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Improved Vegetable Extension Services in North mecha and fogera District: North west Ethiopia

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BAHIR DAR UNIVERSITY

COLLEGE OF AGRICLUTURE AND ENVIRONMENTAL SCIENCES

DEPARTMENT OF AGRICULTURAL ECONOMICS

GRADUATE PROGRAM

FARMERS' WILLINGNESS TO PAY FOR IMPROVED VEGETABLE EXTENSION SERVICES IN NORTH MECHA AND FOGERA DISTRICT: NORTH WEST ETHIOPIA

M.Sc. THESIS

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Farmers' Willingness to Pay for Improved Vegetable Extension Services in North Mecha and Fogera District: North West Ethiopia

M.Sc. Thesis By

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In Partial Fulfillment of the Requirements for the Degree of Master of Science in "Agricultural Economics"

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THESIS APPROVAL SHEET

As member of the Board of Examiners of the Master of Sciences (M.Sc.) thesis open defense examination, we have read and evaluated this thesis prepared by Mrs. Tigist Damtew Worku in titled **"Farmers' willingness to pay for improved vegetable extension services, the case of North Mecha and Fogera District".** We hereby certify that, the thesis is, accepted for fulfilling the requirements for the award of the degree of Master of Sciences (M.Sc.) in Agricultural Economics.

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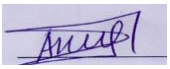
Asresu Yitayew (PhD)		June/02/2024
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DECELARATION

This is to certify that this thesis entitled **"Farmers' willingness to pay for improved vegetable extension services, the case of North Mecha and Fogera district"** submitted in partial fulfillment of the requirements for the award of the degree of Master of Science in "**Agricultural Economics**" to the Graduate Program of College of Agriculture and Environmental Sciences, Bahir Dar University by Mrs. **Tigist Damtew** (ID No. BDU1401297) is an authentic work carried out by her our guidance. The matter embodied in this work was, not submitted earlier for award of any degree or diploma to the best our knowledge and belief.

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ABBREVIATIONS AND ACRONYMS

AAS	Agricultural Advisory Service
AKE	Approach of Knowledge Exchange
ASE	Agricultural Extension Service
CBOs	Community-based organizations
CSA	Central Statistical Agency
CVM	Contingent Valuation Method
DA	Development Agent
DCE	Discrete Choice Experiment
ETB	Ethiopian Birr
FAO	Food and Agriculture Organization
FAS	Frequency of Advisory Service
FTC	Farmers' Training Center
GoE	Government of Ethiopia
HH	Household Head
IFRI	International Food Policy Research Institute
LMIC	lower and Middle-Income countries
MVAS	Major Focus Advisory Service
MWTP	Marginal Willingness To Pay
MXL	Mixed Logit Model
RPL	Random Parameter Logit Model
SSA	Sub-Saharan African
TLU	Total Livestock Unit
TVAS	Types of Vegetables Advisory Service,
WTP	Willingness to Pay

ABSTRACT

Modernizing the vegetable advisory service has significant promise in enhancing the production and profitability of smallholder vegetable farming in Ethiopia. However, current agricultural advisory service (AAS) operates as a public mandate that does not meet the demand due to extension agents' overburdened and poor facilities at farmers' training centers. Private paid extension agents has been proposed as one way to modernize the mostly strained public system that continues to be slow in addressing the need to transform smallholder farming to provide enough healthy foods. This study, therefore, investigated the willingness of smallholder vegetable farmers to pay for private improved vegetable advisory services using data collected from 393 household heads from two districts in northwestern Ethiopia. The study employed discrete choice experiments (DCE), with eighteen choice occasions generated using Ngene software that were blocked into three survey groups and 7074 choice observations. The several choice cards define the proposed extension service by varied attribute and attribute levels. The data was analyzed using a random parameter logit model. The results show heterogeneity in farmers' willingness to pay for advisory services. Specifically, farmers of different socioeconomic backgrounds such as education status, gender and age exhibited heterogeneity over preferred features of vegetable advisory services. Small-scale vegetable farmers in Mecha and Fogera districts preferred receiving enhanced advisory services, which include frequent visits from experts and a more hands-on on-site advisory service, as opposed to cell-phone assisted and on-stop advisory methods. Likewise, farmers are more willing to invest in vegetable extension services that focus on fruity and root-tuber vegetables than leafy vegetables. Through these findings we propose that efforts to establish private enhanced advisories be situated within the contextual differences in preferences exhibited within the smallholder population.

Keywords: Advisory service, Choice Experiment, Random parameter logit, Willingness to pay, Northwest Ethiopia

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Agricultural Advisory (extension) Services (AAS) play a vital role in promoting productivity, increasing food security, improving rural livelihoods, and promoting agriculture as an engine of pro-poor economic growth (Yitayew *et al.,* 2023; Antwi-Agyei & Stringer, 2021; Buehren *et al.,* 2019), especially in LMICs (Lower- and Middle-Income Countries) where agriculture is the engine of growth (Danso-Abbeam *et al.,* 2018). In Ethiopia, the agricultural extension service is said to have started during the imperial regime (Guush *et al.,* 2018). The service is provided free of charge as a public service, which makes government tolerate the total cost of providing the service this means the AAS is publicly operated. The public extension services in Ethiopia have shown great improvement where, the number of extension agents grew from a mere 15 thousand to more than 80 thousand in about five years' time (Berhanu et al., 2006). However the public-based AAS is primarily responsible for the spreading of agricultural information and innovation and the system is operated by large staff of extension personnel with direct contact to geographically dispersed farmers (Abebaw Abebe, 2023).

Participatory Demonstration and Training Extension System/ National Agricultural Extension Intervention Program, which remains the core program implemented today, follows a technology or AES package approach for agricultural development that incorporates information on agricultural technology, provision of inputs and credit, and communication methods Guush *et al.,* 2018. Based on Participatory Demonstration and Training Extension System assessments, the Government of Ethiopia GoE realized the need for additional AES staff in the system. This was in line with the GoE's broader decentralization program. Therefore, Agricultural Technical and Vocational Education and Training colleges were founded to increase the number of Development Agents DAs assigned at the decentralized level (Davis et al. 2010). Regardless of the major investment and considerable effort made to improve the agricultural extension system of the country in the past, the system is not bringing the desired results (ATA, 2019).

Studies have shown that it is inadequate to meet the changing demands for extension due to overburdened extension agents, poor linkage with research, and poor facilities at farmers' training centers (FTC) (Davis *et al.,* 2010; Guush *et al.,* 2018; Leta *et al.,* 2019). Thus, a problem whose effects are much more felt in the horticultural crop (specially vegetable) sectors (Aliyi *et al.,* 2021; Buehren *et al.,* 2019; Gebremariam *et al*., 2023; Gebru *et al.,* 2019).

In Ethiopia, small and commercial farmers grow vegetable crops in various agro-ecological zones for food and profit (Nimona Fufa, 2017). For smallholder farmers, the area planted to vegetables expanded from 350,600 hectares in 2010 with a production of 2.36 million tons to 396,510 hectares in 2013 with an output of 4.48 million tons (Habtamu Deribe, 2019). However, Ethiopian vegetable commercial growers export volume and sales lacks stability and constrained by different challenges, among technological advancement problem, deficiency of inputs, government bureaucracy and seasonality of Ethiopian supply (Mohammed Alebachew, 2018).

Ethiopia set a clear agricultural production and productivity development policy to tackle the challenge and lift millions of smallholder farmers out of the food insecurity trap (Achenef Motbainor *et al*., 2015). One of the policies is that improving the private sector. Building a private, responsive, and demand-driven advisory service that could be vital in addressing the inefficiencies created by the current public AAS (Davis *et al.,* 2010; Uddin *et al.,* 2016). In this case, the private sector will offer some services to farmers for profit, in contrast to the currently free non-profit making motive of the public extension system. While these calls for extension continue to gain steam and energy in the vegetable advisory services in various circles, many questions persist on their feasibility within a context that has been used to free public extension, as in the case of Ethiopia. Specifically, what is farmers' willingness to pay (WTP) for private extension services to receive tailored and efficient information. The imagined advantages of privatized extension services include reduced government spending, improved efficiency of service delivery, and delivery of specialized programs that are flexible and responsive to site-specific needs and problems of customers (Sumo *et al.,* 2023).

Previous studies in Ethiopia have alluded to farmers' willingness to pay; for example, Tolera *et al.,* (2014), studies on determinates of small holder farmers willingness to pay for the current agricultural extension services in eastern Ethiopia (Haramaya) and Abebaw Abebe, (2023),

studies on farmers' willingness to pay for mobile phone based agricultural extension service in northern Ethiopia indicated that most respondents were favorably disposed to paying if the service is satisfying them and could earn more profit than what they are now getting. These findings implied farmers assign a financial value to extension. However, more research is needed to understand the WTP across various areas with different type of advisory service of the country's agriculture and equip policymakers with the right tools to inform decisions. This study responds to the need to understand farmers' willingness to pay in North mecha and Fogera by drawing on the vegetable sector's experiences, a critical niche associated with high-end consumer products.

1.2 Statement of the problem

Fruit and vegetable crops are being promoted for their health and economic benefits (Habtamu Deribe, 2019; Wolfenden *et al.,* 2021). Amongst staggering diet transitions in lower and middle-income countries and thereby increasing food security status (Keatinge, *et al*, 2010; Westbury *et al.,* 2021). Despite a barrier that makes it less productive, vegetable production is becoming an important activity among urban dwellers in developing countries, including Ethiopia to achieve food security (Habtamu Serbessa *et al.,* 2023). Moreover, one of the largest fresh products in Ethiopian export are vegetables, including tomatoes, potatoes and onions (Michel Peperkamp, 2020). However, the production of these critical food items in many countries in sub-Saharan Africa, including Ethiopia is still low (Muluneh Bekele *et al.,* 2016; Michel Peperkamp, 2020). Farmer's hinder from bringing this food to markets to enrich consumer choices. Among the challenges, fruit and vegetable diseases, lack of necessary inputs, and poor market linkage are the major once (Nimona Fufa, 2017; Habtamu Deribe, 2019; Habtamu Serbessa *et al.,* 2023; Shewfelt & Prussia, 2022; Wendimu, 2021). Therefore Farmers requires timely, adequate and appropriate information and technology to increase production and their income (Gebremariam *et al*., 2021).

Agricultural advisory service is the basic mechanism for improving agricultural productivity, rural development, poverty reduction, and food security (Chayot Gatdet, 2022). In Ethiopia, for years an agricultural advisory (extension) service has been provided by the governments and all advisory services are brought by and done with a large staff of extension personnel. However,

the system is not producing the desired results because of failing due to its high administration cost, lack of professional knowledge of extension personnel and limited geographical coverage (Abebaw Abebe, 2023). And a problem whose effects are much more fingered in the vegetables crop sectors (Aliyi *et al.*, 2021, Gebremariam *et al.*, 2023). Under such circumstances rural communities may not get an appropriate advice and technical assistance in case of building their capacity to solve the challenges they face in their vegetable production, to raise their income and improve their lives by using their resources with their own will and to develop local management skills.

There is a need to reform and looking for an alternative way of agricultural extension service, which is diverse and cost-effective (Abebaw Abebe, 2023). Furthermore, introducing modern-based agricultural extension service can solve the challenge that faces by the public sector (Chayot Gatdet, 2022). According to Aydogdu, (2017), advisory services should be demand-driven and given in a way that farmers can understand and implement, since farmers' socio-economic characteristics were not considered, and extension agents were unable to expand and advocate suitable technology that have been well matched with farmers' expectancies and needs..

Moreover many extension professionals and policy-makers are advocating privatized extension services due to governments' financial shortage and sustainable provision of agricultural advisory services (Uddin *et al.*, 2016)**.** Moving the cost of advisory services to farmers could enhance effectiveness and promote financial sustainability of the agricultural advisory (Daniel Temesgen and Teferi Tola, 2015). Kidane Tesfay & Gidey Kidu, (2020) noted that the central objective in privatized extension system is in getting the right message to the right user(s) at the right time through a demand-driven service system that is cost effective and efficient. Privatization is to enhance efficiency and effectiveness of delivery of advisory services to farmers by providing timely and appropriate extension services based on farmer's needs (Muyanga & Jayne, 2008).

Demand-driven extension encourages competition among providers of advisory services; privatization is a way to bring the advantages of competition and flexibility to the delivery of public services. These advantages include greater efficiency, increased responsiveness to the needs of customers, and encouraging innovation. Modernizing the vegetable advisory service has

significant promise in enhancing the production and profitability of smallholder vegetable farming in Ethiopia particularly in the study area. Private paid extension has been proposed as one road to modernize the mostly strained public system that continues to be slow in addressing the need to transform smallholder farming to provide enough healthy foods.

Despite there are handful studies on farmers willingness to pay for AAS, the type of services and associated WTP for improvement of AAS has remained less investigated. Also different studies have used different econometric models to identify households WTP for agricultural advisory services. For instance, Tobit model (Abebaw Abebe, 2023), Logit model (Tolera *et al*., 2014)**,** and Probit model (Aydogdu, 2017) by using the contingent valuation method(CVM). However identifying the households WTP for agricultural advisory services by using random parameter logit model (RPL) with discrete choice experiment approach is also less studied.

Therefore this study examines if vegetable farmers in the study area will be willing to pay for a vegetable advisory service that can deliver the much-needed timely, adequate, and appropriate information through a paid extension service by using discrete choice experiments with random parameter logit model (RPL). Therefore this study initiated to fill this gap by adding knowledge in the area.

1.3 Objectives of the study

1.3.1 General objective

- The general objective of this study is to investigate farmers' willingness to pay for improved vegetable extension services.

1.3.2 Specific objectives

- To identify farmers preferences for vegetable extension service attributes.
- To analyse factors affecting farmers' willingness to pay for vegetable extension services.
- To elicit mean farmers WTP for improved vegetable extension services attributes.

1.4 Research question

This study is expected to answer the following research questions like:

1. Which vegetable advisory service attributes are more important for framers?
2. Do households' preferences affected by farmers' socio- economic characteristics?
3. What is the mean willingness to pay (MWTP) for improved vegetable advisory services?

1.5 Significance of the study

The research is designed to generate information that would be helpful in formulating robust private agricultural extension strategies while intervening to promote horticultural crops to bridge food supply gaps, income and food security by policy makers. At the same time, policy makers at different levels would benefit from the information generated by the research in scaling out of the private agricultural extension services. This is because determining the contribution of private agricultural extension services to household productivity and income improvement of farmers is very important for policy formulation and implementation.

In its generic sense, the outcomes of this research would lead to knowledge accumulation where knowing the private agricultural extension by the government and interested stakeholders would help them to gear income. It would be helpful for different development actors in planning future intervention areas and approaches for private agricultural extension development in terms of household adoption of technology and productivity. Last but not least, all these arguments over the significance of doing this research that is expected to lead to identifying, analyzing and understanding willingness to pay for private vegetable agricultural extension and its determinant factor for willingness to pay for private vegetable agricultural extension. In addition, the findings of the research would be used as benchmarks for further studies in private agricultural extension in general and factor related with private agricultural extension development interventions, policies and institutions in particular.

