THE ASSESSMENT OF ROOT CROPS CONTRIBUTION TO HOUSEHOLD FOOD SECURITY: THE CASE OF SODDO ZURIA WOREDA, WOLAITA ZONE, SNNPR, ETHIOPIA.

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This is to certify that the thesis prepared by Biruk Seifu, entitled: The assessment of root crops contribution to household food security: The case of Soddo Zuria Woreda, Wolita Zone, SNNPRS, Ethiopia: Complies with the regulations of the university and meets the accepted standards with respect to originality and quality signed by the examining committee.

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ABSTRACT

The Assessment of Root Crops Contribution to Household Food Security: The Case of Soddo Zuria Woreda, Wolaita Zone, SNNPR, Ethiopia.

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The study was conducted in Soddo Zuria woreda, Wolita zone, SNNPR, Ethiopia. Multi stage sampling was used to select the respondents. Two kebeles were selected purposefully as to their potential to root crop production and agro ecology. 124 households were selected. Household survey, FGD, KII and field observation were employed to get primary/secondary qualitative and quantitative data. HFB model and three food security pillars were used to measure the contribution of root crops. According to the HH survey results, the trend of root crop production in the area is increasing. Sex of the household, age group, family size, education level and number of oxen do not significantly affect the availability of root crops. But the land holding size significantly affected the allocation of land to root crops. The p-value in all variables test indicates root crops contribute significantly to household food security. The major production and marketing problems for root crops are: crop disease and pest infestation, land shortage, water (soil moisture) problem, labour shortage, input shortage and inadequate or low extension services, market place and market information, price fluctuation and consumers shortage. According to all the results root crop contributes significantly to HH food security. Thus its production has to get more attention.

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LIST OF ACRONYM

BY - Budget Year

CSA - Central Statistics Agency

DPPC - Disaster Prevention and Preparedness Commission

EC - Ethiopian Calendar

EHNRI - Ethiopia Health and Nutrition Research Institute

FAO - Food and Agricultural Organization

FGD - Focus Group Discussion

HFBM - House Hold Food Balance Model

HH - Household

KII - Key Informants Interview

MoARD - Ministry of Agricultural and Rural Development

PY - Production Year

RE- Retinol Equivalent

RDA - Recommended Dietary Average

WFP - World Food Program

WHO - World Health Organization

CHAPTER ONE

1. Introduction

1.1. Background

Ethiopia, with a population of about 81 million, is the second-most populous country in sub-Saharan Africa (Schulz, 2012). Food insecurity is a major and ever worsening problem in the country. Underlying causes include rapidly increasing population pressure, low productivity of the agricultural sector, widespread environmental degradation and recurrent droughts. Efforts to improve food security through a grain-led approach have failed, not even keeping up with population growth (Schulz, 2012).The country is highly prone to recurrent natural hazards. Across the country, an estimated 7.6 million (or 11 percent of the rural population) are considered chronically food insecure (FAO/WFP, 2012).

According to Central Statistical Agency (CSA), 12.9 million hectares are being cultivated by about 13 million farmers to produce cereals, pulses, oil seeds and root, tuber and perennial crops, like coffee. Root and tuber crops are very closely related to household food security and play a pivotal role especially in highly populated areas, such as SNNPR.

The majority of the Ethiopian population depends mainly on cereal crops as food source. The food potential of horticultural crops particularly that of root and tubers crops has not been fully exploited and utilized despite their significant contributions towards food security, income generation, provision of food energy and resource base conservation (Gebremedhin et al. 2001). The same authors also describe that, most of the root and

tuber crops could be attributed to many factors, such as low investment in research, extension and training of farmers on the utilization of these crops.

Despite its importance as a staple food and its potential contribution in combating hunger and poverty, little attention was given to root crops in the study area. Its production and marketing is facing challenges like: shortage of input, disease prevalence, lack of guaranteed and organized market, lack of storage and lack of processing technologies. Little root crops were researched to enhance the productivity and resistance to disease and pests.

Most of the research works (Getachew and Mohammed,2012; Yared,2012; Bezabih and Mengistu, 2011; Tewodros,2010; Adane, 2009; Tewodros, 2013; Tamiru et al.,2005/2007; Tamiru, 2006; Dawit,2009; Dejene, 2006; Aschalew and Ahmed,2012; Tenaw et al., 2011;…) that have been done so far on root crops are focusing on the production, marketing and its constraints. But the contribution of root crops, as a broad crop category, towards the household is not yet studied.

Thus, this study assesses the trend, major production and marketing constraints and contribution of root crops to household food security in Soddo Zuria Woreda, Wolaita Zone, SNNPR. In addition it contributes to the gap that is seen on the documentation of root crops.

1.2 Problem Statement

Food security is dependent on agricultural production, food imports and donations, employment opportunities and income earnings, intra-household decision making and resource allocation, health care utilization and caring practices (Johnson et al. 2000). Poverty at both national and local levels is severe and deepening. Nearly half of the

Ethiopian population is chronically poor (Degefa, 2005). The agricultural sector is dominated by small-scale mixed crop-and-livestock production with very low productivity. The major factors responsible for this low productivity include: reliance on obsolete farming techniques; soil degradation caused by overgrazing and deforestation; poor complementary services such as extension services, credit, markets and infrastructure; and climatic factors such as drought and flood (Deressa, 2007 cited in IFPRI discussion paper, 2009). Thus due to the mentioned reasons and else majority of peoples living in Ethiopia and in the study area are food insecure.

Root crops are among the potential crop categories and major contributor to household food security in the area. Despite its importance as a staple food and potential contribution in combating hunger and poverty, the extension activity in the country and in the study area majorly focuses on grain but little attention was given to root crops. Its production and marketing is facing challenges like: disease and pest infestation, cultivation land shortage, water (soil moisture) problem, input and labour shortage, market and market information, low Price and price fluctuation and consumer's shortage.

Even majority of the researches that have done so far on root crops related to their contribution to household food security are very general, specific to area and single root crop, and considers opportunities of production and marketing. There are very few documents which are specific to single root crops, are researched for the study area. Thus this study intends to fill the gap seen on the documentation of root crops contribution to food security at household level for the study area.

1.3 Objectives

The major objective of the study is to assess the contribution of root crops to the household food security in the study area.

The specific objectives of the study are:-

- To assess the availability of root crops in the study area.
- To assess the accessibility of root crops in the study area.
- To assess the utilization of social services enhanced due to root crop sell in the study area.
- To compare the contribution of root crops to the household food security.

1.4 Research Question

- ✓ How is the trend of root crops production in the study area?
- ✓ What contribution do root crops made to the household food security in the study area?
- ✓ What are the constraints of root crops production and marketing in the study area?

1.5 Significance of the Study

The intent of this research is to compliment the previous research works in the area of root crops and household food security. It contributes some knowledge gaps on the contribution of root crops and related production and marketing challenges. And also serve as the spring board for further studies and show how local government bodies in particular development practitioners and policy makers in general should intervene to facilitate development interventions.

1.6 Scope and Limitation of the study

The study was undertaken in Soddo Zuria Woreda of Wolaita Zone of the SNNP Regional State. The study mainly assesses the root crops contribution to household food security. Root crops production is diverse across ecology and context of rural people. The study emphasizes majorly on household level situations. Due to time and resource constraint the study cover two of the thirty one rural kebeles of the district. Therefore, the study may not be comprehensive and exhaustive.

1.7. Organization of the Paper

This thesis consists of five chapters. Chapter one deals with the background, problem statement, objectives, scope and significance of the study. Chapter two reviews literature related to the research topic. Methodological issues including the study area description are presented in chapter three. Chapter four deals results and discussion on root crop production trend, the contribution of root crop production to household food security and root crop production and marketing constraints in the study area. The final chapter summarizes the paper as conclusions and recommendations.

CHAPTER TWO

2/ Literature Review

2.1. Concepts and Definition

2.1.1 Root Crops Concept and Definition

FAO defines roots and tubers as plants yielding starchy roots, tubers, rhizomes, corms and stems. They are used mainly for human food (as such or in processed form), for animal feed and for manufacturing starch, alcohol and fermented beverages including beer. Apart from their high water content, (70-80 percent), these crops contain mainly carbohydrates (largely starches that account for 16-24 percent of their total weight).

Root and tuber crops also referred to simply as “root crops”, contribute important to income and food security in developing countries. These commodities are grown mainly by small-scale farmers, and most yield more (in terms of calories per hectare per day) than other crops (Christopher et al. 1995). Root crops include a number of vegetables grown for their enlarged, edible storage root. They are hardy, cool-season crops with a long storage life (Tim, 2011). Therefore, in this study all crops that their edible plant part grows underground are called as root crop. The botanical definition of each root crops growing majorly in the study area was reviewed below.

2.1.2 Food Security Concept

Food Security is a concept that evolved over time. There are many definitions of food security (Hoddinnot, 2002**).** The most widely used definition of food security is given as ‘…access by all people at all times to enough food for an active and healthy life (World Bank, 1986).The concept of food security is defined to include both physical and

economic access to food that meets people's dietary needs as well as the food preferences.

The essential elements of food security are the availability of food and the ability to acquire it. There are four core concepts implicit in the notion of "secure access to enough food at all times". These are (a) access to enough food, defined by entitlement to produce, purchase, exchange food, or receive it as a gift. An individual's entitlement is rooted in his/her endowment - the initial resource bundle that is transferred via production and trade into food or commodities which can be exchanged for food (Maxwell, 2003) (b) Sufficiency of food, defined mainly as the calories needed for an active and healthy life. In this case, the definition is individual not household. Where household is aggregate of individuals in household whose food need has to be satisfied (c) security, defined by the balance between vulnerability, risk, and insurance. The notion of risk and risk avoidance have been central to definition of food security since the term came into use in the 1970s (d) time, where food insecurity can be chronic, transitory or seasonal.

In a broader way, Maxwell (2003) defines food security, as '…a country and people are food secure when their food system operates in such a way as to remove that there will not be enough to eat. In particular, food security will be achieved when the poor and vulnerable, particularly women and children and those living in marginal areas have secure access to the food they want…'

In the mid 1970s, food security was conceived as adequacy of food supply at global and national levels (Debebe, 1995). Attaining food self-sufficiency alone does not necessarily imply the achievement of food security. Because many countries those used to be considered as self sufficient in food were found to be food insecure because they lack

either an efficient food system or the capacity to the level of food entitlement. This indicates that attaining macro level food self-sufficiency does not ensure the achievement of household food security (Getahun, 2008). Therefore, food security strategy has to address household-level food production through investment in food production and storage.

Household Food Security

A household is the basic residential unit in which economic production, consumption; inheritance, child bearing and shelter are organized and carried out. A household may or may not be synonymous with family. Household is a group of individuals whose economic decision-making is interrelated. It can also be considered as people or group of people whose housekeeping duties are interlinked socially, economically, and culturally through acceptable lines of responsibilities in the larger society or community.

