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**Effects of Nutrition Sensitive Agriculture on Welfare Outcomes of  
Rural Women: The Case of Basona Worena and Angolela Tera  
Woredas of North Shoa Zone, Amhara Region, Ethiopia**

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**Effects of Nutrition Sensitive Agriculture on Welfare Outcomes of Rural  
Women: The Case of Basona Worena and Angolela Tera Woredas of North  
Shoa Zone, Amhara Region, Ethiopia**

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## **DEDICATION**

This thesis is dedicated to my parents who sacrificed their precious time and energy for my care and comfort, happiness and progress in education.

## DECLARATION

I hereby declare that this thesis is my original work and all materials and information used are duly acknowledged. The thesis is submitted in partial fulfilment of the requirement for M.Sc. degree in Economics at Addis Ababa University. The copy of the thesis is deposited in the University library for consultation or referencing for anyone interested as per the rules of the library. I solely declare that this thesis is not submitted to any other institution for the award of academic degree, diploma or certificate.

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## **CERTIFICATION**

**Addis Ababa University**  
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**Hanna Lemma Gizachew**

This is to certify that the thesis prepared by Hanna Lemma entitled ‘Effects of Nutrition Sensitive Agriculture on Welfare Outcomes of Rural Women: The Case of Basona Worena and Angolela Tera Woredas of North Shoa Zone, Amhara Region, Ethiopia’, and submitted in partial fulfillment of the requirements for the degree of Master of Science in Economics (Development Economics) complies with the regulations of the University and meets the accepted standards with respect to its originality and quality.

As members of the boards of the examiners of the M.Sc. thesis open defense examination, we certify that we have read and evaluated the thesis prepared by Hanna Lemma and examined the candidate. We recommend that the thesis be accepted as fulfilling the requirement for M.Sc. in Economics.

Signed by the Examining Committee

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## ACRONYMS AND ABBREVIATIONS

AGP	Agricultural Growth Program
ATE	Average Treatment Effect
CAADP	Comprehensive Africa Agriculture Development Programme
CSA	Central Statistical Agency
DFATD	Department of Foreign Affairs Trade and Development
DFID	Department for International Development
ECA	Economic Commission for Africa
EDHS	Ethiopian Demographic and Health Survey
ETB	Ethiopian Birr
FAO	Food and Agricultural Organization
FDRE	Federal Democratic Republic of Ethiopia
FGT	Foster Greer Thorbecke
GDP	Gross Domestic Product
GPI	Gender Parity Index
GTN	Growth through Nutrition
GTP	Growth and Transformation Plan
ICN	International Conference on Nutrition
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
MDD	Minimum Dietary Diversity
MDG	Millennium Development Goal

MoA	Ministry of Agriculture
NEPAD	New Partnership for Africa’s Development
NGOs	Non-Governmental Organizations
NSA	Nutrition Sensitive Agriculture
PCA	Principal Component Analysis
PSM	Propensity Score Matching
PSNP	Productive Safety Net Program
SBCC	Social and Behavior Change Communications
SDG	Sustainable Development Goal
UNICEF	United Nations International Children’s Emergency Fund
USAID	U.S. Agency for International Development
WEAI	Women’s Empowerment in Agriculture Index
WFP	World Food Program
WHO	World Health Organization

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## ABSTRACT

Food insecurity and malnutrition are priority development challenges of Ethiopia. To counter the problem, the country embraced the nutrition sensitive agriculture approach and taken decisive measures relevant for wide implementation of the practice. Nutrition sensitive agriculture interventions that are implemented in worst affected parts of the country are already producing number of encouraging results. This study assessed the extent to which the desired welfare outcomes are realized in the intervention beneficiary Basona Worena Woreda as compared to the Agolela Tera Woreda that did not benefit from such intervention. Administratively, these woredas are situated in North Shoa Zone of Amhara Region. Purposive and simple random sampling procedures were used to select these two Woredas, and the 262 representative households respectively. The study employed key informants' interview checklists and structured questionnaires to gather relevant data, which was then analyzed using descriptive statistics and an econometric propensity score matching model. The study findings demonstrated that the intervention has a significant and positive influence on assessed welfare outcomes namely women empowerment, on-farm production and consumption of nutritious diets, household income, and nutrition knowledge. Of the examined women empowerment domains, appreciable improvement was made in leadership and access to resources. Regarding the outcome on production and consumption diversity, mothers' and children's consumption was seriously constrained by socio-cultural and religious factors. Despite these challenges, intervention beneficiary women and their children have had higher minimum dietary diversity than non-beneficiary women and their children. The home production of nutrient dense food sources positively affected the consumption of these items although extremely poor families opted to sale part or the entire farm produce in order to generate the badly needed cash. To countervail this challenge, future nutrition sensitive agriculture intervention programs should consider livelihood and income diversification opportunities as part of the scheme so as to allow the poor households use the home produced nutrient dense foods for intended purpose. In addition, the sustained and wider dissemination of the nutrition sensitive agriculture approach would require building the capacity of key actors and institutionalizing the scheme in the regular publicly supported extension programs.

# CHAPTER ONE

## 1. INTRODUCTION

### 1.1 Background of the study

Agriculture contributes up to 39 percent of Ethiopia's Gross Domestic Products (GDP) and employs 83 percent of the country's population. It is also the sector that generates the largest share of the country's foreign earnings. Due to these facts, the aspiration to transform the agricultural sector has continued to occupy the central place in economic development plan of the country. To this end, the government of Ethiopia has developed series of policies and strategies with the view to increase the contribution of the sector to economic growth, poverty reduction and food security. These national initiatives have produced a number of positive changes, though not to the level desired. The recently completed Growth and Transformation Plan (GTP I), for instance, has reduced the poverty head count from the base year's 29 percent to 23 percent and brought about an average increase of over 5-quintal grain yield per hectare (FDRE, 2015).

Producing enough food for the fast growing population continues to be the single most important daunting challenge of the country. The agricultural sector pursued a variety of strategies to address the problem. Among others, these involved the horizontal expansion of land put under food production, increasing productivity per unit of land or per animal and the introduction of some new avenues of food production e.g. home gardens and mushroom production in towns and cities (Bachewe *et al.*, 2018). For the rural and urban population, however, the mere increase in food production is not enough to ensure food and nutrition security. The affordability, accessibility and wholesomeness of the locally produced food are as important as the production per se. As of recently, the need to give due consideration to the aspects of food products accessibility in government and development partners financed program and projects is gaining momentum. The underlining reason for this is that enhanced agricultural productivity and improved market access would ultimately lead to food security and/ or improved nutrition, provided it is guided by complimentary strategic actions and policies addressing the challenges of gender and other socio-economic inequalities (FDRE, 2017).

A holistic approach that relates the state of nutrition to the wellbeing of the population is the other important subject considered in food and nutrition security. According to UNICEF's conceptual framework, nutritional status has three broad dimensions, i.e. food, health care and sanitation (UNICEF, 1990). Good health care and sanitation are as important as the access to nutritious food for human welfare. Limited access to sufficient and nutritious food, sanitation, and health care could have profound undesirable consequences on children that go beyond individuals' wellbeing, thus leading to nation-wide glitches. A study shows that malnourished individuals are less productive and earn 10 percent less than well-nourished individuals over their lifetime, making a sound argument for investing on programs improving food and nutrition security (IFAD, 2014).

Women contribute to the greater share of food production through their involvement in unpaid domestic labor, on-farm production and off-farm employment. They are the principal agents of food security and household welfare in rural areas. The kinds of women's involvement in on-farm activities notably the backyard horticultural crops production and small stocks (chicken) rearing amplify the role that they play in a household food and nutrition security. However, they are largely neglected from productive development initiatives and the provision of extension services. This risks the availability and diversity of food items available for household consumption, over which women have control. Other than limiting their productivity, such lack of attention make women and children disproportionately suffer from malnutrition (Verhart *et al.*, 2015).

Although increased influence of women over income leads to improved nutrition outcomes, other factors like spending decisions, social networks and cultural norms might have a contradictory effect. Low social status of women that are caused by deep-seated cultural barrier can have an aggravating effect on morbidity as well as related food intake problems. A study reveals that if women and men had equal social status, the under-three child underweight rate would drop by approximately 13 percent, meaning 13.4 million fewer malnourished children in this age group alone (Smith *et al.*, 2003). While the socio-cultural aspects of nutrition security barriers have been overlooked in the past, recent studies are showing great interest in the subject. In the recent years, there are a number of women empowerment initiatives that intend to address the socio-cultural barriers and reduce its negative impact on household food and nutrition security. The impact of women empowerment initiatives in rural households range from improved decision making power to the provision of services that enhance the nutritional status of women (Meeker and Haddad,

2013). There are compelling and empirical evidences that show the positive association of women's discretionary income and child nutrition and food security (UNICEF, 2011; and Smith *et al.*, 2003).

In Ethiopia, the Ministry of Agriculture (MoA) is working with several governmental and non-governmental organizations (NGOs) to bring positive changes in food and nutrition security. Nutrition sensitive agriculture (NSA) is a globally adopted approach that help promote food and nutrition security. The main objective of this initiative is improving the nutritional situation of food insecure people, especially women of child-bearing age and young children. Currently, the national level project is conducting community training schemes in selected woredas of the country focusing on nutrition education, health and hygiene, and child care practices. Hosts of institutions are involved in these programs including the MoA, NGOs and UN-agencies. Amongst these is the Feed the Future Ethiopia, 'Growth through Nutrition (GTN) program'. This is a USAID financed five-year flagship multi-sector nutrition project initiative. The project aims to improve the nutritional status of women and young children in Ethiopia's four regions namely Amhara, Oromia, SNNP and Tigray, focusing on the first 1,000 days of the child's life, period which cover the first two years after conception (Save the Children, 2017).

This study is conducted in Basona Worena and Angolela Tera Woredas of North Shoa Zone in Amhara Region where sizable portion of the population lives under abject poverty and food insecurity. From the total population of North Shoa, which stands at 2.3 million, about 10.5 percent are food insecure, and over 126,700 are Productive Safety Net Program (PSNP) beneficiaries. It is in light of this fact that food security as well as NSA strategies of the government are supported by a number of development partner programs in the zone. NSA program operates in 24 woredas of North Shoa Zone and the total number of people in the area supported by the program are 75,039 nursing and pregnant women. From this, GTN and FAO supported NSA programs target 3,370 nursing and pregnant women. Although the scope of these projects are limited, the above development partners provide the NSA beneficiary women with technical training and awareness creation schemes imparting basic NSA knowledge and some key inputs. The government program on the other hand supports 71,669 women in the Zone. Even though the government coverage is vast, it has limited resources which undermines its influence in achieving food and nutritional security (North Shoa Zone Agricultural Development Office, unpublished report).

## **1.2 Statement of the Problem**

Government and development partners duly recognize the widespread food insecurity and malnutrition problems across the country. National figures on the proportion of the food and nutrition insecure population, particularly those on women and children are very much disturbing. According to Ethiopian Demographic Health Survey (EDHS), over 38, 23 and 9 percent of children under five years of age are stunted, underweight and wasted, respectively (CSA, 2016). For women of reproductive age, the EDHS report put the proportion of thin and undernourished women to 22 percent. To countervail the daunting challenges of malnutrition in women of reproductive age and children under two years of age, development partners are promoting NSA interventions in worst affected parts of the country. In connection to the NSA based interventions, so far the focus is squarely on the promotion of the practice and literally nothing or very little is done to generate information that help highlight the influence of NSA intervention on NSA welfare outcomes and the setbacks encountered. Such information is vitally important to draw lessons relevant for wider promotion and dissemination of the NSA approach at wider scale. Principally, this study was intended to bridge such knowledge and information gaps taking the case of selected woredas of North Shoa Zone in Amhara Region. In addition, the study tried to explore the influences of socio-cultural and religious barriers in the implementation of the NSA intervention.

### **Research hypothesis**

- The NSA intervention positively contributes towards the realization of the desired welfare outcomes

## **1.3 Study Objectives**

### **1.3.1 General objective**

- To investigate the contribution of NSA intervention on welfare outcomes in Basona Worena and Angolela Tera Woredas

### **1.3.2 Specific objectives**

- To assess the socio-economic features of rural women in Basona Worena and Angolela Tera Woredas
- To analyze the effect of NSA intervention on minimum dietary diversity (MDD) of women and young children in Basona Worena and Angolela Tera Woredas
- To determine the effects of NSA intervention on on-farm diversity, women empowerment, household income and knowledge acquisition in Basona Worena Woreda

### **1.4 Scope and limitation of the Study**

The study is limited to observations on the type and level of influences that NSA intervention have on rural women with respect to the production and consumption of nutritious food of plant and animal origin, household income, and their empowerment in addition to nutrition and health knowledge in selected woredas of North Shoa Zone. Two woredas were targeted by the study, one benefitting from NSA intervention and the other lacking such support but both having similar socioeconomic and demographic features. Basona Worena Woreda represented the NSA intervention woreda, while Angolela Tera Woreda represented the non-NSA intervention contiguous geographic areas in the Zone. The most conspicuous and striking common features of these two woredas is the pervasive nature of food insecurity. Significant proportion of the households in these woredas are beneficiaries of the safety-net program. The study was spatially restricted to these two woredas due to resource (budget) and logistical limitation.

### **1.5 Significance of the Study**

Women play a crucial role in the welfare of the family and the economic development of the nation. They are primarily responsible in the provision of food and nutrition to the household, yet again contributing to health care, development and education of children. It is therefore no surprise that the on-going NSA programs and projects tend to preferentially target women than men. However, there are numerous factors that hinder women from actively and wholeheartedly participating in the NSA programs and in some cases disregard advices offered while attending the NSA training

programs. This can be attributed to several barriers, which include economic, cultural, religious, resources endowment, skill, and educational limitations. Ethiopia has made significant progress in reducing chronic child malnutrition – about a 20 percent reduction over the last 16 years (EDHS, 2016). Despite these improvements, stunting of children and women’s micro-nutrient deficiency remain a significant health problem in the country. In the past, many development programs and projects were only partially successful in addressing the above nutritional challenges. Containing such widely observed nutritional problems would demand the sustained implementation of NSA practices, particularly by rural women. This study aims to generate facts and information highlighting the extent of the NSA intervention application among the beneficiary rural women and identifying the underlying factors contributing to the observed level changes. Furthermore, the outcomes of the findings are used to develop gender and behavior sensitive policy recommendations supporting the wider application of the NSA practices.