1.6 Scope and limitation of the study

The study was limited to investigating the Farmers' preference and their willingness to pay for improved vegetable advisory services. The major limitations of this study are: The study only examines the advisory services in relation to vegetables rather looking in general and defined the levels for each selected vegetable advisory services attributes where there is no enough physical data in the area. However, to define the correct levels of each attribute previous scientific

investigation on advisory services under valuation in other area in Ethiopia as well as in other parts of the world and expert advice were used.

1.7 Organization of the Thesis

The study is organized as follows. In chapter one, the following sub-titles are discussed, background, statement of the problem, objectives of the study, research questions, significances, scope and limitation of the study. Chapter two deal with the review of related literatures relevant to the study. In chapter three sampling technique & sample size determination, method of data collection and source of data, method of data analysis, econometrics model, and description of variable are discussed. In chapter four, the study is presented the major findings of the study with interpretation. In chapter five discussions of significant results are discussed. The Paper ends with a conclusion and recommendation sections that reflects on the value of the choice experiment and the potential for paid extension among smallholders. Through these sections, the paper critically contributes to the feasibility of paid extension services by showing how the diversity of farmers' characteristics could inform decisions on willingness to pay, which could allow policymakers to design targeted interventions for potential private extension services.

1.8 Ethical approval

Consent was obtained from respondents prior to each interview. Respondents were provided with the chance to review the study's information and had it thoroughly explained by the research assistants. Those who were not open to participate are not enforced to respond. The study received ethical approval from the Bahir Dar University committee on Research Ethics on Social Sciences (Ethiopia) and permission also obtained from Agricultural Economics department as well as each kebele.

CHAPTER TWO

LITRATURE REVIEW

The purpose of this chapter is to provide background information on general concepts and empirical findings of previous studies on willingness to pay of households for extension services. The review starts by defining terms such as agricultural extension, and Extension Privatization, concepts and definition of willingness to pay. In addition, review of previous studies related determinate factor to willingness to pay for extension service is discussed towards the end of the chapter.

2.1 Definition and concepts of agricultural extension and Extension privatization

Agricultural Extension: The Food and Agriculture Organization (FAO) (2010), defines agricultural extension as; "systems that should facilitate the access of farmers, their organizations, and other market actors to knowledge, information, and technologies; facilitate their interaction with partners in research, education, agribusiness, and other relevant institutions; and assist them in developing their own technical, organizational and management skills and practices". Agricultural extension service could be the government agency or ministry responsible for promoting the adoption and utilization of new scientific farming practices through educational procedures (Bayisa Debelo, 2020).

Extension Privatization: Private extension is simply the provision of a service or advice by a private firm in exchange for a fee; the terms and conditions of the transaction are negotiated in an open market. The degree to which this can be done in practice depends on the extent to which extension services can be converted into a private good (Oladele, 2008). In its pure sense, privatization implies a full transfer of ownership (usually by way of sale) from government to a private entity, with that entity meeting all costs and receiving any profits (Rivera & Cary, 1997).

2.1.1 Types of agricultural extension services providing methods

Agricultural extension offerings can probably be supplied with the aid of using three ways, namely, the general public sector, non-public non-earnings sector, and personal for-earnings

sector. Extension organizations funded and administered completely by the government were treated as public organization. Private for profit organizations are self-funded extension providers, offer service as a part of product promotion and/or maximizing profit. However, private non-profit are donor supported independent and non-government organizations, provide free extension services to their clients for self-development.

Public extension: In most of the low income countries, technical information and technology provisioning are made through the public agricultural advisory systems (Rada & Fuglie, 2019). Publicly funded extension services means a delivery of extension services by governments. The public good of extension on environmental-friendly farming practices requires active participation of government institution (Muhammad et al., 2020). Public sector which provides extension service is Ministries (department of agriculture).

Private non-profit: non-profit-making entities such as non-governmental organization, faith based initiatives and community-based organizations (CBOs) are providing agricultural extension services. They maintain that their involvement in such activities is motivated by the search for sustainable ways to reduce chronic poverty prevalence among the rural communities (Muyanga & Jayne, 2008). Examples of such sector can be universities, commodity foundation, and commodity boards, international research centers.

Private profit: Private extension refers to the innovative ways that a private agency/ corporate adopts in delivering the information and other input services as desired/ demanded by the farmers (Muyanga & Jayne, 2008). Private extension service providers are farmers association, private consulting &Media Company, private production & marketing firms, and input manufactures & distribution etc.

2.1.2 The main contributions of agricultural extension (advisory) services

Growth farming: Extension programs help farmers in Ethiopia to produce more food in a variety of contexts. High agricultural yields are experienced due to extension services (Abebaw Abebe, 2023).

Distribute information: The extension services disseminate information to solve the problems of farmers in the farm fields (Bayisa Debelo, 2020).

Encourage and promote technologies: The extension services contribute to the promotion of farming technologies to farmers. The extension system encourages farmers to adopt new technologies in order to increase yields (Abebaw Abebe, 2023).

Increase commercialization: The fundamental goal of extension services is to improve the commercialization of farm products (Abebaw Abebe, 2023). In terms of selling of agricultural products, it is satisfies the demand of numerous parties. With the extension system, market orientation is supported. Extension services therefore aid in enhancing the marketing of agriculture (Bayisa Debelo, 2020).

2.2 Concepts and definition of Willingness to pay

Understanding the willingness to pay is crucial in many business and policy decision-making areas, including introducing new services and pricing. Many approaches are used in literature to determine willingness to pay (Bohm, 1979; Jedidi & Jagpal, 2009).

Willingness to pay (WTP): It is the maximum amount of income or labor a person were pay in an exchange for an improvement in circumstances (Jedidi & Jagpal, 2009). For non-marketable goods and services, the WTP is not stated in the markets and must be expressed differently. There are two different approaches to deduce WTP. Revealed preference techniques and Stated preference techniques. Revealed preference techniques rely on deriving the costs and revenues from proxy or related markets (Train, 2009). The two most well-known revealed preference methods are the travel cost method and the hedonic pricing method (Alpizar, 2001). Revealed preference approaches adopt an association of complementarity or substitutability between a market good and a non-marketable good. Stated preference methods use survey techniques to elicit willingness to pay for a marginal improvement or avoid a marginal loss in marketed goods (Bromley, 2012). The stated preference method assesses the value of non-market goods by using individuals' stated behavior in a hypothetical setting. Contingent valuation and Discrete Choice Experiments (DCEs) are the most commonly applicable stated preference methods.

The contingent Valuation Method (CVM) requires that individuals (Lancsar & Louviere, 2008) express their preferences for some environmental resource or change in resource status by responding to hypothetical questions about choices. The main strength of this method over DCE method is its capacity to capture non-use values, which are essential for the monetary valuation

of the non-marketed public. In CVM questionnaire design, one of the most important things is the choice of payment vehicle.

DCE uses monetary information on trade-offs between attributes to estimate how much money respondents would be willing to pay for a change in attribute levels (Lancsar & Louviere, 2008; Mangham *et al.,* 2009). DCEs are based on multiple premises: firstly, any good or service can be described by its characteristics (or attributes), and secondly, the extent to which an individual values a good or service depends upon the nature and levels of these characteristics (Lancaster, 1966). The technique involves presenting individuals with choices of scenarios described in terms of characteristics and associated levels. For each choice, they are asked to choose their preferred scenario. Response data are modeled within a benefit (or satisfaction) function, which provides information on whether the given characteristics are important, the relative importance of characteristics, and the rate at which individuals are willing to trade between characteristics, and overall benefit scores for alternative. Features included in DCE are several attributes, choice tasks, alternatives, a range of the alternatives, and several levels used to describe the corresponding attribute (Mariel *et al.,* 2021).

The choice between the contingent valuation method and the choice experiment depends partly on how much detail is required on the characteristics of the good or effect being valued. DCE has some advantages over the CV, such as the reduction of sources of bias by making the interviewees compensate for the various characteristics of the good, the breakdown of the total value into the value of its attributes, the obtainment of more information by the interviewees, and a decreased incidence of ethical protest, provide more clear information in prioritization of product or service features for policy makers (Hanley *et al*., 2006; He *et al*., 2017; Villanueva *et al*., 2017).

2.2.1 Theoretical framework of discrete choice experiment

Discrete choice experiment works based on the random utility theory and the Lancaster theory of characteristics. The random utility theory was Proposed by (McFadden, 1974), posits that when individuals are faced with a choice between multiple alternatives, their decision-making process is influenced by a combination of their socio-economic characteristics and the perceived attractiveness of each alternative. This theory suggests that individuals evaluate the utility or

satisfaction they would derive from each option based on factors such as price, quality, convenience, and personal preferences. By considering these attributes against their own socio-economic traits, such as income, education level, and lifestyle, individuals ultimately make a decision that maximizes their overall utility or satisfaction. In essence, Random Utility Theory provides a framework for understanding how individuals make choices in complex decision-making situations by considering both objective characteristics of the alternatives and subjective preferences of the decision-maker. And the Lancaster theory of characteristics was proposed by (Lancaster, 1966), challenges the traditional view that the utility derived from goods is solely based on the goods themselves. By emphasizing the importance of attributes, Lancaster's theory highlights the idea that consumers do not simply purchase goods for their intrinsic value, but rather for the specific qualities that align with their preferences and needs. For example, when choosing between two smartphones, a consumer may consider attributes such as camera quality, battery life, and user interface design, rather than just the brand name or price. Furthermore, the Lancaster theory of characteristics suggests that individuals derive utility from the combination of attributes present in a good, rather than from the good as a whole. This nuanced perspective acknowledges that different individuals may value attributes differently based on their unique preferences and circumstances.

2.3 Empirical Review

2.3.1 Determinants of Farmers' WTP for extension services

Fee based extension services is only possible if farmers are willing to pay for these services and where extension services have previously been provided free of charge, Farmers' level of interaction with extension offerings is necessarily stricken by socioeconomic and demographic factors. Since these relations take place at the grassroots level, they are integrally dependent on the specificities of this grassroots context. Determining those impacts on the extent of interplay on the grassroots stage can offer an critical contribution to formulating guidelines and techniques that may beautify the dissemination of information (Gebremariam et al., 2021).

According to Yasin Ahmed & Erimase Tesfaye (2021) studies on determinates of farmers' preference for watershed ecosystem services in East and West Belesa Districts, using choice experiment (DCE) result revealed that farmers preferred the inclusion of different ecosystem

services watershed interventions. However, the preference of the services was governed by the interaction of farmers' socioeconomic settings and attitudinal backgrounds. For example, household's family size and farm size found significant result on the choice of participants.

According to Wubante *et al*., (2021) studies on preferences and willingness to pay for cropland attributes in Bahir Dar, northwest Ethiopia, A choice experiment (DCE) result shows that many farmers in the area showed interest in the proposed alternative croplands and seem to have different preferences with respect to these attributes, even though farmers have positive preference for some attribute, some do not this shows their socio-economic characters determine their choice with attributes.

According to Abebaw Abebe, (2023), studies on Farmers' willingness to pay for mobile phone based agricultural extension service in northern Ethiopia indicated that 81.07% of the respondents are generally willing to pay for mobile phone-based extension service and educational status of farmers', ownership of the mobile phone, information-seeking behavior of farmers, distance from home to the nearest town and access to electric power were positively affecting the willingness to pay for the service. Moreover Kidane Tesfay & Gidey Kidu, (2020), studies on Smallholder Farmers Willingness to Pay for Privatized Agricultural Extension Services in Tigray National Regional State, Ethiopia: a result of logit model indicated that 58% of the respondents were willing to pay for the privatization of agricultural extension services and, age, family size, credit access, were negatively influenced farmers' willingness to pay and frequency of extension contact , farm size and income were positively influenced farmers' willingness to pay for privatized of agricultural extension services.

According to (Tolera et al., 2014), studies on eastern Ethiopia (Haramaya) 10.5% of sampled farmers agreed to pay for current extension service provided by development agents in their village. The remaining 89.5% of the respondents were not willing to pay for the current services. But Majority of respondents (64.2%) were favorably disposed to paying for extension services if the service is satisfying them and could earn more profit than what they are now getting. These results imply that there exists significant demand by farmers for extension information services, making it potentially attractive for commercialization or privatization if high-quality extension services can be provided. If these services result in a fee that will not affect the farmer's solvency

and prosperity negatively, farmers will want to make more use of it, and extension service staff will pay more attention and effort that is simply a win-win situation.

Sumo *et al.,* (2023), studies on Determinants of Smallholder Rice Farmers' Willingness-to-Pay for Private Extension Services in Liberia; a result of double- bounded logit model founds that 78.7% of the rice farmers were willing to pay for privatized extension services and on average, a farmer was willing to pay a united states dollar (US$)11.21 per farm visit and the results showed that the household head's age, years of schooling, household size, annual income, and farm experience have significantly influenced the WTP. According to Gosbert *et al.,* (2019), studies on Factors determining crop farmers' willingness to pay for agricultural extension services in Tanzania: a result of Tobit model found that 92% of the respondents are willing to pay for AAS and it was also found that farmer's age, education, farming experience, distance from farm to the nearest important road, income and attitude towards AASs are significant determinants of farmers willingness to pay for AASs. According to Daniel Temesgen and Teferi Tola (2015), studies on Determinates of small holder farmers willingness to pay for agricultural extension services: A case study from Eastern Ethiopia: a result of logit model showed household income and farm size were a significant positive relationship on willingness to pay (WTP) and other household characteristics such as age of household head, media exposure, and family size were negatively influenced farmers WTP.

According to Aydogdu (2017), studies on Evaluation of Farmers' WTP for extension services in GAP- Harran plain, Turkey: a result of Binomial probit and Maximum likelihood found that Marital status, land, and educational level were positively influence farmers' willingness to pay and gravity irrigation user were negatively influenced farmers' willingness to pay. Moreover According to (Oladele, 2008), only 30 percentage of the farmers of the Oyo nation of Nigeria have been willing to pay for decided on extension carrier that's formed via way of means of the various needs of the farmers. Uddin & Gao, (2013), In a study in Uganda, found that about 35 percent and 40 percent farmers were willing to pay Ugandan shilling 3400 (US$ 1.8) and 3700 (US$ 2) per trip for extension services in crop and animal husbandry respectively.

Umali-Deininger, (1997); further strengthened by arguing that small and illiterate farmers were not being entertained by the extension services of both public and private sectors. Large

landholding farmers got information about new technology from private sector that did not pass it on to smallholders and illiterate farmers despite having majority in the country. It became, however, discovered that public area extension became imparting offerings to teach the farmers, now no longer always toward people with massive landholdings. Private extension staff was facilitating the farmers more than the public agricultural extension staff. The vehicles had been provided to every extension field staff for field tours and it was being treated as an attractive travel facility offered by the private sector. Economic analysis revealed that there was a ratio of 1:10 on spending of public and private sector extension agents. The public sector extension agents were only given bicycle to visit the farming communities for extension work (KHOOHARO, 2008).

Each case is one of a kind and the maximum vital issue in assuring development in offerings reform, which includes privatization measures, and improvement of a success partnership among the private and non-private sectors is the preparedness of all actors to engage in open experiential learning processes and stand-in the self-confidence and local leadership necessary for their own lessons and capacities to bring about the outcomes and ends they require. The private sector basically offers some services for a certain profit. It is important to know how many the farmers WTP depending on the costs involved in making a profit. As a result, in both calculations of public and private sectors' cost estimates for efficient management, it is necessary to know the level of the farmers' WTP.

