment Option	Fungicide
3	Natoli	DAP & Inoculant	Full Payment	With Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 4

Card Number	Chickpea Seed	Fertilizer	Payment Option	Fungicide
4	Local Variety	DAP & Inoculant	50 % Pre Payment	With Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 5

Card Number	Chickpea Seed	Fertilizer	Payment Option	Fungicide
5	Natoli	DAP	50 % Pre Payment	With-Fungicide

Least preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 6

Card Number	Chickpea Seed	Fertilizer	Payment Option	Fungicide
6	Local Variety	DAP	Full Payment	With-Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 7

Card Number	Chickpea Seed	Fertilizer	Payment Option	Fungicide
7	Habru	DAP	50 % Pre Payment	With Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 8

Card Number	Chickpea Seed	Fertilizer	Payment Option	Fungicide
8	Arerti	DAP & Inoculant	50 % Pre Payment	With-Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 9

Card Number	Chickpea Seed	Fertilizer	Payment Option	Fungicide
9	Arerti	DAP	50 % Pre Payment	With Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 10

Card Number	Chickpea Seed	Fertilizer	Payment Option	Fungicide
10	Habru	DAP	Full Payment	With Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 11

Card Number	Chickpea Seed	Fertilizer	Payment Option	Fungicide
11	Local Variety	DAP & Inoculant	Full Payment	With Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 12

Card Number	Chickpea Seed	Fertilizer	Payment Option	Fungicide
12	Local Variety	DAP	50 % Pre Payment	With-Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Part II. Variables to be included in conjoint analysis

We will show you 12 cards describing different CommonBean legume technology package. Please rate each card based on your preference on a scale from 1 to 5; 1 being least preferred and 5 being most preferred.

Profile Number 1

Card Number	CommonBean Seed	Fertilizer	Payment Option	Fungicide
1	Nasir	DAP & Inoculant	Full Payment	Without Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 2

Card Number	CommonBean Seed	Fertilizer	Payment Option	Fungicide
2	Ebado	DAP	Full Payment	With Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 3

Card Number	CommonBean Seed	Fertilizer	Payment Option	Fungicide
3	AwasaDume	DAP & Inoculant	Full Payment	With Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 4

Card Number	CommonBean Seed	Fertilizer	Payment Option	Fungicide
4	Red Wolaita	DAP & Inoculant	50% Pre Payment	With Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 5

Card Number	CommonBean Seed	Fertilizer	Payment Option	Fungicide
5	AwasaDume	DAP	50% Pre Payment	Without Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 6

Card Number	CommonBean Seed	Fertilizer	Payment Option	Fungicide
6	Red Wolaita	DAP	Full Payment	Without Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 7

Card Number	CommonBean Seed	Fertilizer	Payment Option	Fungicide
7	Nasir	DAP	50% Pre Payment	With Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 8

Card Number	CommonBean Seed	Fertilizer	Payment Option	Fungicide
8	Ebado	DAP & Inoculant	50% Pre Payment	Without Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 9

Card Number	CommonBean Seed	Fertilizer	Payment Option	Fungicide
9	Ebado	DAP	50% Pre Payment	With Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 10

Card Number	CommonBean Seed	Fertilizer	Payment Option	Fungicide
10	Nasr	DAP	Full Payment	With Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 11

Card Number	CommonBean Seed	Fertilizer	Payment Option	Fungicide
11	Red Wolaita	DAP & Inoculant	Full Payment	With Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Profile Number 12

Card Number	CommonBean Seed	Fertilizer	Payment Option	Fungicide
12	Red Wolaita	DAP	50% Pre Payment	Without Fungicide

Least Preferred Not Preferred Undecided Preferred Most Preferred
1----------2----------3----------4----------5

Appendix 7: Sample Survey questionnaire

Analysis of Preference for the Adoption of Legume Technology: The Case of Chickpea and Common bean Producing Smallholder Farmers in Boricha and Damot Gale District of Southern Region.

