COLLEGE OF DEVELOPMENT STUDIES

CENTER FOR FOOD SECURITY STUDIES

DETERMINANTS OF TECHNOLOGY ADOPTION IN MICRO AND SMALL ENTERPRISES AND ITS CONTRIBUTION TO FOOD SECURITY THE CASE OF ENTOTO CLUSTER ADDIS ABABA, ETHIOPIA

BY

YISHAK ABERA TAKELE

NOVEMBER, 2022

ADDIS ABABA

COLLEGE OF DEVELOPMENT STUDIES

CENTER FOR FOOD SECURITY STUDIES

DETERMINANTS OF TECHNOLOGY ADOPTION IN MICRO AND SMALL ENTERPRISES AND ITS CONTRIBUTION TO FOOD SECURITY THE CASE OF ENTOTO CLUSTER ADDIS ABABA, ETHIOPIA

BY

YISHAK ABERA TAKELE

THESIS ADVISER

ADMASU SHIBRU (PhD)

A THESIS SUBMITTED TO CENTER FOR FOOD SECURITY STUDIES

COLLEGE OF DEVELOPMENT STUDIES ADDISABABA UNIVERSITY

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN FOOD SECURITY AND DEVELOPMENT

NOVEMBER, 2022

ADDIS ABABA

Acknowledgments

Above all, I would like to thank the Almighty God, the everlasting father, and the king of peace and love for giving me the endurance and patience in accomplishing this piece of work.

I would like to extend my heartfelt gratitude to my supervisor, Dr. Admasu Shibru for his indispensable advice and constructive suggestions on my thesis. I am grateful to all staff of the Center for Food Security Studies for their commitment, suggestion and guidance in the past two years.

My heartfelt gratitude also goes to my indebtedness and heartfelt thanks to my friend and co-advisor Kassaye Amosha (PhD candidate) for his information and a lot of good ideas in directing me through this research work. Additionally, my gratitude goes to Entoto Polytechnic College, Gulele sub-city and Two Woredas of Labour, Enterprise and Industry Office Experts that helped me by giving the necessary information and data. Finally, I want to thank all respondents who had spared their valuable time to take part in my research. My apologies to other people whom I have forgotten to acknowledge them here, thanks you for all your contribution in the course of my study life.

Declaration

I certify that this thesis is my original work, that it has not been submitted for a degree or certification at any other universities or institutions, and that all sources of material utilized for the thesis have been properly cited.

_____

Yishak Abera Takele

November, 2022

Addis Ababa

Approval Sheet

ADDIS ABABA UNIVERSITY

COLLEGE OF DEVELOPMENT STUDIES

CENTER FOR FOOD SECURITY STUDIES

As supervisor of the thesis, I certify that I have read and evaluated the thesis prepared by **Yishak Abera Takele** entitled "*Determinants of Technology Adoption in Micro and Small Enterprises and its Contribution to Food Security the Case of Entoto Cluster Addis Ababa, Ethiopia"* and recommend for open defense as fulfilling the requirement for the degree of **Master of Science in Food Security and Development.**

_____	_____
Name, Advisor	Signature & Date

As members of the Examining Board of the Thesis Open Defense, we certify that we have read and evaluated the thesis prepared by **Yishak Abera Takele** entitled "*Determinants of Technology Adoption in Micro and Small Enterprises and its Contribution to Food Security the Case of Entoto Cluster Addis Ababa, Ethiopia"* and recommend that it is acceptable thesis required for the degree of **Master of Science in Food Security and Development.**

……..……	…….……..
Name, Chairman	Signature & Date
……	…….……..
Name, Internal Examiner	Signature & Date
……..…	…….……..
Name, External Examiner	Signature & Date

Final approval and acceptance of this thesis is contingent upon the candidate's submission of the final copy of the thesis, incorporating all the comments by Examining Board, to the Council of Graduate Studies (CGS) through the Center Academic Committee (CAC) of the Center.

_____

Chairperson of the Center or Graduate Program Coordinator

Table of Contents

List of figure

List of tables

List of appendixes

Abbreviations

CI:	Competitive Intelligence
CSTC:	Community Skill Training Centers
ETB:	Ethiopian Trade Birr
ETP:	Education and Training Policy
FDI:	Foreign Direct Investment
FGD:	Focus Group Discussion
GDP:	Gross Domestic Product
IESP:	Industry Extension Stakeholders of Program
IPCC:	Intergovernmental Panel on Climate Change
KII:	Key Informant Interview
MOA:	Minister of Agriculture
MRA:	Minimum Recommended daily Allowance
MSEHs:	Micro and Small Enterprise Heads
MSEs:	Micro and Small Enterprise
NGOs:	Non-Governmental Organizations
NOS:	National Occupational Standards
R&D:	Research and Development
SDG:	Sustainable Development Goal
SMEs:	Small and Medium Enterprises
TVET:	Technical and Vocational Education and Training
WB:	World Bank
WFP:	World Food Program
WHO:	World Health Organization

Abstract

The objective of the research is to examine the determinants of technology adoption in micro and small enterprises and its contribution to food security the case of Entoto Cluster Addis Ababa, Ethiopia. A multistage sampling procedure was employed to draw 256 sample households from two Woreda and four kebeles. The kebeles were selected in random sampling procedure and within the Entoto cluster Colleges. Sample micro and small enterprise heads were grouped in two strata (adopters and non-adopters). To analyze the data both descriptive and inferential statistics were employed to characterize and analyze technology adoption and food security status of the households. Household food insecurity access scale was employed to examine the food security status of the sample households. The statistical models namely, binary logistic regression and ordered logistic regression were employed to determine factors affecting the technology adoption, to analyze the impact of technology adoption on household food security respectively. The binary probit result revealed that, Education status of micro small enterprise heads, saving access, total annual income and training access of micro small enterprise heads affects the technology adoption positively; while expenditure of firms affected negatively technology adoption. According to the results of ordered logit, technology transfer and adoption has a positive impact on household food security. In terms of household food insecurity access scale, the impact of technology adoption on micro and small enterprise head food security has an effect on the household food security. The study concludes that technological adoption has a significant impact on household food security. Based on the findings of this study, it is suggested that micro small enterprise heads awareness and perceptions be improved by training, as well as interventions that address technology transfer and adoption obstacles.

Keywords: *Determinants, Technology Transfer and Adoption, Household Food Insecurity Access Scale, Etototo Cluster College, Addis Ababa.*

CHAPTER ONE: INTRODUCTION

1.1.Background

Technological progress and innovation play an important role in economic growth (Winston, 2014). The wealthiest nations over the last century have been those who have acquired cutting-edge technology skills that have allowed them to become global technological leaders. Countries like the United States, Germany, Japan, the United Kingdom, Finland, Denmark, and Israel are often recognized as technical leaders on a worldwide scale. Many studies have indicated that technical advancement that enhance productivity and lead to new products, processes, or sectors account for more than half of long-term economic development in industrialized nations (Ueno, 2009). Other countries aiming to replicate their economic success can learn a lot from their growing experiences.

Since the 1970s, newly industrialized economies in East Asia such as South Korea, China, Singapore, and Malaysia have revolutionized their economies by increasing the technological complexity of their sectors and implementing well-organized technology transfer strategies. Productivity growth, the strongest proxy for technological advancement, contributed for up to 30% of GDP growth in these nations. They now compete worldwide with sophisticated industrialized nations in a variety of industries as a result of their enhanced technical skills (Bennett & Vaidya, 2005).

The African Union drafted a strategy to update technical, vocational, and training in Africa in 2007 (African union, 2007). According to the report, many African countries are becoming more aware of the critical role that Technical and Vocational Education and Training (TVET) plays in national development. The strategy's goals are to revitalize and modernize TVET in Africa, as well as to make it a mainstream activity for African youth. A comparative analysis of TVET in southern Africa is presented by Akoojee & Simon (2005). In Ethiopia, the strategic thinking behind the expansion of the TVET subsector is to meet the middle level human power demand of the industry, service sector and commercial agriculture, which have become very essential to the overall development of the country. The driving goal of the national TVET strategy of Ethiopia (2008) is to strengthen the culture of self-employment and support job creation in the economy (MOE 2008).

TVET is any educational and training activity, which deals with the acquisition of knowledge and skill, which are relevant to access employment or performance in the work place. TVET indicates the activities which emphasis on the application of skill, knowledge and attitude regarding employment or related occupation in any field of socio and economic activities including agriculture, industry, public and private service (Craigrobert, 1976). TVET is the study of technologies and related science and acquisition of practical skill and knowledge related to occupation in various sector of the economic and social life (UNESCO, 2002).

Hence, poverty continues to afflict large sections of this population. Considering the problem of poverty and unemployment, the federal government puts poverty reduction on its development agenda through skill training service. In attempts to put households and unemployed adult helps to start or expand small business and they can create additional self-employment opportunity (Solomon, 1996). TVET is of paramount importance in developing, competitive economies and better societies. International and regional developmental organizations as well as country planners and decision-making bodies are nowadays focusing on TVET to boost economies and promote equity.

Due to this, the Ethiopian government includes TVET in to the Educational curriculum and policy of the country opening different new technical and vocational education training centers in all regions of the country. Entoto TVET is one of these training centers that was established in Addis Ababa with the intention of providing quality training, improved technical knowledge to settle high level of training quality and industry extension service for surrounding MSEs. According to Kirubel (2014) involvement of community increased commitment to the activities in TVET institutions; in bringing additional resources such as time and expertise; Coming up with new and different approaches to delivering activities by motivating and inspiring existing staff and volunteers and increase the success of TVET institutions; and Becoming a visible part of our activities there by generating wider interest from media and other local/or community organizations.

The papers that have already been cited above focused on various facets of the college and suggested ongoing research; as a result, there were empirical gaps and unexplored areas regarding the factors that influence technology adoption and how it affects food security in small

and micro enterprises. However, this study has attempted to examine determinants of technology adoption in micro and small enterprises and its contribution to food security in the Entoto cluster College.

1.2. Statement of the problem

Technology is now a day a driving force for one country growth and development. The overall effectiveness of technology transfer activities in Ethiopia is explained, through the competitiveness of both Foreign Direct Investment (FDI) inflows and physical transfer of technologies. The country was ranked by Global Competitiveness reports at position 126 out of 140 countries in 2018/19, 120 out of 140 countries in 2016/17 and 118 out of 140 countries in 2014/15 (please see appendix 1) which is indeed very poor in performance, relative to others. This implies that in exception to FDI inflows, Ethiopia is not competitive in term of technology adaptation or assimilation. Another fact to be noted is that transfer of technology through FDI inflows is only limited to the transfer of the high tech for large-scale firms, therefore the approach has limited impact to Micro and Small Enterprises (MSEs) development.

As cited in the MSE strategy over 89 percent of the informal sectors are concentrated in manufacturing, trade, hotel and restaurant activities. Of the small scale manufacturing industries 85 percent are engaged in the manufacture of food, fabricated metal, furniture and wearing apparels. The survey also revealed that the number of people earning their livelihood from the informal sector activities and small scale manufacturing industries is eight times larger than those engaged in the medium and large scale industrial establishments. The survey also indicated that the increased role and contribution that the MSE sector could have provided to the national economy is largely constrained by the various policies structural and institutional related problems and bottle necks (MoTI, 1997).

The role of TVET was determined in terms of their contribution in providing technically skilled-man power both for private and governmental sectors. But, the technology transfer and adoption system of two sector was at infant stage and need multidisciplinary activities (Kirubel, 2014). Moreover, some of the research conducted in rural part of Ethiopia has emphasized on the roles, contributions and impacts of technology of agricultural sector (Azanaw & Girmachew, 2021; Alem *et al.,* 2019; Yitbarek, 2017; Ayalew, *et al.,* 2022; Kebebe, 2015, Berhanu, 2014).

Furthermore, the main problem of this research is that, the urban small and micro enterprises are not as such copy and adapt technologies or innovation that help to produce more products and to improve their food security status. Because of this most of them are not food secured households. For instance when we take poultry production technology, now a day ten thousand chickens are fertilized with in twenty one days by using modern incubation technologies but when we look at small and micro enterprise level they are not adopt this kind of technology to improve their family food security status due to different factors. Still now MSE are baying three month age chickens from large industries to produce egg. Similar problems are also looked in other types of technology.

There are different technologies are transferred from TVETC to SME yearly but when we see the level of food security status of SME are not changed as such. The effectiveness of technologies is under question mark. There are problems both in TVET colleges and SME that challenging the adoption of technology. Technology improve productivity if productivity increased the food security status of the HH also increase. The study will answer what are the factors that determine technology adoption in small and micro level enterprises. Technologies are directly or indirectly linked with HH food security. Technologies are effects on HH food security status when adopted or copied correctly. The technologies that are transferred from TVET colleges must be add some values or upgrade the food security status of the HH is expected, but when we see on the ground the effect of technology on food security status of SME is not like that.

Additionally, poor technology adoption in urban micro and small enterprises was one of the main issues facing Addis Ababa's TVET technology transferring colleges. Despite the purpose of this study was to generate information that would help to fill the gap on the determinants of technology adoption and its contribution on food security of urban MSEHs. Hence, this study aimed to determinants of technology adoption in MSE, its effects on enhancing the food security status of micro and small enterprise heads and its major constraints in TVET and MSEs sectors.

1.3.Objectives of the study

1.3.1. General objective

The general objective of the study was to examine determinants of technology adoption in micro and small enterprises and its contribution to food security the case of Entoto cluster Addis Ababa, Ethiopia.

1.3.2. Specific objectives

The specific objective of the study was to:

1. identify the determinants of technology adoption in micro and small enterprises of the study areas.
2. investigate the effect of technology transfer and adoption in enhancing the food security status of the micro and small enterprises.
3. access major constraints of technology transfer and adoption in TVET and micro and small enterprises sector.

1.4.Research questions

This research intended to answer the following basic questions which are derivatives of the above-mentioned research objectives:

1. What are the factors influencing adoption technology in micro and small enterprises of the study areas?
2. Does participation on technology transfer and adoption have impact in enhancing the food security status of the micro and small enterprises heads?
3. What are the major problems and constraints of technology transfer and adoption in TVET sector micro and small enterprises?

1.5.Scope and limitation of the study

It is clear that a big number of TVET Colleges have been constructed at the national level, particularly in recent years, to teach competent trained workforce to contribute to the country's poverty reduction strategic objective. Among these training venues, this study highlighted Entoto Cluster Colleges (Entoto Polytechnic College and Arada Manufacturing College) to investigate the college's vital role in facilitating technology transfer and improving MSE lives. The socioeconomic, institutional, and demographic factors that impact MSEH technology transfer and adoption were investigated in this study. The study concentrated on the houses that

participated in the survey. In the majority of cases, the researcher had trouble studying the college's general activities or met significant limitations that needed to be resolved. However, because to time and financial constraints, reviewing the industrial extension service activities of all TVET Colleges, including those in Addis Abeba, proved difficult. As a consequence, this study was limited to Entoto cluster Colleges, which aided in the adoption of technology in the country's developing economic force as well as the livelihood of MSEs in Gullele and Arada sub cities.

The methodology of the study was limited to the use of an econometric model to assess the role of Entoto cluster Colleges in encouraging technology transfer to micro and small businesses and to analyze technology transfer adoption. Using data from non-program participants, the model compares several outcome characteristics between program participants and non-program participants. However, finding a comparison group (and frequently an observable) determination and ability that leads the families to join the program might be tough. As a result, the research was done to achieve its objectives within the constraints specified.

1.6. Ethical consideration

Ethical issues are crucial for social researchers who, by definition, solicit people's ideas, attitudes, and experiences. It's likely that sensitive data was acquired that other non-research projects might like to know about. To begin, participants were asked if they wanted to take part in the study method. According to Creswell (2008), the researcher should not only attempt to get consent but also inform the respondents that participation is voluntary. Furthermore, participants were made aware of the need of retaining anonymity when their work was used for academic purposes. The Center for Food Security Studies, Addis Ababa University, and Entoto Polytechnic College submitted a formal letter to start this project. The letter was sent to the appropriate authorities in order to obtain authorization to access all information and papers needed for this study, and the researcher evaluated all ethical considerations.

1.7. Significance of the study

The material acquired from this study, through qualitative analysis, gives critical insights into the key limits of technology transfer in TVET and MSEs. A quantitative analysis was also

performed to determine characteristics impacting technology adoption and its contribution to food security in micro and small businesses. Entoto Cluster Colleges has helped to provide highly-trained and technically skilled labor for micro, small, and medium-sized firms, as well as the industrial sector, in order to assure the country's transformative growth and development, with a focus on poverty and unemployment reduction.

However, there are difficulties that restrict the spread of technology's utility. As a result, at the end of this inquiry, the researcher will attempt to address and critically suggest solutions to the issues raised. I hope the study's findings aided the trainer, society, government, and the college itself. Following the end of the study, all stakeholders must use the supplied suggestions as feedback and take responsibility for improving technology transfer services. Furthermore, the study's findings reveal some realities on the ground, which help the community, policymakers, and implementers determine how to effectively enhance technology transfer and improve MSE household life in the examined regions. Finally, the findings of this study might be valuable for academic scholars who want to do a more in-depth investigation of technology transfer and adoption to MSE livelihood.

1.8.Organization of the thesis

This thesis is divided into five chapters. The background of the inquiry, description of the problem, objectives and research questions, scope and limitation, relevance of the study, and ethical considerations are all presented in Chapter 1 of the thesis. The second chapter is a review of pertinent literature. The topic's theories, concepts, and definitions, as well as empirical literature and conceptual evidences, are analyzed and disputed. The third chapter addresses methodological issues, such as general descriptions of the study field, research design, sample process and determination, data sources and data collection procedures, and data analysis methodologies. In the fourth chapter, the findings are also examined and assessed. Finally, the fifth chapter is devoted to conclusions and suggestions based on the study's findings/results.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.1.Theoretical foundation related to TVET, and technology transfer/development

There has been different thinking in understanding poverty, underdevelopment and micro and small enterprise and development progress. Various approaches have been introduced and applied to alleviate poverty and enhance development. Promoting employment, being one means of addressing extreme poverty especially by state, is discussed in various theories including, Social Cognitive Theory, Malthusian Theory, Bessarabia Theory, Modern Theory, The Classical Theory and the Social Capital Theory. This study considered the classical Theory and Modern Theory because, both are developed on the development of MSEs at different times (Tambunan, 2006).

The **classical theory** on MSEs holds that as economic development progresses, as measured by increases in per capita real income, the economic contribution of MSEs will gradually fall. Large and contemporary businesses, on the other hand, would take off quickly and eventually dominate the economy. According to this school of thought, poverty and the importance of MSEs are positively correlated: the economic share of MSEs increases as the poverty rate, i.e., the percentage of the population living below the poverty line, rises. In other words, the classical theorists' point of view supports the premise that the greater the proportion of people living in poverty, the greater the contribution of MSEs to eliminating poverty (Tambunan 2006). However, the classical theory on MSEs has been questioned since it ignores MSE economic growth through networking and agglomeration/clustering. In other words, traditional perspectives on MSEs concentrated on the relationship between income level and MSE growth. In response to the above-mentioned apparent flaw of classical perspectives, a new/modern theory has evolved that appears to focus on the agglomeration and networking effects of MSEs and their final development of the local economy (Tambunan 2006).