2.3.2 Needs of Extension privatization on vegetables

Vegetables may be described as those plants, which are consumed in relatively small quantities as a side dish with the staple food. The term ‘vegetable’ also can be used to designate the smooth safe to eat shoots, leaves, end result and roots of vegetation which might be eaten entire or component uncooked or cooked as a supplement to starchy foods and meets (Muluneh Bekele *et al*., 2016). Vegetables can be distinguished from field crops by the fact that, vegetables are harvested when the plant is fresh and high in moisture while the fields crops are harvested at the mature stage for their grains seeds, roots fiber etc.

According to Muluneh Bekele *et al*., (2016),there are various problems which encountered in vegetable production of which disease, lack of necessary inputs, perishability, and poor market

linkage are the major ones. Therefore farmers require appropriate, acceptable and applicable information on vegetable production to increase production, minimize the perishability thereby increasing their income and food security status (Gebremariam *et al.*, 2021). And this information can be delivered for farmer through agricultural extension services. However, the current extension system does not bring the expected result where the majority of farmers are subsistence oriented and the problem is worsen in the case of vegetable crops due to the nature of their perishability.

2.4 Conceptual frame work of the study

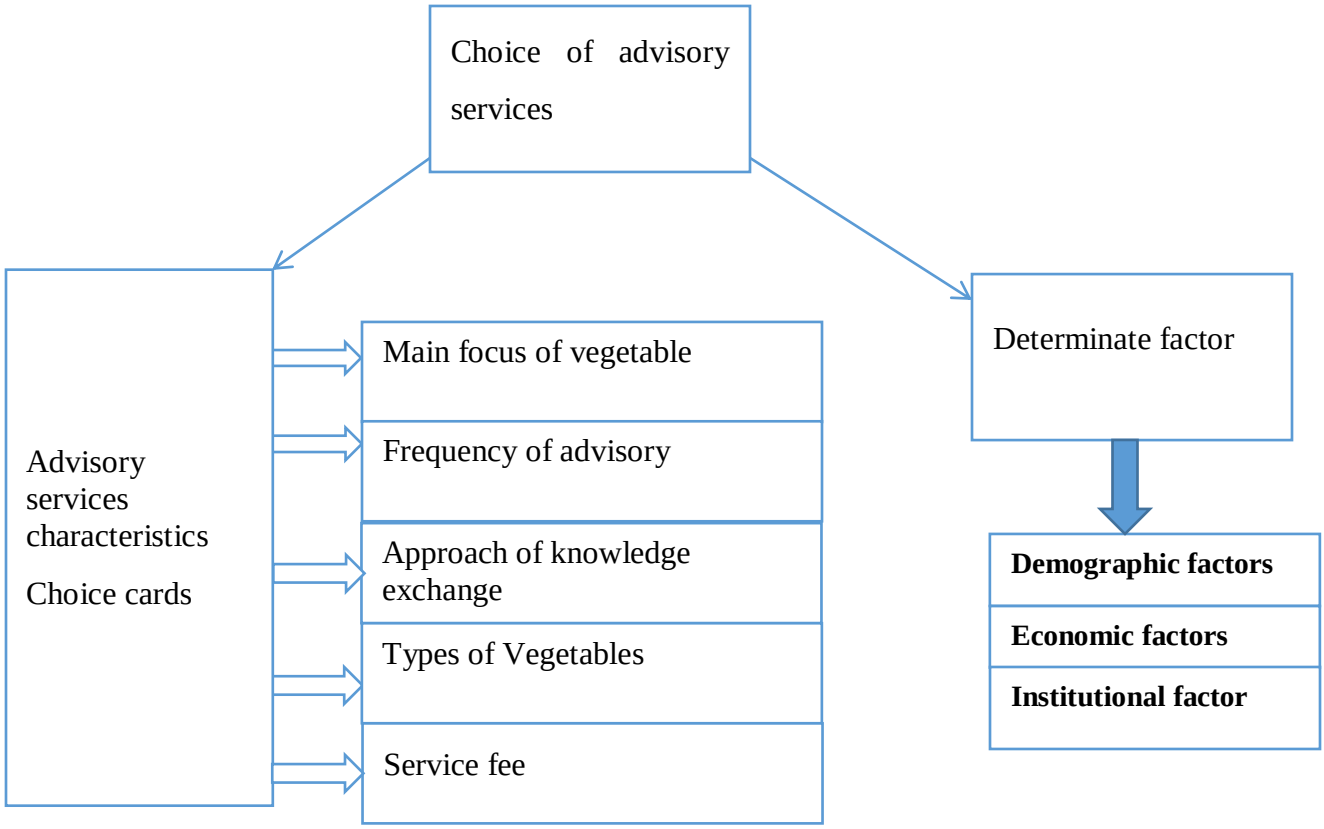

Figure 1: Conceptual frame work of the study.

The conceptual frame work shows that the choice or preferences of the farmers to choose which advisory service and how much their willing to pay is depend on the characteristics of the service described by five attributes and different socio-economic and institutional characteristics by adding his/her personal demographic nature. The characteristics of the good are described by

different attributes and each has their own attribute levels. The other factors are economical factor like income, demographical factor like their age and institutional factors like access to different institution (extension contact, training credit).

CHAPTER THREE

RERESEARCH METHODOLOGY

3.1 Description of the Study Area

The study was conducted in two districts of the Amhara region, Fogera and North Mecha, northwest Ethiopia. These districts are near Lake Tana, Rib and Koga irrigation schemes that provide access to irrigation water facilities, which allows for the cultivation of a variety of vegetables including onions, tomatoes, cabbage, and potatoes (Kassahun Berhanu & Tegegne Gebre-Egziabher, 2014).

Fogera district is located in South Gondar zone of the Amhara regional state in Ethiopia. The Fogera is bordered on the south by Dera, on the west by LakeTana, on the north by the Reb which separates it from Kemekem, on the northeast by Ebenat, and on the east by Farta and the administrative center for this woreda is Wereta City. The district lies between 110 58 N latitude and 370 41 E longitude. The altitude of the district ranges from 1774 mean above sea level to 2410 mean above sea level. Based on the 2021 national census conducted by CSA, this woreda has a total population of 304,703of whom 154,990 are men and 149,713 are women. The District has a total area of 1,111 km2 with a population density of 270.3/km^2persons per square kilometer. The major food crop types grown in the district consist of cereals, vegetables and fruits etc.

North Mecha (formerly known as Merawi) is Part of the North Gojjam Zone, Mecha is bordered on the south by Sekela, on the southwest by the Agew Awi Zone, on the west by the Lesser Abay River which separates it from Debub Achefer and Semien Achefer, on the northeast by Bahir Dar Zuria, and on the east by Yilmana Densa. Towns in Mecha include Merawi and Wetet Abay. Based on the 2021 national census conducted by CSA, this woreda has a total population of 378,704, of whom 191,243 are men and 187,461 are women. The District has a total area of 1,481.64 km2 with a population density of 197.13 persons per square kilometer. The mean annual temperature of the District lies between 17.5°C-20°C and mean annual rainfall of 1200-1800 mm. The major food crop types grown in the district consist of cereals, oil crops, pulses, vegetables and fruits.

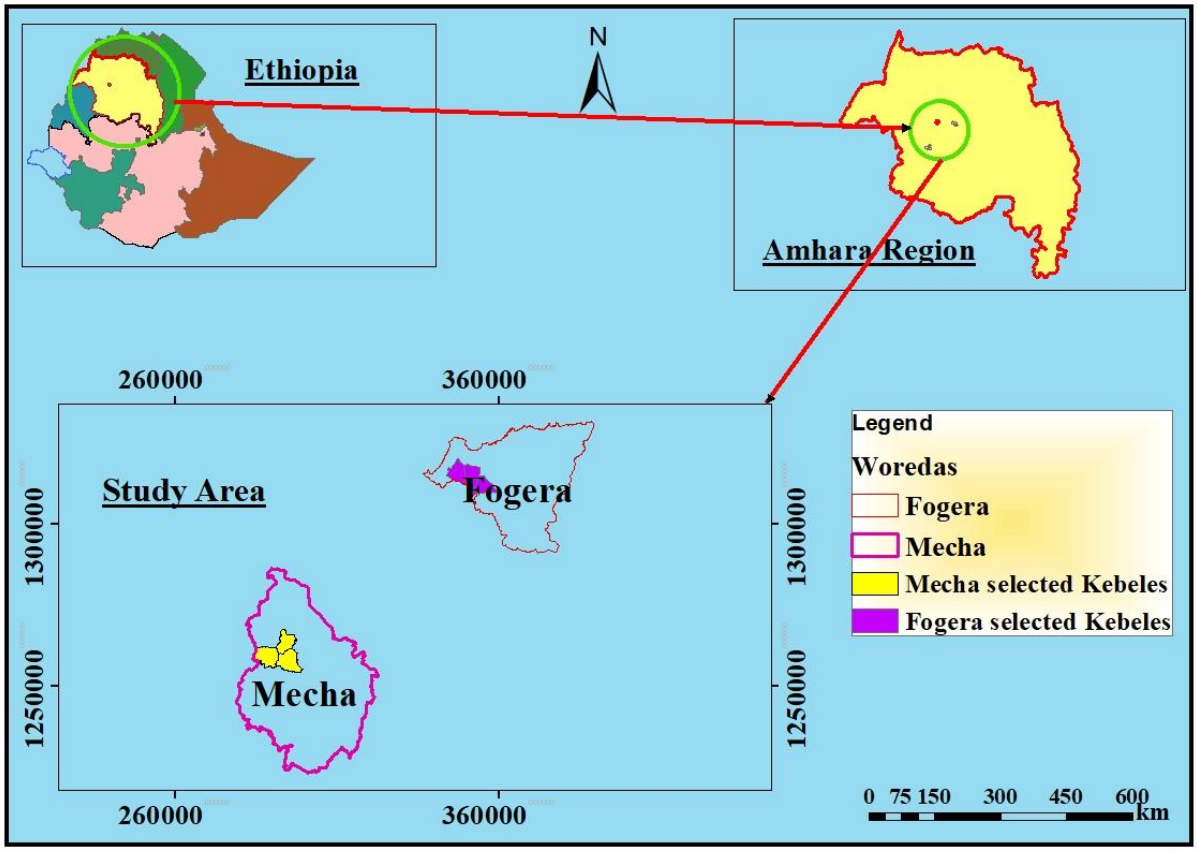

Figure 2: Map of the study area

3.2 Sources of data and Method of data collection

For this study, we collected data from two districts in the Amhara region (Fogera and North Mecha) from both primary and secondary sources. A choice experiment approach was used to gather data from smallholder vegetable producers. The study gathered survey data by conducting face-to-face interviews with sample household heads. A standardized questionnaire was utilized and administered through the kobo tool box online data collecting platform. Secondary data was also used from reports of woredas agriculture office, journals, and Google wekipidea.

3.3 Sample Size and Sampling Technique

3.3.1 Sampling technique

The household heads of the respondents were chosen through a two-stage sampling process. During the initial phase, we carefully chose specific Kebeles in the district that grows vegetable crops. The data regarding the significance of vegetable farming in the two districts was acquired

from the agricultural offices of the respective study districts. Afterwards, 6 Kebeles was chosen by using random sampling technique three Kebeles from each district. Then sample households were chosen by systematic random sampling technique from the designated Kebeles. The sample households were distributed proportional to the population size in each kebele. Since the study target population was vegetable producer households, the sampling frame for this study is the list of households in the sample Kebeles who participate in vegetable farming and the data were collected household level, by face to face survey, thus the sampling unit was households.

3.3.2 Sample size determination

Cochran formula is used to compute the essential sample size for the essential level of precision, confidence level and the estimated proportion of the attribute present in the population. Cochran formula is most suitable for a large population. Cochran (1977) developed an equation to find the sample size for the large population proportion.

$$n_0 = Z^2 * p * q / e^2$$

Which is valid where n_0 is the sample size, Z^2 is the area under the acceptance region in a normal distribution $(1 - \alpha)$, e is the preferred level of precision, p is the estimated proportion of an attribute that is present in the population, and q is 1- p.

$$((1.96)^2 (0.5)(0.5)) / (0.05)^2 = 385$$

But 393 household were used and we have 7074 observations for the choice analysis which came from (393*18) by multiplying each household observe 6 cards and each card have 3 options. The samples are distributed among different Kebeles as follows: 15% from Ambomesk, 20% from Kudmi, 11% from Angut, 23% from Kidist Hana, 17% from Shina, and 14% from Kuharmikceal that means 46% from North Mecha and 54% from Fogera woredas.

Name of Kebeles	Name of woredas		Total
	North Mecha	Fogera	
Ambomesk	58		
Kudmi	79		
Angut	42		
Kidist Hana		92	

Shina		66	
Kuharmikceal		56	
Total	179	214	393

Table 1: Sample size determination by woreda and kebele

3.4 Method of Data Analysis

In this study both descriptive and econometric analytical tools were used and the analysis was performed by using STATA 17 statistical software.

3.4.1 Descriptive Analysis

Descriptive statistics is applicable to summarize and present the data in a manageable form. So by using descriptive statistics the socio-economic and demographic characteristics of the households were analyzed. The descriptive analysis is essential in providing better understanding of relevant features of sample units. The statistics were mean, minimum and maximum values, frequencies, percentages and use graph and charts.

3.4.2 Econometric analysis

3.4.2.1 Discrete choice experiment (DCE) design

Choice experiments are designed with a premises that a service or a policy can be designed using the attributes and attribute levels (Louviere *et al.*, 2009). Thus, it involves presenting sample respondents with a range of competing alternatives, such as different vegetable advisory services, and asking them to choose from. Identifying relevant attributes and levels is vital to designing a stated preference study. Horticulture specialists and preference elicitation research on extension services were reviewed to determine the key features of vegetable advisory services (Altobelli *et al.,* 2021; James *et al.,* 2011; Tesfaye *et al.,* 2020). To initiate the D-efficient design on Ngene, studies were used to determine the priors.

Accordingly, the main attributes of the vegetable advisory service were identified to be: Frequency of advisory service, the main focus of vegetable advisory service, approach of advisory knowledge/information exchange, the Types of vegetables covered by the proposed advisory service and the service fee for the advisory in ETB (Ethiopian Birr). In our case, we have three alternatives: two vegetable extension services and one opt-out. In the choice experiment, respondents were then asked to indicate their preferred alternative. That is, respondents were asked on which of the two alternatives they preferred but could state for opt-

out which represents neither. The opt-out option has been provided to the respondents to avoid a forced choice.

From the five vegetable advisory attributes included in the experimental design, three of them with 3 attribute levels, one of them with 4 attribute levels, and the remaining one attributes with 2 attribute levels. In this study, an efficient design was used to create choice sets using Ngene software, and this resulted in 18 choice sets which have been grouped in to three blocks, each with 6 choice sets which are provided randomly to respondents. The numbers of choice sets are limited to 6 to avert response fatigue. A single respondent accordingly presented with 6 choices sets out of the total 18 in the survey. By this way, from the total of 393 respondents we generated 7074 observations. The attribute and their level are explained in table 2 and an example of a choice set provided to respondents is shown in table 3.

