WERABE UNIVERSITY
COLLEGE OF AGRICULTURE AND NATURAL RESOURCE
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DEPARTMENT OF AGRICULTURAL ECONOMICS

FACTORS AFFECTING FARMERS' ROW PLANTING TECHNOLOGY ADOPTION ON WHEAT PRODUCTION IN DALOCHA WEREDA, SILTIE ZONE, CENTRAL ETHIOPIA

MSc THESIS

BY

KEDIR ABDELLA

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WERABE, ETHIOPIA

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THESIS SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL ECONOMICS, COLLEGE OF AGRICULTURE AND NATURAL RESOURCE, SCHOOL OF POSTGRADUATE PROGRAM DIRECTORATE, WERABE UNIVERSITY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS

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DECLARATION

I, the under signed student of Werabe University, Post Graduate Program in Agricultural Economics, declared that this Master Thesis is my original work and it has not been presented in any MSc/PhD thesis or any other purpose at any University.

Kedir Abdella

Student Name	Signature	Date

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ADVISORS' APPROVAL SHEET

As Thesis researcher advisor, we hereby certify that we have read and evaluated this research developed under our direction, by Kedir Abdella entitled as "Factors Affecting Farmers' Row Planting Technology Adoption on Wheat Production in Dalocha Werada, Siltie Zone, Central Ethiopia".

Abraham Ababiya (PhD) ____________ ____________

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BOARDS OF EXAMINERS APPROVAL SHEET

We, the undersigned, members of the Board of Examiners of the final open defense by having read and evaluated his/her thesis entitled "*Factors Affecting Farmers' Row Planting Technology Adoption on Wheat Production in Dalocha Woreda, Siltie Zone*, Central Ethiopia"and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirements for the degree in agricultural economics.

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DEDICATION

This thesis is dedicated to my wonderful wife, whose unwavering support, love, and encouragement have been my greatest source of strength throughout this journey. Your patience and understanding during this challenging process have made all the difference, and I am deeply grateful for your partnership. I also dedicate this work to my family, whose continuous support and belief in my abilities have inspired me every step of the way. Thank you for your love and encouragement, which have been essential to my success.

BIOGRAPHICAL SKETCH

The author, Kedir Abdella Mohammed, was born in *Meteya Dange Kebele* in *Siltie Zone* on 2 september, 1982. He attended his primary school in *Dange Lasho* and his secondary education and Preparatory school at *Dalocha* secondary High school in *Dalocha* town from 1997-1999. After he successfully passed the Ethiopian School Leaving Certificate Examination (E.S.L.C.E.), he joined Hawassa University in 2000 and graduated with the Degree of Bachelor of Science in Animal and range science in August, 2003. After he completed the first Degree, he was employed to Dalocha woreda Agricultural Office, 2004. In September 2015 he joined to Worabe University to pursue a study program leading to the Degree of Master of Science in Agricultural Economics.

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ACRONYMS AND ABBREVIATIONS

ATA	Agricultural Transformation Agency Bureau
CSA	Central Statistics Agency
FAO	Food and Agriculture Organization
FGD	Focused Group Discussion
GDP	Gross Domestic Product
GTP	Growth and Transformations Plan
HYV	High Yield Variety
ICARDA	International Center for Agricultural Research in the Dry Areas
CIMMYT	International Maize and Wheat Improvement Center
MoARD	Ministry of Agriculture and Rural Development
UNDP	United Nations Development Programme
USDA	United States Department of Agriculture

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ABSTRACT

Row plantation in Ethiopia can significantly increase wheat production and reduce seed consumption, thereby boosting the country's agricultural sector, which heavily relies on small holder farms. This study aims to assess the factors influencing the adoption of row planting technology among farmers in Dalocha Werada, Siltie Zone, Central Ethiopia, identify the factors influencing its intensity and identify major constraints preventing its adoption. A multi-stage sampling technique was used to select 140 wheat producers from three kebeles with high adoption rates of row planting technology. The research employed a cross-sectional study design, gathering data from primary and secondary sources, including official reports and structured household surveys. The analysis utilized descriptive statistics to summarize demographic and socio-economic variables, along with econometric models. The research used a double hurdle model to identify significant variables that influence wheat row planting technology adoption. The study found that out of 140 respondents, 48.57% adopted wheat row planting technology, with labor constraints being the main obstacle, affecting nearly half of respondents, leading to less efficient practices and increased manpower requirements. Distance from the market, Education levels, livestock ownership, access to credit, farm size, frequency of extension contact, and non-farm activity participation are key factors in the adoption decision. The study also revealed that market distance, education level, cooperative membership, access to improved seeds, training, and extension contact are important factors in extent of adoption. The analysis indicated that education, access to credit, access to improved seeds, cooperative membership, and extension service were pivotal in both the decision to adopt and the extent of adoption. To improve agricultural productivity and food security in Silte Zone, policymakers should implement interventions at three levels: input access, capacity building, and institutional support. These measures address key adoption barriers, such as market distance, education gaps, and weak cooperatives, while leveraging success factors.

Keywords: adoption , dalocha , double hurdle , row planting wheat

1. INTRODUCTION

1.1. Background of the Study

Production of sufficient food for the general population is the main challenge that most developing economies face in the world (FAO, 2018). In the developing world, the agricultural sector has a lion's share in poverty alleviation, ensuring food security, for GDP contribution, employment, and income generation. However, agricultural growth in sub-Saharan African countries, considered to be low and not much driven by technological change. (Vandercasteelen *et al*., 2018).

Agricultural policy of Ethiopia gives high priority to increasing food production through the encouragement of improved production technologies among smallholders. In order to increase the production and productivity of agricultural production, the use of modern agricultural technologies are very important, out of which fertilizer, high yielding variety and row planting of crops are the most important technologies to increase the level of crop production (Mekuria and Aynekulu, 2013). The low agricultural productivity could be attributed to many factors including land degradation, small farm size, recurrent drought and poor farm technology. Whereas much of the recent production growth is often attributed to area expansion, there is significant potential for increasing productivity of food crops in Ethiopia through the introduction of promising crop technologies (CSA, 2020).

Adoption of new agronomic practices such as row planting is a potential source for improving crop (e.g., wheat) yield. Though Ethiopian agricultural sector forms higher portion of the country's economy (e.g., contributes about 34% of GDP, 71% of employment, and 75% of the foreign earnings), it is heavily dependent on small holder farm (98%) that holds and cultivates small plot or hectare of land (Agricultural Transformation Agency, 2018).

Agricultural extension activities have been concerned with promotion, adoption and scaling up of wheat row planting technologies; and adoption of row planting is seen as some of the factors for wheat yield enhancement in the country. As a result, planting of wheat in rows has become one of the agronomic practices of smallholder farmers in the country (Berihun *et al.*, 2014).

Adoption of row planting by smallholders is considered one of the farming practices for improving wheat yield in the country. Compared to the traditional broadcasting system, row planting gives better yield with quality of the seed at harvesting period (Joachim *et al.,* 2013). Wheat is Ethiopia's second most consumed cereal, accounting for 11% of the national calorie intake. It is used in various human foods and as roof thatching material. Cultivated on 1,950,000 hectares, it produces 55,200,000 quintals with 28.307 qu/ha, ranking third in area after teff and maize (GAIN, 2022).

Wheat is an especially critical stuff of life for approximately 1.2 billion wheat dependent and 2.5 billion wheat consuming poor men, women and children who live on less than USD 2 per day; and for approximately 30 million poor wheat producers and their families If population growth continues at double the growth of wheat production, there will likely be serious difficulties in maintaining wheat food supply for future generations (CIMMYT, 2012).

The aim of study will try to identify factors that affect farmers' adoption and intensity of use of row planting technology on wheat production in the study area.

1.2. Statement of the Problem

Various studies have been conducted before in different parts of the country showing that, adoption of wheat row planting technology is constrained by different demographic, institutional and socio-economic factors by Wudu (2017); Mulatu *et al*. (2017); Tamirat *et al.*, (2019a) and Siyum *et al.* (2022). However, there was contradicting finding results for some variables in determining the adoption of different agricultural technology among different researchers subject to time and geographical regions. For instance: Mulatu *et al.*, (2017), reported that the variable age has a negative relationship with the adoption of row-planting wheat technology in contrast to him Hagos & Hadush (2017), found a positive relationship between the age of household and the adoption of wheat row-planting technology.

Dorosh and Rashid (2013) on their study found that the demand for wheat has been increased due to growing population, urbanization and the expansion of food processing industries in the country. If the country is to feed the rapidly growing population and meet the high demand, it needs to increase the production and yield of wheat. However, increasing yield requires successful adoption of improved agricultural technologies. One of the technologies is row planting method (agronomic practice) for increasing yield.

Tolesa et al. (2014) conducted a study on socio-economic and institutional factors limiting adoption of wheat row planting in Ethiopia, by applying logit model. The study found that improved seed, agricultural extension services, education, and livestock size are significantly affecting wheat row planting technology. The study showed that row planting of wheat crop better in midland and high land agro ecology than low land.

The study conducted by Bezabih (2012) to analyze factor affecting adoption and intensity of adoption of improved wheat production indicated that the relative influence of different variables on probability and intensity of adoption of improved wheat production sex of household head, education of household, ,attending training on improved wheat production, attending field day programs, conducting demonstration, frequency of extension agent contact with household, mass media exposure, farm income, farm size and ownership of livestock positively and significantly influenced adoption and intensity of adoption of improved wheat production.

Recent studies conducted in Ethiopia show that yields are very responsive to this improved practice. Row planting technologies were found to be very impressive in improving agricultural production and productivity specifically wheat yield at harvesting period. By comparison to the conventional broadcasting technique, for instance, Alemu *et al*. (2014) found on average of 14.6 percent higher wheat yields with row planting technology while Vandercasteelen *et al.* (2014) found an increase in *teff* yields between 12 and 13 percent in farmers' experimental plots and 22 percent in demonstration plots managed by extension agents.

The conventional planting method that is broadcasting seed by hand reduce yield because uneven distribution of the seeds makes hand weeding and hoeing difficult, and plant competition with weeds lowers wheat growth and not allow for better branching out (tillering) of wheat plants. This causes wheat yield reduction. However, row planting with proper distance between rows and plant density allows for sufficient aeration, moisture, sunlight and nutrient leading to proper root system development (Dinssa *et al*, 2016).

Low rates of technology adoption, varying widely across countries due to factors like soil quality and market conditions, contribute to the weak link between agricultural productivity and rural poverty reduction (Tamirat & Abafita , 2019).

The study on row planting adoption in Dalocha Wereda need to be contextualized within Ethiopia's national agricultural policies, particularly the Growth and Transformation Plan (GTP) and the Ministry of Agriculture and Rural Development (MoARD) initiatives, which have prioritized row planting as a key strategy to boost crop productivity. The Agricultural Transformation Agency (ATA) has actively promoted row planting through large-scale campaigns, citing evidence of 70% yield increases in teff (ATA, 2018) and 30% productivity gains in wheat (MoARD, 2012). Despite these efforts, the persistence of traditional broadcasting methods in the study area highlights a critical policy-implementation gap.

This disconnect underscores the study's relevance: while national policies and research (e.g., MoARD's findings on seed efficiency and yield gains) provide a strong rationale for scaling row planting, local adoption remains low. The study thus bridges a key research gap by investigating why farmers in Dalocha Wereda resist adoption despite proven benefits and government investment. By aligning its findings with ATA's campaigns and MoARD's data, the study can offer actionable insights to refine policy outreach like addressing site-specific barriers (e.g., access to tools, training) that hinder adoption in the study area.

Existing literature lacks empirical evidence on the extent of adoption, influencing factors, and constraints to adoption. While varietal adoption is studied, row planting's adoption rate and intensity in Dalocha remain unquantified and factors that limit adoption decision of the wheat row planting technology are not well assessed. Therefore, This study aims to fill these gaps by evaluating adoption status and analyzing determinants affecting farmers' decisions.

1.3. Research Questions

i. What is the current status of wheat row planting technology among farmers' in the study area?
ii. What are the factors affecting farmers' decision to adoption of wheat row planting technology in the study area?
iii. What are the factors affecting intensity of wheat row planting technology in the study area?
iv. What are the major constraint of adoption of wheat row planting technology in the study area?