The concept of household food security is a more recent development and the bulk of literature dated from 1980s equating national food security with food self-sufficiency is a problem that needs to be clearly understood. As Degefa (2005) it is realized that adequate food availability at global and national levels alone could not bring about food security at household and individual levels. Therefore, food self-sufficiency is essential but not sufficient vehicles for solving household level malnutrition and household food insecurity problems. Food shortage becomes a matter of 'lack of access' that is the inability to produce or purchase food and households become food insecure because of failure in entitlement: 'endowment' or 'exchange' entitlement failure (Sen,1981 cited at Degefa, 2005).

Thus the key elements that are critical to household food security are availability and stable access. The former is further influenced by the different sources of food and handling patterns which facilitate the time dimension of food availability in the household.

Food insecurity, on the other hand is a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food required for normal growth and development and an active and healthy life. It may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate use of food at the household level (WFP, 2004).

2.2. Root Crop Production and Marketing in Ethiopia

2.2.1 Root crop production

Root crops are growing in a wide area and different agro climatic zone of the country. For instance Sweet potato (*Ipomoea batatas L.*) is one of the major root crops widely grown in the Eastern and Southern regions of Ethiopia. It grows in the lowland and mid altitude areas of the Southern region and grows both in *belg* and *meher* seasons(Degu and Workayehu, 1990; Degu et al. 1991 cited in Tenaw et al. 2011). According to Dejene (2006) a survey conducted in different parts of southern and south-western Ethiopia indicated that farmers use stem cuttings (30-100 cm length) as planting materials and leave the cassava to grow for a number of years, harvesting the tuberous roots whenever they need it. In Ethiopia taro is cultivated fairly and extensively in densely populated and high rainfall areas of the south and southwestern parts of the country and remained an important food source among the communities and plays critical roles in rural diets (Edossa et al. 1995).

Carrots are produced in a wide range of agro-ecologies from the lowlands to the highlands of Ethiopia. They are frost tolerant and have become one of a few alternative crops that can be grown in the frost prone highlands around 3000 masl. Carrots are usually grown on small plots in the backyards of town and peri-urban dwellers for family consumption; however, some farmers grow carrots on up to 0.25 to 1 ha as a means of income. Carrots can be grown throughout the year if rain and irrigation water is available. In highlands that get bimodal rainfall, two cycles of carrots can be produced based solely on rain. These are the short rainy season (*Belg*, March to May) and the long rainy season (*Meher*, June to September). The third cycle is also possible between October and March with irrigation water (Getachew, and Mohamed, 2012).

Onions are becoming more widely grown in recent years. Currently, the crop is produced in different parts of the country for local consumption and for export of flowers to European markets (Tadesse, 2008). Next to onion, garlic (*Allium sativum* L.) is the second most widely cultivated *Allium* species in Ethiopia. Ambo, Debre-Work, Adet, Sinana and many other areas of the Ethiopian highlands produce the bulk of garlic under the small-scale farmers sector (Getachew, 2000 cited in Yonas and Mashilla, 2012). In the highlands of Bale, south eastern Ethiopia, farmers produce garlic under rain fed condition during both '*Bona*' (August - December) and '*Gena*' (March - July) cropping seasons for commercial purpose (Yonas and Mashilla, 2012).

The country has a potential and provide high production per unit area. The potential yield of sweet potato in research goes up to 50 t ha-1; but on station and on-farm research with improved management practices, it indicated a yield ranging from 17.5 to 35.0 t ha-1. However, because of poor management practices, the yield under farmers' condition is

low, on average, 7.6 to 7.9 t ha-1 (CSA, 2003), while others reported the root yield as low as 5 t ha-1 (Degu and Workayehu, 1990; Degu et al. 1991 cited in Tenaw et al. 2011). Compared to cereals, potato is short duration crop that can yield up to 30-35 t/ha potato in 3-4 months in Ethiopia (Endale et al. 2008b as cited in Bezabih and Mengistu, 2011). In Bhutan, it is reported that the potential yield of potato can reach up to 50 t/ha (Joshi, et al., 2009 as cited in Bezabih and Mengistu , 2011). In Ethiopia, average tuber yield of potato was almost constant between 6-8 t/ha in the last 20-30 years (Endale et al. 2008a as cited in Bezabih and Mengistu , 2011). The highest yield of taro is also in the region SNNP, 81.11 quintal/hectare. This is much more than the national average of 66.19 quintal/hectare (Adane , 2009). In Ethiopia, cassava has been found to have an excellent adaptation and growth performance in different agro ecologies with a total root yield ranging from 28 to 60 t/ha, which is by far greater than the global average tuber yield of 10.5t/ha (FAO, 2005 cited in Tewodros and Biruk, 2012).

Currently, about 12345.8 t of carrot is produced in Ethiopia on 2215 ha of land (CSA, 2010/11). The productivity of tropical onion is around 9.6 tonne/ha, which is very low, compared to the average bulb yield in temperate countries, which is about 19.5 tonne/ha. The world average yield at present is about 17.3 tonne/ha (FAO, 1999). Ethiopia has a great potential to produce onion every year for both local consumption and export with an average yield 13.3 tonne/ha (CSA, 2001/02 as cited Taha, 2007). World garlic productivity ranges from 8.43t/ha and 13.02 t/ha, respectively (www.faostat.fao.org., 2007). In Ethiopia, the total area under garlic production in 2006/07 reached 9,266 hectares and the production is estimated to be over 683,000 quintals (MoARD, 2007).

Root crops grow when there is a shortage of rain and during the failure of other crops. Sweet potato is ideally suited as a post-emergency rehabilitation crop. It as a hardy, drought resistant once established and “low maintenance” crop that is easy to grow even for inexperienced farmers. Large quantities of planting material can be transported at reasonable costs and will produce substantial amounts of food and feed within a short period of time (3 to 4 months) (Schulz, 2012). Potato serves as food and income security to farmers, especially during seasonal food shortage and when grain is depleted from the store. It is a reliable food crop during erratic rainfall condition (Aschalew and Ahned , 2012). Cassava is used mainly by subsistence farmers, grown as hedges and live fence against total crop loss in times of drought and food shortage. A number of characteristics like famine secure, drought tolerance, ability to grow on poor soil, relative insect and pest resistance, more production of carbohydrate per hectare than other food staple, and ability to be left in the ground for a long time before harvesting made the crop encouragingly selectable by the small scale farmers (Nweke et al. 2002 cited in Roza, 2011). In some cases taro fills food shortage gaps during the months when maize and other foods run short and in year of drought (Simon, 1992).

Root crops are used as a source of food and income. In addition, the different parts are used for various purposes: the root for home consumption and sale, the aboveground part for planting material, sale and feed for livestock, and as a soil conservation mechanism. For example, Sweet potato is a good source of carbohydrates, proteins, fiber, iron and moderately rich in vitamin c (woolfe, 1992). The storage root of sweet potato provides considerable amounts of carbohydrates compared to other root crops but has lower protein and fat contents. The orange – flashed sweet potato has high levels of beta-

carotene which is a forerunner of vitamin A, contributing much to human health and nutrition especially for children (woolfe, 1992).

Besides being an important nutrient-dense food, potato is an efficient producer of food energy and nutrition per unit area and must figure prominently in combating any world food crises. Recent data indicate that potatoes have 75 percent more food energy per unit area than wheat and 58 percent more than rice. Also, potatoes have 54 percent more protein per unit area than wheat and 78 percent higher than rice. In fact, no other food can match the potato in its production of food energy and food value per unit area (http://www.uspotatoes.com). Nutritionally, potato is considered to be a well-balanced major plant food with a good ratio between protein and calories, and has substantial amounts of vitamins, especially vitamin C, minerals, and trace elements. Due to its correct balance between protein and calories, it is considered a good weaning food (Berga et al. 1993 cited in Bezabih and Mengistu, 2011).

Cassava is the most important vegetatively propagated food crop and the second most important food staple in terms of calories per capita for more than 500 million people in Africa (Jennings and Hershey 1985; Nweke et al. 2002). It provides 50% of the calorie requirement of over 200 million people in sub-Saharan Africa (Osiru et al. 1996). It is processed into various food forms in many African countries. The main nutritional component of cassava is carbohydrate, which is derived from starch accumulated in the tuberous storage roots. This is processed into various food forms. The tender shoots and leaves are eaten as vegetables in many parts of Africa and it provides protein with a high content of lysine, minerals and vitamins (7 g protein per 100 g edible portion) (Hahn 1989; IITA 1990; Nweke et al. 1994; Fregene et al. 2000; Benesi, 2005). The seed is

processed for oil and seed cake, used for formulating feed for livestock. The seed is also processed into a medicinal product to cure skin diseases (Popoola and Yangomodou 2006).

Sayre at al. (2011) reported that an adult's daily recommended allowance for energy can be provided by cassava by about 80%, while providing an average of 10-20% for vitamin A, iron and zinc. An exceedingly increasing current price of teff in Ethiopia could be a good opportunity to utilize cassava flour as a supplement to teff. In the present situation of our country where by the price of cereals increased from five to six folds higher than their last years price; producing farmers at Gofa and Belle areas of the southern region consider cassava as an important source of cash for household so that it can be sold at a reasonable price and its dried chips are suitably mixed with teff, wheat and sorghum to prepare injera (Yared, 2012).

Colocasia taro, the corms are primarily a source of energy in the form of easily digested starch. They are high in carbohydrates and low in fat and protein. Fresh corms are composed of about 69% moisture, 25% starch, 1.5% dietary fiber, 1.1% protein and 1% sugar (rounded averages from Bradbury and Holloway 1988:58 cited in Adane , 2009). The corms also provide a good range of vitamins, amino acids and minerals. Among the essential amino acids (i.e. those that cannot be synthesized in the human body), phenylalanine and leucine are relatively abundant (Yared, 2007).

Pollock (1992:214 cited in Yared, 2007) estimated that on most days, taro in the traditional (i.e. pre-modern) diet of a Pacific islander could have provided some 1500 calories (kcal). This statement implies a quantity of about 1.25 kg fresh taro corm per day. Taro was also consumed in the form of occasional snacks and during special feasts.

Micronutrient baseline surveys conducted by World Vision Ethiopia in ten rural districts of Ethiopia further showed that 6.4% of the 1246 children aged 6 to 71 months and 7.5% of the 3003 children aged between 6 and 14 years had Bitot's spots (Balcha, 2011 cited in Getachew and Mohammed, 2012). The prevalence is 2- to 15-folds greater than the World Health Organization (WHO) cut-off point (0.5%) for public health significance. Hence, micronutrient malnutrition, vitamin A deficiency in particular, continues to be one of the major public health problems in Ethiopia.