Attribute	**Vegetable advisory service option 1**	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable Inputs 	Focus on vegetable management 	
Frequency of advisory service	Advice service Per two weeks	Advice service Per one month duration	
Approach of knowledge exchange	farmers go to one stop shops 	Advice delivered On-field 	
Types of Vegetables in the advisory service	Main focus Root and tuber 	Main focus on Fruity vegetables 	

Service fee for advisory	100 ETB per month 	140 ETB per month 	
Choice question: which of the alternatives do you prefer?			

Table 2: Choice set sample

3.4.2.2 Choice experiment model specification

This study was applied a discrete choice experiment with farmers WTP for a hypothetical vegetable extension service. Preferring the choice experiment as opposed to contingent valuation is that to analyses the preferences of the farmers between multiple attributes of the service and their willingness to pay. Random utility theory and Lancaster's theory of characteristics serve as the theoretical foundations for DCE. In our case, any individual who was faced with different advisory scenarios is expected to choose a vegetable advisory service alternative that provides the highest level of utility. This choice is depend upon the properties of the alternatives provided (attributes of advisory services) in competition, as well as the characteristics of the individual who is making the choices.

Decision makers (farmers in this case) demonstrate their preferences for certain attributes and their willingness to accept trade-offs for these attributes that are embedded with the alternatives by choosing one alternative over another (Altobelli *et al.*, 2018). Following (Schaafsma *et al.*, (2019) , we define a latent variable Vnjs*, which signifies an indirect utility function associated with the selection of alternative j by farmer n from a given set of choices. As a result, farmer n is provided with K possible alternatives that are within a choice set s. In every conceivable scenario, commonly referred to as a choice set, producers are presumed to optimize their utility. Thus:

$$V_{njs} = \begin{cases} 1 \text{ if } V^*_{njs} = \max(V^*_{n1s}, V^*_{n2s}, \ldots\ldots, V^*_{nKs}) \\ 0 \qquad \text{otherwise} \end{cases} \qquad (1)$$

Farmer n will choose alternative j so if $V^{*}_{njs} > V^{*}_{nKs}\ \forall\ K \neq j$. In Eq. 1, the actual utility is observed through the utility maximizing choiceV_{njs}, but the indirect utility V^{*}_{njs} is not directly observable. Indirect utility is assumed to be linear whereas marginal utility is monotonic (i.e., not increasing nor decreasing), yielding corner solutions where one choice is selected (Silberg *et al*., 2020). Based on this assumption, the utility function of farmer n is written as

$$V^{*}_{njs} = X'_{njs}\beta + \varepsilon_{njs} \qquad (2)$$

Where X'_{njs} represents the vector of attributes of each choice for the jth alternative observed by farmer n; β is the vector of parameters that explain the influence each attribute has on the choice (e.g., frequency of advisory service); and $\varepsilon_{njs}$is the unobserved (stochastic) component of utility, independent from the observed components (i.e., X), and equally distributed across individuals and choices. The unobserved component reflects the hypothesis that unobserved variations and errors occur in a farmer's preferences for an alternative in any given choice set.

The random parameter logit model allows us to examine farmers' preference and their willingness for improved vegetable extension services to varying randomly assigned attributes. The model was also used to evaluate the heterogeneity of choices among individuals. This is intended to show which attribute preferences are associated with specific types of farmers (e.g., male, female). The probability that a farmer n chooses alternative j in choice set s is assumed to be (Train, 2009):

$$\text{prob}\left(V_{njs} = 1 \middle| (X'_{i1s}, (X'_{i2s}, \ldots., (X'_{iks}, \wedge)))\right) \qquad (3)$$

$$= \int \frac{\exp(X'_{ijs}\beta)}{\sum_{k=1}^{k}\exp(X'_{iks}\beta)}\, f(\beta|\wedge)d\beta)$$

Where $X'_{iks}\beta$ are marginal utility parameters and various attribute levels? Λ refers to the parameters characterizing the distribution of random parameters such as the mean and covariance of β (Waldman *et al*., 2017). In this study, we specify the parameters (i.e., the attributes of vegetables advisory services) and their respective attribute levels (e.g., per one week, two weeks and per month delivery frequency). In Eq. 3, the probability is numerically approximated through maximum likelihood simulation. Coefficients corresponding to each attribute are assumed to

follow a normal distribution. By doing so, their sign can either be positive or negative, indicating preferences for each attribute. The random parameter logit model was estimated using STATA17. Due to the non-cardinal nature of utility; the coefficients generated by an RPL have limited economic interpretation (Silberg *et al.*, 2020). To gain insights about the behavior of sampled individuals, economic trade-offs are calculated by dividing attributes that do not have monetary values (e.g., types of vegetables in the vegetable advisory service) with ones that do (e.g., service fee)

$$\text{MWTP attributes} = \frac{\beta i(\text{atributes})}{\beta 6(\text{price})} \qquad (4)$$

A positive, negative, or null WTP ratio is indicated by the values. Instead of giving everyone the identical value for all of their traits, RPLs show whether the coefficients for each person follow a testable distribution (Train, 2009). According to Nahuelhual *et al.*, (2004), the random coefficient in the WTP space might have either a positive or negative sign. Although it's not quite right, when an attribute parameter has a positive ratio, it means people are ready to pay more for an attribute that reduces their utility (more payment for practical farm advice, for example). The monetary cost that people are willing to bear to accept a modification to a feature that reduces its value may be represented as a negative ratio (Rigby & Burton, 2005).

3.5 Definition of variables and working hypothesis

3.5.1 Dependent variables

Willingness to pay for improved vegetables extension services: The dependent variable for analysis is (choice) WTP for improved vegetable extension service using two binary variables each taking a value of 1 if the household is willing (choice) and 0, otherwise.

3.5.2 Explanatory variables

The independent variables of the study were those which are hypothesized to have an association with households' willingness to pay for improved vegetable extension service. And the choices of explanatory variables are based on literature on past studies on households WTP and the existing theoretical explanations.

The explanatory variables are:

1. Age of Household Hade (Age of HH): It is continuous variable measure by year. The farmer's age can be taken as a combination of the effect of farming experience and planning horizon. It is

a proxy measure of farming experience. The result shows with studies of Kidane Tesfay & Gidey Kidu, (2020), which indicated that age was positively correlated with Small holder farmer WTP for Privatized Extension Services Tigray and also Daniel Temesgen and Teferi Tola (2015), indicated that age was negatively correlated with Determinants of small holder farmers WTP for agricultural extension services a case study from Eastern Ethiopia. Therefore age will be hypothtically Proposed to be positve or negetive (+/-)

2. Sex of Household (Sex of the HH): It is the sex of the household head which is considered as a dummy variable taking a value of 1 for male headed household and 0 otherwise. The sex of the household head is included to differentiate between male and female household heads in their WTP for agricultural extension services. The result of (Oladele, 2008), indicates that the variable of sex of household head was significantly (-) contributed to changes in the farmers' WTP for extension 10 services. Thus, the probability of female headed households is expected to pay less for extension services compared to male headed households.

3. Family size: It is continues variable and used to measure family size by taking total number of household members. Findings of Daniel Temesgen and Teferi Tola (2015), which indicated that as household size increases, the farmer may, face the fear to feed his family and this can create negative attitudes towards willingness to pay for advisory services in Haramaya District, Ethiopia. Also Kidane Tesfay & Gidey Kidu, (2020), finds that family size was negative on farmer WTP for Privatized Extension Services Tigray. Family size will be hypothesized to be negative (-)

4. Education level: Categorical variable (not read & write = 0, read & write = 1 & got formal education = 2). Education increases the knowledge and skill of the people in a society. Finding by Aydogdu (2017) shows education had positively effect on Farmers' WTP for extension services in GAP- Harran plain, Turkey. Education will be hypothesized to be positive (+)

5. Land holding (LHH) a continuous variable stands for the total area of vegetable cultivated land (in hectare). According to Daniel Temesgen and Teferi Tola (2015), and Kidane Tesfay & Gidey Kidu, (2020), Farm size was found significant and positively associated with household's willingness to pay for the private agricultural extension service. We can determine that Land

holding will have positive relation with willingness to pay for the use of the vegetables extension services

6. Income of household: It is a continuous variable. It is measured in Ethiopian Birr and is the amount of income the household generates from various sources like crop production, livestock selling, laboring and off-farm activities. According to Daniel Temesgen and Teferi Tola (2015), Kidane Tesfay & Gidey Kidu, (2020), and Gosbert *et al*., (2019), income of household was found significant and positively associated with household's willingness to pay for the agricultural extension service. So this variable expects to affect willingness to pay for the use of improved vegetable extension services positively.

7. Extension contact status: It is a dummy variable, takes 1 if the respondents have contact with extension agent on the issue of vegetables production, 0 otherwise. Contact to extension agent amplified the farmer knowledge and skills about vegetables production activities and the adoption of other agricultural technologies. Kidane Tesfay & Gidey Kidu, (2020), showed that extension contact have positive significant impact on farmer WTP for Privatized Extension Services in Tigray. For this study extension contact status will have an expected positive effect in farmer's willingness to pay

8. Livestock holding of household (TLU): It is continues variable used to measure total livestock owned by household and defines in terms of Total Tropical livestock unit (TTLU), Livestock is considered as a measure of wealth status for the farm community which is hypothesize to have positive relationship with the willingness to pay for extension services. Livestock holding is an important indicator of cash, manure, draft power and food for the agricultural community. This variable expects to affect willingness to pay positively.

9. Access to credit: This is a dummy variable which refers to whether or not the farmer received credit and it takes 1 if the farmer received credit and 0, otherwise. Credit may solve financial constraints and enables the farmer to purchase productive inputs on time, access technologies and enhance farm production. In this case credit would positively affect WTP for extension services. Thus, we can determine that credit utilization is positively related with willingness to pay for the use of the extension services.

10. Membership of association: This variable is shows farmers membership for different local and governmental association and if farmers participate in different association they will get information about different services related with their farming. This variable will hypothesized to positively affect the willingness to pay as well as amount of payment for agricultural extension services

11. Agricultural training: This is a dummy variable that assumes a value of 1 if the household head had access to training in the past year and study that could enable widen the knowledge and skill of farmers and 0 otherwise. Farmers who have got access to such services are expected to develop the awareness about the benefits and problems related to extension services and able to seek own solution. Therefore, training is hypothesized to positively affect the willingness to pay as well as amount of payment for agricultural extension services

12. None and/or off farm activity: It is the participation of the household member in none and /or off farm activities such as daily labor, trade, work for food, etc. It is a dummy variable that takes a value 1 if the household is not participant and 0 otherwise. This variable will expect to affect farmers WTP positively.

13. Farming experience: It is continuous variable and measured in year. This is the farmer number of year spends in farming Gosbert *et al.,* (2019), shows farming experience affect Farmers' WTP for private extension services positively and some others (Gebremariam *et al.,* 2021) shows that farming experience have negatively affect their level of interaction with extension agents . Therefore farming experience will have a negative or appositive (-/+) effect on farmers' willingness to pay for improved vegetable extension service

Variable	Variable type	Effects on WTP	
	Categorical	Continuous	
Age of the HH		√	-/+
Sex of household head	√		-
Family size		√	-
Education level HH	√		+/-
land holding for vegetable		√	+

Extension services	√		+
Access to credit	√		+
Member of association	√		+
Agricultural training	√		+
None / off farm activity	√		+
Farming experience		√	-/+

Table 3: Variables and working hypothesis

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Demographic, institutional, and socioeconomic characteristics of sample household

The demographic and socioeconomic characteristics of sampled households are presented in Table 4, below. The average sample household age was 43.69 with minimum and maximum age of 19 and 81 respectively. This implies smallholder famers in the study area have experience in participating in agricultural activities. Sex of the HH: The study found that 97% of the respondents were male-headed households the remaining 3 % were female headed, this indicates that most of the households were male-headed. It was observed that sample households possess mean farm experience 22.95, with a minimum experience of 1 year and a maximum experience of 58 years. This shows the farmer mean farm experience was relatively high, indicating that the sampled households had considerable experience in agriculture, this would help the farmer to adopt a new technology regarding with agriculture and to understand advisorie services.

With regard to family size the average family size was 7.4, with values varying between a minimum of 1 and a maximum of 11 respectively and the mean working family member was 3.8. this indicates households in the study area had a relatively large family size and high working family member per household means that high labour sources in those households this may help the to increase household overall agricultural productivity. The study found that the have high working family member. This result wolud help the households by increasing laboure source to produce more diversified production and producing vegetables since the area is irrigation use area. Farming practice which is paracticd in most area of Ethiopia is raring of livestock . livestocks have so many purposes they are cash resources, and give maniure as a fertilizer for farmers and this practice also applied in our study area. The result found posess that From the total household, the average TLU was 5.18. It ranges from 0 which meanes a farmer which have no livestock up to 16.67 tropical livestock unit. This result suggested that the average TLU in the study area was samll, this indicated that most of the households focus on crop production and and this may have effect on generating cash income for house holds.

Variable	Obs	Mean	Std. Dev.	Min	Max
Age of HH	393	43.69	11.977	19	81
Family Size	393	7.402	2.078	1	11
Farm experience	393	22.952	12.107	1	58
Working family member	393	3.832	1.551	1	10
TLU	393	5.184	2.337	0	16.67
Total land	393	1.194	.604	.08	5.75
Land for vegetable	393	.389	.268	.007	2

Table 4: Demographic and socioeconomic characteristics

Landholding is a more decisive socioeconomic variable that is important for agricultural practice and livelihood improvement. The study found that the total cultivated landholding size in the study area ranges with a minimum of land 0.08 ha to a maximum of land holding 5.75 ha. On average sampled household has land size greater than one ha (1.194). However land operated for vegetables on averages it ranges 0.389. The total cultivated landholding and total land operated for vegetables data suggest that the sampled households had relatively small landholdings which could limit their ability to generate income from agriculture and production of vegetables. This limited land availability gives a home work for extension services how to be effective in production of crops and vegetables in a small portion of land.

Education together with increased experience could guide farmers to better manage their farm activities and to implement a new technology. Figure 3 indicates that out of the total sampled households 50.38% were cannot read and write and 25.45 % do have formal education. Alternatively, 24.17 % of sampled households, during the survey period, can read and write. This indicates the majority of the respondents were illiterate or had limited education, which could potentially affect their ability to adopt new extension approaches and practices related to vegetable production, this may also affect supply of vegetable .

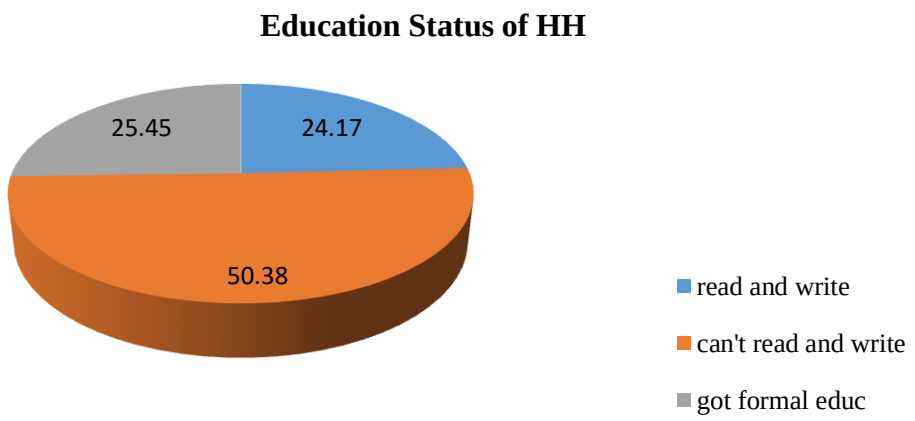

Figure 3: Education status of sampled household heads

Instiitutional services like Extension contact services, membership of an association, participation in extension training and credit access are essential for farmers to acquire knowledge and skills related to vegetable production and to increase their income& Diversifying income sources. Figure 4, below shows the institutional caracteres of sample haousholds.