1.4. Objective of the Study

1.4.1. General Objective

The general objective of this study **will be** to assess factors affecting row planting technology adoption decisions and intensity of farmers' on wheat production in Dalocha Wereda, Siltie Zone, Central Ethiopia.

1.4.2. Specific Objectivess

The specific objectives of the study were:

i. To assess current status of use of row planting technology **adoption** decisions among farmers' on wheat production in the study area
ii. To identify factors influencing the adoption decisions of wheat row planting technology among farmers in the study area for wheat production.

iii. To identify factors influencing the intensity of wheat row planting technology among farmers in the study area for wheat production
iv. To identify major constraint of adoption of wheat row planting technology in the study area.

1.5. Scope and Limitations of the Study

This study investigates the adoption and intensity of row planting technology among wheat farmers in Dalocha Woreda, Siltie Zone, focusing on three representative kebeles (Nadugna Iola, Golecheba, and Aebot). The study used a cross-sectional, farmer-centric, and focuses on household-level decision-making rather than broader market or policy dynamics. The study's single-time survey may not offer long-term adoption trends, may be biased due to its focus on high-adoption kebeles, overlooking low-adoption areas, and not measuring yield or income changes. It aligns with Ethiopia's GTP-II and ATA's row-planting targets for wheat and provides baseline data for future longitudinal studies on adoption impacts.

1.6. Significance of the Study

The study explores the factors influencing farmers' adoption of row planting technology for wheat production in Dalocha Wereda, Siltie Zone, Ethiopia. It informs Ethiopia's GTP-II and ATA's Agricultural Modernization, aids local extension strategies, and provides practical benefits for stakeholders. The findings help identify cost-effective solutions, guide investment in high-impact areas, and advance adoption theory. The study also bridges the policy-farmer gap, exploring why national row-planting initiatives fail to translate into local adoption.

1.7. Organization of the Research

The study contains of three main chapters the first chapter covers the introduction of the study openhanded the background of the study and the study area, statement of the problem, basic research questions, objectives of the study, significance of the study, the scope of the study and limitation of the study. The second chapter deals with the review of the literature, discussion and findings from the literature as well as the conceptual framework of the research. The third chapter is the research methodology. The fourth chapter is about results and discusions and the fith chapter is bout summary, conclusion and recommendations.

2. LITERATURE REVIEW

2.1. Theoretical Reviews

2.1.1. Definition of Row Planting

Loevinsohn *et al*. (2013) define **technology** as the means and methods of producing goods and services, including methods of organization as well as physical technique. According to those authors new technology is new to a particular place or group of farmers, or represents a new use of technology that is already in use within a particular place or amongst a group of farmers. Technology is the knowledge/information that permits some tasks to be accomplished more easily, some service to be rendered or the manufacture of a product.

Row planting as applied in conventional horizontal farming or gardening is a system of growing crops in linear pattern in at least one direction rather than planting without any distinct arrangement. According to Agricultural Transformation Agency (ATA, 2018), **planting in row** helps to reduce plant density and eases weeding, spraying and fertilizer application, making for fewer but stronger plants, producing more stems and grain. It can also help prevent plants from falling over, a common problem with wheat. Another huge advantage for farmers is the reduced cost of seed due to the smaller volume required. Row planting technology involves the growing of plants on a plot of land with sufficient space between each of the plants so that they can develop their roots and shoots more fully.

Operational Definition of Row Planting

Row Planting refers to an agricultural planting method where seeds or seedlings are systematically sown in straight, evenly spaced lines (rows) with consistent intra-row and inter-row spacing. This technique ensures optimal plant population density, efficient use of space, and better access to sunlight, water, and nutrients compared to traditional broadcasting or random scattering of seeds.

According to Khadka, & Raut(2012) also enough spacing between the plants and sowing of two seed grains at one point facilitates needed moisture, aeration, nutrition, and light to the crop roots, as a result; helps faster growth of plants and productivity as well. It is antonyms to the traditional broadcasting sowing method that contributes positively to the low crop yield.

2.1.2. Definition and Concept of Adoption

Adoption process is the change that takes place within individual with regards to an innovation from the moment that they first become aware of the innovation to the final decision to use it or not. However, as emphasized by (Ray, 2001), adoption does not necessarily follow the suggested stages from awareness to adoption; trial may not be always practiced by farmers to adopt new technology. Farmers may adopt the new technology by passing the trial stage. In some cases, particularly with environmental innovations, farmers may hold awareness and knowledge but because of other factors affecting the decision making process, adoption may not occur.

Operational Definition of Adoption Process

The adoption process refers to the series of stages through which an individual (e.g., farmer, household, or firm) progresses from first learning about an agricultural innovation (e.g., row planting, improved seeds, or new livestock breeds) to ultimately deciding to use it regularly. This process is typically measured by behavioral change integrating the innovation into routine practice and is influenced by socioeconomic, institutional, and psychological factors.

Feder *et al.* (1985) define **adoption** as the integration of an innovation into farmers' normal farming activities over an extended period of time. It is also 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. This is because there might be the availability of another practice that is better in satisfying farmers' needs.

Rogers (1983) define diffusion (aggregate adoption) as the process by which a technology is communicated through certain channels over time among the members of a social system. This definition recognize the following four elements: (1) the technology that represents the new idea, practice, or object being diffused, (2) communication channels which represent the way information about the new technology flows from change agents (extension, technology suppliers) to final users or adopters (e.g., farmers), (3) the time period over which a social system adopts a technology, and (4) the social system.

Adoption decision involves the choice of how much resource to be allocated to the new technology and the old technology if the technology is not divisible (like mechanization, irrigation). However, if the technology is divisible (like improved seed, fertilizer, row planting and herbicide), the decision process involves area allocation as well as intensity of use of the technology (Feder, *et al*., 1985). Therefore, the process of adoption includes the simultaneous choice of whether to adopt or not to adopt and the intensity of use of technology and its measurement of intensity of use needs to identify whether the technology is divisible or not.

Operational Definition of Adoption Decision

Adoption decision refers to a farmer's binary choice (yes/no) to use a specific agricultural innovation (e.g., improved seeds, row planting, or new livestock breeds) after evaluating its perceived benefits, costs, and risks. This decision is the critical transition point between awareness and actual trial of the technology.

The intensity of divisible technologies can be measured at the individual level in a given period of time by the share of farm area under the new technology or quantity of input used per hectare in relation to the agricultural research recommendations (Feder, *et al.,* 1985). On the other hand, the extent of adoption of non-divisible agricultural technologies such as tractors and combine harvesters at the farm level at a given period of time is dichotomous (uses or not use) and the aggregate measure becomes continuous. Aggregate adoption of a non-divisible technology can be measured by calculating the percentage of farmers using the new technology within a given period of time.

2.2. Analytical Frameworks of Row Planting Technology Adoption

This study employs three complementary theoretical frameworks to comprehensively analyze the factors influencing farmers' adoption of row planting technology in wheat production across Dalocha Wereda. These frameworks provide distinct but interconnected lenses through which to examine the adoption process, from individual decision-making to broader social and institutional contexts.

Rogers (2003) seminal framework helps explain how row planting technology spreads through farming communities. The theory identifies five stages of adoption: knowledge (initial awareness), persuasion (forming attitudes), decision (adoption or rejection), implementation (first use), and confirmation (continued use or discontinuation). In the context of Dalocha Wereda, this framework is particularly valuable for understanding why some farmers adopt row planting while others resist, despite similar exposure to extension services. The theory's five perceived attributes of innovations - relative advantage (yield improvements), compatibility (fit with existing practices), complexity (ease of use), trialability (ability to experiment), and observability (visible results) - provide a structured way to assess farmers' evaluations of row planting technology. For instance, the relative advantage of row planting in wheat production (documented by MoARD, 2012) may be weighed against its complexity in terms of labor requirements and skill needs.

Ajzen (1991) Theory of Planned Behavior offers a psychological perspective on adoption decisions by examining three key determinants: attitudes toward the behavior, subjective norms, and perceived behavioral control. In Dalocha Wereda, farmers' attitudes toward row planting may be influenced by their beliefs about its outcomes (e.g., increased yields versus increased labor demands). Subjective norms capture the social pressures farmers' experience, such as expectations from extension agents or observations of peers' success with the technology. Perceived behavioral control reflects farmers' assessments of their ability to implement row planting, considering factors like access to tools, training, and suitable land. This framework is particularly relevant for understanding why some farmers, even when aware of row planting's benefits (through DOI's knowledge stage), may still choose not to adopt due to perceived obstacles or social influences. The TPB helps bridge the gap between knowledge and action that is often observed in agricultural technology adoption.

The Sustainable Livelihoods Framework provides a holistic perspective by examining how farmers' livelihood assets influence their capacity to adopt new technologies. The framework's five capital assets - human (skills, knowledge), natural (land, water), financial (income, credit), physical (tools, infrastructure), and social (networks, cooperatives) - offer a comprehensive way to analyze adoption constraints in Dalocha Wereda. For example, even when farmers have positive attitudes toward row planting (TPB) and recognize its advantages (DOI), limitations in financial capital (for purchasing seeders) or physical capital (lack of appropriate tools) may prevent adoption. The SLF is particularly valuable for connecting micro-level adoption decisions with macro-level policy interventions, such as Ethiopia's Agricultural Growth Program (AGP) and the role of local cooperatives in facilitating technology access. This framework helps explain why adoption rates may vary even within the same wereda, as farmers possess different combinations of these livelihood assets (Solesbury, 2003).

2.3. Empirical Studies on Factors Affecting Technology Adoption

Simtowe *et al.* (2016) found that age of household head positively and significantly affect adoption of improved varieties. They explains that older farmers face higher search costs for information on new technologies which reduces their exposure, once they overcome the information barrier, older farmers are quick to adopt them because they have a higher resource endowment than young farmers and also older farmers are able to purchased improved seed for which young farmers cannot due to financial constraints. Young people have more viable options or alternative investments hence may delay adoption of improved varieties.

Wudu (2017) examined the factors that influence the adoption of enhanced wheat technology in the Gozzamen district, east Gojjam of Amhara regional state. The logit model was employed to analyse the factors that determine the adoption of improved wheat technology. The result of the logit model indicates that the variables such as contact extension agent, off-farm income, crop income, education, farm size, total active household labor in man equivalents, and availability of inputs were statistically significant and positively influenced the adoption of improved wheat technology, whereas age and market distance were found to have a significant and unfavourable impact on the decision. Dinku & Beyene (2019) employed the Tobit model to analyse the determinants of adoption and intensity of use of row planting for wheat production in the Munesa district of the Oromia Region. They discovered that the acceptance and intensity of the use of row planting for the production of wheat are positively and significantly influenced by factors such as education level, labor availability, extension contact, credit utilization, participation in training, and access to better seed. The result of the logit model shows that the variables such as the household head's age, level of education, number of children in the household, size of the cultivated land, livestock holding, and use of credit and extension services have a significant impact on the adoption of wheat row planting technology (Tamirat et al., 2019).

A study conducted by Siyum et al. (2022), in the Meket district of Amhara National Regional State in northern Ethiopia, employed a double hurdle model to examine factors influencing the adoption of improved bread wheat technology. The result indicates that the number of oxen in the household, cell phone ownership, the level of education of the head of the household, and access to extension services The observed patterns of technology adoption are also typically influenced by education level of household head.

Alene *et al*. (2000) on adoption and intensity of use of improved maize varieties in the central highlands of Ethiopia also found education level of the household head correlated positively and significant with adoption of technology. These studies explained that more educated farmers are able to access information on a given technology and understand and asses the attributes of that technology compared to less educated farmers.

Tadele (2016) and Yonas (2014) study on adoption of row seeding technology in Ethiopia reported that, probability of farmers to adopt and the level of adoption of row planting are positively and significantly affected by family size. Family size is used as a measure of labor availability which determines agricultural technology adoption process in that, larger families have the capacity to relax the labor constraints required during introduction of new agricultural technology.

Berihun *et al*. (2014) on their adoption decision of chemical fertilizer and HYV study found that, access to credit is one best option whereby smallholders could be instigated in diversifying their economic base; and it is statistically significant in determining the adoption decision of chemical fertilizer and HYV. As a liquidity factor, the more farmers have access to source of finance, the more likely to adopt agricultural technologies that could possibly increase crop yield.