Carrot roots are a rich source of carotenoids, precursors of vitamin A. The carotenoids contained in the edible portion of carrots can range from 6000 to more than 54,000 µg per 100 g, (60–540 ppm) (Simon and Wolff, 1987 cited on Simon, 1992). They are mainly consumed in urban areas of the country which is about 15% of the population. However, their value as an important source of vitamin A is not well exploited in the country due to lack of awareness among the majority of the Ethiopian rural population (Getachew and Mohammed, 2012).

The mature onion bulb contains some starch, appreciable quantities of sugars, some protein, and vitamins A, B, and C (Decoteau, 2000 cited in Tadess, 2008). In addition, Garlic is one of the best studied medicinal plants that its antibacterial and antiseptic property is well known. It contains remedies against headache, bites, worms and tumours (Keusgen, 2002 cited in Tadesse, 2009).

2.2.2 Opportunities and Constraints of Root Crop Production

The importance of root and tuber crops as staple foods is because of their particular agronomic advantages: they are well adapted to diverse soil and environmental

conditions and a wide variety of farming systems and are also highly efficient of edible carbohydrates when compared to other food crops.

Diverse and conducive agro-ecologies that enable year round production, reliable water source, increasing demand and price of products: With increase in population, urbanization, and awareness of consumers and price increase in animal products, the demand and hence the price for root crops in general is increasing. Better infrastructure (roads and telecommunication), cheap labour force, conducive agricultural development policies are the opportunities in the country (Getachew and Mohamed, 2012).

The key constraints to increased production, productivity and utilization of roots and tubers are the declining soil fertility, insufficient and poor quality planting materials, un-suitable varieties for different cropping systems (lack of well adapted varieties); lack of knowledge on pest management, improved processing and market information, post-harvest losses; poor infrastructure; lack of appropriate processing equipment, short shelf life *etcetera*.

2.2.3 Root Crop Marketing

The important market places for buyers to sell these commodities are village markets within the area. Markets outside of the village and city markets are rarely used by producers. These results imply that market interventions to improve the gains to producers need to target village level markets (Onubuogu and Onyeneke, 2012). Lack of proper storage facility, poor access to markets and market information are the major challenges to the root crop production (Kenyon, 2006). The major constraints of marketing include lack of markets to absorb the production, low price for the products, large number of middlemen in the marketing system, lack of marketing institutions

safeguarding farmers' interest and rights over their marketable produces (e.g. cooperatives), lack of coordination among producers to increase their bargaining power, poor product handling and packaging, imperfect pricing system, lack of transparency in market information system mainly in the export market (Bezabih and Hdera , 2007).

2.3 Food Security in Ethiopia

Chronic food insecurity in Ethiopia is the consequence of several long-term contributing factors (Riley et al. 2002); such as Poverty, Large variations in annual and seasonal precipitation, Water shortage for people, crops and livestock, High population density in the highlands and midlands, Environmental degradation, Lack of education, Lack of alternative employment opportunities in rural areas, Lack of productivity enhancing products, High business costs due to bad infrastructure and inefficient markets, High levels of infant and maternal malnutrition (contributing factor of disease and mortality) (Walsund , 2011)

Despite efforts to improve food production through increased use of chemical fertilizers and improved seeds, notable improvement in national food production has not been yet achieved. At the national level the country continues to depend on food aid and to a lesser extent and mainly on food imports (Walsund, 2011).

Rural households produce their own food and also purchase from the market. While the majority of urban households are only purchasers of food, some engage in urban agriculture (mainly livestock and produce) both for their own consumption and for the market. Urban and peri-urban agriculture is intensive in nature and plays an important role in ensuring food security. Most smallholder agriculture in Ethiopia is characterized by a mixed farming system combining livestock and crop activities. Their products are

used for both home consumption and sale at the market. In cash crop producing areas, farmers sell cash crops (coffee, chat, fruits and vegetables, etc.) and purchase food grains from the market. For them, the effectiveness of food market systems is as important as the reliability of food production for personal use. In urban areas where household food security is dependent on household income, work opportunities as well as an efficient food market system are crucial to improving access to food (Walsund, 2011).

The Ethiopian government's development policy emphasizes agricultural sector development led industrialization. In 1996, the government initiated a food security strategy built around: increasing the availability of food through domestic production; ensuring access to food for food deficit households, and strengthening institutional emergency response capabilities (Walsund, 2011).

The prevalence of food insecurity in Ethiopia can be partly attributed to the low purchasing power of the population. Income distribution is significantly unequal. Other major factors influencing access to food in Ethiopia are infrastructure and communication. Although recent efforts to construction major highways have been made, Ethiopia's infrastructure and communication networks are not yet developed (Walsund, 2011).

2.4 Conceptual Framework

Food security is a broad and complex concept, determined by a range of factors-agro-ecological, socio-economic and bio-physical. Thus, there is no single and direct measure of food security. Conceptually food security is divided into three distinct pillars/dimensions: Food availability, access and utilization. According to the definition, household food security could be achieved by increasing agricultural productivity, raising

household incomes and improving household nutrition. Using the mentioned pillars it is possible to define the contribution of root crops to the household food security.

Food availability refers to the households availability of sufficient quantities, appropriate quality of food, supplied through domestic production (this includes crop and livestock), purchase or food aid.

Food access refers to individuals having adequate resource entitlements for acquiring appropriate foods for a nutritious diet. 'Entitlements' are defined as the set of all commodity bundles over which a person can establish command given the legal, political, economic and social arrangements of the community in which they live. Normally food can be accessed through a combination of home production, stocks, purchase, gift, borrowing or food aid. It could also be ensured when communities, households and all individuals within them have adequate resources, such as money, to obtain appropriate foods for a nutritious diet. Access depends on income available to the household, on the distribution of income within the household and on the price of food. It also depends on market, social and institutional entitlement/rights to which individual have access.

Food utilization is defined as the means by which individuals reach a state of nutritional well-being where all physiological needs are met. The pillar also includes clean water, sanitation, health care, and having an adequate diet. It also depicts the importance of non-food inputs into food security including knowledge of dietary needs and their potential impact on human health.

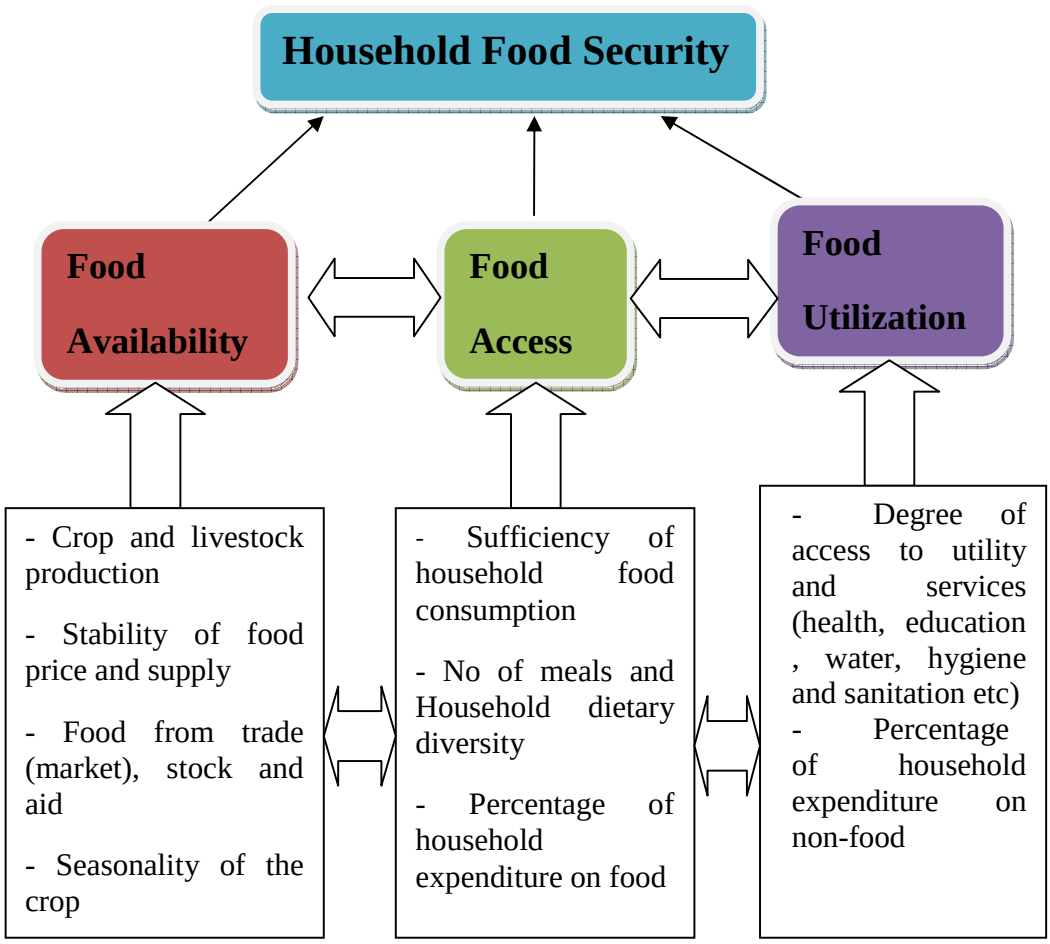


Figure: - 1 Conceptual Framework to show the contribution of root crops to the HH food security (adopted from www. fao.org)

As to the intention of this research by considering Root crops as one of the major, other categories of crops (cereals and pulses) was compared to their contribution to household food securities. The above mentioned indicators were discussed under each food security pillar (dimensions) for root crops, cereals and pulses.

CHAPTER THREE

3. Materials and Methods

3.1 Description of the Study Area

Soddo Zuria Woreda is one of the Twelve Woredas in Wolaita zone found in Southern Nations, Nationalities and Peoples Region (SNNPR). The Woreda is bordered in the south by Humbo woreda, in the west by the Offa, Kindo Koisha and Damot Sore in the north by Boloso Sore Woreda, and in the east by Damot Woide Woreda. The administrative center of Soddo Zuria Woreda is Soddo town.

Based on Wolaita Zone Finance and Economic Development Abstract data of 2003 EC, the Woreda has a total population of 181,692 of which 90, 158 are men and 91,534 women. The total area of Soddo Zuria Woreda is 40.431 square kilometers. A total of 36,689 households were counted in this Woreda, which resulted in an average of 5.0 persons per household.

The agro climatic zone of the woreda is classified in to two categories, the highland (13%) and midland (87%). As to SNNP Regional State of Finance and Economic Development Bureau Statistical Abstract (2009/2010) the annual rainfall for the year 2009 and 2010 is 1051.9 mm and 1341.5 mm, respectively. In addition, according to the same abstract the mean annual rain fall of the study area ranges from 1201 mm to 1600 mm. The mean annual temperature is 15.3 0^{c}. The topography of the area includes plateaus, hills rolling, and rugged mountain systems. The elevation of the study area ranges from 1501 – 2958 m.a.s.l. Among the mountains in the study area 'Damota' mountain is well known and situated along the way to Shashemene-Addis Abeba. The altitude of this mountain is 2958 m.a.s.l. According to the sample examination made by

wolita soil laboratory at 2001 E.C the soil PH of Humbo Larena and Delbo Wogene kebeles ranges from 4.8 – 5.5 and 5.23 – 7.12 respectively.