## CHAPTER TWO

### 2. LITERATURE REVIEW

#### 2.1 Food and Nutrition Security

Food security prevails when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs for an active and healthy life (FAO, 2002). This definition is important to establish a framework and set a norm against which the state of food security is measured. The definition is also useful to visualize where the world stands in terms of fulfilling such vital human needs. Recent estimates show that there are about 815 million food insecure people across the globe (WHO, 2017). The lion's share of this population lives in the developing countries. Africa harbors 20 percent of the above food insecure population, to which Eastern Africa alone contributes 33 percent. The most disturbing fact is that the global food insecurity has been steadily increasing. In 2017 alone, an additional 38 million food insecure people were added globally. This phenomenon is further exasperated by unsustainable methods of crop and livestock farming, and fishing that result in air and water pollution, and climate change (FAO and ECA, 2018). Climate change, which is expressed in terms of drought and other extreme weather events, increases the incidences of crop pests and livestock disease outbreaks. These incidences would ultimately result in failed crop harvests and poor animal production that in turn leads to food scarcity and high prices of the available food.

In the recent decades, the challenges of food insecurity have influenced the global, continental, regional and national policy discourses. Ending hunger, achieving food security and improving nutrition are the main thrusts of the Sustainable Development Goals (SDGs) and Comprehensive Africa Agriculture Development Programme (CAADP) pillars. Food security also occupies a central place in policies, strategies and programs of almost all African countries. Presently, hosts of governmental and non-government actors have been engaged in implementing programs and projects having a promise to reduce the number of food insecure population. To this end, many developing countries including Ethiopia have registered some positive achievements. In Ethiopia, for instance, agricultural intensification, nutrition and safety net related programs have decreased the stunting prevalence in children from 58 percent to 44 percent between 2005 and 2011.

Similarly, children's under-five mortality rate have fallen from 139 deaths per 1,000 live births to 77 between 2000 and 2011. In light of the magnitude of the problem, these achievements might not be regarded sufficient. Significant percentage of the country's population still remain food insecure due to the complex challenges that contribute to the continued mismatch between food production and population growth rate as well as the widespread gender inequality, the vagaries of climate change and political instability (EDHS, 2016).

Structural food deficits in Ethiopia are mainly associated with the low performance of the agricultural sector. The slow pace of improvement in agricultural production and productivity is mirrored by the continued worsening of the food security situation in the country. Agricultural production and productivity is severely constrained due to the negative impacts of climate change that continues to result in poor harvests and in the worse cases complete loss of production. The over dependence of agriculture on rainfall and the limited use of production boosting technologies has made the country vulnerable to the threats of climate change induced food insecurity experienced at household and nation level. The low level of agricultural production and productivity has forced the country to spend the scarce foreign earnings and fall victim of the volatile global food prices (World Bank, 2013).

The 2009 World Summit on Food Security has identified four pillars of food insecurity. These include availability, accessibility, utilization and stability. Many poor countries have put considerable effort to address the challenges of food availability. Despite these efforts, several of these countries still suffer from hunger and malnutrition. The increased availability failed to translate into food security because of the instability of food production, the rise in food prices and lack of disposable income for the largest segments of the population. Therefore, recent development programs on food security aim to go beyond short term availability and encourage integrated strategies that enhance agricultural productions on the sustainable and long term basis. Policy makers in developing countries are also starting to recognize the value of investing in small-scale farmers to ascertain food security (BRIDGE, 2014).

Today, attaining food security is no longer equated with mere stability of food supply. In order to meet food and nutrition security, agricultural development progresses, particularly with smallholder producers, are required to adequately accommodate the aspects of nutrition and the diversity of food sources. Agriculture and nutrition have to be integrated and synergized in order

for agriculture to provide the diversified foods that support healthy nutrition and nutrition. Similarly, healthy and nutritious diets are vital for agriculture as such situations increase the productivity and efficiency of laborers. The due consideration of nutrition in the planning, implementation and evaluation of agricultural development programs warrants good human health and nourishment (Mottram, 2015). Above all, agriculture has to improve nutrition by being a source of food, income, women empowerment and even as a driver of economic growth (FAO, 2015).

Agricultural interventions that integrate nutritional objectives pursue nutrition-sensitive value chain approach, normally referred to as ‘farm to fork’. It seeks to influence the supply chain from production to consumption, while widening the sector’s view beyond market and economics (Hawkes and Ruel, 2012). In addition, investments that target nutritionally vulnerable groups including women are crucial in reducing malnutrition. Access to diverse, nutrient-dense and healthy foods can also be facilitated through poverty reduction programs and supports that create favorable environment for acquisition of knowledge and incentives (Herforth *et al.*, 2012).

## **2.2 Overview of Nutrition Sensitive Agriculture**

Nutrition Sensitive Agriculture (NSA) is an approach that aims at achieving food and nutritional security by putting nutritionally rich and diverse food sources on the table to overcome malnutrition and micronutrient deficiency (FAO, 2014). More importantly, the NSA approach encourage development actors to put a nutrition lens while identifying agricultural interventions. Essentially, NSA is a globally adopted approach, which lends itself for a wide range of improvisation to fit the specific bio-physical and socio-cultural conditions of the target communities. NSA based agricultural production acts mainly in making food available and accessible, diverse and sustainable, and nutritious. The NSA approach endeavors to significantly improve the nutrition of the poor, especially women and young children (Operational Guidance Note, 2015).

In its own right, agriculture affects the three underlying broad determinants of nutrition i.e. food access, healthy environments and care practices. Food access implies the increased availability of nutritious food both on-farm and in the markets at an affordable price. The healthy environment

dimension of nutrition ensures the efficient management and use of natural resources whereas the aspects of care practices look into women's empowerment, labor and income in relation to societal behavioral changes. From the above interconnected relationships, it is thus clear that nutritional security is a complex issue that goes beyond the availability and diversification of diets (Herforth and Ballard, 2016).

IFAD has incorporated 'improving nutritional status of developing nations' as one of its objectives in 1977. Since then a number of government and development organizations have followed suit. Nutrition is now not only considered as a means to spur economic growth but also regarded as key to improve human capital and hence bring about sustainable development. Today, more than any time before, the negative impacts and detrimental effects of under-nutrition, micronutrient deficiencies and overweight have received the global attention. The underlying reasons for under-nutrition are attributed to societal structures like that of access to resources and socio-economic and political processes, which are all directly related to societal welfare (Lancet, 2013).

As of recently, the nutrition based agricultural interventions have started incorporating the gender dimension in their programs. This is so because of the role that women play in food production and utilization, and the vulnerability of themselves and their children to hunger and malnutrition. Children receiving poor care and feeding practices, especially those under two years of age suffer most from the negative impacts of malnutrition, which is manifested in terms of stunting, wasting and underweight, as well as other deficiencies that arise from malnutrition (Verhart *et al.*, 2015). Poor nutrition in the first 1,000 days of a child's life can weaken the immune system and impair cognitive development, having a permanent effect throughout adult life. Evidently, nearly half of all global deaths in children of less than five years of age are attributable to under nutrition (UNICEF, 2018).

### **2.3 Global NSA Experience**

Over the last few decades, the world has made profound strides in food and nutritional security. Nonetheless, the food and nutrition security threats remain the most important and daunting challenges in all nations, with every country experiencing one or more forms of malnutrition. Presently, under-nutrition accounts for about 45 percent of deaths among children under five, and

for about 1.9 billion obese adults’ and for another 462 million underweight children (WHO, 2018). The above disturbing figures clearly show the gravity of the malnutrition challenges both among children and adults.

Considering the aforementioned negative consequences of malnutrition, the United Nations have set several targets to combat the problem through the promotion of NSA related good practices across the globe. Among these, a stand-alone goal for food security, sustainable agriculture and good nutrition was included in the 2015 Sustainable Development Goals (SDGs) agenda. The 2014 Second International Conference on Nutrition (ICN2), after reviewing the progress achieved in nutrition since the First ICN in 1992, has identified challenges and opportunities considered relevant for improving nutrition. The conference also underscored the dire need for worldwide nutrition sensitive approaches in agriculture in order to achieve food and nutrition security (Balz *et al.*, 2015). Although its progresses are slower than expected, the Millennium Development Goals (MDGs) has also endeavored to contain and lessen the global food and nutrition insecurity. The overall slow gains in the MDGs were recently attributed to the lack of investment in nutrition, labelled as the “forgotten MDG” by the global development community (World Bank, 2013).

Africa is considered as a continent heavily relying on agriculture as 60 percent of total workforce and 17 percent of the GDP depend on the sector. Despite the considerable significance of agriculture in the national economy and the high consideration attached to food security in the SDG ‘Zero Hunger by 2030’, hunger and malnourishment remain widespread in the continent. In 2016, 27.4 percent of the population of Africa was reported to be severely food insecure while the other 20 percent was classified as undernourished. Of these figures, East Africa takes the lion’s share of the malnourished population, with one third of the population estimated to be undernourished (FAO, 2017b and FAO, 2018b). This situation has contributed for a considerable increase in the continent’s aid dependency. In 2000 alone, Africa has received 2.8 million tons of food aid. This accounts for over a quarter of the world’s total amount of food aid (NEPAD, 2003).

Past efforts of most African governments has mainly focused on agricultural investments contributing to the attainment of food security. Nutritional security, however, has been neglected in the pursuit of increased productivity of staple foods. Nonetheless, the recent shift in priority complimented the agricultural productivity with investments addressing nutritional gap (ATONU, 2017).

In Ethiopia, agriculture which contributes up to 39 percent of the national GDP, employs 83 percent of the workforce and 75 percent of export earnings, is the main stay of the economy (FDRE's National NSA Strategy, 2017). Despite the immense agricultural potential, Ethiopia is a country in Sub-Saharan Africa with the highest rate of malnutrition and with only 4 percent of the children having access to minimum acceptable diet. According to the United Nations, the under-nutrition related annual losses in Ethiopia amount up to 16.5 percent of GDP (UNICEF, 2009). The status of the country with respect to household consumption of diverse diet is also less comforting. This is related to the lower diversity of agricultural production which has led to the low consumption of diverse diet from different food groups in Ethiopia (Jonesa *et al*, 2014).

The agricultural development strategy of Ethiopia in the first decade of the Millennium and the one before focuses on improving agricultural productivity and commercialization. Among others, these programs include the Agricultural Growth Program (AGP) and the United States Agency for International Development (USAID) supported programs. These programs focused on supporting agricultural productivity in maize, wheat, sesame, chickpeas, coffee, and honey, dairy and also commercialization and livestock marketing. When it comes to the production of nutrient-dense agricultural products including foods of animal origin, these programs are grossly deficient. However, over the last two decades with declining food basket share of cereals and relative growth in importance of animal-source foods, the dietary diversity in Ethiopia is showing some improvements (Heady, 2014). More importantly, the NSA intervention in Ethiopia supports the food and nutrition insecure rural farming households in the production and consumption of nutrient dense food sources.

## **2.4 Overview of Agricultural Innovation Adoption**

Agriculture is the source of employment, income and most importantly food across the globe. To this end, constant attempts are being made globally to promote innovations that increase agricultural productivity and foster smallholder-led agricultural revolution. These innovations include improved agricultural practices, use of improved seed and fertilizers, agricultural mechanization and adoption of technologies, mainly because agricultural development means food security and overall economic growth (Gabre-madhin *et al.*, 2002).

The adoption of agricultural technological innovations is, however, a slow process as it is faced with constraints such as extreme weather conditions, liquidity constraints, culture and awareness, risk aversion and the lack of infrastructural facilities to mention few (Diagne and Demont, 2007). Besides the aforementioned factors, adoption of agricultural innovation primarily depend on adoption behavior of farmers. After being provided with an information, skill or technology, a farmer would decide whether to adopt a given innovation based on subjective conditions that may have been overlooked by researchers (Simtowe *et al.*, 2011).

## **2.5 Challenges in Adoption of NSA**

### **2.5.1 Knowledge and skill barriers**

The advances made in science and technology over the last few decades, are transforming the agricultural industry at an increasing pace and making agriculture a more knowledge-intensive industry. This has increased the complexity of farm-management practices in the developed nations. The NSA approach, which constitutes the diversification of production with nutritionally rich crops or animals, focus on value chains of nutrient-dense foods that meet local nutrient deficiencies, the incorporation of bio fortified crops and improvement in storage and processing in ways that maintain the nutritional content of food, would demand similar sophistication in farm management practices. All of these require intensive hands-on training schemes and the diffusion and transfer of knowledge (Mottram, 2015).

In Ethiopia, the need to fill the knowledge and skill gaps particularly the one on food and nutrition security is starting to be well recognized after decades of agricultural sector's partial impact on nutrition. The 2016 GTP II in its subsection 6.2 states that 'the government of Ethiopia is determined to build a nutritionally secure country through improved household food security, child and maternal care, and environment' (GTP II, 2016). The MoA along with several other stakeholders are currently targeting to work on the lack of sufficient and appropriate technology development and dissemination for post-harvest handling, strengthening the institutional set up and human resource capacity to fully integrate nutrition into the agriculture sector. This is particularly intended to increase the low level of awareness among the farming, agro-pastoral and

pastoral communities on optimal dietary practices, storage, food handling, processing, and consumption of nutritious foods from animal and plant sources (FDRE's National NSA Strategy, 2017).

### **2.5.2 Socio-cultural impediments**

Nutrition and dietary choices often depend on social influences that contain behavioral and psychological determinants. Among others, these determinants take into account factors such as peer pressure, socio-cultural norms, economic considerations and political values that may pose a challenge to dietary change. Societal dietary habits and practices are affected by socio-cultural factors that have been passed on from one generation to the other generation. The beliefs and practices regarding consumption of food at household and community levels have great influence on dietary diversity. Additionally, cultural, religious and traditional knowledge affect food and nutrition security by shaping a community's diet, intra household food distribution patterns, and child feeding practices, which in turn affects the intake of nutrient rich foods in children and adults (Alonso, 2015). With eating behaviors being acquired over a lifetime, altering societal habits and practices can be quite complicated indicating that dietary advices might be far easier to give than to accept and adopt (Nestle *et al.*, 1998).

### **2.5.3 Gender barriers**

Gender is a social construct of the roles, responsibilities and status given to men and women, boys and girls (Njuki *et al.*, 2011). This social construct together with the biological difference among both genders influences the nutritional status of an entire household. Gender based societal biases affect feeding and nutritional security through women's status in the community. Women's low status caused by deep-seated cultural barriers can have an aggravating effect on morbidity as well as related food intake problems. Unfortunately, inadequate attention is given to links between gender and food and nutrition security although there are compelling evidences that show gender-sensitive actions are effective in overcoming malnutrition and in accelerating the progress in food and nutrition security (FAO, 2012). In these regard, the power relationship in decision making and

equitability of access to resources and services between men and women are particularly important.