Different studies by different authors also found that access to market is another important factor that needs to be considered while dealing with technology adoption. Access to markets is not only needed as an outlet for production but also as a means of securing inputs. Farmers need something to do with their increased output. If there are no markets that can bear the extra supply, their investment in new agricultural technologies will be for nothing (Andrei, 2017).

In addition, Paudel and Matsuoka (2008) reported that distance to the market is an important determinant of adoption for farmers producing bulky commodities because of transportation and infrastructure challenges. Poor infrastructure like roads raises transportation costs and as such farmers closer to markets are more likely to adopt improved technologies of bulky crops like soybeans.

Berihun *et al*. (2014) found on their study, distance to the nearest market center have significant and negative effect on adoption of chemical fertilizer and HYV in Southern Tigray, Northern Ethiopia. Beyan (2016) also found similar results.

Extension service access is a very crucial institutional factor that differentiates adoption status among farmers. Studies suggest the likelihood that a farmer will continue using an agricultural technology is related to the frequency of contact with trained extension workers, especially for technically complex technologies, contact with neighboring farmers who possess knowledge of the proposed technology also increases the likelihood of adoption (Andrei, 2017).

Exposure to information about new technologies as such significantly affects farmers' choices about it. Kapalasa (2014) study on adoption of improved soybean varieties in Malawi, Tolosa (2014) study on factors limiting adoption of wheat row planting technology in Ethiopia,

Berihun *et al*. (2014) and Paul *et al*. (2014) study on adoption intensity of soil and water conservation practices by smallholders in from Northern Ghana, and Khosla *et al*. (2015) adoption intensity of agricultural technology in Nepal are reported that farmer frequency of extension contact has positive and significant influence on agricultural technology adoption. They explains that farmers with access to information through contacts with extension workers are the ones who are more likely to adopt improved practice than who are not got access to extension service.

Martey *et al*. (2019) study on fertilizer adoption and use intensity among smallholder farmers in northern Ghana found positive and significant influence of farmer membership to association on fertilizer adoption. They argued that farmer membership to an association let them to access inputs easily with an affordable price that is pertinent to increase agricultural production and thereby increase technology adoption.

Raju *et al*. (2015) and Abreham *etal.*(2014) reported that farmer membership of farmer group/association has positive and significant effect on adoption intensity of agricultural technology. They explained that farmers' exposure to various information sources is able to analyze the risks, benefits and take advantage of new innovations.

The use of new agricultural technology is directly or indirectly related with the level of income of the farm households. The direct relation is most of the time due to the better purchasing power of the higher income induces an improved access to technologies available. Rich farmers are usually observed as the first movers to try new technologies and better risk taking behavior in technology uptake(Mwania *et al*., 1989).

However, Tolosa *et al*. (2014) study on impact of wheat row planting on yield of smallholders in selected highland and lowland areas of Ethiopia reported that income from off-farm is negatively affect technology adoption .He explains that farmer are not willing to use time and labor consuming wheat row planting practice. In addition to off-farm activities which generate income for households, livestock ownership is another important source income.

Leake *et al*. (2015) and Tolosa (2014) on their study in Ethiopia reported that livestock ownership (sometimes a proxy for wealth accumulation) is found to positively and significantly influence the adoption decision. They argued that livestock increases household income from sale of animals and farmers can finance their agricultural requirement (purchase of inputs like fertilizer, herbicide, etc.) easily from their livestock income.

2.4. Conceptual Framework of the Study

Adoption decisions of different technologies across space and time are influenced by different factors and their associations. Factors such as personal and demographic, socioeconomic, institutional and psychological factors determine the probability of adoption of wheat row planting technology. It is obvious that different studies have been conducted to look into the direction and magnitude of the influence of different factors on farmers' adoption decision of agricultural technologies. A factor, which is found to enhance adoption of a particular technology in one locality at one time, was found to hinder it or to be irrelevant to adoption of the same technology in another locality. Hence, the following conceptual structure showed the most important variables expected to influence the adoption of wheat row planting technology considering the study area specifically.

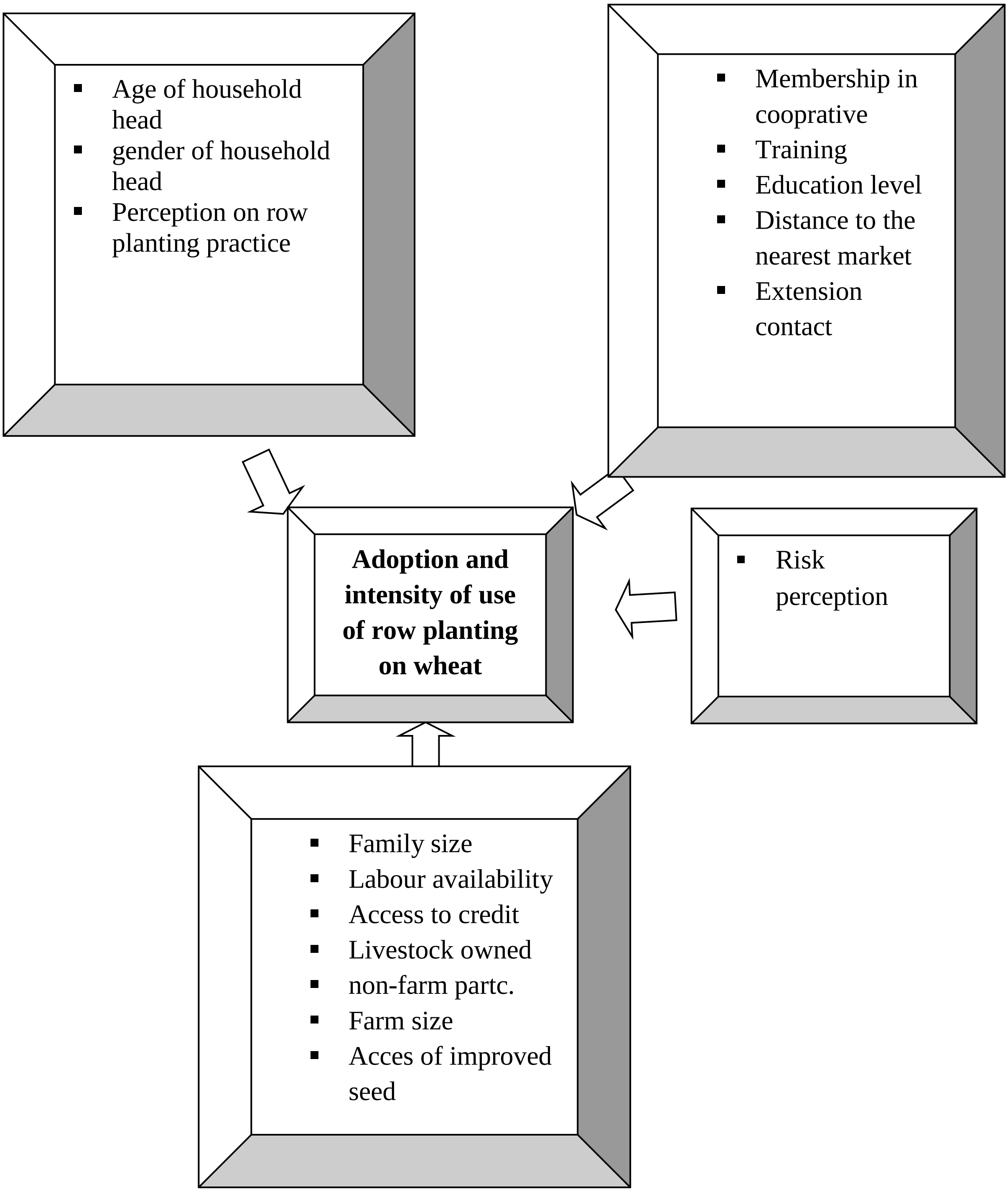

Figure 1: Conceptual frameworks of the study

Source: Own computation based on review of related literature

3. RESEARCH METHODOLOGY

3.1. Description of the Study Area

The study were conducted in dalocha woreda of Siltie zone cetntral Ethiopia region. Dalocha woreda is located in the Silte zone, cetntral Ethiopia region. The area is situated between 38° 8' 1 0'' - 38° 20' 24.00'' E longitude and 38° 0' 74'' - 52° 0' 74''N latitude. Dalocha woreda is found at the distance of 186 km from Addis Ababa through Butajera and and this woreda was bordered by Sankuru in South, by Hulbareg in West, by Silte, in north, by Lanfaro and Mito woreda in east direction.

According to the 2007 data of central statistical authority of Ethiopia Dalocha Woreda has an estimated total population of 120491 of which 60512 are male and 59979 are female. Siltigna is spoken as a first language by 97.41%, and 2.14% spoke Amharic; the remaining 0.45% spoke all other primary languages. Concerning education, 22.74% of the population was considered literate, 24% of children aged 7-12 were in primary school, 42% of the children aged 13-14 were in junior secondary school, and 11.26% of the inhabitants aged 15-18 were in senior secondary school. The mean annual rainfall in the area is about 918.8 mm and the rainfall is seasonal, varying in depth, space and time. The rainfall pattern is bi-modal in nature and the short rains come in March to May, while the long rains come from June to September. From the long-term climatic data, the maximum annual mean temperature is 28.5°C and a minimum annual mean temperature is 13.87°C the average altitude of the woreda ranges between 1000-1980 m.a.s.l.

The woreda is characterized by mixed farming system where crop and livestock production are the main activities, where crops play the dominant role in terms of contribution to farmers income. Major crops produced for food consumption as well as for income source in the area are wheat, barley, maize, bean, pea, haricot bean, beetroot, potato, tomato, pepper, onion, garlic, cabbage, and some other garden spices. Furthermore, oxen and sheep fattening are very common serving as an alternative source of income generating strategy of farmers in Siltie zone (Dalocha woreda Agriculture Office, 2022).

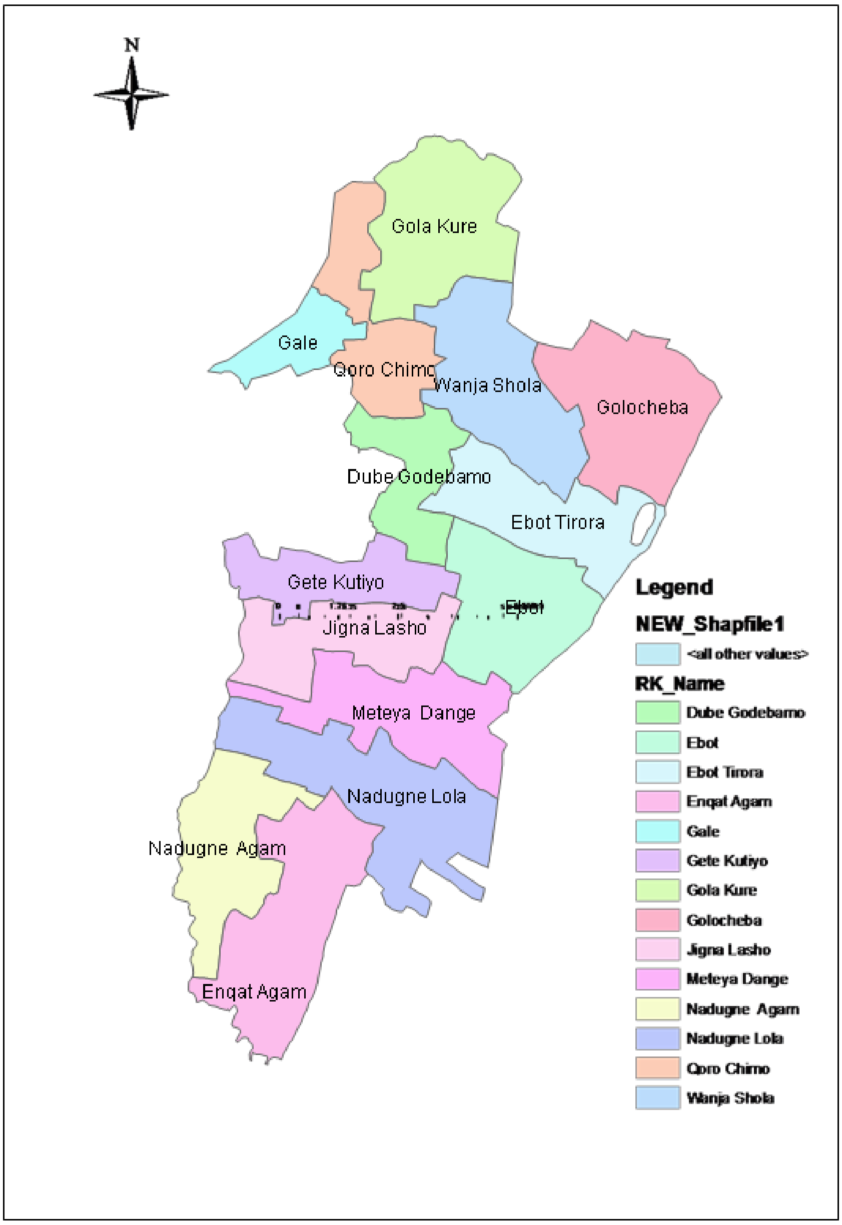

Figure 2:Administrative map of Dalocha wereda Source DWPC(2025)

3.2. Research Design

In this study cross sectional study design were employed. Based on the specific objectives and the nature of the research questions study used quantitative household survey for the sake of understanding and examining factors affecting adoption and intensity of use of row planting technology on wheat production in the study. The quantitative data were substantially supplemented by qualitative data.