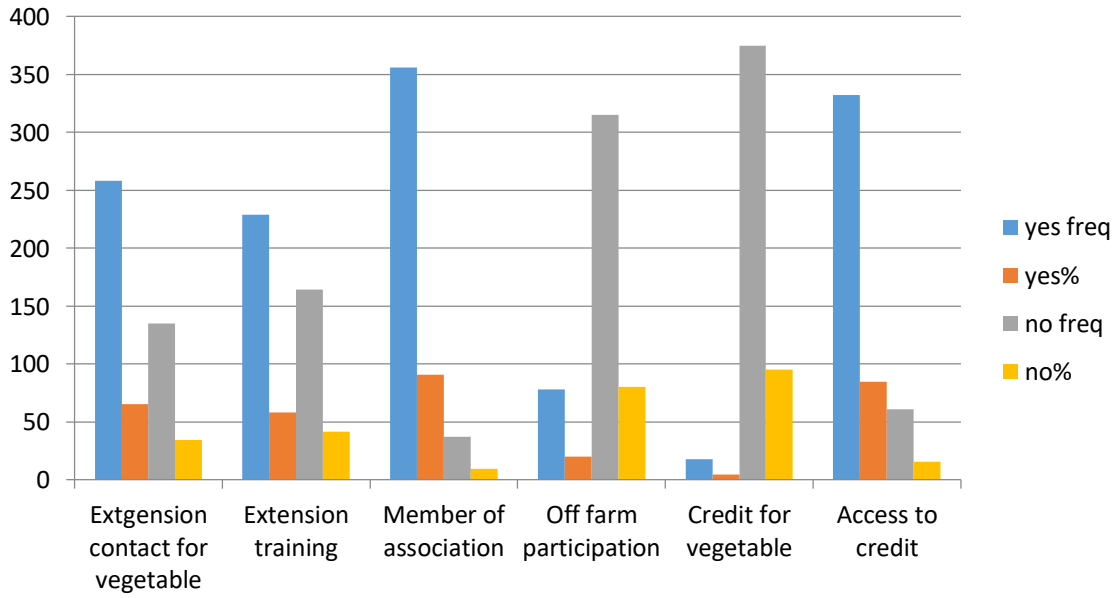

Figure 4: Institutional characteristics of HH

4.2 Vegetable advisory service choices and preferences (regression model results)

Agriculture remains the backbone of many Sub-Saharan African (SSA) countries as it contributes to maintaining food security, generating employment opportunities, being a source of foreign exchange, and providing raw materials for industries (Christiaensen, *et a*l., 2006; Diao, *et al.*, 2007; Modi, 2019). However, accessibility of agricultural information to smallholder farmers, who form the sector's core, remains a critical barrier (Megerssa, *et al.*, 2020; Ndimbwa *et al.*, 2021), to ensuring equity and inclusivity in transforming food systems to further contribute to the development of these regions. Identifying optimal conditions to ensure the right information reaches farmers at the right time to aid production decisions is a priority for many regional governments. In Ethiopia, like many other countries in the region, the government's efforts to facilitate access to information through extension have been challenged at best, necessitating calls for private supplementation to expand reach to as many farmers as possible. This study, therefore, examined whether smallholders are willing to pay for privately provided extension services and the conditions under which they will do so in Ethiopia. The econometric analysis of the data reveals some interesting results, which we will discuss in the rest of this section.

The findings of the DCE data are provided below. A positive coefficient estimate suggests a positive impact of attribute increase on the selection of a vegetable advice service, while a negative coefficient suggests a negative influence. On occasions where the attribute has three discrete levels (such as approach used for knowledge (AK) & Types Vegetables in the advisory service (TVAS)), one of the levels is used as comparison reference to the rest levels. 'Vegetables management oriented," delivered on field, and 'leafy vegetables were used as base levels for focus of vegetable advisory services, approach of knowledge exchange and types of Vegetables in the advisory service attributes, respectively.

Before the estimation of the parameters, the choice data was checked. One respondents have 3 option in each choice cards and chose 1 option and the rest 2 option are not chosen and each alternative have the probability to chosen 2358 times although we have 393 respondent (7074) observation so we have 2358 chosen option including the opt-out and the rest (4716) is not chosen options. The result of the inspection showed that the opt-out alternative was chosen in

approximately 2.5 percent of the times or (59) observation over all respondents choice. The other attributes based alternative one and alternative two were 49.2 percent and 48.3 percent as their attribute levels.

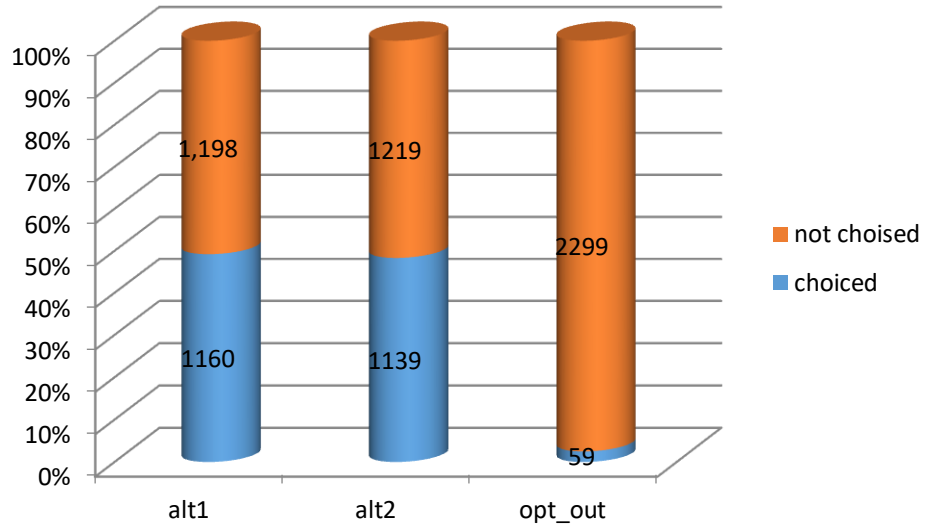

Figure 5: Alternative based choice

In the estimation, the price attribute is set fixed, and all other variables have a normal distribution. The RPL was specified as fixed or random coefficients for attributes of vegetable extension services. Main focus of vegetable advisory service (MVAS), Frequency of advisory service (FAS), Approach of knowledge exchange (AKE) &Types of Vegetables in the advisory service (TVAS) are set to random. The results from the maximum likelihood estimation of the RPL are shown in Table 6.

The results of the RPL (Mixed logit) showed that frequency of advisory, face-to-face practice-oriented mode of advisory, Rooty vegetables focused services, and monthly advisory fee significantly influenced the type of service preferred by vegetable-producing farmers by (<0.01) & (<0.05) significant level except vegetable input delivered oriented advisory service feature. The coefficient of the fixed variable of price attribute is negative and significant at <0.05 (−0.0079 ±0.00389), which indicates that the respondents' preferences decrease as the price

increases, which is consistent with the theory of demand; that demand decrease as price increase.

In Mecha and Fogera, vegetable producers highly preferred frequent visits from advisory providers, with a <0.01 level of significance. This may be due to the susceptibility of vegetables to disease, pests, and other calamities. As hypothesized, vegetable producers responded to increases in advisory fees by shifting to self-management and traditional options. The negative coefficient of the advice delivered through mobile call and advice delivered by farmers going to one-stop-shop attribute implies that practical advisory types, accompanied by expert field-level visits, were more preferred by vegetable producers than mobile-assisted and one stop-shop services, with <0.01 and <0.05 levels of significance, respectively. The result is in line with similar studies in Nigeria where high input oriented and farm-specific advisory services are preferred by maize producers (Oyinbo *et al.*, 2019), The finding underlines the long way that conventional on-site vegetable advisory service delivery through to be replaced by digital advisory service options (Aker, 2011). The result however seems to contradict with the current efforts in Ethiopia to replace field-level advisory visits with digital-assisted services eventually. According to Abebaw Abebe, (2023), previous research conducted in northern Ethiopia has shown that farmers exhibit a willingness to pay for mobile-based advising services. However, in contrast to face-to-face advisory services, the research results indicate that farmers continue to exhibit a preference for practice-oriented face-to-face advice. The potential source of this issue might be attributed to the inadequate digital accessibility resulting from the substandard digital infrastructure experienced by smallholder farmers in Ethiopia (Lulseged Tamene & Ashenafi Ali, 2022). Whereas the positive coefficients for fruit type vegetable and root type vegetable implies that those improved vegetables extension services with a focus on leafy vegetables (i.e. the comparison base) are considered desirable advisory services.

	Attributes only model			
Mean of fixed parameter	**Coefficient**	**standard Error**	**Z**	**P > (Z)**
Advisory Fee	-0.00795	0.00389	-2.04	0.041

Mean of random parameter				
Input advisory	0.20241	0.33676	0.60	0.548
Frequency of services	0.01503	0.00441	3.41	0.001
On mobile-phone	-0.94881	0.17139	-5.54	0.000
One stop shop	-0.39843	0.20088	-1.98	0.047
Fruity vegetables	0.96074	0.09472	10.14	0.000
Rooty vegetables	1.62075	0.12757	12.71	0.000
Standard Deviation random parameter	**Coefficient**	**standard Error**	**Z**	**P > (Z)**
Input advisory	0.85835	0.28376	3.02	0.002***
Frequency of services	0.00319	0.00037	8.71	0.000***
On mobile-phone	0.99874	0.15475	6.45	0.000***
One stop shop	0.03019	0.23527	0.13	0.898
Fruity vegetables	0.76422	0.14829	5.15	0.000***
Rooty vegetables	1.27165	0.14543	8.74	0.000***
Log likelihood = -1546.0302				
LRchi2(6) = 255.40				
Prob >chi2 = 0.0000				

Table 5: Random parameter logit model result with attribute only

Notes: Dependent variable is choice; Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1; or are statistically significant at 1%, 5% and 10-% level of significance, respectively

Moreover, the significant standard deviations associated with the random parameters indicate existence of unobserved sources of preference heterogeneity in the sample. Mixed logit results also indicated whether each variable exhibits preference heterogeneity, depending on whether the variable has statistically significant standard deviations. Here, advice delivered by farmers going to one stop shop attribute has not statistically significant and other attributes like advice delivered through mobile call and sms frequency of the advisory services, the main focus of the advisory which is input delivered focus, the type of the vegetable which is root type vegetable

and fruit type vegetable attributes all are significant at <0.01, level. This indicates that those significant attributes exhibits preference heterogeneity. However, the insignificant standard deviation of farmers going to one stop shop attribute implies that all farm households regardless of their socioeconomics background agree on one stop shop extension service have no more important vegetables extension service attribute over other important vegetables extension services attributes benefits.

4.3 Heterogonous effects on choices of vegetable advisory services

The mixed logit model (MXL) also estimated with interaction terms included. The inclusion of these interaction terms allowed us to account for the idea that people with different demographic socioeconomic and attitudinal variables may have different utilities with respect to vegetable producing advisory services.

The interaction between frequency of the advisory service attribute and sex was positive and statistically significant at <0.05 level. This shows male headed household Farmers have higher preference for frequent vegetable extension advisories. This result is inconsistent with the result of (Oladele, 2008), which is sex of the household have a negative influence on farmers' willingness to pay for extension services in Oyo state, Nigeria. The interaction between Frequency of the advisory service and Age was negative and statistically significant at<0.1. This means that as the farmer grows older his preferences for more frequent vegetable advisory services are less as opposed to the youngest one. This result is consistent with the result of Kidane Tesfay & Gidey Kidu, (2020), & Daniel Temesgen and Teferi Tola (2015) and inconsistent with the finding of Gosbert *et al.,* (2019) and Sumo *et al.,* (2023) which have positive effect.

However the Interaction between education statuses with frequency of advisory service has positive and statistically significant at <0.05 level. This shows that farmer with got education have more preferences for frequent vegetable advisory services. This is may be because of educated people have known more about the vulnerability of vegetables for different diseases during production and the importance of extension services for reduction of this vulnerability. This result is consistent with the result of Aydogdu (2017), Gosbert *et al.,* (2019), and Abebaw

Abebe, (2023), it assumed that an educated farmer knows the importance of AESs hence should be more willing to pay than the uneducated one.

The interaction between educations with advisory service delivered through mobile attribute is negative and statistically significant at <0.01 indicating, implying framers who got education have less concerned on advisory service delivered through mobile attribute. This result indicated that farmers with more education prefer field visit mode of delivers by field experts than mobile phone. This result is inconsistent with the result of Gosbert *et al.*, (2019), and Abebaw Abebe, (2023), which have a positive effect of education. So, generally, farmers were more willing to pay for advisory services delivered by expert field-level visits than mobile-assisted and one-stop-shop services**,** with <0.01 and <0.05 levels of significance, respectively. Hence, the result contradicts current efforts in Ethiopia, and elsewhere to replace field-level advisory visits with technology-assisted services in the long run. This result is important to broader efforts to enhance access to advisory services in Ethiopia. It is no secret that governments and international development entities in the last decade have favoured and promoted widespread digitalization of agriculture, with extension and advisories at the center of such programs (Abdulai, 2022; Abdulai *et al.,* 2023; Tsan *et al.,* 2019). Digital extension and advisories are premised on reaching the hard-to-reach farmers who turn to be left out of the mostly overstretched public extension schemes. Ironically, some have questioned if such, (McCampbell, *et al.,* 2022), who, according digital efforts are truly built in the interest of farmers (see, for example to this study's findings, tend to prefer the old face-to-face mediums). Many reasons could have accounted for this preference. The delivery of digital extension in languages (mostly English) inaccessible to smallholders, low literacies among farmers, and the sometimes-poor delivery of such information (one-way communication), among many other shortcomings of digital extensions (Kansiime, *et al.,* 2022; McCampbell, *et al.,* 2022; Tsan *et al.,* 2019), could have accounted for the choices of farmers against that medium. While this finding cast doubts on the feasibility and acceptability of digital extension for vegetable farmers in Ethiopia, it is important to note that it does not fully discount the value such services may offer farmers. Rather, this must be taken a critical avenue to open discussions on how to make such digital advisories contextually relevant and ultimately acceptable to smallholders who so badly require the right information at the right

within at a time when government resources may be so strained in ways that make face to face options practically difficult in many countries

The interaction between Extension training and root type vegetable advisory attributes has a negative and significant at <0.01 indicating, the framers who got extension training have less preferences for root and tuber type vegetables extension services than that of who doesn't got extension training. Vegetable producers in the Mecha and Fogera regions were prepared to spend five and eight times more for extension information on root and fruit vegetables (such as potatoes) than leafy vegetables (such as lettuce and cabbage). While the reason for these preferences was not apparent from the experiment, it could be based on the variations in susceptibility of these different crops to disease risk and the agronomic care required. The emergence and potential of different pathogens and diseases affecting these crops would mean farmers must constantly update their knowledge and stay updated with knowledge and information to remain profitable (Ebert, 2017; Golding, *et al.,* 2019). Hence, the fear of losses to emergent diseases could explain why farmers are willing to invest more in obtaining the right extension knowledge on these crops. Whatever the reason for this finding, it is imperative to note, however, that it further highlights the necessity of designing extension services to the specific needs of farmers rather than blanket services that do not consider differences in preferences.