As to the data of Zonal Agricultural Department, farmers in the study area grow a mixture of cereals, pulses and root crops. The major cereals and pulses growing in the study area: such as Maize, Teff, Wheat, Barley, Sorghum, Haricot Bean, Horse Bean, Peas and Chick Peas are common. In the other hand the area has great potential and practices of root crop growing. Among the root crops grown are potato, sweet potato, yam, taro, cassava, carrot, beetroot, bulb onion, garlic etc. are common and produced majorly as a staple and cash crop. In addition to crops, livestock production is also the major activity in the woreda. The estimated livestock population is 79,600 cattle, 824 goats, 738 sheeps, 7312 equines, 3084 chickens.

All the kebeles under the study area are accessible at all whether condition. The infrastructures such as road, telecommunication, and social services etc which are very essential to agricultural activities are adequately available compared to other woredas of Wolita Zone. To enhance the marketing system cooperatives and storage houses are nearly available for the farmers.

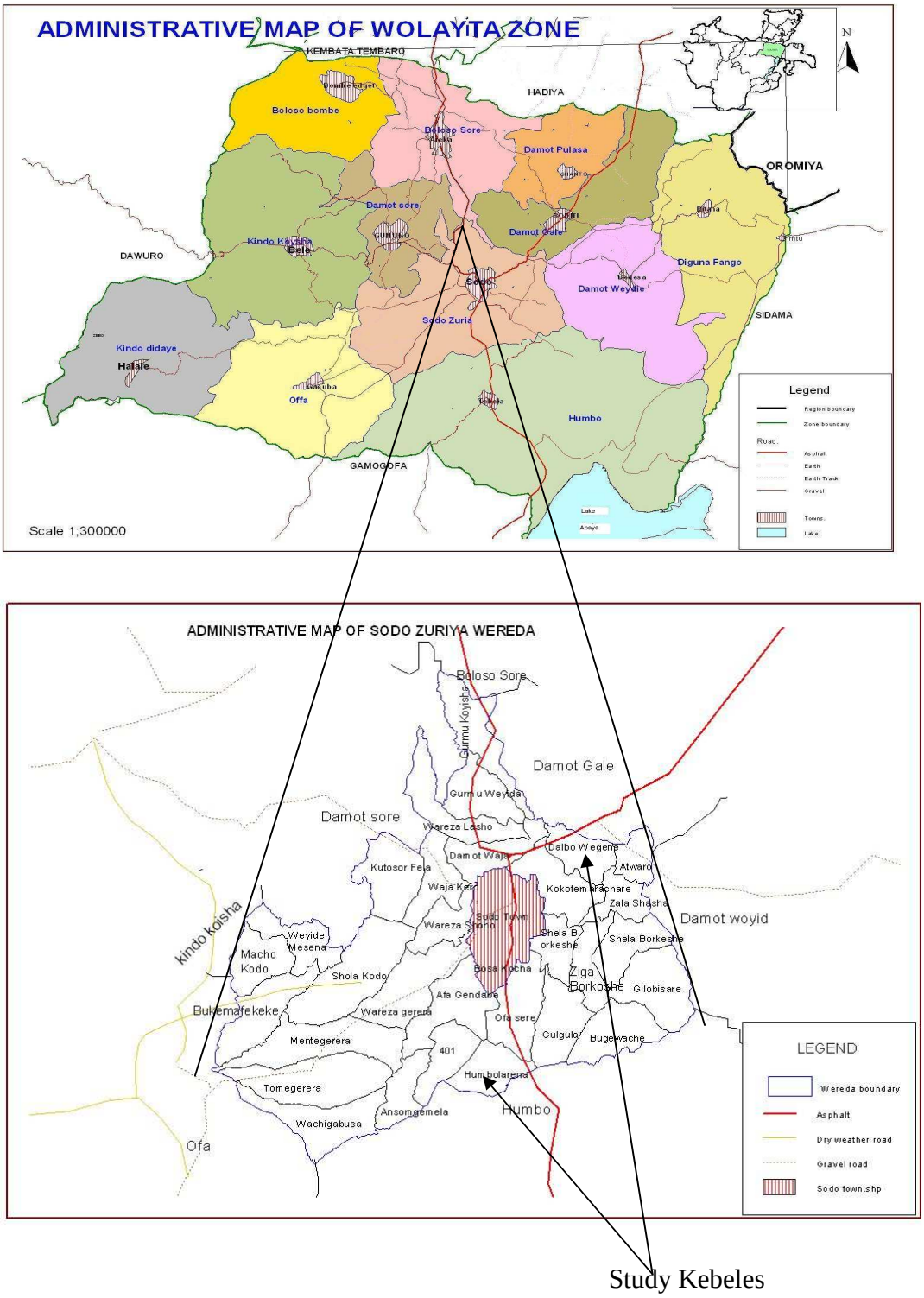


Figure:-2 The Administration Map of Soddo Zuria.

Source:- Wolita Zone Finance and Economic Dev't Dep't,2004

3.2 Research Design, Data Collection and Analysis

3.2.1 Sampling Technique

A multi- stage sampling procedure was used to obtain the survey data. In the first stage, among the woredas of Wolita zone, SNNPR, one Woreda (Soddo Zuria) was selected purposefully. The potential, production and marketing problems of root crops, less extension services given to root crops and the long year experience of the researcher on agricultural activities around the study area are the main reasons for selecting the woreda.

In the second stage, thirty one rural kebeles of the study area were stratified into two strata's according to the agro climatic zone namely Dega and Woinadega. Two kebeles (Delbo Wogene and Humbo Larena) were selected purposefully, One kebele from each agro-ecological zone. Delbo Wogene and Humbo Larena were kebeles selected from Dega and Woinadega agro-climatic zone respectively for this study. In addition the concentration of root crops production was taken as criterion.

In the third stage, simple random sampling method was used to select respondents from all households who have cultivated at least one root crop. Then questionnaires were designed to collect all data's required to meet the objective of the research. All annual crops growing at the selected two kebeles were categorized to three crop categories i.e cereals, pulses and root crop as to agronomic classification. Then the contribution of each crop categories to household food security were analyzed within a household using comparative analysis. A household could grow one, two or more from each category. The comparative analysis was made as to the category not as a single crop. Since kebeles differ in terms of the total number of households they encompass, proportionate stratified

sampling technique was applied to identify number of households from each agro-ecology and kebeles.

For determining the representative sample size from the total sample frame, the formula adopted from Cochran (1977) was used. The formula can be described as below,

n= Z^2pq/d^2

Where, **Z**= 1.96=the standard of normal variable in the accepted level of d^2confidence

P= the proportion of the target population estimated to have the desired characteristics that is 90 % (for this survey)

q=1-p

d=level of statistical significance (0.05)

q=1-0.90= 0.10

$$n = \frac{(1.96)^2 \times 0.9 \times 0.1}{(0.05)^2} = 138$$

Hence the desired sample size (fn) was

Fn = n/ (1+ (n/N)) where, fn =desired sample size

$n = Z^2pq/d^2$

N = Sample frame of the study (Total No. of HHs i.e 1183)

Fn=138/[(1+(138/1183)] = 123.5

Therefore, a total of **124** sample households (Table 1) were surveyed from the study area.

Table:- 1 Number of Sample Households in each selected Kebeles.

Name of kebeles	**Total Number of households**	**Percent share of HHs from the total**	**Total number of sample HHs**
Delbo wogene	**618**	**52.24**	**65**
Humbo larena	**565**	**47.76**	**59**
Total	**1183**	**100**	**124**

3.2.2 Data Collection Methods

Data's for the entire analysis of the study was collected from two sources and data types. The data sources were primary and secondary but types were qualitative and quantitative. Primary qualitative data was collected through focus group discussion, key informant interview, observation and household interview. Primary quantitative data was collected from sample household heads interview. On the other hand, secondary data's were obtained from published and unpublished documents; CSA, governmental office (agriculture etc) and non-governmental reports, books, Journals, research report and other sources like websites are also important secondary data sources.

Focus Group Discussion

One focus group discussion consisting of seven members was conducted at each kebele. The participants were drawn from different age group, sex, wealth status and individual with different occupation. To manage the discussion a general guideline was prepared by considering the objective of the study. Data's obtained through the FGD were used to crosscheck the quantitative data surveyed from household.

Key Informant Interview

From each two administration level (zone and woreda), one expert from crop and root crop production main work process, one expert and coordinator of disaster prevention and preparedness and food security main work process, heads of the department/office were interviewed. Totally 16 individuals were interviewed. Semi-structured interview schedule was used to conduct the key informant interview. This interview was also used to confirm the quality of the data collected through household survey.

Observation

Field observation of the activities and general living conditions of the household was made by the researcher to cross-check the information gathered through household survey, focus group discussion and key informants interview.

Household Survey

A semi- structured questionnaire was designed for household survey. All the data's were collected from 05/02/2013 to 26/03/2013. It was to collect data related to household's socio-demographic characteristics, farming system, crop production and nutrition, storage, transport and marketing situation, house hold income, accessibility of utilities and social services and household food security situation. The developed semi- structured questionnaire was translated in to the local language, 'wolitigna and Amharic' for the convenience of data collection during household survey.

To achieve the objective of the study, one enumerator at each study sites was selected based on their ability in communicating with local language, educational background and prior exposure to similar work. A brief orientation for one day was given to enumerators on the content of the interview schedule and procedures to be followed in the process of conducting the interview. Though and close monitoring by the researcher was made regularly during the interview.

3.2.3 Methods of Data Analysis

The quantitative data was coded and entered into statistical package for social science version (SPSS) 20 and then analyzed. Using this software each crop categories (cereals, pulses and root crops) were compared. The mean was used to compare the relationship (association) of demographic and socioeconomic data's with the production area of these

three crop categories and all the remaining variables. Some variables to the interest of the researcher and objective of the study were analyzed by using descriptive statistics such as mean, minimum, maximum and standard deviation. In addition competition of frequencies and percentage were also applied. In dependent t test and one way anova test were used to test the significance of some variables. In addition, one sample t-test was also conducted to compare the contribution of root crops to household food security. Normality of the distribution for these variables was examined before conducting the one sample t-test. The t- test was run to see if there is any statistically significant difference between the means of the three (cereals, pulses and root crops) crop categories. In addition some quantitative variables were correlated to see their association and significance. The household food balance model was used to quantify the average daily per capita food energy available per person.

For measuring and analysis of household food security, the researcher employed the three dimension/pillar of food security (i.e. food availability, food access and food utilization) and household food balance model (HFBM). The model was used and/or adopted by different researcher such as (Degefa,1996; Eshetu,2000; Messay,2001).