3.3. Sampling techinques and Sample Size

The study were used multi-stage sampling technique to select sample respondents. First, from high wheat producing woreda in silte zone, dalocha woreda was purposively selected because of its higher wheat production potential.

In the second stage, three rural *kebeles* were selected from 17 *kebeles* using simple random sampling techniques. In the third stage, farmers were classified in to strarta of adopter and non adopter of wheat row planting. In the final stage, a total of 140 farm household were selected randomly using the probability proportional sampling technique darwn from 1362 identified wheat producer. As a result, the survey were administered and data were collected and analyzed on 140 respondents. The sample size of 140 household were determined by following a formula developed by Yemane (1967). The formula is:

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

$$n = \frac{1362}{1+1362(0.08)^2}\ 140$$

Where n is the sample size for the study, N is the population of interest which is 1362, e is the precision level which is 0.08 in this study. The formula is valid for 95% confidence level and p=0.5 (the level of variability assumed to exist in the population which is the maximum level in this case). The sample size from each *kebeles* were determined based on their proportion to total share of households residing in each *kebeles.*

Table 1: Sample distribution by kebles using PPS

No	Kebeles	Total number of households			adopter		non-adopter
		Adopters	Non-Adopters	Total		n	N
1.	N/lola	251	243	494		26	25
2.	Golecheba	220	233	453		22	24
3.	Aebot	191	224	415		20	23
	Total	662	700	1362		68	72

Source:Dalocha woreda FTC, 2025

3.4. Type, Source and Method of Data Collection

Data for the study was captured from two both primary and secondary source. The majority of primary data were collected from respondents through household survey. Secondary sources of data that support primary data were also used for this study purpose; published and unpublished documents like official reports, articles, journals and Internet sources.

The major instrument used for primary data collection from sample respondents for this study were structured interview schedule with questions which are carefully constructed.

3.5. Method of Data Analysis

3.5.1. Descriptive analysis

Descriptive statistics includes ratios, frequency, percentages, mean, standard deviation, minimum, maximum, chi-square for nominal variables, and F-test comparison for continuous/discrete variables. These methods were employed to assess the household's personal and demographic factors, economic, institutional, and psychological related factors with the adoption and intensity of usage.

3.5.2. Econometric model specification

Various econometric models have been employed to analyze the adoption level of farmers and to identify the key factors of technology adoption. Based on the objectives of the study and the type of data available, the econometric model can be specified. The determinants of wheat row planting technology adoption was estimated using double hurdle model assuming that the rate of adoption and intensity of adoption were affected by different set of factors at different levels. Moreover, it is assumed that the two decisions were-made separately.

The double hurdle (DH) model (Cragg, 1971) is a useful and appropriate approach to analyze technology adoption under constrained access to agricultural inputs. Many Ethiopian farmers faced constraints in accessing inputs like fertilizer and improved seed varieties in this case the DH model is suitable for analyzing technology adoption. The DH model examines technology adoption in two steps. In the first step, the farmer decides whether to participate in the fertilizer or other input market. If he/she chooses to participate, then the next step is to decide how much to purchase (Yu *et al*., 2011). In this model, the zero values in the dependent variable signifying non adoption of the technology could be resulted either from households that decided not to adopt the technology or households that have the willingness to adopt but are unable to do so due to reasons not embodied in the Tobit framework (for example, the unavailability of inputs discussed above). In other words, we can separate farming households into three categories using DH model; households applying fertilizer (or improved seed), households wanting to adopt but reporting no positive application, and households choosing not to adopt. Hence, using the DH model to include this additional information enables us to obtain more efficient and consistent estimates of technology (Amemiya and Powell, 1981).

The Double Hurdle model is preferred for analyzing technology adoption decisions, such as wheat row planting technology, due to its ability to separate adoption decision from intensity. It allows for different variables to affect each stage, handles zero observations better, and is more flexible than other models, as it does not impose restrictions on factors influencing adoption and intensity (Teklewold et al., 2013).

The double hurdle model was used to identify factors affecting the probability and intensity of use of an improved bread wheat technology. The double hurdle model is a model in which two separate stochastic processes determine the decision to adopt and the intensity of use of a technology. Thus, the model permits the possibility of estimating the first and the second decision processes using a different set of explanatory variables.

In the first hurdle, the latent variable underlying the producer's decision adopt row planting is represented as a binary process:

$$y^*_{1i}=\gamma'_1 X_{1i}+\pi_i \qquad \pi_i \sim N(0, 1) \tag{1}$$

Where $\boldsymbol{X}_{1i}$ is a vector of explanatory/independent/ variables, and π_i is the error term.

The observed decision of the producer is then modeled as:

$$y^*_{1i} = \begin{cases} 1, \text{ if } y^*_{1i}>0 \\ 0 \text{ otherwise} \end{cases} \tag{2}$$

In the second hurdle, a latent variable and DH takes the value 1 if a farmer adopts improved wheat row planting technology and zero otherwise, Z is a vector of householdsocioeconomic and institutional characteristics and α is a vector of parameters. is represented as:

$$y^*_{2i}=\gamma'_2 X_{2i}+u_i \qquad u_i \sim N(0, \sigma^2) \tag{3}$$

Where u_i is the error term, and the observed percentages is represented as:

$$y_i= \begin{cases} \gamma'_2 X_{2i}+u_i 0, \text{ if } y^*_{1i}>0 \text{ and } y^*_{2i}>0 \\ 0 \text{ otherwise} \end{cases} \tag{4}$$

And the γs are coefficients to be estimated.

Given the cross-sectional nature of the data, the DH model is estimated using maximum likelihood estimation procedures and tested for potential presence of heteroscedasticity using a chi-squared test.

If there is heteroscedasticity, the model estimates will be inconsistent. Consequently, the variance of the error term in Equation (4), σ^2 is allowed to vary across observations. The standard deviation σ_i is specified as:

$$\sigma_i = \sigma \,.\, \exp(\delta' h_{2i}) \tag{5}$$

where h_{2i} is a vector of select continuous variables included in $\boldsymbol{X}_{2i}$, and δ is a vector of coefficients (Aristei & Perugini, 2022).

If the model is homoscedastic, $\delta = 0$. The specification in Equation (5) ensures that the standard deviation is strictly positive ((Rude *et al.*, (2014); Ricker-Gilbert *et al.*, (2011)).

The DH models outlined above with and without specification adjustments for heteroscedasticity were estimated for adoption decisions to of wheat row planting .

Factors affecting adoption and the intensity of use of wheat row planting technology will be estimated by using Duble hurdle model.

3.6. Definition of Variables and Hypothesis

In the estimation of factor that affect farmer's decision for adoption and intensity of use of wheat row planting technology, the dependant variable that used:

The first equation of double hurdle model deals with adoption decision. Then dependent variable of the first hurdle takes dichotomous value depending on the farmers' decision either to adopt or not to adopt the wheat row planting technology.Thus,the household who adop wheat row planting have the value of one otherwise, zero. However, the truncated regression model will have a continuous value, which is the intensity, measured using adoption index expressed as ratio.
adoption index= area under wheat row planting/total area under wheat planting.
Adopters: farmers who are adopting wheat row planting during the survey year .
Non- Adopters: farmers who are not adopting wheat row planting in the last crop production

The independent variables were identified from previous studies and the nature of the study area and as well as from relevant empirical reviews. These variables are expected to affect farmer adoption and intensity of use of row planting technology on wheat production in the study area. These independent variables are defined as follows:

Age of a household head: Age is a continuous variable and measured in years. According to Hagos & Hadush (2017), the increase in the age of the household increases the likelihood of adoption of row planting technology. older farmers may assume have more experience or financial ability which creates more possibility to adopt wheat row planting technology. Young farmers are assumed they are educated, more energetic, and have a greater age possibility to adopt wheat row planting technology. The increase in the age of the household negatively affects the likelihood of adoption of row planting technology (Odoemlam & Nzeakor, 2021). Thus, age of household head will be hypothesized to have postive or negative relationship with adoption and intensity of use of row planting on wheat production.

Gender of household head: is a dummy variable (takes a value of 1 if the household head is male and 0 otherwise.Gender is found to be one of the factors influencing adoption of new technologies. Due to many socio-cultural values and norms, males have freedom of mobility and participation in different extension programs and consequently have greater access to information. Therefore, it is hypothesized that male farmers' household head are more likely to adopt new technology (Tesfaye *et al*., 2001; Mesfin, 2005). This variable is expected to have a positive relationship with adoption and intensity of use of row planting on wheat production.

Educational level of the household head: it is continuous variable measured in number of formal schooling.It is often assumed that educated farmers are better able to process information and search for appropriate technologies to alleviate their production constraints. Nevertheless, it is significant to examine the role education plays in technology adoption decisions (row planting technology). Adoption correlates positively with education (Getahun *et al*., 2000). In this study education were measured as level of education and expected to influence adoption and intensity of use of row planting technology on wheat production positively.

Number of livestock owned (TLU): It's a continuous variable measured in terms of Tropical livestock unit In this study. The study by Kassie et al. (2013) finds that farmers with larger livestock holdings are less likely to adopt certain crop technologies, such as improved seeds or conservation agriculture, due to labor and land allocation trade-offs. Livestock rearing demands significant time for grazing, fodder collection, and animal care, diverting labor away from crop farming. Additionally, land that could be used for cultivating improved crop varieties may instead be allocated to pasture or forage production. This competition for resources reduces farmers' ability or willingness to invest in new agricultural technologies, even when they could enhance crop productivity. The findings highlight how mixed farming systems create adoption constraints, as farmers prioritize livestock over crop-related innovations. It will be hypothesized that as livestock ownership decrease adoption and intensity of use of new technology.

Access to credit service: Access to credit is an important source of cash which improve farmer capital constraint and enable them to by agricultural inputs. Credit is an important source of cash which improve farmer capital constraints and enable them to buy agricultural inputs. According to Simtowe *et al.* (2016) credit helps farmers to purchase inputs such as improved seeds, fertilizers and chemicals which are used as input for agricultural production. Therefore, the amount of credit received has affects wheat row planting adoption decision.This variable is treated as dummy variable which takes value 1 if the household have access to credit and, 0 otherwise.

Frequency of extension contact: The frequency of contact between the extension agent and the farmers is hypothesized to be the potential force, which accelerates the effective dissemination of adequate agricultural information to the farmers, thereby enhancing farmers' decision to adopt new wheat row planting technologies. Farmers' visited by extension agents are believed to be exposed for different, new, updated information used to adopt new agricultural technologies thereby increase and double agricultural production (Wondimagegn *et al.*, 2011). It will be expected to influence adoption and intensity of use of row planting on wheat production positively.