In contrast to the classical view on MSEs, modern theory has been linked with the topic of flexible Specialization, which appeared in 1980. Proponents of this viewpoint contend that the protracted discussion over how to interpret the new global pattern of production generated by globalization forces and industrial restraint is the primary reason for the birth of the concept of flexible specialization. These have altered the organization of production and labor. And global production has shifted from Fordist (mass production) to non-Fordist production. As a result, one

of the key properties of such transformation is flexible specialization (Tambunan, 2006). Three organizational aspects of flexible specialization have been found by the same authors:

- ✍ Flexibility and specialization: enterprises in the community are members of a bounded group that is mainly excluded from outsiders.
- ✍ High level of competitive innovation: enterprises in the community are constantly under pressure to encourage innovation in order to maintain a competitive advantage.
- ✍ High level of collaboration: enterprises in the neighborhood face restricted competition over pay and working conditions, encouraging more cooperation among them.

The flexible specialization thesis' core claim is that MSEs can grow quicker than large companies during the development process, and they are important sources of invention, creativity, and efficiency. They have been shown to be capable of competing with major firms and even improving their current relative position in numerous cases. Furthermore, according to the literature on flexible specialization, new technologies improve the relative viability of MSEs, reduce scale economies, and lead to smaller efficient plants and enterprises. The need to improve industry's ability to respond to rapid changes in demand quickly, inexpensively, and efficiently has also given MSEs a new position in developed economies (Tambunan, 2006).

2.1.1.A historical continuum to explain technological change

Toffler (1981) established a historical continuum for technological change, which is useful in providing the background for TVET history. The three ages, or waves, began with the Agricultural Revolution, which occurred between approximately 8000 B.C. and A.D. 1700. Prior to 8000 B.C., Toffler's Agricultural Revolution might be split into a subsistence phase in which families, clans, and tribes devoured what they produced, an obsolete phase, and then the family farm phase, which is currently being supplanted by the new industrial model of an agro business phase. Toffler overlooked the fact that his ages/waves overlapped in time and space. Domestication of animals is another aspect of agricultural growth that Toffler may not have emphasized enough. According to a report from the Hap Map project, which was founded on the decoding of the human genome in 2003, gene changes in East Asians and Europeans 6,000-7,000 years ago were caused by the spread of agriculture to Europe from the Near East around the same time that rice farming became widespread in China (Wade, 2006).

Another method to comprehending the beginnings and evolution of TVET is to follow the evolution of tools and technology and link them to education. According to Maclean and Wilson (2013), the first tool might have been a "stone in the first." He also claimed that fire was the "sole true development in technology from Cro-Magnon days to the Industrial Revolution." He went on to say that a rock sharp at one end and round at the other to suit the palm of the hand became a hammer, axe, chisel, scraper, knife, and saw for primitive man. These distinct instruments were gradually separated from the one homogenous form. Holes were drilled to attach a handle, teeth were inserted to produce a saw, branches were topped with the coup-de-poling to make a pick, an arrow, or a spear, the rough-surfaced stone became a file, and the stone in a sling became a weapon of war that outlasted classical antiquity.

Toffler's second wave was the industrial age, which he defined as the period from 1700 to 2000 A.D. Tjaden (1995) recognized that the separation of production and consumption was an essential feature of this age. Eventually, another significant feature was the partition of manufacturing into component manufacture and assembly, which led to the creation of assembly lines. This 'industrial model' has had an impact on the structure and organization of the educational system. It is critical to understand that transitions from one so-called era to another are: (a) not straightforward; (b) gradual rather than sudden; and (c) neither continuous nor complete. According to Tjaden, Toffler's third wave, dubbed the Information Age, began in the United States in the mid-1950s, when 'white-collar and service employees outnumbered blue-collar ones' (1995). It was stated that Toffler's paradigm is oversimplified since what appears to be happening is the merging of qualities from prior ages/waves.

2.2.Concepts food security and technology adoption

Food security emerged as a term in the mid-1970s in the context of various incidents that triggered talks about aggregate food supply and sufficiency at the global and national levels (Ingela and Nagothu, 2017). However, family or individual sufficiency, nutritional quality, and environmental sustainability were all overlooked (Ingela and Nagothu, 2017). Within this context, the World Food Summit in 1996 presented a commonly accepted definition of food security: "food security occurs when all people have access to sufficient, safe, nutritious food at

all times to support a healthy and active life" (WHO, 2010). This concept was eventually expanded to encompass availability, access, utilization, and stability.

In the 2009 Declaration of the World Summit on Food Security, food security was defined in the following way: *Food security exists when all people, at all times, have physical, social and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2009).* Access to food was recognized as one of the pillars of food security. It is this dimension of food security – food access – that experience-based food insecurity scales are designed to measure in populations, based on data collected at the household and individual level.

TVET technology transfer and adoption

Each country should have a network of vocational training facilities for the need of residents and adjusted as a curriculum to economic requirements and employment possibilities of the country as a whole or more appropriate for each region (UNESCO, 2002). Technical and vocational educational and training refers to education and training that prepares persons for gain full employment (Hirut, 2017). In other words, TVET refers to deliberate interventions to bring about learning which was make people more productive or simple adequately productive in designed areas of economic activity. TVET has the potential to enhance human capabilities and enlarge people's choices.

The perception of the origin of TVET by many is in diverse ways. However, general education and training began in prehistory with the transmission of knowledge and culture from one generation the next. The education and training that occurred is best embodies in the Chinese proverb, "*give a man a fish and he will eat for a day. Teach him how to fish and he will eat for a life time*." TVET is the most effective means for society to develop its member's potentials to respond to the challenge of the future (MOE, 2003).

Technology transfer within and across national boundaries is critical for technological learning and innovation. While the term "transfer" suggests a direction of movement, in practice it is often a collaborative and complex process whereby knowledge and information move in many

directions and human capacities develop to ensure the transfer. This process often requires an adaptation of the technology to the conditions and circumstance in the transfer destination. Technology transfer occurs when there are enough incentives to commercialize a given technology in a new location through trading products, licensing or investing. Transfer of technology usually occurs through trade, Foreign Direct Investment (FDI), licensing, and the movement of workers, managers, professionals and academics. Trade and FDI are the major channels for the transmission of technical knowledge across countries, and their effect on technology transfer is not easy to separate.

Actually, defining the term "technology" has not found to be easy as per different scholars argument. Due to this nature of technology, researchers have been discussed the definition from different perspectives as is widely explained in previous literatures. Technology consist two primary components (Wahab, 2012).

- ✓ A physical component which comprises of items such as products, tooling, equipment's, blueprints, techniques, and processes; and
- ✓ The informational component which consists of know-how in management, marketing, production, quality control, reliability, skilled labor and functional areas.

Technology transfer can also be defined as:

"The process of movement or transfer of information, technical know-how, and people among corporate technical functions such as R & D, engineering, manufacturing and nontechnical functions such as sales in order to yield innovative products and services that meet corporate business goals and fulfill customer needs" (Mojaveri, 2011).

Movement of knowledge among firms or sectors located in different countries refers to the process of learning to understand, utilize and replicate the technology including the capacity to choose and adapt it to local conditions, integrate it with indigenous technologies. Technology transfer can be seen further as is a comprehensive term covering mechanisms for shifting information across borders and its effective diffusion into recipient economies (Maskus, 2004). Technology transfer has been defined closely as the cross-border flows of both physical goods and knowledge, be it tacit or formal (UNCTAD, 2010). David (2002) explains technology

transfer as is a transaction or a process through which technological knowhow is transferred normally between businesses or agencies representing businesses.

Transfer of technology is viewed as an important channel of technological learning and innovation capability-building in Ethiopia. However, the relationship between the transfer of technology and local technological learning and upgrading is not automatic. How the transfer takes place, the policies and incentive schemes used to prompt the transfer and, more importantly, what happens to the technology once it has been transferred are key determinants of the ability of Ethiopia to upgrade its technological capability and acquire the capacity to assimilate and generate new technologies. For the study purpose the researcher used the integration of TVETs for local sustainable development. Here;

Technical and Vocational Education and Training: refers to an education and training to "acquire the practical skills, know-how and understanding necessary for employment in a particular occupation, trade or group of occupations or trades.

Enterprise: Organized business activities aimed specially at growth and profit. In our cases, it defines micro and local enterprises that engaged in organizing trainees for employment

Micro enterprise: when the numbers of its employees (including the owner or family) are not greater than 5 & total asset is ≤ 100,000 ETB for industrial sector and ≤ 50,000 ETB for service sector (Mizan Sibhatu, 2018).

Small enterprise: means a business engaged in commercial activities whose capital is not exceeding birr 1.5million and 6-30 employees for industries and 500,000 for service other than high technology and consultancy service institutions.

Industry Extension Service: The service which is provided to MSEs by TVET institutions and colleges among other includes Skills trainings on Entrepreneurship, Business Management, Best Technology adaptation and transfer, productivity, quality, maintenance and product standardization and certification.

Education for Sustainable Development: "Education for sustainable development aims to help people to develop the attitudes, skills and knowledge to make informed decisions for the benefit of themselves and others, now and in the future, and to act upon these decisions" (UNESCO, 2010).

Key aspects of successful TVET: contributions of **developing a workforce skilled** on integrated sustainable (knowledge, skills and attitudes), leading by example, and partnership with key stakeholders and adopting relevant pedagogical approaches.

Supports: mean that TVETs offer for MSEs towards gaining **physical capacity** like, technology transfer and adaptation, productivity, quality, product standardization and certification.

Training: - mean that TVETs offer for MSEs towards gaining **human capital** for, technical skills development.

2.3.Empirical literature reviews

2.3.1. Technological capability: identify, select, accumulate and transfer

Another intervention area of IESP is making MSEs technologically capable and copying different technologies so that MSE operators use those copied technologies and generate their own income rather than doing the same thing by many enterprises. As a principle it is provided that TVETs are the incubation places of those copied and invented technologies and these technologies are accumulated and transferred turn by turn after the necessary technology formalities are fulfilled. There are different development target sectors for economic development in the urban areas according to the case of our country. To make MSEs technologically capable and to bring new innovators, TVETs select, accumulate and transfer new, copied and improved technologies to MSEs.

TVETs identify, select, accumulate and transfer technologies to MSE enterprises. These technologies are expected to solve social and economic problem of the society. As it is cited in the industrial strategy of Ethiopia ,industrial sectors for development formulates different value chain analysis and by identifying technology gaps and selecting best technologies and preparing sample from those technologies and selecting them to transfer to industry levels. This enhances the competitiveness of the enterprises. To accomplish this activity, competent MSE enterprises will be incubated by TVETs and selected and necessary technologies will be transferred to the industry. TVETs are expected to produce competent MSEs by selecting technologies, accumulating and transferring using MSEs in the development targeted sectors. In general technologies are selected, copied, adopted and accumulated by TVETs and transferred for further growth of MSEs. This also helps for further technological transfer of our country and MSE operators can produce import substitution items and the society at large will be benefited from

those technologies and the income and profitability of MSEs can be increased. Technology as a transformer factor from input to output is composed of four basic elements:

Techno-ware: is represents the tangible part of technology i.e. hard-ware. It comprises complex equipment and machinery. Techno-ware is the main action for transforming the input to output. Two other factors should be taken into account, namely:

- In underdeveloped countries more prestige is accorded to techno-ware than the other three factors of technology.
- The tendency among politicians and industrialists, in developing countries, is to give greater attention to techno-ware and in doing so neglect the expansion of the other factors of technology thus hindering the advance of technology.

Human-ware: This can be defined as the animate machines of industry. It encompasses skill, knowledge, creativity and motivation. The required level of these attributes varies from industry to industry; suffice to say that without the right level of skill, adequate research, innovation and technical know-how developing countries cannot hope to compete with the more advanced nations. Developing countries are net importers of technology. They need the kind of human-ware that is capable of utilizing such imported technology to full advantage. This being so, adequate provision for training of operatives should be considered as a high priority.

Info-ware: is the major element of Tech; it embodies all the technical information necessary for the smooth implementation of machinery obtained. Naturally producers of "technology" are more protective of info-ware than techno-ware. The main reason being that such information may include references to intellectual property, sensitive data etc. It is up to the recipient country to use the supplied information to best advantage.

Org-ware: it can be defined as the instrument for achieving goals. It comprises such activities as management, resource allocation and marketing. The effective co-ordination of these activities renders the organization more efficient. In general, org-ware canalizes skills and know-how of "Human-ware" in order to achieve the best use of men and machine. The interaction of "Tech-ware" and "Info-ware" on the one hand and the increase in technical development of "Human-

ware" should lead to further advances. This makes the need for adequate data processing pivital if productivity is to increase in line with more absorption of information.

2.3.2. Factors influencing technology transfer

i. Law and Policy Factors

Technology is a kind of knowledge product; it needs to be protected by the legal system, particularly in the field of intellectual property rights. The degree of protection for intellectual property rights varies in different countries in the cross-border business environment. In some countries, a large number of counterfeit products infringe the international technology transfer and reduce the profit of export. Many companies in these countries can rarely get rid of the infringement problem, but the protection of intellectual property rights of technology transfer in the host country or region is an important factor. The policy system plays a decisive role in the effectiveness of technology transfer. It is difficult for technology transfer to succeed in a country or region, where there are frequent government interventions, and many restrictions on foreign-funded enterprises. Policies of technology-importing countries or regions will have a direct impact on technology transfer in scientific technical and quality contents (Winston, 2004).

ii. Market Factors

Market factors are the fundamental factors of technology transfer. The effect of market competition and market size on technology transfer is particularly obvious. If the opening level of the home country or region is low, only a small number of transnational companies operating a monopoly in an industry will be able to maintain the technical advantage of their monopoly status to gain more profits. So the industry slows down the speed of technical progress and hampers the technical development. The size of the market determines the scale of production. If the market capacity is large, economy grows steadily, residents' purchasing power is strong in a country or a region, and the growing space of technology-importing countries or regions will be great. Accordingly, these areas' attraction of investment and technology transfer will be stronger (Winston, 2004).

iii. Technology Basis

A nation or region's technology basis is important for technology transfer. The availability of human resources, the knowledge level, the development of productive forces, and the technology

level will have a real impact on the transfer. The countries and regions with a great technology base and high skill levels will be capable of exporting technology. The conditions of technology-importing countries or regions restrict their ability to accept new technologies. If other conditions remain constant, the country with high-performance technology and good technical basis is more likely to promote the country's technology transfer (Winston, 2004).

iv. Infrastructure Status

Infrastructure includes transportation, canals, ports, bridges, telecommunications, electricity, water and urban water supply and drainage, gas, electricity, and other facilities. These are substantial engineering facilities to provide public service for production and the residents. It is the common material base for production, management, work and life, and guarantees that the main facilities in a city operate normally. Moreover, it is not only an important condition for material production, but also an important condition for reproduction of labor. As the exporter or recipient of technology, the infrastructure construction must be taken into consideration in implementation of technology transfer (Winston, 2004).

v. *Training and Qualification*

Developing countries lack enough skilled IT persons who can design, program, install, configure and maintain Information Technology in this constantly changing industry. Lack of qualified and globally recognized IT professionals in this region is seriously hampering IT adoption and development. The acquisition of some professional and technical skills by few professionals in developing countries, or the relocation of advanced technical equipment from industrialized nations to developing countries does not constitute technology transfer. Udo and Edoho (2000) noted that technology transfer takes place when the recipient country has corresponding technical information to enable it use the hardware in an effective and efficient manner. This would make it easy for effective communication and interactions with the transferring agents. It may be easy to relocate equipment; it is more difficult to transfer capacity which is human-embodied. Development skills should be aligned with development goals, and both require human skills. Developing countries do not have enough graduates and technologists in science and technology, though there is now a growing awareness of the importance of Information Technology for

development. Despite global availability of the Internet, universities and polytechnic institutions have limited access to the Internet and modern computing (Mutula, 2003).

For simplicity, all the factors that affect technological development in developing countries fall under three major categories, according to Odigie 2006. Problem related with transferring issues, problems associated with effective usage and problems connected with updating that knowledge and technology. An early assessment of the impact of the national regimes on technology transfer suggests that the regimes had an important positive effect in three key major categories.

a) Reducing the explicit prices of the technology within technology transfer agreements,
b) Eliminating restrictive clauses in technology transfer agreements and in
c) Shortening the terms & duration of the agreements.

Another scholar classifies the factors in other way as human capital and absorptive capacity, Connectedness and networking dynamics, Trust and common objectives (Araujo, 2014). Factors are different in between different clients of knowledge and technology transfer. Knowledge and technology transfer factors can exist in between universities and industries.

2.4.Conceptual framework

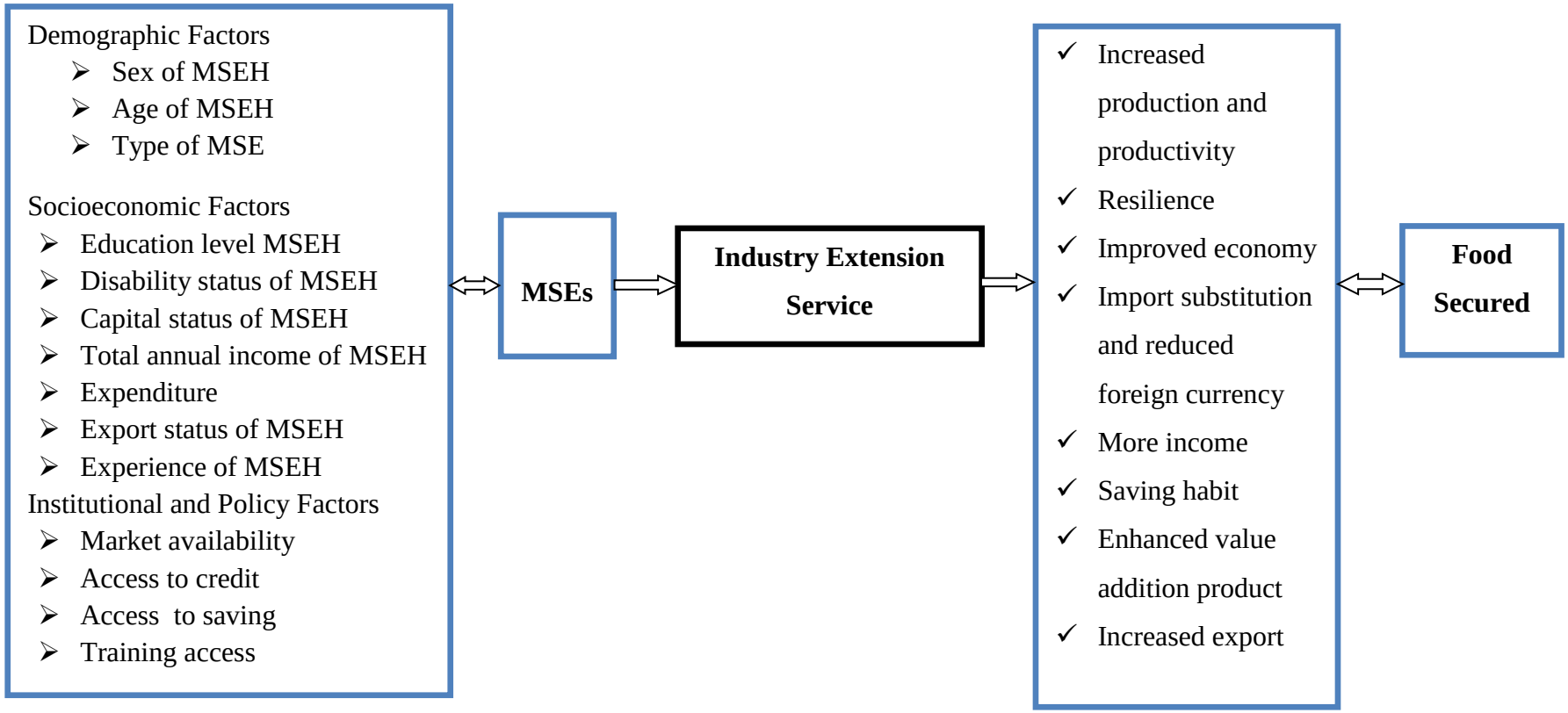
I have considered a number of factors which are likely to influence entrepreneurs' adoption decision can be appropriately adapted to develop a conceptual framework of MSEs decision to adopt new technology. As shown in Figure 2.1, these factors are classified as demographic factor, socio-economic factors and institutional factors. For instance, sex as a demographic factor influence MSE heads decision to adopt new technology as female-headed households compared to male-headed households are more affected. Females are most likely to take care of their extended families, and will usually sacrifice their food intake to feed other members of their households, and hence, threatened by food insecurity and moreover they are most likely to be single parents than their male counterparts.