MSc. Thesis Research

Sample Survey questionnaire

Prepared by Dagmawit Getachew (MSc. Student, Haramaya University)

CASE STUDY PROTOCOL (CHECKLIST) FOR COMMONBEAN AND CHICKPEA PRODUCING FARMERS

I. GENERAL BACKGROUND INFORMATION:

1. Gender:

   1. Male ___ 2. Female____

2. Age: _____years

3. Education level

   1. Non- literate____2. Read and write___3. Elementary (1-6 years)____

   4. High School (7-12 years)____5. Others (specify)_____

4. Family size:_____

II. FARM CHARACTERSTICS AND ECONOMIC BACKGROUND

5. a. Size of total land holding in hectare _____

   b. do you have any rented land? 1. Yes 2. No

   c. how much in hectares _____

6. What are the three major crops that you produce?

	Crop type	Purpose	Area in hectare	Cultivated variety
1				
2				

3				

Purpose: 1. Home consumption cultivated variety: 1. Name of Improved variety

2. Cash or sale 2. Local variety

3. Sale and consumption

Others (specify)

7. Do you consider yourself?

a) Rich_____ b) medium_____ c) poor_____

8. Total annual income

	Average annual Income in br.(in a year)	Major three Source of income
1		
2		
3		

9. Income from off-farm activity

	Average annual non-farm Income in br.(in a year)	Major three Source of non-farm income
1		
2		
3		

Source: Labor employment, Sale of livestock product, Remittance, Others

10. Production Process Requirement for New Variety In Comparison With the Local Variety

No.	Type of activity	Additional effort or cost required		Ease of effort or minimized cost	
		Improved	local	Improved	local
1					
2					
3					
4					
5					
6					
7					

III. LABOR AVAILABILITY

11. Where do you get your labor?

a) Family members_____

b) Hired labor_____

c) Both_____

12. Do you face labor shortage? _____

a) If yes, how do you solve it?

_____

IV. SEED AND PRODUCTION

13. Have you ever planted improved varieties? _____

a) If yes how many varieties are there? Which one do you most and leastpreferred and Why?

_____

_____

b) If not, why not? What were the limiting factors in using improved varieties?

_____

_____

14. Do you think you will continue planting the improved variety?_____

a) If yes, why?

_____

_____

b) If no, why not?

_____

_____

15. What other inputs in combination with the improved variety do you use?

_____

_____

16. From where do you get the improved varieties?

_____

17. What are the three most preferred characters/traits of the seed you planted?

_____

18. How do you perceive yourself when adopting a technology?

19. What is the communities' perception of adopters?

V. TRAINING AND DEVELOPMENT AGENT VISIT

20. Do you get development agent visit? How often per month?

21. How do you evaluate the DA service?

High _____ Medium_____ Low__

____

22. Have you ever attended any agricultural training program?

VI. MARKET AND CREDIT

23. Where do you sell your product?

24. What are the most and least important markets?_____ _____

____

25. List the market and farm gate prices that you face

26. Do you have access to credit? If not, why?

CASE STUDY PROTOCOL (CHECKLIST) FOR DEVELOPMENT AGENTS

1. How often do you visit farmers with activities related to the adoption of new technologies?
2. Please characterize the farming system (tools, rainfall …) in your District.
3. What are the major farming problems in the District?
4. What are the potentials of the farmers in the District for adopting new technologies?
5. Were there any technology introductions to the farmer in the District?
   a) If yes what are they?
   b) Are they successfully adopted or not?
   c) If not why? What was the perception of farmers about the technology?
6. What kind of approaches do you use to introduce new technologies to farmers in your District?
7. In your opinion, what factors influence the level of the adoption of new technologies to farmers in your District?
8. Please characterize the ecological situation of the area (e.g. rainfall)
9. What are the farming problems in the District? What are the potential of the District for new technology adoption?_____
10. Are there any technologies introduced to the farmers in your District?_____
    a) If yes, what are they?
    b) Were they successfully adopted?
11. If not why? What was the major problem?
    What was the perception of farmers about the new technology?
    What kind of approaches do you use to introduce new technologies to farmers in your District?_____
    a. How often do you visit farmers in the process of new technology adoption?