Distance to the nearest market: It is measured by kilometer taken to arrive nearest market center from the respondent residency. It shows access to the market to buy input and/or to sell output. As the farmers are closer to the markets, the higher will be the chance of adopting agricultural technology because they do not have to travel long distance with their produce to sell hence incur no costs on transport unlike those that are far and have bulky and a lot of harvest and they have access to information about the new agricultural technologies. Therefore, distance from market is hypothesized to influence negatively the farmers' decision to adopt improved agricultural technology (Kabuli, 2005; and Namwata *et al*., 2010). In this study it will be expected to influence adoption and intensity of use of row planting on wheat production negatively.

Membership to social association/group: Farmers usually belong to various types of social association and also form part of various networks. As discussed, the evidence suggests that network effects are important for individual decisions, and that, in the particular context of agricultural innovations, farmers share information and learn from each other (Foster and Rosenzweig 1995; Conley and Udry, 2000). Therefore, membership in social association/group may lead to sharing of information on new agricultural technologies and how to use them on their farm plots; thus it's expected to affect positively farmers' decision to adopt and intensity of use of row planting technology on wheat production.

Availability of improved wheat seed: It is a dummy variable that assumes a value of 1' if the farmers have access to improved seed and0' otherwise Access to improved seed refers to the possibility of acquiring improved seed by households.. According to Dinku & Beyene (2019), acquiring improved wheat seed at the right time with the required quantity has a positive and significant influence on the adoption and intensity of the use of row planting for wheat production. This study also assumed that, access to improved seeds to have a positive effect on the likelihood of the adoption of wheat row planting technology.

Labor availability: Labor was measured in terms of Man Equivalent (Storck *et.al.*, 1999). The variable was interred in to the model as continues variable. Availability of labor is likely to influence the gross margin of the innovation. A farm with larger number of workers per hectare (unit of land area) is more likely to be in a position to try and continue using a potentially profitable innovation (Million and Belay, 2004). Thus, in this study, it will be expected to influence adoption and intensity of use of row planting on wheat production positively. Household's labor availability has positive effect on adoption.

Participation in non- farm activities: In this study, it was treated as a dummy variable taking a value 1 if a household head participated in non-farm activities; 0 otherwise. Non-farm participation negatively impacts the adoption of wheat row planting due to labor diversion, reduced agricultural investment, limited exposure to agricultural extension services, and a risk preference shift towards stable non-farm income over adopting new farming techniques (Matsumoto & Yamano, 2010).This variable is hypothesized to affect adoption of row planting negatively.

Farm size: Farm land is a key factor of production in farming community. Alene *et al.* (2000) studied determinants of adoption and intensity of use of improved Maize varieties in the Central Highlands of Ethiopia found a significant positive effect of farm size on technology adoption. Therefore, the farmer who owns relatively more cultivated farm land will be hypothesized to be more likely to adopt wheat row planting technology and it is expected to influence adoption and intensity of use of row planting on wheat production positively.

Participation in training: Training is one of the means by which farmers acquire new knowledge and skill on new agricultural technology provided for them and then increases the probability of adoption of technology (wheat row planting technology). It is measured by the number of times the farmer has participated in training in the last year. Hence, participation in training is expected to positively influence farmers' adoption behavior of new agricultural technology and intensity of its use (Belay, 2003). In this study, it will be expected to affect adoption and intensity of use of wheat row planting technology positively.

Perception on row planting technology: It's dummy variable taking the value of 1 if the household head perceive a given technology positively and superior to existing one and 0 otherwise. Perception is important determinant of technology adoption decisions and tells us whether farmer has positive or negative perception towards technology adoption. Neupane *et al.* (2002) found that farmer's positive perceptions towards a given technology have significant and positive effects on adoption decision. In this study, it will be expected to affect adoption and intensity of use of row planting on wheat production positively.

Table 2:Summary of variable definition and working hypothesis

Variables	**Characteristics**	**Expected sign**
Age of household head	Continuous variable	-/+
Sex of household head	Dummy variables	+
Education level	Continues variable	+
land sizeunder wheat	Continues variable	+
Labor availability	Continues variable	+
Livestock ownership	Continuous variable	-
Access to Improved Seed	Dummy variable	+
non-farm participation	Dummy variable	-
Extension contact	Discrete variable	+
Access to credit	Dummy variable	+
Distance from thenearest market	Continuous variable	-
Participation in Training	Discrete variable	+
Perception on row planting technology	Dummy variable	+
Membership to social association	Dummy variable	+

4. RESULTS AND DISCUSSION

4.1. Demographic characteristics of households

This part discuss abou descriptive analysis of demographic characteristics of respondents. The result of survey showed that out of 37 female respondents, 17 (46%) did not adopt the technology, while 20 (54%) did adopt it. Among 103 male respondents, 55 (53%) did not adopt the technology, while 48 (47%) did adopt it. The p-value (0.437) is greater than 0.05, indicating that fail to reject the null hypothesis. This suggests that there is no statistically significant relationship between the gender of the respondents and their decision to adopt the wheat row planting technology as shown in the table below.

Table 3: relationship between adoption decision and gender

sex of respondent	the farmers' decision to adoption			
	no-adopter	Adopter	Total	P-value
Female	17	20	37	0.4366
Male	55	48	103	
Total	72	68	140	

Source: own survey result, 2025

4.2. Current Level of Adoption of Wheat Row Planting Technology

In this study, farmers who did not apply/use wheat row planting technology during the survey were considered as non-adopters while the farmers who applied/used wheat row planting technology were considered as adopters. As a result, out of 140 sample respondents, 68 (48.57%) were adopters of wheat row planting adoption categories and the rest 72 (51.43%) were non-adopter households. This shows that the percentages of adopters are less than nonadopters because farmer's adoption technologies in variable level, this different level of adoption may be related to several reasons or factors as shown in the above table 3.

4.3. Description of dummy variables

Cooperative membership

The survey result showed that among the 82 farmers who are not members of any cooperative membership, 59 (72%) chose not to adopt the technology, while only 23 (28%) decided to adopt. In contrast, among the 58 farmers who are members of cooperatives, a significantly higher number 45 (77.6%) adopted the technology, whereas only 13 (22.4%) did not. The p-value (0.000) indicate a strong statistical association between the two variables. The analysis confirms that membership in social associations is significantly associated with the likelihood of adopting wheat row planting technology. Farmers who are members of social associations are more likely to adopt innovative agricultural practices compared to non-members as shown in the table below.

Table 4:summary of relationship between adoption decision and dummy variables

the farmers' decision to adopt	Membership to coopratives			p-value
	No	Yes	Total	
no-adopter	59	13	72	0. 0000
adopter t	23	45	68	
Total	82	58	140	
the farmers' decision to adopt	Participation in non- farm activities			0.0187
	No	Yes	Total	
no-adopter	51	21	72	
adopter t	35	33	68	
Total	86	54	140	
the farmers' decision to adopt	Access to credit			0.3388
	No	Yes	Total	
no-adopter	51	21	72	
adopter t	43	25	68	
Total	94	46	140	
the farmers' decision to adopt	Perception on row planting technology			0.0005
	Perceived negatively	Perceived positively	Total	
no-adopter	41	31	72	
adopter t	19	49	68	
Total	195	175	140	
the farmers' decision to adopt	Availability of improved wheat seed			0.0276
	No	Yes	Total	
no-adopter	42	30	72	
adopter t	27	41	68	
Total	69	71	140	

Source: own survey result, 2025

non-farm participation

The the descriptive result showed that there was a statistically significant relationship ($p = 0.019$) between off-farm participation and the decision to adopt wheat row planting technology. Farmers who did not engage in non-farm activities had a higher adoption rate (35 out of 86) compared to those who did engage (33 out of 54). This suggests that non-farm participation may negatively influence the likelihood of adopting new agricultural practices. Farmers involved in non-farm work often have limited time available for their agricultural responsibilities. This can reduce their engagement with farming tasks that are critical for learning and implementing new technologies. Effective adoption of new technologies often requires training and education. Farmers with non-farm commitments may find it challenging to attend workshops or training sessions, limiting their knowledge and skills related to wheat row planting as shown in the above table. Even though participation in non-farm activities can offer farmers additional income and exposure to new ideas, it can also create significant competing time demands that negatively affect their ability to adopt new agricultural technologies, such as wheat row planting.

access to credit

According to the survey result, out of 140 sample households 94(67.1%) of households was no access to credit.The p-value of 0.339, which is significantly higher than the conventional threshold of 0.05. This indicates that there was no statistically significant relationship between access to credit and the decision to adopt wheat row planting technology. The lack of a significant association suggests several potential interpretations regarding the role of credit in technology adoption.

perceptions of wheat row planting technology

The p-value of 0.001, which is significantly lower than the conventional significance threshold of 0.05. This indicates a strong statistical relationship between farmers' perceptions of row planting technology and their adoption decisions. Specifically, farmers who held a positive perception of the technology were more likely to adopt it, while those who viewed it negatively tended to refrain from adoption. A favorable perception of row planting technology likely encourages farmers to embrace new practices. This highlights the importance of educating farmers about the benefits and effectiveness of such technologies as indicated in table above.

access to improved seed

Among farmers without access to improved seed, 39% (27 out of 69) adopted the technology and with access to improved seed, 58% (41 out of 71) adopted the technology. This suggests that access to improved wheat seed is associated with of adoption of the row planting technology. A p-value less than 0.05 indicate that there is a statistically significant association between the availability of improved wheat seed and the decision to adopt the technology. The results suggest that the availability of improved wheat seed significantly influences farmers' decisions to adopt row planting technology. The chi-squared test indicates that this association is not due to random chance, providing evidence that interventions aimed at improving seed availability could positively impact technology adoption among farmers as shown in table 4 above.

4.4. Description of continuous variables

According to the current study the average age of non-adopting farmers was 43 years and the average age of farmers who adopted the technology was approximately 41 years and that of non-adopters (42.5) was slightly higher than that of adopters (40.56) but statistically it was not significant.

The average educational level of non-adopting farmers was approximately 3.28 and the average educational level of adopting farmers was about 7.16.

The educational level of non-adopters (3.28) is significantly lower than that of adopters (7.16). A t-value was 6.4915 indicated that there was a statistically significant association between the educational level and the decision to adopt the technology. This suggests that farmers who adopt the wheat row planting technology tend to have higher levels of education. Higher educational attainment may correlate with better access to information, resources, and a greater understanding of the benefits of adopting new technologies.

According of result of survey the average frequency of training sessions was significantly higher for adopters (3.16) than no-Adopter (1.92). There was significant difference between the two groups in frequency of training in the study area during survey period as a t-statistic of 4.4099 in table below. This suggests that farmers who receive more training opportunities are more likely to adopt new technologies.

The result of descriptive analysis indicated that there was significant difference between the two groups in frequent contact with extension agents in the study area during survey period as a t-statistic of 10.6922in table below. The disparity is quite pronounced, with adopters having average frequent contact with extension agents (7.74) than no-adopters (1.57). This may suggest that regular contact with experts provides crucial support, information, and encouragement, which could enhance farmers' confidence to adopt new practices.

The result of descriptive analysis indicated that there was significant difference between the two groups in average distance to the nearest market in the study area during survey period as a t-statistic of 7.0596 in table below. The average distance to the nearest market was shorter for adopters (7.13 km) compared to non-adopters (11.13 km). Proximity to markets can facilitate the sale of produce and the procurement of inputs, making the adoption of new technologies more viable. This highlights the potential barrier that distance can create in technology adoption; farmers further away might find it more challenging to implement new practices effectively. The closer distance to markets for adopters indicates that logistics play a vital role in technology adoption, as easier access facilitates resource procurement and market sales.

The result of descriptive analysis indicated that there was significant difference between the two groups in average land sizes in the study area during survey period as a t-statistic of 3.7271 in table below. While both groups operate on relatively small farms, adopters have slightly larger average land sizes (1.46 ha) than no-adopters (1.17ha). This might indicate that farmers with a bit more land may have the capacity and resources to experiment with innovations such as row planting.

The mean of availability of active family labor in sample households in terms of man equivalent (ME) was found to be 2.96. The mean of availability of active family labour for non-adopters was 1.87 but it was statistically insignificant.

The result of descriptive result indicated that there was significant difference between the two groups in livestock holding in the study area during survey period as a t-statistic of -1.9542 in table below.