In terms of age, young people are economically active than old people and can operate in challenging jobs within the labor market. Households with old age heads are exposed to chances of less decision maker to adopt new technology. Likewise, education status of the MSE

members, experiences of the producing goods practices and participation of the households in various organization (such as MSE association, corporations and MSE cooperatives and other social institutions also have a positive and significant relationship with adoption of improved goods production technologies (Gebeyehu, 2014). Similarly, it is explained in terms of contribution of education on working efficiency, competency, diversify income and becoming visionary in creating conducive environment to educate dependents with long term target to ensure better living condition or food secure than illiterate ones. On the other hand; an increase in the age of household head, inadequate working experience, and low level of MSEHs education have less probability for the adoption of new technologies. Alternatively, the MSE ownership of the households directly or indirectly relates with the household food security. A household benefiting from the MSE has the capacity to contribute and fulfill its requirements in view of the four components of household food security which are availability, access, utilization and stability.

Similarly, total annual income of household is important factor influencing decision to adopt new technology. Employing different technology has a positive impact on MSE livelihood since it enables them to increase income and productivity in insuring food security. So, high-income MSE are more likely to adopt new technology and to be food secured. Continuous market access, saving habits and training or technical follow up on the provided technology is very vital in proper adopting new technology was enhancing production and productivities of MSE and their income.

However, in order to improve their livelihoods each MSEs, the government support indifferent extension service, and to develop their resilience to shocks over the last one decade. From four components of industry extension service: technology capability. This program effects on developments of MSEs, food self-sufficiency at household level and economy status of the country: it improves economy, reduced foreign currency, resilience, more income, better saving culture, enhanced value addition product, increased export and increased production and productivity. Hence, the expected final outcome of this program is developing strong economy and insuring food security at national or household level.



Source: Formulated from several literature reviewed, 2022.

Figure 1: Conceptual framework of the study.

CHAPTER THREE: DESCRIPTION OF THE STUDY AREA AND RESEARCH METHODS

3.1.Description of the study area

The study was conducted in Addis Ababa specific area of Gulele and Arada sub-cities. Addis Ababa is the capital city of Ethiopia, located at 9° 0' 19.4436" N and 38° 45' 48.9996" E coordinates. The projected population of Addis Ababa in 2017 was 3,433,999 and the city divided into eleven sub-cities named as Arada, Addis Ketema, Yeka, Kirkos, Lideta, Kolfe, Akaki Kaliti, Nifas Silk Lafto, Lami Kura, Gulele and Bole. Under each sub-city, there are *Woredas* and *Ketenas* which are the lowest units of administrations. The city is simultaneously experiencing high rates of economic growth and urbanization having 25% of the urban population of Ethiopia (UN-HABITAT, 2017; World Bank Group, 2015). According to the State of Ethiopian Cities 2015 Report 2, Addis Ababa's share in GDP accounts for 29% of the total urban centers (UN-HABITAT, 2017). Addis Ababa is also the political center being the head quarter for the African Union and United Nations Economic Commission for Africa.

Gulele sub-city is one of the ten sub-cities of Addis Ababa is located in the northern part of the city. Within the city, it shares borders with four sub-cities. While Addis Ketema and Arada sub-cities borders Gulele sub-city to the South-West and South-East respectively, Kolfe Keranyo and Yeka sub-cities are to the West and East of this sub-city, respectively. To the north, Gulele sub-city shares borders with the Oromia National Regional State. Administratively, according to information from the Addis Ababa City Administration Integrated Land Information Center (AACA-ILIC, 2014: 6). Gulele sub-city covers 3,119.09 hectares (31.19 sq. km^2) of land which is 6 percent of the total land area of the city. This makes Gulele the sixth largest sub-city in Addis Ababa. The total projected population in 2017 was 137,690 male 147,175 Female total 284,865 populations. It has ten *Woredas* (or districts) administered under its jurisdiction and with population density per sq. m: 9,438.9 (UN-HABITAT, 2017). The study has chosen eight *Woredas* from Gulele sub-cities

Arada Sub-City is found in the central part of Addis Ababa City administration. The Sub City has 9,502,409 m2 physical land coverage. According to the Census in 2007, the Sub City had a total population of 334,050. Out of the total population 47% (156,000) and 53% (178,050) were

males and females respectively. The sub city is center of culture and education, with a great number of schools, cultural establishments and annual cultural events. Arada is also one of the oldest parts of Addis Ababa and early history is most apparent. Its narrow, sloping streets are dotted with beautiful old one- and two-story buildings variously adorned with verandas, pillars, bay windows and other decorations in accordance with Indian, Middle-Eastern and European styles (Mehari, 2011).

The present Entoto Cluster College was established in 1925. The provisions of education serve as primary school gradually improve the provision in to secondary education. Since its foundation until 1974, it was known by the name of the then Emperor Haileselasie I of Ethiopia - 'Teferi Mekonen'. When the military Government of Ethiopia came into power, its name was changed to Entoto Comprehensive Secondary School in 1974. The College was legally established according to Proclamation No. 22/1999 published in the Negarit Gazette. Entoto TVET College is one of the known and giant public TVET clusters found in Addis Ababa. In 2000, it however changed its name to Entoto TVET College. The new reform of the TVET Strategy in the country was also amended in 2011. Thus, the previous name of the College was changed in to Entoto TVET Cluster College including Arada Manufacturing College. Since then, it has been named as Entoto TVET College. According to the Entoto TVET College (2020), there were 445 teachers, and 234 administrative workers. Moreover, the College had 21 administrative staff members who were working on a contract basis. In general, the College had a total of 682 employees last year. As a vocational training center, the trainers offer both formal and non-formal trainings.

However, a new chapter was opened in the College in 2011 because of the decision made to offer training on different skills that may require more practices only in (hard skills) both in the premises and in the provisions of training on Kaizen, technology adoption and transfer and entrepreneurship in the MSEs. During the time of data collection, the College was offering the training at Level I to IV on those occupations, including hotel management, information technology, metal and wood work, automotive technology, drafting and survey, construction technology, textile and garment technology, electrical and electronics, and aesthetics. All those occupations are derived from the National Occupational Standards (NOS) prepared by the Ministry of Education in collaboration with the stakeholders (Alemu, 2012).

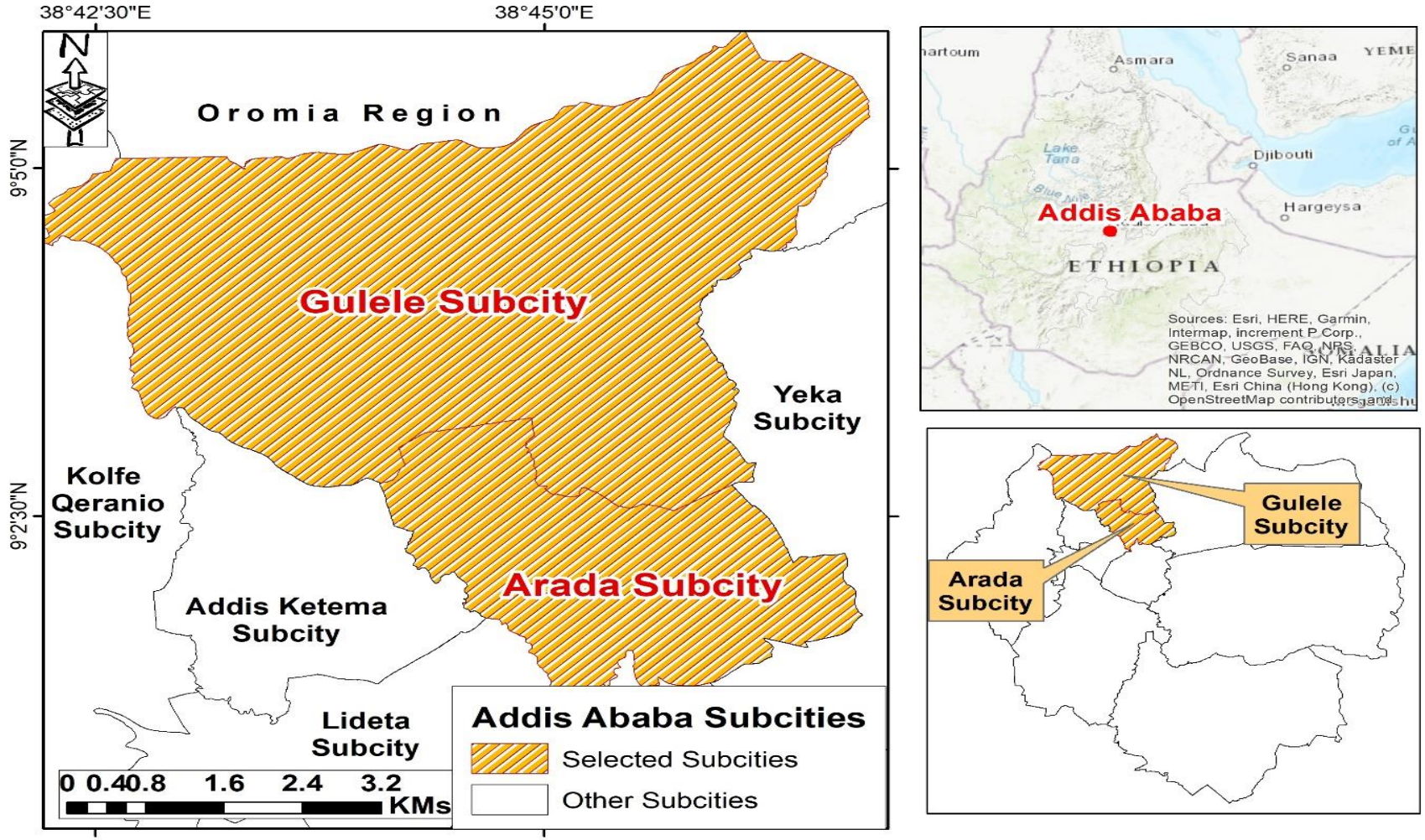


Figure 2: Location of Arada and Gulele sub cities.

Source:http://www.addisababa.gov.et/fi/web/guest/gulele/arada/sub-cities retrieved at 9:20pm Jun 22, 2022.

3.2.Research design and approach

This study used a cross-sectional research strategy, which is suited for studying multiple units at a specific point in time. In order to generate a full analysis of the study, a mixed strategy of both qualitative and quantitative data collection was employed from both primary and secondary sources.

The qualitative approach was used to gain a deeper understanding of the micro and small enterprise: technology transfer and adoption program, main activities, contribution to improving MSE households, livelihood, and participation activities undertaken, respondents' perceptions of technology transfer in TVET implementation (targeting, major constraints to training access, and contribution to local economy transformation), and major challenges of technology transfer and adoption. Semi-structured interviews, focus group discussions, and observation were utilized to acquire qualitative data (Fraser, 2015).

The quantitative approach comprises numerically representing a quantity or amount and observing the relationship between components. The MSEH survey was carried out to gather data on the socioeconomic, demographic information, and instructional elements of MSEH, the major determinants of technology and adoption in MSEs, and the influence of technology transfer and adoption on enhancing MSEs' food security status. A number of statistical and economic approaches are employed to examine data in such research. It also investigates the link between variables through the use of correlation, binary, and ordered logistic regressions (Mitchell, 2015).

3.3.Sampling technique and sample size determination

The households were chosen using a multi-stage sampling procedure. The heavily populated Gulele and Arada sub-cities were purposefully drawn in the initial stage. The fast development of the urban population, both naturally and as a result of migration, has put a strain on public services such as housing, sanitation, transportation, water, energy, health, and education in the chosen sub-city (Rai, 2017, Kassaye, 2020). Similarly, UN-HABITAT (2017) stated that Addis Ababa's fast and unregulated demographic development and spatial expansion, in general, and the Gulele sub-city in particular, has resulted in significant environmental harm, with high levels of water and air pollution today. Similarly, densely populated sites can impose pressure of the

food insecurity households. At the second stage, Entoto Polytechnic College is one of Gulele and Arada sub cities cluster College and two *Woredas* from two sub cities were purposively selected because of high rate of MSEs were supported in industry extension and technology transfer service program. In addition, the reason for selecting Entoto TVET College was also due to the fact that it has been acting as the cluster center of 5 government and private TVET institutions (Kirubel, 2014). In the third step, four ketans namely: 1, 3, 2, and 5 were selected through simple random sampling technic. In the fourth stage, a stratified random sample approach was used to divide MSEs into two groups: beneficiaries of technology transfer and adoption and non-beneficiaries of technology transfer from the *Woredas* of Gulele and Arada Sub Cities. The MSEHs within the two strata were chosen in random sampling methods. Finally, the sample MSEHs were chosen using simple random sampling. A total of 256 samples were chosen for this investigation, with 133 MSE technology adopters and 123 non-adopters providing main data. The sample size for the study is identified by using Cochran's (1977) formulas.

$$n = \frac{pqz^2}{u^2}$$

Where, n= Sample size required

p= The estimated proportion of MSEHs an attribute that is present in the population (expected prevalence of participant households)

q=1-p (P is the estimated proportion of households an attribute that is present in the population)

Z= Z- Score (critical value associated with appropriately chosen level of confidence)

u= The desired level of precision or marginal error

To estimate the sample size, the estimated prevalence for Addis Ababa is unknown because there have been few previous research. Assume p=5 as a result (maximum expected prevalence). As a result, the Z value equals 1.96 when the intended level of precision is 5% and the level of confidence is 95%. The sample size is estimated to be: According to Gebeyehu (2014), the actual number of MSE technology adoption beneficiaries in TVET may range between 16% and 20%. The researcher wants to calculate this sample size with a 5% precision.

$$\frac{0.2*0.8(1.96)^2}{0.05^2} = 246$$

Adding 10 MSEHs contingency for expected non-response rate, the final sample size of MSEHs for the household survey is: $n = 246 + 10 = 256$

The following formula was used to determine the sample size of each stratum in the two *Woredas* of four Ketanas. Pi= ni/N where; Pi= proportion of population included in stratum I,

ni= the number of element,

N= the total number of the population

Pi= 256/967 = 0.264

Table 1: Distribution of sample respondent probability proportional to size by *Woredas*

Study sub cities and *Woreda*	**Sample *Ketena***	**Total MSEH in each woreda**	**MSEHs technology transfer beneficiary group**		**MSEHs technology transfer non-beneficiary group**		**Total Sample**
			Total	**Sample**	**Total**	**Sample**	
Gulele Worada 3	2	306	181	48	109	29	77
	3	203	105	28	118	31	59
Arada Worada 7	1	183	109	29	113	30	59
	5	240	106	28	126	33	61
Total		**967**	**501**	**133**	**466**	**123**	**256**

Source: Computed based on data obtained from *Woreda* 3 and 7 and Entoto cluster college administrations, 2022.

This research has been conducted by questionnaire survey to 256 respondents or MSE heads are determined as a sample size of study form stratum one 133 technology adopters and 123 non-adopters MSE heads was selected for this study.

3.4.Tools and techniques of data collection

All relevant primary and secondary data sources were used in the investigation. A household survey, direct observation, key informant interviews, structured interviews, and a focus group discussion were used to collect primary data. Secondary data on dairy technology adoption and food security issues was acquired from published and unpublished studies. Among the data sources were books, journals, research papers, articles, statistics reports, and official world-wide web sites for literature reviews and information on the topic field.

A household survey, focus groups, field observation, and key format interviews were used to collect data for the research project. To collect information, the home survey was led by aids such as instructions and checklists.

3.4.1. Household surveys

In the research locations, 256 sample houses were surveyed using a questionnaire. As part of the study ethics, a standard questionnaire was used to give a questionnaire-based survey to a sample of recipient MSEs. The questionnaire was translated into Amharic to facilitate communication between the enumerators and the respondents. The surveys were gathered from MSE technology adopters and non-adopters through face-to-face interviews with household heads, as well as through my supervision and filling out on my own. The surveys were used to collect data on the socioeconomic and demographic characteristics of households, as well as to examine the factors influencing technology transfer and adoption in the research area's MSEs. Furthermore, using a household survey, information on the contribution of technology transfer and adoption to MSEH food security, significant constraints of technology transfer and adoption in TVET and MSEs, and respondents' perceptions of program execution were acquired. Before beginning the surveys, it was critical to inform participants about the research aims and contents in order to collect accurate data.

3.4.2. Focus group discussion

Two focusing group discussions were held with six to eight individuals in each group, including producer MSEHs from both groups (adopters and non-adopters), as well as industry extension and technology transfer experts, to gather opinions, qualitative and quantitative descriptions of production status, factors that influenced technology adoption and constraints and the effects of technology adoption on MSEHs food security. Furthermore, important constraints and possibilities related to technology transfer and adoption in the TVET and MSE sectors were discussed in the focused group discussion.

3.4.3. Key Informant Interviews (KII)

A key informant interview was conducted to acquire the necessary primary data, which led to a conversation with involved bodies to obtain information about the issue connected to the study objectives and a description of the study region. Entoto Poly Technic College's vice dean of industry extension and technology transfer service program head, at Woreda level from Arada

sub city Labor Enterprise and Industry Development office directorate, and kebele level extension agents were important informants in this study.

3.4.4. Field observations

In addition to the methods described above, field observations were conducted to validate the information obtained from primary and secondary data gathering technologies. Observation is a qualitative strategy used to help researchers understand about the perspectives held by study households. Data gathered through observation serve as a check against participants' subjective reporting of what they believe and do (Mitchell, and Fraser, 2015). Observation is a vital data collection strategy. Field observation was utilized to really cover the land and to supplement the data collected by other approaches. This technique is especially useful for critically examining the roles and restrictions of technology transfer and adoption work operations in the studied area.

3.4.5. Secondary data collection

In addition to the aforementioned data gathering approaches and procedures, a thorough desk evaluation of published and unpublished literatures such as books, journals, articles, reports, and e-resources was conducted. Documents are ranging from Woredas of Gulele and Arada Sub Cities Labor Enterprise and Industry Development Office and Entoto Poly Technic College, Arada Manufacturing College, AATVET Bureau, Federal TVET and Minster level reports, plans, and publications of various government departments and NGOs working in the area.

3.5.Technique and method of data analysis

The obtained survey data were input into a computer, edited, coded, and entered into a computer for analysis using Statistical Packages for Social Science (SPSS 26) and "STATA Version 16" software. The quantitative data in the study was analyzed using both descriptive statistics and an econometric method. The descriptive statistical tools are critical for obtaining a clear image of the households included in the sample. It was used to summarize data such as percentage, frequency distribution table, mean and standard deviations. Inferential methods such as chi-square (for categorical variables) and t-test (for continuous variables) were used to investigate the associations between technology transfer and adoption beneficiary MSE heads and non-adoption beneficiary MSE heads characteristics/factors. The binary logistic regression model was employed in the study to assess the factors influencing technology adoption in the study area's MSEs. In addition, an ordered logistic regression model was used to investigate the effects

of technology adoption. The models aided in the description of the link between an outcome variable and a set of explanatory variables.