Food availability was measured using indicators or variables such as area cultivated, yield (productivity), crop diversity, seasonality (i.e planting date, length of growth and no of harvest per year), crop prices and expansion and dissemination of extension services.

Food access was determined using indicators or variables such as dietary diversity (amount of macro and micro nutrients obtained), kcal energy obtained per day per person, types of crops consumed per day for number of meals, income obtained from crops and other sources, percentage of expenditure for food items.

Food utilization was measured using indicators or variables such as distance from the household and number of social institutes, frequency (income, knowledge) to use social service (water, health, sanitation and education) and Percentage expenditure of non food items.

HFB model (Messay, 2012) was computed using simple arithmetic formulas described below:

Nij= (Cij +Pij +Bij +GPij)-(Sij + Mij + Gij)

Where, Nij is the net food available for household **i** in year **j.**

Cij is the total root crops harvested after harvest loss by household **i** in the year **j**

Pij is the total root crops Purchased by household **i** in the year **j**

Bij is the total root crops borrowed by household **i** in year **j.**

GPij is the total root crops obtained through different government projects by household i in year **j**

Sij is the total root crops utilized for seed by household **i** in year **j**

Mij is the total root crops sold by household **i** in year **j**

Gij is the total root crops given to others (gifted) household **i** in year **j**

The quantity of food produced from cereals, pulses and root crops by the sampled household was calculated and converted in to dietary calorie equivalent separately, based on Ethiopian health and nutrition research institute (EHNRI/FAO, 1998) food composition table. Then each category was compared. Then the calculated calorie was compared against the national average daily calorie requirement for a moderately active adult (2100 kcal) to look into the contribution of crops to the dietary calorie supply of the

households in the study area. Finally the share of root crops was compared to cereals and pulses.

CHAPTER FOUR

4. Result and Discussion

4.1 Demographic and Socio Economic Characteristics of sample HH's

Sex of Household Heads

A community consists of two types of house heads, the male and female headed households. Due to many socio-economic factors the allocation of land for different crop types varies. Particularly in rural settings, men and women's have different access to knowledge, participation in the community, desire and ability to manage their resources. Although the mentioned situations vary from place to place, they are not yet developed in our country.

An independent t-test has been made to test the influence of household type (Male or Female headed) on the allocation of cultivation land for different crops. At significance level of 0.05 the area allocated for root crop production is not significantly affected by the sex of the household head (Table 2). This implies that both male and female headed households have equal awareness on the contribution of root crops to household food security. At similar significance level Pulse (P=0.168) are not significantly affected by sex of the household but cereals (P= 0.042) are affected.

Table:- 2 Sex Composition and Production Area Allocated (in ha.) for Root Crops (2004 EC, PY)

Sex category of HH heads	Frequency		Production area allocated for root crops	
	count	%	Mean	SD
Male	101	81	0.246	0.237
Female	23	19	0.194	0.247
Total	124	100	0.241	0.237
Independent t-test – t value= 0.64 p=0.536				

Source :- Household survey data, 2013.

In addition, during FGD and KII it is depicted that due to more production from small unit area, availability in short period and food shortage gap filling nature of root crops both male and female headed households give similar attention during land allocation at every production in the study area.

Age Group

Age of the household has a great effect on social interaction in the study area. Table 3 indicates that majority of the household are under active age group. Perception to new technologies and observation to risks also varies accordingly.

Table:-3 Age Group and Production Area Allocated (in ha.) for Root Crops (2004 EC, PY)

Age group of the HH	Frequency		Production area allocated for root crops	
	Count	%	Mean	SD
0 - 29	45	36.29	0.246	0.191
30 - 64	65	52.42	0.252	0.267
>65	14	11.29	0.151	0.206
Total	124	100	0.241	0.237
P= 0.454				

Source : Household survey data, 2013.

One way ANOVA t-test has been used to test the significant difference due to age of the household head to the allocation of cultivation area for root crops. The p value of root crops is not less than the significance level 0.05. This implies that the area allocated for root crops in the study area is not significantly affected by the age group. But the p value for cereals and pulses is 0.018 and 0.075 respectively at similar confidence interval.

Family Size

The average family size of the study area is 6 (six). The minimum and maximum family size is 1 and 17, respectively. One way ANOVA was conducted to see the significant difference between family size groups.

Table :- 4 Number of Family Size vs Production Area Allocated (in ha.) for Root Crops (2004 EC,PY)

Family Size	Frequency		Production Area Allocated for Root Crops	
	Count	%	Mean	SD
<3	6	4.8	0.125	0.108
3-5	45	36.3	0.184	0.177
6-8	55	44.4	0.273	0.263
9-11	12	9.7	0.300	0.314
12+	6	4.8	0.360	0.200
Total	124	100	0.241	0.237
One way ANOVA P= 0.220				

Source:- Household survey, 2013.

As to the result of one way ANOVA the area of cultivation land allocated for root crops (Table 4) is not significantly different with family size group at alpha 0.05. Thus the availability root crop is not affected by the number of family size groups. In addition according to the mean value, the mean size of area allocated root crop increase as the family size increase. FGD and KII depict the reason as the family size increase farmers need more food thus root crops fulfill the need per unit area. That is why respondents in the area are increasing as the farm size accordingly.

Crops which could be produced intensively require more technology, labour and capital. The agricultural system in the study area is labor intensive. The availability of labor is variable at different age group, family size and social interaction of the household head.

The allocation of land for different crop types also varies accordingly. The mean family size of the respondents for the age group 15- 64 and >65 is 6(six) and 8 (eight) respectively.

According to the FGD and KII as the age increases the participation, labour, land size and allocation for different crop types increase. Because of the family of this household is extended and resides closely. This is mostly true for farmers who own more land and have capital to hire lands but not for poor peoples.

Education Status of the Respondents

Education is everything. It is an important tool that enhances people's ability to acquire information, perceive and interpret and response. This holds true for every group of people whether he is from urban or rural setting. Farmer's preference to cultivate and consume is also dependent on the information he/she perceive, benefit and skill or experience owned. In addition to farmer's indigenous knowledge, knowledge acquired due to education also affects the habit of food preference to consume and produce. This would vary as the level of education increase.

To identify the significance of different education level towards the allocation of production area for root crops one way ANOVA was conducted. The result of the analysis indicates that the area allocated for root crops in the study area had no significant difference with different education level (Table 5) at significance level 0.05. Food preference to consume and produce does not be affected by education level in the research kebeles.

Table:- 5 Education Level and Production Area Allocated (in ha.) for Root Crops (2004 EC, PY)

Education level of HH heads	Frequency		Production Area Allocated for Root Crops	
	Count	%	Mean	SD
Illiterate	36	29.0	0.313	0.315
Read and Write	18	14.5	0.254	0.124
Grade 1-4	31	25.0	0.198	0.159
Grade 5-10	32	25.8	0.204	0.241
>10th Grade	7	5.7	0.141	0.129
Total	124	100	0.241	0.237
One way ANOVA P=0.196				

Source : Household survey data, 2013.

Religion, Ethnicity and Marital Status of the Respondents

As to the household survey result depicts (Table 6) the dominant religion and ethnic in the study area are protestant (63.06%) and wolaita (99.1%) respectively. In addition most of the respondents are married (94.59 %). Independent t test and one way ANOVA were made to see the significance difference to the allocation of cultivation land for root crops due to religion, ethnicity and marriage. The survey result shows that religion, ethnicity and marital status do not affect the area allocated for root crops.

Table:- 6 Ethnicity, Religion and Marital Status of the Respondents

	Ethnic of the HH		Religion of the HH			Marriage status of the HH		
	wolaita	Oromo	Protestant	Orthodox	Catholic	Married	Widow	Single
%	99.1	0.9	63.06	34.23	2.71	94.59	3.61	1.80
	P=0.745		P=0.704			P=0.731		

Source : Household survey data, 2013.

4.2 Resource Endowments and Access to Services

House Roofing

Now-a-days in ruarl area the type of roofing is becoming one of the indicator for wealth status of the household. Since shelther is one of the basic needs, peoples give priority to improve it as the income of the household increase. Peoples living in the rural area change their roof type from thatched (Grass Cover) to corrugate iron sheet as their income is getting better. The source for this income variation could be different. The result displays root crops have contributed more to the income for changing the roof type (Table 7).

Table:- 7 House Type and Income (in Birr) generated from root crops (2004 EC, PY)

House Roof Type	Frequency		Income generated from root crops	
	Count	%	Mean	SD
Grass Cover	31	25	837	667
Corrugated Iron sheet	93	75	2395	1910
Total	124	100	2158	1861

Source : Household survey data, 2013.

Oxen

Oxen are the most important means of land cultivation and basic farm asset. Households who own more oxen have better chance to be food secured than others. This is because oxen possession allows farm activities on time. Mulugeta (2002) and Ayalneh (2003) have shown that this variable has a positive and significant effect on food security.

According to Dessalegn Rahamato (1997) the role of oxen to household has described as follow “those households who have more farm oxen are more likely to have farmland and to obtain bigger harvest than those who do not, even though the size or quality of the land of both groups may be the same”. As to one way ANOVA significancy test cultivation area allocated for cereals and pulses is significantly affected with the number of oxen. The p value for cereals and pulses is 0.001 and 0.003. But root crops are not significantly affected by the number of oxen (Table 8) at significance level of 0.05. This implies that root crops are available equally with any number of oxen possessed. Thus the household

could get food from root crops even under less or no oxen. They use hand tools or borrow oxen.

Table:- 8 Number of oxen owned and Root crops produced in kg 2004 EC, PY

Number of oxen owned	Frequency		Root crops produced (in kg)	
	count	%	Mean	SD
0	20	16.1	1531.9	1763.3
1	62	50.0	1610.0	1504.1
2	34	27.5	1857.2	1738.2
3	4	3.2	1629	0
5	4	3.2	800	0
Total	124	100	1654.3	1601.6
One way ANOVA P= 0.093				

Source : Household survey data, 2013.

Size of Land Holding

The average land size of the study area is 0.57 ha. The minimum and maximum land size is 0.063 and 3 ha respectively. But the national average land holding size per person is 1.2 ha (CSA, 2010/11). And 10.8 % of the respondents rented the land from the minimum of 1 year to maximum of 16 years.

In order to identify the significance of cultivation land allocated with land size owned group one way ANOVA was conducted. The survey result depicts that the amount of land allocated is significantly affected by the amount of land size owned. The p value for root crops is below the significance level 0.05(Table 9). Under subsistence agriculture, size of land holding is expected to play a significant role in influencing farm household's food security (Degefa, 2002). It is a basic asset for majority of rural livelihoods i.e more land size means more cultivation and more possibility of production which in turn increases farm income and improves food security (Teshome, 2003).