Gender sensitive food and nutrition security policies, strategies and programs greatly contribute to all rounded development since well-nourished people have the health and the physical strength necessary to bring positive change in social and economic development. There are empirical evidences that highlight how interventions overcoming the deeply entrenched gender inequalities could help in creating favorable conditions for rural women to act and improve their own and their children's nutritional wellbeing. According to a study conducted by IFPRI, when women and men had equal social status, the under-three child underweight rate would drop by approximately 13 percent, meaning 13.4 million fewer malnourished children in this age group alone (Smith *et al.*, 2003). Similarly, in South Asia, Africa south of the Sahara (SSA), Latin America and the Caribbean, women's social status in the household and community were found to have a positive impact on the nutritional status of children (Bold *et al.*, 2013). Same study demonstrated that the improvement in women's education was responsible for almost 43 percent of the total reduction in children underweight between 1970 and 1995. Improved nutritional outcome is also greatly affected by women's work, which leads to increased income, and henceforth influence decision-making on household income allocation. According to FAO, an increase in women's income by 10 US\$ achieves the same improvements to children's nutrition and health as an increase in a man's income by 110 US\$. In addition, farm yield could increase by 20–30% on average and reduce the number of people facing hunger worldwide up to 17% when women had the equitable access to productive resources (FAO, 2011 and FAO, 2012a).

Similarly, women's responsibility in feeding their families is strained due to lack of access to resources like that of access to land, education, information, credit, technology, and decision making power. The lack of access to resources is observed to have an adverse effects on child, maternal and women nutritional status (Oniang'o and Mukudi, 2002). The access to resources is also known to drive up empowerment in women. Empowerment, however, is much more than ownership of resources. It is the process by which those who have been denied the ability to make strategic choices and decision acquire such an ability (Kabeer, 1999). Essentially, empowerment is a multidimensional concept which can be indirectly measured through social norms, education status, labor market, marital status, legal frameworks, and ownership of land and other resources

of women. If empowered, women as primary caregivers can have considerable positive impact on the household's and especially their children's nutrition through their own nutritional status and childcare practices.

A study on the rural empowerment of women highlights numerous initiatives that found helpful ways to address gender issues in food and nutrition security. Among others, these involve the women empowerment indicators accommodating resource ownership, income, and socio-cultural dimensions (Okali, 2011). This is so because targeting women in development interventions is perceived to holistically improve the nutrition and livelihoods through the provision of childcare practices, women empowerment and overall household nutritional security. Gender-sensitivity in NSA is the most effective ways to tackle the widespread micro-nutrient deficiencies that affect one in three person globally, which commonly known as hidden hunger and the menaces of malnutrition associated stunting and wasting in children (FAO, 2018b).

Despite the previously mentioned significances in achieving overall nutritional security, the gender aspects of NSA are often neglected by development practitioners as they are considered too complex or as something that overburdens women who already have multiple roles and responsibilities in the household. In fact, the involvement of women in NSA related activities and their empowering could go a long way in addressing the food and nutrition insecurity and the overall wellbeing of the household. It can also be seen as a way to untangle several development shortcomings. However, it is important to note that attaching utmost attention to women in NSA intervention did not mean to exclude men. To this end, development partners should be mindful of accommodating men in NSA interventions. Engaging the entire member of the households and reaching out to both genders help avoid bias. This would contribute to the global agenda of promoting gender equality and the sharing of tasks between men and women within the household (FAO, 2012).

## **2.6 Outcomes of NSA Intervention**

NSA intervention is a nutrition-sensitive investment which intends to ensure better nutrition to all. In order to realize this goal, it is necessary to fulfil number of important conditions. These conditions include access to safe and nutritious foods, adequate care, and a healthy environment.

In the simplified impact pathways, six outcomes to agriculture and nutritional interventions are specified. These outcomes include on-farm availability, diversity and safety of food, food environment in markets, income, women’s empowerment, nutrition knowledge and norms, and natural resource management practices. The realization of these outcomes would result in improved diet and health, with ultimate positive impact on food and nutrition security (Herforth and Ballard, 2016).



Figure 1. Project result chain (NSA intervention) (FAO, 2012)

The flow diagram above highlights the chain of inter-linkages commonly encountered in NSA based projects. These chain of inter-linkages, which extend from inputs to impacts, help visualize the whole process and evaluate the NSA intervention implementation efficiency. Basically, the project progress monitoring is undertaken to assess the extent of association between the implemented activities and the realized results. The impacts of such projects are also measured through NSA outcome indicators. In the sections that follow these indicators are highlighted in some detail.

### 2.6.1 On-farm availability, diversity, and safety of foods

Agricultural programs that are destined to bring positive change in food or nutrition security primarily focus on improving household level food production and consumption. To materialize these, it is necessary to build the technical capacity of the household in agricultural intensification and diversification. These supports are commonly rendered by the government extension system and/or development partners (Chetail *et al.*, 2015), but the extent of these supports are very much limited. As a result, the extent of malnutrition continued to be high in a number of countries. The

above fact highlights the need for the capacity development in agriculture to incorporate dietary diversity in both production and consumption (World Bank, 2013).

The promotion of NSA practice would require a favorable agriculture policy nurturing sustainable intensification and diversification. Meaningful improvement in output per unit land or individual animal and the integration of complimentary enterprises would require supports that facilitate the increased access to crop and livestock related inputs and services. A household who is able to combine livestock rearing (poultry, dairy, or small stock fattening) with crop production, particularly with backyard vegetable and/or fruit production is nutritionally much better-off than the one who limited himself to a single farm enterprise. Mixed crop-livestock producers have to be supported to pursue such kinds of on-farm diversification (FAO, 2017a). The increased and diverse output of nutrient dense food of plant and animal origin are important to ensure food and nutrition security, and produce surplus for the market.

The main targets in NSA intervention for nutrient dense foods consumption are women of reproductive age (15 – 49 years) and children below two years of age (first 1,000 days). However, this does not mean that the other members of the household are excluded from similar pattern of dietary consumption. The indicator used to measure such dietary diversities is conventionally called the ‘Minimum Dietary Diversity – for women of reproductive age and young children’ (FAO, 2016). In the ‘Minimum Dietary Diversity’ assessment framework, 10 food groups are assigned for women of reproductive age, and seven food groups are assigned for young children. Women who consume five or more and young children who consume four or more from the assigned food groups are said to have a higher likelihood of micronutrient adequacy. The detail of these food groups are shown in the Table 1 below.

Table 1. Dietary diversity in women and children

<b>Food groups</b>	<b>Dietary diversity in women</b>	<b>Dietary diversity in children</b>
<b>1</b>	Starchy staple food	Grains, roots and tubers
<b>2</b>	Beans and peas	Legumes and nuts
<b>3</b>	Nuts and seeds	Dairy products
<b>4</b>	Dairy products	Flesh foods
<b>5</b>	Flesh foods	Eggs
<b>6</b>	Eggs	Vitamin A-rich fruits/ vegetables
<b>7</b>	Dark green leafy vegetable	Other fruits/ vegetables
<b>8</b>	Vitamin rich fruits and vegetables	
<b>9</b>	Other vegetables	
<b>10</b>	Other fruits	

Source: 'Compendium of Indicators for NSA' (FAO, 2016)

### **2.6.2 Food market environment**

Food environment in markets is an outcome that encompasses availability, affordability, convenience and desirability of diverse foods in the markets. Availability is the physical presence of specific foods that are promoted by the NSA intervention in the market place. Therefore, a program needs to primarily study the availability of nutrient rich produces before endorsing them to the beneficiary population. Affordability, on the other hand, is used to track the price of specific foods as well as a basket of food, and check whether or not the consumer can acquire them easily. A healthy diet requires diversity, which in turn requires affordability. The convenience component of food environment in markets encompasses the time and labor cost of obtaining, preparing, and consuming a food. Sequentially, even if all the above are met, desirability of a food source might decrease depending on the freshness, preventability and fluctuations in food safety (FAO, 2016). In recent years, Ethiopia has started to exhibit an increased agricultural commercialization due to increased gross agricultural production as well as the purchase behavior of households. This has, in more ways than one, spurred the amount of food consumed away from home. In 2011, food consumed away from home in the urban food budget was at 16%, a figure that is twice as high as

expenditures on vegetables and fruits (Minten *et al.*, 2018). In addition, consumption of marketed vegetables and fruits is 4 times less than consumption of marketed cereals, while animal products consumptions is even 10 times lesser. This shows that although food production and consumption is increasing at an increasing rate, achieving nutrition sensitivity in on and off-farm production and consumption is still a long way to go (Worku *et al.*, 2017).

### **2.6.3 Income**

At national level, poverty and under-nutrition are directly correlated, and overcoming one will pave the way to address the other. Furthermore, improved income increases households' ability to purchase and consume foods that are more nutritious. Practicing NSA equips one with the mental and physical resource to be more productive and become health conscious, which has a long lasting effect on human capital development and wealth creation. NSA intervention therefore has a direct influence on household income. Wealth indices such as asset scores and income or consumption data are used to measure this indicator (World Bank, 2013).

Income generation for nutrition is compulsory to attain an impactful NSA intervention. Although household income does not necessary ascertain adoption of NSA, it increase the likelihood of purchasing healthy foods, access to health care and education services. This is the reason behind why development agents' extension messages focus on income diversification along with production and dietary diversity. Financial inclusion of vulnerable groups through formal and informal credit systems is also a way to increase and stabilize income stream and consumption (FAO, 2017a).

### **2.6.4 Women Empowerment**

Women empowerment is considered as a key pathway to alleviate poverty and/ or improve investments in human capital. There is a wealth of research findings showing the positive associations between improved women's empowerment and enhanced nutritional outcomes. As a result, several agricultural and nutrition interventions consider women as their priority target beneficiaries (IFPRI, 2013). Child under-nutrition is also positively affected by women's status. From the year 1970 to 1995 alone, the reduction in child under-nutrition was attributed to women's

status and education, and the environmental health and national food availability. From these four determinants, the first two contributed 12 and 43 percent, respectively (Smith and Haddad, 2000).

The word ‘empowerment’ has several meanings depending on the context. When it comes to agriculture and nutrition, empowerment often deals with matters of autonomy, freedom, ownership and control over assets, self-awareness, agency, collective action, power and its redistribution, self-determination, participation, dignity, social inclusion, and choice (Ibrahim and Alkire, 2007). Women’s empowerment has several aspects including income, resource ownership, knowledge, decision-making power, and many more. NSA intervention is hypothesized to affect each of these factors at a different rate and intensity. The changes observed on these factors can be measured using the Women Empowerment in Agriculture Index (FAO, 2016).

### **Women Empowerment in Agriculture Index**

The Women’s Empowerment in Agriculture Index (WEAI) is a survey-based index designed to measure the empowerment and inclusion of women in the agricultural sector. It was primarily initiated in 2012 by the ‘Feed the Future Initiative’ to observe changes in women’s empowerment over time. Ever since then, the index has been used to measure gender parity and the state of women empowerment in agriculture by several institutions and organizations (Malapit *et al.*, 2015). Furthermore, the Index aims to increase the understanding of the existent of the link between women’s empowerment and food security and agricultural growth. It consists of two sub-indexes, the first one measuring the five domains of empowerment for women while the second measures the gender parity in empowerment within the household. The five domains in empowerment are decisions about agricultural production, access to and decision-making power over productive resources, control over use of income, leadership in the community, and time use. The gender parity measures women’s empowerment relative to men within their households. According to the five Domains of Empowerment Index (5DE), a woman is said to be empowered if she possesses four out of the five indicators in production, resources, income, leadership and time. The Gender Parity Index (GPI), on the other hand, measures relative inequality between male and female members of the household in the realm of the 5DE (IFPRI, 2012).

$$5DE = H_e + H_n (A_a),$$

Where,  $H_e + H_n = 100\%$  and  $0 < A_a < 100\%$ .

$H_e$  - the percentage of women who are empowered

$H_n$ - percentage of women who are not yet empowered

$A_a$  - the percentage of dimensions in which disempowered women have adequate achievements

Following the Foster Greer Thorbecke (FGT) “poverty gap” measure, the formula for Gender Parity Index:

$$GPI = \{1 - (H_{WGP} \times I_{GPI})\}.$$

Therefore, the 5DE is  $(1 - H_A)$ , and the GPI is  $(1 - H_I)$ .

Where  $H_{WGP}$  - the percentage of women without gender parity

$I_{GPI}$  - women who do not have gender parity (because they are not empowered, and their 5DE score is less than their male counterpart's)

The total Women Empowerment in Agriculture Index score is computed as a weighted sum of the country or regional-level 5DE and the GPI.

### **2.6.5 Nutrition knowledge and norms**

This aspect of the NSA outcome is separate from practices in consumption and production. It is an information an individual may acquire about NSA while accustoming to the social norms that affect caregiving, feeding and eating practices. Here, interventions promote nutritional behaviors in production, consumption and care practices. However, there is still a lag in making agriculture and rural development projects/ trainings nutrition sensitive because the concept is relatively new. And there is further need for instigating behavioral change and filling of knowledge gaps in the project systems (IFAD, 2015).

Care practice is an important aspect of nutrition knowledge outcome in NSA. It evaluates the mothers' knowledge and behavior when it comes to dietary diversity, feeding frequency and energy intake of children by breastfeeding status. It provides a useful way to track progress of

quality and quantity dimensions of children's diets (FAO, 2016). Several development partners in NSA are now promoting Social and Behavior Change Communications (SBCC), an initiative aimed at promoting doable actions for women smallholder farmers and their families. SBCC programs that are imbedded in NSA help capitalize on already existing agricultural interventions to improve nutritional outcome. It creates the platform for strategic communication in order to address social barriers and bring about behavioral change. This makes the community more open to adoption of both new and improved ways of doing things.

WASH and SBCC interventions focus on five pro-nutrition behaviors (USAID, 2015). These include:

- ✓ *Raise and grow* – this aspect includes engaging women in raising livestock and poultry, growing nutrient-dense vegetables or fruits for home consumption, sanitizing and keeping a hygienic household.
- ✓ *Earn and buy* – here, women smallholder farmers and their families are encouraged to earn agricultural income and then use the money to improve household dietary consumption and health by buying animal source foods, nutrient-rich vegetables or fruits, and cleaning materials like soap from the market.
- ✓ *Prepare, preserve and store* – the intervention demonstrates the preparation and preservation of nutritious meals and snacks in order to reduce spoilage as well as waste.
- ✓ *Rest, share and eat/feed* – rural women are commonly faced with laborious activities even at times of pregnancy and breast feeding. This initiative promotes reduced workloads during these times. It also strives for increased and equitable share of food for the women in the family.
- ✓ *Relate, communicate and decide* – this aspect looks closely at gender and family roles, and works on instigating communication and understanding within a household so that decision making could become more informed and fair. Additionally, it tries to engage men in pro-nutrition activities. This approach has a tendency to reduce gender based violence at home.