However, the statistically significant standard deviation estimate of the interaction between those attributes with those variables suggests that the level of heterogeneity of the attribute varies beyond what can be explained by the variables.

VARIABLES	Mean	SD
FeeA	-0.0139*(0.00245)	
SeXFrAS	0.00290**(0.00124)	
AgeVI	0.0207(0.0149)	
AgeFrAS	-5.77e-05*(3.11e-05)	

EducOnM	-0.373***(0.125)	
EducFrAS	0.00161**(0.000692)	
ExtTrainingXFrAS	0.000961(0.000714)	
ExtTrainingXRTV	-0.599***(0.219)	
TLUXVI	0.0938(0.0738)	
ExtencontactforvegeXFrAS	-0.000450(0.000418)	
totallandforvegetablesXRTV	-0.121(0.375)	
VI	-1.763**(0.718)	1.154***(0.304)
FrAS	0.0219***(0.00346)	-0.00649***(0.00111)
OnM	-0.0677(0.239)	1.036***(0.157)
FV	1.025***(0.103)	0.911***(0.142)
RTV	2.061***(0.242)	1.412***(0.156)
Observations	7,074	7,074

Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 6: Mix reaction result

4.4 Estimation of mean willingness to pay (MWTP)

Table 8 displays the MWTP values, which are expressed in Ethiopian birr, which indicate the intensity of respondents' preference on each level of the attributes. Respondents anticipate obtaining less value from an advisory attribute for vegetable expansions with a lower MWTP, whereas a higher MWTP for the same characteristic suggests that respondents anticipate acquiring greater utility. One indicator of limited willingness to pay is the advisory service attribute's frequency (1.89). The results showed that farmers didn't really care about how often the advising practices were implemented after they started obtaining the required information. In comparison to the starting point (leafy type vegetable), the WTP to acquire the advisory for fruity vegetables is 120.89ETB, and for root type vegetables it is 203.94 ETB. Evidence like this

suggests that features might be better included in an upgraded vegetable advice service. An increase in the number of consulting services that are mobile advisory services, the average WTP is -119.39, whereas for one-stop-shop services, it is -50. Based on the results of the field expert visit, it seems that farmers do not want certain traits as much as the basic level. In addition, the findings showed that farmers were not very interested in the frequency of the practice, as shown by their relatively low readiness to pay, even after they started getting the required advising information and practices. The advising services that concentrate on root and fruit types of vegetables, as well as those that are practice-based tend to have a greater readiness to pay from vegetable growers.

	Inp. based adv. Serv	Freq Adv. Serv	Adv. Thr. Mob	Adv. Thr. 1-stop	Frut veg foc. adv. Serv	Root veg foc. adv. Serv
Wtp	25.47	1.89	-119.39	-50.14	120.89	203.94
Lower limit	-78.28	1.13	-264.53	-142.42	4.88	3.08
Upper Limit	129.22	2.65	25.75	42.15	236.90	404.80

Table 7: Estimation of marginal willingness to pay

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Building a private, responsive, and demand-driven advisory service can play a vital role in addressing inefficiencies. The study aimed to determine farmers' preferences and willingness to pay, which can offer insights into the differences in the attributes of improved vegetable extension services. The broader insight from the choice experiment is the heterogeneity in farmers' willingness to pay for extension. As anticipated through prior literature on the willingness of Ethiopian farmers to pay for extension services. Vegetable farmers showed a high willingness to pay for the private, paid agricultural information delivered through various mediums. However, the critical aspect of the results is the conditionality's associated with willingness. Specifically, the results indicate that farmer's willingness is moderated by the elements of the service, such as the mode of delivery, the cost of the service, and the type of information provided. Essentially, there is no blanket acceptance and willingness to pay for the extension. The models in this study report heterogeneous effects related to socio-economic interaction with the extension service attributes. Specifically, significant results were obtained for farmers' age and educational status. Specifically, there was a significant result of the interaction between the advisory service's frequency and Age. Generally the fundamental point of the findings would be that respondents are generally willing to pay for private based extension service for the vegetable and also they exhibit heterogynous in preference. Overall, this thesis result used as practical evidence for the interested once to introduce private advisory institutions and an additional choice experiment case study for the limited literature.

5.2 Recommendation

The main contribution of private extension services contribute for the improvement of infrastructure and delivery of public services by the involvement of private capital and expertise; reduction of the demand for government resource and generation of additional government revenues by receiving return for privatizations.

Producers of vegetables in North Mecha and Fogera have found a significant willingness to pay for improved vegetable advisory services and bring e critical insights for future potential design and implementation of private extension in Ethiopia.

- Attributes like frequency of giving the service, type of vegetables in the advisory, mode of delivery attributes found significant effect on farmer's willingness to pay for improved vegetable extension services. Improving such a service should be discussed in the context of type of extension, mode delivery of the extension service, and product type wills such a service be based.
- Age, education, sex and extension training have a significant effect on the willingness to pay in vegetable producers in study area. By this result moving forward, the willingness for farmers to pay for private extension should be viewed with regards to heterogeneities within the smallholder sector and populations.
- Essentially, we believe that the results of this study would help agricultural extension use policy and decision makers in the study area to consider the various attributes of vegetable advisory and should give emphasis for the institutionalization of privatized agricultural extension service delivery through considering number of visits, socioeconomic, and institutional factors.

REFERENCES

Abdulai, A. R. (2022). A New Green Revolution (GR) or neoliberal entrenchment in agri-food systems? Exploring narratives around digital agriculture (da), food systems, and development in Sub-Sahara Africa. *The Journal of Development Studies*, 58(8), 1588-1604.

Abdulai, A. R., Kc, K. B., & Fraser, E. (2023). What factors influence the likelihood of rural farmer participation in digital agricultural services? Experience from smallholder digitalization in Northern Ghana. *Outlook on Agriculture*, 52(1), 57-66.

Abebaw Abebe. (2023). Farmers' willingness to pay for mobile phone-based agricultural extensionserviceinnorthernEthiopia.*CogentFood&Agriculture*,9(1).https://doi.org/10.1080/23311932.2023.2260605.

Aker, J. C. (2011). Dial "A" for agriculture: A review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics*, 42(6), 631–647. https://doi.org/10.1111/J.1574-0862.2011.00545.

Aliyi, I., Faris, A., Ayele, A., Oljirra, A., & Bayessa, M. (2021). Profitability and market performance of smallholder vegetable production: evidence from Ethiopia. Heliyon, 7(9), e08008. https://doi.org/10.1016/J.HELIYON.2021.E08008.

Alpizar, F. (2001). Using Choice Experiments for Non-Market Valuation. Transport, 8(1), 1–37. http://www.idrc.org/uploads/user-S/10301141930 choice experiments pdf.

Altobelli, F., Lall, U., Dalla Marta, A., Caracciolo, F., Cicia, G., D'urso, G., & Giudice, T. Del. (2018). Willingness of farmers to pay for satellite-based irrigation advisory services: a

southern Italy experience. https://doi.org/10.1017/S0021859618000588.

Altobelli, F., Marta, A. D., Heinen, M., Jacobs, C., Giampietri, E., Mancini, M., Cimino, O., Trestini, S., Kranendonk, R., Chanzy, A., Debolini, M., Courault, D., Kanecka-Geszke, E., Kasperska-Wolowicz, W., Blanco-Velázquez, F. J., Anaya-Romero, M., De Witt, M., de Clercq, W., Espejo, A. D., … Giudice, T. Del. (2021). Irrigation Advisory Services: Farmers preferences and willingness to pay for innovation, 50(3), 277–285. https://doi.org/10.1177/00307270211002848.

Antwi-Agyei0, P., & Stringer, L. C. (2021). Improving the effectiveness of agricultural extension services in supporting farmers to adapt to climate change: Insights from northeastern Ghana. Climate Risk Management, 32, 100304

ATA (2019) *Ethiopian Agricultural Transformation Agency: Annual Report 2018-19*.

Aydogdu, M. H. (2017). Evaluation of Farmers' Willingness to Pay for Agricultural Extension Services in GAP Harran Plain, Turkey. 19, 785–796.

Bayisa Debelo, (2020). Review on Roles and Challenges of Agricultural Extension System on Growth of Agricultural Production in Ethiopia. *Journal of Plant Sciences*, *8*(6), 189. https://doi.org/10.11648/j.jps.20200806.11.

Berhanu, G., D, H., & Tegegne Azage. (2006). Commercialization of Ethiopian agriculture : extension service from input supplier to knowledge broker and facilitator. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 1. *ILRI (International Livestock Research I*. *1*.

Bohm, P. (1979). Estimating willingness to pay: why and how?. In Measurement in Public Choice (pp. 1-12). London: Palgrave Macmillan UK.

Buehren, N., Goldstein, M., Molina, E., & Vaillant, J. (2019). The impact of strengthening agricultural extension services on women farmers: Evidence from Ethiopia. *Agricultural Economics (United Kingdom)*, 50(4), 407–419. https://doi.org/10.1111/agec.12499.

Chayot Gatdet, (2022). The Ethiopian agricultural extension services: A mixed perspective. *Cogent Food&Agriculture*, 8(1), 1–11. https://doi.org/10.1080/ 23311932.2022.2132848.

Christiaensen, L. J., Demery, L., & Khl, J. (2006). The role of agriculture in poverty reduction: An empirical perspective (Vol. 4013). *World Bank Publications.*

CSA (Central Statistical Agency). (2021). Population Size by Sex, Region, Zone and Wereda : July 2021. *Csa*, *July*, 39. https:/www.statsethiopia.gov.et/our-survey-reports/.

Cochran Wiliam G. (1977). Sampling Techniques, Third Edition, by John Wiley & Sons, *Published in Canada*.

Daniel Temesgen & Teferi Tola. (2015). Determinates of small holder farmers willingness to pay for agricultural extension services: A case study from Eastern Ethiopia. *African Journal.*

Danso-Abbeam, G., Ehiakpor, D. S., & Aidoo, R. (2018). Agricultural extension and its effects on farm productivity and income: insight from Northern Ghana. *Agriculture & Food Security*, 7(1), 1-10.

Davis, K. E., Babu, S. C., & Ragasa, C. (2020). Agricultural extension: Global status and performance in selected countries. https://doi.org/10.2499/9780896293755.

Davis, K., Swanson, B., Amudavi, D., Mekonnen, D. A., Flohrs, A., Riese, J., ... & Zerfu, E. (2010). In-depth assessment of the public agricultural extension system of Ethiopia and recommendations for improvement. *International Food Policy Research Institute (IFPRI) Discussion Paper*, 1041, 193-201.

Diao, X., Hazell, P. B., Resnick, D., & Thurlow, J. (2007). The role of agriculture in development: Implications for Sub-Saharan Africa (Vol. 153). *Intl Food Policy Res Inst*.

Ebert, A. W. (2017). Vegetable production, diseases, and climate change. In World Agricultural Resources and Food Security: *International Food Security* (pp. 103-124). Emerald Publishing Limited.

Food and Agriculture Organization (FAO) of the United Nations. Ethiopia Country Brief; 2010. Retrieved from www.fao.org/countries/55528/en/eth/.

Gebremariam, Y. A., Dessein, J., Wondimagegnhu, B. A., Breusers, M., Lenaerts, L., Adgo, E., Ayalew, Z., Minale, A. S., & Nyssen, J. (2021). Determinants of farmers' level of interaction with agricultural extension agencies in northwest Ethiopia. *Sustainability (Switzerland)*, 13(6), 1–24. https://doi.org/10.3390/su13063447.

Gebremariam, Y. A., Dessein, J., Wondimagegnhu, B. A., Breusers, M., Lenaerts, L., Adgo, E., Van Passel, S., Minale, A. S., & Nyssen, J. (2023). Undoing the development army: a paradigm shift from transfer of technology to agricultural innovation system in Ethiopian extension.*Environment, Development and Sustainability*. https://doi.org/10.1007/s10668-023-04136-6.

Gebru, K. M., Leung, M., Rammelt, C., Zoomers, A., & van Westen, G. (2019). Vegetable business and smallholders' food security: Empirical findings from Northern Ethiopia. *Sustainability (Switzerland)*, 11(3). https://doi.org/10.3390/su11030743.

Golding, J., Tesoriero, L., & Daniel, R. (2019). Leafy Vegetables In Postharvest Pathology of Fresh Horticultural Produce (pp. 339-372).CRC Press.

Habtamu Deribe. (2019). Review on contribution of fruits and vegetables on food security in Ethiopia. *Journal of Biology, Agriculture and Healthcare*, 6(11), 49-58.

Habtamu Serbessa, Teferee Mekonnen &, & Meskerem Abi. (2023). Opportunities and Challenges of Urban Farming in Ethiopia: Evidence from Vegetable Producers in Addis Ababa. *Journal of Developing Country Studies*, 7(2), 1-16.

Hanley, N., Colombo, S., Tinch, D., Black, A., & Aftab, A. (2006). Estimating the benefits of water quality improvements under the Water Framework Directive: Are benefits transferable? E*uropean Review of Agricultural Economics*, 33(3).

He, J., Dupras, J., & G. Poder, T. (2017). The value of wetlands in Quebec: a comparison between contingent valuation and choice experiment. *Journal of Environmental Economics and Policy*, 6(1), 51–78. https://doi.org/10.1080/21606544.2016.1199976.

James, P. A., Smart, J. C., Smith, J., Bulling, M., Beed, F. D., & Luwandagga, D. (2011). The effect of participation in the Ugandan National Agricultural Advisory Services on willingness to pay for extension services. AfJARE, 6(1).

Jedidi, K., & Jagpal, S. (2009). Willingness to pay: measurement and managerial implications. In Handbook of pricing research in marketing (pp. 37-60). *Edward Elgar Publishing*

Kansiime, M. K., Mugambi, I., Rware, H., Alokit, C., Aliamo, C., Zhang, F., … & Romney, D. (2022). Challenges and Capacity Gaps in Smallholder Access to Digital Extension and Advisory Services in Kenya and Uganda. Frontiers of Agricultural Science and Engineering, 9(4), 642-654.

Kassahun Berhanu & Tegegne Gebre.-Egziabher. (2014). Socio-Economic Base-Line Survey of Rural and Urban Households in Tana Sub-Basin, Amhara National Regional State. Forum for Social Studies (FSS). www.fssethiopia.org.et.

Keatinge, J. D., Waliyar, F., Jamnadas, R. H., Moustafa, A., Andrade, M., Drechsel, P., ... & Luther, K. (2010). Relearning old lessons for the future of food—by bread alone no longer: diversifying diets with fruit and vegetables. *Crop Science*, 50, S-51.