Table 5:summary of relationship between adoption decision and continuous variables

Variables	Total		Adopter		Non- Adopter		t-test
	Mean	Std.	Mean	Std.	Mean	Std.	
AGE	41.55	0.599	40.55	0.737	42.5	7.86	1.6267
Education	5.16	0. .340	7.16	0. 498	3.27	0.341	-6.4915***
Extension	4.56	0 .388	7.735	0.435	1.56	0.380	10.6922***
Training	2.521	.150	3.161	.184	1.916	.211	-4.4099***
Distance	9.185	.328	7.132	0 .387	11.125	0.41	7.0596***
Land	1.312	0.040	1.459	0.057	1.173	0.051	-3.7271***
Livestock	4.89	0.146	5.188	0.229	4.621	0.180	-1.9542*
Labr	3.01	1.001	2.96	0.725	1.87	0.253	1.023

Source: own survey result, 2025

4.5. Barriers to Adoption of Wheat Row Planting Technology

The result of descriptive analysis showed that the major barriers to adopting wheat row planting technology, ordered by frequency (highest to lowest), are:

Labor Constraint (28.57%): it is ranked first among the constraints of adoption of wheat row planting.The most critical challenge, limiting farmers due to high labor demands during planting and harvesting. Labor constraints emerge as the most substantial barrier, affecting nearly half of the respondents. This indicates that many farmers struggle with insufficient labor availability, particularly during critical planting and harvesting periods. Labor shortages can deter farmers from adopting more labor-intensive practices like row planting, which may require additional manpower compared to traditional methods. As a result, farmers may continue with less efficient practices that require fewer labor resources.

Limited Access to Inputs (27%): it is the second ranked constraints identified during survey season. Difficulty obtaining seeds, fertilizers, and pesticides hinders adoption. Access issues can arise from geographical constraints, poor supply chains, or high costs, preventing effective implementation of new technologies.

Insufficient Extension Services (26.42%): it is the third major constraint. Lack of training and technical support leaves farmers unaware of proper row planting methods. Extension services play a vital role in disseminating knowledge about new technologies and practices. And a lack of support from extension agents can result in farmers being unaware of the benefits of row planting or unsure how to implement it correctly. Improved training and information dissemination are essential to empower farmers.

Access to credit is a barrier for about 11% of farmers. Financial constraints can hinder the ability to invest in new technologies and inputs. Farmers may be unable to afford the initial costs associated with adopting row planting methods, including hiring labor or purchasing necessary equipment. Addressing credit access through financial institutions can be crucial for encouraging adoption.

About 6% of farmers express concerns about perceived risks associated with adopting row planting technology. These perceived risks could stem from uncertainties about the technology's effectiveness, potential for crop failure, or changes in market conditions. Education and demonstration projects may help alleviate these concerns by showcasing successful implementations as shown in the table below.

Table 6: Barriers of row planting technology

What is the major barriers to adoption wheat row planting	Freq.	Percent	Rank
Insufficient Extension Services	37	26.42	3
Labor Constraint	40	28.57	1
Limited Access to input	39	27.00	2
Access to Credit	15	10.71	4
Perceived Risks	9	6.42	5
Total	140	100.00	

Source: own survey result, 2025

4.6. Perceptions, availability of resources and source of improved seed

This analysis focuses on the perceptions and availability of resources related to wheat row planting technology among farmers. The data reveal key insights into the relevance of various aspects of row planting, including seed rates, weed control, fertilizer use, and seed availability.

Row Planting with Reduced Seed Rate

A significant 78.57% of respondents find reduced seed rates either quite or very relevant, highlighting a strong recognition of the potential benefits of this practice. This suggests that farmers are aware of the efficiency gains in resource utilization, which is crucial for enhancing profitability. The acknowledgment of reduced seed rates reflects an understanding of sustainable farming practices.

Justifying this adoption is important as it can lead to lower input costs and reduced seed wastage, which is particularly beneficial in resource-limited settings.

Table 7: perception on seed rate

The application of row planting with reduced seed rate	Freq.	Percent
Not relevant	30	21.43
Quite relevant	50	35.71
Very Relevant	60	42.86
Total	140	100.00

Source: own survey result, 2025

Weed Control Technical Support/Advice

Nearly 89.29% of farmers consider weed control advice relevant, with half categorizing it as very relevant. Effective weed management is critical for maximizing the yields of row-planted wheat, as weeds can significantly compete for nutrients, water, and light. This highlights the necessity of providing adequate technical support in weed management to encourage the adoption of row planting practices. Extension services should focus on delivering practical advice tailored to the specific challenges faced by farmers in their regions.

Table 8: weed management

Weed control technical support/advise	Freq.	Percent
not relevant	15	10.71
quite Relevant	56	40.00
Very Relevant	69	49.29
Total	140	100.00

Source: own survey result, 2025

Fertilizer and Improved Wheat Seed Application on Row Planting

With 93.57% of respondents recognizing the relevance of fertilizers and improved seed applications, it is clear that these inputs are seen as essential for successful row planting. The balanced use of fertilizers can enhance soil fertility, leading to higher yields. This underscores the importance of education and access to high-quality inputs to support the adoption of row planting. Farmers need guidance on optimal fertilizer application rates and timings to fully realize the benefits of this technology.

Table 9: utilization of input

Fertilizer and improved wheat seed application on row planting	Freq.	Percent
not relevant	9	6.43
Quite relevant	62	44.29
very relevant	69	49.29
Total	140	100.00

Source: own survey result, 2025

Availability of Improved Wheat Seed

A significant majority (67.14%) of respondents reported not having access to improved wheat seeds when needed. This barrier can severely limit the ability of farmers to adopt row planting technologies, as the availability of quality seeds is crucial for successful crop establishment. Addressing seed availability through improved distribution networks or support from agricultural offices can enhance adoption rates. Initiatives to stock seeds in local markets and promote timely access can make a substantial difference.

Table 10: timely availability of input

is their availability of improved wheat seed with time and required quantity	Freq.	Percent
No	94	67.14
Yes	46	32.86
Total	140	100.00

Source: own survey result, 2025

Sources of Improved Wheat Seeds

The primary sources of improved wheat seeds are local agriculture offices and markets, indicating that farmers rely heavily on accessible, local supply chains. However, the low percentage sourcing from research centers suggests a gap in dissemination of newly developed varieties. Strengthening partnerships between research institutions and local agriculture offices can facilitate better access to the latest seed varieties and technologies, which can ultimately enhance productivity.

Table 11: source of improved seed

From where did you get improved wheat seeds?	Freq.	Percent
Research Centre	4	2.86
agriculture office	46	32.86
Market	42	30.00
own seed source	26	18.57
Neighbors	22	15.71
Total	140	100.00

Source: own survey result, 2025

4.7. Factors influencing adoption of wheat row planting technology

The adoption of row planting technology in wheat production is a critical factor in enhancing agricultural productivity, particularly in regions like Dalocha Wereda in the Siltie Zone of Central Ethiopia. Given the pressing need to improve food security and farmers' livelihoods, understanding the factors that influence farmers' adoption of this technology becomes imperative. Adoption of agricultural innovations is often impacted by a multitude of variables, including socio-economic conditions, access to resources, and exposure to training and extension services. This study employs a Cragg Hurdle Model to examine the statistically significant factors affecting the adoption of row planting technology, shedding light on the multifaceted dynamics at play in this specific agricultural context.

The Cragg Hurdle Model divides the analysis into two stages: the hurdle stage, which examines the decision to adopt a specific technology, and the selection stage, which assesses the extent of adoption among those who have decided to use the technology. This model is particularly useful when the dependent variable (adoption index) is zero-inflated, allowing researchers to discern differences between non-adopters and adopters. The model's log likelihood value, -3.1755, and LR Chi-squared (LR Chi2) value, -172.73, indicate a strong fit. The Pseudo R^2 value, -0.9662, indicates that approximately 96.62% of the dependent variable's variability can be explained by the model. The model's lnsigma coefficient, -1.9551, indicates that the model's predictors influence the dependent variable's variability. The sigma coefficient, -0.1415, indicates the level of dispersion around the predicted values. These coefficients are important for handling heteroskedasticity, model fit, and improved predictive capability.

4.7.1. Econometric Model Analysis

In the hurdle model, analyze seven significant variables that showcase their impact on the decision to adopt row planting technology. These variables include education level, livestock ownership, access to credit, farm size, and distance from market, perception of wheat row planting, and frequency of extension contact.

Selection model mnalysis: Conversely, the selection model reveals six significant variables affecting the intensity of adoption among those who choose to adopt. This model gives insight into the factors that enhance the degree of commitment to row planting technology.

Hurdle Model:

Education Level The sign of the coefficient of education level is positive and significant at 5% and these imply positive relationship between education level of and level of adoption of wheat row planting technology. Education significantly influences the likelihood of adopting row planting technology. If the education level increase by one unite (e.g., years of schooling), increases the adoption index by 0.11 units, indicating that educated farmers have better access to information and understanding of modern agricultural practices. This finding is consistent with expectation and previous findings of Assefa and Gezahegn, 2010.

Livestock Ownership: The sign of the coefficient of this variable is negative and significant at 1% and these imply negative relationship between livestock ownership and level of adoption of wheat row planting technology. If the livestock Ownership increase by one unite (tlu), deccreases the adoption index by 0.03 units. The negative coefficient suggests that higher livestock ownership may correlate with lower adoption of row planting technology. Farmers with more livestock may allocate their time, labor, and financial resources toward animal husbandry rather than investing in crop-related innovations like row planting. Livestock management (grazing, feeding, healthcare) can be labor-intensive, leaving fewer resources for adopting new agricultural techniques. This finding as consistent with previous findings of Kassie *et al*.(2012).

Access to Credit: Access to credit is positively associated with adoption. If the farmers get access to credit, inccreases the adoption index by 0.103 units. Farmers who can secure financial resources are better equipped to acquire inputs necessary for row planting technology, making this a critical factor in agricultural advancement. This highlights the importance of financial services in facilitating the adoption of innovative agricultural practices. This finding consistent with previous findings of Simtowe *et al.* (2016).

Farm Size: The sign of the coefficient of this variable is positive and significant at 1% and these imply positive relationship between farm size and level of adoption of wheat row planting technology**.** If the farm size increase by one unite (ha), inccreases the adoption index by 0.219 units. Larger farm sizes facilitate the adoption of new technologies due to economies of scale. Farmers managing more land are likely to experience greater benefits from implementing row planting, reinforcing the link between farm scale and innovation uptake. This finding consistent with previous findings of Alene *et al.* (2000).

Distance from Market: The sign of the coefficient of this variable is negative and significant at 10%and these imply negative relationship between distance from nearest market and level of adoption of wheat row planting technology. If the distance to nearest market increase by one *km*, inccreases the adoption index by 0.011 units. This negative relationship indicates that increased distance from markets can discourage adoption. Farmers located farther from market access may struggle to justify the investment in new technologies that improve productivity without secure avenues for selling their crops and faces higher transaction costs, which may limit their willingness to invest in row planting technology. This finding consistent with previous findings of Namwata *et al*., 2010.

Frequency of Extension Contact: the sign of the coefficient of this variable is positive and significant at 5% and these imply positive relationship between frequency of extension contact and level of adoption of wheat row planting technology. If the frequency of extension contact increase by one *unit*, inccreases the adoption index by 0.012 units. Regular interaction with development agents positively influences the likelihood of adopting row planting. This reinforces the idea that knowledge transfer and hands-on assistance from extension services are vital in encouraging technology uptake. This finding consistent with previous findings Wondimagegn *et al.*, 2011.

Non-Farm Activity Participation: The sign of the coefficient of off-farm activity participation is negative and significant at 1% and these imply negative relationship between non-farm participation and level of adoption of wheat row planting technology. If the farmers participate in non farm activity, deccreases the adoption index by 0.136 units. Farmers involved in non-farm work often have limited time available for their agricultural responsibilities. This can reduce their engagement with farming tasks that are critical for learning and implementing new technologies. Farmers with non-farm commitments may find it challenging to attend workshops or training sessions, limiting their knowledge and skills related to wheat row planting as shown in the above table. Even though participation in non-farm activities can offer farmers additional income and exposure to new ideas, it can also create significant competing time demands that negatively affect their ability to adopt new agricultural technologies, such as wheat row planting. This finding consistent with previous findings Matsumoto & Yamano, (2010).