CASE STUDY PROTOCOL (CHECKLIST) FOR AGRICULTURAL PRODUCE TRADERS

1. From where do you get your products?
   a. from farmers_____
   b. from the market_____
   c. If from farmers, are the products of good quality?_____
      _____
      _____
   d. If no, why not?_____
      _____
      _____

2. Which variety is most and least demanded in the market and why?_____
   _____
   _____

3. Do you get enough products to sell?_____
   a. If not, why?_____
      _____
      _____
   b. If yes, is there a demand in the market for your sells?_____
      _____
      _____
      _____

4. What are the three major problems you face in the market in relation with the products from farmers?_____
   _____
   _____

CASE STUDY PROTOCOL (CHECKLIST) FOR INPUT (E.G. SEED) DISTRIBUTORS (PRIVATE, GO AND NGOS)

1. What are the inputs that you provide to the farmer?What are their characters?
   _____
   _____
   _____

2. Which variety of seed is the most and least preferred by farmers and why?

   _____

   _____

   _____

3. How do you distribute these inputs? What are your distribution channels?

   _____

   _____

   _____

4. Do you have enough market (demand by farmers) to your input supply? If not why?

   _____

   _____

   _____

5. What problems are you facing in distributing these inputs?

   _____

   _____

   _____

CASE STUDY PROTOCOL (CHECKLIST) FOR FOCUS GROUP (FGD) DISCUSSION WITH FARMERS

1. What is the overall perception of farmers to new technology?
2. What kinds of technologies are provided to the farmer in this area?
3. Which technology do farmers adopt in this area?
4. what are the major three preferred qualities of a technology)
5. How do you evaluate a previous or an existing technology?
6. Does adopting a new technology require more effort and cost than not adopting?
7. Do farmers use the technology continuously or not? If not why did farmers drop out?
8. What is the communities' perception of adopter farmers in your area?
9. Do you think you will adopt a new technology in the future? Please explain

Appendix 8: Pilot Survey questionnaire report

Analysis of Preference for the Adoption of Legume Technology: The Case of Chickpea and Common bean Producing Smallholder Farmers in Boricha and Damot Gale District of Southern Region.

MSc. Thesis Research

Pilot Survey questionnaire report

Prepared by Dagmawit Getachew (MSc. Student, Haramaya University)

INTRODUCTION

Executive summary

Increasing agricultural productivity is a major challenge in Sub-Saharan Africa. To address the problems of food and nutrition insecurity, and to increase the incomes of rural households, productivity of smallholder farmers in Sub-Saharan Africa has to increase. A key component of improving agricultural productivity and therefore achieving food and nutrition security is the diversification and intensification of farming systems. Regarding the diversification of farming systems, grain legumes play a key role, as they are able to capture the infinite resource of transforming atmospheric gas into protein, address the food and nutrition needs of rural households, the crop residuals of those grain legumes also provide a high-quality feed for livestock, these residuals add nitrogen to the soils, which enriches exhausted soils and stimulates productivity of crops grown in rotation and Lastly grain legumes also provide an additional source of income (N2Africa, 2013; Shiferaw et al., 2008).

However, in order to make rural farmers reap the benefits of grain legumes and nitrogen fixation, research is necessary to investigate. A survey with an objective to collect data on smallholder farmers' legume technology awareness, agricultural practices, input (improved

seed, inoculants, fertilizer) use and preferences and individual and social factors in relation with legume technology adoption was conducted from October 26-30, 2015 in SNNPR Buge and Gacheno kebele and Sidamochale and Sheloelancho kebeles of Damot gale and Sidama zones respectively. These locations were selected based on their production potential of chickpea and common bean and as they target areas of the N2 Africa project.

The findings of the pilot survey will help in the construction of the formal surveys' identification of critical variables.

Survey objective

A pilot survey was conducted on legume (chickpea and common producing smallholder farmers) with the objective of setting baseline data for the indicators at farmers' preference of legume technology package, part-worth utility for different levels of attributes and farmers attitude.

The specific objectives of the pilot survey are:

- To better understand the farming system of the district and understand farmers' and communities perception of legume technology.
- identify major constraints and opportunities for scaling-up the adoption of legume technology and
- To identify variables for the formal survey

Selection of the study area and Participants

The survey was conducted in four kebeles of Damot gale and Boricha district of the SNNPRs which were purposely selected from both districts based on their potential for the production of chickpea and common bean and being the target areas of N2 Africa project.

Eight (4 at each district) development agents, four (2 at each district) stakeholders, 16 farmers from both districts has involved in individual interviews and 34 farmers involved in four focus group discussions.

Through individual interviews farmers were asked about general background information, farm and economic background, labor availability, improved seed access and production,

development agent visit and farm trainings, market and credit access and recent environmental problem.

Individual farmer interviews and the four focus group discussions were composed of mixture of chickpea and common bean producing farmers of different age and sex, sadly one was a woman.