Table:- 9 Land Size Category and Production Area Allocated for Root Crops (in ha., 2004 EC, PY)

Land size category	Frequency		Production area allocated for root crops	
	count	%	Mean	SD
<=0.500	78	62.9	0.181	0.189
0.501-1.000	29	23.4	0.213	0.218
1.001-1.500	7	5.6	0.334	0.276
1.501-2.000	7	5.6	0.250	0
2.501+	3	2.5	0	0
Total	124	100	0.241	0.237
One way ANOVA p=0.000				

Source : Household survey data, 2013.

Access to Credit Service

The survey shows 47.7 % of the respondents get credit services from legal institutions or local borrowers and almost all of the beneficiaries ware used the credit for cereals mainly, pulses. This implies that the households in the study area get low credit services for root crop production from legal institutions.

The availability of agricultural credit to the subsistence farmers who have little or no capital to invest in farming is a paramount important. Access to credit service helps the farmers to purchase agricultural inputs such as fertilizers, improved seeds and oxen, and which in turn increases production and contributes to food security.

Access to Agricultural Inputs

Since the land holding in the study area is very small the respondents practice different activities to enhance the fertility of the soil and productivity of the crop. Intercropping, crop rotation and using organic and artificial fertilizer are among the agricultural activities practiced in the study area. According to the survey, households practice intercropping cereals with pulses and root crops (34.2%) and rotate cereals with pulses and root crops (91.9%). Weeding is also one of the agronomic activities which have a great impact to the amount of production. According to the survey, the mean practice of weeding for cereals, pulses and root crop is 0.86, 0.4 and 0.63 respectively.

On the other side, 35.1% of the respondents get root crops planting material from previous harvest, 11.7% from private seed center, 9% from government, 3.6% from relatives, 9.9% from market, 2.7% from research center and 27.9 % from two or more of the mentioned sources. In addition to agronomic activities which have a great impact on production, households in the study area use artificial fertilizers such as DAP and UREA for cereals (Maize) and pulse (H/bean) and sometime for potato. The average DAP (kg/ha) used for cereal, pulse and root crops is 91.4, 20.4 and 10.34 respectively in 2004 EC, PY. The respondents do not use urea to cultivate root crop. However averagely they use 40kg per hectare for cereals and 1.2kg per hectare for pulses. They also used improved seed of Maize, Wheat, Potato, Carrot, Beet and Taro (Bolosso one or Bereket). For the same production year the mean improved seed (in kg) for cereals is 12.4 and 3.7 for root crop but none for pulses. But the national amount of chemical fertilizer and improved seed per hectare is 108 kg and 50kg respectively (CSA, 2010/11).

High return of agricultural production depends on the adequate usage of fertilizer, improved seeds, pesticides (herbicides and fungicides) and labor force. Subsistence farming, by its nature, is production for direct consumption. Any farm input that augments agricultural productivity is expected to increase the overall production, which in turn contributes towards attaining household food security (Brown, 2004).

4.3 Root Crop Production Trend

Households in the study area have different experience of farming. All of the respondents have started producing root crops in the study area. The survey result indicates 95.2 % of the respondents have an experience of > 11 years root crops farming. They had produced root crops for similar years for food, feed and income generation. Respondents were also asked to explain the trend of root crop production during the last five years (Table 10). The majorities of them had responded as if the trend of root crop production is increasing.

Table:- 10 How is the trend of root crop production during last 5 years in the study area?

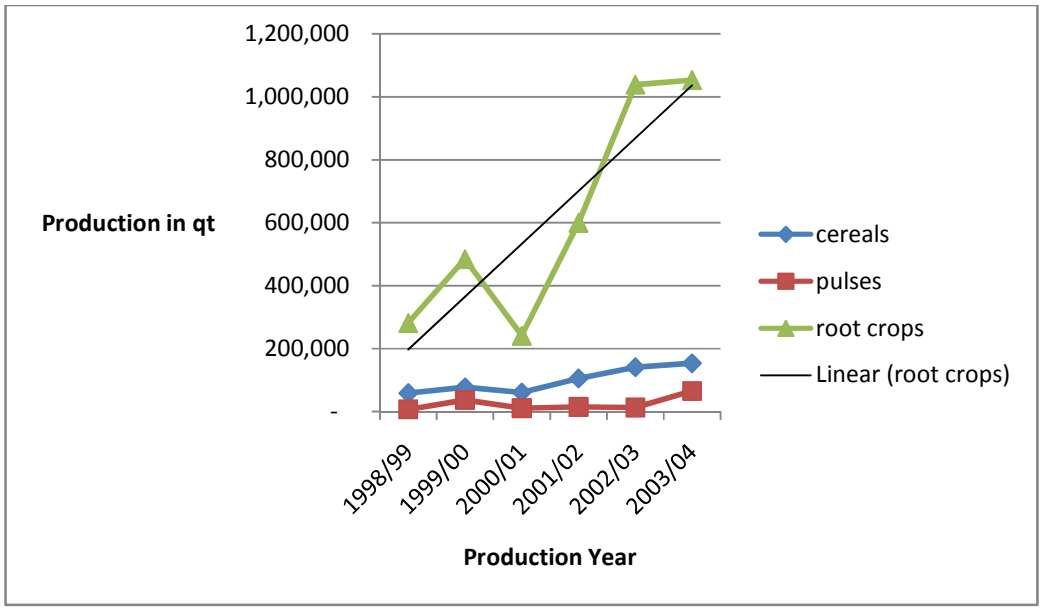
Trend of root crop	Frequency	
	count	%
Increasing	62	50
Decreasing	33	26.6
Fluctuating	27	21.8
Not known	2	1.6
Total	124	100

Source:- Household survey, 2013.

Similarly according to last six years Wolaita Zone Agricultural Department data, the total amount of production harvested and the production area allocated for root crops indicates an increasing trend (Figure 3).This implies that the households in the study woreda were benefiting more from root crops for food and also income generation.

At national level the trend also holds similar patterns, according to CSA agricultural sample survey made for three years (2008/09 – 2010/11) the trend of root crop production area in hectare (146625, 213747, 218760) and total production in quintal (12226563.9, 18301753.7, 20151941.9) is increased.

Figure:-3 Production (in Kg) Trend of Cereals, Pulses and Root crops in Soddo Zuria Woreda (Six Years 1998/99-2003/04 PY)



Source:- Wolita Zone Agricultural Department, 2013.

4.4 The Contribution of Root Crop Production to Household Food Security

Throughout the entire body of this section the researcher has employed the three pillars (availability, access and utilization) and household food balance model in order to describe the contribution of root crop towards household food security.

4.4.1 Food Availability

Food availability is the physical presence of food in the area through all forms of domestic production, commercial imports and food aid. Availability is determined by food produced in the area, food brought into the area through market mechanisms and food supplied by the government and/or aid agencies.

The household survey displays that, from all respondents: 27.9 % responded as if they are food self sufficient, 52.3% as if not and 19.8 % responded that their food self sufficiency varies from year to year or season to season. Furthermore, during shortage of food 64% of the respondents get food from market but 36% from other different sources such as borrowing, aid, daily labor and petty trading. Also according to the study 78.4% of the respondents do not get enough amount of food from their own production but 21.6%.

4.4.1.1 Diversity and Seasonality of Root Crops

Diverse crop types grow in the study area. According to the survey under the category of cereal: one to four (including sorghum but insignificant) crops were cultivated. But for root crops the diversity ranges from one to nine (includes yam and one to four for pulse crops. As the diversity of the crops increases, household have a chance to get more food at different normal and bad situations

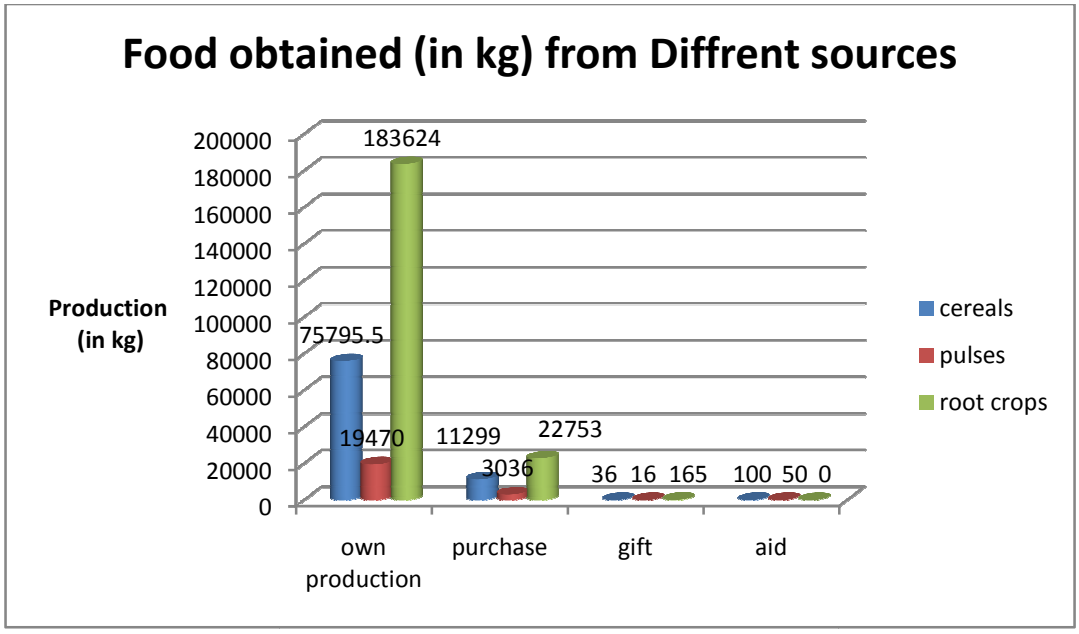
The planting and harvesting dates are variable with different crop categories. They have direct relation with food availability at household level. Some root crops like sweet potato, potato can be available within short period (Three to Four months) of time after risk had occurred on other crop types. Sweet potato, Potato, Carrot, Onion Garlic and Beet can be harvested more than twice per annum if water is available. But cereals and pulse are harvested once per annum.

Most farmers in the study area practice rain-fed agriculture. Root crops are produced by rain (98.2%) and irrigation (1.8%). At least one of the root crops is available throughout the year. Among the root crops, the most important feature of cassava is its adaptability and produce yield in various ecological and agronomic conditions and it often grows where most other crops fail (Mesut and Ahmet, 2002 cited in Tewodros, 2012). In Ethiopia, the crop has been found to have an excellent adaptation and growth performance in different agro ecologies with productivity Variation.

4.4.1.2 Quantity of Root Crops

A community can get food through different ways. Some of these are: own production, by purchasing from market, through social relation such as gift and aid (it could also be by government when the food security of that community becomes seriously affected). Similarly the study area was getting food from the mentioned means (Figure 4).

Figure:- 4 Food obtained from different sources in 2004 EC



Source:- Household survey,2013

In the study area food is available significantly from own production and purchase than other means's. The total amount of area allocated for production has significant contribution to the total production to be harvested. Total area allocated for root crops (26.8 ha) in the study sites is ranked second next to cereals (34.6 ha) in 2004 EC production year. In addition the mean production area of root crops is 0.24 ha. This shows that root crops have significant contribution to household food security in terms of production area.