4.7.2. Selection Model:

Market Distance: The sign of the coefficient of this variable is negative and significant at 5%and these imply negative relationship between distance from nearest market and decision to adoption of wheat row planting technology. In the selection model, market distance continues to display a negative association, confirming that not only does it affect the decision to adopt, but also the degree to which those who adopt engage with the technology. If the distance to nearest market increase by one unite, the liklihoods to participation decsion to adopt wheat row planting decreased by 2.8%. This negative relationship indicates that greater distances to markets deter farmers from considering adoption. The logistical challenges and increased costs associated with distance can significantly impact farmers' willingness to invest in new technologies.

Education Level: The sign of the coefficient of education level is positive and significant at 5% and these imply positive relationship between education level of and decision to adoption of wheat row planting technology. If the education level increase by one unite, the liklihoods to participation decsion to adopt wheat row planting increased by 1.4%.

Similar to the hurdle model, education plays a significant role in intensification of usage among adopters, further stressing the need for educational interventions. A positive association suggests that higher education levels increase the likelihood of considering row planting technology. Educated farmers are better equipped to understand and implement innovative practices.

Cooperative Membership: The sign of the coefficient of cooperative membership is positive and significant at 5% and these imply positive relationship between education level of and decision to adoption of wheat row planting technology. If the members participate in cooperative, the liklihoods to participation decsion to adopt wheat row planting increased by 9.24%. This positive relationship signifies that membership in cooperatives encourages greater extent of adoption. Cooperatives can provide resources, market access, and shared knowledge, incentivizing members to adopt new practices.

Access to Improved Seed: Access to improved seeds positively influences the decision to adopt at 10%. If the have access to improved seed, the liklihoods to participation decsion to adopt wheat row planting increased by 12.8%. Farmers who have reliable access to quality seeds are more likely to experiment with new practices. Ensuring a steady supply of improved seed varieties is essential for promoting technology adoption.   Access to improved seeds relates positively to the extent of technology adoption. Farmers equipped with superior seed varieties are likely to engage more fully with improved agricultural practices.

Frequency of Training: The sign of the coefficient this variable is positive and significant at 10% and these imply positive relationship between frequency of training of and decision to adoption of wheat row planting technology. If farmers get training, the liklihoods to participation decsion to adopt wheat row planting increased by 3.4%. Training provides crucial skills and knowledge, directly enhancing the intensity of adoption. With training, farmers can better understand and implement row planting techniques effectively.

Frequency of Extension Contact: the sign of the coefficient of this variable is positive and significant at 1% and these imply positive relationship between frequency of extension contact and decision to adoption of wheat row planting technology. If frequency of extension contact increased, the liklihoods to participation decsion to adopt wheat row planting increased by 3.5%. The variable is significant in both models, reiterating the crucial role of extension services in influencing farmers' decisions. Enhanced extension services can provide the necessary support for adopting innovative practices.

Table 12: summary of double hurdle model

Variables	First Hurdle			Second Hurdle	
	Coef.	Std. Error	Marginal effect	Coef.	Std. Error.
Availability of lbr	0.003	0.040	-0.025	-0.144	0.392
Age	-0.001	.003	-0.002	-0.007	0.026
Gender	-0.013	0.050	0.073	0.427	0.445
Market distance	-0.011*	0.006	-0.028	-0.119**	0.050
Education lvl	0.014**	0.006	0.0278	0.110*	0.058
Livestock	-0.030***	0.110	-0.025	0.352	0.415
Access to crdt	0.102**	0.045	0.077	-0.046	0.114
Farm size	0.219***	0.049	0.180	0.129	0.455
Coop. member	-0.002	0.047	0.170	0.924**	0.408
Access to improved seed	0.028	0.039	0.128	0.613*	0.344
nonfarm activity	-0.136***	0.044	-0.053	0.097	0.429
Training	-0.003	0.015	0.034	0.194*	0.105
Perception on row p.	-0.071	0.046	0.042	0.427	0.355
Extension contact	0.012**	0.006	0.035	0.153***	0.044
_cons	0.460**	0.228		-4.011**	1.857
Lnsigma MP				-1.955***	. .088

Source: own survey result, 2025

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary and Conclusion

This study aimed to assess the factors affecting the adoption of row planting technology among wheat farmers in Dalocha Werada, Siltie Zone, Central Ethiopia. The main focus lied in measuring adoption level, and identifying key factors influencing adoption decisions of row planting technology among wheat farmers. The research adopted a cross-sectional study design. The data was collected from both primary and secondary sources (official reports, articles, and internet sources) through structured household surveys. The multi-stage sampling technique were used to selected 140 wheat producers from three kebeles known for high adoption rates of row planting technology. The analysis involved descriptive statistics to summarize demographic and socio-economic variables, along with econometric models, primarily the double hurdle model, to evaluate adoption level and its determinant.The findings highlighted key demographic characteristics. Access to cooperative membership, positive perceptions of row planting technology, availability of improved seeds, and frequency of extension contact were identified as important factors influencing adoption. The study found that labor constraints (28.57%) and limited access to necessary agricultural inputs (27%), such as seeds, fertilizers, and pesticides, are major barriers to the adoption of wheat row planting technology in the study area. These issues can deter farmers from adopting more labor-intensive practices, leading to less efficient practices and increased costs. The double hurdle model highlighted two main decision-making processes: the choice to adopt and the level of technology usage. The research used a double hurdle model to identify significant variables that influence wheat row planting technology adoption. Distance from the market, Education levels, livestock ownership, access to credit, farm size, frequency of extension contact, and non-farm activity participation are key factors in the adoption decision. The study also revealed that market distance, education level, cooperative membership, access to improved seeds, training, and extension contact are important factors in extent of adoption. The analysis indicated that education, access to credit, access to improved seeds, cooperative membership, and extension service were pivotal in both the decision to adopt and the extent of adoption.

5.2. Recommendations

Based on the analysis of affecting the adoption of wheat row planting technology in Dalocha Wereda, the following detailed recommendations outline specific responsible bodies and actions needed to enhance adoption rates among farmers.

- ✓ Ministry of agriculture, local education authorities, NGOs (e.g., agricultural training organizations) have to develop targeted training programs that focus on modern agricultural practices, including row planting techniques. Organize workshops and seminars in collaboration with local schools and universities to raise awareness about the benefits of education in agriculture and increase access to adult education programs that enhance farmers' knowledge of modern practices.
- ✓ Local banks, microfinance institutions, agricultural development office need to design flexible credit schemes specifically for farmers adopting new technologies, ensuring loans are accessible with minimal collateral by Conduct outreach programs to educate farmers on available credit options and financial management skills and establish partnerships between financial institutions and agricultural cooperatives to streamline the credit process.
- ✓ Agricultural extension services, ministry of agriculture, development agents needs to increase the frequency and quality of extension contact by deploying more extension workers to the field and provide continuous professional development for extension agents to ensure they are well-equipped to assist farmers as well as facilitate farmer field schools where farmers can learn from each other and extension agents about row planting techniques and practices.
- ✓ Local agricultural cooperatives, cooperative development offices needs to encourage farmers to join existing cooperatives or establish new ones, emphasizing the benefits of shared resources and collective knowledge. Provide training for cooperative leaders on best practices for supporting member farmers in adopting new technologies and facilitate access to markets and resources through cooperative networks, enhancing collective bargaining power.
- ✓ Local government, infrastructure development agencies, market associations needs to invest in rural infrastructure to improve roads and transportation, making it easier for farmers to access markets. Establish local market days to connect farmers with buyers, ensuring better prices for their products. Implement mobile markets or direct-to-consumer sales initiatives to reduce dependency on distant markets.
- ✓ Seed companies, agricultural research institutions, office of Agriculture needs to ensure a stable supply of high-quality, improved seed varieties that are suited to row planting methods. Conduct demonstration plots showcasing the advantages of improved seeds in conjunction with row planting technology and Provide training on seed selection and management to enhance farmer engagement with new technologies.

Coordinated efforts from government, financial institutions, cooperatives, and agricultural organizations are needed to enhance wheat row planting technology adoption in Dalocha Wereda, enhancing agricultural productivity and livelihoods.

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APPENDICES

Survey Questionnaire

Research Title: Factors Affecting Farmers' Row Planting Technology Adoption on Wheat Production in Dalocha Woreda, Siltie Zone, Central Ethiopia

General Instruction for Enumerators

- ✓ Greet the respondents before starting any question in local ways
- ✓ Please introduce yourself before starting the interview.
- ✓ Inform the purpose of the study, which is to collect the first hand data that will be used only for MSc thesis writing on the above indicated topic.
- ✓ Please careful on the estimates that exact measurements are not available.
- ✓ Carefully read and follow the instructions while you are starting the interview.
- ✓ Please ask each question clearly and patiently until the farmer gets your points.
- ✓ Please do not use technical terms and do not forget local units
- ✓ During the process put (√) mark or write answers on the space provided.

Part one: Identification Information

Woreda ………………………………………………….…….

Kebele…………………………………………………….…

Name of Enumerator……………………………………

Date of Interview ………………………………………..

Respondent ID…………………………………………..

Signature of Enumerator ………………………………

Name of Supervisor……………………………………...

Signature of Supervisor ………………………………...

Date ………………………………………………………

I. Personal and Demographic related variables

1. Age of the household head ____________________

2. Sex of the household head _____________

1) Male 2) Female

3. Relation to household head (status):

1) Head, 2) husband, 3) wife, 4) Son, 5) Daughter; 6) Brother; 7) Sister;

8) Hired labor; 9) If other, specify ______________________

4. Main occupation of household head:

1) Crop farming; 2) Crop farming and off-farm activity (like Pity trade, hired labor….);

3) Student; 4) Military; 5) Dependent; 6) Watch after animals; 7) House wife;

8) If other, Specify ___________________

5. Education level of household head---------------------

6. What is your family size? ______________________

6.1. Are you getting help from family members for agricultural activities? 1, Yes 2, No

6.2. If "yes" questions #6.1, in which type of agricultural activities? Specify___________________

7. Household labor availability bin 2015/16 E.C agricultural production season

Age Categories	Male	Female	Type of agricultural activities participated in
<15 year			
16-65			
>65			
			Wheat production activities includes: - 1) Land preparation 2)row planting/sowing 3)Weeding 4) Harvesting 5) Threshing 6) Transportation 7) Storage 8) Marketing 9)others (specify)

7.1 Do you think that shortage of labor is the major production constrain for wheat row planting technology? 1, No 2, Yes

7.2 If yes Q7.1, for what specific activities do you encounter labor shortage?

1, Cultivation of land 2, Weeding 5, Row planting activity 3, Crop harvest 4, Threshing 6, Others (Specify)

7.3 If yesQ7.1, how did you overcome this labor shortage?

1, by using family labor 2, Hiring labor 3, Labor pooling mechanism/asking for cooperation 4, others, specify

II. Economic related variables

1. Do you participate on work outside agriculture/off-farm activities in 2015/16E.C? 1, Yes 2, No

1.1 If yes, who participates in off-farm activity? Specify name of participant ______________and number of days spent in a year ____

1.2 If "yes" questions #1, do you earn income from the activities? 1, Yes 2, No

1.3 If "yes" questions #1.2, for what purpose you use the income you earn from the activities? 1) To buy agricultural inputs like fertilizers, improved seed 2) To purchase oxen 3) for household consumption 4) To construct house 5) To pay other debit 6) All 7) if other, please specify ___________________________________

1.4 If "yes" questions #1.2, what is/are your source of income outside agriculture/off-farm activities? 1, Paid daily labor 2, Petty trade 3, Handcraft 4, other, specify ______________________

2. Please fill the following table about land holdings during 2015/16E.C agricultural season in hectare

Land Ownershp	Total area in Hectare	Land size in ha for wheat	Land size in ha for wheat row planting	Fall ow land	Rented out Land	Other sourc
Own						
Rented out						
Other						
Total						

2.1. From your total hectare of crop production, how many hectares you allocate for wheat crop production? __________________

2.2. If you use row planting technology for wheat production in 20115/16 E.C, how many hectare you allocate for wheat production through row planting from total area of wheat? Please specify it _________________

2.3. Do you think that shortage of land is the major production constraint for you to practice row planting technology? 1, No 2, Yes

3. Are you engaged in livestock production? 1, Yes 2, No

3.1. If “yes”Q3, what is your total livestock size in 2015/16 E.C. agricultural season?

Animal categories		Total
Cattle	Oxen	
	Cows	
	Heifer	
	Bull	
	Calves	
	Total	
Sheep and goat	Sheep	
	Goat	
	Chicken	
	Total	
Marines	Camel	
	Donkey	
	Mules	
	Hoarse	
	Total	
Total livestock size		

3.2. Do you think that having large livestock size will increase the adoption of agricultural technology (row planting technology?) in your area? 1, yes 2, No

3.3. If “yes”Q3.2, how? ____

III. Institutional Factors

1. Do you have contact with extension/ development agent? 1, Yes 2, No

1.1. How frequently do extension agents visit you?

1, Never 2, Ones in a week 3, Twice in a week 4, Ones in a month 5, Twice in a month 6, Three times in a month 7, Yearly 8, If other specify…………………………..