### **2.6.6 Natural resources management practices**

The indicators for this outcome include access to improved and efficient drinking water source. This includes the water quality to be used in food production ranging from home production and consumption to provision for external consumers. It also incorporates the promotion of mitigation based agricultural practices in restoring soil productivity as well as provision of adequate sanitation facilities both at home and at the level of health institutions (FAO, 2016).

Maintaining and improving the natural resource base is crucial for attainment of sustainable intensification in diverse production as well as healthy consumption. The methods currently employed by development agents include integrated farming systems (e.g. agro-pastoral systems, legume-based cropping systems including crop rotation and intercropping), ecosystem-based strategies and water conservation and land rehabilitation methods. Incentives and regulations are needed to further encourage initial adoption of sustainable practices (FAO, 2017b).

## **2.7 Impact of NSA**

An improved status of nutrition is important for social and economic development. This has forced many global development initiatives to prioritize the issue in their policies and strategies (FAO, 2014). Combating malnutrition is central to FAO's corporate strategic objectives. This strategic objective calls for a holistic approach that imbeds nutrition objectives into agriculture, health, education, economic and social policies. Ending hunger, achieving food security, improving nutrition, and promoting sustainable agriculture is also recognized as SDG 2 (FAO, 2017a). Despite the concerted effort to improve situations, under-nutrition continues to weigh heavily on global growth and development. With under-nutrition contributing for 3.1 million child deaths annually and affecting the nutritional wellbeing of over 10% of women in Asia and Africa, the world is more in need of any measure that can be taken to ascertain the health and development of communities so as to tackle the issue (Black *et al.*, 2013).

There are three forms of under-nutrition. These are acute, chronic and micronutrient under-nutrition. Acute under-nutrition is short term (days to weeks) wasting (low weight for height) in children, leading to illness and even death. It is estimated to affect 52 million children under 5

years of age. Chronic under-nutrition, on the other hand, is a long term (months to years) dietary intake deficiency which causes stunting (low height for age), leading to long term impediments to education, work and overall productivity. It is estimated that 165 million children under 5 years of age are affected. Micronutrient under-nutrition differs from the above two as it is caused by insufficient intake of essential vitamins and minerals, and has a far reaching effect of more than 30% of children under 5 years of age suffering from it. It causes irreversible blindness and lower cognitive function (UNICEF, 2012).

Until recently, most of the efforts undertaken to overcome under-nutrition globally focused on interventions that promote breast feeding, food fortification, and dietary supplements. However, these solutions although effective in reducing related child deaths, stunting and wasting, do not tackle the roots of the underlying causes of the problem. This calls for a more thorough nutrition sensitive intervention that integrates agriculture, sanitation, water, and education components into the mix. NSA aims for the same goals as the nutrition specific interventions in the past, i.e. reducing deaths and ailments on children and women contributing for under-nutrition (Ruel *et al.*, 2013). However, the new intervention direction specifically emphasizes on agricultural investments that improve nutritional status and hence good health and well-being. A Multi-Sectoral Nutrition Strategy for NSA was designed by USAID to determine how these nutrition sensitive agricultural interventions can directly impact nutrition and food security. The technical brief was able to incorporate three pathways of implementation, namely agricultural income, food production and women's empowerment. These constitute of outcomes that brings positive impact provided they are given a focus in NSA interventions (USAID, 2014).

## **2.8 Empirical Literature**

Work by IFPRI (2013) reviewed vast number of empirical literature relating NSA interventions to welfare outcomes on nutrition. The review concluded that the NSA intervention have had positive influence on women's and children nutrition, production diversity, household income, women empowerment, and nutrition knowledge and norms. In another work, the extent of the positive change on aforementioned welfare outcomes was noted to vary by the literacy level of women participating in NSA programs (Bold *et al.*, 2013). Other observations do highlight similar

association of marital status and age of women with the adoption of innovations on agricultural and nutrition practices.

An impact evaluation study on a project that targeted women in Benin showed an increment in both production and consumption of fruits and vegetables due to NSA interventions. The same study demonstrated the marked improvement in household income among households benefitting from the NSA intervention (Alaofe *et al.*, 2016). Similar improvement in income as well as the passion of farm animals were documented in NSA project implemented in Nepal (Miller *et al.*, 2014). In Burkina Faso, NSA related support increased the area put to home garden production and significantly improved women's and children's MDD (Olney *et al.*, 2016)

In addition to improvements in income and production and consumption diversity, the NSA intervention enhances women empowerment. This is so because increased women empowerment improves the nutrition of the household (Okali, 2011). Studies has empirically showed that women's control over land, other productive assets, income and the power to make decision reduces the prevalence of child malnutrition (Rahman *et al.*, 2015; Allendorf, 2007). Women's ability to earn and control income is important to the overall nutritional security of the household since such opportunities allow women to spend their earnings on the nutrition and healthcare of their families (UNICEF, 2011; Smith *et al.*, 2003).

A cross-sectional impact evaluation study conducted in Zambia with an intervention and control group showed that NSA intervention was able to affect nutrition knowledge along the agriculture-nutrition pathways (Kumar *et al.*, 2017). In a similar study that was conducted in Rwanda, training of women in NSA practices improved the production, consumption and overall child health (Rawlins *et al.*, 2014).

## **2.9 Conceptual framework**

The conceptual framework for the study is shown in Figure 2 below. Basically, the NSA intervention works on women's understanding and behavior change when it comes to nutritional status. The conceptualized framework shows how the NSA intervention affects four visible outcomes in the beneficiary households. Amongst these, this study covered on-farm availability,

which encompasses the household dietary consumption and production. The NSA intervention also tries to provide households with practical and informative tools that enable them to adopt the recommended practices. This was included as a nutrition and health knowledge outcome variable. The women's empowerment component of the outcomes was based on the intervention actions (Social and Behavioral Change Communication (SBCC) strategy) that are projected to affect women empowerment through community engagement and awareness creation interactions. Finally, the intervention promotes the adoption of NSA which might affect an outcome of change in household income. In addition to increased annual income, this can also be observable from increased production/ productivity and consumption.

As previously stated, FAO identifies six NSA outcomes that are used as indicators to measure the realization of the NSA approach (FAO, 2016). In this study, four NSA outcomes are used to construct the conceptual framework. The NSA intervention is, therefore, analyzed for its effect over the four desired outcomes namely on-farm availability, household income, women's empowerment and nutrition knowledge.

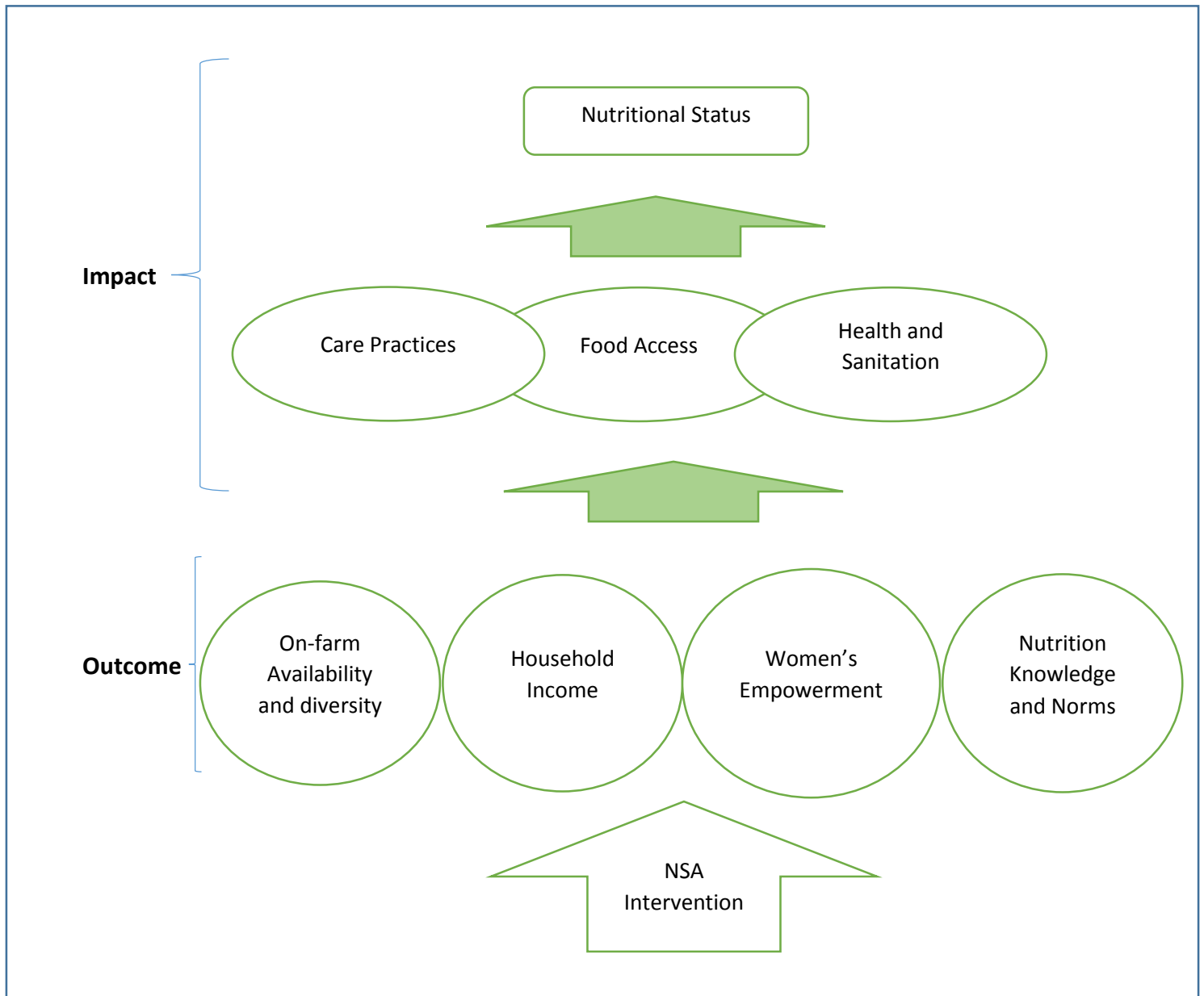


Figure 2. Conceptual Framework

*Adapted from 'Compendium of Indicators for NSA' (FAO, 2016) and modified to suit present study purpose*

## CHAPTER THREE

### 3. METHODOLOGY

#### 3.1 Study Area

Geographically, North Shoa Zone is situated in the central highlands of Ethiopia. Agriculture, which constitute the principal source of livelihood in the Zone, provides food, cash income and security. The major staple food crops grown in the study area include wheat, teff, sorghum, barley, bean, and lentils. Vegetables like cabbage, carrot, onion, garlic, tomato, potato and Swiss chard are also grown in the area. Livestock rearing is an integral part of the farming system. Livestock products notably, milk and egg complement the household dietary intake, although the level of consumption is erratic and insufficient. This is associated with the status of resource ownership and socio-cultural factors (FAO, 2018a). Livestock production is practiced in all 24 NSA beneficiary woredas of the Zone. Among them, the dominant livestock keeping woredas are Angolela Tera, Basona Worena, Moret Ena Jeru, Siyadeber Ena Wayu, Menz Gira, Menz Mama, Menz Lalo, Gishe Rabel, Moja, Menz Keya and Debre Berhan.

The MoA undertakes different development initiatives contributing to the improved livelihood of the farming community in North Shoa Zone. Among these is the Natural Resource Management (NRM) program. Considering the predominantly rugged terrain of the Zone, there is a need to have strong NRM practices across all woredas. Presently, the Growth through Nutrition (GTN) program targets five woredas of the Zone through its NSA intervention. Another one Woreda in the Zone also benefits from similar intervention that is supported by FAO. The GTN woredas are Antsokiya Gemaz, Qewet Tarmaber, Basona Worena, and Moret Ema Jeru while the one targeted by FAO is Siya Deber Woreda.

The study was conducted in one of the GTN project NSA intervention beneficiary woreda and in another woreda in the Zone where no such NSA intervention is provided to the target communities. The NSA intervention and non-NSA intervention woredas were selected for the study based on the similarity of their socio-cultural background, challenges of chronic food and nutrition insecurity, and accessibility. Both of the study woredas lie along the Addis Ababa – Dessie main

highway, and are within reasonable (less than 30 kilometers) proximity to the Zone's capital city, Debre Berhan. Basona Worena is the NSA intervention woreda, whereas Angolela Tera is a woreda with no NSA intervention (control).

## **3.2 Research Design**

This study uses a cross-sectional research design. Therefore, the data was based on the differences that are existing within the sample, instead of measuring for change that has occurred due to the NSA intervention over time. Hence, this study measures the impact of intervention on welfare outcomes at the time the study was done.

### **3.2.1 Site Selection**

One NSA beneficiary woreda and an additional one woreda with no such NSA intervention were purposively selected within North Shoa Zone in consultation with Federal MoA, North Shoa Agriculture Development Office and Save the Children. The two woredas have similar socio-economic features, which are relevant to measure the extent of changes realized due to the focused NSA intervention. Additionally, these woredas are selected for this study because of their logistical convenience and demographic similarities. The NSA beneficiary woreda is Basona Worena, while the corresponding non-NSA intervention woreda is Angolela Tera.

### **3.2.2 Sampling Techniques and Beneficiary Identification**

A comparative, cross-sectional study design was used, with the data and information collected using a key informant interview, formal structured questionnaires and semi-structured questionnaire techniques. The subjects of the key informant interview were officials and experts drawn from Zonal and Woreda Agriculture Development Offices and Save the Children Offices who have experience in issues pertaining to food and nutrition security in North Shoa Zone. These individuals were systematically identified based on their involvement in NSA programs and the

relevance of the department or units to the research subject. The key informant interview focused on issues such as socio-cultural NSA adoption barriers in women, sources of livelihood, gender relations and resource access, challenges in the promotion of NSA practices and its impact. The key informants' interviews were also used to explore the existence of gaps in empowerment and equality actions undertaken by various actors in the study area.

For the formal structured questionnaire interviews, women of reproductive age, of which mothers and caretakers with children of less than two years of age, were included. A purposive sampling technique was used in the selection of study woredas. From each study target Woreda, 131 respondents were randomly selected with minor variation in the selection process. The selection process for the GTN program is poor households, while similarly the selection process for the non-beneficiaries in the study is poor and safety-net beneficiary households. In Basona Worena Woreda, the 131 respondents were drawn from a pool of GTN beneficiaries, whereas the same number of respondents were randomly selected from Angolela Tera Woreda from the safety net beneficiary households. Data gathered from women members of the households in the village constitute the main source of information, though additional information were collected from other sources in the Zone. Additional relevant data and information were gathered during the course of the field work.