Since production area is basic for food availability, it's correlation between crop categories was tested to look the significance. According to table 11, the p value at 0.01 significance level, indicates that there is significant relationship between production areas of root crops.

During FGD and KII, HHs describe that even though the land holding size of the study area is small, they allocate land for root crops because root crops are considered as an insurance crop. Besides root crops are growing at both Belg and Meher season in the area. Farmers allocate considerable amount of land in both production seasons. They are also intercropped and provide significant amount of food, even for low land size holders.

Table:- 11 Production Area Correlations between Crop Categories, 2004 EC PY

		Production area of cereals	Production area of pulses	Production area of root crop
Production area of cereals	Pearson Correlation	1	0.315**	0.246**
	Sig. (2-tailed)		0.001	0.009
	N	124	124	124
Production area of pulses	Pearson Correlation	0.315**	1	0.164
	Sig. (2-tailed)	0.001		0.085
	N	124	124	124
Production area of root crop	Pearson Correlation	0.246**	0.164	1
	Sig. (2-tailed)	0.009	0.085	
	N	124	124	124

**. Correlation is significant at the 0.01 level (2-tailed).
Source: Household Survey, 2013.

The mean of root crop produced (1654.3 kg) is by far greater than cereals (682.84 kg) and pulses (175.41 kg). And it provide greater energy per hectare per day than cereals and pulses Therefore, root crops (1654.3*460.2 kcal per day per person) provide more food than cereals (682.84*533.41 kcal per day per person) and pulses (175.41*155.28 kcal per day per person).

According to FGD, KII and different administration level report root crops can be harvested more from unit area (6800.6-21500 kg/ha) and provide more food. Thus they contribute more than cereals and pulses to the household food security.

In order to see the significance of root crops produced with cereals and pulses one sample t-test was used. Before proceeding one sample t- test, the distribution normality of root crop produced was tested and it is significant at the level of significance 0.05 (Both $P>0.05$).

By considering the mean of root crop produced as sample mean and mean of cereals and pulses as test value one by one, the t- test was made to see the significance of root crop produced with cereals and pulses. The p value of mean root crop produced to the test value of mean cereals and pulse produced is 0.000 at significance level 0.05. The t value is also positive. This depicts that the amount of root crops produced was significantly greater than cereals and pulses.

Furthermore it would also be good to analyze crop categories purchased to know the food availability; following the above similar procedure the p value analyzed for the means of root crops purchased is 0.019 and 0.000 to compare with cereals and pulses, respectively, at the level of significance 0.05. This indicates that the mean root crop purchased is significantly greater than the mean cereals and pulses purchased. The t-score while comparing with cereals and pulses is also positive. Thus both tests imply that root crops purchased (in 2004 EC, PY) are significantly greater than cereals and pulses purchased. But on the other hand, according to the survey result, root crops are not significantly gifted and aided at household level in the area.

During the survey some households to crosscheck the information's collected through household survey were interviewed. W/ro Aster Goa had explained the availability of root crops at household level by considering Taro.

> *"I can get from 9-10kg of taro per plant. This amount from one taro plant is enough for two meals per day. I lost my husband by death. Now I have four family members including me. Look how much the crop is blessed, therefore we locally called the crop "Bereket" it is to mean the blessed. It contributes much to our food consumption during food gap and normal time. We live the crop at field even after maturation. Because we can consume when we need and lack other food source".*

According to w/ro Aster Goa, root crops are available with low price, always at required amount from market. In addition, although the respondents had very fragmented land size, root crops are always available at their farm. They can be planted at marginalized land and around the boarder of the farm.

figure 5-a : w/ro Aster Goa *figure 5-b: w/ro Aster's son & home* *figure 5-c w/ro Aster's taro farm*

Figure:- 5 w/ro Aster Goa's taro farm

Source:- Own Capture

4.4.2 Food Accessibility

Household can access food from different sources. Among these: market, own production and transfers (by gift, aid etc) from public programs or relatives are common. These

means are categorized as entitlements (Sen, 1982). Thus food security could not only be achieved by own production at household level but also through those means. In order to identify the accessibility of crops produced towards household food security, it would be necessary to know the income generated by selling products of crops and other ways (social and political system). But here income generated through root crop production was only considered.

4.4.2.1 Income Generation

The household survey result shows that 1.8, 45.9 and 52.3% of the respondents get meal once, twice and triple times per day. The food can be acquired from different sources such as own production, purchasing crop and livestock products, transfers (borrowing, aid), income from petty trade, remittance and other (Figure 6).

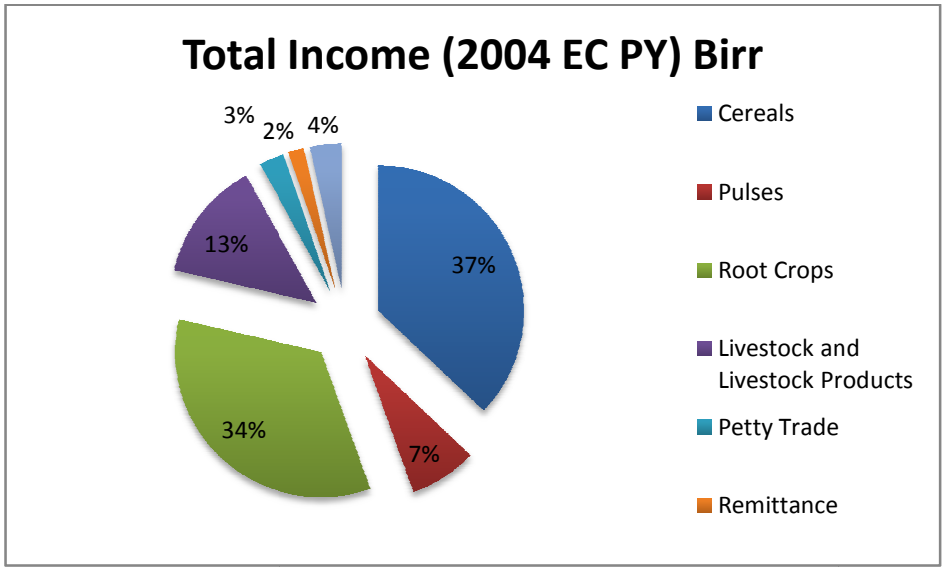


Figure :- 6 Total income generated in the study area (2004 EC. PY)

Source:- Household Survey, 2013.

For analysis income generated from three crop categories were considered in this study. The minimum, maximum and mean income generated from cereals and root crops are (0.00, 10200.00, 2066.16) (150.00, 8770.00, 2157.63) consecutively.

On the other hand the total amount of cereals, pulses and root crops sold is 31097 kg, 7018 kg and 75625 kg respectively. The minimum amount of three crop categories sold were 0(zero) but the maximum for cereal, pulses and root crops is 2500 kg, 750 kg and 6800 kg respectively for 2004 EC PY.

To test the significance of the income generated from root crop categories, the normality of the income distribution has tested. Both p values are greater than the level of significance 0.05 (Table 12). The distribution of income generated from sell of root crops is significant for the normality test.

Table:- 12 Tests of Normality of Root Crops Income Generated, 2004 EC, PY

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Total income from root crops	.134	64	.201	.979	64	.329

a. Lilliefors Significance Correction

Source :- Household survey, 2013.

According to one sample t- test of root crops with cereals (Table 13), the *p*-value of the test is .707. This value is greater than the level of significance 0.05. It indicates that the mean income of the root crops is not significantly different from 2066.16 (the mean income of cereals). The positive *t* score implies that the sample proportion (root crop sample mean income) is greater than 2066.16 (the mean income of cereals) but the evidence (based on the p value) is insufficient to conclude that the mean income of root

crops in the population is significantly different from 2066.16 (the mean income of cereals). Therefore root crops generate income equal to cereals but greater than pulses.

In addition to the income generated from the sell of root crops, households in the area get money from processing root crops to market. Farmers around river "Delbo" are organized as an association and wash carrot before market for local traders and earn money.

Table:- 13 One-Sample Test of Mean Income Generated by Root Crops with Cereals, 2004 EC, PY.

	Test Value = 2066.16(Mean income of cereals)					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Total income from root crops	.378	58	.707	91.46712	-393.4726	576.4068

Source:- Household survey, 2013.

But while comparing income generated by root crops with pulses, the p value (0.035) is below the level of confidence 0.05 and the t-score is positive (Table 14). Thus the mean income generated by root crop is significantly greater than the mean income generated by pulses. Finally from both comparisons it is possible to conclude that root crops generate income significantly to the household food security than pulses and equally to cereals.

Table :- 14 One-Sample Test of mean income generated by Root Crops with Pulses, 2004 EC, PY.

	Test Value = 1634.71(Mean income of pulses)					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Total income from root crops	2.158	58	.035	522.91712	37.9774	1,007.8568

Source:- Household survey, 2013.

4.4.2.2 Dietary Diversity

As to the definition of many scholars food has to be available and accessed to be healthy at household level. To fulfill these requirements any household has to get enough energy and nutritious food at any time. A food composition during a meal time has to compose recommended macro and micronutrients. The energy (in kcal), macro and micro nutrients available per 100gram of crop types are described and annexed. Thus it could be possible to compare which crop categories provide more energy, micro and macronutrients in accordance to the total amount produced and/or consumed. The result of the survey also depicts that the mean cereals, pulses and root crop consumed (from own production, market, gift and aid) is 455.33, 130.81 and 932.69 respectively.

For normality test both the p values are >0.05, one sample t-test p value (0.000) and the positive t- score indicates the mean root crop consumed is significantly greater than the mean cereals and pulses consumed. Although they are consumed at significant amount, the households in the study area use root crops by only boiling. In addition as it is mentioned earlier root crop are produced and purchased significantly in the area. This implies that root crops are more accessible and provide greater divers diet per hectare per day per person than cereals and pulses at household level.

4.4.2.3 Household Expenditure on Food

People preference and expenditure to food varies as to the amount of income earned i.e when the income of any household gets increased the preference and expenditure to food also increases. Respondents in the study area expend money for food and non food item. The mean value of birr expended for food during 2004 EC from cereals, pulses and root crops is 953.02, 488.75 and 975.08 respectively.

Both p value of the normality test for root crops expenditure are >0.05 which shows it is significant at alpha 0.05. The p value to test the significance (one sample t-test) of the mean expenditure of root crops with cereals is 0.863. The value is greater than the significance level 0.05. Thus the mean expenditure of root crops is not significantly greater than cereals. But the p value of the mean expenditure of root crops with pulses is 0.001, which is less than the level of significance 0.05. Thus the mean expenditure from root crop to food is significantly greater than pulses. Thus root crops contributes equally to household expenditure for food with cereals, but greater than pulses.