KHOOHARO, A. A. (2008). a Study of Public and Private Sector Pesticide Extension and MarketingServicesforCotton.December.https://www.researchgate.net/profile/.

Kidane Tesfay & Gidey Kidu, (2020). Smallholder farmer's willingness to pay for privatized agricultural extension services in Tigray National Regional State, Ethiopia. *Journal of Agricultural Extension*, 24(4), 29-38.

Lancaster, K. J. (1966). A New Approach to Consumer Theory. *Journal of Political Economy*, 74(2), 132– # 157. https://doi.org/10.1086/259131.

Lancsar, E., & Louviere, J. (2008). Conducting discrete choice experiments to inform healthcare decision 601 making: A user's guide. *In PharmacoEconomics* (Vol. 26, Issue 8).

https://doi.org/10.2165/00019053-200826080-00004.

Leta, G., Kelboro, G., Stellmacher, T., & Hornidge, A. K. (2017). The agricultural extension system in Ethiopia: operational setup, challenges and opportunities.

Louviere, J. J., Pihlens, D., & Carson, R. (2009). Design of Discrete Choice Experiments: A Discussion of Issues That Matter in Future Applied Research. *Journal of Choice Modelling*, 4(1), 1–8. www.jocm.org.uk.

Lulseged Tamene & Ashenafi Ali. (2022). Digital Agriculture Profile: Ethiopia.

Mangham, L. J., Hanson, K., & McPake, B. (2009). How to do (or not to do)… Designing a discrete choice experiment for application in a low-income country. *Health policy and planning*, 24(2), 151-158.

Mariel, P., Hoyos, D., Meyerhoff, J., Czajkowski, M., Dekker, T., Glenk, K., Jacobsen, J. B., Liebe, U., Olsen, S. B., Sagebiel, J., & Thiene, M. (2021). Developing the Questionnaire. https://doi.org/10.1007/978-3-030-62669-3_2.

McCampbell, M., Schumann, C., & Klerkx, L. (2022). Good intentions in complex realities: Challenges for designing responsibly in digital agriculture in low-income countries. *Sociologia Ruralis*, 62(2), 279-304.

Megerssa, G. R., Gemede, B. G., & Jarsa, A. W. (2020). Challenges of smallholder farmers in accessing agricultural information in Southern Ethiopia. *Agricultural Science & Technology* (1313-8820), 12(1).

Michel Peperkamp, (2020). EU Market Research – Ethiopia Fresh Fruit and Vegetables. (December28).

Modi, R. (2019). The role of agriculture for food security and poverty reduction in sub-Saharan Africa. *The Palgrave handbook of contemporary international political economy*, 391-410.

Mohammed Alebachew. (2018). Assessment of Challenges in Export Marketing: The Case of Ethiopian Vegetable and Fruit Commercial Growers. *IBusiness*, *10*(01), 1–20. https://doi.org/10.4236/ib.2018.101001.

Muhammad, Z. F., Badar, N. S., Khalid, M., M., R. A. K., Waqar-ul-Hassan, T., Muhammad, A., Adnan, R., Syed, A. A. S., Khawaja, M. D., Muhammad, & Ghazanfar, N. (2020). Comparison between public and private extension services for sugarcane production in Muzaffargarh District, Punjab, Pakistan. *Journal of Agricultural Extension and Rural Development*, 12(1), 1–5. https://doi.org/10.5897/jaerd2018.0946.

Muluneh Bekele., Kebenu Feyisa & Shimelis Getu. (2016). Challenges and Opportunities of Marketing Fruit and Vegetables at Logia, Northeastern Ethiopia. The Case of Onion , Tomato and Banana. *Journal of Marketing and Consumer Research*, 22, 51–58.

Muyanga, M., & Jayne, T. S. (2008). Private Agricultural Extension System in Kenya: Practice and Policy Lessons. *The Journal of Agricultural Education and Extension*, 14(2), 111–124. 522 https://doi.org/10.1080/13892240802019063.

Nahuelhual, L., Loureiro, M. L., & Loomis, J. (2004). Using random parameters to account for heterogeneous preferences in contingent valuation of public open space. *In Journal of Agricultural and Resource Economics* (Vol. 29, Issue 3).

Ndimbwa, T., Mwantimwa, K., & Ndumbaro, F. (2021). Channels used to deliver agricultural information and knowledge to smallholder farmers. *IFLA journal*, 47(2), 153-167.

Nimona Fufa. (2017). Opportunity, problems and production status of vegetables in Ethiopia: *a review. J Plant Science Res*, 4(2), 172.

Oladele, O. I. (2008). Factors Determining Farmers' Willingness To Pay for Extension Services in Oyo State, Nigeria. *Agricultural Tropical Et Subtropical*, 41(4), 165–170. http://agriculturaits.czu.cz/pdf_files/vol_41_4_pdf/oladele.pdf.

Phiri, A., Chipeta, G. T., & Chawinga, W. D. (2019). Information needs and barriers of rural smallholder farmers in developing countries: A case study of rural smallholder farmers in Malawi. *Information Development*, 35(3), 421-434.

Rada, N. E., & Fuglie, K. O. (2019). New perspectives on farm size and productivity. *Food Policy*, 84, 147-152.

Rigby, D., & Burton, M. (2005). Preference heterogeneity and GM food in the UK. *European Review of Agricultural Economics*, 32(2). https://doi.org/10.1093/eurrag/jbi009.

Rivera, W. M., & Cary, J. (1997). Privatizing agricultural extension.

Schaafsma, M., Ferrini, S., & Turner, R. K. (2019). Assessing smallholder preferences for incentivised climate-smart agriculture using a discrete choice experiment. *Land Use Policy*, 88. https://doi.org/10.1016/j.landusepol.2019.104153.

Shewfelt, R. L., & Prussia, S. E. (2022). Challenges in handling fresh fruits and vegetables. In Postharvest Handling (pp. 167-186). Academic Press.

Silberg, T. R., Richardson, R. B., & Lopez, M. C. (2020). Maize farmer preferences for intercropping systems to reduce Striga in Malawi. *Food Security*, 12(2), 269–283. 619 https://doi.org/10.1007/s12571-020-01013-2.

Sumo, T.V.; Ritho, C.; Irungu, P. (2023). Determinants of Smallholder Rice Farmers' Willingness-to-Pay for Private Extension Services in Liberia: The Case of Gibi District. *Sustainability*, 15, 14300. https://doi.org/ 10.3390/su151914300.

Tesfaye, A., Hansen, J., Kagabo, D., Birachi, E., & Radeny, M. (2020). Rwanda Climate Services for Agriculture: Farmers willingness to pay for improved climate services. https://ccafs.cgiar.org/donors.

Tolera, T., Temesgen, D., & Rajan, D. S. (2014). Factors affecting farmers' willingness to pay for agricultural extension services : The case of Haramaya District, *Ethiopia. Agric. Sci. Res.*, 3(December), 268–277.

Train, K. (2009). Discrete choice methods with simulation, second edition. In Discrete Choice Methods with Simulation, Second Edition (Vol. 9780521766). *Cambridge University Press*. https://doi.org/10.1017/CBO9780511805271 26.

Tsan, M., Totapally, S., Hailu, M., & Addom, B. K. (2019). *The digitalisation of African agriculture report* 2018–2019. CTA.

Uddin, E., & Gao, Q. (2013). Prospects and Challenges of Privatization of Agricultural Extension Service in. *Asian Journal of Agriculture and Rural Development*, 3(7), 477–487.

Uddin, E., Gao, Q., & Mamun-Ur-Rashid, M. D. (2016). Crop Farmers' Willingness to Pay for Agricultural Extension Services in Bangladesh: Cases of Selected Villages in Two Important Agro-ecological Zones. *Journal of Agricultural Education and Extension*, 22(1), 43–60. https://doi.org/10.1080/1389224X.2014.971826.

Umali-Deininger, D. (1997). Public and private agricultural extension: Partners or rivals? World Bank Research Observer, 12(2), 203–224. https://doi.org/10.1093/wbro/12.2.203.

Villanueva, A. J., Glenk, K., & Rodríguez-Entrena, M. (2017). Protest Responses and Willingness to Accept: Ecosystem Services Providers' Preferences towards Incentive-Based Schemes. *Journal of Agricultural Economics*, 68(3), 801–821. https://doi.org/10.1111/1477-9552.12211.

Waldman, K. B., Ortega, D. L., Richardson, R. B., & Snapp, S. S. (2017). Estimating demand for perennial pigeon pea in Malawi using choice experiments. *Ecological Economics*, 131. https://doi.org/10.1016/j.ecolecon.2016.09.006.

Westbury, S., Ghosh, I., Jones, H. M., Mensah, D., Samuel, F., Irache, A., & Oyebode, O. (2021). The influence of the urban food environment on diet, nutrition and health outcomes in low-income and middle-income countries: a systematic review. *BMJ Global Health*, 6(10), e006358.

Wubante, A., Steven, V., Jan, N., Amare, S., Enyew, A. (2021). Eliciting farmers' preferences and willingness to pay for land use attributes in Northwest Ethiopia: A discrete choice experiment study: www.elsevier.com/locate/landusepol, land use policy 109 (2021)105634.

Wolfenden, L., Barnes, C., Lane, C., McCrabb, S., Brown, H. M., Gerritsen, S., ... & Yoong, S. L. (2021). Consolidating evidence on the effectiveness of interventions promoting fruit and vegetable consumption: an umbrella review. *International Journal of Behavioral Nutrition and Physical Activity*, 18, 1-21.

Yasin Ahmed & Erimase Tesfaye | (2021) Determinates of farmer's preference for watershed ecosystem services: The case of Belesa districts, Amhara region of Ethiopia", Cogent Food & Agriculture, 7:1, 1917135, DOI: 10.1080/23311932.2021.1917135

Yigezu Wendimu, G. (2021). The challenges and prospects of Ethiopian agriculture. *Cogent Food & Agriculture*, 7(1), 1923619.

Yitayew, A., Abdulai, A., & Yigezu, Y. A. (2023). The effects of advisory services and technology channeling on farm yields and technical efficiency of wheat farmers in Ethiopia. *Food Policy*, 116. https://doi.org/10.1016/j.foodpol.2023.102436.

APPENDIXS

Appendix 1: Conversion factors used to compute tropical livestock units

Animal Category	Tropical Livestock Unit (TLU)
Ox	1.10
Cow	1.00
Heifer	0.50
Bull	0.60
Calves	0.20
Sheep	0.10
Goat	0.09
Donkey	0.50
Horse	0.80
Mule	0.70
Poultry	0.01

Source: Storck, *et al*. (1991)

Mixed logit model

Number of obs = 7,074
LR chi2(6) = 255.40
Prob > chi2 = 0.0000

Log likelihood = -1546.0302

Choice	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
Mean						
FeeA	-.0079472	.0038924	-2.04	0.041	-.0155762	-.0003182
VI	.2024116	.3367553	0.60	0.548	-.4576166	.8624398
FrAS	.015032	.0044094	3.41	0.001	.0063897	.0236743
OnM	-.9488107	.1713895	-5.54	0.000	-1.284728	-.6128936
OnS	-.3984326	.2008784	-1.98	0.047	-.7921471	-.0047181
FV	.9607405	.0947234	10.14	0.000	.775086	1.146395
RTV	1.620753	.1275667	12.71	0.000	1.370727	1.870779
SD						
VI	.8583509	.2837556	3.02	0.002	.3022002	1.414502
FrAS	.0031864	.000366	8.71	0.000	.002469	.0039038
OnM	.9987392	.1547477	6.45	0.000	.6954393	1.302039
OnS	.0301931	.2352681	0.13	0.898	-.4309239	.49131
FV	.7642219	.1482997	5.15	0.000	.4735598	1.054884
RTV	1.271646	.145431	8.74	0.000	.9866063	1.556685

Appendix 2: Attribute based regression model result

Mixed logit model

Log likelihood = -1544.6939

Number of obs = 7,074
LR chi2(5) = 225.15
Prob > chi2 = 0.0000

Choice	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
Mean						
FeeA	-.0138364	.0024428	-5.66	0.000	-.0186242	-.0090487
seXFrAS	.0028178	.0012497	2.25	0.024	.0003684	.0052671
AgeFrAS	-.0000551	.0000424	-1.30	0.194	-.0001381	.000028
EducOnM	-.3698541	.1244031	-2.97	0.003	-.6136797	-.1260284
EducFrAS	.0015989	.0006639	2.41	0.016	.0002976	.0029002
ExtTrainingXFrAS	.0009096	.0009016	1.01	0.313	-.0008576	.0026768
TLUXVI	.1242309	.0722923	1.72	0.086	-.0174594	.2659212
extencontactforvegeXFrAS	-.0004455	.0004358	-1.02	0.307	-.0012996	.0004085
totallandforvegetablesXRTV	-.1817836	.3687763	-0.49	0.622	-.9045718	.5410047
VI	-.9941007	.4216244	-2.36	0.018	-1.820469	-.1677321
FrAS	.021694	.0038325	5.66	0.000	.0141824	.0292056
OnM	-.0661239	.2380884	-0.28	0.781	-.5327686	.4005208
FV	1.019448	.1027608	9.92	0.000	.818041	1.220856
RTV	1.698244	.1937259	8.77	0.000	1.318548	2.07794
SD						
VI	1.089375	.3118179	3.49	0.000	.4782229	1.700527
FrAS	-.0064522	.0011529	-5.60	0.000	-.0087119	-.0041925
OnM	1.026101	.1573486	6.52	0.000	.7177036	1.334499
FV	.9019278	.1396473	6.46	0.000	.6282241	1.175632
RTV	1.396642	.1551981	9.00	0.000	1.092459	1.700825