3.5.1. Statistical model specification for technology transfer and adoption study

Binary logistic regression model

The binary logistic regression method was employed to examine the association between independent variables and the dependent variable, which is dichotomous. According to Gujarati (2004), binary probit is used when there is a qualitative response variable or when regressing and taking two values. In other words, and is a binary (or dichotomous) variable. In regression, given E (Yi | X1i, X2i,..., Xki), where the X's are quantitative and qualitative repressors and Y is qualitative. As a result, qualitative response regression models are sometimes referred to as probability models, and they were typically estimated as a function of individual attributes utilizing Statistical data analysis software package STATA version 16 statistical model such as logit or probit model.

The Probit model and its binary outcomes enable researchers to investigate how each explanatory variable influences the likelihood of events occurring, as well as the level and direction of the relationship between dependent and independent variables in the adoption of new technology in the manufacturing industry at the firm level (See Long and Freese, 2006). This was a set of outcomes (determinants of technology adoption in MSE household heads who were either technology beneficiaries or non-beneficiaries). The dependent variables have binary values, with 1 indicating that the holders are beneficiaries of technology transfer and 0 indicating that they are not. As a result, binary regression is utilized to assess the relationship between the outcome variable and the independent factors.

The mathematical (functional) expression of the model is given as follows:

$$Probit\,(\mathrm{Y}) = 0 + 1\,X1i + 2X2i + \cdots + Xni$$

3.5.2. Statistical model specification for the food security study

Food security is intended to assess food availability, accessibility, consumption, and stability at the global, national, household, and individual levels. Food insecurity occurs when people do not have consistent access to an appropriate and safe source of food. In other words, access to sufficient nutritionally adequate food at all times for an active and healthy existence. There are a

variety of measurement instruments available for households to assess their food security status, which vary depending on the scope and goal of the evaluation. Similarly, data was generated using a combination of techniques. In this study, the Household Food Insecurity Access Scale (HFIAS) food security measurements were employed, to the examination of the influence of technology transfer and adoption in improving food security of MSE heads.

3.5.3. Independent variables

Independent variables are variables that stand alone and are not affected by other variables that create changes in dependent variables. The independent variable for the study was selected by a review of the various literature and those influencing the MSEHs decision to embrace technologies and their implications on the outcome variable. As a result, household socioeconomic, institutional, and demographic characteristics are recognized as independent variables. The independent variables are clearly presented in both the empirical literature review and the conceptual framework. These variables influenced MSEHs' decision to adopt technologies, and they had an impact on productivity and household food security. The independent variables are;

Age of the head of the household (AGEMSEH): It is a continuous variable that is measured in years. The age of the household head is predicted to influence technology adoption in this study. The likelihood of adoption reduces as the age of the family increases. Because as a farmer ages, he or she gets less involved in technological issues or becomes risk adverse to new technologies. As a result, the age of the family head had a greater impact on dairy technology, both favorably and adversely. Furthermore, because the home's leader is older, the household is more likely to be food insecure (Awoke, et al, 2019).

Sex of the household head (SEXMSEH): It is a dummy variable; it is maleness and femaleness of the household head. Due to socio-economic activity and engagement, the role of male and female involvement in technology adoption process through different extension program and access to information, male farm headed are exposing for information.

Education level of the household head (EDU): This is a continuous variable that represents the year of education in grade maintained by the respondents. Education is critical for adopting new

technology, and it also enhances MSEHs' willingness to absorb new technologies. Furthermore, it enhances the desire of MSEHs to adopt upgraded technology, which aids in decision-making. In this scenario, it was assumed that household education status would favorably influence the likelihood of adopting upgraded technology. According to the report of Koffio-Tessio et al., (2005), education boosts agricultural output in rural regions, resulting in food security.

Firm member size (MEMBSIZE): It is a continuous variable. MSEHs with access to labor are expected to adopt new ideas faster than those without. The increased availability of active labor will have a favorable impact on the adoption of advanced dairy technology. This concept was similar to the one proposed by Bukusuba et al. in Uganda (2007). According to the study, large households have the potential to recruit sufficient labor, allowing them to produce more food and become food secure.

MSEH's annual income (TOTAL INCOME): It is a variable that changes throughout time. Most households with access to MSE employment had a good effect on technology adoption, as well as another source of revenue for technology expenditures such as raw materials and transportation. As a result, many members of firms involved in income-generating activities are likely to have a better chance of earning more money. Off-farm income alternatives, according to Amha (2004), are key methods of ensuring food security. Participating in income-generating activities has an impact on household food security.

MSE head's experience (EXPERIENCE): It is a continuous variable represented in years that the MSEH has gone through. It may be expected that there is a direct relationship between working experience and technology adoption, as well as willingness to adopt a technology because they have production experience.

Saving MSEH access (SAVING): It is a dummy variable with a value of one if an MSEH has a saving habit and a value of zero otherwise. MSEHs with a savings habit have access to buy input and sell products. Saving habits were expected to influence technology adoption while MSEH have access to savings and can easily sell their products and use new technology. Better access to saving, expected to improve return to labor and capital, increase farm gate price and incentive to participate in technology adoption.

MSEH export status (EXPORT): It is a dummy variable that has a value of one if an MSEH export is production and a value of zero otherwise. These decide the MSEHs in terms of technology access and utilization. As a result, MSEHs who export their commodities have a better opportunity of copying and adopting technology, so improving their livelihood and food security.

Credit availability (CREDIT): It was tested as a dummy variable, with a value of 0 if the household did not have access to credit and 1 if they did. Because of the high investment cost, which the household may not be able to afford easily, the variables were projected to influence technology adoption. Credit institution helps to cover the household financial expenditure for technology adoption.

Table 2: Explanatory variable description and its expected sign

Explanatory variables	Nature of variable	Unit of Measurements	Expected Sign
Age of the micro and small enterprise head	Continuous	Years	-/+ve
Sex of the micro and small enterprise head	Dummy	1 for male and 0 for female	-ve
Educational level of the micro and small enterprise head	Continuous	Year of education	+ve
Type of firms micro and small enterprises	Continuous	Number	-/+ve
Marital status of micro and small enterprise head	Dummy	Married or No	
Health status of micro and small enterprise head	Dummy	Yes or No	-/+ve
Total annual income of firms	Continuous	Number	+ve
Expenditure of micro and small enterprise	Continuous	Number	-/+ve
Experience of micro and small enterprise head	Continuous	Years	+ve
Access to credit	Dummy	Yes or No	+ve
Access to saving	Dummy	Yes or No	+ve
Access to training	Dummy	Yes or No	+ve
Export status of MSE	Dummy	Yes or No	+ve

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1.Demographic and socio-economic characteristics of respondents

This section describes the household characteristics of MSE owners, including age, gender, educational level, marital status, experience, kind of MSE, income, access to saving and credit, health status, expenditure, and so on, and their impact on technology transfer and adoption. According to Table 3, the average age of adopters' heads is 36.2 years, while it is 36.1 years for non-adopters. The mean age variance in the two groups was determined to be statistically insignificant (p-value = 0.5226).

Table 3: Demographic and socioeconomic characteristics for continuous variables

Name of the variables	Participant (N=133)	Non-participant (N=123)	Total value (N=256)	T-value	P-value
	Mean value	Mean value	Mean value		
AGEMSEHs	36.25564 (3.239562)	36.06504 (.6620861)	36.16406 (2.377269)	-0.6402	0.5226
EDUMSEH	7.571429 (2.394076)	6.593496 (1.974582)	7.101563 (2.25211)	-3.5492	0.0005***
EXPERIENCE	7.533835 (3.679486)	8.699187 (4.334261)	8.09375 (4.041816)	2.3246	0.0209**
TYPEMSE	1.879699 (.5778434)	1.853659 (.5822923)	1.867188 (.578993)	-0.3589	0.7200
TOTALINCOME	28418.8 (44205.75)	10152.85 (10864.13)	19642.58 (33935.8)	-4.4592	0.0000 ***
EXPEND	10966.92 (18509.89)	6724.39 (7135.209)	8928.516 (14360.44)	-2.3832	0.0179 **

Note: ***, **, *, show significance at p<0.01, p<0.05, and p<0.1 respectively

( ): means standard deviation

Source: Computed from own survey (2022).

The statistics result also revealed that the year of education of adopters is 7.57, while the figure for non-adopter families is 6.59. Furthermore, with a p-value of, the mean difference was judged to be statistically significant (0.0005). The estimated likelihood indicates a significant mean difference in education status between beneficiary and non-beneficiary MSEHs at the (p0.01)

significant level. This finding indicates that as the number of MSEH with an education status increases, so does their proclivity to use technology.

The results further revealed that the experience of the adopters was 7.53 while the figure is 8.69 for the non-adopter households, respectively. In addition, the mean difference was found to be statistically significant with p-value of (0.0209). The calculated probability implies that there is significant mean difference in experience status of the beneficiary and non-beneficiary MSEHs at ($p<0.05$) significant level.

Adopters have a mean total annual income of 28418.8, whereas non-adopters have a total income of 10152.8. In terms of technology adoption, the mean total income of adopters exceeds the mean total income of non-adopters. As a result, the mean variation was found to be statistically significant (p-0.000). This shows that MSEHs with higher yearly incomes are more likely to adopt new technologies than MSEHs with lower annual incomes.

Similarly, the average mean spending of adopters was 10966.92, while the mean difference for non-adopter respondents was 6724.39, and the difference between the two groups is significant at p0.05 of significance level. In terms of technology adoption spending, adopters pay less on average than non-adopters. This demonstrates that MSEH that have not implemented technology have dedicated the majority of their revenue to other interests and are unwilling to do so.

Among the dummy variables, the results in Table 4 demonstrate that approximately 55.5% of total respondent MSEHs had access to credit services, while the remaining 44.5% did not. In terms of technology transfer and adoption, the majority of adopters (63%) were involved in technology adoption activities and continued to have access to credit services, whereas the remaining 37% of MSEHs had no access to credit. Approximately 47% of non-adopter MSEH respondents had access to credit, whereas the remaining 53% did not. Despite the fact that the statistical test demonstrates a significant difference between technology adopters and non-adopters, the chi2 (0.05) result indicates that MSEHs of adopters have access to credit more than non-adopters responses.

Similarly to this saving habit, 89 percent of MSEHs that implemented new technology lacked credit. Approximately 76% of non-adopter MSEH respondents had access to savings, whereas the remaining 24% did not. Despite the fact that the statistical test demonstrates a significant difference between technology adopters and non-adopters, the chi2 (0.05) result indicates that MSEHs of adopters have more access to savings than non-adopters responders.

Table 4: Demographic and socioeconomic characteristics for dummy variables

Name of the variables	Category	Participant (N=133)		Non-participant (N=123)		Total value (N=256)		Chi2 -value (probability)
		N	%	N	%	N	%	
Sex MSEHs	Female	45	33.8	37	30.1	82	32.0	0.520
	Male	88	66.2	86	69.9	174	68.0	
Marital status	Married	73	54.8	67	54.5	140	54.7	0.546
	Single	60	45.2	56	45.5	116	45.3	
Disability status	Yes	8	6.0	7	5.7	15	5.8	0.912
	No	125	94.0	116	94.3	241	94.2	
Credit	Yes	84	63.1	58	47.1	142	55.5	0.010**
	No	49	36.9	65	52.9	114	44.5	
Saving	Yes	119	89.5	94	76.4.	213	83.2	0.040**
	No	14	10.5	29	23.6	43	16.8	
Export	Yes	27	20.3	3	2.4	30	11.7	0.000***
	No	106	79.7	120	87.6	226	88.3	
Training	Yes	109	81.9	44	35.8	153	59.8	0.000***
	No	24	18.1	79	64.2	103	40.2	

Note: ***, **, *, show significance at p<0.01, p<0.05, and p<0.1 respectively

Source: Computed from own survey (2022).

In terms of export status, 20.3% of technology adopters have engaged in export, while the remaining 79.7% do not export their commodities. In terms of non-adopters, only 2.4% are involved in the exporting stage, with the rest 87.6% not exporting their goods. In the reversal, 96.88% of adopters and 13.55% of non-adopters had access to dairy input supplies. The chi-square test result demonstrated a statistically significant correlation between adopters and non-adopters in input availability and dairy technology adoption at the (p0.01) level of significance.

This could be because the availability of dairy input in a neighboring market is critical to the adoption of new or existing technology.

Similarly, involvement in MSEH training may enhance technology adoption. In this regard, 81.9% of adopters' MSEHs had access to training, whereas 18.1% did not have access to training. Similarly, 35.5% of non-adopters were found to participate in various trainings, whereas 64.5% were not. According to the chi2 test, there was a statistically significant difference in participation technology adoption between technology adopters and non-adopter MSEHs. This result is consistent with KII.

In response to this, a beneficiary male MSEH trainee who was interviewed at age 40 stated:

> *'The sub-cities and woredas Labour, Enterprise and Industry Development Office facilitate training with collaborating Entoto Polly Technique College for as long as we have been in the sector as MSEs. Now that we are an association, we have training twice a week and I have skill or experience on leather garment /designing and sewing/ skills as well as other trainings from Entoto Polly Technique College. After I complete this program, I will take level three national tests known as Certificate of Competence (COC). Not only do they teach technical skills, but they also teach entrepreneurship, bookkeeping, and KAIZEN. Before two years, the college exchanged technology with consistent instruction, and we adopted one technology that we choose for design with less expense and efficient machine …' (Interview 01 adopter, June 30 2022, Addis Ababa).*

4.2.Factor affecting technology adoption of MSEHs

4.2.1. Model diagnosis test results

This study employed all of the needed model diagnosis tests, including an overall model fit (goodness of fit) model specification test, a multi-collinearity problem, and a model specification error test. In this scenario, model tests were run prior to running the logistic regression, and model specification error tests (link tests) were run afterwards. The explanatory variables were evaluated for multi-collinearity or correlations with the dependent variables in order to identify the determining factors that influence technology adoption. To test multi-collinearity, the variance inflation factor was used (VIF). As a result, the findings indicated that multi-collinearity

is not a problem because the tolerance among explanatory variables is greater than 10%. (See appendix 4).

Table 5: Diagnostic test result for regression models

Tests	Test name	Factors of participation
Estat gof	Pearson>chi2	0.9506
Link test	Hat	0.000
	Hatsq	0.655
VIF	Multi-collinearity	1.30

Source: Own competition result using STATA 17.

The model fitness test for logistic equations indicated that the models are adequate for explaining the dependent variables. The model's Pseudo R2 statistics of 0.9506, which lies between 0 and 1, confirm this. The findings demonstrated that the model's explanatory variables (independent variables) could explain the dependent variable and that the model was well fitted (see appendix 3). Because the p-value indicates that it is not significant, we fail to reject the null hypothesis and infer that no model specification mistake exists (see appendix 3).

4.2.2. Regression analysis and interpretations for factor affecting technology adoption

Binary logistic regression is useful when the dependent variable is dichotomous. We might be curious about which of the two result categories a new instance will fall into. As shown in Table 3, binary regression was used in this study to investigate the relationship between technology adoption and its explanatory components. The binary probit result for the factor influencing technology adoption is shown in Table 6. Data is the model's output. This data's pseudo R2 score is 0.3808, indicating that the prediction was correct. The model fits the data because the number of observations is 256, the log pseudo likelihood is -109.69149, the Wald LR chi2 (13) = 134.95, and Prob > chi2 = 0,0000.

The estimated binary regression model revealed that the explanatory variables utilized in the logit estimation model had a substantial influence on MSE program participation. Only five of the twelve explanatory factors, namely MSEH education status, access to savings, total yearly income, expenditure, and access to training, had a significant impact on MSEH technology

adoption at the 1% and 5% level of significance. Furthermore, MSEH education status, saving access, total yearly income, and training access all have a positive impact on technology adoption, while company expenditure has a negative impact. As predicted, MSEH education status had a substantial effect on technology adoption at the 1% likelihood level. The coefficient variation is positive and 0.532, meaning that increasing the education status of MSEHs enhances the probability of the firm adopting technology by 53%. As a result, education and technological adoption are inextricably linked. This is due to educated people having greater ability, experience, and knowledge, all of which help them adapt technology. MSE managers with a higher level of education are more likely to adopt new technologies. This results is consistent with those of Mesay et al. (2013) and Tolesa et al. (2013). (2014).

Table 6: Binary probit result for factor affecting technology adoption on MSEs

Variables	Coef.	Std. Err.	Z	P>z	95% Conf.	Interval
SEXMSE	-.217	.236	-0.92	0.358	-.681	.246
AGEMSE	-.044	.225	-0.20	0.845	-.486	.398
MARSTATUS	.134	.126	1.06	0.287	-.113	.382
TYPEMSE	-.108	.188	-0.57	0.566	-.477	.261
HEALTHSTATUS	.3058	.416	0.73	0.463	-.510	1.122
EDUMSEH	.532	.095	5.56	0.000***	.344	.719
EXPERIENCE	-.067	.139	-0.48	0.628	-.341	.205
CREDIT	-.010	.253	-0.04	0.967	-.507	.486
SAVING	.743	.331	2.24	0.025**	.093	1.392
TOTALINCOME	.000	6.340	3.36	0.001***	8.880	.000
EXPEND	-.000	.000	-2.28	0.023**	-.000	-.000
EXPORT	.648	.293	2.21	0.027**	.074	1.222
TRAINING	1.302	.267	4.87	0.000***	-1.827	.778

Source: Owen regression result using STATA 16.

Note: the sign ***, ** and* denote the coefficients are statistically significant at 1%, 5% and 10% respectively.

At a 5% significance level, saving access to MES heads has a significant and beneficial influence on the possibility of micro and small enterprises adopting technology. This implies that an MSE leader who has a good saving habit will have strong technological copy and adoption, which can create other money and generate additional income to better his or her livelihood. The coefficient variation suggests that it is positive and 0.742, meaning that if MSEHs save more, the probability of the firm adopting technology improves by 74%. As a result, strengthening each MSE's saving status is critical for technology transfer and adoption to better their livelihood.

Total annual income of MSE head also significantly and positively influences the probability of adopting technology in the MSE program at 1% significant level. This is because of household head with high amounts of annual income earned will have strong technology adopting willingness to improve their livelihood and in seek or adopting new technologies in their life. This is because of MSEH with high amounts of annual income earned will have strong livelihood which can make other money and seek new technologies to improve his/her livelihood.

Similarly, as shown in Table 6, MSE export status had a statistically significant and favorable influence on the probability of technology adoption readiness in the MSE program at the 0.5% level. At the same time, the coefficient variation reveals a positive and 0.648, meaning that if MSEHs' saving habits improve, the probability of the firm adopting technology improves by 65%. This implies that MSE heads who reach the export level have an opportunity to participate in technology adoption. As a result, participating in or creating export standard products is developing the potential for embracing new technologies.

On the other side, the amount spent on MSE had a statistically significant and negative influence on the likelihood of adopting new technology, with a p-value of -0.000. This suggests that household heads with high expenditures have a lower participation likelihood in technology adoption, whereas households with low expenditures have a higher possibility of adopting new technology.