At each district two focus group discussions were conducted. Each focus group discussions started with 8-10 individuals. The discussion covered legume technology awareness, input use, input preference and preferred traits and the limiting factors of non-adopters and quitters of legume technology.

Data collection method

The survey used qualitative data collection method. The data used for this study were collected from primary data. Separate questioners were designed for the farmers, development agents and stakeholder representatives and for the focus group discussions different ideas were given to the farmers to discuss on and to forward their ideas.

MAJOR SURVEY RESULTS

Legume production

Farmers in Damot gale district produce both Chickpea and common bean. There are two improved varieties of chickpea; Habru and arerti and local variety. In the last cropping season among interviewed farmers all planted Habru. There are two varieties of common bean; Painor and Nasir and a local variety called red wolayita. Among interviewed farmers in the last cropping season 50% planted Painor, 32% planted red wolayita and 16% planted Nasri. There is not enough supply of Nasri variety and most farmers prefer the local variety over Painor.

In Boricha district farmers only grow common bean there is no chickpea production. There are three improved varieties of common bean seeds; Nasri, Hawasa dume and Ebadu(Bure) and a local variety. In the last cropping season among interviewed farmers 30% planted Nasri, 30% planted Hawasa dume, 10% planted three times planted Nasri variety seed wheras 10% planted all three varieties in one plot and 20% planted Hawasa dume and Ebadu in a way of

reducing risk. Farmers stated their preferred traits of the three improved seeds; Ebadu (Bure) has first place in market with higher price, market demand and productivity was given for Hawasa dume and weight was for Nasri.

In Boricha district the mean common bean production is 26 quintal per hectare where as in Damot gale is 7.9 quintal per hectare of chickpea and 11 quintal per hectare of common bean. Farmers in both districts don't inter crop common bean or chick pea with other cereals. In addition to these legume crops farmers produce maize and sweet potato. Among interviewed farmers 70% uses own and family labor and in case of shortage they use "debo" for farm activities the rest fills the gap with hired labor.

All interviewed farmers stated that they get development agents' visits, trainings and farm demonstrations. In Boricha district 90% of the farmers evaluated the development agents service high, 10% has given them medium rank whereas in Damot gale district 60% of the interviewed farmers ranked their service high, 30% medium and 10% to be low which in other word shows a lower trust on the development agents.

Legume technology awareness

In focus group discussion when farmers were asked about their understanding of legume technology, they were able to discuss in detail. Regarding legume technologies use most farmers uses improved seeds with fertilizer (mostly DAP), Some uses improved seed, fertilizer (DAP), inoculants (bio-fertilizer) and spacing and the others uses local varieties with DAP, compost and farmyard manure.

Farmers stated the benefits of adopting legume technologies like increased productivity by using improved seeds with fertilizer and inoculants, seed and fertilizer saving by spacing, production of legumes with a better market demanded and price.

Even non-adopter farmers stated the benefits of adopting legume technologies which they have seen from their adopter neighbors. If any conclusion can be drawn from the data, farmers and the society have a good awareness about legume technology.

Input source, use and access

In Boricha district farmers are using a list of inputs in their cultivation. Among the interviewed farmers all uses DAP and compose, 50% uses inoculants (bio-fertilizer) , 90% uses improved seeds and 10% uses local varieties, 10% uses NPS (nitrogen phosphate sulfate) and 90% uses spacing.

In Damot gale district among interviewed common bean producing farmers all uses DAP and compost, 16% uses inoculants, 50% uses improved common bean seeds not because it is preferred rather because there is no other improved seed choice (sometimes the local variety (red wolayita) is more productive) and these 50% uses raw spacing.

In Damot gale district among interviewed chickpea producer farmers all uses DAP and improved variety (Habru), 33% uses inoculants and 50% uses spacing and compost.

Farmers in both districts can be categorized into two;

1. Farmers who are members of farmer unions: this farmers have access to improved seed, DAP, NPS and inoculants (even though the supply doesn't met the farmers need)
2. Farmers who are not-members of farmer unions: such farmers struggle to get input and sometimes they even plant 2nd or 3rd round planted improved seeds from other farmers and if impossible they plant local varieties.

Chickpea producing Farmers in Damot gale district stated a pest and rust problem in their production but does not have access to pesticides. In conclusion even if some farmers are using these technologies it is impossible to conclude that farmers have access to legume technologies because the supply doesn't meet their demand.