The NSA intervention beneficiary households were selected by the project staff based on their living standards, priority given to poorer households. Therefore, representative households for the study are selected randomly from NSA training beneficiaries for the intervention group. As for the control group, food insecure households with a similar socio-economic setting were selected. Preference was given to households with women who have a child of less than two years of age in both groups. The structured interviews have captured various socio-economic data in relation with NSA practice adoption among the selected rural women. Among others, these include women empowerment, production and consumption of diverse foods, household income, and acquisition of nutritional and health knowledge.

### 3.2.3 Sample Size

The required sample size was determined by the proportionate sampling methodology (Anderson *et al.*, 2007). It was used to determine the total sample size which includes both the NSA intervention beneficiary and non-NSA beneficiary population. The minimum sample size was made by assuming that 50% of the individuals included in the study adopt the NSA methods, with a marginal error of 6% and 95% confidence interval.

$$N = \frac{Z^2 pq}{e^2}$$

Where:

e = the desired level of precision, i.e. margin of error

N = the desired sample size

Z = the standard deviation at the required confidence level

P = the proportion in the target population which has the attribute in the question

q = 1-p

$$\text{Thus, } N = \frac{1.96^2 \times 0.5 \times 0.5}{0.06^2} = 263$$

In accordance to the single proportion formula, the suitable sample size is 263. The inclusion criteria is any randomly selected mother/ caregiver from a household in the selected villages. In order to assign equal number of intervention and control groups for comparison, 131 sample respondents were taken from each group. Equal number of respondents from each group were selected so as to avoid bias that may arise from differences in sample size.

### **3.2.4 Data Collection**

The detailed socio-economic data and information collection was conducted in March, 2019. The structured interview questionnaires and key informant interview checklists were introduced to the women members of the household and key informants, respectively. The tasks of the data and information collection were conducted by the principal investigator with close support from development agents in the two study woredas. In the course of the data collection, most relevant socio-economic data that help understand the extent to which the NSA practice benefits the households in the selected woredas were gathered. Among others, the collected data cover women's resource access, women's control over income generating farm and off-farm activities and the purpose it is used for, and changes observed in terms of decisions making. In addition, the interviews gathered data on cultural norms, income, household health and nutrition.

The key informant interview was conducted using a semi-structured checklist and series of discussions with respondents. The respondents were experts working directly or indirectly with NSA both in North Shoa Zone and Amhara Region at large. Among these are NSA experts at the MoA, gender and nutrition specialists at Save the Children Office, and NSA experts and technical staff of the Zonal Office of agriculture in North Shoa Zone and in the respective woredas of Angolela Tera and Basona Worena Woredas.

## **3.3 The NSA Outcomes Assessment Framework**

Research conducted in developing countries show that adoption of NSA interventions are affected by a number of socio-economic conditions (DFATD, 2014). Some of these studies have identified a positive correlation between the NSA interventions and the desired NSA outcomes (FAO, 2017a). In the present study, the outcomes of interest are household resource endowment, women's empowerment, on-farm diversity and knowledge acquisition. Women's empowerment function considers the aspects of access to and control over resources, income and decision making power and women's involvement in social groups, which are observed as outcomes positively influenced by NSA intervention. These empowerment variables are aggregated and measured through an

index with values ranging from 0 to 1, where all the components of women empowerment have equal weight (IFPRI, 2012).

To assess the NSA outcomes, the study employed FAO's 'Compendium of indicators for Nutrition-Sensitive Agriculture framework'. According to this framework, the extent of the NSA practice application is measured along six components. Namely:

1. On-farm availability, diversity, and safety of foods
2. Household income
3. Women's empowerment
4. Nutrition knowledge and norms
5. Food environment in markets - off-farm availability, diversity, and safety of foods
6. Natural resources management practices – access to drinking water

The extent of the observed changes in NSA outcomes, which came into being due to the NSA intervention, were assessed employing indicators established by FAO. Of the six indicators recommended by FAO, the first four were used in the present study to assess the adoption and application of the NSA practices. The remaining two outcomes are not considered because of the absence and difficulty of getting reliable figure on exposition of outcomes among the households. In this study, women empowerment was measured along the four domains of indicators namely access and control over resources, decision making ability, leadership and independent income.

Consumption score was calculated using an instrument where the dietary diversity questionnaire was used. The administered questionnaire comprise of two questions with seventeen choices (7 for the child and 10 for the mother). The choices were aggregated into seventeen food groups to create the household dietary diversity score as suggested by Coates *et al.* (2007). In this study, food production captures the aspects of household ownership of livestock and garden vegetables. The production and consumption factors were analyzed employing the Principal Component Analysis (PCA) in order to find one component that reflects mother's diet, child's diet, animal ownership and garden vegetable ownership. The computed score represents the on-farm dietary diversity of households in dietary production and consumption.

## 3.4 Method of Data Analysis

### 3.4.1 Description of Variables and Hypothesis

In this study, the effect of NSA intervention on the selected four welfare outcome variables is measured. Therefore NSA intervention is an independent variable while the remaining 4 variables of on-farm diversity, household income, women empowerment and nutrition knowledge are dependent variables. Considering this, the effect of NSA intervention will be measured along all four outcomes independently. The dependent variables hypothesized to be influenced by the explanatory variable (NSA intervention) are described below.

1. **On-farm availability, diversity, and safety of foods:** This is an outcome variable comprising of both the production and consumption of improved dietary diversity. In addition to NSA trainings, the intervention provides seeds and poultry to NSA intervention beneficiary households. Therefore these beneficiary households are more likely to diversify their household production as well as their dietary intake.
2. **Household income:** The household income refers to total annual earnings of the household from both on-farm and off-farm activities. This is believed to be the main source of capital for the application of NSA recommended production and consumption. Considering this, NSA intervention promotes the diversification and intensification of production which can be used both for home consumption and market sales. Thus, greater income level is expected from households that participated in the intervention than those who have not.
3. **Women's empowerment:** This aspect of the welfare outcomes refers to the four domains of women's access and control over resources, decision making ability, leadership and independent income (IFPRI, 2012). The NSA intervention provides beneficiary women with minor inputs and community engagement opportunities. These are both leading factors in their generation of independent income and participation in groups, respectively. The women empowerment outcome index is therefore expected to be higher for women who have participated in the intervention than those who have not.
4. **Nutrition knowledge and norms:** The core part of the NSA intervention are physical demonstration inclusive trainings. In these trainings, NSA knowledge and practices are advocated through extension agents. Mothers/ caretakers from beneficiary households are

also given health and childcare tips. Therefore, NSA intervention beneficiary women are expected to have a higher knowledge in nutrition and health.

### 3.4.2 Model Specification

The econometric model, which is used in this study, assessed the effects of the NSA intervention on the desired welfare outcomes. In other words, the analysis was used to determine whether the NSA intervention had achieved the anticipated objectives. Here,  $\alpha_{it}$  is the effect of the intervention on individual  $i$ 's at time  $t$ . It is the difference between the potential outcome of intervention group ( $Y_{it}^T$ ) after being part of the intervention and the potential outcome of the control group ( $Y_{it}^C$ ) without participating. This can be reckoned through:

$$\alpha_{it} = Y_{it}^T - Y_{it}^C$$

The Average Treatment Effect (ATE) was the mean effect of the program on individuals randomly selected from both control and intervention groups' population. This value was calculated as follows:

$$ATE = E(\alpha_{it}) = E(Y_{it}^T - Y_{it}^C) = E(Y_{it}^T) - E(Y_{it}^C)$$

A Propensity Score Matching (PSM) model was used as suggested by Rosenbaum and Rubin (1983), to match the scores of those who were part of the intervention to those that were not. The mean difference between the two groups was then accredited to the GTN program's NSA intervention (Gertler et al., 2012).

$$ATE = E[Y_{it}^T(t=1, D=1) - Y_{it}^C(t=1, D=0)]$$

$t=1$  is the period post-intervention

$D=1$  is program participation

$D=0$  is non-participation

The PSM model was chosen over other methods for its advantages. Primarily, as the model is a non-experimental method, it applies in this study considering GTN intervention does not have experimental non-beneficiary women (control groups). In addition, other models like the

difference-in-difference were not applicable as they require baseline data about the welfare status of the women before the treatment. On the other hand, the model was preferred over regression discontinuity method as it does not require large number of respondents in order to draw a significant result. Although instrumental variables and encouragement design approach can be used, finding an appropriate instrumental variable that affects participation and not the dependent variables on ex post evaluation is proven to be difficult, despite the approach's ability to solve the problem of self-selection. PSM assumes, in addition to the difference in treatment between intervention and non-intervention groups, there exists a variation in characteristics that affect outcome between the two groups.

The PSM model was helpful to analyze the extent of influence that the intervention program has on adoption of the NSA practices, specifically with respect to the realization of the NSA outcomes considered in this study. After calculating for the propensity score, each individual participant of the NSA program was matched to a non-participant with a similar propensity score. There are four types of matching methods which can be used to compare the outcome of a program beneficiary individual with the outcome of the control. These are:

*Nearest Neighbor Matching* – In this approach a match with the closest propensity score is found for the intervention group from the control group. A match from the control group can be used once without replacement or more than once with replacement. This choice can be made based on the sufficiency of the data because replacement can cause trade-off between bias and variance in analysis.

*Radius Matching* – This approach is similar to nearest neighbor matching, with an addition of a tolerance level on size of the difference between propensity score of the beneficiary and non-beneficiary individual. This makes the radius matching method more likely to drop bad matches, yet it also might have fewer matches because of this.

*Kernel Matching* – This matching method uses weighted averages of all individuals in the control group to estimate the counterfactual outcome. It uses more information, hence lowering the variance. Yet, is more prone to the use of bad matches causing a tradeoff between bias and variance similar to the others.

*Stratification Matching* – This method uses an interval in order to divide the common support of propensity score and then match the intervention and control groups within each interval. Although a rich dataset is needed, it has an advantage over the others as the estimation is based on many more observations enabling it to provide better matches.

A matching algorithm is picked for a research study based on the sample data collected, with an inevitable trade-off between bias and variance. Bias can be reduced through the quality of the information used to construct the counterfactuals, which causes lower variance and hence a better match for the intervention group. All intervention group observations whose propensity score is higher than the maximum or lower than the minimum propensity score of the control group have to be dropped. There is also a common support condition which can be used as a guide in selection of matching methods. This condition is more important when the nearest neighbor with replacement and kernel methods are used as the counterfactuals (Sianesi, 2001).

There are still some shortcomings associated with matching. Amongst these is the need for quality covariates as unobserved variables might cause selection bias. However, it is advantageous as in the absence of baseline data, it finds close matches from the control group to the intervention group. Therefore, first, a propensity score on the basis of a probit model was estimated for this study. Then a matching approach was selected based on the aforementioned pros and cons to the approaches. For this study a stratification approach was used for interpretation of the results as it provides better matches compared to nearest neighbor and creates intervals making interpretation that much easier. Despite this, ATE and t value of every approach was presented for comparison in this study. The common support condition was also checked to see if it was satisfied.

The first step taken in calculating the propensity score is to define the intervention and control group and the relevant outcome variables. The two groups of the target populations in this study were one woreda with NSA intervention participants and another with non-NSA participants. Individuals who are part of the GTN program's NSA intervention were primarily selected based on their living standards. These are individuals living in households recognized as poor by the extension program. In the random selection process of this study, the control group selection was done after a detailed description of the intervention group was finalized. This was done so as to make the control group most similar in demography as well as socio-cultural background to the intervention group. Finally, eligibility of the individuals in the control group was checked based

on their living standards and participation in safety net program offered by the Zonal Agricultural Development Office.

After the selection and assignment of the NSA intervention and control groups, an effort was made to find observable characteristics that might affect the outcome of the program. These variables were first selected through review of previous works concerning the NSA program participation and then used for matching. These are then used to control for background information which could possibly influence the NSA outcome indicator of an individual. For this particular study, the variables age, marital status and literacy were considered. This measure is assumed to identify households that will be similarly affected by the intervention and hence are most comparable.

### **3.4.3 Data entry and analysis**

The data and information gathered through the key informant interview were analyzed and tabulated employing the descriptive statistics. On the other hand, the socio-economic data that were gathered through structured interviews were cleaned and entered using STATA Version 13.1 Software. The data was then analyzed using descriptive statistics and econometric regression analysis. Using the comparative cross-sectional study analysis, the socio-economic backgrounds of the women in the NSA beneficiary households were compared with the ones that did not benefit from NSA intervention.

The dependent variables of the welfare outcomes were measured through the PSM model which helped in the matching and then comparing of the responses of the rural women respondents in the selected study woredas. The factors examined under the adoption outcomes were on-farm dietary diversity, women's empowerment, household income and the acquisition of health and nutrition knowledge. The analysis of the on-farm dietary diversity utilizes the PCA method, the extent of women empowerment was assessed based on FAO suggested indicators (See Section 4.2 and 4.3).

## **CHAPTER FOUR**

### **4. RESULTS AND DISCUSSION**

The results and discussion section covers the detail account of the findings of the study, which are presented below under different sub-sections. In the first section, the socio-economic features that relate to the situations of food and nutrition security and resource endowment of the rural women in the study area were dealt in some detail. The sections that follow focus more on the status and effects of NSA intervention on desired welfare outcomes. Essentially, the status and the extent of the impacts of NSA intervention was assessed in relation to the indicators commonly used for measuring changes observed in NSA welfare outcomes.

#### **4.1 Descriptive Statistics for Household and Demographic Variables**

##### **Marital status**

The study tried to explore the marital status of the women respondents in order to assess whether these characteristics affect the rural women's application of the NSA practices and hence alter the dietary diversity of women and their children. The findings of the marital status assessment of the women included in the present study indicated that the majority of the women (69%) were married and only small portion (4.5 %) of the women respondents were single (Table 2). In married households, traditionally the decision making power largely rests in the hands of the husband. Discussions held among the respondents in the same category of households' revealed similar situation. In the study area, a good share of the women respondents (26.5%) do assume the sole responsibility of leading their households' only after they lose their marriage partners either due to divorce or death. Small portion of unmarried singles exercise similar household leadership role. In either of the women led households, scope and the burden of caring and fulfilling the welfare of the household is much higher than their married counterparts. Although these categories of women are technically better off with respect to the authority to make decisions on issues that matters to them, they remain disadvantaged when it comes to the ownership and control over

resources and accessing services. As learnt from the respondents, these categories of households possess small size farm plots, own small stocks and limited sources of income in comparison to the male-headed households. These situations could have an obvious and negative implication on the nutrition of the family.