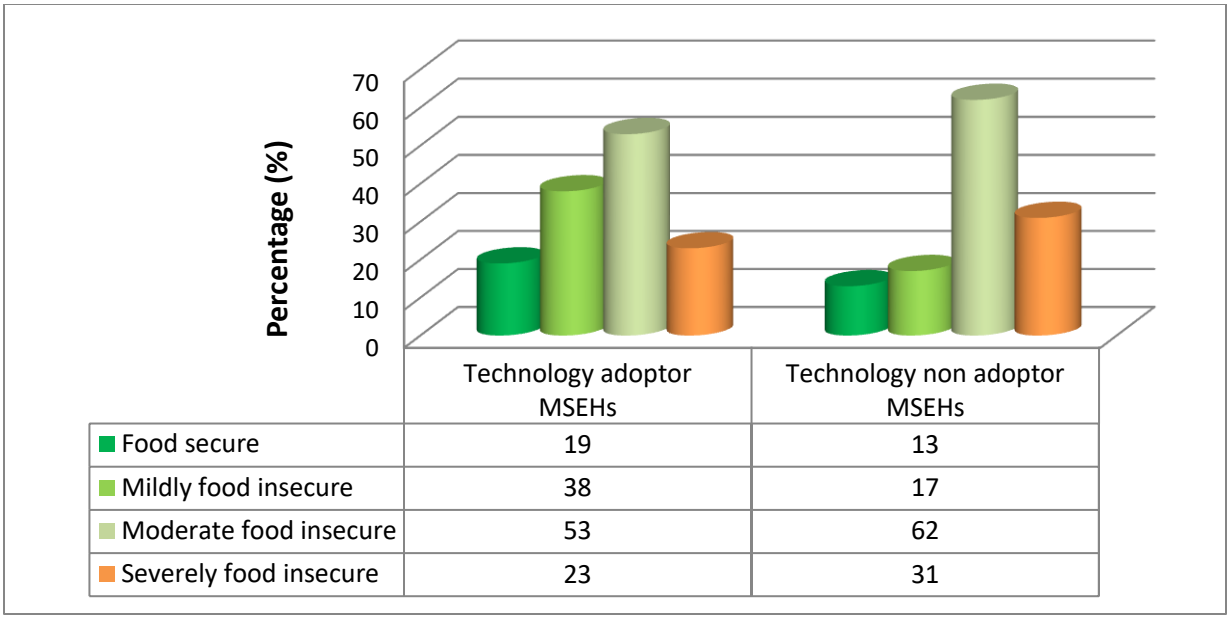
Finally, MSEH training availability and technology adoption had a statistically significant and unfavorable influence on the likelihood of adopting new technology. This shows that the

household heads who are capable of adopting technology have easy access to training in the study area. As a result, long-term training delivery has an impact on technology adoption. Based on the above talks, it is possible to conclude that explanatory variables can explain the likelihood of MSEHs technology adoption. The null hypothesis was rejected in this study's research; there is a substantial association between explanatory variables and new technology adoption in MSE.

4.3. Food security status of the study households

4.3.1. Household food insecurity access scale

The HFIAS module contains data on household food insecurity (access). The Household Food Insecurity Access Prevalence (HFIAP) status indicator was used to evaluate the prevalence of household food insecurity (access) and to make regional targeting decisions. HFIAP variant was also recorded. For example, if 60% of families are severely food insecure (access) at the start of the program and only 30% are at the end, the prevalence of household food insecurity (access) has decreased by 30% (Alternatively, by 50%). Because the average HFIAS score is a continuous variable, it is more sensitive than the HFIAP indicator to catching smaller increments of change across time. As a result, for program monitoring and evaluation, the HFIAP indicator should be presented in addition to, rather than instead of, the average HFIAS Score. The HFIAP indicator, as shown in Table 4.5 below, categorizes respondent families into four degrees of household food insecurity. According to the findings, only 12.4% of respondent homes were food secure, while the bulk of study households (44.9) were significantly food insecure. The remaining 21.5% and 21.4% of respondent households were either somewhat or severely food insecure.



	Technology adoptor MSEHs	Technology non adoptor MSEHs
Food secure	19	13
Mildly food insecure	38	17
Moderate food insecure	53	62
Severely food insecure	23	31

Figure 3: Food security and participation status of MSE heads in the study area
Source: Own computation of regression result using STATA 16.

This suggested that the majority of technology adopter MSEHs were mildly to moderately food insecure, whereas the majority of non-technology adopter MSEHs were moderately to severely food insecure. The findings indicate that the impact of MSE on household food insecurity is critical in order to improve the status of food insecurity. However, both technology adopter MSE households and non-adopter households are mildly to moderately food insecure. Few people in both groups are food secure, and even fewer are seriously food insecure.

4.3.2. Ordered logit

This section explains the econometric study used to determine the effects of factors on technology transfer and adoption, as well as food security in urban MSEHs. It was examined utilizing the HIFAS model and ordered logistic regression analysis. The researcher used an ordered logit regression model in this study to forecast the impacts of technology transfer and adoption on the food security status of sample MSEHs. The number of observations is 256, as shown in Table 7. The LR Chi-squared test, with a score of 87.22 (P-value =0.0000), demonstrates that models fit the data better than the null. The Pseudo R2 value is 0.1333.

STATA results show that MSE heads have statistically significant credit, saving, total income, expenditure, export status, and training access. The remaining variables are insignificant.

Nonetheless, it suggests that the p-value of four variables strongly influenced and determined the risk of the MSE home in the research area becoming food insecure. As indicated, the p-value for these four variables is less than 0.05 or greater than the Z score of 1.96. The remaining variables were not significant (See Table 7and 8).

Table 7: Ordinary logit result for effects of MSEHs on food security

Variables	Coef.	Std. Err.	Z	P>z	95% Conf.	Interval
AGEMSE	.068	.052	1.31	0.191	-.034.	- .171
MARSTATUS	-.125	.155	-0.81	0.419	-.431	.179
TYPEMSE	.30	.227	1.36	0.174	-.136	.756
HEALTHSTATUS	-.045	.540	-0.08	0.933	-1.104	1.013
EDUMSEH	.021.	.058	0.36	0.715	-.093	.136
CREDIT	.68	.30	2.29	0.022**	.099	1.28
EXPERIENCE	.000	.033	0.02	0.982	-.065	.066
SAVING	1.87	.482	3.88	0.000***	.925	2.815
TOTALINCOME	7.88	4.15	1.90	0.057*	-2.50	.000
EXPEND	-.000	.000	-1.95	0.05**	-.000	6.05
EXPORT	.712	.306	2.33	0.020**	.112	1.313
TRAINING	1.187	.317	3.74	0.000***	.564	1.810
/cut1	7.161	2.552			2.158	12.164
/cut2	8.641	2.565			3.613	13.670
/cut3	11.234	2.614			6.109	16.358

Source: Own computation of regression result using STATA 16, 2022.

Note: the sign ***, ** and* denote the coefficients are statistically significant at 1 %, 5% and 10% respectively.

Credit access of MSEHs: The outcome of MSEH credit access is statistically significant and has a positive association with household food security at P5 (P=0.02). It implies that saving access to MSEHs in food security categories increases the likelihood of being in food secure. Furthermore, the marginal effect of credit availability increases by one in the food secure and

mildly food insecure MSEHs (less likely in the other two categories) by -0.05% and -0.08%, while the probability of food security increases (more likely in the other two categories) by 0.04% and 0.08%. This is due to relatively the coefficient results of Table 7 indicated that, if the credit access of moderate and severely food insecure category MSEHs increases the ability to become mildly insecure or food secure increase by 68%.

Table 8: Marginal effects after ordered logit model

Variables	Marginal effect dy/dx for food secure	Marginal effect dy/dx for mildly food insecure	Marginal effect dy/dx for moderate food insecure	Marginal effect dy/dx for severely food insecure
AGEMSE	-.005	-.008	.005	.009
MARSTATUS	.009	.016	-.009	-.016
TYPEMSE	-.023	-.039	.022	.040
HEALTHSTATUS	-.022	-.037	.021	.038
EDUMSEH	-.001	-.002	.001	.002
CREDIT	**-.053**	**-.088**	**.050**	**.090**
EXPERIENCE	-.000	-.000	.000	.000
SAVING	**-.144**	**-.239**	**.136**	**.246**
TOTALINCOME	**-6.07**	**-1.01**	**5.75**	**1.04**
EXPEND	**1.51**	**2.51**	**-1.43**	**-2.59**
EXPORT	**-.054**	**-.091**	**.052**	**.093**
TRAINING	**-.091**	**-.151**	**.086**	**.156**

Source: Author's regression result using STATA 16, 2022.

Saving of MSEHs: According to the results of the ordered logit regression model, saving MSEHs is statistically significant and has a positive link with household food security at P0.1 (P=0.000). It demonstrates that the more MSEHs save, the more likely they are to be in the food secure category and less likely to be in the food insecure category. Keeping other variables constant, the marginal effect of saving access increases by one birr, the probability of being in

the food secure and mildly food insecure MSEHs decreases by -.14% and -23%, respectively, and the probability of being in the moderate and severely food insecure category increases by 0.13% and 0.24%. This is because the ability to become slightly insecure or foods secure grows if the saving habit of moderate and severely food insecure MSEHs increases. The coefficient fluctuation also indicates a 19% chance of food security. This finding is consistent with the findings of the key informant interview.

> *I feel the issue of money has become a lot better, as I joined our private association I had started saving. Unlike in the bank in town, there is an interest I earn when I save in the savings group. We are able to buy raw materials, to produce leather product so that I can sell to pay for school fees for my children. For the future based on I was taken sewing training and I want to form and join legal small scale enterprise with my colleagues who works on textile garment sector …' (Interview 02 non- adopter, June 15 2022, Addis Ababa).*

Total annual income: Annual income has a statistically significant positive relationship with MSEH food security at 10% (P=0.057). The data reveal that in the research location, MSE heads with high income are more likely to be food secure in all food secure levels of MSEHs categories. Furthermore, the marginal effect in Table 8 shows that increasing total annual income by one Birr by food secure and mildly food insecure MSEH increases the probability of being food insecure by -6.07 percent and -1.01 percent, respectively, while increasing the probability of being moderately and severely food insecure by 5.75 percent and 1.04 percent. Because the value of adding one birr in moderate and severely food insecure MSEH have strong change or increases the likelihood of food security, and the outcomes are dependent on total cash income per year and with the coefficient of 78%.

Expenditure: Expenditure has a statistically significant negative relationship with MSEH food security at 10% (P=0.051). The data reveal that in the research region, MSE heads with high expenditure are less likely to be in the food secure all food insecurity MSEHs categories. Furthermore, the marginal effect in Table 8 shows that increasing expenditure income by one Birr by food secure and mildly food insecure MSEH decreases the probability of staying in food secure by 1.51% and 2.51%, respectively, while increasing the probability of being in the

moderate and severely food insecure categories by -1.43% and -2.59%. Because the value of losing one birr in moderate and severely food insecure MSEH have strong change or increases the likelihood of food insecurity, and the outcomes are dependent on expenditure and their coefficient values also 00%.

Export status: Similarly to export status of MSEHs this variable has a statistically significant and positively influence on the level food secure at 05% (P=0.020). The result indicate that household head who export its commodity are more likely to be in the food secure in all food insecurity levels of MSEHs in the study area. The marginal effect in Table 8 indicates that, in food secure and mildly food insecure MSEH if the export status increase by one commodity the probability to food secured increases by -0.05% and -0.09%, the probability to be in the moderate and severely food insecure category increase by 0.05% and 0.09%. This means that MSEHs moderate and severely food insecure having export access have the chance becoming food secured than food secure or mildly food insecure in 71% coefficients.

Training access: This variable has a statistically significant and positive influence on the level of food security of MSEHs at 1% (P=0.000) as indicated in Table 7 above. The result indicates that MSE heads whose have training access are more likely to be food secured all food security MSEHs in the study area. Furthermore the marginal effect in Table 8 indicates that, if food secure and mildly food insecure MSEHs having training by one, increase the probability to food secured by -0.09% and -0.15%, the probability to be in the moderate and severely food insecure increase by 0.08% and 0.15%,. Because, more training access in moderate and severely food insecure MSEH increases the probability to be food security 12% as coefficients indicated.

4.4. Constraints of technology transfer and adoption in TVET and MSE of study area

Based on the descriptive analysis, this subsection outlines the primary restrictions that MSEs participants face from production to consumer in the research region. Micro and small businesses have the capacity to contribute to the overall and local economic growth of the country. Their contribution must be recognized in various regions of the world so that nations may establish diverse policies and strategies to promote and increase the role of MSEs in the nation-building process. A considerable number of individuals, particularly the economically poor, actively participate in MSEs and receive vital assistance from such sub-sectors. Despite their significant contribution to the growth of the local economy, they face several obstacles. According to the

respondents perceived the core constraints were identified as: market instability, limited role of private sector, limited adaptation activities, inadequate of collaboration among stakeholders, inadequacy of technology transfer readiness, inadequacy quality of human capital and technological intelligence.

Market instability: According to the findings of this survey, 14.6% of respondents saw market insecurity as a key limitation to the growth and development of SMEs in Gulele and Arada Sub-cities. The urban marketing system for agricultural goods is not well established to encourage industrialization, provide job possibilities, and improve connectivity with rural regions, which is still in its infancy due to slowly increasing infrastructure and services (FAO, 2017). According to Farrington (2002), finance is a vital aspect in ensuring urban productivity. Thus, MSEHs' financial status impacts their amount of food availability more than production. The study has taken into the trends of markets in the Addis Ababa, majority of study MSEHs responded that markets were functioning reasonably well and everything was available until early 2016 in general. However, some households felt that by the end of 2016, food markets became unstable, due to inflation money in market. Consistently, some of the FGD discussants indicate unusual huge price increases for the scarce raw material in the Addis Ababa.

> *'…the price of raw materials in the manufacturing industry was as low as or less before mid-2018, and by mid-2022, it had increased four to five times. This year, in particular, the costs of textile, construction, leather, and wood and metal works inputs have climbed day by day. Another food and non-food commodity climbed three to four fold. Internal displacement, artificial price increases as a result of opportunistic traders, brokers, and farmers, price increases from the source of commodities, high demand, increase in fuel prices, and shortage of foreign currencies were the major causes of market instability or price increases in the city…' (FGD 01, July 12, 2022, Addis Ababa).*

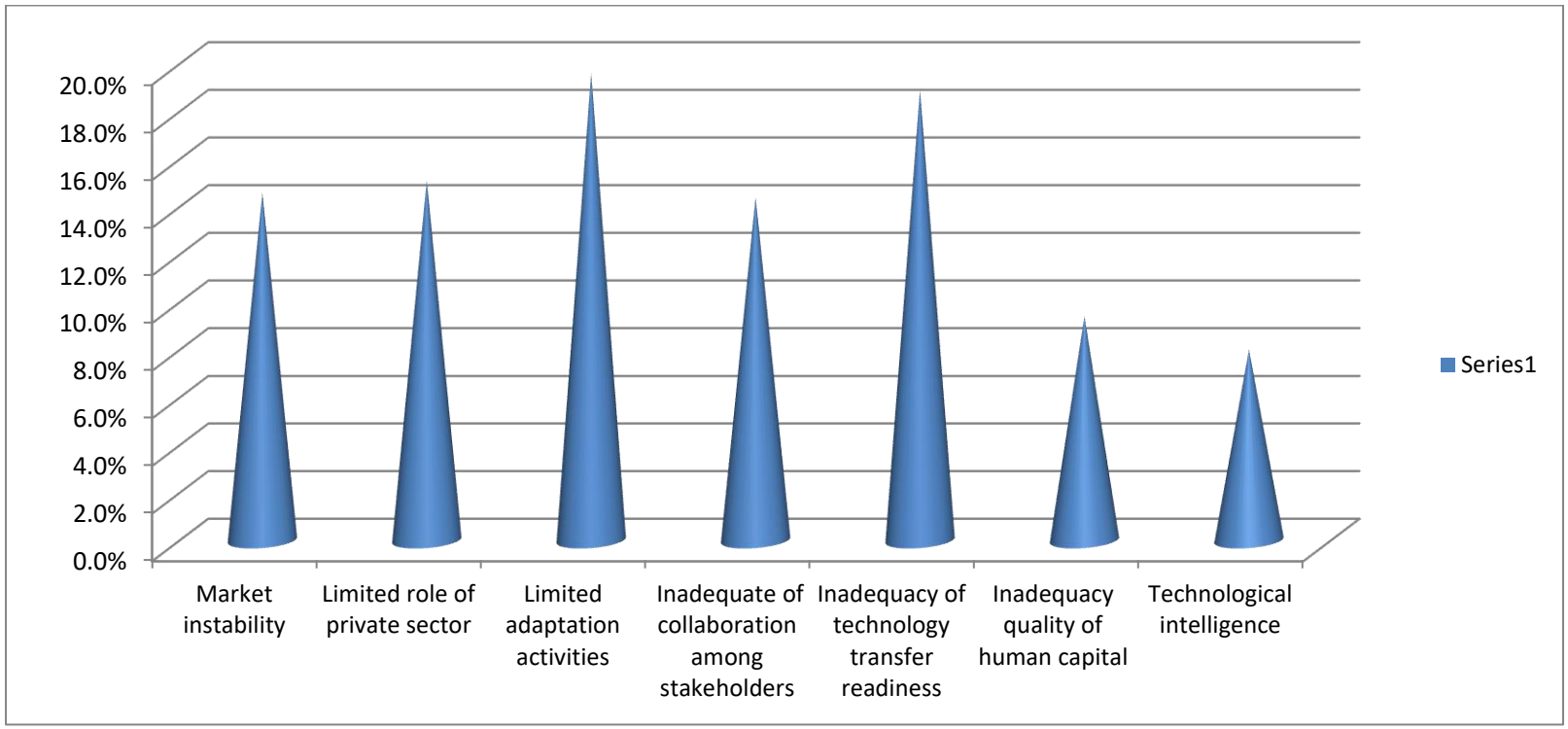


Figure 4: Constraint of technology transfer and adoption in TVET and MSE in study area

Source: Own computation result of SPSS 16, 2022.

Limited role of private sector: According to the findings of this study, the causes of ineffective technology transfer and adoption are widespread and very much associated with very low limited role of private sector or irregular employment. 15.1% of the study respondents perceived that limited role of private sector is one of the core constraint of limited technology transfer and adoption in the study area. There is the limited role of private sector investing on technology transfer and adoption and R&D activities. The government owns most of the available R&D institutions in Ethiopia, and therefore there are limited platforms for private sector to be involved in R&D activities. Under competitive market situation, the private sector is supposed to dominate and determine the transfer of technology.

Based on the fact that, the private sector possess the competitiveness attribute, and based on the fact that they are always driven by profit making principles, the private firms are more likely to succeed in technological market in comparison with the public institutions. Since the private sector is driven by profit making desire, they are superior on making decision regarding what, where and how to transfer, produce and sale. Therefore, technology transfer as part of the chain of technology production and business can effectively be executed by private sector. The government is supposed to remain as an enabler to technology transfer environment, and not as a sole actor. It is on the opinion of the respondent that, the government should incorporate private sector through projects within R&D framework in order to boost capability of the R&D institutions to transfer technology in study area.

Limited adaptation activities: About 19.6% of the study households perceived that limited adaptation activities is the main constraint in limited technology transfer and adoption. Technology and knowledge transfer activities can be enabled through three main platforms; R&D; Production; and commercialization. Therefore, the transfer of knowledge and technology can be done either through R&D institutions or through production firms. As presented before, the innovation institutions in Ethiopia particularly Minster of Science and Technology (MoST), TVET Colleges and Federal TVET, Regional TVET are legally directed to transfer and adapt foreign technologies. Despite the presence of legal permission, there are limited adaptation activities in the country and study area. There are a number of shortcomings, which had eroded the effectiveness of R&D institutions in study area.