1.2. If you have contact with extension agent, what type of information you get from extension agent on wheat production through row planting technology?

No	How relevant is the information from DA's on wheat production through row planting method		
	Very Relevant	Quite relevant	Not relevant
The application of row planting with reduced seed rate			
Fertilizer and improved wheat seed application on row planting			
Wheat seeding depth and width between rows			
Weed control technical support/advise			

1.3. Do you think that having frequent contact with extension agent will increase adoption of agricultural technology? 1, yes 2, No

1.4. If "yes" for questions# 3.3, how? ____

2. Are there any credit institution/sources in your area? 1, yes 2, No

2.1. Did you get access to credit? 1, Yes 2, No

2.2. If "yes"Q2, do you received credit for the agricultural production?

1, No 2, Yes

2.3. If "yes" questions #4.2, for what purpose you use the credit received from the sources?

1) To buy modern farm inputs like fertilizers 2) To purchase oxen 3) To buy improved seeds 4) for household consumption 5) To construct house 6) To pay another debit 7) to hire labor for agricultural activities 8) all 9) If other, please specify______________________

2.4. If "yes" Q2.2, what is the source of your credit? 1, Banks 2, Friends\relative 3, Micro finance institutions 4, if others specify __________________

2.5. Do you think that credit obtained will increase adoption of new agricultural technology (row planting technologies)? 1, Yes 2, No

2.6. If “yes” Q2.5, how? Specify ______________________________________

3. Do you participate in any social group/ association?

1) Yes 2) No

3.1. If “yes” Q3, in which social group/association? 1, Equb 2, Edir 3, Debo

4, Social network 5, if others, specify ___________________

3.2. If “yes” Q3, what is/are the advantage you get from participation in social group/ association with respect to agricultural information? Specify it ______________________

4. Do you need improved wheat seed for wheat production through row planting technology? 1, Yes 2, No

4.1. If yes Q4, is their availability of improved wheat seed with time and required quantity during cropping season in the district? 1, Yes 2, No

4.2. If yes Q4.1, do you have access in last three years? 1, Yes 2, No

4.2. From where did you get improved wheat seeds?

1, BOA ___________ 2, Research Centre ________ 3, Own source ___________

4, Market __________ 5, Neighbors________ 6, NGO ________7, Others, specify

4.3. Have you ever used improved wheat seed for row planting technology during 2015/16 E.C cropping season?

1, No 2, Yes

4.4 If no to Q4.3, reason for not using improved wheat seed? Please specify___________

4.5 If yes, what was the size of area under row planting technology using improved wheat seed during 2015/16 production season in hectare? ______________________________

4.6. Do you think that timely unavailability of improved wheat seed will affect adoption of row planting technology in your area? 1, Yes 2, No

5. Does your home near to the market center? 1, Yes 2, No

5.1. How many kilo maters is the market far from your home? __________

5.2. Do you get market information about prices and demand conditions of agricultural inputs and out puts? 1, Yes 2, No

5.3. If yes Q5.2, what is your source of information

1, Development agent 2, Traders 3, Neighbor farmers 4, Friends 5, other…………….

5.4. How do you transport agricultural produce to the market place?

1) On back 3) Horse cart

2) Vehicle 4) If other, specify ____________

5.5. Do you think that distance from the market has negative effect on the adoption of agricultural technology (wheat row planting technology)? 1, Yes 2, No

5.6. If "yes" Q5.5, how? If "No" how? Specify __________________________

6. Do you participate in wheat row planting training given at farmers training center (FTC) and technology demonstration cite?

1, yes 2, No

6.1. If yes Q 6, how many times do you participate in a year?______________________

6.2. If "yes" Q6, what is the advantage you get from training after participation? Specify it

____

____

6.3. Do you think that participation on training will improve the problems on adoption of agricultural technology (row planting method)? 1, Yes 2, No

6.4. If "yes" Q6.3, how? Specify it ____

____

IV. Row Planting Technology Adoption

1. Do you have information about row planting method of wheat production? 1, Yes 2, No

1.1. If yes question #1, where do you get such information about row planting? 1, Extension agents (DAs oral orientation at FTC) 2, Friends and families

3, Neighbors 4, Social network 5, from kebele administration 6, Training at demonstration center 7, If others, specify __

1.2. As you get information about it, do you adopt row planting technology? 1, yes 2, No.

1.3. If “yes” question #1.2, since when you adopt this row planting methods of wheat production system?____ (Years), if No, go to question #1.4

1.4. After you adopt it, have you seen any productivity difference between broadcasting and row planting method of wheat production? 1, Yes 2, No

1.5. Reasons for not adopting row planting technology on wheat production.

1, It requires many labors 2, It takes time when plowing and planting than traditional 3, It is low yield than broadcasting system 4, if other, specify ________________

2. Do you think that there is risk associated to the use of wheat row planting technology? 1, No 2, Yes

2.1. If yes, what are the risks associated to the use of row planting technology?

1. ____________________________2.___________________3. _____________________

3. How do you perceive the effectiveness of row planting technology on wheat production? 1, very good 2, good 3, No change 4, bad 5, very bad

3.1 How do you perceive the effectiveness of row planting technology on wheat production with respect to wheat yields, seed germination and quality of output, and input seed and fertilizer consumption? Please fill the following table

Description	Superior	Inferior
The capacity of the yield		
The capacity of seed germination and output quality		
Input seed and fertilizer consumption		
Other		

3.2 Describe the advantages and disadvantages you have seen on the application of row planting technology on wheat crop production.

Advantages

____

____

____

Disadvantages____

____

____

Test results

Tabulation of GEN ADOPT

sex of respondent	the farmers' decision to adopt or not to adopt the wheat row planting technol		
	no-adopter	Adopter	Total
Female	17	20	37
Male	55	48	103
Total	72	68	140

Pearson Chi2 = 0.61 Prob = 0.4366

Tabulation of COPMENBR ADOPT

Membership to social association/group	the farmers' decision to adopt or not to adopt the wheat row planting technol		
	no-adopter	adopter	Total
No	59	23	82
Yes	13	45	58
Total	72	68	140

Pearson Chi2 = 33.37 Prob = 0.0000

Tabulation of OFFRMACTV ADOPT

Participation in non- farm activities	the farmers' decision to adopt or not to adopt the wheat row planting technol		
	no-adopter	adopter	Total
No	51	35	86
Yes	21	33	54
Total	72	68	140

Pearson Chi2 = 5.53 Prob = 0.0187

Tabulation of PERCRWPLT ADOPT

Perception on row planting technology	the farmers' decision to adopt or not to adopt the wheat row planting technol		
	no-adopter	adopter	Total
No	41	19	60
household head perceive a given technology positively	31	49	80
Total	72	68	140

Pearson Chi2 = 12.01 Prob = 0.0005

Tabulation of AVIMSD ADOPT

Availability of improved wheat seed	the farmers' decision to adopt or not to adopt the wheat row planting technol		
	no-adopter	adopter	Total
No	42	27	69
Yes	30	41	71
Total	72	68	140

Pearson Chi2 = 4.85 Prob = 0.0276

Cragg hurdle regression Number of obs = 140
LR chi2(14) = 172.73
Prob > chi2 = 0.0000
Log likelihood = -3.0175138 Pseudo R2 = 0.9662

adopindex	Coef.	Std.Err.	z	P>z	[95%Conf.	Interval]
adopindex						
AVLBR	0.003	0.040	0.070	0.944	-0.076	0.081
AGE	-0.001	0.003	-0.1420	0.878	-0.007	0.006
GEN	-0.013	0.050	-0.260	0.794	-0.112	0.086
MDC	-0.011	0.006	-1.800	0.072	-0.023	0.001
educlvl	0.014	0.006	2.310	0.021	0.002	0.025
LVTCK	-0.030	0.011	-2.890	0.004	-0.051	-0.010
ACCRDT	0.102	0.045	2.260	0.024	0.014	0.189
FARMSIZE	0.219	0.049	4.490	0.000	0.123	0.315
COPMENBR	-0.002	0.047	-0.040	0.964	-0.095	0.090
AVIMSD	0.028	0.039	0.720	0.473	-0.049	0.105
OFFRMACTV	-0.136	0.044	-3.100	0.002	-0.221	-0.050
TRING	-0.003	0.015	-0.220	0.824	-0.032	0.025
PERCRWPLT	-0.071	0.046	-1.550	0.122	-0.160	0.019
EXTCONTCT	0.012	0.006	2.180	0.029	0.001	0.024
_cons	0.460	0.228	2.020	0.043	0.014	0.907
selection_ll						
AVLBR	-0.144	0.392	-0.370	0.714	-0.912	0.625
AGE	-0.007	0.026	-0.260	0.791	-0.057	0.044
GEN	0.427	0.445	0.960	0.337	-0.445	1.299
MDC	-0.119	0.050	-2.380	0.017	-0.217	-0.021
educlvl	0.110	0.058	1.910	0.056	-0.003	0.223
FARMSIZE	0.352	0.415	0.850	0.396	-0.461	1.165
LVTCK	-0.046	0.114	-0.400	0.687	-0.269	0.177
ACCRDT	0.129	0.455	0.280	0.777	-0.763	1.022
COPMENBR	0.924	0.408	2.260	0.024	0.124	1.724
AVIMSD	0.613	0.344	1.780	0.075	-0.061	1.286
OFFRMACTV	0.097	0.429	0.230	0.821	-0.743	0.937
TRING	0.194	0.105	1.850	0.065	-0.012	0.400
PERCRWPLT	0.427	0.355	1.200	0.229	-0.268	1.122
EXTCONTCT	0.153	0.044	3.500	0.000	0.067	0.238
_cons	-4.011	1.857	-2.160	0.031	-7.650	-0.371
lnsigma						
_cons	-1.955	0.089	-22.020	0.000	-2.129	-1.781
/sigma	0.142	0.013		0.119	0.168	

Marginal effects after churdle

y = Conditional mean estimates of dependent variable (predict)

= .2465981

variable	dy/dx	Std.Err.	z	P>z	[	95%	C.I.
AVLBR*	-0.025	0.076	-0.330	0.739	-0.173	0.123	0.371
AGE	-0.002	0.005	-0.300	0.764	-0.011	0.008	41.557
GEN*	0.073	0.085	0.860	0.389	-0.093	0.239	0.736
MDC	-0.028	0.010	-2.810	0.005	-0.047	-0.008	9.186
educlvl	0.028	0.011	2.430	0.015	0.005	0.050	5.164
LVTCK	-0.025	0.022	-1.120	0.264	-0.068	0.018	4.897
ACCRDT	0.077	0.087	0.890	0.374	-0.093	0.248	1.329
FARMSIZE	0.180	0.083	2.160	0.031	0.017	0.344	1.313
COPMENBR	0.170	0.079	2.150	0.032	0.015	0.325	1.414
AVIMSD	0.128	0.067	1.920	0.055	-0.003	0.259	1.507
OFFRMA~V	-0.053	0.084	-0.640	0.523	-0.217	0.111	1.386
TRING	0.034	0.021	1.640	0.102	-0.007	0.075	2.521
PERCRW~T	0.042	0.070	0.600	0.550	-0.095	0.179	1.571
EXTCON~T	0.035	0.009	4.040	0.000	0.018	0.052	4.564

(*) dy/dx is for discrete change of dummy variable from 0 to 1