Table 2. Marital status of the respondent women

<b>Marital status</b>	<b>Frequency (N=262)</b>	<b>Percent</b>
Single	12	4.50
Married	181	69
Divorced	30	11.50
Widowed	39	15

## **Age**

The Table 3 below shows that most of the respondent women were in the active reproductive age group (97%). As observed during the course of the study, most respondents in these age groups have more than two kids. These are the most nutritionally vulnerable groups as the demand for better nutrition for the young children and the nursing and pregnant is so high. The age structure of the respondents was skewed towards the active reproductive stage. This does imply that the likelihoods of the reception for NSA related intervention would comparatively be high. This fact has already been verified in the course of the discussion. Most of the respondents indicated that they are aware of the importance of NSA and its benefit on the household nutrition. However, they are constrained to apply the practice due to limited source of livelihood opportunities.

Table 3. Age distribution

<b>Age group</b>	<b>Frequency (N=262)</b>	<b>Percent</b>
18-30	116	44
31-45	138	53
46 years and above	8	3

### **Literacy**

The distribution of total sample respondents in terms of literacy level has shown that 51 percent were literate and hence can read and write. The other 13 percent of the respondents are at least capable of writing. Such fairly high level of literacy has positive implication on the adoption and dissemination of extension messages relevant to NSA or to any other forms of improved agricultural practices. The level of education is useful to increase women's ability to obtain, process, and use information relevant to the adoption of NSA practices. Furthermore, education increases the probability of adoption of improved dietary diversity, empowerment and nutrition knowledge accumulation. From what has been learnt from the discussion, relatively the literate categories of the respondents try to apply some components of the NSA practices for the betterment of their families' nutrition.

Table 4. Women's literacy

<b>Literacy status</b>	<b>Frequency (N=262)</b>	<b>Percent</b>
Neither read nor write	94	36
Read only	34	13
Read and write	134	51

## 4.2 Household Resource Endowment

### Garden vegetable, poultry and livestock ownership

The resources ownership status of the respondent households is shown in Table 5 below. In this study, the resources considered are those promoted by the NSA practices and include garden vegetables, poultry and livestock. As noted in the study, the majority of the households (67%) possess livestock including large ruminants, small ruminants and poultry. Comparatively, this group of households have fairly reasonable level of resource endowment. The households that make up 24% of the population possesses small stock and are still regarded as poor in the area. The remaining 9% of the respondent households are extremely poor and have no livestock resources. So when the households owning small stock are combined with those having no single animal, the poor segment of the population rises to 33%.

Table 5. Ownership of poultry and livestock

<b>Animal ownership</b>	<b>Frequency (N=262)</b>	<b>Percent</b>
None	23	9
Poultry	39	15
Poultry and small ruminants	24	9
Poultry, small and large ruminants	176	67

The livestock ownership status has profound implication on household food and nutrition security. It is likely that the households who own no livestock or few heads of poultry and small ruminants have a limited scope to consume animal source food. In terms of livestock ownership, households that own all mixes of animals including cattle comparatively have better chance of meeting the household food and nutrition security, although the reality is quite the contrary. Discussion with the respondents reveal that much (59%) of the animal products are marketed to generate income, while the rest of the respondents (41%) either use the whole of their production for home consumption or use half of the produce for sale and the other half for consumption.

Table 6. Level of home produced livestock products consumption

<b>Animal Ownership Practice</b>	<b>Frequency (N=239)</b>	<b>Percent</b>
Fully consumed at home	43	18
Partly consumed & partly sold	55	23
All sold	141	59

Over half (58%) of the respondents in the study area owned garden vegetables, while the remaining 42% do not own vegetable plots at all (Table 7). Households growing vegetables on fairly reasonable size of plots use the produce both for home consumption and for sale. On the other hand, observations indicate that households with small size garden plots either consume or sale the entire produce.

Table 7. Ownership and use of garden vegetable

Own garden vegetable	<b>Vegetable practice</b>		<b>Total Frequency (N=262)</b>	<b>Percent</b>
	<b>Usage</b>	<b>Percent</b>		
Own garden vegetable	Own consumption	27	152	58
	Sales	14		
	Both	59		
Lack garden vegetable	Solely market dependence		110	42

The findings of the present study indicate that mothers/ caretakers make conscious decision regarding the use of the home grown vegetables to improve household nutrition and generation of additional income. Similar observations were also noted in Malawi where the home production of vegetables brought positive change in households' dietary intake and income (Malapit *et al.*, 2015). In addition, the work in Malawi clearly demonstrated the positive association between production diversity and maternal and child dietary diversity.

## **Consumption status**

### ***Minimum dietary Diversity in women***

MDD guideline advocates the consumption of 10 food groups' for mothers in the reproductive age group and 7 food groups for children of less than two years of age. By using the 24 hours recall method, consumption data was collected from respondents. In order to fulfil the acceptable minimum nutritional diversity, women are required to attain the daily consumption of at least 5 or more food groups, whereas children are required to attain the daily consumption of at least 4 or more food groups.

As shown in Table 8 below, the NSA intervention has allowed women meet the desired MDD consumption. Among the rural women receiving the NSA training, 77% of them were able to achieve MDD. However, it was only about 35% of the non-beneficiary women who managed to achieve the same result. Over 64% percent of the non-beneficiary women respondents fall short of meeting the recommended minimum standard, while the proportion of the beneficiary women who fall in this category were 23%. This figures show the positive effect of the NSA intervention on women's dietary diversity. In other words, this implies that the daily dietary diversity increases with participation in the NSA program.

As learned from the study respondents, the dietary diversity of the NSA intervention beneficiaries is somehow lesser than that could have been possibly achieved due to religious factors. In North Shoa where 95% of the population is practicing the Orthodox Christianity, adults are required to abstain themselves from the consumption of animal products in certain days of the week and in some parts of the year. Certainly, this restriction has lowered the observed women's dietary diversity. The restriction have had negative consequence on the health and wellbeing of pregnant and nursing mothers, and breastfed infants.

Table 8. Dietary diversity in women

Mother's food group consumption	Non-beneficiary		Beneficiary		Total frequency (N=262)	Total percentile
	Frequency (N=131)	Percent	Frequency (N=131)	Percent		
1	1	0.76	0	0	1	0.4
2	9	6.8	0	0	9	3.5
3	34	26	11	8.3	45	17
4	41	31.3	20	15.2	61	23
5	18	13.7	31	23.6	49	19
6	17	13	29	22	46	17
7	7	5	24	18.3	31	12
8	3	2.3	9	7.8	12	4.6
9	0	0	5	3.8	5	2
10	1	0.7	2	1.5	3	1

### *Dietary diversity in children*

The MDD for children under two years of age is defined as the attainment of four out of the seven food groups for children. Analysis of the indicator requires data on breastfeeding status, dietary diversity and number of semi-solid/ solid feeds (Mottram, 2015). The Table 9 below shows the dietary diversity in children below two years of age, disaggregated by intervention that was received by their mothers or caretakers. According to the study findings, 88.5% of the children from the intervention group and 63.5% of children from non-intervention group have achieved the minimum and above the MDD. Although the difference between the two was not large, the NSA intervention has brought some improvement in the dietary diversity of children. Similarly, the proportion of the children that fell short of meeting the recommended MDD is smaller in NSA intervention beneficiary households than the children from non-beneficiary households. As shown in Table 9 below, only 11.5% of the children from trained group and 36.5% of children from non-intervention groups did not get the recommended MDD. This clearly shows the positive effect that the NSA intervention had on the dietary diversity of children.

Table 9. Dietary diversity in children

Children food group consumption	Non beneficiary <sup>1</sup>		Beneficiary <sup>2</sup>		Total frequency (N=262)	Total percentile
	Frequency (N=131)	Percent	Frequency (N=131)	Percent		
1	0	0	0	0	0	0
2	17	12.9	2	1.5	19	7.2
3	31	23.6	13	10	44	16.7
4	43	32.8	30	23	73	28
5	22	17	26	20	48	18.1
6	17	13	21	16	38	14.5
7	1	0.7	39	29.5	40	15.5

<sup>1</sup> Children belonging to non NSA beneficiary women

<sup>2</sup> Children belonging to NSA beneficiary women

## Household income

Household income refers to the annual collective earning of the family. The sources of income varies for different households depending on their wealth status. For the majority of the respondents, the household income come from the sale of the on-farm and home garden produced agricultural products, the sale of local beverages, and wage earned from off-farm labor or public works (e.g. safety-net programs). Few households also compliment their income to a small extent from remittance. The agricultural products that are brought to the market to generate income include grains and vegetables, livestock and poultry, livestock products (dairy products and eggs).

Table 10. Average annual income (ETB)

NSA intervention	Beneficiary	Non beneficiary
Number of observation/respondents	131	131
Mean income	15,160	12,897
Minimum income	5,000	2,000
Maximum income	48,000	40,000

In order to have access to healthy foods, health care, and education services, farm households require consistent and decent incomes. However, an increase in household income does not necessarily lead to improved nutrition. Several factors like income distribution and control, spending decision and preference, and the prevailing market prices must be considered. As agriculture and food systems become increasingly commercialized, income is becoming more important for nutrition than own food production. Recently, the need to integrate nutrition objectives and components into interventions whose main goal is to generate income and vice versa is given due consideration (FAO, 2017a).

The study woredas are among the areas in Amhara Region where the proportion of poor households is high. For households with serious economic deprivation, social support programs constitute an important sources of survival. These social support programs are mostly delivered along the productive safety net schemes. In the light of the high level of poverty and limited livelihood opportunities, the proportion of the households that are accommodated by the productive safety net scheme is small. Due to the socio-cultural factors, women suffer more from the widespread economic deprivation. Experiences elsewhere show that interventions increasing the disposable income of women positively contribute to the betterment of their own and their children's nutrition and wellbeing (Rahman *et al.*, 2015; Allendorf, 2007; UNICEF, 2011; Smith *et al.*, 2003).

Irrespective of the marital status, it was noted that many women respondents strive to allow their children get regular and enough food. The appreciation on the importance of good nutrition on children's and mothers' health and wellbeing is particularly high among those households who have been engaged in NSA programs. Unfortunately, the majority of women lack the economic opportunities to fulfil this desire. According to the findings of the present study, the underlying causes are the lack of resources and absence of well-developed income generating livelihood opportunities. While the majority (67%) of the male members of the households use farming to produce food to the family and generate income, the majority of the rural women (56 %), the home brewed alcoholic beverage, locally called 'Areke', is the common means of generating income. Some have endeavored to apply the NSA promoted interventions to improve the nutritional status of their household. Among others, these involve the production of garden vegetables and raising chicken. The high level of economic deprivation, however, tempts many of these households to

sale part or whole of the produce to generate cash needed to cover for other basic needs. This is done at the expense of their own and their children's nutrition.

In some households, the male members of the households generate modest income from petty trade and wage labor (public works). As for the women, the profit margin that is generated from the local brewery is small since the cost of the inputs are high and the selling prices of the alcoholic beverages are low. Utmost, the women engaged in this particular activity earn a maximum of 6,000 ETB a year. This is not only a less paying economic activity but an activity that seriously compromise the health of the women involved. Unfortunately, many rural women in the study area drain their energy and spend a good deal of their time in its production.

Table 11. Gender disaggregated income sources

<b>Income sources for men</b>	<b>Percent</b>	<b>Income sources for women</b>	<b>Percent</b>
Grain/livestock (own or rented plots)	67	Grain/livestock (own or rented plots)	15
Off-farm casual labor	23	Public works	4
Livestock produces	17	Local brewery	56
Garden vegetables and fruits	-	Garden vegetables and fruits	11
Public works	3	Livestock produces	20

### **4.3 Women Empowerment**

Conventionally, the extent of women's empowerment domains are grouped into six categories and the corresponding same number of indicators (IFPRI, 2012). In this study, only four of the women's empowerment domains and indicators are used. As indicated in Table 12 below, these domains are given equal weight and hence the average score of each ranges between 0 and 1.

Table 12. Women Empowerment Domain<sup>1</sup>

<b>Women Empowerment Domain</b>	<b>Indicator</b>	<b>Weight</b>
Access to resources	Ownership/ control over assets (land, livestock, poultry, garden vegetables)	1/4
Decision making	Input in productive and lucrative decisions	1/4
Income	Control over use of income	1/4
Leadership	Group member	1/4

<sup>1</sup>*Adapted from the domains of empowerment in the 'Women Empowerment in Agriculture Index'*

As shown in Table 13 below, most of the trained women were part of the groups and associations that support women's leadership. Furthermore, the women accommodated in the groups were also noted to earn more independent income. This can be attributed to the fact that significant portion of the NSA trainings tends to encourage women to engage in leadership and participate in decision making processes. The Table 13 below also indicates that there are more women in the woredas who have access or control over a minimum of one asset than those who do not participate in the groups. The resources that women have access and control over are poultry and garden vegetables, and in few cases small and large ruminants. In the women headed households, land is also owned by women. These refer to women-headed households, which include households led by single, widowed and divorced women who in the majority of the cases make decision on issues that matter to them.

Table 13. Percent Women Empowerment Domain

<b>NSA intervention</b>	<b>Leadership</b>	<b>Access<sup>1</sup></b>	<b>Income</b>	<b>Decision-making</b>
Beneficiary HHs	37.02%	40.46%	28.24%	11.07%
Non beneficiary HHs	16.03%	36.64%	27.10%	10.3%
Total	53.05%	77.10%	55.34%	21.37%

<sup>1</sup>*Largely refers to control over garden vegetables, poultry and small ruminants (few respondents own farm land)*

As it is clear from Table 13, women in the NSA beneficiary households are more empowered than those in non-NSA beneficiary households. This applies for all women empowerment domains. The difference between NSA beneficiary and non-beneficiary respondents with respect to the measured empowerment domains was significant in leadership, and relatively mild in access to resources, independent income and decision making power.

The respondent women in both study woredas have multiple domestic roles and responsibilities. These activities range from the engagement in on-farm activities to caring for the children and home management. The implication of such multiple roles and responsibilities means that women have limited time to spare for paid activities and to participate in leadership enhancing tasks. As shown in other studies, improving the status of women empowerment will have a far reaching positive impact on their own wellbeing and their children's nutritional status (Meeker and Haddad, 2013). In the present study, it is also evident that empowered women have better dietary diversity and better motivation to apply the practices advocated by the NSA programs.

## **4.4 Analysis and Empirical Results**

### **4.4.1 Results of Propensity Score Matching**

The Propensity Score Matching (PSM) model is a Probit Model that is used in this study to identify the outcome of the NSA intervention in 262 households. In the absence of baseline data, the model found close matches from the control group to that of the intervention and compared them. There is close socio-economic similarity between the NSA project intervention and the non-NSA beneficiary (control) woredas. The majority of both woredas' households are very poor with a number of them being accommodated under the productive safety net program. In the course of the analysis, the variables which include literacy, marital status and age were used to match between the households in the intervention and control groups.

The outcome variables that are being tested for change over the NSA intervention were on-farm dietary diversity in production and consumption, women empowerment, household income and knowledge acquisition. While empowerment uses an index that ranges between 0 and 1, knowledge, on-farm dietary diversity and household income are continuous variables.