Inadequate of collaboration among stakeholders: about 14.4% of respondent articulate inadequate of collaboration among stakeholders in the study area. Another constraint against technology transfer activities is an inadequate of collaboration among stakeholders in research projects. Inflows of the high-qualified researchers from advanced countries into Ethiopia are necessary inputs to knowledge and technology transfer. However, there is limited number of foreign researchers who play part on domestic research projects. This shortcoming is more associated with weakness within the foreign instruments; and the R&D institutions are just victims of the situation. Based on observation, there is no official bridge between TVET and MSE, the innovation instruments and the foreign instruments, as outcome it has become challenging to enable international collaboration in research and innovation activities, and this is one of the constraint against knowledge and technology transfer and adoption in two sub city.

Inadequacy of technology transfer readiness: About 18.9% of the respondents perceived that, the inadequacy of technology transfer readiness. Inadequacy of technology transfer readiness is another key constraint against technology adaptation activities in study area. The education backgrounds of MSEs indicate that there are in low education status. The R&D institutions doesn't consider technology transfer activities as one of their key responsibilities in MSE and other institution therefore, the transfer activities are ignored. Despite dedicating of specific department to deal with technology transfer activities, the department was completely dormant. Based on these details, it is clear that lack of adequate political willingness and lack of technology transfer readiness is the main factor behind neglecting technology transfer and adoption activities at TVET. The FGDs had shown the weakness of technology transfer readiness in MSE as follows:

> *'The majority of micro and small business owners, like ourselves, have little time to invest (or waste) on technology 100% copy and adoption. The requesting from TVET colleges as by utilizing different check lists, particularly on our gap and a technological need is one of the important components in industrial extension service. However, we do not pay attention since we are focused on increasing our daily revenue rather than improving our output and productivity by supporting new technology. The major reasons for the inadequacy of technology transfer preparedness include a lack of money, a lack of information technology skills, a lack of training and development, a lack of troubleshooting abilities, a lack of*

awareness, and an overall mismatch between technology and the social/business system.…' (FGD 02, July 18, 2022, Addis Ababa).

Inadequacy quality of human capital (9.4%): technology transfer and adoption, ranging from education and training, manufacturing and R&D institutions. In addition, it includes SMEs and large-scale firms, testing platforms as well as standards and quality assurance regulatory agencies. All these instruments need to be legally, strategically and politically positioned to facilitate transfer of technology in the countries. Technology transfer actors need to be able to interact, complement each other and share responsibilities in order to enable success in transfer activities. Moreover, these instruments need to be technologically ready, willing more training and capable to facilitate the transfer process in TVET, MSE and other sector.

Technological intelligence: Another crucial driver to technology transfer and about 8% is technological intelligence, which some authors refer to it as competitive intelligence. The focus of this part is to address the link between intelligence and technological advancement. There is no universal definition of the term intelligence. Hans and Marina (2007) defined Intelligence as "the activity and process by which information is systematically collected and made available to Government officials in a usable form". Based on these definitions, four elements of intelligence can be noticed: information collection, secrecy, information collected to support decision or policymaking and intelligence for national competitive advantage. Therefore, intelligence approach can be deployed to enable technological advancement in the country. As it has been revealed before, one of the inputs of technology transfer is availability of the reliable information about foreign technologies and market situation.

The technology transfer stakeholders (TVET, MoST, MOSHE, FTVET, RTVET and all universities) need to be informed about transfer inputs available in the advanced countries including, availability of experts and options of competitive technologies. In addition, information regarding availability, cost and quality of parts required in manufacturing of adapted technology are crucial in making decision on whether to import, to produce own parties or to do a combination of both approaches, import and produce own parts. In addition, the good decision regarding marketability of the transferred technology requires information about the response of demand in a comparable environment where the technology was used previously. Moreover, in

order to make a good decision MSEs regarding investing in a particular technology, it is necessary to have reliable and adequate information about the following elements of transferred technology; cost of the whole process of technology transfer, market value, production cost and details of the comparable technologies available in the global market.

In general, it is an expensive task, which requires possession of special skills in its execution, therefore without the government support, it is almost impossible for SMEs to apply intelligence as technology transfer enabler. About private sector, only big companies particularly multinational companies can afford to establish competitive intelligence units or departments within their companies. Therefore, the SMEs cannot possess the capability to establish and run technological intelligence units. Based on these arguments, State's intelligence apparatus has an obligation to intervene and support the SMEs technically in order to enhance technology transfer activities in the study area.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1.Conclusions

This study has been conducted at the Entoto Cluster College in Gullele and Arada Sub Cities, Addis Ababa City Administrative. The study assessed and analyzed on technology adoption in micro and small enterprises and its contribution in micro and small enterprises food security enhancement. A cross-sectional survey design and multi stage sampling procedure was employed. The data was mainly collected from 256 MSEHs working in four randomly selected ketenas. The sample was 133 technology adopters and 123 non-adopter MSEHs. This study employed both descriptive statics and econometric methods used to analyze the empirical data that were collected from the study areas. Results of descriptive analysis generally showed that technology transfer and adoption MSEH participants differ from non-participants counterparts in various demographic, socio-economic and institutional related perspectives between the two participants and major constraints of technology transfer and adoption in TVET and MSE sector.

The result of the binary regression (probit) model indicated that Education status of MSEH, access of saving, total annual income, expenditure and access of training had affected MSEHs technology adoption significantly at 1% and 5% level of significance level in the study area. Education status of MSEH and access of training has positive and statistically significant relationship with participant technology adoption. Similar to that, access of saving, total annual income is statically significant and determine the technology adoption MSE. On the other hands, expenditure of household head has negatively and significantly determines the technology adoption of MSEH in program. The study confirmed that the performances of technology adaption MSEHs are determined by capacity building and access to finance in both technology adopter and non-adopter.

The HFIAS score was determined and the effects of technology transfer and adoption on food security status of micro and small enterprise heads was explained. The result shows that, about 115 (50.4%) were moderately food insecure, 55 (21.5%) mildly food insecure, 54 (21.4%) were severely food insecure, and relatively 32 (12.4%) were food secure. Additionally the effect of MSE on food security is analyzed by ordered logit model. The outcome of the study reveals that six variables out of twelve become significant. Those factors are credit access, saving access,

Total annual income, expenditure, export status and training access determinants the effect of technology transfer and adoption on food security of MSEHs of study area. This difference would suggest that the technology transfer and adoption activities are positive effect on food security status of MSEHs. The major constraints of technology transfer and adoption in TVET and MSE sector is market instability, limited role of private sector, limited adaptation activities, inadequate of collaboration among stakeholders, inadequacy of technology transfer readiness, inadequacy quality of human capital and technological intelligence.

In general, this research concludes that MSEHs who adopted technology were relatively food secured than non-adopting ones. Therefore, adoption of MSE technology has a positive and significant impact on household food security.

5.2.Recommendation

In view of the fact that socio-economic and institutional related factors are seemingly associated with stated technology adoption participation and food security the following recommendation was made.

- ✍ This study recommends that programs should be designed to improve these socioeconomic characteristics of MSE household food security status and LED in the Sub city and woreda level. This will go a long way as to improved food security status of urban in the area. Participants should receive more training and knowledge about how to improve livelihood through steady flow of information by development agents like Addis Ababa City Administration Technical and Vocational Education and Training Agency (AATVETA) have the responsibility to transfer knowledge on appropriate technology transfer and adoption in industry extension.
- ✍ This study revealed that accesses are socio-economic and institutional characteristics are the major components which contributed for the improvement of MSEs performance. Hence the government and other concerned bodies should give strong support to MSEs in these areas.
- ✍ In the process of local economic development, MSEs face a number of challenges though their impact is low in the Sub- city. Factors like, lack of affordable access to raw materials and inputs, lack of market linkage and lack of raw materials source are among the major challenges. Therefore, big emphasis should be given to these problems by the (federal, city, sub-city, and woreda level) Labour, Enterprise and Industry Development Office and Trade and Industry Offices to enhance the performance of MSEs thereby increasing their contribution to LED.
- ✍ One of the findings in this research is a very limited participation of women in the MSEs sub-sector in the study area. Creation and Enterprise Development Office and different affirmative actions are applied to motivate women to participate in MSEs, due consideration should be given to increase their participation. Though enough is stated at the policy level to encourage women to participate in the MSEs, aggressive awareness raising mechanism, provision of special credit window and women focused special training is mandatory to increase their number. This will create a better conducive environment for women to play a major role in local economy development.

- ✍ Finally, additional research should be carried out at different locations to acquire more empirical findings on effect of technology adoptions in enhancing the food security status of beneficiaries and major constraints or challenges that MSEs participants are facing in marketing their products in Addis Ababa as well as to other MSE beneficiary cities in Ethiopia and in the same case policies and other regulations at all levels must gear towards transparent planning, implementation and reporting processes to improve the problems in this aspect at all levels.

References

African Union. (2007). Strategy to revitalize technical and vocational education and training (TVET) in Africa. Addis Ababa: conference of ministers of education of the African union.

Akoojee, & Simon. (2005). Vocational education and training n southern Africa: a comparative study. Cape town: hsrc press.

Alem, H., Lien, G., Hardaker, J., & Guttormsen, A. (2019). Regional differences in technical efficiency and technological gap of Norwegian dairy farms: A stochastic meta-frontier model. Applied Economics, 51(4), 409–421.

Alemu Demessew. (2012). The Implementation of an Apprenticeship Training Programme in the Addis Ababa Technical Vocational Education and Training (TVET) Colleges and Enterprises.

Amha Wolday. (2004). Managing Growth of Microfinance Institutions (MFIS): Balancing Sustainability and Reaching Large Number of Clients in Ethiopia. Ethiopian Journal of Economics, Volume XIII, No 2.

Anthony k and Thomas C (2012): Access to Credit and Growth of Small and Medium Scale Enterprise in the Ho Municipality of Ghana, Britian journal of Economics, Finance and management science, Vol 6(2)

Ayalew Kassahun, Claudia Ayim, Chris Addison & Bedir Tekinerdogan. (2022). Adoption of ICT innovations in the agriculture sector in Africa: a review of the literature Agriculture & Food Security volume 11, Article number: 22 (2022)

Aynabeba Zewdei. (2014). Assessment of Challenges and opportunities of Industry Extension Service Program Implementation. Addis Ababa University. Unpublished a Master thesis.

Azanaw Abebe & Girmachew Siraw. (2021). Adoption of Tef (Eragrostis Tef) Production Technology Packages in Northwest Ethiopia. Raoul Fani Djomo Choumbou (Reviewing editor) Published online: 29 Dec 2021

Bennett, D. and Vaidya, K. (2005), "Meeting Technology Needs of Enterprises for National Competitiveness", International Journal of Technology Management, Vol. 32 Nos. 1/2, pp. 112-153.

Berhanu, Melesse. (2018). A Review on Factors Affecting Adoption of Agricultural New Technologies in Ethiopia. Journal of Agricultural Science and Food. Department of

Rural Development and Agricultural Extension, College of Agriculture and Rural Transformation, University of Gondar, Ethiopia.

Bukusuba J, Kikafunda KJ, Whitehead GR (2007) Food security status in households of people living with HIV/AIDS (PLWHA) in a Ugandan Urban setting. British Journal of Nutrition 98 (1):211–217.

Chen, Patton and Kenney, (2016), University technology transfer in China: a literature review and taxonomy, in The Journal of technology transfer, Vol. 41, No. 5, Pp. (891–929), Springer, USA.

Choi.J, (2009), Technology transfer issues and new technology transfer model. The Journal of Technology Studies, Vol. 35, No.1, Pp. (49-57).

Colibasanu. A, (2008), Between Intelligence and Espionage in the Contemporary Business Environment, in the Ekonomika a Management, Vol. 4, Bucharest Academy of Economic Studies, Bucharest, Romania. Pp. 2-3.

Craigrobert, (1976). Education training and employment toward new vocationalism England.

Dadi Tufa (2013): The role of TVET in Technology Transfer for Urban Local Economic Development, The case of Assela Town Oromiya Regional State, Ethiopian CivilService University, Addis Ababa Ethiopia.

Datt, G., K.Simler, Mukherjee and G. Dava. (2000). Determinants of Poverty in Mozambique: 1996-97. Food Consumption and Nutrition Division, Discussion paper No. 78, Washington, D.C., International Food Policy Research Institute.

David Bennett, Kirit Vaidya, Meeting Technology Needs of Enterprises for National Competitiveness, 2001.

DeVaus, C. H. F., Schneider S. G., Deil-Amen, R. and Rios-Aguilar, C. (2002/3). Social Media in Higher Education: A Literature Review and Research Directions. Arizona: The Center for the Study of Higher Education at the University of Arizona and Claremont Graduate University.

Entoto TVET College. (1989). The historical development of Entoto Academic, Vocational and Technical School/Unpublished/. Addis Ababa.PP.115.

FDRE (2016). The growth and transformation plan. National Planning Commission. Addis Ababa.

Ganta Gemea, (2011). Evaluation of the Effectiveness of Productive Safety Net Program in Reducing Food Insecurity at Household Level: The Case of Mierab Abaya Woreda,

Gamogofa Zone, SNNPRS, Ethiopia. Haramaya University Thesis presented to the Adaptive Planning Research Team Bi-annual Review Meeting, Mangu, Zambia, 13-16 April.

Gebeyehu Tuji. (2014). The Contribution of Public TVET Institutions to Strengthen Micro and Small Enterprises in Addis Ketema Sub- City. Addis Ababa University. Unpublished a Master Thesis.

Getachew Abebe and Getachew Belay (1997). Micro-Business Development in Ethiopia. Small-Scale Enterprise Development in Ethiopia. Proceedings of Sixth Annual Conference on the Ethiopian Economy. Addis Ababa, Ethiopia: Ethiopian Economic Association.

GTP. (2010). Growth and Transformation Plan 2010/11 to 2014/15. Federal Democratic Republic of Ethiopia. Ministry of Finance and Economic Development. Addis Ababa.

Hans and Marina, (2007), Democratic Control of Intelligence Services: Containing Rogue Elephants, Switzerland. Pp. (4-6).

Hirut Sileshi. (2017). Assessing The Role of Tvet Colleges in Promoting Entrepreneurship: The Case Of Entoto Tvet College, Addis Ababa". St.Mary's University. School of Graduate Studies. Faculty of Business.

Ingela T. Flatin and Udaya S. Nagothu [Eds.], (2017). ―Food Security in the Context of Global Environmental and Economic Change‖ In Food Security and Development: Country case Studies. London and New York: Routledge

Israel, Glenn D. (1992). Determining Sample Size. Program Evaluation and Organizational Development, IFAS, University of Florida. PEOD-5. November.

Kassaye Amosha. (2020). "Urban productive safety net program in Ethiopia: beneficiaries" food Security status, participation determinants and its contributions in Gulele sub-city, Addis Ababa" College of Development Studies: AAU.

Kebebe Ergano. (2015). Understanding factors affecting technology adoption in smallholder livestock production systems in Ethiopia. The role of farm resources and the enabling environment.

Kingombe, C. (2012). Lessons for Developing Countries from Experience with Technical and Vocational Education and Training. Working Paper11/1017.

Kirubel Girmachew (2014). The Status of Community Participation in Technical Vocational Education and Training Programs: The Case Study of Entoto Technical Vocational.

Kitchin, R. and Tate, N. (2000): Conducting research into human geography: theory, methodology & practice. London: Prentice Hall.

Maclean Rupert & Wilson David. (2013). International Handbook of Education for the Changing World of Work. Bridging Academic and Vocational Learning. University of Toronto Canada.

Maskus Keith E. (2004). Encouraging International Technology Transfer. International Centre for Trade and Sustainable Development (ICTSD). Intellectual Property Rights and Sustainable Development.

Mateso. P, (2014), Technology transfer: the concepts, practices, and lessons for Tanzania and its TVET system a paper presented at the vet forum held in December 10/11/2014, in Arusha, Tanzania.

Mehari Haile (2011). the roles and contributions of civil society organizations in education service delivery: the case of Arada sub-city, Addis Ababa city government. Addis Ababa University.

Mesay Yami, Teklu Tesfaye and Adam Bekele. (2013). Determinants of Farmers‟ Participation Decision on Local Seed Multiplication in Amhara Region, Ethiopia. Int. J. Sci. Res. 2(1):423-430.

Mizan Sibhatu. (2018). Factors Affecting Performance of Micro and Small Business Enterprises In Addis Ababa. St. Mary's University School Of Graduate Studies. Mba Program In Project Management.

MoE (2013). Financing Technical and Vocational Educational and Training in Ethiopia. Addis Ababa: Brehana Selam Printing Enterprise.

MoE. (2008). National Technical and Vocational Education and Training Strategy, Addis Ababa: Federal Ministry of Education.

Mojaveri, H. E. (2011). A New Model for Overcoming Technology Transfer Barriers in Iranian Health System.

MOTI. (1997). Micro and Small Enterprise Development strategy. The Federal Democratic Republic of Ethiopia Ministry of Trade and Industry: Addis Ababa.

Mutula, G. P. (2003). Assessment of Africa's telematics, policy and regulatory infrastructure: potential for e-learning. Paper presented at the NTESU International Conference in Durban, University of Natal, South Africa.

Rai, M. (2017).Impact of Urbanization on Environment. International Journal on Emerging Technologies 8(1): 127-129.

Shashikant.S and Khor.M, (2010), Intellectual property and technology transfer issues in the context of climate change, in Intellectual property rights series 14, TWN, Penang, Malysia.

Solomon, (1996). A credit to households: The case of financing micro Enterprise. In Debrebrhan Town. Addis Ababa (Unpublished).

Taddese Molla. (2010). An assessment of the linkages between public Technical and Vocational Education and Training and Micro and Small Business enterprise sector in Addis Ababa. Unpublished a Master Thesis

Tambunan T., (2006). Micro, small and medium enterprise: economic growth and poverty: A gender analysis. Report prepared for the gender equality unit, Indonesia.

Tjaden, G.S. (1995). Measuring the information age business. Atlanta, GA: Georgia Institute of Technology.

Toffler, A.C. (1981). The third wave. New York, NY: Bantam Books.

Tolesa Alemu, Bezabih Emana, Jema Haji and Belaineh Legesse. (2014). Impact of Wheat Row Planting on Yield of Smallholders in Selected Highland and Lowland Areas of Ethiopia. International Journal of Agricultureand Forestry, 4(5): Pp. 386-393.

Udo, G. J., & Edoho, F. M. (2000). Information Technology Transfer to African Nations: An Economic Development Mandate. *Journal of Technology Transfer*, 25, 329-342.

Ueno, T, 2009. Technology transfer to China to address climate change mitigation. Resources for the Future, Issue Brief 09-09, August 2009. Washington D.C

UNESCO (2009). International Hand Book of Education for changing World of Work. Vol.I.

UNESCO. (2002). Technical and Vocational Education and Training in the Twenty-First Century: New Roles and Challenges for Guidance and Counseling. Paris: UNESCO.

UNESCO. (2010). Strategy for the Second Half of the United Nations Decade of Education for Sustainable Development. United Nations Decade of Education for Sustainable Development (2005-2014).

UN-HABITAT. (2017). The State of Addis Ababa: 2017 The Addis Ababa We Want.

United Nations Conference on Trade and Development, Investment and Innovation Policy Review on Ethiopia, United Nations Publication, UNCTAD/ITE/IPC/Misc.4, 2012.

Wade, N. 2006. Still evolving, human genes tell new story. New York Times, 7 March

Wahab Sazali Abdul. (2012). Defining the Concepts of Technology and Technology Transfer: A Literature Analysis Some of the authors of this publication are also working on these related projects: University Malaysia Kelantan, Malaysia

Weldegebriel mezgebe, (2012). Problems of micro and small enterprises in Addis Ababa: the case of Kirkos, Kolfe, and Yeka sub-cities, Addis Ababa, AAU.

Williamson, S. (2007). Entrepreneurial and Vocational Skills Training for Poverty Alleviation: Common Practices, Lessons, and a Strategic Framework. Washington, USA: Evans School of Public Affairs.

World Health Organization (WHO), (2010). "Food Security".

Appendixes

Appendix 1: General competitiveness of FDI and technology transfer in Ethiopia

Ethiopia - Global Competitiveness Index

Date	Competitiveness ranking	Competitiveness index
2019	126º	44.37
2018	122º	44.45
2017	108º	54.00
2016	109º	53.50
2015	118º	51.46
2014	127º	49.94
2013	121º	50.80
2012	106º	53.77
2011	119º	50.12
2010	118º	48.98
2009	121º	48.73
2008	123º	46.87
2007	116º	46.69

Source: Data was extracted from a series of annual reports of the Global Competitiveness Reports (2018/19).

Appendix 2: Explanatory variables and descriptions

Name of the variables	Descriptions
SEX MSEH	Sex of Micro and Small Enterprise Heads
AGE MSEH	Age of Micro and Small Enterprise Heads
MAR STATUS MSEH	Marital status of MSE heads
MEMBER SIZE	Member Size of Firm
DISABILITY STATUS	Disability Status of Micro and Small Enterprise Heads
EDUCATIONMSEHS	Education of Micro and Small Enterprise Heads
EXPERIENCE	Experience of Micro and Small Enterprises
CREDIT	Credit Access of Micro and Small Enterprises
SAVING	Saving Access of Micro and Small Enterprises
TOTAL INCOME	Total annual income of Micro and Small Enterprises
EXPENDITURE	Expenditure of Micro and Small Enterprises
TRAINING	Training Access of Micro and Small Enterprises
MARK STATUS	Market Access of Micro and Small Enterprises
EXPORT STATUS	Export status of Micro and Small Enterprises

Appendix 3: Logistic model test (goodness of fit and link test) for factor affecting technology adoption and transfer

```
. reg POTTA SEXMSE AGEMSE MARSTATUS TYPEMSE HEALTHSTATUS EDUMSEH EXPERIENCE CREDIT SAVING TOTALINCOME EXPEND EXPORT TRAINING
```

Source	SS	df	MS	Number of obs =	256
				F(13, 242) =	12.65
Model	26.6204505	13	2.04772696	Prob > F =	0.0000
Residual	39.1881432	242	.161934476	R-squared =	0.4045
				Adj R-squared =	0.3725
Total	65.8085938	255	.258072917	Root MSE =	.40241

POTTA	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SEXMSE	-.0516827	.0590725	-0.87	0.382	-.1680446	.0646791
AGEMSE	-.0212105	.0577092	-0.37	0.714	-.1348869	.092466
MARSTATUS	.0294931	.0324923	0.91	0.365	-.0345107	.0934969
TYPEMSE	-.0217523	.0480374	-0.45	0.651	-.1163771	.0728726
HEALTHSTATUS	.1003347	.1094705	0.92	0.360	-.1153019	.3159713
EDUMSEH	.1443585	.0233187	6.19	0.000	.098425	.190292
EXPERIENCE	-.0264258	.036976	-0.71	0.475	-.0992618	.0464101
CREDIT	-.0408753	.0637602	-0.64	0.522	-.1664711	.0847206
SAVING	.1680864	.0922976	1.82	0.070	-.0137229	.3498956
TOTALINCOME	4.29e-06	1.07e-06	4.01	0.000	2.19e-06	6.40e-06
EXPEND	-.000057	.0000213	-2.67	0.008	-.000099	-.000015
EXPORT	.1550025	.0700978	2.21	0.028	.0169228	.2930822
TRAINING	.3241769	.0649131	4.99	0.000	-.4520437	.1963102
_cons	.2664043	.3892988	0.68	0.494	-.5004423	1.033251

```
. estat gof
```

Probit model for POTTA, goodness-of-fit test

```
       number of observations =       256
number of covariate patterns =       227
           Pearson chi2(213) =       180.11
                 Prob > chi2 =         0.9506
```

```
. linktest
```

Source	SS	df	MS		
Model	26.6515044	2	13.3257522	Number of obs	= 256
Residual	39.1570894	253	.154771104	F(2, 253)	= 86.10
				Prob > F	= 0.0000
Total	65.8085938	255	.258072917	R-squared	= 0.4050
				Adj R-squared	= 0.4003
				Root MSE	= .39341

POTTA	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_hat	1.086769	.2081777	5.22	0.000	.6767875	1.496751
_hatsq	-.0880308	.1965268	-0.45	0.655	-.4750676	.2990061
_cons	-.0121228	.0543493	-0.22	0.824	-.1191574	.0949119

Appendix 4: Multi-collinearity test (VIF) for logit

```
. estat vif
```

Variable	VIF	1/VIF
CREDIT	1.59	0.629922
TRAINING	1.59	0.630653
SAVING	1.51	0.661271
EXPORT	1.50	0.666245
TOTALINCOME	1.35	0.739404
AGEMSE	1.29	0.772574
EDUMSEH	1.28	0.781639
EXPERIENCE	1.23	0.816212
TYPEMSE	1.22	0.820905
SEXMSE	1.20	0.832618
MARSTATUS	1.15	0.868433
EXPEND	1.12	0.892482
HEALTHSTATUS	1.05	0.956923
Mean VIF	1.31	

Appendix 5: Logistic model for factor infulencing technology adoption of MSEHs

```
. probit POTTA SEXMSE AGEMSE MARSTATUS TYPEMSE HEALTHSTATUS EDUMSEH EXPERIENCE CREDIT SAVING TOTALINCOME EXPEND EXPORT TRAINING

Iteration 0:   log likelihood = -177.16433
Iteration 1:   log likelihood = -110.84779
Iteration 2:   log likelihood = -109.69932
Iteration 3:   log likelihood = -109.69149
Iteration 4:   log likelihood = -109.69149

Probit regression                               Number of obs     =        256
                                                LR chi2(13)       =     134.95
                                                Prob > chi2       =     0.0000
Log likelihood = -109.69149                     Pseudo R2         =     0.3808
```

POTTA	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SEXMSE	-.2175575	.2364766	-0.92	0.358	-.6810433	.2459282
AGEMSE	-.0442439	.2257984	-0.20	0.845	-.4868006	.3983128
MARSTATUS	.1344612	.1262637	1.06	0.287	-.113011	.3819335
TYPEMSE	-.1081353	.1882614	-0.57	0.566	-.4771208	.2608502
HEALTHSTATUS	.3058835	.4164087	0.73	0.463	-.5102625	1.12203
EDUMSEH	.5319531	.0957512	5.56	0.000***	.3442842	.719622
EXPERIENCE	-.0675014	.1394088	-0.48	0.628	-.3407376	.2057348
CREDIT	-.0103851	.2536171	-0.04	0.967	-.5074655	.4866952
SAVING	.7429455	.33144	2.24	0.025**	.0933351	1.392556
TOTALINCOME	.0000213	6.34e-06	3.36	0.001***	8.88e-06	.0000337
EXPEND	-.0001956	.0000858	-2.28	0.023**	-.0003638	-.0000274
EXPORT	.6480773	.2929993	2.21	0.027**	.0738093	1.222345
TRAINING	1.30268	.2676969	4.87	0.000***	.7780034	1.827356
_cons	-1.386252	1.494387	-0.93	0.354	-4.315197	1.542694

Appendix 6: Orderd logit o effects of technology taransfer and adoption on food security

```
. ologit HFIAS AGEMSE MARSTATUS TYPEMSE EDUMSEH HEALTHSTATUS CREDIT EXPERIENCE SAVING TOTALINCOME EXPEND EXPORT TRAINING

Iteration 0:   log likelihood = -327.18622
Iteration 1:   log likelihood = -285.11527
Iteration 2:   log likelihood = -283.58191
Iteration 3:   log likelihood = -283.57744
Iteration 4:   log likelihood = -283.57744

Ordered logistic regression                     Number of obs   =        256
                                                LR chi2(12)     =      87.22
                                                Prob > chi2     =     0.0000
Log likelihood = -283.57744                     Pseudo R2       =     0.1333
```

HFIAS	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
AGEMSE	.0685316	.0524098	1.31	0.191	-.0341897	.1712528
MARSTATUS	-.1257758	.1557328	-0.81	0.419	-.4310064	.1794548
TYPEMSE	.3099809	.2278526	1.36	0.174	-.136602	.7565639
EDUMSEH	.0214498	.058805	0.36	0.715	-.0938058	.1367055
HEALTHSTATUS	.2946002	.5203131	0.57	0.571	-.7251947	1.314395
CREDIT	.688523	.3006525	2.29	0.022	.099255	1.277791
EXPERIENCE	.0007787	.0336347	0.02	0.982	-.0651442	.0667015
SAVING	1.870556	.4823714	3.88	0.000	.9251256	2.815987
TOTALINCOME	7.88e-06	4.15e-06	1.90	0.057	-2.50e-07	.000016
EXPEND	-.0000196	.00001	-1.95	0.051	-.0000393	6.05e-08
EXPORT	.7125592	.3063573	2.33	0.020	.1121098	1.313009
TRAINING	1.187362	.3177038	3.74	0.000	.5646745	1.81005
/cut1	7.161435	2.552442			2.158741	12.16413
/cut2	8.641928	2.565696			3.613256	13.6706
/cut3	11.23401	2.614717			6.109254	16.35876

Appendix 7: Marginal effects of ologit for food security and its outcomes

Marginal effects after ologit
y = Pr(HFIAS==1) (predict, outcome (1))
= .08418477

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
AGEMSE	-.0052836	.00406	-1.30	0.194	-.013251	.002684	36.1641
MARSTA~S	.009697	.01206	0.80	0.422	-.013949	.033344	1.69531
TYPEMSE	-.0238988	.01776	-1.35	0.178	-.058706	.010909	1.86719
EDUMSEH	-.0016537	.00454	-0.36	0.715	-.010545	.007238	7.10156
HEALTH~S	-.022713	.04019	-0.57	0.572	-.101493	.056067	1.93359
CREDIT	-.0530835	.02433	-2.18	0.029	-.100762	-.005405	1.44531
EXPERI~E	-.00006	.00259	-0.02	0.982	-.005143	.005022	8.09375
SAVING	-.1442156	.04213	-3.42	0.001	-.226786	-.061645	1.12891
TOTALI~E	-6.07e-07	.00000	-1.85	0.064	-1.3e-06	3.6e-08	19642.6
EXPEND	1.51e-06	.00000	1.90	0.058	-5.0e-08	3.1e-06	8928.52
EXPORT	-.0549367	.0243	-2.26	0.024	-.102558	-.007316	1.73828
TRAINING	-.0915429	.02656	-3.45	0.001	-.143606	-.03948	1.39063

. mfx, predict (outcome (2))

Marginal effects after ologit
y = Pr(HFIAS==2) (predict, outcome (2))
= .20357133

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
AGEMSE	-.0087621	.00677	-1.29	0.196	-.022036	.004512	36.1641
MARSTA~S	.016081	.01998	0.80	0.421	-.023083	.055245	1.69531
TYPEMSE	-.0396326	.02971	-1.33	0.182	-.097857	.018591	1.86719
EDUMSEH	-.0027425	.00752	-0.36	0.715	-.01749	.012005	7.10156
HEALTH~S	-.0376661	.06673	-0.56	0.572	-.168456	.093124	1.93359
CREDIT	-.088031	.04009	-2.20	0.028	-.166598	-.009464	1.44531
EXPERI~E	-.0000996	.0043	-0.02	0.982	-.008528	.008329	8.09375
SAVING	-.2391596	.0657	-3.64	0.000	-.367924	-.110396	1.12891
TOTALI~E	-1.01e-06	.00000	-1.85	0.065	-2.1e-06	6.2e-08	19642.6
EXPEND	2.51e-06	.00000	1.90	0.057	-7.7e-08	5.1e-06	8928.52
EXPORT	-.0911041	.0405	-2.25	0.024	-.170474	-.011734	1.73828
TRAINING	-.15181	.04403	-3.45	0.001	-.238113	-.065507	1.39063

```
. mfx, predict (outcome (3))

Marginal effects after ologit
      y  = Pr(HFIAS==3) (predict, outcome (3))
         =  .55591095
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
AGEMSE	.0050069	.00412	1.22	0.224	-.003068	.013082	36.1641
MARSTA~S	-.0091891	.01171	-0.78	0.433	-.032149	.013771	1.69531
TYPEMSE	.0226471	.01843	1.23	0.219	-.013478	.058772	1.86719
EDUMSEH	.0015671	.00432	0.36	0.717	-.006909	.010043	7.10156
HEALTH~S	.0215234	.03863	0.56	0.577	-.054198	.097245	1.93359
CREDIT	.0503032	.02816	1.79	0.074	-.004884	.10549	1.44531
EXPERI~E	.0000569	.00246	0.02	0.982	-.004759	.004873	8.09375
SAVING	.136662	.05443	2.51	0.012	.029975	.243349	1.12891
TOTALI~E	5.75e-07	.00000	1.61	0.108	-1.3e-07	1.3e-06	19642.6
EXPEND	-1.43e-06	.00000	-1.65	0.098	-3.1e-06	2.7e-07	8928.52
EXPORT	.0520593	.02747	1.89	0.058	-.00179	.105909	1.73828
TRAINING	.0867482	.03631	2.39	0.017	.015592	.157905	1.39063

```
. mfx, predict (outcome (4))

Marginal effects after ologit
      y  = Pr(HFIAS==4) (predict, outcome (4))
         =  .15633295
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
AGEMSE	.0090388	.00696	1.30	0.194	-.004596	.022673	36.1641
MARSTA~S	-.0165889	.02061	-0.80	0.421	-.056985	.023807	1.69531
TYPEMSE	.0408843	.03012	1.36	0.175	-.018153	.099921	1.86719
EDUMSEH	.0028291	.00776	0.36	0.715	-.012376	.018035	7.10156
HEALTH~S	.0388557	.06875	0.57	0.572	-.095896	.173607	1.93359
CREDIT	.0908113	.03984	2.28	0.023	.012722	.168901	1.44531
EXPERI~E	.0001027	.00444	0.02	0.982	-.008592	.008798	8.09375
SAVING	.2467132	.06865	3.59	0.000	.112154	.381272	1.12891
TOTALI~E	1.04e-06	.00000	1.88	0.060	-4.3e-08	2.1e-06	19642.6
EXPEND	-2.59e-06	.00000	-1.92	0.054	-5.2e-06	4.8e-08	8928.52
EXPORT	.0939815	.04138	2.27	0.023	.012878	.175086	1.73828
TRAINING	.1566047	.04318	3.63	0.000	.071967	.241242	1.39063

Appendix 8: Household survey questionnaires

General Introduction

Dear Sir/Madame, Yishak Abera Takele is my name. I am a Master's degree candidate at the University of Addis Abeba's Center for Food Security Research. Currently, I am working on a study named "determinants of technology transfer and adoption, its benefits to boosting food security, and its obstacle in beneficiaries' micro and small enterprises at Entoto Polytechnic College Addis Ababa, Ethiopia." The goal of this study is to identify the determinants of technology transfer and adoption in the study areas' micro and small enterprises, to investigate the effect of technology transfer and adoption in improving the food security status of the micro and small enterprises, and to access challenges of technology transfer and adoption in the TVET sector's micro and small enterprises. The responses provided by respondents for this survey will be kept secret and used exclusively for the purposes of this study. The researcher also feels that the true responses provided by respondents are of great value and might be used by policymakers, planners, and other assistance and development agents working on technology transfer to micro and small firms in the country's poverty reduction program. As a result, I urge that you be truthful and forthright in your response. Furthermore, whatever information you submit is useful to this research. I'd want to express my gratitude and appreciation for your cooperation and commitment of your valuable time.

Can you spare a few minutes to help? Yes_____ (continue the interview).

No_____ (Thank and stop)

Instructions for Use

The respondent's name is necessary.

When answering questions with a choice, make a check mark or a circle. A household is obliged to respond to all questions. Please fully justify the queries that require your answers. Particulars of identification Enumerator's name: _____ Date of interview: ___/___/2022 Started time of interviewing: _____ Ended time: _____

Name of *Woreda*: ____ Ketena: _____

Respondent [1] Technology transfer adopter MSE [0] Non-adopter MSE

Part I: Socio-demographic characteristics of the MSEHs

No	Question	Response	Code
1	Sex of the MSEH	0. Female 1. Male	
2	Age of the MSEH	In years_____	
3	Religion	1. Orthodox 2. Protestant 3. Catholic 4. Muslim 5. Other (specify):_____	
4	Marital status	1. Single 2. Married 3. Divorced 4. Widowed 5. Separated	
5.	MSE size /Forms of business ownership/		
5.1.	How many people are member in your MSE?	Specify the No: _____	
5.2.	Please, identify your MSE forms of business ownership?	1. Sole proprietorship 2. Partnership 3. Corporation 4. Cooperative 5. Other (specify):_____	
6.	Household Health status		
6.1.	Do any of MSE members have a permanent/chronic disease/health problem/disability?	0.No 1.Yes	

6.2.	If yes, what is the kind of disability/disease?	1. Blindness 5. Mental retardation 2. Deafness 6. Paralysis 3. Dumbness 7. chronic illness 4. Amputation 8. Other (specify) :_____	
7.	Household education level		
7.1.	Level of education of the household head	1. Did not attend formal education 2. Read and write 3. C 4. Completed High school 5. Completed higher institution education 6. Other (specify)_____	
8.	Access to credit and saving services		
8.1.	Did you have access credit service before the program (in 2012)?	1. Yes 0. No	
8.2.	If yes, how many times do you get in last three year?	1. One time only 2. Two time only 3. Three time only 4. Other; specify_____	
8.3.	If yes, what were the sources of the credit?	a. Cooperatives c. Individuals b. Government d. others :----------	
8.4.	What was the type of the credit you obtained?	1=Money /cash 2= Machinery 3=job facility /tools/ 4= Other specify_____	
9.	Income status of the MSE		
9.1	Please tell us your income?	Daily per-capita income:_____ Birr Monthly per-capita income :_____Birr	

10.	Expenditure	Annual per-capita income :_____Birr Specify: _____Birr	
11.	How many do you have Capital/ fixed and non-fixed asset/	Specify: _____Birr	
12.	How you decide market access	1. High market access 2. Medium access to market 3. Low access	
13	Do you get training opportunity after you joined this program?	0. No 1. Yes	
13a	If Yes, what kinds of training provided from this program?	1. Life skill training 2. Entrepreneurship 3. Other (specify) _____	

Part II: Food access information (Household Food Insecurity Access Scale) and causes of urban food insecurity.

No	Questions	Responses	Code
1	In the past four weeks, did you worry that your household would not have enough food?	0=No (skip to Q2) 1=Yes	
1. a	How often did this happen?	1=Rarely (once or twice in the past four weeks) 2=Sometimes (three to ten times in the past four weeks) 3=Often (more than ten times in the past four weeks)	
2.	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of	0=No (skip to Q3) 1=Yes	

	resources?		
2.a	How often did this happen?	1=Rarely (once or twice in the past four weeks) 2=Sometimes (three to ten times in the past four weeks) 3=Often (more than ten times in the past four weeks)	
3.	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	0=No (skip to Q4) 1=Yes	
3.a	How often did this happen?	1=Rarely (once or twice in the past four weeks) 2=Sometimes (three to ten times in the past four weeks) 3=Often (more than ten times in the past four weeks)	
4.	In the past four weeks, did you or any member have to eat some foods that you really did not want to eat because of lack of resources to obtain other types of food?	0=No (skip to Q5) 1=Yes	
4.a	How often did this happen?	1=Rarely (once or twice in the past four weeks) 2=Sometimes (three to ten times in the past four weeks) 3=Often (more than ten times in the past four weeks)	
5.	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because	0=No (skip to Q6) 1=Yes	

	there was not enough food?		
5.a	How often did this happen?	1=Rarely (once or twice in the past four weeks) 2=Sometimes (three to ten times in the past four weeks) 3=Often (more than ten times in the past four weeks)	
6.	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	0=No (skip to Q7) 1=Yes	
6.a	How often did this happen?	1=Rarely (once or twice in the past four weeks) 2=Sometimes (three to ten times in the past four weeks) 3=Often (more than ten times in the past four weeks)	
7.	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?	0=No (skip to Q8) 1=Yes	
7.a	How often did this happen?	1=Rarely (once or twice in the past four weeks) 2=Sometimes (three to ten times in the past four weeks) 3=Often (more than ten times in the past four weeks)	
8.	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	0=No (skip to Q9) 1=Yes	

8. a	How often did this happen?	1=Rarely (once or twice in the past four weeks) 2=Sometimes (three to ten times in the past four weeks) 3=Often (more than ten times in the past four weeks)	
9.	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	0=No (questionnaire is finished) 1=Yes	
9. a	How often did this happen?	1=Rarely (once or twice in the past four weeks) 2=Sometimes (three to ten times in the past four weeks) 3=Often (more than ten times in the past four weeks)	

Part III: Technology transfer and adoption main constrains in TVET and MSEs

	Major constraints of technology transfer and adoption in TVET and MSEs		
10.	Please indicate us, the constraints of adoption technology transferring in TVET and MSEs?	1. Inadequacy of technology transfer readiness	
		2. Poor performance of innovation inputs	
		3. Limitation of knowledge and technological capability	
		4. Limited role of private sector, 5. Market instability	
		6. Inadequate of collaboration among stakeholders, 7. Inadequacy quality of human capital 8. Other _____ _____	

THANK YOU!

Checklists for Key Informants Interview (KII)

Please note that your insightful answers are crucial to our efforts in understanding overall assessment the determinants of technology adoption in micro and small enterprises and its contribution in food security enhancement.

1. Do many people participate in the industry extension services?
2. Do MSEHs participate in technology adoption?

2.1. If yes, in what kinds of technologies? /organ-ware, human-ware, techno-ware and info-ware

3. What are the constraints for the adoption of technologies?
4. What the community members involved in industry extension (the rich/poor, female /male HHs, the literate/ illiterate, or other?)
5. What are the roles of women in MSEH management?
6. Do you MSEs get sufficient extension service and training from TVET colleges?

6.1. Is the adoption technology profitable to MSEHs after participating in the technology?

7. What intervention must be used for better implementation of technologies transfer and adoption in the future to increase the level of adoption in the area?
8. Please mention all problems associated with technology transfer and adoption the area?
9. Describe any social, economic and environmental problems in the district associated with technology adoption?
10. What potentials in colleges are there for technology extension in your area?

Check list for Focusing Group Discussion (FGD)

For extension agent and MSEHs

1. Did you know about TVET industry extension service concept?
2. What is your perception on the technology transfer and adoption?
3. What are the main constraints or challenges faced in the area during technology transfer and adoption?
4. How is the technology adoption and food security status of the MSEHs in the study area?
5. Which method you prefer to transfer technologies in the area?
6. Did you get on technology transfer and adoption related training?
7. Which technologies are difficult to adopt (organ-ware, human-ware, techno-ware and info-ware)?

Appendix 9: Amharic questionnaire

በአዲስ አበባ ዩኒቨርስቲ

የልማት ጥናት ኮሌጅ

የምግብ ዋስትና ጥናት የትምህርት ክፍል

በአዲስ አበባ ከተማ አስተዳደር ጉለሌ ክ/ከተማ ለሚገኙ በወረዳው የኢንዱስትሪ ኤክስቴንሽን እና ቴክኖሎጅ ሽግግርተጠቃሚዎች እና ተጠቃሚ የሆኑ እና ያልሆኑ ጥቃቅንና አነስተኛ ኢንተርፕራይዞችን ኃላፊዊች /አባላት/ የሚሞላ መጠይቅ ነው፡፡

ውድ የዚህ ጥናት ተሳታፊዎች፡፡

እኔ ይስሐቅ አበራ ታከሌ እባላለሁ፡፡ በአዲስ አበባ ዩኒቨርስቲ የልማት ጥናት ኮሌጅ በምግብ ዋስትና ጥናት የትምህርት ክፍል የምረቃ ተማሪ ስሆን ለማስተርስ ዲግሪ ማሟያ ጽሁፌ በአዲስ አበባ ከተማ አስተዳደር በጉለሌ ክ/ከተማ በወረዳ 2 3 እና 8 ውስጥ ለሚገኙ ቀጠናዎች ተለይቶ የከተማ የኢንዱስትሪ ኤክስቴንሽንና ቴክኖሎጅ ሽግግር ተጠቃሚዎች የሆኑና ተጠቃሚ ያልሆኑ የጥቃቅና አነስተኛ ኢንተርፕራይዝ በከተማ በቴክኖለጅ ሽግግር ድጋፍ የምግብ ዋውስትናቼውን ለማረጋገጥ ያለው አንድምታ ምን እንደሚመስል ለመገምገም፤ የተሻለ የቴክኖሎጅ ሽግግርና ቴክኖሎጅ አባዝቶ ለተጠቃሚ ለማድረስ የሚገቱ ማህበራዊ፤ ኢኮኖሚያዊና ተሯዊ ችግሮችን ለመለየትና ዋና ዋና ማናቆዎችን ትንተና ለማከናወን ስከሆነ እርስዎ የሚሰጡት ትክክለኛ መልስ ለጥናቱ ውጤት አስተማማኝነት ወሳኝ ነው፡፡ ለቃለ መጠይቁ የሚሳተፉት በእርስዎ ፍቃደኝነት ሲሆን አጠቃላይ አራት ክፍሎት ያሉትና 25 ደቂቃ ልወስድብዎት ይችላል፡፡

ስለትብብርዎ በቅድሚያ አመሰግናላሁ!!

የቃለ መጠይቁ መለያ ቁጥር፡ _____

ቃለ መጠይቁን ለመመላት የጀመሩበት ሰዓት፡ _____ የጨረሱበት ሰዓት፡_____

ቀን፡ ___/___/2014 ዓ.ም ወረዳ፡ _____ ቀጠና፡ _____

እባኮ (O) የክብ ምልክት ወይም (√) የጭረት ምልክት ቢቻ ያስቀምጡ::

በወረዳዎ የኢንዱስትሪ ኤክስቴንሽን ድጋፍ ውስጥ የቴክኖሎጅ ሽግግር ተጠቃሚ ኖት?

1. አዎ 2. አይደለሁም

ክፍል 1፡ ከማሕበራዊና ሰብዓዊ ሁኔታዎች ጋር የተያያዙ ጥያቄዎች ፡-

ተ/ቁ	ጥያቄዎች	ኮድ	ምርመራ
1.	ፆታ	1. ሴት 2. ወንድ	
2.	በማህበሩ ውስጥ ያለው ሀላፊነት?	1. ሰብሳቢ	
		2. ጸሀፊ	
		3. ሌላ /ይግለጽ/: _____	
3	እድሜ	_____	
4.	ሀይማኖት	1. ኦርቶዶክስ ክርስቲያን	
		2. መስልም	
		3. ፕሮቴስታንት	
		4. ካቶልክ	
		5. ሌላ (ይገለጽ)_____	
5.	የጋብቻ ሁኔታ	1. ያገባ/ች	
		2. ያላገባ/ች	
		3. የተፋታ/ታች	
		4. በሞት የተለያት	
6	የቤተሰብ ሁኔታ		
	በማህበሩ ውስጥ አባላት ብዛት ስንት ነው?	፡_____	
	በየትኛው የእድሜ ክልል ውስጥ ናቸው? /ሁለት ምርጫ መምረጥ ይቻላል/	1. ከ0 — 15	
		2. ከ16 - 34	
		3. ከ35 - 50	
		4. ከ51 — 65	

		5. ከ65 አመት በላይ: _____	
7	**የጤና ሁኔታ**		
7.1	ከበማህበሩ አባላት ውስጥ የጤና ችግውር ያለበት ሰው አለ እንዴ?	1: አዎ 0: የለም	
7.2	መልሶ "አዎ" ከሆነ ምን አይነት የጤና ችግር ነው?	1.ህመም 2.እድሜ 4.ሌላ ካለ ግለፅ 3.የአካል ጉዳት : _____	
8	**የትምህርት ሁኔታ**		
8	የእርሶ ትምህርት ደረጃ	1. መደበኛ ክፍል ያልተከታተለ	
		2. ማንበብና መፅሐፍ የሚችል	
		3. አንደኛ ደረጃ (1-8)	
		4. ሁለተኛ መሰናዶ ትምህርት (9-12)	
		5. የኮላጅ ምሩቅ	
		6. የዲግሪ ምሩቅ 7. ማስተር እና ከዚያ በሊይ	
9	**የኢንተርፕራይዙ ያለበት ደረጃ እና ሁኔታዎች**		
9	የኢንዱስትሪ ኤክስቴንሽን ድጋፍ ተጠቃሚ ከሆኑ ስንት አመት ሆነዎት	1. አንድ እና ሁለት አመት 2. ሶስት እና አራት አመት 3. አምስት እና ስድስት አመት 4. ሌላ ካለ /ይግለጽ/: _____	
10	የቴክኖሎጅ ሽግግርና አባዝተው ለተጠቃሚ ማህበረሰብ የመሸጥ ተጠቃሚ ከሆኑ ስንት አመት ሆነዎት	1. አንድ እና ሁለት አመት 2. ሶስት እና አራት አመት 3. አምስት እና ስድስት አመት 4. ሌላ ካለ /ይግለጽ/: _____	
11	የማህበሮ አደረጃጀት በምን መልክ ነው?	1. የግል ማህበር 2. ህብረት ስራ ማህበር 3. ህብረት ሽርክና 4.ሌላ ካለ ይግለፁ _____	

12	የስራ ሁኔታ፤ብድርና ቁጠባን ሁኔታ		
12	ይህን ስራ ከመቀላቀሎ በፊት ምነ አይነት ስራ ስሰሩ ነበር	1. የመንግስት ስራ 2. ሌላሰው ጋር ተቀጥሬ ስሰራ ነበር 3. የግል ስራ 4. ስራ አልነበረኝም 5. ሌላ ካለሆነ ይግላጹት፡ _____	
13	በቴክኖሎጅ ማባዛት ላይ የብድር አገልግሎት አግኝቷል ያውቃሉ?	1: አዎ 0: የለም	
14	መልሶ "አዎ" ከሆነ ብድሩ ከማን አገኙ?	1. ከግል ድርጅት 2. ከመንግስት 3. ከግለሰብ 4. ሌላ ካለ /ይግለጽ/: _____	
15	ምን አይነት የብድር አገኙ?	1. ገንዘብ 2. የመስሪያ ማሽን ወ 3. ጥሬ ፍጆታ ዕቃዎች 4. ሌላ ካለ /ይግለጽ/: _____	
16	የቁጠባ አጋጣሚዎችን ተጠቅመው ይቆጥባሉ ?	1: አዎ 0: የለም	
17	መልሶ "አዎ" ከሆነ ምን ያህል ገንዘብ በየወሩ ይቆጥባሉ?	_____	
18	በቴክኖሎጅ ሽግግርና ማባዛት ዙሪያ ስልጠና ማግኘት ችለዋል	1. አይ አላገኘሁም 2. አዋ አግንቻለው	
19	መልሶ "አዋ" ከሆነ፡ ምን አይነት ስልጠና ከፕሮግራሙ አገኙ?	1. ቴክኖሎጅ 100٪ መቅዳት ስልጠና 2. የስራ ፈጠራ ስልጠና 3. በእሴት ትንተና ስልጠና 4. የቴክኖሎጅ አብሻሮነት ስልጠና	

		ሌላ ካለ ግለጽ: _____	
20	**የገቢ ሁኔታ**		
20	የቴክኖሎጅ ሽያጪን ጨምሮ ምን ያክል ገቢ የገኛሉ?	1. የቀን ገቢዎ፡- _____ብር 2. የወር ገቢዎ_____ብር	
21	ሌላ ገቢ ካሎት?	ተጨማሪ ገቢዎትን ይግለጹ፡_____ በብር	
22	ጠቅላላ በቀንና በወር ውስጥ ወጭዎ ስንት ይሆናል?	የቀን_____ብር የወር_____ብር	

ክፍል 3፡ ከቤተሰብ የምግብ ዋስትና ጋር ተያያዥ ጥያቄዎች

Household Food Insecurity Access Scale (HFIAS)					ምር መራ
(አሌፎ አሌፎ፡ 1 እስከ 2 ጊዜ፣ አንዳንድ ጊዜ፡ 3 እስከ 10፣ ሁልጊዜ፡ ከ10 ጊዜ በሊይ)					
1	ባለፈው 4 ሳምንት ቤተሰቡ በቂ ምግብ ባለማግኘቱ የተጨነቀበት ቀን አለ? ወይም ምግብ ለማግኘት የተጨነቀበት ቀን አለ? (ከሌለ ወደ ጥያቄ 2 ይሂዱ)	1: አዎ	0: የለም		
1a	በየምን ያህል ጊዜ ይከሰታል?	1: አልፎ አልፎ	2: አንዳንድ ጊዜ	3: ሁልጊዜ	
2	ባለፈው 4 ሳምንት ማንኛውም የቤተሰቡ አባል በሪሶርስ/በሀብት እጥረት ምክንያት የሚስማማውንና የሚወደውን በቂ ምግብ ማግኘት ያልቻ አለ? (ከሌለ ወደ ጥያቄ 3 ይሂዱ)	1: አዎ	0: የለም		
2a	በየምን ያህል ጊዜ ይከሰታል?	1: አልፎ አልፎ	2: አንዳንድ ጊዜ	3: ሁልጊዜ	
3	ባለፈው 4 ሳምንት ማንኛውም የቤተሰቡ አባል በሪሶርስ/በሀብት እጥረት ምክንያት ውስን የምግብ ዓይነት (limited variety) የተመገበ አለ? (ከሌለ ወደ ጥያቄ 4 ይሂዱ)	1: አዎ	0: የለም		

3a	በየምን ያህል ጊዜ ይከሰታል?	1: አልፎ አልፎ	2: አንዳንድ ጊዜ	3: ሁልጊዜ	
4	ባለፈው 4 ሳምንት ማንኛውም የቤተሰቡ አባል በሪሶርስ/በሀብት እጥረት ምክንያት ጥቂት የምግብ ዓይነት ብቻ የተመገበ እና ሌሎች የምግብ ዓይነቶችን መመገብ የማይፈልግ አለ? (ከሌለ ወደ ጥያቄ 5 ይሂዱ)	1: አዎ	0: የለም		
4a	በየምን ያህል ጊዜ ይከሰታል?	1: አልፎ አልፎ	2: አንዳንድ ጊዜ	3: ሁሌጊዜ	
5	ባለፈው 4 ሳምንት ማንኛውም የቤተሰቡ አባሌ በቂ ምግብ ባለመኖሩ ምክንያት ከሚያስፈሌገው በታች ትንሽ የምግብ ዓይነት ብቻ የተመገበ አለ? (ከሌለ ወደ ጥያቄ 6 ይሂዱ)	1: አዎ	0: የለም		
5a	በየምን ያህል ጊዜ ይከሰታል?	1: አልፎ አልፎ	2: አንዳንድ ጊዜ	3: ሁልጊዜ	
6	ባለፈው 4 ሳምንት ማንኛውም የቤተሰቡ አባሌ በቂ ምግብ ባለመኖሩ ምክንያት በቀን ከሚያስፈልገው በጣም ያነሰ ምግብ የተመገበ አለ? (ከሌለ ወደ ጥያቄ 7 ይሂዱ)	1: አዎ	0: የለም		
6a	በየምን ያህል ጊዜ ይከሰታል?	1: አልፎ አልፎ	2: አንዳንድ ጊዜ	3: ሁልጊዜ	
7	ባለፈው 4 ሳምንት ማንኛውም የቤተሰቡ አባል በሪሶርስ/በሀብት እጥረት ምክንያት ፈጽሞ ምግብ ያላገኘ አለ? (ከሌለ ወደ ጥያቄ 8 ይሂዱ)	1: አዎ	0: የለም		
7a	በየምን ያህል ጊዜ ይከሰታል?	1: አልፎ አልፎ	2: አንዳንድ ጊዜ	3: ሁልጊዜ	
8	ባለፈው 4 ሳምንት ማንኛውም የቤተሰቡ አባል በቂ ምግብ ባለመኖሩ ምክንያት እንደራበው የተኛ አለ? (ከሌለ ወደ ጥያቄ 9 ይሂዱ)	1: አዎ	0: የለም		
8a	በየምን ያህል ጊዜ ይከሰታል?	1: አልፎ አልፎ	2: አንዳንድ ጊዜ	3: ሁልጊዜ	
9	ባለፈው 4 ሳምንት ማንኛውም የቤተሰቡ አባል በቂ ምግብ				

	ባለመኖሩ ምክንያት መሉ ቀንና ለሊት ምንም ዓይነት ምግብ ያልተመገበ አለ?	1: አዎ	0: የለም		
9a	በየምን ያህል ጊዜ ይከሰታል?	1: አልፎ አልፎ	2: አንዳንድ ጊዜ	3: ሁልጊዜ	

ክፍል *4*: ስለ ቴክኖሎጅ ሽግግርና ቴክኖሎጅውን አባዝቶ ለመሸጥ ችግሮችን መልያ ጥያቄዎች

30. የቴክኖሎጅ ሽግግርና ማባዛት በሚሰሩበት ስራ ላይ ችግር ገጥሞዎት ያውቃል

☐ **አዎ** ☐ **አላገጠመኝም**

መልሶ አዎ ካሉ የችግሮችን ክብደት በመለየት ተራ ቁጥር ይስጡበት

	ችግሮች	**የችግሩ መጠን ስለካ**		**በደረጃ ያስቀምጡ**
		ዝቅተኛ	**ከፍተኛ**	
31	የመስሪያ ቦታ እጥበት			
32	የመስሪያ ገንዘብ እጥረት			
33	የገቢያ እጥረት			
34	የብድር አቅርቦች እጥረት			
35	የጥሬ እቃ ዋጋ መጨመር			
36	የጥሬ እቃ አለመኖር			
37	ሌሎችም ችግሮች ካሉ ይግለጹ			
38				
39				

ቃለ መጠይቁን ጨርሷል። ከልብ አመሰግናለሁ!!!