Appendix 3: The mix interaction regression model result

```
. wtp FeeA VI FrAS OnM OnS FV RTV

             VI        FrAS         OnM         OnS          FV         RTV
wtp   25.469594   1.8914857  -119.38952  -50.135056   120.89066   203.94047
 ll  -78.282277   1.1280748  -264.52809  -142.41557   4.8830837    3.081484
 ul   129.22146   2.6548965   25.749041   42.145458   236.89823   404.79946

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Appendix 4: The willingness to pay result

HOUSEHOLDS INTERVIEW

General information

Name of Woreda North Mecha _____ Fogera _____

Name of Kebele _____

Name of enumerator _____ Sign_____

Name of the village _____ Date of interview_____

1. RESPONDENTS GENERAL INFORMATION
   1.1. Name of the respondents _____
   1.2. Age of the respondent's _____
   1.3. Sex of respondents (please tick one) _____ 1. Male_____ 0. Female _____
   1.4. Martial statues of the respondents_____ 1. Single 2. Married 3. Divorce 4. Widowed
   1.5. Education statues of the respondents
   1.6. Can't read and write 2.Read and write 3. Got formal education
   1.7. If the answers is Got Formal Education Years of schooling _____
   1.8. Number year the respondents work in farming (years) _____
   1.9. How many number of total household including household head_____.
   1.10. How many they have economic active _____in (number)
2. LAND POSSESSION

Land use types	Own	Rented in	Rented out
2.1. Total land			
2.2. total land for vegetable			

3. LIVESTOCK PRODUCTION

3.1. Would you please tell me the type and number of livestock possessed during the last 12 months?

Type of livestock	Total number owned
Oxen	
Bulls	
Cows	
Calves	
Heifers	
Sheep	
Goats	
Chicken	
Mule	
Donkey	
Horse	

4. SOURCE OF INCOMES AND LIVELIHOOD ACTIVITIES

4.1. Would you please tell your participation in the following livelihood activities and the amount of income obtained during the last 12 months?

Livelihood activities	Annual income (birr)
Petty trade (kiosk)	
Hiring out labor	
Firewood collection and sell	
Renting out animal drawn cart	
Remittance income	
Sale of handicraft	
Sale of beverages	
Livestock trading	

Weaving	
Carpentry	
Petty trading	
Daily labor	
Livestock trading	
Pottery	
Others	

5. FINANCIAL SERVICES

5.1. If you would have wanted you would you get credit services?_____ 1. Yes 0. No

5.2. Have you taken get credit for vegetable in last 12 months? _____ 1. Yes 0. No

5.3. If the above question answers is yes. how many ?_____.(birr)

6. AGRICULTURAL EXTENSION CONTACTS

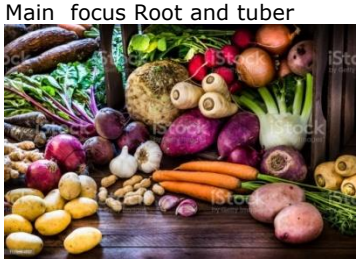
6.1. Do you contact with development agent in vegetable production activity in last12 months? _____ 1. Yes 0. No

Appendix 5: Household survey questionnaires

VII. CHOICE EXPERIMENT

Scenario number, number scenario, block number, segment number 1, 18, 1, 1

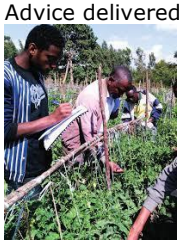
	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable Inputs 	Focus on vegetable management 	
Frequency of advisory service	Advice service Per two weeks	Advice service Per one month duration	

Approach of knowledge exchange	farmers go to one stop shops 	Advice delivered On-field 	
Types of Vegetables in the advisory service	Main focus Root and tuber 	Main focus on Fruity vegetables 	
Service fee for advisory	100 ETB per month 	140 ETB per month 	
Choice question:			

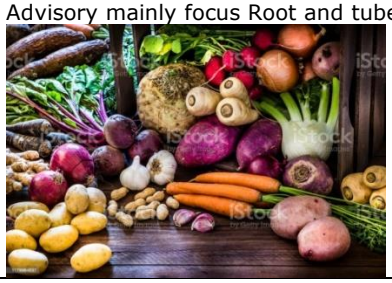
Scenarionumber,numberscenario,blocknumber,segmentnumber 2, 18, 2, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable management 	Focus on vegetable management 	
Frequency of advisory service	Advice service Per two weeks	Advice service Per one week	
Approach of knowledge exchange	Advisory Services through mobile phones 	Advisory Services through mobile phones 	
Types of Vegetables in the advisory service	Main focus on Fruity vegetables 	Advisory mainly focus Root and tuber vegetables 	
Service fee for advisory	100 ETB per month 	100 ETB per month 	
Choice question:			

Scenarionumber,numberscenario,blocknumber,segmentnumber 3, 18, 3, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable Inputs 	Focus on vegetable Inputs 	
Frequency of advisory service	Advice service Per one month	Advice service Per two week	
Approach of knowledge exchange	Advice delivered On-field 	Advisory Services through mobile phones 	
Types of Vegetables in the advisory service	Advisory mainly focus Leafy vegetables 	Advisory mainly focus Leafy vegetables 	
Service fee for advisory	100 ETB per month 	80 ETB per month 	
Choice question:			

Scenarionumber,numberscenario,blocknumber,segmentnumber 4, 18, 3, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable management 	Focus on vegetable management 	
Frequency of advisory service	Advice service Per one week duration	Advice service Per two week duration	
Approach of knowledge exchange	Advisory Services through mobile phones 	Advice delivered On-field 	
Types of Vegetables in the advisory service	Main focus on Fruity vegetables 	Advisory mainly focus Root and tuber vegetables 	
Service fee for advisory	140 ETB per month 	120 ETB per month 	
Choice question:			

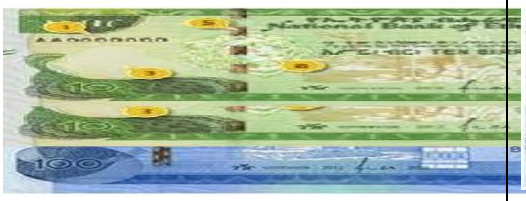
Scenarionumber,numberscenario,blocknumber,segmentnumber 5, 18, 1, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable management 	Focus on vegetable Inputs 	
Frequency of advisory service	Advice service Per two weeks	Advice service Per one month	
Approach of knowledge exchange	Advice delivered On-field 	farmers go to one stop shops 	
Types of Vegetables in the advisory service	Advisory mainly focus Root and tuber vegetables 	Advisory mainly focus Leafy vegetables 	
Service fee for advisory	140 ETB per month 	100 ETB per month 	
Choice question:			

Scenarionumber,numberscenario,blocknumber,segmentnumber 6, 18, 2, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable management 	Focus on vegetable management 	
Frequency of advisory service	Advice service Per one week	Advice service Per one month	
Approach of knowledge exchange	Advice delivered On-field 	Advice delivered On-field 	
Types of Vegetables in the advisory service	Main focus on Fruity vegetables 	Advisory mainly focus Leafy vegetables 	
Service fee for advisory	120 ETB per month 	120 ETB per month 	
Choice question :			

Scenarionumber,numberscenario,blocknumber,segmentnumber 7, 18, 2, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable management 	Focus on vegetable management 	
Frequency of advisory service	Advice service Per one week	Advice service Per one month	
Approach of knowledge exchange	Advice delivered On-field 	Advisory Services through mobile phones 	
Types of Vegetables in the advisory service	Main focus on Fruity vegetables 	Advisory mainly focus Root and tuber 	
Service fee for advisory	120 ETB per month 	140 ETB per month 	
Choice question:			

Scenarionumber,numberscenario,blocknumber,segmentnumber 8, 18, 3, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable Inputs 	Focus on vegetable Inputs 	
Frequency of advisory service	Advice service Per two weeks	Advice service Per one month	
Approach of knowledge exchange	farmers go to one stop shops 	Advisory Services through mobile phones 	
Types of Vegetables in the advisory service	Advisory mainly focus Root and tuber vegetables 	Main focus on Fruity vegetables 	
Service fee for advisory	80 ETB per month 	80 ETB per month 	
Choice question:			

Scenarionumber,numberscenario,blocknumber,segmentnumber 9, 18, 3, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable Inputs 	Focus on vegetable Inputs 	
Frequency of advisory service	Advice service Per two weeks	Advice service Per one month	
Approach of knowledge exchange	Advisory Services through mobile phones 	Advice delivered On-field 	
Types of Vegetables in the advisory service	Advisory mainly focus Root and tuber vegetables 	Main focus on Fruity vegetables 	
Service fee for advisory	100 ETB per month 	80 ETB per month 	
Choice question:			

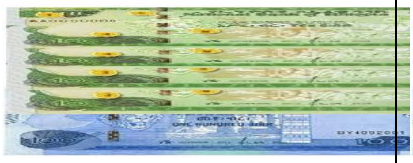
Scenarionumber,numberscenario,blocknumber,segmentnumber 10, 18, 3, 1

	Vegetable advisory service option 1	Vegetable advisory service option 2	Opt-out
Main focus of vegetable advisory service	Focus on vegetable Inputs 	Focus on vegetable Inputs 	
Frequency of advisory service	Advice service Per two weeks	Advice service Per one week	
Approach of knowledge exchange	Advisory Services through mobile phones 	farmers go to one stop shops 	
Types of Vegetables in the advisory service	Advisory mainly focus Leafy vegetables 	Advisory mainly focus Root and tuber vegetables 	
Service fee for advisory	100 ETB per month 	100 ETB per month 	
Choice question:			

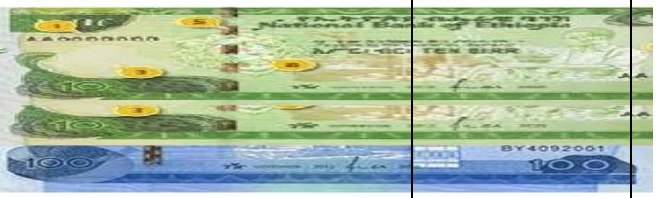
Scenarionumber,numberscenario,blocknumber,segmentnumber 11, 18, 1, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable Inputs 	Focus on vegetable Inputs 	
Frequency of advisory service	Advice service Per one month	Advice service Per two week	
Approach of knowledge exchange	farmers go to one stop shops for services 	Advice delivered On-field 	
Types of Vegetables in the advisory service	Advisory mainly focus Leafy vegetables 	Advisory mainly focus Root and tuber vegetables 	
Service fee for advisory	140 ETB per month 	80 ETB per month 	
Choice question:			

Scenarionumber,numberscenario,blocknumber,segmentnumber 12, 18, 3, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable management 	Focus on vegetable management 	
Frequency of advisory service	Advice service Per one month	Advice service Per one week	
Approach of knowledge exchange	Advice delivered On-field 	Advice delivered On-field 	
Types of Vegetables in the advisory service	Advisory mainly focus Leafy vegetables 	Main focus on Fruity vegetables 	
Service fee for advisory	140 ETB per month 	140 ETB per month 	
Choice question:			

Scenarionumber,numberscenario,blocknumber,segmentnumber 13, 18, 1, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable management 	Focus on vegetable management 	
Frequency of advisory service	Advice service Per one month	Advice service Per one week	
Approach of knowledge exchange	farmers go to one stop shops 	Advisory Services through mobile phones 	
Types of Vegetables in the advisory service	Main focus on Fruity vegetables 	Advisory mainly focus Leafy vegetables 	
Service fee for advisory	120 ETB per month 	120 ETB per month 	
Choice question:			

Scenarionumber,numberscenario,blocknumber,segmentnumber 14, 18, 1, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable Inputs 	Focus on vegetable Inputs 	
Frequency of advisory service	Advice service Per one month	Advice service Per one week	
Approach of knowledge exchange	Advisory Services through mobile phones 	farmers go to one stop shops 	
Types of Vegetables in the advisory service	Main focus on Fruity vegetables 	Advisory mainly focus Leafy vegetables 	
Service fee for advisory	80 ETB per month 	100 ETB per month 	
Choice question:			

Scenarionumber,numberscenario,blocknumber,segmentnumber 15, 18, 1, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable Inputs 	Focus on vegetable Inputs 	
Frequency of advisory service	Advice service Per one week	Advice service Per two week	
Approach of knowledge exchange	Advisory Services through mobile phones 	farmers go to one stop shops 	
Types of Vegetables in the advisory service	Advisory mainly focus Root and tuber vegetables 	Main focus on Fruity vegetables 	
Service fee for advisory	80 ETB per month 	100 ETB per month 	
Choice question:			

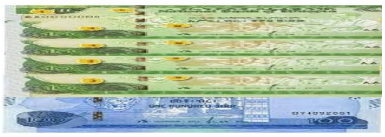
Scenarionumber,numberscenario,blocknumber,segmentnumber 16, 18, 2, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable management 	Focus on vegetable management 	
Frequency of advisory service	Advice service Per one week	Advice service Per two week	
Approach of knowledge exchange	farmers go to one stop shops 	Advisory Services through mobile phones 	
Types of Vegetables in the advisory service	Advisory mainly focus Leafy vegetables 	Advisory mainly focus Root and tuber vegetables 	
Service fee for advisory	120 ETB per month 	120 ETB per month 	
Choice question:			

Scenarionumber,numberscenario,blocknumber,segmentnumber 17, 18, 2, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable management 	Focus on vegetable management 	
Frequency of advisory service	Advice service Per one month	Advice service Per two week	
Approach of knowledge exchange	farmers go to one stop shops 	farmers go to one stop shops 	
Types of Vegetables in the advisory service	Advisory mainly focus Root and tuber vegetables 	Advisory mainly focus Leafy vegetables 	
Service fee for advisory	80 ETB per month 	80 ETB per month 	
Choice question:			

Scenarionumber,numberscenario,blocknumber,segmentnumber 18, 18, 2, 1

	Vegetable advisory service option 1	**Vegetable advisory service option 2**	**Opt-out**
Main focus of vegetable advisory service	Focus on vegetable Inputs 	Focus on vegetable Inputs 	
Frequency of advisory service	Advice service Per one week	Advice service Per one week	
Approach of knowledge exchange	Advice delivered On-field 	farmers go to one stop shops 	
Types of Vegetables in the advisory service	Advisory mainly focus Leafy vegetables 	Main focus on Fruity vegetable 	
Service fee for advisory	80 ETB per month 	140 ETB per month 	
Choice question:			

Appendix 6: Choice sets cards for survey

Title	Methodology	Significant Variables & their outcomes
Small holder farmer WTP for Privatized Extension Services in Tigray (Kidane Tesfay & Gidey Kidu, (2020)	-Percentage and -Logit Model 58% willing	-Age (+) -Farm size (+) -Family size (+), Income (+) -Credit access (+),-Extension contact(+)
Determinants of small holder farmers WTP for agricultural Extension services: A case study from Eastern Ethiopia (Daniel Temesgen and Teferi Tola, 2015)	-Logit Model and -Descriptive Analysis	-House hold Income (+), -Age (-), Farm size (+). - Media exposure (-), -Family size (-)
Determinants of Farmers level of interaction with Agricultural extension agencies in North West Ethiopia. (Gebremariam *et al.,* 2021)	-Spearman's correlation coefficients, -Kuruskal-Wallis analysis & -Ordered Probit Model	-Education level(+), age(-) -Member of iddir &mahiber -radio owner (-), farming experience(-), number of active family (-), number of dependent family (+), oxen ownership (-), Access to irrigation (-), wealth status(+), participate in training
Evaluation of Farmers' WTP for extension services in GAP- Harran plain, Turkey Aydogdu, (2017)	-Contingent Valuation Method (CVM) & - Binomial probit and Maximum likelihood	-Marital status (+), land (+) -educational level (+), -gravity irrigation user (-), -Bid proposed price (-0)
Factor determining crop farmers WTP for	- Frequency counts - Percentages	-Age (-),Farm experience (+), -income from both non-farm

Agricultural extension service in Tanzania Gosbert *et al*., (2019)	-Tobit regression 88% willing	and farm, education ,distance from farm to road
Crop farmers' WTP for agricultural extension service in Bangladesh Uddin & Rashid, (2014)	-CVM -Logit and Tobit Model 81% willing	-Education -Income from agriculture -Farm experience
Small holder Rice Farmers' WTP for private extension services in Liberia Sumo *et al.,* (2023)	-CVM - Heckpoission Model& -A double- bounded logit model	-Age(+) -Farm experience(+) -Farm Income(+) -Year of schooling (-) -Household size(+)
Factors determining farmers' willingness to pay for extension services in Oyo state, Nigeria (Oladele, 2008)	- frequency counts, - percentages and - Probit regression model	-farmers age (+) -gender (-) -Educational level (+) - Farm size (+) - farming experience (-) - land tenure (+) -income and (+) - proportion of crops (-)

Appendix 7: Researches related with willingness to pay for extension services