It is customary to run the multicollinearity and heteroskedasticity tests in most of economics related research studies. However, these tests were not conducted in the present study. The reasons for this include, the fact that heteroskedasticity error terms have little influence on the estimated intervention effect in propensity score matching (Williams, 2009). And since multicollinearity implies a linear relationship among some or all explanatory variables of a regression model, there was also no need to run multicollinearity tests in this study as there is one explanatory term per estimation (Gujarati, 2004).

To calculate the propensity score, a probit model was used where the intervention variable was regressed against the age, marital status and literacy of the female respondent. The results for the regression are shown in the Table 14 below.

Table 14. Probit regression for calculating the propensity scores

<b>Training</b>	<b>Coefficients</b>	<b>Standard Errors</b>	<b>z</b>	<b>P&gt; z </b>	<b>[95% Conf. Interval]</b>
Marriage	0.2089247	0.1719874	1.21	-0.12816	0.546014
Age	0.0079901	0.010437	0.77	-0.01247	0.028446
Literacy	0.2583177	0.0581674	4.44	0.144312	0.372324
_cons	-1.112157	0.4290631	-2.59	-1.95311	-0.27121

The common support region was between 0.2413 and 0.7154. This means that the highest propensity score was 0.7154 while the lowest was 0.2413. The mean propensity score was 0.5. In other words, the probability for a respondent to be in the NSA intervention program is 50%. The estimated propensity score and the regions of common support are depicted in Appendix 4.

The final number of blocks estimated were four. These number of blocks ensure that the mean propensity score is not different for intervention and control groups in each block. This information is used in the analysis as a basis for stratification. The blocks of strata were also used to satisfy the balancing property of the propensity score. This result is also shown in Appendix 4.

#### 4.4.2 Welfare Effects of NSA intervention

##### *Effect of NSA intervention on on-farm food environment*

The NSA intervention are promoted with the intention of influencing the amount, type and even quality of food produced and consumed at home. Basically, food production is a factor consisting of the household's ownership of garden vegetables, livestock and poultry where consumption includes the intake of dietary diversity in women and children. In connection to this, a standard assessment framework was used to determine the dietary diversity comprising of two questions with seventeen choices (7 for a child and 10 for a mother) (FAO, 2016). The consumption choices and ownership were then analyzed using Principal Component Analysis (PCA). PCA is a way of dimension reduction by forming new variables (principal components) as linear combinations of the variables in the multivariate set. In this study, an individual principal component score was calculated and used to reflect the dietary diversity (Simona *et al.*, 2016).

The PCA applied in STATA showed only one component with an Eigen value greater than one. As a result, only one component was used to represent the four variables that include the mothers' diet, children's diet, and ownership over garden vegetable and livestock. The Kaiser-Meyer-Olkin measure was then run to check sampling adequacy. As all the values were above 0.5, the test justified the use of PCA (Kellow, 2006). The table is shown in Appendix 4.

After assigning scores to all the respondents (based on the PCA component), the outcome was summarized by intervention. As seen from the Table 15 below, those who were supported through the NSA intervention have had higher dietary production and consumption compared to those who did not get similar support. However, this result might be explained through the existing difference among the explanatory variables. Although both groups have similar marital status and age groups, they have different literacy rates. Respondents in the trained group were relatively more literate than the non-trained group.

Table 15. Summary of production and consumption diversity sorted by intervention

<b>Training = 0</b>					
<b>Variable</b>	<b>Observation</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
Consumption and Production	131	-0.4930392	2.208322	-3.788015	1.775979
Marriage	131	0.656489	0.476703	0	1
Age	131	32.48855	7.068202	18	55
Literacy	131	2.358779	1.398178	1	4
<b>Training = 1</b>					
<b>Variable</b>	<b>Observation</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
Consumption and Production	131	0.4930392	2.332768	-3.00403	3.256811
Marriage	131	0.725191	0.448132	0	1
Age	131	32.51908	8.454722	18	55
Literacy	131	3.114504	1.280872	1	4

Using the PSM model, the observations under each of the identified variables were compared for the desired outcomes. Following to this, the aggregate scores were then incorporated into the PSM model to see the effects of NSA intervention on the targeted rural women and their children's dietary diversity. The 131 NSA training participants were matched to 131 participants who did not get the NSA training. The t-statistics was greater than two thus showing that there was a significant difference between the NSA intervention beneficiaries and non-NSA study participants. Furthermore, the result indicates that the respondents in the NSA training program had a higher production and dietary diversity score, which was higher by 0.77 point. This value was generated employing the stratification approach. A stratification approach was used as it provides better matches compared to nearest neighbor and creates intervals that make interpretation much easier. Most of the methods used show an increment ranging from 0.77 to 0.82 which is high. This shows that the NSA intervention enabled women to have more diverse diet for themselves and their children in comparison to the women who were not in the program.

Furthermore, NSA intervention beneficiary households' fare better in terms of resource ownership, which include garden vegetables, poultry and livestock in some sort of combination. Similar findings were found in Burkina Faso where 510 control and 787 intervention participants were involved (Olney *et al.*, 2015). This study showed a significant increase in fruit intake and marginal increase in dairy products intake among the individuals in the intervention group. Similar outcome was recorded in Benin where women were provided with similar support (Alaofè *et al.*, 2016). In

this particular work, comparison of baseline and end-line data indicated an increase in the variety of fruits and vegetables produced and consumed by the intervention group. After controlling for baseline values, the intervention group was three times more likely to increase their fruit and vegetable consumption compared to the non-intervention group. The increase in dietary diversity was further re-enforced as a result of the purchase of other nutrient-rich foods.

In a similar NSA study conducted in Bangladesh, it was noted that intervention group have greater area of home garden, production of leafy vegetables, and overall per capita vegetable production. This group of households also exhibited a greater diversity of vegetable consumption. While sample mean of production for the intervention was higher by 46 points than control group, consumption of household process for the intervention was only higher by 0.4 points (Schreinemachers *et al.*, 2014). Follow up study, uphold the significant difference between the control and intervention groups with respect to the consumption of NSA recommended food groups although the production difference was marginal (Schreinemachers *et al.*, 2016). Additionally, as the intervention encouraged consumption of own produces, the trained households consumed most of the home garden produce within their own household (75%).

Table 16. Effect of NSA intervention on diversity in production and consumption using all matching methods

Matching Method	Treatment	Control	ATT	Std. Err	t
Radius	131	131	0.828	0.179	4.612
Kernel	131	131	0.802	0.188	4.266
Stratification	131	131	0.772	0.071	10.850
Nearest Neighbor	131	81	0.375	0.160	2.339

### ***Effect of NSA intervention on women empowerment***

To measure the impacts of the NSA training on the empowerment of the rural women respondents, the Women Empowerment Index of the respondents was entered into the PSM model and matched using the Stratification Method. The results of this findings are shown in the Table 17 below. The difference in women empowerment between the NSA intervention and non-NSA beneficiary study participants was significant since the t-statistic was greater than two. Furthermore, women in the NSA intervention beneficiary households are more empowered by a degree of 0.065. The

intervention contributed to improved women empowerment through increased group participation, diversification of production and dietary consumption, generation of additional income and some level of improvement in decision making power within their households. These changes have come mainly due to the increased awareness in the production and consumption of diverse food sources (at least from garden vegetables and poultry).

In integrated agricultural and nutrition intervention study conducted in Zambia, it was observed that such interventions could improve women’s social capital, access to and control over assets, financial and agricultural decision-making power (Kumar *et al.*, 2017). The intervention had a gender equality agenda imbedded in its agricultural treatment and was able to affect women empowerment in addition to maternal knowledge on care practices. On the contrary, a qualitative study conducted in Burkina Faso shows that there was no impact on women’s control over productive resources/ assets (Van den Bold *et al.*, 2015). However, the communities’ perceptions about women’s ownership and control of assets has undergone some improvement.

Table 17. Effect of NSA intervention on women empowerment

<b>Matching Method</b>	<b>Treatment</b>	<b>Control</b>	<b>ATT</b>	<b>Std. Err</b>	<b>t</b>
Radius	131	131	0.065	0.023	2.805
Kernel	131	131	0.064	0.020	3.203
Stratification	131	131	0.065	0.012	5.310
Nearest Neighbor	131	81	0.005	0.030	0.163

### ***Effect of NSA intervention on household income***

One of the outcomes to NSA intervention is the change in household income. In order to see the change in income, the desired outcome was summarized by NSA intervention. As shown in Table 18 below, those households who benefitted from the NSA interventions had higher household income of 2,264 ETB (15,160 vs. 12,896 ETB) than those who did not benefit from similar intervention. In part, the observed difference in income was associated to the level of education. This is so because the literacy rate among the respondents is higher for NSA beneficiary group than that under the control group.

Table 18. Household income sorted by NSA intervention

<b>Training = 0</b>					
<b>Variable</b>	<b>Observation</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
Household income	131	12896.95	7566.047	2000	40000
Marriage	131	0.656489	0.476703	0	1
Age	131	32.48855	7.068202	18	55
Literacy	131	2.358779	1.398178	1	4
<b>Training = 1</b>					
<b>Variable</b>	<b>Observation</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
Household income	131	15160.46	8664.913	5000	48000
Marriage	131	0.725191	0.448132	0	1
Age	131	32.51908	8.454722	18	55
Literacy	131	3.114504	1.280872	1	4

The impacts of the NSA training on income were also determined employing a technique that accounts for the matching variables. Here, the impacts of the NSA training on household's income were assessed whereby the annual household income of matching variables were entered into the PSM model and matched using different methods, from which stratification matching method was employed for interpretation. The outputs of this analysis are shown in Table 19 below.

Table 19. Effect of NSA intervention on household income

<b>Matching Method</b>	<b>Treatment</b>	<b>Control</b>	<b>ATT</b>	<b>Std. Err.</b>	<b>t</b>
Radius	131	131	2096.818	898.45	2.334
Kernel	131	131	1913.537	691.188	2.768
Stratification	131	131	1719.825	200.831	8.564
Nearest Neighbor	131	81	654.097	1491.400	0.439

The t-statistic was greater than two for stratification hence showing a significant difference between the NSA beneficiary and non-NSA beneficiary respondents following matching. The output of the analysis still did confirm the positive influence of the NSA intervention on annual household income, although the additional annual income due to NSA intervention was 1,719 ETB. In this case, the matching of the explanatory variables has decreased the annual income by 545 ETB. A similar research that was conducted in Eastern Ethiopia on Farmer Training Center

(FTC) based training program showed that training has positive influence on roles of rural people's income and livelihoods in Ethiopia (Gezahegn and Sassi, 2017). PSM model was run to assess the extent of influence that training has on farmers' income. Accordingly, the average treatment effect of training on farm income of trained farmers is positive and significant, ranging from 9,557 ETB /year (Nearest Neighbor) to 10,388 ETB/year on average using the Kernel approach. Similar study in Nepal documented the benefits of training on household income (Miller *et al.*, 2014). The training also focused on women empowerment, and livestock management activities through women's self-help groups.

### ***Effects of NSA intervention on knowledge***

To ascertain the effect that NSA intervention has on women's nutritional and health knowledge, respondents were asked questions exploring the diversity of diets and its impact on the health of their family. The questions, which had 14 choices were graded out of 14 and then entered into the PSM model and matched using all the matching methods. The outputs of this analysis are shown in Table 20 below.

Table 20. Effect of NSA intervention on knowledge accumulation

<b>Matching Method</b>	<b>Treatment</b>	<b>Control</b>	<b>ATT</b>	<b>Std. Err.</b>	<b>t</b>
Radius	131	131	0.904	0.217	4.161
Kernel	131	131	0.786	0.142	5.546
Stratification	131	131	0.777	0.302	2.573
Nearest Neighbor	131	81	0.979	0.393	2.488

The findings of the analysis showed significant difference between the NSA trained and non-trained groups. Using the stratification approach, when assessed in terms of nutritional consumption, care practices and health, the trained group was more knowledgeable by a factor 0.77. This finding is in agreement with similar work that was conducted in Burkina Faso (Olney *et al.*, 2015). The Burkina Faso study documented improvement in mothers' nutritional, care and agricultural production knowledge with training.

## CHAPTER FIVE

### 5. CONCLUSION AND RECOMMENDATIONS

#### 5.1 Conclusion

The present study assessed the effects of the NSA intervention on desired welfare outcomes among households in selected woredas of North Shoa Zone of Amhara Region. Qualitative and quantitative field survey techniques were employed to explore the socio-economic situations of the population in the study areas and determine the influence that the NSA intervention had on the welfare of women and children. The information and data gathered revealed a widespread poverty and economic deprivation among the largest share of the population in the study area. It was also noted that the state of the economic deprivation was much worse among the rural women because of the deeply rooted gender inequalities that undermine women's decision making power and their ability to control productive resources. Religious and cultural factors were also observed to impose some influence on women's and their children's state of nutrition. To a greater extent, the daily dietary diversity and the kinds of food sources that women consume in relation to the other members of the family are determined either by the periodic religious restrictions or the cultural norms.

The PSM analysis indicated that the NSA intervention have had positive, although at varying degrees, influence on the desired NSA outcomes that the study examined. Rural women exposed to the NSA intervention were better-off in all measured women empowerment domains than women who did not get such supports. The improved women empowerment domain cover the aspects of decision making power, access to independent income and participation in community leadership.

The finding of the study indicated that the NSA intervention helped the beneficiary households improve their technical knowledge, which contributed to the better achievement of the MDD and the increased production and consumption of diverse food sources. The MDD achievement was somehow higher in children of less than two years of age partly due to the attention that mothers attach to the wellbeing of their children and the religious and socio-cultural barriers. Most rural women that approached in this study do appreciate the consumption of diverse food sources but

unfortunately lack the means to provide it to themselves and their children. Even when the nutritionally dense foods are produced within the farm, poor households opt to sell the entire produce to generate the badly needed cash. Women empowerment, most specifically independent income has an important bearing on household nutrition. As household income increases, it was noted that the MDD and the dietary intake of the households tend to improve considerably. The NSA intervention, which is noted to increase household income, has had such positive influence on MDD.

## **5.2 Recommendations**

On the basis of the findings of the present study, the following recommendations are suggested.

- The NSA intervention have had positive contribution towards the studied welfare outcomes of the NSA intervention. However, the implementation of the scheme is restricted to woredas where NGOs and other development partners operate. To ensure the wider dissemination of the NSA practice, there is need to incorporate the NSA approach within the regular extension programs along with allocation of adequate resource.
- The NSA intervention promoted in the study area exclusively targeted vulnerable rural women. Given the key role that women play in the household food preparation and their own predisposition to micro-nutrient deficiency, the priority attached to women is appropriate. The point of concern while implementing the program, however, is the limited control of women over productive resources. Addressing the challenge would require to devise strategies that help improve women's control over such resources. Among others, these includes encouraging community dialogues that help break the socio-cultural setup alienating women's resource ownership, and educating and enhancing the awareness of men on the subject. Apart from easing the strain over the control of resources, engaging husbands (in men-led households) would help promote the NSA practices and achieve nutrition and food security at the level of the household.
- Adequate empowerment of rural women is also indispensable and key for sustainable and the wider dissemination of the NSA practices. This is subject to the fulfillment of number of conditions including the overcoming of the widely observed gender biases in extension

services, which often alienate women. It is, therefore, necessary to give due attention to women in practical skills and knowledge development schemes, support group formation, and enhance the decision making power. The wider use of women empowerment tools at zonal, woreda and kebele levels and the use of participatory platforms by the regular extension and development partners would greatly help achieve these objectives.

- Socio-cultural and religious barriers hinder the promotion and the wider application of the NSA intervention. To overcome these challenges, some development partners are using religious leaders as an entry point and introducing the SBCC approaches. The regular government extension program needs to adopt these and other similar approaches to overcome the socio-cultural and religious barriers and eliminate the distrust that the community has on the NSA practices.
- From the findings of the present study it is evident that higher household income encourages the application of NSA practices. Despite the considerable recognition of the NSA practice in alleviating the problem of malnutrition, most rural women are unable to effectively implement the practice due to severe economic deprivation. Incorporating alternative income and livelihood diversification opportunities in NSA interventions would, therefore, greatly contribute to its wider application and the ultimate improvement of the household food and nutrition security among rural women and their children. Market linkages that connect rural women with small as well as large local markets can be beneficial in this setting.
- It is high time for the government to step up the attention given to the NSA approach promotion programs and the integration of the scheme within the development of the livestock and crop subsectors. The first and foremost action that needs to be taken to this end are the allocation of adequate resources on NSA linked crop and livestock extension programs. Furthermore, the NSA dedicated agricultural policies should encourage the institutionalization of the practice in humanitarian and development initiatives across the country.

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## Appendices

### **Appendix 1. Letter of intent written to rural women respondents participating in the field study**

Dear participants,

I am a graduate student of Addis Ababa University, College of Business and Economics, Department of Economics. Currently, I am conducting a study on: “The Effect of Nutrition Sensitive Agriculture intervention on Desired Welfare Outcomes of Rural Women”. The purpose of the research is to determine the effects of NSA intervention on selected program outcomes. The findings of the study will help understand the underlying factors contributing to the observed changes so as to suggest gender and behavior sensitive policy recommendations that support the application of the NSA.

**Remark:** Your sincere and genuine cooperation in answering each question is very important for the success of the study. The information you provide will be treated confidentially and will be used only for academic purpose. Please, give the right answer to the following questions to the best of your knowledge.

Thank you in advance.

## Appendix 2. Instructions to Enumerators

1. Make sure that the mother and/or care taker of the household whose age is of the reproductive group (15-49 years) is the appropriate respondent to this questionnaire. And that the woman has a child of two years or less, amongst whom the youngest will be used in this record.
2. Briefly introduce yourself to the farmer before starting any question (your name and organization).
3. Greet them in local ways and clarify objective of the study.
4. Fill the interview schedule according to the mother/ caretaker's reply (do not put your own opinion).
5. Ask each question clearly and politely till the farmer gets your points well; all through.
6. Please do not use technical terms and do not forget local units.
7. Check that all questions and responses are correctly filled accordingly.

## Appendix 3. Structured interview questionnaires

### General information

Date	<i>(day/month/year)</i>
Identity no of the Household	<i>(Woreda....., Kebele..... village....., household.....)</i>
Name of enumerator	
Name of mother/ caregiver	
Age of mother/ caregiver	
Physiological status of mother/ caregiver	<input type="radio"/> <i>pregnant</i> <input type="radio"/> <i>lactating</i> <input type="radio"/> <i>non-pregnant/ non-lactating</i>
Name of child	
Birthday of child	<i>(day/month/year)</i>

## **A. General Interviewee Profile**

1. What is your marital status?
  1. Married
  2. Single
  3. Widowed
  4. divorced
2. What is your religion?
  1. Orthodox Christian
  2. Protestant
  3. Catholic
  4. Islam
  5. Other
3. Sex of household head:
  0. Male
  1. Female
4. Literacy
  1. Can neither read nor write
  2. Can read
  3. Can write
  4. Can both read and write
5. Highest level of education
  1. None
  2. Religious education
  3. Adult literacy education
  4. Formal primary education
  5. Formal secondary education
  6. Formal tertiary education

## **B. Adoption Status of NSA**

6. Are you trained on nutrition sensitive agriculture methods?
  1. Yes
  2. No

### **a) Production**

7. Do you grow vegetables at your homestead?
  1. Yes
  2. No
8. Do you have access (rent or share) to vegetable?
  1. No
  2. Yes, currently
  3. Yes, but not currently
9. If you answer is “yes” to the previous question, what kind of vegetables do you grow or are accessible to you? (You can choose more than one option)
  - Tomatoes
  - Onions
  - Carrots
  - Swiss chard
  - Lettuce
  - Kale
  - Cabbage
  - Green pepper
  - Red pepper
  - Beet root
  - Garlic
  - Potatoes
  - Other, specify:
10. What is the main use of vegetable produce?
  1. Mainly own consumption
  2. Mainly for sale
  3. Both

11. If vegetables are sold in local markets, who decides upon the use of the (additional) income?
1. Husband
  2. Wife
  3. Both (in consultation)
  4. Not selling
12. Do you have any fruit trees at your homestead?
1. Yes
  2. No
13. Do you have any fruits accessible to you and your family through rent and share or buying at the market?
1. Yes
  2. No
14. What kind of fruit trees do you grow or are accessible/ shared with you? (You can choose more than one option)
- Mango
  - Citrus
  - Guava
  - Papaya
  - Banana
  - Avocado
  - Beles (cactus fig)
  - Apple
  - Peach
  - Other, please specify:
15. Main use of fruits
1. Mainly own consumption
  2. Mainly for sale
  3. Both
16. Does this household own any livestock, poultry or fishpond?
1. Yes

2. No

17. What kind of animals do you keep? (You can choose more than one option)

- Shoat (sheep and goat)
- Cattle
- Poultry
- Fish

18. Main use of animal produce? (Meat, milk, eggs, fish, etc.)

1. Mainly own consumption
2. Mainly for sale
3. Both

**b) Consumption**

19. How many times did you eat yesterday?

1. Once
2. Twice
3. Thrice

20. Which of the following meals did you have yesterday? (You can choose more than one option)

- Starchy staple food, cereal, white roots and tubers, and plantains
- Pulses (beans, peas and lentils)
- Nuts and seeds
- Dairy products
- Meat, poultry and fish (flesh foods)
- Eggs
- Dark green leafy vegetables
- Other vitamin A-rich fruits and vegetables
- Other vegetables
- Other fruits

21. Did you fast yesterday, or was your food intake different from usual?

1. No
2. Yes, fasting day
3. Yes, different from usual

22. How many times did your child receive food including meals and snacks yesterday?
1. Once
  2. Twice
  3. Thrice
  4. Four times
  5. More
23. Did your child have any of the following liquids yesterday during the day or night? (You can choose more than one option)
- Infant formula
  - Tinned, powdered, fresh or packed milk
  - yogurt
  - Fruit juice
24. Which of the following meals did your child below 2 years have had yesterday during the day or night? (You can choose more than one option)
- Staples (grains/ cereals, roots and tubers)
  - Legumes, pulses and nuts
  - Dairy products (milk, yogurt and cheese)
  - Flesh foods (meat, fish, poultry and liver/ organ meats)
  - Eggs
  - Vitamin A-rich fruits and vegetables
  - Other fruits and vegetables
25. Was the child's intake of food yesterday different from usual?
1. Yes
  2. No

**c) Knowledge**

26. What are the reasons people get malnourished? (You can choose more than one option)
- Not getting enough food
  - Food is undiversified, does not contain enough nutrients
  - Disease, ill and not eating food
  - Neglect by family members/ caretaker

27. Can you tell me which one of this porridges you would give to a young child? (show picture)
1. Thick porridge
  2. Watery porridge
  3. Don't know
28. Can you tell me some ways to make porridge more nutritious or better for your baby's health? (Don't show the respondent the list of options, tick as/ if they mention the options)
- Animal-source foods (meat, poultry, fish, liver/ organ meat, eggs, etc.)
  - Pulses and nuts, flours of groundnut and other legumes (peas, beans, lentils, etc.), sunflower seed or other seeds
  - Orange (vitamin A rich) fruits and vegetables (carrot, orange-fleshed sweet potato, yellow pumpkin, mango, papaya, etc.)
  - Green leafy vegetables (e.g. spinach)
  - Energy-rich foods (e.g. oil, butter, margarine)
29. What should we do to prevent malnutrition among young children (6-23 months)? (Don't show the respondent the list of options, tick as/ if they mention the options)
- Give more food
  - Give different types of food each day
  - Feed frequently
  - Give attention during meals
  - Go to health center/ hospitals and check that the child is growing

### **C. Household Resource Endowment**

30. What are your household's source of income throughout the year? (You can choose more than one option)
- Sale of produced grains or vegetables/ fruits (market sale)
  - Sale of animals/ own produced animal products
  - Sale of own produced or gathered goods/ crafts
  - Casual labor/ temporary salary (daily wages)

- Petty trade/ small businesses (mini shops, local drinks)
- Employment/ regular salary
- Remittance from relatives
- Income generated by sale or exchange of public transfers (cash for work, food for work, food vouchers, fertilizers or seed vouchers etc.)
- Renting farm land to others
- Farming only
- Other

31. Does your household own a farm?

- 0. Yes
- 1. No

32. If you answer yes, what is the household farm size (in hectares)\_\_\_\_\_

33. What is the estimated income of the household per year (sum of all the possible income sources, i.e. crop, livestock, off-farm) \_\_\_\_\_

34. If you are adopting the nutrition sensitive agriculture methods (produce and consume), is there any observable change in your income?

- 1. Yes, it has increased
- 2. Yes, it has decreased
- 3. No, there is no change

35. Which crops did you grow on the land the past two years? (You can choose more than one option)

- Maize
- Teff
- Wheat
- Barely
- Oats
- Wazera
- Sorghum
- Finger millet
- Rice
- Green gram

- Other legumes (beans, peas, lentils, pulses)
- Irish potato
- Orange fleshed sweet potato
- Fenugreek
- Sunflowers
- Safflower
- Sesame
- Noug
- Linseed
- Lupin
- Other, specify:

**D. Women Access and Control Over Resources (if you are not household head)**

36. Which of these resources do you have a control over? (You can choose more than one option)

- Farm land
- Home grown fruits and vegetables
- Livestock products (dairy products, meat and eggs)
- Shoat (sheep and goat)
- Cattle
- Poultry
- Fish

37. Are you a member in any group/ association?

- 0. Yes
- 1. No

38. Do you have your own income?

- 0. Yes
- 1. No

39. If you answer yes to the previous question, what is your source of income? (You can choose more than one option)

- Sale of produced grains or vegetables/ fruits (market sale)

- Sale of animals/ own produced animal products
- Sale of own produced or gathered goods/ crafts
- Casual labor/ temporary salary (daily wages)
- Petty trade/ small businesses (mini shops, local drinks)
- Employment/ regular salary
- Remittance from relatives/ husband
- Income generated by sale or exchange of public transfers (cash for work, food for work, food vouchers, fertilizers or seed vouchers etc.)
- Renting farm land to others
- Subsistence farming only
- Other

40. What do you invest your income on? (You can choose more than one option)

- Buy more food
- Hand to husband
- Invest on household health
- Educational expenses
- Buy sanitary goods
- Buy shoes and clothes

### **E. Cultural Influences**

41. Where do you get the information about what to produce and feed your household? (You can choose more than one option)

- Existing norm/ communal tradition
- Nutrition counseling/ trainings
- Mass media (radio, TV, etc.)
- Public/ religious gatherings
- Formal education

42. If you have acquired the knowledge through nutrition counselling/ trainings, have you ever tried to apply the knowledge acquired in your household?

1. Yes
2. No

43. If no, why not? (You can choose more than one option)

- Lack of income
- Can't see the relevance
- Lack of access to resource (land, animals, and seeds)
- Lack of decision making power over food produced and consumed
- Religion (fasting)
- Too complicated, lacks practical demonstration
- If other, please specify

44. The food groups that are recommended by the Nutrition Sensitive Agriculture are:

- Starchy staple food, cereal, white roots and tubers, and plantains
- Pulses (beans, peas and lentils)
- Nuts and seeds
- Dairy products
- Meat, poultry and fish (flesh foods)
- Eggs
- Dark green leafy vegetables
- Other vitamin A-rich fruits and vegetables
- Other vegetables
- Other fruits

If you have an adequate income, what do you believe will prevent you from using these in your socio-cultural environment for women and children? (You can choose more than one option)

- Fasting
- Difficulty of application
- Lack of priority given to women and children
- Access to inputs (seed and animal provision)
- Access to services (i.e. extension services, technical advice)
- If other, please specify

## Appendix 4. Tables

Table 1. Estimated propensity score in region of common support

<b>Percent</b>	<b>Percentiles</b>	<b>Propensity Scores</b>
		Smallest
<b>1%</b>	0.2565284	0.2413314
<b>5%</b>	0.2802248	0.2488682
<b>10%</b>	0.3105534	0.2565284
<b>25%</b>	0.357459	0.2565284
<b>50%</b>	0.543064	
		Largest
<b>75%</b>	0.6322365	0.6962223
<b>90%</b>	0.6589848	0.712774
<b>95%</b>	0.6735167	0.712774
<b>99%</b>	0.712774	0.7154905
<b>Observation</b>	262	
<b>Sum of Weight</b>	262	
<b>Mean</b>	0.5003867	
<b>Std. Dev.</b>	0.1425378	
<b>Variance</b>	0.020317	

Table 2. Inferior bound, number of participants and non-participants for each block

<b>Inferior of block of propensity score</b>	<b>Treatment Variable</b>		<b>Total</b>
	Non-participants	Participants	
<b>0.2</b>	64	32	96
<b>0.4</b>	30	30	60
<b>0.6</b>	37	69	106
<b>Total</b>	131	131	262

Table 3. Principal Components (Eigen Vectors)

<b>Variable</b>	<b>Component</b>	<b>Unexplained</b>	<b>KMO</b>
Garden vegetable	0.5428	0.3646	0.7084
Livestock ownership	0.381	0.687	0.7006
Mother's diet	0.529	0.3964	0.6918
Children's diet	0.5295	0.3953	0.6909
<b>Total</b>			0.6975