St. MARY'S UNIVERSITY

SCHOOL OF GRADUATE STUDIES

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DETERMINANTS OF SUSTAINABLE SMALL-SCALE MUSHROOM CULTIVATION IN ADDIS ABABA, ETHIOPIA

BY

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Addis Ababa, Ethiopia

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BOARD OF EXAMINERS

This is to certify that the thesis prepared by **Seyifemikael Gutema Wolde**, entitled: Determinants of sustainable small-scale mushroom cultivation, in Addis Ababa and submitted in partial fulfillment of the requirements of Master of science in Agricultural Economics complies with the regulations of the St. Mary's University and meets the accepted standards with respect to originality and quality.

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DEDICATION

I dedicate this thesis manuscript to my brother HabtamuGutema who has a special place in my life forever.

DECLARATION

I, the undersigned, declare that this is my original work, prepared under the guidance of Ass. Professor MaruShete. All sources of materials used for the thesis have been duly acknowledged. I further confirm that the thesis has not been submitted either in part or in full to any other higher learning institutions for the purpose of earning any degree.

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ENDORSEMNT

This thesis has been submitted to St. Mary's University School of Graduate Studies for examination with my approval as a university advisor.

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Advisor Signature and date

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ABBREVIATIONS

DID	Development Induced Displacement
FAO	Food and Agriculture Organization
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
MLE	Maximum Likelihood Estimation
SD	Standard Deviation
STATA	Statistics and Data
VIF	Variance Inflation Factor

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ABSTRACT

Even though the climate in Ethiopia is favorable and there are lots of opportunities for mushroom cultivation, due to different factors the cultivation of mushroom in Ethiopia in general and in Addis Ababa in particular is incommensurate. Moreover, in Addis Ababa those who have already joined the business are facing the problem of sustainability so that they are withdrawing from the business. Thus, the main objective of this study was to find out the major determinant factors affecting sustainable small-scale mushroom cultivation in Addis Ababa.

The study applied multi-stage sampling techniques, i.e stratified and random sampling techniques. Using these methods, the study selected154 sample respondentsfor the purpose of collecting primary data. 71 sample cultivators were those who are still in cultivation while the rest83 were those who pulled out of the business. These respondents are legally registered and licensed by the authorized body and joined the business since 2005-2008 budget years.

The study employed logistic regression model to analyze and find out the major factors affecting sustainable small-scale mushroom cultivation in the study area. And, according to the econometric result, out of 8(eight) explanatory variables 4 (four) were found to have significant correlation with sustainable mushroom cultivation. These are: access to extension services, access to product storage, development-induced displacement (DID) and access to product promotion on bazaar while the remaining four explanatory variables namely; level of education, house-hold size, seed price and business experience were found to be less powerful in explaining variations in sustainable mushroom cultivation in the study area.

Based on the core findings, it is recommended that the concerned body (every district's trade and industry development offices and micro and small enterprise development offices) should work very hard to enhance cultivators' awareness aboutextension services and should equally provide the services to all cultivators.In addition, all cultivators should be equally invited on bazaars to promote their products. On the other hand, Addis saving and credit association should facilitate a long term loan to cultivators so that they easily access to proper product storage. Moreover, micro and small enterprises should facilitate an alternative land for cultivation to those who displaced.

Key words: Mushrooms, Cultivation, Small-scale, Sustainable

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Mushrooms are a fleshy, spore-bearing fruiting body of a fungus, typically produced above the ground on soil or on its food source, mostly in forests (Zhang et.al, 2014: 46).They include edible, medicinal and poisonous species (Chang, 2006: 67).Edible mushrooms are a nutritious food source, being rich in protein, vitamins and minerals. They are also known to contain substances that enhance the immune system, fight infectious diseases, and lower blood pressure and cholesterol levels (Gurja, 1993: 111).

Harsh and Joshi (2008: 93) reported that world production of mushroom is growingand now exceeds three million tons worth a market value of US $ 10 billion. Globally, mushrooms are traded mostly in processed form. However, lately fresh mushrooms are being preferred over preserved ones in EU and American countries. Major exporting countries of fresh mushrooms are Netherlands, Poland, Ireland and Belgium. China is the largest exporter of preserved mushrooms with a market share of 41.82%. Netherlands (25.11%) and Spain (7.37 %) are the other major countries. The major importing countries of prepared and preserved mushrooms are Germany, USA and France while of fresh mushrooms are UK, Germany, USA and France.

Small-scale mushroom production represents an opportunity for farmers interested in an additional enterprise and is a specialty option for farmers without much land. Mushroom production can play an important role in managing farm organic wastes when agricultural and food processing by-products (such as cereal straw, grass straw, cotton waste, corn cobs, coffee waste, sawdust, animal dung, chicken manure, brewers' spent and bagasse) are used as growing media for edible mushrooms. The used substrate can then be composted and applied directly back to the soil (Sher et.al, 2011: 183).

Mushrooms' production process is one of the most unique stories in agriculture. For example, cultivators can produce continuously as inputs to the composting process are mainly agricultural by-products and recycled materials which are easily accessible. As a result mushroom production is naturally sustainable (Todd, 2009: 34). Thus, Sustainable mushroom cultivation refers to the ability to cultivate and supply mushrooms for an indefinite period without depleting natural resources and is measured in terms of continuing to produce or stop production.

Ethiopia has a lot of opportunities for small-scale mushroom cultivation. For instance, there is a favorable climate, comparatively abundant land and labor as well as reasonably good water resources that created

ample opportunities for horticulture production (Kiflemariam, 2008: 3). However, the cultivation of mushrooms in Ethiopia is not sustainable as peoplewho joined the business are continuously flowing out of the market and in turn the level of product to be suppliedis declining year to year.As a result Ethiopia is not benefiting from mushrooms as the rest of the world (Kalkidan, 2010: 13).

Sustainable mushroom cultivation has various determinant factors. According to studies conducted by different scholars, of different countries, some of the factors are: cultivators' household size and level of education, access to storage facility (Dada and Fulmilano (2012: 81-82), seed/spawn price, access to extension services, access to product promotion such as demonstration on seminar and bazaar (Nyakundi, 2006: 61-62), development-induceddisplacement, business experience (Jonathan, 2002: 26)etc. Each factor is discussed in detail in literature review.

1.2 Statement of the Problem

According to Dagne (2012: 32) citing Dawit (1998) the prevailing mild temperature in Ethiopia is conducive to mushroom growing. In addition it can be produced indoor with small area of land and with little investment throughout the year using agricultural and industrial by-products as substrate.

Even though the climate in Ethiopia is mild and there are ample opportunities for mushroom cultivation (Kiflemariam, 2008: 3), due to different factors the cultivation of mushroom in Ethiopia in general and in Addis Ababa in particular is incommensurate. Moreover, in Addis Ababa those who have already joined the business are facing the problem of sustainability so that they are withdrawing from the market.

According to Addis Ababa city administration urban agriculture bureau, from 2005 up to the end of 2008 budget years 232 people registered and given license to cultivate mushroom. However, the bureau's 2009 annual report showed that only 109 (47%) cultivators are in the business and the rest, 123 (53%),pulled out of cultivation. Surprisingly, according to the bureau officials, no license has been given to new cultivators since 2009 E.C up to the date this information is gathered. This shows that people in Addis Ababa are neglecting mushroom cultivation even though it can directly improve livelihoods through economic, nutritional and medicinal contributions (Marshall and Nair, 2009: 53).

In Ethiopia, so far, no study has been conducted on factors affecting sustainable small-scale mushroom cultivation. However, there are a lot of studies conducted on the issue in different countries. For instance, in Nigeria cultivators' household size, information on mushroom production, cultural beliefs, storage and output size of mushrooms are found to be major socio-economic and cultural factors affecting the

cultivation of mushroom (Dada and Fulmilayo, 2012: 80-81). Nyakundi (2006: 61-62) examined the issue in Western Kenya and found out that knowledge and skill about mushroom cultivation, access to extension service and follow up, spawn (seed) price, quality of spawn, product price, access to product promotion (advertising, fair pricing, free demonstration in seminars, bazaars), public awareness about mushroom and appropriate management practices as major determining factors for sustainable mushroom cultivation. According to Asharf et al (2013: 49-50) quality of substrate (different agricultural residues on which the mushroom grows) is a major deterministic factor for mushroom cultivation.On the other hand,Kuforiji and Fasidi (2008: 606) reported that quantity of spawn is a factor which affects mushroom cultivation in Nigeria.Salama et al (2016: 3) revealed thatthe type of agricultural residues used as a substrate has a significant effect on the quality and quantity of mushroom product in Cairo, Egypt. So, the type of substrate used is another deterministic factor which affects the sustainable cultivation of mushroom. Thus, as stated above in Ethiopia, particularly in Addis Ababa, there is scanty of research done on the determinants of sustainable mushroom cultivation. Therefore, this research tried to fill up this contextual research gap by investigating the factors that affect sustainable cultivation of mushroom in Addis Ababa.

Hence, the main objective of this research was to proof that whether the above factors can also determine the sustainable small-scale mushroom cultivation in Addis Ababa or not.

1.3 Research Objective

1.3.1 General Objective

The general objective of this research is to identify the factors which affect sustainable small-scale mushroom cultivation in Addis Ababa.

1.3.2 Specific Objectives

The specific objectives of this research are:

- To identify the opportunities of small-scale mushroom cultivation in Addis Ababa.
- To find out the constraints/challenges that affects the sustainability of small-scale mushroom cultivation in Addis Ababa.
- To identify the mushroom species that mostly cultivated in Addis Ababa.

1.4 Scope and Limitation of the Study

Due to time and budget related constraintsthis study delimited, in sample selection, only to cultivators who were registered and given license in between 2005-up to date.However, as discussed in the statement of the problem, no new cultivators are registered and given license since 2009 up to date. For this reason, the study selected samples only from those who registered in between 2005-2008 budget years. In addition, due to difficulties in locating their addresses, the study excluded those who don't have license but are still in cultivation or stopped cultivation. Above all, the study only focused on small-scale mushroom cultivators in Addis Ababa.

In conducting this study, some limitations were encountered. For instance, absence of respondents at the planned time during data collection and unwillingness of some respondents to fill questionnaire, to be interviewed and to return back the questioner they filled.

1.5 Significance of the Study

This study is significant as it intended to empirically inform decision-makers (such as Addis Ababa city administration urban agriculture bureau)about thedeterminant factorsthat significantly affect sustainable small-scale mushroom cultivation in Addis Ababa. And, this enablesdecision makers to take corrective measuresin order to empower cultivators who arestill in the business andthose who are interested to join the business.

1.6 Organization of the Thesis

The main thesis structured under five chapters. The upcomingchapter, chapter two,reviewed different theoretical and empirical researches with regard to the study while chapter three discussed in detail on research methodologies such as the type and sources of data, sampling techniques, data collection techniques and methods of data analysis.On the other hand, chapter four is data analysis and discussion part whichpresentedthe major findings of the research. The last chapter, chapter five, drew conclusions and recommendations (policy implications) based on the research findings.

CHAPTER TWO: LITERATURE RIVIEW

2.1 Conceptual Framework

2.1.1 What are Mushrooms?

Mushrooms are fruiting bodies of micro-fungi, which may be gathered wild or grown under cultivation (Kiflemariam, 2010).They belong to the kingdom of Fungi, a group very distinct from plants, animals and bacteria. Fungi lack the most important feature of plants: the ability to use energy from the sun directly through chlorophyll.Thus, they depend on other organisms for food, absorbing nutrients from the organic material in which they live. The living body of the fungus is mycelium made out of a tiny web of threads (or filaments) called hyphae. Under specific conditions, sexually compatible hyphae will fuse and start to form spores. The larger spore-producing structures (bigger than about 1 mm) are called mushrooms. In nature this is the most striking part of the organism, but in fact it is just the fruiting body and the major part of the living organism is found under the ground or inside the wood (Oei and Nieuwenhuijzen, 2005: 8).

Current studies estimates that 1.5 million species of fungi may exist and that there may be 14,000 species that produce fruiting bodies of sufficient size and structure to be considered as mushrooms. However, out of which, about 7,000 species possess varying degrees of edibility, and more than 3,000 species may be considered prime edible species, of which only 200 species have been experimentally grown, 100 economically cultivated, approximately 60 commercially cultivated, and about 10 species cultivated on an industrial scale (Chang and Miles, 1930: 6).

Fungi are found just about everywhere. Mushrooms, a special group of macro-fungi, are rather more selective than other fungi in that the size of the fruiting body requires the availability of more nutrients than are required for the production of asexual spores by micro-fungi. In damp places, such as tree-fern ecosystems and tropical rain forests, plentiful moisture leads to abundant mushroom formation. Therefore, mushrooms can be collected at most times of the year. But in drier regions, they occur only after seasonal rains. In these ecosystems there may be a particular flora of mushroom species associated with the seasons of autumn, summer and spring. Relatively few mushrooms are produced during the cold winter months, although there are perennial fruiting bodies that persist during the winter. The formation of mushroom fruiting bodies depends very much on the pattern of rains and, in some years, there may be virtually total lack of mushroom fruiting (Chang, 2006: 10).

2.1.2 Categories of Mushrooms

There are about 14,000 to 15,000 species of mushrooms in the world. These species can be roughly divided in to four categories: 1) those that are fleshy and edible fall in to the edible mushroom category, *e.g., Agaricusbisporus(Button),Pleurotusostreatus (Oyster),Lentinulaedodes(Shiitake)etc*; 2) mushrooms that are considered to have medicinal applications are referred to as medicinal mushrooms, *e.g., Ganodermalucidum*; 3) those that are proved to be or suspected of being poisonous are named poisonous mushrooms, *e.g., Amanita phalloides*; 4) those in a miscellaneous category, which includes a larger number of mushrooms whose properties remain less well defined. These may tentatively be grouped together as "other mushrooms" (Chang and Miles, 1930: 4).

Figure 2.1 Categories of Mushrooms

Pleurotusostreatus (Oyster) Mushroom

Lentinulaedodes (Shiitake)Mushroom

Agaricusbisporus(Button/White)Mushroom

Ganodermalucidum mushroom

(Source: Google)

2.1.3 Benefits of Mushrooms

Some mushrooms are a food of good nutritional values, some have medicinal value as dietary supplements, and there some that have both of these properties. The public has become increasingly concerned about health and nutrition matters in recent years, and this has sparked the commercialization of natural foods consumed as dietary supplements. Mushrooms can be considered a functional food (medical and nutritional food) in this way. Such functional or medical foods should not claim to cure diseases, but there are an increasing number of scientific studies that strongly support some functional foods such as mushrooms as having a role in disease prevention and in some cases of bringing about suppression or remission of a diseased state (Chang and Miles, 1930: 27).

1.Nutritional Values of Mushrooms

The greatest difficulty in feeding man is to supply a sufficient quantity of the body-building material protein. The other three nutritional categories are: the source of energy food-carbohydrates and fats; accessory food factors-- vitamins; and inorganic compounds which are indispensable to good health. Of course, water, too, is essential (Chang, 2006: 28).

Mushrooms add flavor to bland staple foods and are a valuable food in their own right: they are often considered to provide a fair substitute for meat, with at least a comparable nutritional value to many vegetables (Marshall and Nair, 2009: 3).According to Kiflemariam (2010: 9) citing Chaube (1995)mushrooms usually contain 20-30% protein (about 3% on fresh weight basis) which is higher than most of the vegetables. Quality of mushroom protein is superior to that of vegetable protein. The proteins have high digestibility. Mushrooms are rich in essential amino acids that cannot be synthesized by our body as well as the most commonly occurring non-essential amino acids. In mushrooms, starch is absent. Moreover, cholesterol and the sterol known to be dreaded for heart patients, remain absent in mushrooms. Mushrooms are rich in Vitamin B-Complex and they contain Vitamin C. The vitamins are well retained during cooking, canning, drying and freezing. Gyenge et.al (2016: 5) also added that mushrooms area real “vitamin bomb” because they contain a high amount of vitamins B1, B2, C and D, magnesium, iron, phosphorus, zinc, potassium, copper, selenium, manganese, niacin, pantothenic acid, folic acidandfibers.

2.Medicinal Properties of Mushrooms

The other major attribute of mushrooms is their medicinal properties.According to Chang and Miles (1930: 39),of the 14,000 to 15,000 species of mushrooms in the world, around 1,800 species of

mushrooms estimated to have potential medicinal attributes. Such medicinal mushrooms produce substances that can improve biological functions and thus the health of the consumer. These products have been called by various names, including dietary supplements, functional foods, phyto-chemicals, nutraceuticals, and nutriceuticals.

The medicinal properties of mushrooms depend on several bioactive compounds and their bioactivity depends on how mushrooms are prepared and eaten. Shiitake (Lentinulaedodes) are said to have anti-tumor and anti-viral properties and remove serum cholesterol from the blood stream. Other species, such as Pleurotus (oyster), Auricularia (mu-er), Flammulina (enokitake), Termella (yin-er) and Grifola (maitake), all have varying degrees of lipidlowering, anti-tumor, microbial and viral properties, blood pressure regulating, and other therapeutic effects (Marshall and Nair, 2009: 5). The FAO(1994) report cited by Frempong (2000: 8) shows that mushrooms can activate intestinal peristalsis and prevents chronic constipation.

Research in animals indicates that mushrooms like pleorotusostreatus (Oyster), cord caps, saneness, lentinulaedodes and grifolafrondosa have a positive effect on diabetes.They also protect our body against free radicals and infection. Free radicals damage body cells and induce cancers. Many bio active compounds protect the body against these radicals. These substances are often called anti oxidants and are present in many mushrooms. In other words, the body immunity is boosted. This will be a relief to those suffering from HIV/AIDS (Asmamaw et.al, 2015:18).In addition,according to Koopman and Laney (2010: 3) the scientific studies conducted over the past 10 years have shown a direct relationship between the consumption of fresh mushrooms and a declining rate of breast and prostate cancer growth, as well as the suppression of a compound believed to play a role in cancer tumor development.

3. Economic Values of Mushrooms

Globally, mushrooms are traded mostly in processed form. However, lately fresh mushrooms are being preferred over preserved ones in EU and American countries. Major exporting countries of fresh mushrooms are Netherlands, Poland, Ireland and Belgium. China is the largest exporter of preserved mushrooms with a market share of 41.82%. Netherlands (25.11%) and Spain (7.37 %) are the other major countries. The major importing countries of prepared and preserved mushrooms are Germany, USA and France while of fresh mushrooms are UK, Germany, USA and France (Harsh and Joshi, 2008).

According to Manjit (2011) cited by Mikias (2014: 42) presently, mushroom farming is being practiced in more than 100 countries and its production is increasing at the rate of 6 - 7 per cent per annum.

Production of mushrooms has already crossed 6 million metric tons annually in the world and is expected to reach around 7 million metric tons in the next ten years.

In 2002, world production of cultivated mushrooms was estimated to be 12,250 tons and was valued about at US$32 billion, whereas mushroom products (mushroom derivatives from medicinal, edible and wild mushrooms) used mainly for dietary supplements (mushroom nutriceuticals) were assessed to have generated about US$11 billion and wild mushrooms collected mainly from the wild, was valued at US$3.5-4 billion(Chang, 2006: 2).

Mushroom cultivation activities can also play an important role in supporting the local economy by contributing to subsistence food security, nutrition, and medicine; generating additional employment (for women and youth particularly in rural areas in less developed countries) and income through local, regional and national trade; and offering opportunities for processing enterprises such as pickling and drying (Marshall and Nair, 2009: 5). In addition, cultivation and development of mushrooms can positively generate equitable economic growth and reduce environmental pollution. Therefore, sustainable research and development of mushroom production can become a "non-green revolution" (Chang, 2006: 2).

2.1.4Inputs Required for Small-Scale Mushroom Cultivation

1. Mushroom House

Mushroom house should not be sited near dumping sites and livestock pens to reduce the risk of insect infestation and diseases. It should preferably be under shade. The house can be made from locally available materials that can main cool temperatures and high humidity such as clay or bricks. In a small scale farmer scenario, a grass thatched mud walled house is the most ideal. The house should have air vents or small windows on the upper walls for ventilation and required light during fruiting. The vents and door should have insect screens and be closed. If the temperature inside the house is high, water can be sprayed on the floor using a knapsack sprayer with fine nozzles and vents and door opened at night. Wooden shelves for holding bags or wooden racks for hanging spawned substrate tubes should be constructed at the height of about 1.5 m from the ground and 1 m apart for ease of working in the growing house (Asmamaw et.al, 2015: 20).

2. High Quality Spawns

Spawn/mushroom seed is the other important input for mushroom cultivation. It is wise to purchase the best quality spawn available. Even if it costs much more, it is probably worth the extra money. The large spawn producers keep very fresh inoculums; they sterilize carefully and check everything at every stage. A lesser supplier may unknowingly introduce viruses or sell spawn that is already old. Farmers should read the spawn producers material carefully. Normally, the spawn company will specify the best growing temperature and other factors (Chang, 2006: 9).

3. Substrate

The yield of mushrooms depends on the type of substrate used, the method of preparation and the suitability of environmental conditions (temperature and humidity) for growth and fruiting-body formation. Therefore, once the capacity to produce quality (uncontaminated) spawn had been established, the emphasis was shifted to an evaluation of potential substrates (Gurja, 1993:112).

Substrate is an organic-based material on which mushrooms grow. And a good substrate should be rich in nutrients, have good aeration and water holding capacity. Substrates commonly used in mushroom production include agricultural by-products such as cereal straws (wheat, barley, rice, maize etc), cotton waste, maize cobs, coffee husks and pulp, sawdust, sugar bagasse, water hyacinth among others (Asmamaw et.al, 2015: 17).

2.1.5 Sustainable Mushroom Cultivation

In agriculture, sustainability is a complex idea with many facets, including the economic (a sustainable farm should be a profitable business that contribute to a robust economy), the social (it should deal fairly with its workers and have a mutually beneficial relationships with the surrounding community), and the environmental (Azeb, 2011: 12).

Mushrooms' production process is one of the most unique stories in agriculture. For example, cultivators can produce continuously as inputs to the composting process are mainly agricultural by-products and recycled materials which are easily accessible. As a result, mushroom production is naturally sustainable (Todd, 2009: 34). Thus, Sustainable mushroom cultivation refers to the ability to cultivate and supply mushrooms for an indefinite period without depleting natural resources and is measured in terms of continuing to produce or stop production.

2.1.6Small-Scale Mushroom Cultivation in Ethiopia: Opportunities and Challenges

Some years ago, in most cultures of the people in Ethiopia, wild mushrooms have different names tagged with them. The Amharic names of wild mushrooms reflecting negative intuition include: “Ye-abohayfes” meaning the “Pert of Monk”, “Ye-Jib Tilla” meaning “Hyena’s Umbrella”, “Dem Astefy” meaning “that causes vomiting of blood” etc. Due to this bad impression about mushrooms in Ethiopia, the nutritional and medicinal values of mushrooms have been undermined (Kiflemariam, 2010: 11).However, nowadays,people are changing their negative attituderegarding mushrooms. According to Gezahegn and Gizachew (2016: 63) currently small scale mushroom cultivationis spreading in most of Ethiopian cities like Addis Ababa, Bishoftu, Hawassa, Bair Dar, etc.

Research on mushroom cultivationwasconducted in 1993 at Addis Ababa University, department of Biology. The outcomes of the research project have provided the basis for the establishment of small-scale commercial mushroom enterprises in and around Addis Ababa. The most successful of these, the Africa Mushroom Company, is the first private enterprise to supply fresh edible mushrooms to the Addis Ababa market throughout the year. The enterprise has gradually gained experience in the technology of cultivation as well as the training of technicians capable of managing the mushroom farm. This project has shown that sustainable and environmentally friendly small-scale mushroom cultivation is feasible in Ethiopia (Gurja, 1993: 110).

2.1.6.1 Opportunities of Small-Scale Mushroom Cultivation in Ethiopia

Most developing countries like Ethiopia should look forward to solve acute protein deficiency in the diets of its increasing population and providing employment opportunity by cultivating mushrooms in the urban area, without heavily depending on agricultural lands and capital (Gezahegn and Gizachew, 2016: 63).

Ethiopia has a lot of opportunities for mushroom cultivation. For instance, mushrooms can be cultivated on easily accessible substrates including agricultural and agro-industrial waste materials such as cereal straw, grass straw, cotton waste, corn cobs, coffee waste, sawdust, animal dung, chicken manure, brewers’ spent and bagasse (the biomass remaining after crushing of sugarcane or sorghum stalks for juice extraction), which are abundant in Ethiopia. The prevailing mild temperatures in Ethiopia, particularly in the highlands, are conducive to mushroom growing. The area of land required for cultivation is small, labor intensive, do not need light for growth and they are commonly produced on

shelves indoors. As aresult, mushrooms can be produced and harvested throughout the year with relatively little investment in Ethiopia.(Gurja, 1993: 110-111).

Moreover, According to Azeb (2008) cited by Mikias (2014: 45-46),the cultivation of mushroom enables the producers to have a healthy nutritious diet, enhance household food security, generate cash income and once the mushroom harvest is finished the substrate can be added to a compost pile and be reused as a natural fertilizer. In addition, the acquired knowledge can be effectively transferred to their back yard to ensure food security and income, fresh and healthy food for the family, good image in the society, excellent opportunities for direct selling and consumers are in the position to see how their food is produced and the experience can be scaled up in other urban and rural areas of the country.

2.1.6.2 Challenges of Small-Scale Mushroom Cultivation in Ethiopia

The initial challenges which mushroom growers have to face include determining the most suitable mushroom to grow and identifying a spawn supplier, organizing available resources to develop a growing system, and assessing requirements for supplying different marketing outlets. In spite of these, starting with home production is an advisable approach (Marshal and Nair, 2009: 44).

On top of these, lack of knowledge and skillabout the cultivation (due to absence of adequate training), lack of extension and follow up, lack of access to market, lack of appreciation about the food and dietary importance of mushrooms, and the monotonous traditional diets and the conservative eating habit of the people are may be some of the reasons that challenge thesmall-scalecultivation of mushrooms in Ethiopia (Kiflemariam, 2010: 11).

2.1.7 The Supply and Demand of Mushroom Product in Ethiopia

The mushroom demand in Ethiopia has grown significantly over the past 10 years. Traditionally, the Ethiopian diet includes a relatively smaller number of vegetables and animal products (around 50 types compared to more than 3,000 in Asian countries, for example). However, as international cuisines began to take root, the popularity of mushrooms shot up. For instance, the growing popularity of Italian pizza and Chinese stir-fry has increased the demand for mushrooms from hotels, airports, and restaurants (Kalkidan, 2010: 14).

At the same time, climate change threatens Ethiopia’s limited crop diversity. Mushrooms, which require no sunlight, little water, and less acreage than grains, are a climate-resilient crop that can contribute to Ethiopian’s food security(Mikiyas, 2014: 29).

Despite the growing demand, the Ethiopian supply is generally poor and local companies import most mushrooms from china: while cottage farmers sprang up to fill the demand, they lacked training, equipments such as storage, and contamination often ravaged their production-it was common to lose 30-40% of a crop to mold and bacteria (Kalkidan,2010:13).

2.2 Empirical Review

In Addis Ababa, so far, few studies have been undertaken on determinants of sustainable small-scale mushroom cultivation. However, there are a lot of researches conducted on the same issue in different countries. Accordingly, a study conducted by Dada and Fulmilayo (2012: 80-81) on Socio-Economic and Cultural Factors that affect Mushroom production revealed that cultivators' household size and education level, storage facility, information on mushroom cultivation, cultural beliefsand output size of mushrooms are major socio-economic and cultural factors affecting the cultivation of mushroomin Southwest Nigeria.He used descriptive statistics for analysis and reported that only 36% and 32% of the respondents were found to consider taboos and other cultural beliefs, respectively, as important factors in their decision to grow mushrooms. Significant relationship was found to exist between cultivators' household size and education level, information on mushroom production, storage and output size of mushrooms.The study reported that as cultivators' household size and education level increase so is their chance to cultivate sustainably and the same is true in access to information, storage facility and output size.

According toNyakundi (2006: 61-62), who used descriptive statistics for data analysis, reported that knowledge and skill about mushroom cultivation, access to extension service and follow-up, spawn (seed) price, quality of spawn, product price, access to product promotion (advertising, fair pricing, free demonstration in seminars, bazaars), public awareness about mushroom, storage facility and appropriate management practices are found to be the main deterministic factors for sustainable small-scale mushroom cultivation in Western Kenya.According to the study,most of the farmers lacked basic knowledge of mushroom production. In total 23 (76.7%) of the respondents had an experience of less than one year and 2-4 years were 6 (20%) farmers and only one (3.3%) with more than 5 years. The storage facilities are lacking in the division. The farmers are not able to store fresh mushrooms even for two days since they do not have fridges or cold rooms.As a result they faced a problem of sustainable cultivation.

An analysis was made by Asharf et al (2013: 49-50) oneffect of different substrate supplements on Oyster Mushroom (Pleurotusostreatusspp.) productionin Pakistan. Accordingly, the study revealed thatquality of substrates (which are different agricultural residues on which the mushroom grows) is a major deterministic factor for mushroom cultivation. The study evaluated three Pleurotus species on three different substrates i.e. cotton waste (CW), paddy straw (PS) and wheat straw (WS). Among all the treatments cotton west was found most favorable for mushroom cultivation.

Salama et al (2016: 3) also conducted a study on the impact of substrates on sustainable mushroom cultivation in Cairo, Egypt. He revealed thatthe type of agricultural residues used as a substrate has a significant effect on the quality and quantity of mushroom product. However, the result he found contradicts with that of Asharf. He reported that the highest total weight of fruits (yield) and biological efficiency were obtained from corn cob and soybean straw substrates and the largest cap diameter was found from soybean straw substrate. As a result, cultivators who are using corn cob and soybean straw substrates have a higher probability to cultivate sustainably as they earn a higher yield.

On the other hand, Kuforiji and Fasidi (2008: 606), who conducted a research in laboratory, reported that quantity of spawn is a factor which affects mushroom cultivation in Nigeria. There was a highly significant increase in yield of sclerotia (the hard dark resting body of mushroom) (188.0 g/kg waste), in total darkness, while malformed fruit bodiessporophores (the spore-bearing structure of a mushroom) were produced in all the substrates under the same condition. Increasing the quantity of spawn from 5 to 30% reduced the period of spawn run from 13 to 6, 15 to 8 and 24 to 17 days, respectively, in P. tuber-regium fruitbodies grown in cotton waste, rice straw and sawdust of B. angustifolia, with yield values of 38.0 and 20.0 g/kg waste in cotton waste and rice straw. The optimal spawn levels for sclerotia formation in the two wastes were 10 and 5%, respectively. The mushroom did not produce sclerotia in corn cob and groundnut shell when exposed to light. However, maximal yield values of 286.8 and 288.4 g/kg waste were obtained in both substrates in total darkness.

Jonathan (2002:26) conducted a study on factors affecting mushroom cultivation in Liberia and revealed that development-induced displacement and business experience are found to have a significant (negative and positive, respectively)relationship with sustainable mushroom cultivation. He used logit model for analysis and, according to the result, both variables are significant at 1% and 10% level of significance, respectively.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Research Approach and Design

Even though the dependent variable, i.e. sustainable mushroom cultivation, and some explanatory variables such as access to extension service, access to product promotion, development-induced displacement and access to product storage are qualitative in nature, this study followed**quantitative research approach.**To do so, the outcome of the dependent variable and the qualitative explanatory variables put in to different categories and codes. For instance, the outcome of the dependent variable categorized and coded as 1 for Yes (i.e. still cultivating mushroom) and 0 for otherwise (i.e. stopped cultivating mushroom) and for independent variables (for example access to extension), it will be 1 if cultivators have access to extension and 0 if otherwise.As a result, data produced are numerical and analyzed using mathematical and statistical methods.

On the other hand, thisresearchapplied**causal research design** as it is concerned with cause-effect relationship. In other words, changes in the value of independent variable directly or indirectly cause changes in the value of dependent variable (Bordens and Abbott, 2011: 108). In this study the dependent and independent variables have such relationship, i.e. the causes are explanatory variables cultivators' level of education, cultivators' household size, seed price,business experience, access to product storage, access to product promotion on bazaar, access to extension and follow up and development-induced displacementand the effect is sustainable mushroom cultivation. So, a change in the value of explanatory variabledirectly or indirectlyaffects the sustainablecultivation of mushroom.To conclude, as the objectives of the study demand such type of design this study relied on casual research design.

3.2Variables, Data Sources and Data Collection Methods

To address the research questions, there are variables that should be collected.These are cultivators' house-hold size and education level, price of seed,access to extensionservice, access to product promotion on bazaar, access to product storage, business experience and development-induced displacement whichare collectedmainly from primary sources (i.e. sample cultivators).

Regarding data collection techniques, the study employed different methods and instruments. Face to face interview and self- administered interview (questionnaire) are the methods that the research used.

The study used**face to face interview** with structured questions to collect primary data from individuals that have knowledge about the status of mushroom cultivation in Addis Ababa. These individuals

wereurban agriculture officials from sub cities, districts and Addis Ababa city administration urban agriculture bureau who have a direct contact with cultivators through theprovision of extension services to mushroom cultivators in Addis Ababa. In addition to the face to face interview, the study also collected primary data from sample respondents through **structured questionnaire** (self-administered interview).

3.3 Population, Sample Design and Sample Size

The target population of this study has the following characteristics. It composed ofcultivators who are stillin the business and pulled out of the business,legally registeredand licensedby the authorized body and joined the business since 2005 budget year.The study selected sample respondents from this population and the sampling techniquesare as follows.

The research applied multi-stage sampling techniques. Firstly, it stratified cultivators in to two based on their current status on mushroom cultivation: those who are still incultivationand those who stopped cultivation. Secondly, random sampling technique employed and the required samples are drawn from each stratum.

On the other hand, the sample size decided using Yamane (1967: 886) sample size determination formula.i.e.

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

Where$n$ is the sample size, N is the population size, and e is the level of precision. According to Addis Ababa City Administration Urban Agriculture Bureau the total number of mushroom cultivators who registered and given license since 2005 budget year was 232. Of these, 109 are still in the business and the rest, 123, withdrawn from the business.So, N = 232. Yamane (1967:886) stated that if the exact level of precisionis unknown,it is possible to take0.05as a value of precision. Hence, e = 0.05. Substituting the values to the above formula gives:

$$n = \frac{232}{1+232\,(0.05)^2} = 147 \text{ sample respondents}$$

And, adding 5% for a possibility of un-returned questionnaires, the sample size will be 154 (147+147x 0.05 = 154).Finally out of the total sample size (154), 71 respondents randomly selected from the total cultivators who are still in the business (109)while the remaining sample respondents, i.e. 83, randomly selected from those whopulled out ofthe business (123).

3.4 Methods of Data Analysis

This study employed both descriptive statistical tools and non-linear econometric model (i.e. logit model) for data analysis and used the so called STATA software to encompass statistical tools and logistic regression. It presented the data analyzedusing tables.

3.4.1 Descriptive Analysis

Descriptive statistics is used to characterize and describe univariate data (Bordens and Abbott, 2011: 97).Thus, this studyemployeddescriptive statistical tools(such as frequency, percentage, mean, SD, minimum and maximum) to analyze the opportunities and constraints of sustainable mushroom cultivation in Addis Ababa and to identify mostly cultivated mushroom species in the study area.

3.4.2 Econometric Analysis

Furthermore, the study usedeconometric model to analyze the cause-effect relationship between the dependent and independent (explanatory) variables. According to Kothari (2004: 342) if there is a cause-effect relationship between two or more than two variables (i.e. bivariate or multivariate), regression is the relevant technique for analysis. As discussed above, on research approach and design,sustainable mushroom cultivation has a cause-effect relationship with different explanatory variables such as cultivators' level of education, cultivators' household size, seed price,business experience, access to product storage, access to product promotion on bazaar, access to extension and follow up and development-induced displacement. As a result, the study applied regression model.

Since the dependent variable (sustainable mushroom cultivation) is qualitative in nature, it is impossible to employ linear regressionas it has its own limitation but can be overcome by using probit or logitmodels which are working for non-linear regression model (Belay, 2017: 21).

There is no significant difference between logit and probit estimation.However, the former is powerful and can easily explain/ interpret the result and has slightly fatter tails than the normal function(Wakjira, 2014). Thus, based on this argument, binary logistic regression (logit) was preferred for this study. In this case the value of the dependent variable has exactly two values, i.e. 1 and 0, where 1 stands for respondents who are still in mushroom cultivation while 0 denotes respondents who withdrawn from the business. It can be specified as sustainable mushroom cultivation a function of different explanatory variables which are assumed to affect the dependent variable, i.e.

Sustainable mushroom cultivation (Y) = f (Cultivator' level of education, cultivators' household size, business experience, access to extension service, access to product storage, access to product promotion on bazaar, development-induced displacement)

$Y_i = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8)$ orit can be rewritten as:

$Y_i = f(Z_i)$ ……..……. (1)

This means there is a functional relationship between the observed survey and the latent index function,Z_i.

Where, $Zi = b_o + \sum b_i X$ ……... (2)

Y is the response for the i^{th} observation with binary variables 1 for who are still in cultivation and 0 for those who pulled out of cultivation and Z_i is the latent index function for the i^{th} observation. There is a threshold index for each cultivators Z^*, such that $Z_i^* < Z_i$ the cultivator is considered as still in cultivation and $Z_i^* > Z_i$ the cultivator pulled out of cultivation. The probability of the cultivators who are still in cultivation is presented as follows:

$$Pi = \frac{e^{zi}}{1+e^{zi}} \quad \text{……} (3)$$

Where, $zi = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots + \beta_k X_k$……... (4)

Where β_0 is the intercept and β_1, β_2 β_3 β_k are the slopes of the parameters of the model. The slopes tell how the log-odds in favor of sustainably cultivate mushrooms change as the independent variable changed by a unit. Thus, the model is specified as follows:

$Y = ((\ln\{p(Xi))/(\ln(1-p(Xi)) = (\alpha_i x_i + u_i)$ ……(5)

Y is the natural logarithm of the probability of cultivating sustainably (P) divided by probability of not cultivating sustainably (1-P).

$\alpha_i$is coefficient of factors influencing sustainable cultivation.

X_i represents factors influencing sustainable cultivation.

$u_i$denotes error term.

If p is a probability then P/(1−P) are the corresponding odds, and the logit of the probability is the logarithm of the odds. Once the logit model has been estimated, then transformed the logit in to a

probability, first it is required to exponetiate the logit, then find the odds and convert the odds in to probability (i.e. Odds = P/1-P Or P= Odds/1+Odds); where: p= a probability of event (Gebissa, 2014).

3.4.3 Definition of Variables and Hypothesis

1. Dependent Variable

Sustainable Cultivation: is the dependent variable for the logit analysis, and is dichotomous.Hence, it has exactly two values, i.e. 1 and 0, where 1 stands for respondents who are still in cultivation while 0 denotes sample cultivators who withdrawn from cultivation.

2. Independent Variables

There are eight independent variables that are assumed to affect sustainable mushroom cultivation in the study area. These are:

Cultivators' Level of Education:is a continuous variable and measured in terms of years that the cultivator spent in formal schooling. Education plays an important role in cultivating mushroomson a sustainable manner as it enables them to grow mushrooms with calculated risks and plans.Thus, it is expected that the value of the coefficient for cultivator's level of education is different from zero and sustainable mushroom cultivation has a significant positive relationship with cultivators' level of education.

Cultivators' Household Size:it is measured in terms of number of individuals in one family. Therefore, it is a continuous variable and is assumed to have a positive association with sustainable cultivation. This is because there will be division of labor in a family as small scale mushroom cultivation is labor intensive. For this reason, it is hypothesized that the value of the coefficient for cultivator's level household size is different from zero and sustainable mushroom cultivation has a significant positive relationship with cultivators' household size.

Seed Price:is a continuous explanatory variable and measured in terms of birr expended to purchase mushroom seed. Itis assumed to have a negative relationship with sustainable cultivationbecause higher seed price discourages cultivation and vice versa. Hence, it is expected the value of the coefficient for seed price to be different from zero and sustainable mushroom cultivation to have a significant negative relationship with seed price.

Access to Extension Service (AExtS): It is the provision of advice, information, and other supports to cultivators. The advices and supports are may be provision of training on the mechanisms of disease and pest control, post-harvest product management, way of preparing quality substrates and implementation of

Kaizen (Kaizen is a Japanese philosophy meaning continuous improvement). Thus, it is measured in terms of accessing extensionservice or not. Hence, it is a dummy variable and expected to have a positive correlation with the dependent variable. Therefore, the hypothesis is that the value of the coefficient (β) for extension service is different from zero and sustainable mushroom cultivation has a significant positive relationship with extension service.

Access to Product Promotion on Bazaar (APProm):is the provision of appropriate information about the product to potential consumers which increase customer traffic and, as a result, build sales and profit. It is a dummy variable measured in terms of accessing productpromotion on bazaar or not and assumed to have a positive relationship with sustainable cultivation. The hypothesis is, therefore, the value of the coefficient (β) for access to product promotion on bazaar is different from zero and sustainable mushroom cultivation has a significant positive relationship with access to product promotion on bazaar.

Access to Product Storage (PS): is expected to have a positive association with the dependent variable because a proper product storage (such as fridges) extend or keep the freshness of products a bit longer which, in turn, increases cultivators bargaining power to sell the product with a good price. It is measured in terms of accessing product storage or not and is a dummy variable.The hypothesis states thatthe value of the coefficient (β) for access to product storage is different from zero and sustainable mushroom cultivation has a significant positive relationship with access to product storage.

Development Induced Displacement (DID): is also a dummy explanatory variable measured in terms of being displaced from land of cultivationor not. Development induced displacement occurs when people, in this case mushrooms cultivators, forcibly displaced from their plot of land due to development related reasons. This indicates that it has absolutely negative relationship with sustainable mushroom cultivation because cultivators may not be given an alternative land for cultivation. Based on this, the hypothesis can be formulated as the value of the coefficient (β) for development-induced displacement is different from zero and sustainable mushroom cultivation has a significant negative relationship with development-induced displacement.

Business Experience (BEx):A more experienced cultivator will be more able to cultivate sustainably. Therefore, with the skills obtained over time from other businesses, these cultivators will have a greater chance of sustaining and achieving business success in mushroom cultivation. The expected sign for the coefficient is, therefore, positive. It is a continuous variable and measured in terms of number of years that the cultivator spent in working other businesses. The hypothesis statesthat the value of the coefficient (β) for business experience is different from zero and sustainable mushroom cultivation has a significant positive relationship with business experience.

Table 3.1: Expected sign of explanatory variables

S.No	Variables	Type of variable	Expected sign
1	Seed price	Continuous	–
2	Cultivators' household size	Continuous	+
3	Cultivators' level education	Continuous	+
4	Access to extension service	Dummy	+
5	Business Experience	Continuous	+
6	Development induced displacement	Dummy	–
7	Access to proper product storage	Dummy	+
8	Access to product promotion on bazaar	Dummy	+

CHAPTER FOUR:RESULTS AND DISCUSSION

In this section, the data collected are analyzed and discussed through descriptive statisticsand econometric model. The descriptive statistics are used to analyze specific objectives i.e. opportunities and challenges of small-scale mushroom cultivation andmushroom species that mostly cultivated in Addis Ababa where asthe logistic regression analysis was carried out to identify the most important factors that affect the sustainable small-scale mushroom cultivation in the study area.The descriptive statistical tools employed for analysis are frequency, percentage, mean, standard deviation, minimum and maximum.

4.1 Descriptive results

4.1.1 Opportunities of small-scale mushroom cultivation in Addis Ababa

1. Mushrooms Require Smaller Land/space for Cultivation

Land is the basic asset as it is considered to be the most important aspect in agricultural production. Mostcash crops and vegetables in agricultural business require huge acre of land. However, in contrast to other cash crops, mushrooms can be produced on smaller plot of land(Gurja, 1993: 110).Sample respondents were asked their extent of agreement on "mushrooms require smaller land" and their perception is reported as follows:

Table 4.1 Perception of respondents on whether mushrooms require smaller land

Mushrooms require smaller land/space for cultivation	Still in cultivation (71)		Stopped cultivation (83)		Total (154)	
	No	*%*	*No*	*%*	*No*	*%*
Strongly Agree	28	39.4	19	22.9	47	30.5
Agree	39	55.0	57	68.7	96	62.3
Disagree	4	5.6	7	8.4	11	7.2

Source: survey result, 2018

The above descriptive results showed that of total 154 sample respondents,30.5% were strongly agreedand 62.3% were agreed that mushroom cultivation requires a smaller landwhile on the contrary 7.2% were disagreed that mushrooms require smaller land for cultivation. About 39.4%, 55% and 5.6% of respondents who are still in the business were strongly agreed, agreed and disagreed that mushroom production requires smaller land, respectively. On the other hand, out of the total samples who withdrawn

from cultivation, 22.9%, 68.7% and 8.4% were strongly agreed, agreed and disagreed that mushrooms can grown on a smaller plot of land, respectively. This shows thatalmost all respondents from both groups (i.e. 94.4% of who are still in the business and 91.6% of who pulled out of the market) perceived as mushrooms require smaller land/space for cultivation.

Of the total sample respondents, about66.9%were cultivated mushrooms in the range of 5-7.99m^2 of land whereas the rest, 14.9%, 13% and 5.2%, were cultivated on <5, 8-10.99 and >10.99m^2 of land, respectively (table 4.2).Most respondents (i.e. 64.8%) who are still in the business were cultivated on the land lying in between 5-7.99$m^2$and the remaining,11.3%, 16.9% and 7%,were cultivated on <5, 8-10.99 and >10.99$m^2$of land, respectively.The same is true as majority of respondents (i.e. 68.7%) who stopped cultivation were cultivated on 5-7.99$m^2$of landand the rest, 18.1%, 9.6% and 3.6%, were used <5, 8-10.99 and >10.99$m^2$of land for cultivation, respectively (table 4.2).From the above analysis, it is easy to understand that most respondents (i.e. 66.9%) were cultivated mushrooms on 5-7.99$m^2$of land.

Table 4.2 Amount of land required for cultivation

Land size (m^2)	Still in cultivation (71)		Stopped cultivation (83)		Total (154)	
	No	*%*	*No*	*%*	*No*	*%*
<5	8	11.3	15	18.1	23	14.9
5-7.99	46	64.8	57	68.7	103	66.9
8-10.99	12	16.9	8	9.6	20	13.0
>10.99	5	7.0	3	3.6	8	5.2

Source: survey result, 2018

The descriptive statisticsin the table below showed that, the average land required for cultivation wasnearly7.30m^2, the minimum and maximum being 4.25 and 20.5m^2, respectively.Specifically, theaverage plot of land used by cultivators who are still in the business was 7.68m^2, with the minimum and maximum of 4.55 and 20.50 m^2, respectively. On the other hand, respondents who pulled out of the businesswere cultivated averagely on 6.97 m^2 of land. The minimum was 4.25m^2 andthe maximum 14.35 m^2(table 4.3). This implies that the average land size required for mushrooms (i.e. 7.30m^2) is much smaller than the minimum amount of land needed for cultivation of profitable cash crops and vegetables in urban and peri-urban areas which is 14.0m^2 (Mulugeta, 2016: 33).

Table 4.3 Descriptive statistics (Mean, SD, Minimum and Maximum) ofland size required for cultivation in m^2

Respondents	Obs.	Mean	SD	Minimum	Maximum
Still in cultivation	71	7.68	3.02	4.55	20.50
Stopped cultivation	83	6.97	1.74	4.25	14.35
Total	154	7.30	2.43	4.25	20.50

Source: survey result,2018

2. **Mushrooms Require Smaller amount of Capital**

In comparison to other businesses, small-scale mushroom farmingis the low-cost business with high profits and income (Kakidan, 2015). Table 4.4 showed that of total sample respondents 67.5% were agreed that mushrooms require little investment while 24.7% were strongly agreed and only 7.8% were disagreed that mushrooms are a low-cost cash crops.Specifically, about 64.8% of who are in the business and 69.9% of who withdrawn from the business were agreed that mushroom production does not require huge amount of capital and they account most respondents intheir group.As majority of respondents confirmed, i.e. 92.2%, mushrooms can be cultivated with smallerinvestment. As a result, it isa great opportunity to those who do not have much capital but interested in mushroom growing.

Table 4.4 Perception of respondents on whether mushrooms require smaller cost of production

Mushrooms require smaller capital	Still in cultivation (71)		Stopped cultivation (83)		Total (154)	
	No	*%*	*No*	*%*	*No*	*%*
Strongly Agree	22	31.0	16	19.3	38	24.7
Agree	46	64.8	58	69.9	104	67.5
Disagree	3	4.2	9	10.8	12	7.8

Source: survey result, 2018

The survey result in the following table declared thatabout 47.7% of who are still in cultivation were invested less than 500br and36.6% of themcost between 501-1,000br. The rest 8.4% and 11.3% were started cultivation with a budgetbetween1,001-1,500br and greater than 1,500br, respectively. On the other hand, around half percent of sample respondents who pulled out of the business were required less than 500br to start cultivation. And 21.7% of respondents, in the same group, revealed that their cost of

production were between 501-1,000br. The remaining 12% and 15.7% were invested between 1,001-1,500br and more than 1,500br, respectively.

Table 4.5 Initial capital required for cultivation

Initial capital (br)	Still in cultivation (71)		Stopped cultivation (83)		Total (154)	
	No	*%*	*No*	*%*	*No*	*%*
<500	31	43.7	42	50.6	73	47.4
501-1,000	26	36.6	18	21.7	44	28.6
1,001-1,500	6	8.4	10	12.0	16	10.4
>1,501	8	11.3	13	15.7	21	13.6

Source: survey result, 2018

The start-up capital varied among the sample cultivators from minimum of 300br to a maximum of 2,150br.The average was 790.68br. The survey result also revealed that on average 762.82 and 814.52br were invested by respondents who are still in the business and withdrawn from the business, respectively(table 4.6).Thus, based on the above analysis,it can be concluded that mushrooms can be grown with a capital of less than 1,000br which is smaller amount of money compared to other businesses as most businesses, nowadays, require huge amount of investment.

Table 4.6 Descriptive statistics (Mean, SD, Minimum and Maximum) on initial capital required for cultivation in birr

Respondents	Obs.	Mean	SD	Minimum	Maximum
Still in cultivation	71	762.82	432.93	300	2,150
Stopped cultivation	83	814.52	459.53	430	1,950
Total	154	790.68	446.76	300	2,150

Source: survey result, 2018

3. **Substrates are Abundant and Easily Accessible**

Substrates are simply any substances on which the mushrooms will grow and are easily accessible both in urban and peri-urban areas.Some of the most known types of substrates in mushroom cultivation are cereal straw, grass straw, cotton waste, corn cobs, coffee waste, sawdust, animal dung, chicken manure, brewers' spent and bagasse (the biomass remaining after crushing of sugarcane or sorghum stalks for juice

extraction)and are abundant everywhere (Chang, 2006: 19). The used substrate can then be composted and applied directly back to the soil (Sher, 2011: 44).Thus, cultivators can still use the substrate as a good soil conditioner or sell it to other businesses so that earn an additional income (Oei andNieuwenhuijzen, 2005:6).With regard to abundance and easily accessibility of substrates, sample respondents were asked their perceptionsand what theyresponded is tabulated as follows:

Table 4.7 Perception of respondents on whether substrates are easily accessible for mushroom cultivation

Substrates are easily accessible	Still in cultivation (71)		Stopped cultivation (83)		Total (154)	
	No	*%*	*No*	*%*	*No*	*%*
Strongly Agree	25	35.2	10	12.0	35	22.7
Agree	37	52.1	56	67.5	93	60.4
Disagree	9	12.7	17	20.5	26	16.9

Source: survey result, 2018

As table 4.7 demonstrated, of total samples in the study area, almost all (i.e. 83.1%) perceivedthat substrates are abundant and easily accessiblein their areas. Most, i.e. 87.3% and 79.5%,respondents of who are still in cultivation and pulled out of cultivation, respectively, also believed that substrates are both abundantand easily accessible.Hence, such abundance and easily accessibilityof substrate isa great opportunity for cultivators as substrates are one of the main inputs for a profitable and sustainable mushroom cultivation.

Respondentswere also asked where they get substrate, and of total sample respondents, 83.1% of them replied asthey prepared it by themselveswhile the rest 16.9%answered they purchased it from private suppliers (table 4.8).

From this, one can easily conclude that majority of respondents (i.e. 83.1%) prepared substrate by themselves and it is may be because the raw materials required (such as cereal straw, grass straw, cotton waste etc) are abundant and easily accessible around their working areas. In doing so, cultivators enabled to minimize their cost of production and this is may be one of the reasons why mushrooms are considered as a “low-cost/investment cash-crops” as discussed above.

Besides sources of substrate, respondents were asked who gave them training on their way of preparing quality substrate, and answered as they trained by extension officers of nearby woreda and, some, by private substrate suppliers.

Table 4.8 Sources of substrates

Where do you get substrates?	Still in cultivation (71)		Stopped cultivation (83)		Total (154)	
	No	*%*	*No*	*%*	*No*	*%*
Own preparation	62	87.3	66	79.5	128	83.1
Private suppliers	9	12.7	17	20.5	26	16.9

Source: survey result, 2018

4. **Mushrooms can be Harvested within a Shorter Period of Time**

One of the most important opportunities in mushroom cultivation is the time it requires from spawningto harvesting.Spawning is the process of sowing a mushroom seed or spawn in to the growing container. While harvesting, the final stage in production process, is the process of collecting a ripen mushroom.According to different studies, the time between these two production stages (spawning to harvesting) is shorter by nature compared to other agricultural crops and vegetables. For instance, Oei and Nieuwenhuijzen (2005: 6) revealed that the time between spawning and harvesting is as short as three weeks (21 days) while Hill (2013: 24) reported as it may took up to 1 month (30 days).The perception of respondents in table 4.9also confirmed asmushrooms can be harvested within a shorter span of time.

Table 4.9 Perception of respondents' on mushrooms harvest time

Mushrooms can be harvested within a shorter span of time	Still in cultivation (71)		Stopped cultivation (83)		Total (154)	
	No	*%*	*No*	*%*	*No*	*%*
Strongly Agree	57	80.3%	51	61.4%	108	70.1%
Agree	14	19.7%	32	38.6%	46	29.9%

Source: survey result, 2018

Based on the survey result, of total samples 41.6% answered as time between spawning to harvesting is less than 30 days while the remaining, i.e. 34.4% and 24%, replied as mushrooms would be ready for harvest within 31-35 and 36-40 days, respectively (table 4.10).

Specifically, 54.9% of respondents who are still in cultivation required less than 30 days to harvest mushrooms while 31% and 14.1% of themresponded as it tookbetween31-35 and 36-40 days,respectively. On the other hand, 30.1%, 37.4% and 32.5% of who withdrawn from the business replied as spawning to harvestingof mushrooms took less than 30 days, 31-35 and 36-40 days, respectively (table 4.10).

Table 4.10 Time between spawning and harvesting in days

Time between spawning to harvesting (days)	Still in cultivation (71)		Stopped cultivation (83)		Total (154)	
	No	*%*	*No*	*%*	*No*	*%*
< 30	39	54.9	25	30.1	64	41.6
31-35	22	31.0	31	37.4	53	34.4
36-40	10	14.1	27	32.5	37	24.0

Source: Survey result, 2018

As the descriptive result indicated, respondents who are still in cultivation and who pulled out of cultivation harvested mushrooms on average within 31.32 and 33.80 days, respectively.While the whole respondents required, on average,32.66 days with the minimum and maximum of 28 and 40 days, respectively (table 4.11) and is nearly similar to what Hill reported, i.e. 30 days (2013: 24).According to Mulugeta (2016: 24), most cash-crops and vegetables require a minimum of 3 months (90 days) from the time they are planted (sowed) up to the date of harvesting. Hence, in contrast to other crops/vegetables, mushrooms can be harvested within a shorter period of time (as shorter as one month)and is a great opportunity for cultivators as it enables them to produce the whole months of a single yearand in turn maximizetheir annual income.

Table 4.11 Descriptive statistics (Mean, SD, Minimum and Maximum) on number of days required from spawning to harvesting mushrooms

Respondents	Obs.	Mean	SD	Minimum	Maximum
Still in cultivation	71	31.32	3.14	28	36
Stopped cultivation	83	33.80	3.30	30	40
Total	154	32.66	3.45	28	40

Source: Survey result, 2018

5. **The public bad Perception on Mushrooms' Food Value is Changing as a result the Demand is Increasing**

Some years ago, in most cultures of the people in Ethiopia, wild mushrooms have different names tagged with them. The Amharic names of wild mushrooms reflecting negative intuition include: "Ye-abohayfes" meaning the "Pert of Monk", "Ye-Jib Tilla" meaning "Hyena's Umbrella", "Dem Astefy" meaning "that causes vomiting of blood" etc. Due to this bad perception about mushrooms in Ethiopia, the nutritional and medicinal values of mushrooms have been undermined (Kiflemariam, 2010: 11). However, nowadays,

people are changing their negative attitude regarding mushrooms. According to Gezahegn and Gizachew (2016: 63) currently small scale mushroom cultivation is spreading in most of Ethiopian cities like Addis Ababa, Bishoftu, Hawassa, Bahirdar, etc.

Table 4.12 Perception of sample cultivators on whether the public bad perception on mushrooms' food value is changing

The public bad perception on mushrooms is changing	Still in cultivation (71)		Stopped cultivation (83)		Total (154)	
	No	*%*	*No*	*%*	*No*	*%*
Strongly Agree	26	36.6	23	27.7	49	31.8
Agrees	34	47.9	37	44.6	71	46.1
Neutral	11	15.5	23	27.7	34	22.1

Source: survey result, 2018

From the above table, 84.5% and 72.3% of respondents who are still in cultivation and stopped cultivation, respectively, perceived that the bad public perception on mushrooms is changing positively. While the rest 15.5% and 27.7% of cultivators, of the two groups,had no idea on the issue. In general,of total sample cultivators 77.9%, the majority, believed that the public changing their negative attitude on mushrooms.

Though there are lots of factors that affectthe demand for a product, the public perception on the product is the most important oneaspositive perception significantly increases demandand vice versa (Kalkidan, 2010: 32). Therefore, the changing people's bad attitude on mushrooms significantly increases the demand for the product and is an important opportunity that attracts people who are interested in mushroom cultivation.

4.1.2 Constraints of Sustainable Small-Scale Mushroom Cultivation in Addis Ababa

In the process ofmushroom growing, there are a lot of factors that hinder/challenge a successful and sustainable cultivation.Some of these are:

1. **Lack of Extension Services**

Extension services are the services provided by extension officersand are the provision of advice, information, and other supports to cultivators.The advices and supports are,according to key informants such as extension officers,provisionof training on the mechanisms of disease and pest control, post-harvest product management, the way of preparing quality substrates and implementation of Kaizen (Kaizen is a

Japanese philosophy meaning continuous improvement). In doing so, cultivators will be enabled to improve their production (both quality and quantity) and productivity.Regardingthe extension services, sample cultivators were asked whether they have access to the services or not and their responses are displayed under the table 4.13:

Table 4.13 Cultivators' access to extension and follow-up services

Do you have access to extension and follow-up services?	Still in cultivation (71)		Stopped cultivation (83)		Total (154)	
	No	*%*	*No*	*%*	*No*	*%*
Yes	61	85.9	7	8.4	68	44.2
No	10	14.1	76	91.6	86	55.8

Source: Survey result, 2018

As table 4.13 depicted, of total samples,44.2% responded as theyhave access to extension services while more than half (i.e. 55.8%) revealed as they do not have the access. Specifically, almost all respondents (i.e. 85.9%) who are still in cultivation demystified that they have been provided the serviceswhereas, in contrast to respondents who are still in cultivation, nearly all cultivators (i.e. 91.6%) who withdrawn fromcultivation unveiled as they have no access to the services. This shows that theextension services are not equally provided to all cultivators in the study area. As a result,it enables some to continuecultivation with improved production and productivity, whilediscourage others so that struggle to cultivate sustainably.Hence, lack of extension services isone of the challenges that hinder sustainable cultivation in the study area.

2. **Lack ofProper Product Storage**

Mushrooms, similar to other perishable agricultural products, have a shorter shelf life, usually up to four (4) days after being harvested (Mulugeta, 2016: 53).Therefore, cultivators need to havea properstorage(such as fridges)to extend or keep the freshness of their producta bit longer which,in turn, increases their bargaining power to sell the product with a good price.

Hence, it is expected all sample cultivatorsto haveaccess toproper storage.Unfortunately,of total respondents, only 48.1% of them have proper storage facility. While the rest, i.e. 51.9%,revealed as they do not have the access (table 4.14).Therefore, according to respondents, the harvested mushroomsweresusceptible to spoil within ashorter days.As a result,they were exposedeither to totalloss or necessitated to sell with lower priceand, these madethem to think mushroom cultivation as a nonprofit-

able business so thatdecided towithdraw from the business.For this reason, lack of proper product storage is a serious problem that challenges sustainable cultivation in the study area.

Table 4.14 Cultivators' access to product storage

Do you have product storage?	Still in cultivation (71)		Stopped cultivation (83)		Total (154)	
	No	*%*	*No*	*%*	*No*	*%*
Yes	54	76.1	20	24.1	74	48.1
No	17	23.9	63	75.9	80	51.9

Source: Survey result, 2018

3. Lack of Access to Product Promotion onBazaar

As it is obviously known, product promotion is very crucial in any type of business as it allows provision of appropriate information about the product to consumers which increase customer traffic and, as a result, build sales and profit (Mishra, 2015: 22).

According to key informants (i.e. extension officers, coordinators and office managers from trade and industry development offices and micro and small enterprise development offices),every woreda of each sub-cityin Addis Ababa prepares bazaar at least twice every year and in this bazaar mushroom cultivators invited to participate in order to promote their product. However, as table 4.15 demonstrated, only 32.5% of total sample respondentsparticipatedwhile the majority, i.e. 67.5%, do not participated (though they sought to participate).This shows thatthe bazaars prepared do not gaveequal access to all cultivators. For this reason, those who had the accessmighthave better customer traffic and, in turn,a better sales and profit than those who donot have the access. Therefore, lack ofequally participative product promotion on bazaar is one of the challenges that constrain sustainable cultivation in the study area.

Table 4.15 Cultivators' access to product promotion such as bazaar

Do you have access to product promotion such as bazaar?	Still in cultivation (71)		Stopped cultivation (83)		Total (154)	
	No	*%*	*No*	*%*	*No*	*%*
Yes	46	64.8	4	4.8	50	32.5
No	25	35.2	79	95.2	104	67.5

Source: Survey result, 2018

4. Development-Induced Displacement

Development-induced displacement is one of the major constraints that challenge sustainable cultivation in the study area. It occurs whenpeople, in this case mushrooms cultivators, forcibly displaced from their plot of land, where they used to grow mushrooms, due to development related reasons and, as a result, they may stop cultivation unless they are given alternative cultivation land.With regard to this, sample respondents were asked whether they have been displaced from their cultivation land or not and what they responded is displayed as follows:

Table 4.16Respondents' exposure to development induced displacement

Have you been displaced from your home/land due to development?	Still in cultivation (71)		Stopped cultivation (83)		Total (154)	
	No	*%*	*No*	*%*	*No*	*%*
Yes	8	11.3	57	68.7	65	42.2
No	63	88.7	26	31.3	89	57.8

Source: Survey result, 2018

According to table 4.16, 57.8% of total sample respondents revealed that they are not displaced from their land of cultivation while the rest 42.2% responded as they displaced due to development related reasons.Moreover, of respondents who displaced (i.e. 42.2% of total respondents), 87.7% unveiled/complained as they are not given alternative cultivation land and, accordingly, they stopped cultivation. Hence, development-induced displacement is the major threat for sustainable mushroom cultivation in the study area.

4.1.3. The Mushroom Species that mostly Cultivated in Addis Ababa

There are about 14,000 to 15,000 species of mushrooms in the world. Some of these are:*Agaricusbisporus(Button), Pleurotusostreatus (Oyster),Lentinulaedodes(Shiitake), Ganodermalucidum*, *Amanita phalloides*etc(Chang and Miles, 1930: 4).

Both groups of sample respondents (i.e. who are still in cultivation and withdrawn from cultivation) were asked which type mushroom they were cultivated and their response is recorded in the table below:

Table 4.17 Mushroom species grown by sample respondents

Which type of mushroom species have you cultivated?	Still in cultivation (71)		Stopped cultivation (83)		Total (154)	
	No	*%*	*No*	*%*	*No*	*%*
PleurotusOstreatus (Oyster) only	68	95.8	83	100	151	98.1
Oyster and Shiitake together	3	4.2	-	-	3	1.9

Source: Survey result, 2018

According to table 4.17,majorities of respondents (i.e. 95.8%) who are still incultivationgrow only Oyster mushroom while the remaining few respondents(i.e. 4.2%) cultivate both Oyster and Shiitake together. On the other hand, all samples (i.e. 100%) who pulled of cultivation demystified that they were only cultivated Oyster mushroom. In general, of total respondents, only 1.9% cultivated both Oyster and Shiitake together while 98.1% revealed as they only cultivated Oyster mushroom. Therefore, the most cultivated type of mushroom specie in the study area is Oyster mushroom specie and this agrees with Chang (2006: 16) as he reported oyster is the most known and cultivated type of mushroom in the world.

4.2 Econometric Results

This section discusses and presents the determinant factors affecting sustainable small-scale mushroom cultivation in Addis Ababa using binary logistic regression model (simply logit model). The unknown parameters (β_s) are estimated through maximum likelihood (ML).

In this study the dependent variable is sustainable mushroom cultivation while there are about eight independent (explanatory) variables which are assumed to determine the dependent variable. In general, the results and discussions of economic analysis are presented in the section that follows.

4.2.1 Model Diagnostics Test Result

Prior to running the logistic regression model variables were checked for the basic assumptions of the linear regression model.

Test for Multicollinearity

Both continuous and discrete independent variables were checked for the existence of multicollinearity and the degree of association using Variance Inflation Factor (VIF). Thus, the values for both explanatory variables found to be very small (mush less than 10) which indicates the absence serious multicolliniarity problem in the model (Annex 2).

Test for Heteroscedasticity

Heteroscedasticity occurs when variance of the errors varies across observations. It can be tested using Breusch-pagan/Cook-Weisberg test. STATA run Breusch-pagan/Cook-Weisberg test and found variance of errors being constant. Hence, there is no heteroscedasticity problem.

4.2.2Goodness of Fit of the Model

As discussed in the methodology section, the logit econometric model was selected for this study. The software (STATA) was run to identify the independent (explanatory) variables that are good predictors of the determinants of sustainable mushroom cultivation in the study area.

According to Kothari (1990: 251), the measure of goodness-of-fit used in the binary choice model is the pseudo-R^2 and has the same kind of interpretation as that of adjusted-R^2 in linear regression model; and liesin between 0 and 1. As it is shown in table 4.18, the pseudo R^2 is 0.7795 and is interpreted as 77.95% of the variations in the dependent variable (i.e. sustainable mushroom cultivation) are explained by the explanatory variables. And, the unexplained part (i.e. 22.05%) is expected to go for un-captured information.

The likelihood ratio test statistics exceeds the Chi-square critical value with 8 degree of freedom. The result is significant at less than 1% probability level indicating that the hypothesis that all the coefficient (β_s) except the intercept are equal to zero is not tenable. Thus, the null hypothesis is rejected. Likewise the log likelihood value (-23.43) was significant at 1% level of significance.

4.2.3 Discussion of the Significant Explanatory Variables

As per the table 4.18, four explanatory variables were found to be statistically significant (of eight variables). These are access to extension services (**AExtS**), access to product storage (**PS**), development-induced displacement (**DID**) and access to product promotion (bazaar) (**APPrrom**)while the remaining four explanatory variables namely; level of education (**EduLev**), house-hold size (**HHSize**), seed price (**SeedP**) and business experience (**BEx**)are found to be less powerful in explainingsustainable mushroom cultivation in Addis Ababa.

The detail results of statistically significant explanatory variables of sustainable mushroom cultivation are explained as follows:

Access to Extension Services: As table 4.18 depicted, it is statistically significant at 1% level of significance and found to have a positive correlation with sustainable cultivation.Its coefficient is 4.311. Hence, the null hypothesis that stated the coefficient (β) for access to extension service equal to zero and access to extension service does not has a significant positive relationship with the dependent variable (sustainable cultivation) are rejected.This shows that cultivators who have access to extensionservice more likely cultivate mushrooms sustainably compared to those who do not have the access. The odd ratio is 0.013 and it implies,other things keptconstant, cultivators' decision to grow mushrooms sustainably increased by a factor of 0.013 for a unit increase in access to extension service per month. This is maybe because cultivators get advices and supports from extension officers on the mechanisms of disease and pest control, post-harvest product management, way of preparing quality substrates and implementation of Kaizen (Kaizen is a Japanese philosophy meaning continuous improvement) which enable them to cultivate mushrooms with full knowledge.

Development-Induced Displacement: It is statistically significant at 5% level of significance and has a negative association with sustainable mushroom cultivation. Its coefficient (β) is -2.984. Hence, the null hypothesis is rejected because the value of the coefficient is different from zero and development-induced displacement is negatively related with sustainable mushroom cultivation. This implies that cultivators who do not displaced from their land of cultivation more likely cultivate mushrooms sustainably in comparison to those who displaced. On the other hand, the odd ratio is 19.761 and it shows that, other things being constant, when cultivators are more susceptible to displacement from their land of cultivation, their decision to cultivate mushrooms sustainably decrease by a factor of 19.761. The reason is maybe they are not given alternative land for cultivation. This finding is supported by Jonathan (2002:26) who revealed the

negative significant relationship of development-induced displacement with sustainable mushroom cultivation.

Access to Product Promotion on Bazaar: According to table 4.19, access to product promotion on bazaar is statistically significant at 1% level of significance. The value of its coefficient (β) is 3.606. As a result, the null hypothesis which stated the coefficient (β) for access to product promotion on bazaar equal to zero is rejected and, likewise, the null hypothesis stating access to product promotion on bazaar does not has a positive significant relationship with sustainable mushroom cultivation also rejected. Moreover, the odd ratio is 0.027 and it implies that, keeping other things constant, cultivators' decision to grow mushrooms sustainably increased by a factor of 0.027 for a unit increase in access to product promotion on bazaar per year. This is maybe because product promotion on bazaar allows cultivators to provide appropriate information about the product to consumers which, in turn, increase customer traffic and, as a result, build sales and profit. This result agrees with Nyakundi (2006: 61). He reported that access to product promotion on bazaar has a positive significant relationship with sustainable mushroom cultivation.

Table 4.18: The Maximum Likelihood Estimation(Logistic regression)

Number of obs = 154 Prob> chi^2 = 0.0000

LR chi^2 (8) = 165.69 Log likelihood = -23.4297

Pseudo-R^2 = 0.7795

SusCul	Coefficients	Odds Ratio	Standard Error	Z	P>|z| (P-value)	[95% Conf. Interval]	
EduLev	-0.0556948	0.9458278	0.1282111	-0.43	0.664	-0.3069839	0.1955943
HHSize	-0.2968144	0.7431819	0.3127477	-0.95	0.343	-0.9097886	0.3161598
AExtF	4.31099	0.0134203	0.9832393	4.38	0.000 ***	-6.238104	-2.383877
SeedP	-0.121982	0.8851643	0.0946446	-1.29	0.197	-0.307482	0.063518
PS	2.2575	0.1046116	0.9151528	2.47	0.014 *	-4.051167	-0.4638339
DID	-2.983719	19.76118	0.9266633	-3.22	0.001**	1.167493	4.799946
BEx	0.2548691	1.290293	0.1392923	1.83	0.067	-0.0181387	0.527877
APProm	3.605765	0.0271667	1.01911	3.54	0.000 ***	-5.603184	-1.608345
_cons	14.3341	1679652	4.263549	3.36	0.001**	5.977694	22.6905

Source: Survey result, 2018

Where: *, ** and *** denotes levels of significance at 10%, 5% and 1%, respectively

Access to Proper Product Storage: It is found to be significant at 10% level of significance and has a positiveassociation with sustainable mushroom cultivation. The value of the coefficient is 2.2575. For this reason, the null hypothesis that stated the coefficient (β) for access to proper product storage equal to zero and access to proper product storage does not has a positive significant relationship with the dependent variable are rejected.This shows that cultivators who have access to proper product storagemore likely cultivate mushrooms sustainably compared to those who do not have the access.The odd ratio is 0.105 and is interpreted as when cultivators have more access to proper product storage, their decision to cultivate mushrooms sustainably increase by a factor of 0.013*, citrus paribus*.The reason behind this may be, mushrooms, similar to other perishable agricultural products, have a shorter shelf life, usually up to four (4) days after being harvested (Mulugeta, 2016: 53). As a result, cultivators need to have a proper storage (such as fridges) to extend or keep the freshness of their product a bit longer which, in turn, increases their bargaining power to sell the product with a good price.Dada and Fulmilayo (2012: 80) also agreed that, based on their report, proper product storage facility has a positive and significant association with sustainable mushroom cultivation.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Core Findings

The result of the study elucidated positive and significant correlation between access to extension service, access to proper product storage, and access to product promotion on bazaar. Development-induced displacement found to negativelyaffect cultivators' sustainable mushroom cultivation.Cultivators' levels of education, cultivators' house-hold size, seed price, and business experience are found to be less powerful in explaining sustainable cultivation in the study area.

The econometric result indicates thataccess to extension service was statistically significant and has a positive correlation with sustainable cultivation. This might be because cultivators get advices and supports from extension officers on the mechanisms of disease and pest control, post-harvest product management, ways of preparing quality substrates and implementation of Kaizen which enable them to cultivate mushrooms with full knowledge.

Access to proper product storage is also found to significantly affect sustainable cultivation. Thus, cultivators who have access to proper product storage more likely to cultivate sustainably compared to those who do not have the access. The reason behind is that mushrooms are highly susceptible to perish.

Access to product promotion on bazaar also exerted a positive and significant impact on sustainable cultivation. This is because promoting a product on bazaar allows cultivators to provide appropriate information about the product to potential consumers which, in turn, increase customer traffic and, as a result, build sales and profit.

The only variable that is found to negatively affect sustainable cultivation is development-induced displacement. Furthermore, the odd ratio (19.761) has shown that it is the most important variable in sustainable mushroom cultivation. This evidence supports that development-induced displacement significantly explained the variations in sustainable mushroom cultivation.

The study also identified the major opportunities and challenges of sustainable mushroom cultivation in the study area.The opportunities are, therefore, mushrooms require smaller land and capital, substrates are abundant and easily accessible, public bad perception on mushrooms' food value changed so that the demand is increasing, and mushrooms can be harvested within a shorter period of time.

On the other hand, the constraints that hinder sustainable mushroom cultivation in the study area are: lack of extension services, lack of proper product storage, lack of access to product promotion on bazaar and development-induced displacement.

With regard to mushroom species, the most known and cultivated type of mushroom (mushroom species) in the study area is PleurotusOstreatus (Oyster) mushroom.

5.2 Conclusion and Recommendations

The concerned body, especially Addis Ababa City Administration Urban-Agriculture Bureau, should take in to consideration the above variables, i.e. variables that significantly affect sustainable mushroom cultivation, in designing various policies and programs for the enhancement of urban-agriculture in the study area. Thus, the following recommendations are forwarded based on the findings:

- ✓ Extension service was not equally provided to all cultivators; some have the access while others not. Extension officers were asked on this issue and replied that some cultivators have a negative attitudefor extension services because they linked the services provided with high taxation. Therefore, all stakeholders such as Addis Ababa city administration urban agriculture bureau and trade and industry development bureau should work together in enhancingcultivators' awareness about extension services.
- ✓ Proper product storage is mandatory in mushroom cultivationas theyare highly susceptible toperish within a shorter period of time.However, some cultivators do not have a storage facility. And, it is due to lack of money to buy fridgesfor storage. Thus, Addis saving and credit association should facilitate a long term loan for cultivators to buy proper storage (fridge).
- ✓ Cultivators highly complained that they displaced from their land of cultivation but do not given the alternative land for cultivation.So, each woreda's micro and small enterprise development office should facilitate the alternative land to those who displaced from their land of cultivation.
- ✓ Product promotion on bazaar is very important for cultivators as it enables them to provide information about their product to customers in order to increase customer traffic and, in turn, earn a higher profit.Therefore, when each micro and small enterprise development office (of each woreda) prepares a bazaar, they should invite to all cultivators.

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ANNEXES

Annex 3. Questionnaire

St. Mary's University ቅድስት ማርያም ዩኒቨርሲቲ
committed to excellence

St. MARY'S UNIVERSITY

Institute of Agriculture and Development Studies (IADS)

Department of Agricultural Economics

Dear participants,

I am a graduate student at St. Mary's university, Institute of Agriculture and Development Studies (IADS), and currently working a research on title "***Determinants of sustainable small scale mushroom cultivation in Addis Ababa".*** The purpose of the research is to assess the major internal and external determinants of sustainable small scale mushroom cultivation and identify its opportunities and challenges/constraints and to give recommendation for further policy measures. To this end, I would like to invite you to participate on the study. The information you provided will be treated confidentially and will not be used for any other purpose other than academic purpose.

PART 1: **General information**

Direction: Please put a "√"mark to the alternative that is most applicable to you in respect of each of the following items.

1. Sex [1]. Male [2]. Female
2. Age: [1]. < 20 years [2]. 21-30 [3]. 31-40
   [4]. 41-50 [5]. >50

3. Marital status: [1]. Singe [2]. Married

[3]. Divorced [4]. Widowed

4. Household size: [1]. One [2]. Two [3]. Three

[4]. Four [5]. Five and above

5. Educational status: [1]. Unable to read and write [2]. Elementary (1-8)

[3]. Secondary school (9-10) [4]. Preparatory school (11-12)

[5]. Diploma [6]. Degree and above

6. If your choice for question # 5 is "Degree and above", how many years did you spend in University? _____

PART 2: Basic research questions

Direction: Please encircle the alternative that is most applicable to you in respect of each of the following items.

1. What is your current status on mushroom cultivation?

[1]. Am still on cultivation [2]. I stopped the cultivation

2. Which type of mushroom species are you cultivating?

[1].PleurotusOstreatus (Oyster) Mushroom

[2]. Lentinulaedodes (Shiitake) Mushroom

[3]. Agaricusbisporus(Button/White) Mushroom

[4]. Ganodermalucidum mushroom

[5]. other species (specify) ……

3**a).*For the table below put a"√" mark corresponding to your answer.***

S.No	To what extent you agree that the following statements are opportunities for sustainable small-scale mushroom cultivation in Addis Ababa?	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	Require smaller land for cultivation.					
2	Require smaller initial capital.					
3	Product can be harvested within a shorter period of time.					
4	Grows on easily accessible agricultural wastes (substrates).					
5	The public perception for mushroom is changing as a result the demand for the product is growing up.					

Please encircle the alternative that is most applicable to you in respect of each of the following items and fill the blank space where necessary.

4. With how much capital did you start the cultivation? _____

5. On how much sq. m of land are you cultivating? _____

6. On average how many days it took from spawning up to the date that your product is ready for harvest? _____

7. How do you know that your product is ready for harvest?

_____

_____

_____

8. Where do you get substrates?

[1] Own preparation [2].From seed suppliers [3]. From governmental institutions

9. To whom do you sell your product?

[1]. Direct consumers [2]. Seed suppliers

[3]. Hotels/restaurants [4]. Super markets

10. Do you have access to extension and follow-up service from your nearby district (woreda)?

[1]. Yes [2]. No

11. If your answer for question # 10 is "YES", how many times do district officials visit you per month?

[1]. 1-4 times [2]. 5-8 times [3]. > 8 times [4]. None

12. If your answer for question #10 is "YES", what kind of services are they providing you?

(NB: you can √more than one choice).

[1]. How to prepare substrate (material on which the mushroom grows)

[2]. How to control diseases and pests

[3]. How to increase product size and productivity

[4]. Post harvest (storage, transportation, packing etc) product management techniques

[5]. other (specify)……

13. Do you have access to storage facilities for your product?

[1]. Yes [2]. No

14. How much do you cost for 250 gm of mushroom spawn/seed? _____

15. Do you have access to bazaar through which you promote your product?

[1]. Yes [2]. No

16. If your answer for question # 15 is “YES”, how many times per year do you promote your product through bazaar?

[1]. 1-3 times [2]. 4-6 times [3]. > 6 times [4]. None

17. For how many years have you been engaged in other businesses before mushroom cultivation?

_____

18. Have you forcibly/voluntarily displaced from your land, where you cultivate mushrooms, due to development related activities?

[1]. Yes [2]. No

19. If your answer for question #18 is “YES”, have you been given the alternative cultivating land?

[1]. Yes [2]. No

Thank you!

Annex 2 VIF of explanatory variables

```
. vif
```

Variable	VIF	1/VIF
AExtS	1.65	0.605686
APProm	1.47	0.680483
DID	1.35	0.738012
PSF	1.34	0.746533
SeedP	1.27	0.787365
BExp	1.10	0.912250
EduLev	1.03	0.974498
HHSize	1.02	0.976250
Mean VIF	1.28	