Market and credit availability

Farmers stated they face no market problem in other word there is enough demand in the market to accommodate their produce rather the problem arises with the price they receive. Union member farmers are not only benefiting from input access but also through market for their produce. These farmers get higher prices and also avoid price fluctuations by selling the product to farmers unions.

Whereas non member farmers struggle with low prices and price fluctuations. These farmers also stated that "because we sell to the marketer we face lower prices and we also sell our product just after harvest because we have to pay fertilizer debt and rent".

Regarding credit there is a contradicting fact which is farmers want to finance their investment (farmers) but they also don't want any credit. interviewed farmers try to avoid any dept by rejecting credit rather farmers prefer different payment option for input (improved seed, fertilizer and inoculants) supplies like; 25% down payment/75% after harvest, 50% down payment/50% after harvest and 0% down payment/100% after harvest.

In both districts among the interviewed farmers 50% sell their product to the market and the other to farmer unions. Non-member farmers if their economy grows in the future they want to join farmer unions in order to share the benefit.

Districts	Farmer Unions	Local markets
Damot gale district	Damota wolayita farmer union	Boditi, Sheno & Gacheno
Boricha district	Sidama elito farmer union	Moricha
	Kayo common bean multiplier union	Belela

*list of local markets and farmer unions

Problems of the district

No.	Problems	Damot gale district	Boricha district
1	Land shortage/a problem of access to land	×	×
2	Economic limitations	×	×
3	Lack of common bean improved seed	×	
4	Rust	×	
5	Lack of pesticide access	×	
6	Mismatch between farmers demand of inoculants and seed supply	×	×
7	Non-continuous supply of improved seed	×	×
8	Environmental problem: lack of rainfall	×	×

Variables to be included in conjoint analysis

- Seed variety

  (Habru, Arerti, Natoli and Local variety……..… for chickpea)

  (Nasir, Ebado, Awassa dume and Red wolaita……...for common bean)
- Fertilizer (DAP only and DAP and Innoculant)
- Fungicides (with fungicide and without fungicide)
- Payment option (50% pre-payment and 100 full payment)

Variables to be included in technology acceptance model

Variables related to the behavioral intention to use technology or to the actual use of technology could be grouped into four categories: individual context, system context, social context, and organizational context. While social context means social influence on personal acceptance of technology use, organizational context emphasizes any organization's influence or support technology use. Individual context refers to age, gender, risk perception or attitude of the farmer, assets and labor endowment, knowledge and education, farm size. The system context includes relative advantage, compatibility, complexity, trial ability, and observability. Based on the pilot survey I have selected the following variables to be taken as external variables that influence farmers' attitude towards legume technology.

External variables

1. Membership in cooperatives
2. Relative advantage: the degree to which a new technology is perceived as superior in comparison to the traditional one.
3. Access to improved seed
4. Access to inoculants
5. Cost of inputs (improved seed, fertilizer and inoculants)
6. Livestock ownership
7. Credit access

CONCLUSIONS

The important objectives of the pilot survey were to identify current legume (chickpea and common) production, legume technology application and to set baseline data for the

indicators at farmers' preference of legume technology package, part-worth utility for different levels of attributes and farmers attitude.

The result of the survey indicated that in Boricha district the mean common bean production is 26 quintal per hectare where as in Damot gale is 7.9 quintal per hectare of chickpea and 11 quintal per hectare of common bean. Farmers and the society have a good awareness about legume technology.

Majority of the farmers use DAP and compost but there are some limitation to the other inputs due to lack of access and economical limitations. Farmers face no market problem i.e. there is enough demand in the market to accommodate their produce but the problem arises with the price they receive. Union member farmer benefits from input access, they get higher prices and avoid price fluctuations by selling the product to farmers unions. Regarding credit there is a contradicting fact which is farmers want to finance their investment (farmers) but they also don't want any credit.

Farmers has stated Land shortage/problem of access to land, Economic limitations, Lack of common bean improved seed, Rust, Mismatch between farmers demand of inoculants and seed supply, Lack of pesticide access, Non-continuous supply of improved seed, and Environmental problem: lack of rainfall are among constraints reducing the productivity, limiting the adoption of legume technology.

Photos taken while conducting a pilot survey: