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Determinants of Urban Agricultural Practices and Its Impact on Household Food Security: In Case of Bako Town, Oromia Regional State, Ethiopia

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Abstract: Current global agricultural practices are recognized as unsustainable. The increase in overall human population as well as the global trend of rural to urban migration, partially as a result of continual traditional agricultural practices, exacerbates the vicious cycle of poverty and hunger in developing countries. In Ethiopia, urban agricultural practices are widespread and are a well-established practice but not officially accepted by the central and local government officials. Studies conducted about determinants of urban agricultural practices in Ethiopia were limited to identifying determinants and measuring its extent rather than investigating how it influences welfare outcomes like food security. The study, therefore, sought to examine the determinants of urban agricultural practices and its impact on household's food security in Bako town, Oromia regional state, Ethiopia. The study employed a descriptive and inferential statistics aimed at identifying the determinants of urban agricultural practices and its impact analysis on household food security in study area. The study used both primary and secondary data. The primary data collected using stratified random sampling technique via structured questionnaire and it collected from 258 sampled household among the residents of the town. Descriptive statistics (frequency, percentage, mean, t-test) and econometrics models like multi-nominal logit model for investigating determinants of urban agricultural practices and propensity score matching model for measuring the impact of urban agricultural practices on household's food security employed. Descriptive statistics result pointed out that some of urban households practice urban agriculture activities instead of relying on non-urban agriculture only. MNL logit that different variables included in the model influenced the UAP significantly. From these, age of household heads, marital status, extension contact, total livestock unit, market distance, cooperative membership, and land size influence UAP positively; and family size, dependency ratio, risk preference of household heads, and education level influence UAP negatively. Result from PSM suggests that UAP brought a positive significant impact on household food security. Finally, the study recommends preparation of effective agricultural policy that promote urban agriculture should prepared by concerned body, and also highlights that additional work is required in this area.

Keywords: Urban Agriculture, Multinomial Logit, Propensity Score Matching, Bako Town, Ethiopia

1. Introduction

1.1. Background of the Study

The problems of urban agriculture are numerous and they vary according to the types of farming or the locations where they are found. A recent study of urban food production in Ilorin, Nigeria has afforded us the opportunity to share parts of the challenges of Urban Agriculture in developing World [42]. Sub-Saharan Africa (SSA) faces more development challenges than any other major region of the World. This region has a growing share of the world's absolute poor. In 1980, one out of every 10 poor people lived in SSA. In 2000, that ratio had risen to one in three. Future projections predict that soon it will be one in two, with increasing numbers of the poor living in urban areas in SSA, approximately 38 percent of the population currently lives in urban areas. By 2030, it is predicted that almost half (48.3 percent) of SSA's

population will be urban. Most of these people will be living in slums, without access to adequate food, water, or sanitation. Urban poverty in SSA has a broader meaning of cumulative deprivation, characterized by squalid living conditions, risk to health and life from poor sanitation, air pollution, natural disasters, and the breakdown of traditional family and community safety-networks [14].

Ethiopia has a high rate of urbanization, averaging about 4.3% per annum. About 30% of this population is concentrated in the capital and primate city, Addis-Ababa. The City's population growth has been accompanied by growing unemployment, urban poverty and malnutrition. The Addis-Ababa City Government has recognized urban agriculture as one of the important methods to escape poverty. However, its contribution towards income generation, employment creation, food security, poverty alleviation and environmental protection has remained negligible. It was due to the apparent paradox between the latent and actual contribution of urban agriculture in Addis-Ababa City, the study identified and analyzed the factors that were hindering the sustained development and growth of urban agriculture in Addis-Ababa. The study revealed that, while some farmers were benefiting from urban agriculture, the sector suffered from weakness in the institutional, financial and human capacities of the City. These included lack of a facilitating policy, unavailability of collateral, high cost of the requisite inputs, and the absence of extension services [5].

Study by [61] recommended the urgent formulation of facilitating policies and strategies at both national and regional levels. These should specifically address issues related to land tenure, access to credit, as well as training and extension services to improve the capacity and productivity of urban farmers. A study by Dikson [14] revealed that development of urban agriculture has been affected by lack of specific laws and policies geared towards addressing the development this important sub- sector. However, various legislations refer individually to the sub-sector. Some of these legislations indirectly support or hinder the growth and development of the sub sector.

As study by *[40],* Challenges of urban agriculture due to high growth rate of *Urbanization* is highlighted to two related spatial challenges, which are the shrinking of urban spaces due to population growth and the resultant lack of 'readily' available space for food production. This low percentage reflects scarcity of land for food production. Secondly, insecure land tenure is one of the key challenges faced by urban farmers; they also noted that the ambivalent attitude of government towards UPA discouraged them from making investments in their practices as they could be removed from the land at any time. Challenges points out that most farmers did not own the land they cultivated; while the designation of vacant spaces to UA in is a rarity.

The challenge of providing nutritionally adequate and safe food to city dwellers is substantial. Accomplishing this task under conditions of growth and congestion demands that policy-makers seize opportunities for integrating resource management and planning efforts, understanding relationships between rural and urban areas, and anticipating the changing needs of a country's citizens - both rural and urban. Many urban households are facing a serious falls in their purchasing power. People have responded in various ways, most notably by diversifying their income sources. A wide range of activities are being employed, all in the informal sector. Urban agricultural practices have increased considerably over the past decades. It is a way to improve the food situation of urban households and to diversify their livelihood options under conditions of persistent economic uncertainty and threats. It is widely believed that the urban poor could benefit from farming in town because of the relatively low start-up investments [28].

According to Research Centre on Urban Agriculture and food Security (2014), urban Agriculture can be defined shortly as the growing of plants and the raising of animals within and around the cities. The most striking feature of urban agriculture, which distinguishes it from rural agriculture, is that it is integrated into the urban economic and ecological system: urban agriculture is embedded in- and interacting with-the urban ecosystem. Such linkages include the use of urban residents as laborers, use of typical urban resources like (organic waste as compost and urban wastewater for irrigation), direct links with urban consumers, direct impacts on urban ecology (positive and negative), being part of the urban food system, competing for land with other urban functions, being influenced by urban policies and plans etc. Urban Agriculture is not a relic of the past that will fade away (urban agriculture increases when the city grows) nor brought to the city by rural immigrants that will lose their rural habits over time. It is an integral part of the urban system.

According to the study by [62], city and suburban agriculture takes the form of backyard, roof-top and balcony gardening, community gardening in vacant lots and parks, roadside urban fringe agriculture and livestock grazing in open space. (20) State that the popularity of urban agriculture has increased considerably in the last few years as concerns about the environment have combined with increased interest in health and community-building issues, giving rise to support for food systems in metro areas as an integral part of a sustainable development path for cities. [29] stated that most common forms of Urban Agriculture surveyed in cities include community gardens, vegetable gardens, Community Supported Agriculture, Greenhouse Agriculture, Kitchen gardens, Edible landscapes, Berry patches, Vineyards, Greenbelt Agriculture.

Since the 1970s, urban agriculture has been growing in the developing world as a result of rapid urbanization, crippled domestic food distribution systems, wage cuts, soaring inflation, rising unemployment, declining purchasing power, limited urban land use regulations, civil strife and natural disasters in urban areas. To meet part of the food needs of urban dwellers, urban farming both in intra-urban and peri-urban areas, is becoming a familiar and almost permanent feature in the developing world [38].

Urban agriculture practices (UAP) include the growing of plants and raising of animals within and around the cities. In Ethiopia, most of the agriculture is undertaken in the rural

with major components of crops and livestock. In urban areas, the practice of urban agriculture is smaller in magnitude. It is not well recognized by the authorities. In fact, in the past cropping and livestock used to be destroyed or confiscated by the municipal or urban council in accordance with existing by laws. Despite this, urban agriculture is on the rise but there is no appropriate policy to this effect. Ethiopian people carry along with them indigenous knowledge on livestock keeping and crop production to the urban areas when they migrate from the rural areas [24].

1.2. Statement of the Problem

Most of the world's urban growth in the next two decades 92% will be absorbed by Cities of the developing world, which are least equipped to deal with rapid urbanization. This will be particularly notable in Africa and Asia, where the urban population will double between 2000 and 2030, making up 81 percent of urban growth during that period, with harmful consequences if governments do not prepare now for the coming growth [18]. Lack of resources/competition for funding, history/gentrification/neighborhood, demographic changes cultural or language diversity, lack of volunteers, lack of youth involvement, need for infrastructure, labor for maintenance and upkeep of existing gardens, access to water/affordable water/drought and Environmental concern such as soil contamination are the factors that challenges/ hinder urban agricultural practices [19].

Urban and peri-urban agriculture has a significant share in the food supply of many cities in Sub-Saharan Africa (SSA) and takes special care of urban diets, which include exotic or perishable vegetables, fresh milk and poultry products. The challenge for urban agriculture in Africa derives from being in most cases in a vacuum of semi-official recognition with limited active support from city authorities, or even in conflict with city planners or health authorities with respect to land tenure and water use. It is therefore, stated that urban authorities, policy makers and planners need more data on the contribution of urban and peri-urban agriculture to urban food supply to give this agricultural sector appropriate recognition [10].

Mwangi, W., (2015) [40] conducted a research on factors influencing urban agricultural practice in Kenya Nairobi County and found as urban food insecurity, population increase, needs for fresh foods, urban planning and urban governance can influence urban agricultural practices by using descriptive methods of data analysis. [17] Urban Agriculture contributes to both availability and access, in particular of fresh and nutritious crops and livestock products. Self-production of food by the urban poor represents from 18 percent on East Jakarta, Indonesia to 60 percent on Harare, Zimbabwe of total food consumption in low-income households. In Kampala, urban producers obtained 40 to 60 percent or more of their household food needs from their own urban garden.

Henok, T. (2014) [28] identified the potentials and constraints of urban agriculture. The potentials includes food security, economic potentials, social advantage, environmental advantage etc [24, 36, 27] identified as space for cultivation and livestock keeping, lack of access to resource, lack of extension contact/service and health problems are considered as constraints of urban agricultural practice. Studies conducted about factors influencing urban agricultural practices in Ethiopia were limited to identifying determinants of urban agricultural practices rather than investigating its impact on urban household's food security.

1.3. Objective of the Study

1.3.1. General Objectives

The general objective of the study is to assess the determinants of urban agricultural practices and its impact on urban food security in case of Bako town.

1.3.2. Specific Objectives

The specific objectives of the study are:-

1) To describe socio-economic characteristics of urban agricultural households within urban farm households in Bako town;
2) To analyze determinants of urban agricultural practice in case of Bako town and;
3) To estimate the impact of urban agricultural practices on the food security status of urban farm households in Bako town.

1.4. Research Questions

Based on the stated problem, the study objective, and the literature reviewed, the study answer following research questions.

1) What are the socio-economic characteristics of urban agricultural households at study area?
2) What are the major determinants of urban agricultural practices in study area?
3) What is the impact of urban agricultural practices on household's food security in Bako town?

2. Literature Review

This chapter is devoted to the literature on the factors influencing urban agricultural practices and impact analysis on urban food security. It is divided into three main sections. The first section explores the theoretical literature. The second section reviews empirical studies related to urban agricultural practices and its impact on household's food security, and finally conceptual framework of the study will be discussed.

2.1. Definition of Some Concepts and Terms

2.1.1. Urban Agriculture

Urban agriculture can be defined as the growing of plants and the raising of animals for food and other uses within and around cities and towns, and related activities such as the production and delivery of inputs, and the processing and marketing of products. Urban Agriculture is located within or on the fringe of a city/town and comprises of a variety of production systems, ranging from subsistence production and

processing at household level to fully commercialized agriculture [40].

2.1.2. Urban Agricultural Practices

Urban agricultural practices refers to the combination of income-generating activities that a household pursues in order to sustain or improve their livelihood [40].

2.1.3. Urban Planning and Design in Ethiopia

At present more than half of Ethiopian urban centers have some form of plans. So far about 578 urban centers have plans that guide their spatial development. Structure Plans for 22 towns; 219 urban centers with Basic Plans; 63 with Local development Plans; 247 base maps for smaller towns; and satellite imageries of 27 have been prepared. The predominant hierarchy of spatial plans has been effectively limited to Urban Structural and Land-use Zoning Plans and Detailed Parcelisation Schemes which have provided distinct benefit. The absence of an integrated planning hierarchy is significant. While National and Regional Economic Development Planning are underway, the spatial dimension is reportedly not integrated. Sectoral national or regional infrastructure and service plans have reportedly been prepared but they are not integrated functionally or spatially [39].

The scope and functions of planning as presently practiced serves Land-use Allocation and Regulation functions; meets primary Land Administration requirements; serves specific Engineering functions; and demarcates Municipal Boundaries. Planning as presently practiced does not serve significant development functions (with particular emphasis on public health and safety); Strategic Planning functions; Infrastructural and Economic Developmental functions; or enabling and creative functions. Furthermore, Urban Planning is constrained to the confines of designated municipal boundaries and sectors of municipal responsibility. Such constraints are inappropriate for integrated spatial planning and clearly impair developmental planning and inter-sectoral coordination. Until very recently, the primary processes, practices, and techniques of planning in Ethiopia appear to have remained static for decades despite changes in the nomenclature. Urban Plans consist of Urban Structure / Land Use Maps and extensive reports, weighted with detail and short on conclusions and recommendations

Plans generally lack clear statements of "vision", goals, and objectives; definition of trends, interest, conflicts, potentials, threats, and strategies; conceptual choices for assessment and decision-making; wider scale spatial integration with neighboring rural areas; basic infrastructural elements; flexibility in implementation including minimal reserve allocations; and the third dimension in its entirety. Planning documents also lack clear defined quantitative and qualitative programming directing the spatial dimensions of planning; as well as appropriate development and building regulations. The prevalent planning process, reportedly to normally extend over 1-2 years, is inappropriate in the light of constitutional and policy directives and the nature and scale of developmental imperatives and resource limitations. It also clearly impacts, indeed possibly determines, the qualitative aspects of the planning product, lacking client and stakeholder involvement and characterized by the effective compartmentalization of those inputs that are covered in the process [50].

Given evident professional, financial, and technological resource constraints at the local level, the local authorities clearly cannot undertake plan preparation on the scale and to the standard required. This does mean that Local Authorities, even the smaller ones, are not capable of initiating, administering, and most specifically approving or rejecting plans. These resource constraints cannot be allowed to jeopardize or even delay the planned devolution of powers to the local level. It does, however, mean that alternative supply options for plan preparation needs be assured. The private sector is severely limited in scale and in scope and, as presently constituted, does not represent an adequate alternative for the supply of planning services. It must however be viewed as the kernel of a future, if only partial, option for service provision, to be enabled and cultivated [39].

2.1.4. Enhancing Urban and Peri-Urban Food Production in Ethiopia

The government plays a key role in the success of urban agriculture. Urbanization in most countries has historically pushed all forms of agriculture out of the city and into rural areas, considering it too dirty for the wealth and glory of the city. Land use regulations today still follow that same valorization, despite prevailing evidence that producing food within cities today would solve many looming problems. Urban agriculture is a proven means of livelihood and source of food for many urban dwellers, particularly low-income households in developing countries. However, its contribution towards urban food security and sustainable livelihoods has never been clearly recognized, simply because urban agriculture is largely assumed to be a poor replacement for rural agricultural activities [50].

Urban agriculture in Addis Ababa is a traditional practice that is taken as a means of livelihood especially for low income communities and it is practiced in a formal and informal manner with practitioners Larger towns' specifically Regional capitals like Mekelle, Bahirdar, Adama, and Hawassa have increased their size more than two fold during the last two decades. Compound guards are often found cultivating small patches, particularly with 'gomen', next to their guard posts. In the 1990s there was no stated policy regarding urban agriculture in Ethiopia. Now, however, in many large regional towns and cities in Ethiopia, municipal governments are gaining interest in urban farming; as part of their poverty-reduction programs, they encourage urban dwellers, especially the poor and formally unemployed, to raise fast-return animals. For instance, the city of Addis Ababa even has an Office of Urban Agriculture. Some of the responsibilities of the office include: Design strategies for the production and supply of quality agricultural products and for the expansion of investment that enhances agricultural development in the city and implement same upon approval and Facilitate the ways for the distribution of improved products of agricultural technology, selected seed, and

fertilizer, supervise the outcome thereof; give education and training as well as render professional support to farmers [39].

2.1.5. Impact Evaluation Method

Impact evaluations are part of a broader agenda of evidence-based policy making. This growing global trend is marked by a shift in focus from inputs to outcomes and results, and is reshaping public policy [65]. Impact evaluation of a given intervention is intended to determine more broadly whether the treatment had desired effects on individual households, organizations, institutions and others as per the intervention design. The impact may results positive or negative effect on beneficiaries [34]. Generally there are three impact evaluation methods in estimating treatment group participants and control groups. These are randomization/or experimental design, non-experimental design and quasi-experimental design [10].

(i). Experimental Design / Evaluation / Method

Random assignment (or 'experiments') is generally viewed as the most robust evaluation approach. This operates by creating a control group of individuals who are randomly denied access to a treatment. Properly carried out, random assignment creates a control group comprising individuals with identical distributions of observable and unobservable characteristics to those in the treatment group (within sampling variation). Hence, the selection problem is overcome because participation is randomly determined. The mean outcome for those participating in the treatment relative to those in the control group provides an estimate of the treatment effect. There are, however, a number of provisos. At the practical level, experiments are often costly and require close monitoring to ensure that they are effectively administered. They may also require informing potential participants of the possibility of being denied treatment. The potential for denying treatment can pose ethical questions that are politically sensitive. Hence, those lead us to look for others [65, 34].

(ii). Quasi-Experimental Method

A quasi-experimental method is the only alternative utilized where there is no baseline survey or randomization is not a feasible option and not take place prior the intervention. It involves matching treatment participants with a comparable group of individuals, who did not participate in the treatment after intervention.

(iii). Non-experimental Evaluation Method

A non-experimental method is used when the treatment located intentionally. There are a number of non-experimental evaluation techniques and the choice of best approach is determined in large part by practicalities. Specifically, the characteristics of the treatment and the nature and quality of available data are key factors. These non-experimental techniques all share one thing in common: in the absence of an observable counterfactual, assumptions have to be made to identify the causal effect of a treatment on the outcome of interest [10]. The main approaches can be categorized in to before-after estimators and cross-section estimators. The idea of the before-after estimator is to compare the outcomes of a group of individuals after participating in a treatment with outcomes of the same or a broadly equivalent group before participating and to view the difference as the estimate of treatment effect. A more widely-used approach in this method is the difference-in-differences (DiD) estimator, also known as the 'natural experiment' approach when there is the baseline data about the participants. If longitudinal or repeated cross-section data are not available, cross-section estimators use non-participants to derive the counterfactual for participants. It can be used through the access of cross-sectional survey data after the treatment is introduced and the coefficient for the 'participation' indicator would be interpreted as the treatment effect on the treated (ATT) after controlling for the observables. In other words, observables which enter the regression capture selection into the treatment. Here cross-sectional estimators which are common in the literature and deal with selection on unobservable were discussed.

Instrumental variable regression: The IV method is possible when a variable can be identified that is related to participation but not outcomes. This variable is known as the 'instrument' and it introduces an element of randomness into the assignment which approximates the effect of an experiment. Where it exists, estimation of the treatment effect can proceed using a standard instrumental variables approach. The main drawback to the IV approach is that it will often be difficult to find a suitable instrument because, to identify the treatment effect, one needs at least one regressor which determines programme participation but is not itself determined by the factors which affect outcomes [34].

Heckman selection estimator: This approach allows for selection into the treatment group on the basis of variables that are unobservable to the analyst and operates by assuming a particular form for the distribution of the unobservable characteristics that jointly influence participation and outcome. While not strictly necessary from a mathematical viewpoint, credible implementations include an instrument; that is, a variable included in the estimation of the participation equation that is excluded from the outcome equation. This approach appears to offer an elegant means of obtaining an estimate of ATT in the presence of selection. However, as with the IV approach, the identification of a suitable instrument is often a significant practical obstacle to successful implementation and the resulting estimates are entirely contingent on the underlying distributional assumption relating to the unobserved variables. In fact, research has shown that estimates can be surprisingly sensitive to these assumptions not being met [34].

2.1.6. Urban Agricultural Practices and Food Security in Ethiopia

In Ethiopia, urban agriculture has been shown to be a final stage by households in their sequence of survival strategies. Households in the urban areas respond to the extreme threat of poverty and food insecurity by carrying out urban farming on any vacant space available. Urban agriculture is also

practiced because of shortage of income and unemployment in the urban centers. Urban agriculture has also been studied as a contributor to improved nutritional levels among the urban poor in Ethiopia. Vegetable production has been very important in most of the studies. Most of the urban population in Ethiopia consists of the poor who cannot afford to buy high-valued food stuffs. In Ethiopia, urban agriculture is carried out on land in transitional use where usufruct rights are at issue. This problem leads to low investment in urban agriculture and hence poor productivity [38].

2.2. Theoretical Literature Review

This work is grounded by definition of some concepts and terms, theories such as:- the innovation-diffusion theory, the rational choice theory, Von Thunen's primary, The modernist theory, The New Marxist theory, and other related theories to deal with urban agricultural practices and determinants with practicing urban agricultural practices and its impact on urban food security.

2.2.1. Von Thunen's Theory

Von Thunen's primary concern was to discover and examines the laws which governed the pattern of agricultural land use existing in his time and within his experience. He recognized that land use pattern depended upon competition between different types of agriculture for the use of a particular pilot of land. The controlling factor in this competition was Economic Rent, defined here as return from investment in the land. Stated briefly, that form of land use providing the greatest Economic Rent would make the highest bid for the land and displace all others. Moreover, because transport costs increased with distance, they imparted a spatial variation to Economic Rent. Hence, Economic Rent from any one land use can be expressed as a function of distance from the market. Commodities which yield a large bulk per hectare, e.g., potatoes or firewood, in Von Thunen's time, yield a high Rent close to the market, but because the transport cost per hectare is high, the rent diminishes rapidly with distance from the market. Commodities which yield a lower bulk per hectare, e.g. grain, do not yield such a high rent close to the market. However, because transport costs per hectare are relatively low, and the actual value per unit of weight is relatively high, i.e. economic rent diminishes much more slowly with distance from the market. Because of rapid deterioration, perishable commodities, e.g., milk, during Von Thunen's time, can only be produced close to the market. Hence their Economic Rent falls very rapidly with distance from the market. At the market, an extremely intensive use of land is desirable, because the resulting increased production pays off in higher Economic Rent. With greater distance from the market, such intensive land use becomes less feasible, because the advantages of raised per-hectare production are offset by rising transport costs. A less intensive system becomes more desirable [49].

Food security has been a development and equity concern for many decades. [54], pointed out over three decades ago, 'starvation is the characteristic of people not having enough food to eat. It is not the characteristic of there being enough food to eat' [54].

The definition that is still most widely used was coined at the 1996 World Food Summit. It states that 'food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life' [18]. The most notable difference between this definition and pre-1996 ones is the shift from a narrow focus on food production to a broader conceptualization that encompasses four key dimensions: availability, access, utilization and stability. The emphasis now is thus not only on food supply but also on physical access and affordability, and safety and nutritional balance, as well as socially and culturally determined preferences [18]. Dimensions of food security:

Physical availability of food: Food availability addresses the "supply side" of food security and is determined by the level of food production, stock levels and net trade.

Economic and Physical access to Food: An adequate supply of food at the national or international level does not in itself guarantee household level food security. Concerns about insufficient food access have resulted in a greater policy focus on incomes, expenditure, markets and prices in achieving food security objectives.

Food utilization: Utilization is commonly understood as the way the body makes the most of various nutrients in the food. Sufficient energy and nutrient intake by individuals are the result of good care and feeding practices, food preparation, and diversity of the diet and intra-household distribution of food. Combined with good biological utilization of food consumed, this determines the nutritional status of individuals.

Stability of the other three dimensions over time: Even if your food intake is adequate today, you are still considered to be food insecure if you have inadequate access to food on a periodic basis, risking a deterioration of your nutritional status. Adverse weather conditions, political instability, or economic factors (unemployment, rising food prices) may have an impact on your food security status.

2.2.2. Empirical Literatures on Determinants of Urban Agricultural Practices

The research concluded the factors such as tenure insecurity, high price for inputs, shortage of irrigation/water, contamination of irrigation/water, in adequate cultivable land, lack of credit and extension service, lack of good quality of farm equipment, crop losses from pests/disease, pollution and night time theft influences urban agricultural practices in Addis Ababa. [24]

Major factor determinants urban agricultural practices identified as Access to inputs, Inability to get land and its granting system, Absence of allotment gardening, Priority to non edible trees in urban areas, Seasonal rain, Disease, Fragmentation of members group gardening, Market Accessibility, Availability and access to credit, Health risks, Lack of technical support from the concerned body, Lack of

training. [5].

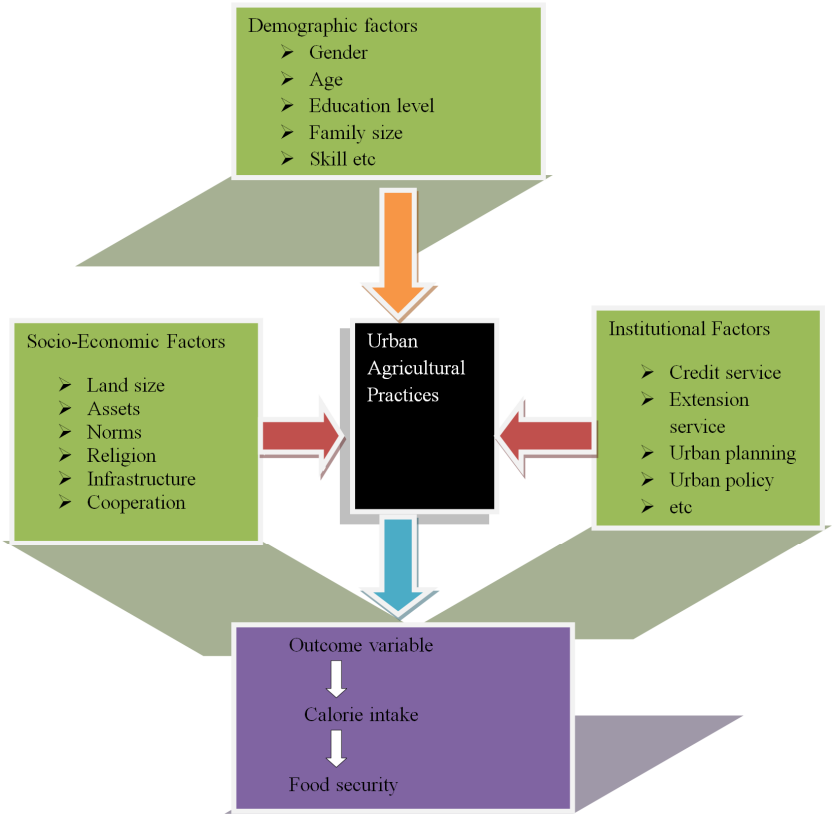
Peri-urban and urban agriculture have the potential in achieving food security for many people in Addis Ababa in Ethiopia. Available evidence indicates that there has been a lot of focus on peri-urban agriculture with less attention given to urban agriculture despite the many barriers that make it less productive. Given the rapidly increasing population in urban areas in Ethiopia, addressing constraints to urban agriculture has high prospects of improving the food and malnutrition challenges [6].

There are several obstacles for urban agriculture such as soil contamination, financing, site vandalism, staffing problems and skepticism from governments and independent organizations, Governments, local government and community development organizations can support urban agriculture to overcome the obstacles. Found in their study that municipal governments don't see urban agriculture as the best use of urban vacant land in the inner city. The municipal governments want instead the land for better taxpaying land uses such as housing and industries another problem is that many stakeholders consider that food growing only belongs to farm land instead of urban land [27].

A major feature of urban agricultural practices (UAP) is the diversity of the socioeconomic profiles of the actors involved, and their varying income and livelihood strategies, a reflection of the diversity of the labor and capital basis in urban areas, and has categories. The first category, home subsistence farmers, refers to urban residents who practice agriculture on small plots around their homes, mostly for subsistence purposes. The second category also refers to urban farmers with predominant subsistence strategies, but whose location in peri-urban areas makes it possible to associate multiple food crops on large plots, without use of chemical inputs or irrigation. This type is especially observed in the rain fed agricultural systems of Central Africa. The third type refers to commercial urban and peri-urban farmers who are involved in agriculture to earn a monetary income for basic family expenditures, while the entrepreneurs (fourth type) have diversified sources of income and are able to invest in a larger scale of production than farmers in the other categories. For these farmers, agriculture not only represents a source of income, but also a source of leisure. This dimension is also present in the other categories, although it may not be the major driver of the activity [40].

2.2.3. Conceptual Framework

Figure below presents the determinant of urban agricultural practices framework and its impact on household's food security with the main concepts used, that is, assets, activities, and outcomes. The center piece of the urban household's agricultural practices framework is the activities that households make to achieve their livelihood goals. These practices are shaped by their assets (e.g., land, labor, livestock etc), infrastructures, social capitals, institutional factors, household's demographic characteristics, and location factors.



Source: own computation from literature reviewed (2019)

Figure 1. *Conceptual frame work.*

The framework shows determinants of urban agricultural. first, whether to participate in a particular urban agriculture or not; and second, conditional on practices, on what urban agriculture the practices; third impacts urban agriculture on households food security. However, since urban agricultural practices is a vast it is difficult to capture all factors which determine/ influence it.

3. Research Methodology

This chapter provides the details of the processes and methodologies adopted in this study. It refers to the descriptions of the study area, sampling design and techniques, methods of data collection and analysis, definition, measurements and formulation of hypotheses of the study.

3.1. Date Source and Type

The study use both primary and secondary data. Primary data collected through household survey. Primary data collected from both participant and non participant households on urban agricultural activity. As the survey of (2010 E.C) Bako town has total population 66,914 of them (51.28%) 34313 are male and (48.72%) 32,601 are females. Bako town has a total of 23,614 households with 82.66% male headed and 17.34% female headed households. Secondary data collected from Bako Tibe Woreda agricultural office, Bako town animals resource and fish office, Bako town small scale & enterprises office, Bako town administration office and all offices those this study concerns them.

In order to insure the appropriateness of the quality of the data, short trainings was provided for enumerators on the objectives of the study, translation or meaning of the questions in line with the local language (Afan Oromo), time plan of the survey and other related issues also provided by the researcher. Moreover, the field pre-test was conducted to test the survey instrument and accordingly, conducted in some parts of the questionnaire based on the result of the pre-test questionnaire. Besides, at the end of every data collection day, each questionnaire was examined for completeness and proper feedback was provided for the enumerators for any correction required.

3.2. Sampling Techniques and Procedures

Three criteria's (parameters) are needed to be specified to determine the appropriate sample size. These are the level of precision, the level of confidence or risk, and the degree of variability in the attributes being measured (55; 65), the first criterion is the risk level of confidence level based on the ideas of the Central Limit Theorem. Therefore, t is the value of the t-distribution corresponding to the chosen alpha level for .05 which is 1.96; the second criterion is the degree of variability in the attributes being investigated, the distribution of attributes in the population.

The variables with more homogeneous population, the smaller the sample size required. For more heterogeneous population, the larger the sample size required to obtain a given level of precision. When p is unknown, generally it is best to set it at 0.5 (25) But, a proportion of 50% indicates a greater level of variability than either 80% or 20% (55); (25).

This is because 80% and 20% indicate that a large majority do or do not, respectively, have the attribute of interest. Thereby, a proportion of .5 indicates the maximum variability in a population, it is often used in determining a more conservative sample size, that is, the sample size may be larger than if the true variability of the population attribute were used (55). Therefore, as adopted by (15) for related purpose, for this study the p value was 20% & 80%. The level of precision, sometimes called sampling error, is the range in which the true value of the population is estimated to be and this range is often expressed in percentage (± 5%) i.e. is the margin of error and mostly recommends using 5%. Finally, the researcher will employed the commonly used sample size formula to determine the random sample size [25].

$$\frac{Z^2\,P(1-P)}{e^2} = \frac{(1.96)^2\,.80(1-.80)}{.05^2} = 246.$$

But, as practiced by [15] to reduce sampling error 12 or (5%) more respondents are added and then the total of 258 sample respondents is drawn.

$$\frac{Z^2\,P(1-P)}{e^2} = \frac{(1.96)^2\,.80(1-.80)}{.05^2} = 246 + 12/(5\%(246)) = 258$$

Sample from participants →258×(4994÷23614)≈55.
Sample from non participants→258×(18620÷23614)≈203.

Table 1. *Distribution of sample size.*

Kebeles	Households (population)	Households (sample)	Percentage (%)
01	Participant= 2993	Participant=33	12.8%
	Non participant=10537	Non participant=115	44.6%
02	Participant=2001	Participant=22	8.5%
	Non participant=8073	Non participant=88	34.1%
Total	Participant=4994	Participant=55	20%
	Non participant=18610	Non participant=203	80%
G. total	23614	258	100%

3.3. Method of Data Analysis

3.3.1. Descriptive and Inferential Data Analysis

Descriptive statistics such as mean, percent, Chi-square test and F-tests is employed to implement descriptive analysis. Chi-square test is used to see whether there are significant differences among the participant and non participant households in relation to dummy/categorical variables, while ANOVA is used for continuous variables. Econometric model such as multinomial logit model and propensity score match method is employed in order to test determinants of urban agricultural practices and impact of urban agricultural practice on household's food security in study area.

3.3.2. Multinomial-Logit Model Specification

The multinomial (polytomous) logistic regression model is a simple extension of the binomial logistic regression model. It is used when the dependent variable has more than two nominal or unordered categories, in which dummy coding of independent variables is quite common. This means that there is a variable for all categories but one, so if there are M categories, there will be M-1 dummy variables. All but one category has its own dummy variable. Each category's dummy variable has a value of 1 for its category and a 0 for all others. One category, the reference category, does not need its own dummy variable, as it is uniquely identified by all the other variables being 0. With regards to the above, Factors influencing urban agricultural practices using multinomial logistic regression can then estimate a separate binary logistic regression model for each of those dummy variables. The result is M-1 binary logistic regression models. The farmers were categorized into four based on the type of urban agricultural activity.

The urban agricultural activity includes urban crop production (Y0), urban livestock production (Y1), and urban crop + livestock production (Y2) and non participants (Y3). These four categorized practices were used for this model as dependent variables. So, when there is a dependent variable with more than two alternatives among which the decision maker has to choose unordered qualitative or polytomous variables; the appropriate econometric model would be either multinomial logit or probit regression model and often considered an attractive analysis because; it does not assume normality, linearity, or homoskedasiticity [31]. The general Long, 2001 form of the multinomial Logit model is:

$$\ln \Omega\, m/b = ln\frac{pr(y=m/x)}{pr(y=b/x)} \quad (1)$$

Where b is the base category, which is also referred to as the comparison group.

Since lnΩb|b (x) = ln1 = 0, it must hold that βb/b = 0. That is, the log odds of an outcome compared to itself is always 0, and thus the effects of any independent variables must also be 0. These J equations can be solved to compute the predicted probabilities.

$$pr\left(y=\frac{m}{x}\right)=\frac{\exp(x\beta m/x)}{1+\sum_{i=1}^{J}\exp(x\beta\ j/b)} \quad (2)$$

Where j=1, 2, 3, 4.

While the predicted probability will be the same regardless of the base category b, changing the base category can be confusing since the resulting output from Mlogit appears to be quite different. For example, suppose you have three outcomes and estimate the model with outcome 1 as the base category. Your probability equations would be:-

P_{i0} Is the probability of being in the reference group or group 0. In practice, when estimating the model, the coefficients of the reference group are normalized to zero. This is because, the probabilities for all the choices must sum up to unity [26]. Hence, for four choices only (4 -1) distinct sets of parameters can be identified and estimated.

The natural logarithms of the odd ratio of equations (1) and (2) give the estimating equation. As [26]

$$ln=\frac{pi0}{pi0}Xi\beta j \quad (3)$$

This denotes the relative probability of each of the group 0, 1 and 2 to the probability of the reference group. The estimated coefficients for each choice therefore reflect the effects of Xi's on the likelihood of the households participating that alternative relative to the reference group.

(i). Checking Model Adequacy

Once a model has been fitted to a given data, it is a good statistical practice to check the adequacy of the model, which is essentially checking the agreement between the observed and fitted values under the model. If the agreement between the observations and the corresponding fitted values is good, the model may be acceptable. If not, the current form of the model will certainly not be acceptable and the model will need to be revised. This aspect of the adequacy of a model is widely referred to as goodness of fit.

(ii). Testing Significance of Model Parameters and the Effect of Adding Terms

In order to test concerning the model parameters we need to know the distribution of the estimates. Under certain regularity conditions the maximum likelihood estimates have an asymptotic multivariate normal distribution with expected value equal to the true parameters. A test procedure that uses this general result is the Wald test, which can be used to test individual as well as several parameters at a time.

(iii). Outliers and Influential Cases

The observed response for a few of the cases may not seem to correspond to the model fitted to the bulk of the data. Cases that do not follow the same model as the rest of the data are called outliers, and identifying these cases can be useful. Single cases or small groups of cases can strongly influence the fit of logistic regression model. The most useful and important method of perturbing the data is deleting the cases from the data one at a time. Cases whose removal

causes major changes in the analysis are called influential. DFBETA (S) is a diagnostic measure which measures the change in the logit Coefficients for a given variable when a case is dropped. If DFBETAs is less than unity it implies no specific impact of an observation on the coefficient of a particular predictor variable, while DFBETA of a case is greater than 1.0, is considered as potential outlier. Cook's distance is a measure of the influence of a case. It is a measure of how much the residual of all cases would change if a particular case were excluded from the computation of the regression coefficients. Cook's distance less than unity shows that an observation had no overall impact on the estimated vector of regression coefficients β. Analog of Cook's influence statistics of a case greater than 1.0 indicates that a potential outlier, while the value of the leverage statistic less than one shows that no subject has a substantial large impact on the predicted values of a model.

(iv). Multicollinearity

Refers to a situation where there is either an exact or approximately exact linear relationship among the predictor variables. In other words Multicolinirety is the degree of redundancy or overlap among explanatory variables. The existence of Multicollinearity makes it hard to get coefficient estimates with small standard error [8]. Then the existence of this situation will be conducted by VIF and contingency coefficients to test the Multicollinearity problem among continuous and dummy/categorical variables respectively. If VIF is greater than 10 it shows serious Multicollinearity between independent variables. The value of contingency coefficients ranges between 0 and 1. A value close to 0 refers to weak association and values close to indicate 1 strong association, additionally if a contingency coefficient is greater than 0.75 it shows there is strong association among dummy variables.

3.3.3. Propensity Score Matching Model (PSM)

To address this objective the first task is measuring the outcome (food security) and treatment (urban agricultural practices) variable. Non participants (non-basic activity) income share respective of households, total income by using agriculture as the main income source employed to classify the households as participant or non-participant. So, a household whose income from urban agriculture (basic source) was greater than and equal to half (50%) of his total income were considered as participant and a household whose income from Non urban agriculture (other source) was greater than this threshold (50%) considered as non-participant households. Consumption (calorie intake) approach employed to measure the food security status of the households. It conducted based on the data obtained from households own food production, purchased and aided from others by asking the kind and amounts of food which they consumed (served) for limited periods in this case one week before interviewing date for the purpose of recall. In converting the physical food quantities consumed by household into food calories adjusted for household age and sex composition will follow four steps. First, local measurement units are converted into a common unit of measurement for each food item consumed. Second, each of the food items consumed is converted into calories using the recommended conversion factor. Third, all food calories consumed added-up and converted into daily amounts. Finally, the aggregate food calorie is adjusted in an adult equivalent unit per household.

After measuring the treatment and the outcome variables, PSM method employed to estimate the impact of UAP on food security status. This is because to correct the potential sample selection biased that might be arise due to systematic difference between participant and non participant urban agricultural practices as used by [15], for the related purpose. PSM consists propensity score (i.e. probability of participating in the treatment conditional on the characteristics Xi) and matching (i.e. find participants and non-participants with equal/similar propensity score). It estimates the impact by matching participants into non participants with the same observed characteristics or covariates. But, the main question of impact evaluation is one of attribution isolating the effect of the treatment of other factors and potential selection bias and to determine what would have happened to the beneficiaries if the program had not existed. A beneficiary's outcome in the absence of the intervention would be its counterfactual [65].

With matching methods, one tries to develop a counterfactual or control group that is similar to the treatment group as possible in terms of observed characteristics. The idea is to find, from a large group of non participants, individuals who are similar to participants in terms of observable characteristics not affected by the treatment. The fundamental problem arises because only one of the potential outcomes is observed for each individual i and unobserved outcome is called counterfactual outcome. Hence, estimating the individual treatment effect is not possible and one has to concentrate on (population) average treatment effects [65].

The consecutive steps in implementing PSM were estimation of the propensity scores, choosing matching algorithm, checking on common support condition and testing the matching quality. Estimation of propensity score: It was the first step in PSM analysis. Match participants to non-participants on every possible observed characteristic would give good results, but the problem is when the number of characteristics determining selection increases, it is more and more difficult to find comparable individuals and that is called curse of dimensionality. However; the solution was recommended by Rosenbaum and Rubin (1983) it is better to matching on a single index (propensity score), reflecting the probability of participation, could achieve consistent estimates of the treatment effect in the same way as matching on all covariates. Normally, logit or probit function is recommended for this purpose since treatment is typically dichotomous (i.e., D=1 for the treated (participant) and D=0 for untreated (non participant) units [65].

The logit assumes a logistic distribution of the error term and the probit assumes a normal distribution, but both logistic and normal distributions generally give similar

results in practice. So, logit was employed to estimate the propensity score in this study.

$$P(X) = pr\ (D=1/X) \quad (4)$$

Check for assumptions: In order to determine if a matching is likely to effectively reduce selection bias, the underlying assumptions were considered before matching the estimated propensity score. The first assumption is Common Support Approach (CSA). ATT has to be an estimate only over the CS region. The CS region is the area which contains the minimum and maximum propensity scores of treatment and control group households, respectively. It ensures the existence of a non-treated (non-participant) analogue for each treated (participant) household and existence of a treated (participant) household for each non treated (non-participant) household. It would be impossible to find matches for a fraction of program participants if this condition is not met. Thus, it is recommended to restrict matching and hence the estimation of the program effect on the region of common support. It requires deleting of all observations whose propensity scores is smaller than the minimum and larger than the maximum of common support area. It will be checked by visual analysis of propensity score distribution.

$$0< (=1/X) <1 \quad (5)$$

The other approach is Conditional Independence Approach (CIA) and it states that given a set of observable covariates X that were not affected by treatment, there were no systematic differences between participants and non-participants in terms of unobserved characteristics that may influence them. All the variables that affect simultaneously D (treatment, in this case participants) and Y (outcome, in this case calorie intake) were observed. In other words, it is to mean that after controlling for X, the participation assignment is "as good as random" and participation in the urban agricultural practice is not affected by the outcomes of interest and it allows the non-treated households used as the counterfactual of participant households [65].

$$(Y1, Y0) \perp Di/Xi \quad (6)$$

The outcome in the counterfactual state is independent of participation, given the observable characteristics. Thus, once controlled for the observables, outcomes for the non-participant represent what the participants would have experienced had they not participated in the program.

$$(Y0) \perp Di/Xi \quad (7)$$

Choose among alternative matching algorithm: There is no one recommended matching algorithm and there is trade-off between them. But, it depend on the sample size, the available number of treated/control observations and the distribution of the estimated PS and there is trade-offs between bias and efficiency among algorithms [65]. However, Nearest Neighbor matching (NNM), Caliper Matching (CM), and Kernel Matching (KM) are commonly used algorithms and accordingly the algorithm will be employed which will be best fitted.

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Assessing the matching quality: Difference among covariates is expected before matching, but after matching the covariates should balance in both groups and hence significant differences is not expected. Standardized bias, t-test, joint significance and Pseudo-R2 commonly used to check and there by those tests employed for this study.

Calculation of treatment effect: After assessing the matching quality the impact of UAP on household's food security status is estimated. The impact of UAP on individual i, is note as δi. It is the difference between potential outcomes for participant households and non participant households.

$$\delta i = 1-0; = (1 \mid =1) - (0 \mid =0) \quad (8)$$

Where: - 0 and 1 correspond to non-participant and participant households, respectively. But, the study will attempt to estimate the average effect for both participant and non-participant households.

Average treatment effect on the treated (ATT): It is the average of the difference between the outcomes of participants and matched control individuals [65].

$$ATT=E\ (Y1-Y0 \mid D=1) \quad (9)$$

Where D = 1 refers to the treatment. We can rewrite ATT as,

$$ATT=E\ (Y1 \mid D=1) - E\ (Y0 \mid D=1) \quad (10)$$

$$Or;\ (1 \mid =1]-(0 \mid =0] = + (0 \mid =1)-(0 \mid =0) \quad (11)$$

The difference between the left hand side equation and ATT is the so-called `self-selection bias. The true parameter ATT is only identified if:

$$(0 \mid =1)- (0 \mid =0) = 0 \quad (12)$$

Sensitivity analysis: The un-confoundedness assumption either conditional on covariates or Score is strong and almost impossible to test statistically. It could be easily violated if there are unobservable household characteristics simultaneously influence the participation decision in UAP. Checking the sensitivity of the estimated result with respect to deviations from this identifying assumption has become an increasingly important topic in the applied evaluation literature. Therefore, it is crucial to perform sensitivity or robustness check of estimated result from hidden bias. However, robustness check can only reduce the biases of

matching estimates, not eliminates. It can be done by using various matching and if each method provides consistent results it is possible to conclude that matching estimates fairly reliable.

Table 2. *Summary of variables in multinomial logit models.*

	Dependent variable	Characteristics (measurement)	Hypothesis
	UAP	Categorical Y0=crop production Y1=livestock production Y2=crop + livestock production Y3=non participant	

Code	Independent variables	Measurements	Hypothesis
RPR	Risk preference	Dummy, 1: risk averse, 0: other	_
INC	Households Income	Continuous (in terms of money)	+/-
EXTS	Extension service	Continuous; number of contacts	+
CRTS	Access to credit	Continuous; in terms of birr	+/-
AIR	Access to irrigation	Dummy; 1: if access, 0: otherwise	+
AGE	Age of household head	Continuous (in year)	+/-
GEND	Sex of household head	Dummy; 1: male, 0: female	+
EDL	Educational level of household head	Continuous (year of schooling)	+/-
DPR	Dependency ratios of household	Continuous (dependent to labor force ratio)	_
LND	Land size	Continuous (squared meter)	+
MDC	Market distance	Continuous in meters)	+
FSZ	Family size	Continuous (number in AE)	+
COOP	Membership in cooperative	Dummy; 1; member, 0; other wise	+
TLU	Livestock	Continuous variable in TLU	+
MST	Marital status	Dummy; 1 married, 0 other wise	+

Source: own computation (2019)

Then the model seems:

$$UAP = \beta 0 + \beta 1GEND + \beta 2INC + \beta 3EDL + \beta 4FSZ + \beta 5LSZ + \beta 6RPR + \beta 7MST + \beta 8\ TLU + \beta 9\ FSZ + \beta 10EXTS + \beta 11CRTS + \beta 12\ MDC + \beta 13AIR + \beta 14\ DPR + \beta 15COOP + \varepsilon i \quad (13)$$

Where-
UAP:-Urban Agricultural Practices.
βj-Coefficient of variables/unknowns.

3.4. Definitions, Measurements and Formulation of Hypothesis for Impact of Urban Agricultural Practices on Household's Food Security

Dependent variable: In this study the treatment variable is urban agricultural practices (UAP). The variable is dummy variable and assign 1 for Participant and 0 for non participant Households. It is measured by non-basic activities income share. The household considered as participant if the income from non-basic income source share 50% and above respective to the total income and the inverse is for non participant households. UAP is hypothesized to influence food security status of household positively.

Outcome variable: The outcome variable is food security. It is continuous variable and is measured by calorie intake level per day per adult equivalent. This study also hypothesized that, food security status of household is expected to influence by UAP positively.

Independent variables: The explanatory variables included in PSM are similar to the above mentioned, except the different in measurement for some variables. This is because a variable that affects UAP but not food security should be excluded and hence to include the covariate variable. Therefore, Family size of household was converted to adult equivalent in this case. Since the need of calorie intake different for different age level and sex of household members, family size was adjusted in adult equivalent by using recommended conversion factor.

In this study urban agriculture which is categorized to two is such urban agricultural participant (Y0) and non-participant (Y1) is dependent variable. While variables such as age of household heads, education level of household heads, marital status of household head, risk preference of households, extension contact, credit access, total livestock unit, irrigation access, family size, dependency ratio, gender of household heads, cooperative membership, land size, family income and distance from the market/the center of the town are factors that expected to influence urban agricultural practices.

4. Result and Discussion

This chapter is subdivided into three sub-sections. The first part presents the descriptive statistics on the social, demography, and economics characteristics of the sampled households. The second section, presents the results and discussion on the determinants of urban agricultural practice and finally, the third section refers to the results and discussion on the impact of urban agricultural practices on household food security in the study area.

4.1. Descriptive Results and Discussions

4.1.1. Socio-demographic Characteristics of Sampled Households

Table 3 *Gender of sampled household heads.*

Gender of household heads	Number	Percent
Male	225	87.21
Female	33	12.79
Total	258	100

Source: own computation from survey result (2019).

As explained in table 3, from the total households under analysis about 87.21% of the households were male headed while, 12.79% of households were female headed.

Table 4. *Marital status of house hold heads.*

Marital status of household heads	Number	Percent
Married	198	76.74
Others (single, divorced, widowed)	60	23.26
Total	258	100

Source: own computation from survey result (2019).

As explained in table 4, from sampled households 76.74% of households were married and 23.26% (widowed, divorced, and single) collectively. As the survey result married household heads are more likely practiced urban agricultural practice relative to other class.

4.1.2. Economic and Institutional Characteristics of Sampled Households

Table 5. *Summary of continuous variables.*

Variables	Obs	Mean	St dev.	Min	max
EXTS	258	2.093023	2.174997	0	12
CRTS	258	3.666705	19.90105	0	300
EDL	258	10.20543	4.203071	0	18
FSZ	258	4.054264	2.066257	1	12
TLU	258	1.155039	1.7882	0	9
DPR	258	1.651744	.6304069	1	4
MDC	258	11.15504	7.716221	5	45
INC	258	63.57029	639.9243	.6	10207
LSZ	258	.2916667	.5735058	0	2.5

Source: own computation from survey result (2019).

In the sampled respondents the average land owned by households was about 1.375 in 1000 meter squared with 0 and 2.5 in 1000 meter squared and maximum owned, respectively. Similarly, the respondents owned about 1.15 livestock in TLU with minimum and maximum value of 0 and 9, respectively. In terms of educational level of the sampled population mean of schooling year is 10 with 0 and 18 minimum and maximum year of schooling respectively. As survey result the annual mean income of house hold is about 63.57 in 10,000 birr with .6 and 10207 in 10,000 birr minimum and maximum annual income respectively. As the survey result the mean distance travelled to attain the center of the town or market is about 11.15 minutes with 7.72 standard deviation the minimum and maximum minutes traveled is 5 and 45 respectively. Mean of dependency ratio is about 1.65 with 0.63 standard deviation, among the sampled households, the maximum and minimum numbers of dependents in families are in having 1 and 4 dependency ratio respectively.

Table 6. *Summary of dummy variables.*

Variables	Observation (frequency)	percentage
Access to irrigation		
Access	101	39.15
not access	157	60.85
Total	258	100
Cooperative membership		
member	194	75.19
non member	64	24.81
Total	258	100
Risk preference of household heads		
risk aversors	168	65.12
others	90	34.88
Total	258	100

Source: own computation from survey result (2019).

In institutional characteristics, there were cooperatives, local associations, credit institutions and extension provisions which facilitate the household livelihood. From all sampled households about 75.19% of households reported as they are the member at least for one local association (such as *mahiber, ikub, idir, wonfel, consumers association etc*), while 24.81% did not participate in local association. Among the sampled households about 65.12% are reported as non risk aversors (risk lover/neutral) and the left 34.88% were considered as risk aversors.

4.1.3. Current Situation of Urban Agricultural Practices in Study Area

Table 7. *Distribution of sampled household among livelihood (UAP) strategies.*

Types of urban agricultural practices	Observation / frequency	percent
Urban crop production (Y0)	13	5.04
Urban livestock production (Y1)	12	4.65
Urban crop + livestock production (Y2)	30	11.63
Non participant (Y3)	203	78.68
Total	258	100

Source own computation from survey result (2019).

Urban Agriculture (UA) is defined as mostly crop and livestock rearing on private, leased, or rented land in urban and peri-urban areas, in backyards, on vacant public lands and in semi-public areas [31]. It has become one of the main activities undertaken by urban residents to alleviate threatening poverty and to improve both food security and nutrition in their households [32]. There is no adequate data related to urban farming in Bako town. However, it is quite to say that many urban households engage in local production of food, vending and related activities (e.g. production of food grains, vegetables, dairy and feed supply) as a main or complementary strategy to secure food supply for their families and/or to earn cash. Urban agriculture has ecological benefits by reducing the city waste, improving

urban biodiversity and air quality, and overall reducing the environmental impact related to both food transport and storage. The production of crops goods shows the main benefits of urban agriculture there is no comprehensive strategy that could effectively address the sustainable development, management and function of urban farming. Due to this lack of recognition by concerned organs, such as planners and executives, the role and functions of urban agriculture have remained invisible in Bako town.

4.1.4. Description of Sample Household Characteristics on Comparison Between

Livelihood strategies in study area

In this study one-way analysis of variance and chi-square test were used to test the mean difference of sampled household characteristics in their chosen livelihood strategies for continuous and to see if there is a significant relationship between dummy variables, respectively. And as shown from the Table 10, the ANOVA results suggest that the presence of statistically significant mean differences between households among their strategies. Chi-square statistic in Table 7 also provides a statistical test for ascertaining whether an association exists between dummy variables and it shows there is association between household characteristics and livelihood strategies with high x2 value.

Table 8. *ANOVA analysis for continuous variables by choice of livelihood strategies.*

Households' livelihood strategies

Exp. Variable	Y0	Y1	Y2	Y3	Total	F-value
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
EXTS	1.8 (.46)	3.2 (.92)	1.2 (.52)	1.4 (.5)	2.1 (2.2)	23.48***
CRTS	5 (21)	2 (12)	.5 (17)	1.5 (16)	3.7 (20)	11.13***
EDL	4 (2.9)	6 (4.1)	11 (3.9)	11 (4)	10 (4.2)	49.65***
FSZ	5.4 (1.3)	3.4 (1.75)	4.4 (1.9)	2 (3.3)	4 (2.1)	4.86*
TLU	2 (1.2)	1.2 (1.5)	.8 (1.2)	.8 (1.2)	1.1 (1.8)	1.72
DPR	2.1 (2.67)	1.2 (2.01)	3.2 (4.01)	3.2 (4.1)	1.65 (.63)	10.35***
MDC	24 (4.5)	16 (4.8)	14 (3.9)	14 (3.9)	11 (7.7)	15.13***
INC	23.58 (.02)	43.8 (.042)	33.51 (.04)	36 (.14)	63.6 (64.9)	5.87**
LSZ	1.25 (2.25)	1.30 (2.90)	1.92 (3.14)	2 (3.14)	1.35 (3.05)	13.87***
AGE	52.2 (8.90)	48.17 (9.90)	46.45 (12.4)	44.5 (13)	40.05 (8.77)	14.15*

Source own computation from survey result, (2019).

As it is observed from the above survey result, there is significant mean difference among livelihood strategies status of households across the all variables except total livestock unit.

Table 9. *Chi-square analysis for dummy variables by choice of livelihood strategies.*

Explanatory variables	Households livelihood strategies					X^2-value
	Y0	Y1	Y2	Y3	Total	
	N=13	N=12	N=30	N=203	N=258	
GEND; 1: male	11	12	26	176	225	24.99***
MST; 1: married	9	11	27	151	198	31.3***
COOP; 1: memb	8	7	22	152	194	27.08***
RPR; 1: aversor	1	3	7	157	168	10.23**
AIR; 1: access	12	10	28	51	101	24.21***

Source: own computation from survey result (2019).

4.2. Determinant of Urban Agricultural Practice of the Households

Multinomial-logit Model Result

When the households participate on urban agriculture, they decide to participate in a particular agricultural category. Therefore, the determinants of urban agricultural practices were analyzed after identification of types of urban agricultural practiced by the households in the study area. Multinomial logit models were used to analyze the determinants of urban agricultural practice.

Model diagnostics and tests: In order to check the plausibility of the model result the necessary econometric tests, especially for primary data (hetroskedasticity and Multicollinearity) were conducted. The Variance Inflation Factor (VIF) and the contingency coefficient were used to test the Multicollinearity problem among continuous and dummy/categorical variables, respectively. The larger value of Variance Inflation Factor (VIF), usually values exceeds 10 indicates a serious Multicollinearity problem [26]. The value of contingency coefficient ranges between 0 and 1. A value close to 0 indicates weak association and a value close to 1 indicates presence of strong association (26). But, the mean VIF value was 1.28 and for each explanatory variable, the VIF ranged between 1.75 and 1.02. The spearman correlation coefficient is below the recommended i.e. near to zero (between 0.0013 and 0.31). Hetroskedasticity occurs when the error term does not have a constant variance; thus, the conditional variance of the Y population varies with increases in X [26].

The effect of independent variable and the IAA test: The

test for the effect of the independent variables on dependent variables can be tested by Likelihood ratio (LR) or/and wald test, but LR test is generally considered superior, if the model is complex or the sample is very large, the computational costs of the LR test can be prohibitive, and alternatively wald test can be computed using test without estimating additional models [31]. But, here both LR and Wald test were done and the result was almost the same. It suggests that, the result is against null hypothesis and significant for all independent variables at below 10% significant level. More over the model was run and tested for the validity of the irrelevant alternatives assumptions (IAA) by using Housman and Small and Hsiao's test. Both Housman and Small and Hsiao's test were performed, while none of the tests reject the H0 that IAA holds. The result of Small and Hsiao's test also considerably similar to the Hausman test, which was insignificant and hold for the null hypothesis. What this means is that adding or deleting outcomes (UAP) does not affect the odds among the remaining outcomes (UAP) or there is no difference in odds ratios of one alternative choice to remove or add one of the alternative outcome choices from the model. Thus, the multinomial logit specification is appropriate to model of the determinants of urban agricultural practice (see appendix).

Reading the model output: The upper parts of the regression result shows, the Log likelihood equal to -40.7609 which corresponds to the value of the log likelihood at convergence. For the probability models log likelihood always negative, because the likelihood itself is always between 0 and 1 [31]. Number of obs: is the number of observations, excluding those with missing values and after any if or in conditions have been applied. LR chi2 [45] =305.75, is the value of a likelihood-ratio chi-squared for the test of the null hypothesis that all of the coefficients associated with independent variables are simultaneously equal to zero. The *p*-value is indicated by Prob>chi2, where the number in parentheses is the number of coefficients being tested at 1 percent significance level. Pseudo R2= 0.8014 is the measure of fit also known as McFadden's R2. The marginal effect result of the regression for the significance variables are discussed as follows.

The magnitude of the coefficient estimates of the independent variables in the multinomial choice models describes the relative probability of a choice to a base-case. However, this gives limited information only its signs and level of significance are relevant. The effect of independent variables on the choice decision can be assessed by the size of its marginal effect. The marginal effect is a measure of the instantaneous effect that a change in a particular explanatory variable has on the predicted probability of the dependent variable. The marginal effect result of the regression for the significance variables are discussed as follows.

The multinomial logit model analysis result shows that, out of the total fifteen explanatory variables hypothesized to influence urban agricultural practices eleven of them significantly influence at least one category/strategy of urban agricultural practices. Among them land size, age of household, access to extension service, marital status of household head and cooperative membership were influenced urban crop production significantly. On the other hand, urban livestock production is significantly determined by age of the household head, family size, land size, total livestock unit, and access to extension service, education level and household risk preference. At the end land size, age of household head, education level of household head, dependency ratio, total livestock unit, cooperative membership, and risk preference of households were affect urban crop plus livestock production up to 10% level of significance.

Table 10. *Mlogit result on the determinants of urban agricultural practices of households.*

Household urban agricultural practices

Dependent Variables	Urban crop pdn (Y0)		urban livestock pdn (Y1)		Urban crop +liv. pdn (Y2)	
	Coefficient (SE)	Marg.effct (dydx)	Coefficient (SE)	Marg.effct (dydx)	Coefficient (SE)	Marg.effct (dydx)
AGE	-.4325643** (.1805399)	-.0774	3796913 ** (.1892793)	.0157	.2535652 *** (.1514484)	.0162
GEND	21.22772 (2711.319)	.03799	12.06173 (2520.258)	.0498	-2.663946 (2.814694)	-.0.0172
MST	4.128523** (2.305849)	.00739	1.719384 (2.761716)	.000710	-.6675085 (2.376657)	-.00425
EXTS	2.034088* (.7174241)	.0364	1.557282** (.6317391)	.00643	1.465154* (.5860872)	0.0945
TLU	.1876 (.6429329)	.00336	4.926822* (1.224268)	.0203	3.540146 * (1.04199)	.0228
FSZ	-.2945205 (.4490304)	-.00527	-1.697977 ** (.6856113)	-.00701	-.9410252** (.5123007)	-.00606
DPR	.4654371 (1.664377)	.00833	-3.155095 (3.030242)	-.00130	-5.625413* (2.803821)	-.0363
MDC	.171734 * (.0739359)	.00307	.2232522 (.1488832)	.09211	.0612979* (.0931618)	.00395
COOP	1.530824 (1.889029)	.00274	5.473756 (3.770576)	.00231	6.285406*** (3.237968)	.00405
RPR	-.6034069 (1.346905)	-.0108	-5.675192* (2.181285)	-0.0234	-4.271796** (1.698871)	-.0275
EDL	-3.747644 (2.848359)	-.0067	-14.82822** (6.595024)	-.006128	-16.58589* (6.004804)	-.01690
CRTS	0084596 (.0298041)	.00151	.0402709 (.053764)	0.00166	.0217696 (.0245061)	0.00871
INC	-.0006402 (.0011061)	-.00115	.0002225 (.0028332)	0.00919	-.0035611 (.0075317)	-.00229
LSZ	7.241703* (2.243796)	.01296	6.911222* (2.551965)	0.0285	8.974931 * (2.394962)	.0578
AIR	1.289577 (1.328763)	.00231	.3861609 (2.24775)	1.59e-04	2.084525 (1.805268)	.00134
-cons	-23.25407 2711.33)	-	-35.26471 (2520.275)		5.180681 (6.490273)	

Number of obs: 258 Pseudo R2 = 0.8014

LR ch2 (45) = 302.75, with prob ch2<0.0000 Log likelihood = -37.508436

Note:* significant at p<1%, ** significant at p<5% and *** significant at p<10%

Source: own computation from survey result, (2019).

The magnitude of the coefficient estimates of the independent variables in the multinomial choice models describes the relative probability of a choice to a base-case. However, this gives limited information only its signs and level of significance are relevant. The effect of independent variables on the UAP can be assessed by the size of its marginal effect. The marginal effect is a measure of the instantaneous effect that a change in a particular explanatory variable has on the predicted probability of the dependent variable. The multinomial logit model analysis result shows that, out of the total fifteen explanatory variables hypothesized to influence urban agriculture Age of household head, marital status of household head, extension contact, distance from a market/center of the town and land size influenced urban crop production significantly. On the other hand, urban livestock production is significantly determined by age of the household head, family size, dependency ratio, land size, cooperative membership, extension contact, risk preference of household head, education level of household head and total livestock unit. In other way urban crop plus livestock production is influenced by age of household head, extension contact, family size, total livestock unit, dependency ratio, cooperative membership, and risk preference of household heads, education level of household head and land size significantly up to 10% of significance level.

Age of household head: - Household heads age influence urban crop production negatively at less than 5%, and urban livestock production and urban crop plus livestock production positively at less than, 5% and 10% significance level respectively. When the household head age increases by one year; being the other determinants are constant urban crop production decreases by 7.7%, in contrast to this urban livestock production and urban crop plus livestock production increase by 1.6%. The possible reason could be urban households whose age is relatively old could be pushed to engage less in urban crop production (vegetables, fruits cereals etc) and pushed to engage more in urban livestock production (fattening, dairy farming, poultry, been keeping) and also urban crop plus livestock production; especially those who retired from government and non government organizations practice urban agricultural. This result is in line with [42]; he concluded as the youngest attitude towards urban agricultural practice less and the older are more likely participate urban agricultural practice, which support the posative relation ship between age of household head and urban livestock prodion and urban crop plus livestock production). Incontrast to this one, it is in line with Mwagi [40] justified as the olders were less likely practice urban agricultural practice compared to the younger conter parts due to the elders need rest in towns and cities or they prefer to participate on shopping other than urban agriculture; which shows negative relation ship between age of household heads and urban crop production.

Education level of household heads:-As expected household head educational level was found to be one of the important determinants of urban agricultural practice. It affects urban livestock production and urban crop + livestock production negatively at $p<5\%$ and $p<1\%$ significant level, respectively. The result suggests the probability of households to participate urban livestock production and urban crop + livestock production decreases by 0.61% and 1.7%, respectively when year of education increases by one, but other things are constant. As elsewhere in urban Ethiopia, education is an important barrier to entry in urban agriculture, particularly for the sake of salaried jobs and petty business in the study area. The highly educated person shifts their options through opting for salaried jobs, self employment activities other than urban agriculture, etc. Whereas, low-educated and illiterate persons engage themselves in urban agricultural activities which are not required education that much. More educated farmers easily communicate others and have better access to claim as well as to have better linkage with someone and simplify their entry barrier to other sector by leaving urban agriculture. This is in line with Olawepo [42, 6], while it inconsistent with the study by [5, 59] who justified that highly educated household could be practiced urban agriculture more likely.

Family size:-An increase in family size by one decreases the likelihood of practicing urban livestock production and urban crop + livestock production by 0.7% and 0.61% relative to non participant being the other determinants constant. In other words, the larger the household size, the higher is the tendency to practice urban agricultural sector since the household who have more family size believed to have more labor force, faces financial/resource problem to satisfy the basic needs and thereby they look for income source like urban agriculture. This is in line with, (30); (32).

Dependency ratio:-The variable dependency ratio was found to negatively affect the urban crop + livestock production, and it suggest that the likelihood of households to practice urban crop + livestock production decrease by 3.63%, when the number of dependence increases by one and significant at $p<1\%$ significance level. This means that, dependency ratio decreases the ability of urban household to participate in different urban agricultural activities due to they devote most their time to care for in active labour force family and this decrease the financial as well as the labor power of households to practice urban agriculture in full package. This study is in line with (6); (5).

Land size:-Keeping the other factors constant; the probability of urban households to practice urban crop production, urban livestock production and urban crop + livestock production increases by 1.3%, 2.7% and 5.8% respectively as the land size increases by 1000 meter squared at the $p<1\%$ significance level. Compared to the landless households, landowners tend to have a higher degree of probability to practicing urban agricultural activities. It is well known that access to farmland is the most critical issue for farm households to stay in urban agricultural practices. This result also supported by (24), (5), (22).

Total livestock unit:-The survey result also suggests, as

livestock in increases by one TLU, the likelihood of households' to practice urban livestock production and urban crop+ livestock production increase by 2.03% and 2.3% respectively at p<1% significance level. In the study area, livestock are the source of cash income and source of power for agriculture. Thus, the household who owned large livestock have a better opportunity to earn more income from livestock production and crop production. Moreover, the large herd size has also a great importance in improving soil fertility and farmers' power to implement and to expand his farming activity on time and hence this increases field crop production. This study result also supported by [25, 32].

Marital status of household head:-As a survey result being married household is more likely increases urban crop production by 0.74% compared to those who are un married (single, widowed, divorced) counter parts and is significant at p<10% significance level. This result is in line [36, 27], who justified married household most probably practice urban agriculture compared to other class.

Extension contact/service:-As expected extension contact influence urban agricultural practice positively, It refers the number of times the household received extension service within a year and measured in number of frequency which the household receive the service in year. The main objective of the extension service is to increase the UA by using modern agricultural technologies like chemical fertilizer, irrigation etc and had more participated in agriculture intensification activities than their counterparts. Other things being constant when extension contact increases by one, urban crop production, urban livestock production and urban crop + livestock production increases by 3.64%, 0.64% and 9.45%, and significant at p<1%, p<5%, and p<5% significance level. This survey result is in line with Mesay [38, 21], those concluded that extension service/contact improves urban agricultural practices.

Market distance:-The proxity of market distance is an other variable that influence urban agricultural practices. Market distance / the proxity of distance from the market to sell their product and buy factors of production is measured either interms of distance in meters or walking hour in minutes, for the purpose of this study the researcher used the walking hour in minutes, since urban area is relatevily access to infrastructure. Distance from the market has posative impact on urban agriculture; that means the opportunity coast of land in the center of urban area is high to practice urban agriculture in the center. while urban agriculture is practiced more at the edge of urban and pre urban. Other determinants being conistant, as the distance increases from the center of urban by one unit in this context one minute walking hour the likelyhood of practicg urban crop production, urban livestock production and urban crop + livestock production increase by 0.31%, 0.092%, 0.40% & significant at p<5%, p<1%, and p<5% respectivily.

Risk preferance of household heads:-The other variable that influce urban agricultural practices is that risk preferance of household heads. As expected the survey result show that risk aversor household heads are less likely practice urban agriculture with respect to risk lover/neutral counter part by 2.34% and 2.6% for urban livestock production and urban crop + livestock production respectively. And also is significant at p<1% and p<5% for urban livestock production and urban crop + livestock production respectively and it is in line with [27].

Cooperative membership:-Membership to cooperative found to have a positive and significant effect on urban crop + livestock production and implies that, the probability of household to practice urban crop + livestock production increases by 0.41% when they are member to cooperative. The possible reason for this could be mostly cooperatives focus on how they get modern/improved seed and fertilizers at required time and they facilitate for the accessibility of factors of production and make market linkage for their products and hence their entire aim is to increase output by providing loans, financial assistance, and information access. The other possible reason could be it promotes access to social capital in which different experiences gained and enable households to be effective within the available factors for urban agriculture through training and experience sharing. It is in line with [27] who justified cooperative membership positively associated with UAP since membership of different associations is important to overcoming the entry barriers associated to agricultural practices by providing loans, financial assistance, information and it builds social capital and entrepreneur skill among the household to practice urban agriculture.

4.3. Impact of Urban Agricultural Practices on Households Food Security

This section presents the entire process or implementation of propensity score matching (PSM) to evaluate the impact of UAP on household food security. More precisely, it presents the estimation of the propensity score, common support region, matching algorithm and balancing test or robustness. At the end it provides the UAP impact among the participant households.

4.3.1. Estimation of the Propensity Scores

To address objective three the propensity score matching model was applied. To implement this, the first task was estimating propensity scores and it was computed based on the logistic model. The estimated score used as a tool to balance the observed distribution of covariates across the treated (participant) and the untreated (non-participant) group [55]. As shown from the table 11 below logistic model results, the Chi-square value is 198.89 with p<1% significance level and it suggests the model is well fitted. The pseudo-R2 value is 0.2139 which is fairly low; pseudo-R2 value indicates that how well the model explains the participation probability [55]. A low pseudo-R2 value means participant households do not have much distinct in overall characteristics and hence the match between participant and non participant households becomes easier [65]. Here, the overall intention was to balance the observed covariates by using propensity score. Therefore, a detailed interpretation for determinants were not discussed since the determinants of urban agricultural practices is

discussed more in the above model. However to mention, from all included variables in to the model eight variables (age of households, total livestock unit, access to irrigation, market distance, risk preference, education level of household head, extension service and land size) were found statistically significance. From those, age of households, risk preference and education level of household head influence negatively at less than 10% p-value. On the other hand, total livestock unit, access to irrigation, market distance, extension service and land size influence UAP positively.

Table 11. *Estimation of Propensity Score: Dependent variable urban agricultural practice.*

Number of obs = 258

LR chi2 (15) = 199.22

Prob > chi2 = 0.0000

Log likelihood = -34.068766 Pseudo R2 = 0.2151

UAP |	Coef.	Std. Err.	Z	P>|z|	[95% Conf. Interval]
AGE	-.0624622	.0317313	-1.97	0.049	-.1246543 -.00027
GEND	.826685	.6266721	1.32	0.187	-.4015698 2.05494
MST	.0574799	.5147295	0.11	0.911	-.9513715 1.066331
EXTS	.2297783	.0856001	2.68	0.007	.0620052.3975514
TLU	.6595009	.1262965	5.22	0.000	.4119642.9070376
FSZ	-.0672533	.1140837	-0.59	0.556	-.2908532.1563466
AIR	1.934145	.5277164	3.67	0.000	.8998399 2.96845
DPR	-.2730742	.4188612	-0.65	0.514	-1.094027.547878
MDC	.0522674	.0253578	2.06	0.039	.002567.1019678
COOP	.3491038	.5841513	0.60	0.550	-.7958118 1.494019
RPR	-.8159692	.415824	-1.96	0.050	-1.630969 -.0009691
EDL	-2.308967	.8996042	-2.57	0.010	-4.072159 -.5457752
CRTS	-.0056596	.0064212	-0.88	0.378	-.0182449.0069256
INC	.0007362	.0018658	0.39	0.693	-.0029206.004393
LND	.8572469	.3400604	2.52	0.012	.1907407 1.523753
_cons	.4292259	1.521338	0.28	0.778	-2.552543 3.410994

Source own computation from survey data, (2019).

4.3.2. Matching Participant and Non Participant Households

There is no one recommended estimator rather testing of different matching estimator and selecting one with different criteria [55]. Therefore, three matching estimators NNM, CM and KM with different band width were employed. As suggested by [14] the final choice of a matching estimator is guided by different criteria such as equal mean test referred to as the balancing test, pseudo-R2 and matched sample size. Further, [55] suggested the low mean standardized bias and low LR- chi2 value revealed as the best estimator. Therefore, a matching estimator having balanced (insignificant mean differences in all explanatory variables) mean, bearing a low pseudo R2, chi2 and mean standardized biased value and also the one that results in large matched sample size is preferred in this study. Based on these as shown in Table 11, NNM estimator with neighbor 3 was selected. But, the ATT effect estimation for this study is not restricted in NNM algorithm only. Further, CM estimator with bandwidth 0.05 and KM 0.25 were employed, to assess the consistence of the ATT in different estimator as suggested by [48]. CM 0.05 and KM 0.25 were selected because of they are the best estimator next to NNM3 based on the criteria.

Table 12. *Performance of different matching estimators.*

Matching Algorithm	Pseudo R2	(p>chi2)	LR-chi2	Mean std Bias	Matched sample size		
					participant	Nonparticipant	Total
NNM1	0.283	0.292	17.47	13	51	177	228
2	0.268	0.29	18.57	13.5	51	177	228
3	0.150	0.845	10.41	11.3	51	177	228
4	0.152	0.836	10.56	14.3	51	177	228
5	0.154	0.827	10.71	13.4	51	177	228
6	0.164	0.767	11.66	16.4	51	177	228
KM 0.1	0.123	0.933	8.50	83.6	51	177	228
0.25	0.159	0.810	10.99	79.5	51	177	228
0.5	0.158	0.813	10.95	77.4	51	177	288
CM 0.1	0.224	0.870	10.95	68.2	48	171	219
0.25	0.140	0.974	6.98	14.3	51	177	228
0.5	0.272	0.205	20.34	13	51	177	228

Source own computation from survey result, (2019).

Table 12 Depicts the matching quality test by using the selected best estimator based on the above criteria. Therefore, it shows that the balancing test of covariates before matching of participant and non participant household heads were significantly different in many covariates. But, after matching no significant differences were observed between participant and nonparticipant households. The distribution of propensity scores before and after matching as shown in table also indicates that estimating the p-score balances the participant and non participant groups adequately, a result which highlights the importance of the PSM approach. The fifth and sixth columns of 14 shows, the standardized bias before and after matching and the total bias reduction obtained by the matching procedure, respectively. The standardized difference in covariates and propensity score before matching was in the range of 2.1% and 335%, but it significantly reduced to the range of 1.3% and 20.7% after matching. And after matching there is no significance difference in all covariates observed.

Table 13. *Propensity score and covariate balance.*

Variable	U	Mean		%bias	%reduction |bias|	t-test	
	M	Treated	Control			t	p>|t|
_pscore	U	.81996	.04878	355.0		29.29	0.000***
	M	.61231	.59768	6.7	98.1	0.17	0.863
AGE	U	36.855	36.296	7.4		0.47	0.639
	M	37.08	38.347	-16.8	-126.6	-0.49	0.626
GEND	U	.94545	.85222	31.2		1.84	0.067*
	M	.88	.86667	4.5	85.7	0.14	0.890
MST	U	.8	.75862	9.9		0.64	0.521
	M	.8	.82667	-6.4	35.6	-0.24	0.813
EXTS	U	4.2182	.18719	152.8		14.02	0.000***
	M	2.28	2.56	-10.6	93.1	-0.31	0.755
TLU	U	3.4	.5468	164.3		13.86	0.000***
	M	2.36	2.2133	8.4	94.9	0.28	0.784
FSZ	U	4.4727	3.9409	24.4		1.70	0.090*
	M	4.48	4.32	7.4	69.9	0.34	0.734
AIR	U	.41818	.05419	94.1		7.86	0.000***
	M	.28	.2	20.7	78.0	0.65	0.518
DPR	U	1.5451	1.6806	-23.7		-1.42	0.158
	M	1.65	1.816	-29.0	-22.5	-1.02	0.312
MDC	U	13.782	10.443	45.1		2.89	0.004**
	M	13.36	14.453	-14.8	67.3	-0.59	0.561
COOP	U	.76364	.74877	3.4		0.23	0.822
	M	.84	.86667	-6.2	-79.4	-0.26	0.795
RPR	U	.34545	.73399	-84.1		-5.67	0.000***
	M	.48	.41333	14.4	82.8	0.47	0.644
EDL	U	.77073	.80379	-7.3		-0.41	0.683
	M	.748	.6536	20.9	-185.5	0.99	0.326
Crserv	U	3.9456	3.5911	2.1		0.12	0.907
	M	4.32	4.7867	-2.8	-31.6	-0.06	0.950
Income	U	206.27	24.908	18.6		1.87	0.062*
	M	26.686	14.096	1.3	93.1	1.60	0.117
Lndsz	U	.95727	.11133	159.3		12.17	0.000***
	M	.764	.71333	9.5	94.0	0.25	0.805

Note:* significant at p<10%, **significant at p<5%, *** significant at p<1%
Source: own computation from survey result, (2019).

4.3.3. Treatment Effect on Treated

The purpose of these all process was, to see whether the participant households have significant difference in food security status compared to non-participant households or not. To identify this, there are two parameters; ATE and ATT, but ATE does not reveal the true impact of participation and might not be of relevance to policy makers since it does not consider into account the common support assumption [65]. This implies households who were highly motivated and the households who had extremely low motivated to participate in urban agricultural practices included in treatment effect (ATE). Therefore, the average treatment effect on the treated (ATT) was computed to evaluate explicitly the impact on those for whom at least the probability to participation was approximated. The ATT result implied that, urban agricultural practices brought statically positive significant impact on household's calorie intake level or food security. It has been found that UAP increase household's calorie intake for participant households in the range of 433.49 and 439.2 kcal on average at less than 10% significant level for all estimators even though there is modest varying among algorithms. This result also supported by [60].

Table 14. *Average treatment effects on treated by different estimator.*

Algorithm	Outcome	participant	Nonparticipant	ATT	SE T- value
NNM3	Calorie intake	2814.92	2375.72	439.2	197.95 (2.23)
Ker 0.1	Calorie intake	2814.92	2381.43	433.49	175.87 (2.46)
Caliper0.1	Calorie intake	2814.92	2379.57	435.35	169.68 (2.57)

Source: own computation from survey result (2019).

4.3.4. Checking the Robustness of Average Treatment Effect

There are several ways to check robustness of the findings. One approach is to estimate the propensity score equation and then use the different matching methods to check consistency of the results with different matching techniques like table 15. This method used by many studies such as [65, 2], and [51]. The other method which used commonly is applying direct nearest-neighbor matching instead of estimating the propensity score equation first with "nnmatch" command in stata. The study by [48] in Cambodia used this method to assess the robustness of the result and also recommended by [65]. They suggested that, if it gives similar/nearly similar result with selected matching estimator, then the finding is assumed to be more reliable.

As shown from the Table 14 even if there is variation in the size of ATT (between 439.2 and 433.49) across estimators, the impact is positive and significant for all at p<10%. The nonparametric (nnmatch) estimate suggests participant households have 464 kcal more on Average (Table 15).

Table 15. *Direct nearest neighbor matching result for checking robustness.*

DNNM	Outcome	Coefficient	Std. Err.	Z	P>|z|	[95% conf. Interval]
DNNM1	Calorie Intake	472**	111.01	4.31	0.00495	283.46 763.06
DNNM2	Calorie Intake	464*	107.03	4.33	0.01342	309.91 761.87

Source own computation from survey result, (2019).

Result from Rosenbaum bounding approach also shows that the impact is not changing though the participant and nonparticipant households has been allowed to differ in their odds of being participant up to 100% (Gamma 2) in terms of unobserved covariates (see Table 16). This implies that the sensitivity of ATT is controlled up to doubled deviation in hidden covariates. The significant Gamma value further indicates that the study considered important covariates that affected both UAP and food security. Overall, it is possible to conclude that the impact estimates (ATT) is fairly insensitive to unobserved selection bias and is a pure effect of participation on households' food security.

Table 16. *Rosenbaum bounding approach result for checking robustness.*

Outcome	Gamma1	Gamma1.25	Gamma1.5	Gamma1.75	Gamm2
Calorie Intake	P<0.00	P<0.04112	P<2.0e-7	P<.011254	P<0.03224

Source: own calculation from survey result, (2019).

But, the thing it needs to be clear are, PSM does not eliminate the bias resulting from Confounding factor rather it reduces it, the sensitivity of ATT to hidden bias does not imply existence of unobservable only and these test statistics also does not imply the overall validity of CIA [40].

5. Summary, Conclusion and Recommendations

5.1. Conclusion

Generally, this study finding confirms existing literature on the characteristics of urban agricultural and impact of urban agricultural practices on urban household's food security, except some contradict in the sign of some variables in determinant analysis. Therefore, in the study area even though there is significant number of households who participate in different strategies of urban agricultural practices further than non urban agricultural (non participant) only, the government or agricultural sector due not give attention to promote urban agriculture. As the findings of the work many factors influence urban agricultural practice at least of one category. who are less educated, contact extension more, has more livestock, resided at the edge of the town, married house hold heads, non risk aversors, membership to cooperatives, has less dependency, has more land size, practice at list one of urban agricultural activities among urban crop production, urban livestock production and urban crop + urban livestock production. The negative relationship in more educated households comes from because of the more focus on non agricultural activities rather than encouraging farmer's engagement most of them are government employee's producer cooperatives etc. Specifically *urban crop production (Y0)* is affected by land size, access to extension service, marital status of household head and cooperative membership were influenced urban crop production positively and significantly while age of household heads affects urban crop production negatively and significantly. On the other hand, *urban livestock production (Y1)* is significantly determined by age of the

household head, land size, total livestock unit positively, and family size, education level and household risk preference influence urban livestock production negatively. At the end land size, age of household head, extension service, cooperative membership, and total livestock unit influence urban agricultural practices positively, and risk preference of households, family size, education level of household head, dependency ratio were affect *urban crop plus livestock production (Y2)* up to 10% level of significance. The survey also found as urban agricultural practice has positive and significant impact on urban food security up 10% level of degree of freedom.

5.2. Recommendations

1) In light of the findings of the positive and significance roles of land size towards urban agricultural practice, it can be suggested that a more focused towards urban land administration and development for effective utilization of urban land to promote urban agricultural practice, Therefore, the woreda Administration in collaboration with municipality of the town should create a conducive environment to solve the problem of land shortage for urban agriculture to increase the contribution of urban agriculture to reduce urban food insecurity.
2) Even though extension service has positive and significant effect on urban agricultural practice, due to lack of independent body that follow up & govern urban agriculture, urban agricultural households didn't get extension service regularly as rural household which are follow up by woreda agricultural office, hence administration of the town should establish urban agricultural office that govern and follow up urban agricultural activities to promote urban agricultural practices to reduce urban food insecurity at town level.
3) Since family size, risk preference of household heads, dependency ratio affects urban agricultural practice negatively and significantly government should give attention towards population policy and improve the awareness of households toward risk prevention rather than fearing risk to promote urban agricultural practice as well as reduce urban food insecurity.
4) While irrigation is insignificant in multinomial logit model, it is significant and positively influences participation probability; therefore the town should utilize the rivers cross in to them or near to them to promote urban agricultural practice to reduce urban food insecurity.
5) Researchers, academicians', policy makers and all conserved bodies should work on the attitude of highly educated households towards urban agricultural practice since education level negatively and significantly influence urban agricultural practice.
6) Cooperative membership is another variable that play a positive and significant role towards urban agricultural practices, therefore towns administration should create conducive environment to cooperate urban household that help them to engage urban agriculture that reduce urban food insecurity.
7) Any policies targeted at promoting urban food security should go beyond just food supplying measures; they should prepare sound policy that promote urban agricultural practices which may guarantee for urban households as source of food and cash income.
8) Generally the policy makers should give do attention to the aforementioned variables to increase urban agricultural practices and its impact on smallholder household's food security.

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