4.4.3 Food Utilization

Food utilization refers to the physiological ability of a person to absorb and utilize consumed nutrients. This could be affected by the availability and frequent utilization of social services or institutions such as health, education, potable water, sanitation etc.

Almost all respondents (97.3%, 96.4%, 97.3% and 91%) use always potable water, sanitary services, schooling and energy respectively. But 97.3% of respondent use seldom the health institutions. The maximum and the mean of the distance (in km) of these social service are for water (6,1.3), health (7,2.5), sanitation (6,0.29), education (6,1.64) and energy (4,0.12).

Nowadays the government has given great attention for the enhancing of the coverage and dissemination of these services at rural. Almost all the respondents get majorly the awareness to use these institutions from government sectors and sometimes from Non government organizations.

Besides the facilitation due to the policy, households in the study area get the service by expending their money. The mean money expended for non food items from crop

categories such us cereals, pulses and root crops is 675.7, 314 and 719.53 respectively. The normality test of the mean expenditure for non food items from root crop (Both P value >0.05) is significant at alpha 0.05. The p value for mean expenditure of root crops to cereals is 0.610, which is not significantly different at significance level 0.05. And the p value for mean expenditure of root crops to pulses is 0.000; it is significantly different at significance level 0.05. Thus farmers in the area use the income generated from root crops equally as cereals does to get non food items such as school, health service, clothing, water service etc. But they use greater than pulses.

4.4.4 Food Energy Availability

The amount of energy available from each crop categories is another indicator used to measure their contribution to household food security. To measure net food available at household level, household food balance model was used. Using this model the net amount of cereals, pulses and root crops available was computed and converted to energy per person per day (food composition table(EHNRI/FAO,1998) was used to convert the net available food to energy).

The survey result depicts that the energy (kcal) per person per day available from cereals, pulses and root crops in the study area is 533.41, 155.28 and 460.20 respectively. Thus the total kcal per person per day for these three crop categories is 1148.89, which is below the medically required national adult average 2100 kcal (Messay, 2012) by 951.11 kcal. The contribution of these three crop category is 46.4, 13.5 and 40.1 percent for cereals, pulses and root crops respectively. This implies that root crops provide greater energy next to cereals and above pulse kcal per person per day. But root crops contribute more than all as to the amount produced and/ or consumed at household level.

According to Birhanu (2004) many Ethiopians live in conditions of chronic hunger with both a low average daily energy supply (kcal/capita/day or DES) of 1880 and a very high (44%) prevalence of under-nourishment. This compares to an average 2199 kcal/capita/day and a prevalence of 33% under-nourishment for the whole of sub-Saharan Africa (1998-2000 average). Moreover, 81% of this calorie supply comes from cereals, roots and tubers (Berhanu, 2004). Roots and tubers provide an estimated average of 20% of the daily per capita calorie intake for the 640 million inhabitants of Sub-Saharan Africa, where with the growing population there is increasing demand for these crops both for food and for feed (Lawrence et al., 2006).

4.4.5 Relationship among Food Availability, Access and Utilization

The primary source of food is agriculture. All over the world agriculture is practicing. The production harvested is variable from place to place due to the available potential of resources. This resource could be affected with manmade and natural phenomenon. The population growth has also direct effect to the amount of agriculture harvested. Thus due to diverse effect food can be produced surplus or short. Thus the availability is also affected. It could also be affected by policy issue and/or political system.

Food can be available through different mechanisms: Own production, marketing and social/political system. Food availability deals about the quantity of food available at household, community and national level. And food access deals about the quantity and quality of food, available from different sources. This accessed food has to be absorbed to get healthy and active life (food utilization).

Thus at household level if the family gets surplus production than home need, it can generate income and purchase foods that are not produced by his own but very essential

to his healthiness. And also the family can utilize social services to get healthy and knowledge full life. Therefore the three pillars of food security are strongly interlinked.

Any developmental intervention has to intervene on these pillars to get food security at household level. Thus:

Food security is a function of food availability, access and utilization.

- Food availability is a function of quantity of food produced, purchased and transferred due to many means's.
- Food accessibility is a function of quantity and quality of food produced, purchased, transferred due to many means's, income, price and political system and stability.
- Food utilization is the function of body absorption capacity to the available quantity and quality of food.

4.5 Root Crop Production and Marketing constraints in the Study Area

4.5.1 Root crop production constraints

The empirical data analysis made under each category is for specific crops significantly growing in the study sites. These are Maize, Wheat and Barley as cereal crop Pea, Chick Pea, Field Bean and Haricot Bean as pulse crops and Sweet Potato, Potato, Taro, Cassava, Carrot, Onion, Garlic and Beets as root crops.

Land preparation is a crucial activity to enhance the production of root crops. This activity could vary as to the labour available, number of oxen and farm implements. It is also affected by the perception, knowledge and experience of the households toward any agronomic activity. The mean number of ploughing to cereals, pulses and root crop in the study area is 1.63, 0.93 and 1.18 respectively. Number of ploughing has positive impact

on the amount of production i.e as the number of ploughing increase/decrease the amount of production increase/decrease. In addition if the land preparation is poor, some crops may majorly lose their productivity and some could tolerate and give adequate amount of production.

According to FGD, KII and the survey, the allocation of cultivation land to different crop types at different production years depends on productivity of the crop, consumption need, total amount of cultivation land owned, seasonality, agronomic activity of the crop, market need and price.

During last five years there were pest and disease infestations on crops in the area. Root crops were also affected but the extent of damage was moderate than other crop categories. Root crops like Cassava, Taro tolerate pest and disease infection.

To disseminate new technologies to the rural community, broadening extension work is crucial. In order to do the dissemination faster and effective the government is employing three extension agents at each kebele. The study kebeles have three to four development agents from disciplines of crop production, animal husbandry and natural resource. The household survey data indicates 97.3 % of the respondents receive technical advices from development agents and woreda experts. But the frequency of the follow up varies, 0.9% was followed always, 16.2% two times per week, 15.3% once per week, 34.2% twice per month and 33.3 % once per month. The extent of extension service for root crops is 9.9% low, 77.5% medium and 12.5% maximum. The major production constraints in the study area are described on table 15.

Table:- 15 Root crop production constraints in the study area.

Root crop production constraints	Frequency	
	Count	%
Disease and pest	13	10.5
Cultivation land shortage	11	8.9
Water/moisture problem	32	25.8
Labour shortage	4	3.2
Inputs shortage	11	8.9
Inadequate or low extension services	4	4.8
Two or more of the mentioned	47	37.9

Source:- House Hold Survey,2013

4.5.2 Marketing Constraints

Storage facilities are very important for marketing to make them available at required season. Households in the study area store root crops by preparing bed (4.5%), storing at field (5.5%), spreading at the bed (47.7%) and both by spreading at bed and storing at field (42.3%).

Marketing is basic to households to generate money for food and non food items. Out of the total sample size, 83.7% sold their crop products during last five years. They sold their products at different market places (0.9% at farm gate, 21.6% near local market, 27% near city market and 34.2% at two or more of the mentioned market places). From the total respondents, 16.3% did not sold any crop type since they did not harvest surplus due to their farm land size. Majority (83.7%) gets market information from local farmers and specially prefers to sell root crops (44.1% during food shortage, 10.8% during

holiday, 3.6% during crop harvest, 14.4% during sowing or planting period and 10.8% at two or more of the mentioned).

Wolita Soddo town is surrounded by Soddo Zuria woreda kebeles. These kebeles are transected by four major roads (Areka- Addis Abeba Road, Bodity-Shashemene-Hawassa- Addis Abeba Road, Humbo – Arbaminch Road and Kindo Koisha- Dawro Road). Thus most of the households are favored by market place and market information unless those reside at the tip of mount "Damota". From the study kebeles Delbo Wogene share parts of this mountain. From the total respondents 77.5% do not face marketing problem but 22.5% who reside at mount "Damota".

The major problems these households encountered are: road problem 0.9%, market and market information's problem 0.9%, price fluctuation 14.4%, consumer's shortage 2.7% and two or more of the mentioned 3.6%. Since root crops are not introduced more to other major markets of the country the brokers or local trader's purchase at low price from the farmers and are required less by major merchants. Since some root crops perish soon after harvest, unless they did not sell, some households lose the product. Mostly root crops are transported by lobar, animal power (Mules, Horses, and Donkeys etc) to market places.

CHAPTER FIVE

5. Conclusion and Recommendation

5.1 Conclusion

The food security of the study woreda is mainly dependent on crop production. Crops are cultivated for many years. Root crops are growing diversely in the area than cereals and pulses. The trend of root crop production within the last six production years is increasing.

Farmers in the study area have broad experience of traditional and modern agricultural practices. Different agricultural extension systems and packages were disseminated for the last many decades. But farmers in the study areas are still food insecure. The agronomic practices such as ploughing, weeding etc are implementing but it is not still as recommendation. In addition improved seed and artificial fertilizers are also used below the recommendation rate. Local seed material from last year harvest is mainly used. Almost all farmers do not use improved seed for root crops. Although the extension service given for root crops is rated as medium, root crops are still the major source of food and provide more food than others.

Households in the study area get financial service from legal governmental institutions and local borrowers. They sold their crop and livestock products during last five years. Mostly farmers sell their root crops at the gate, local market, nearby city (Soddo town) market. The major marketing problems for root crops are: market and market information, price fluctuation and consumers shortage. In addition major root crop production challenges in the study area are: crop disease and pest infestation, cultivation

land shortage, water (soil moisture) problem, labour shortage, input shortage and inadequate or low extension services.

Socio economic profile of the household could affect the production of root crop in the study area. According to the result of the survey: sex of the household, age group, family size group, education level and number of oxen do not significantly affect the availability of root crops but cereals and pulses are variably affected. But allocation of land for cereals, pulses and root crops is significantly affected by the amount of cultivation land owned. According to the p value the mean of root crops produced and purchased (or are available) is significantly greater than cereals and pulses at household level.

The energy (kcal) per person per day available for cereals, pulses and root crops in the area is 533.41, 155.28 and 460.20 and the contribution ratio is 46.4, 13.5 and 40.1 percent respectively. This implies that root crops contribute greater energy per hectare per day per person at household level.

To look the accessibility of food the major determinant factor is income additional to own production. The p value indicates that the mean income generated from root crops contributes significantly at equal extent to cereals but greater than pulses. Furthermore it could also be possible to compare which crop categories provide more energy, micro and macronutrients in accordance to the total amount produced and/or consumed. The result of the household survey depicts that root crops are more accessible than cereals and pulses at household level and provide energy, macro and micro nutrients significantly.

The p value of the mean of birr expended for food and non food items was also used to measure their contribution. The result shows root crops contribute significantly equals to

cereals and greater than pulses. Thus households utilize the income generated from root crops significantly to get food and non food items.

5.2 Recommendations

- Household food security is majorly affected by own production and income generated from this production. To consume adequately and generate more income there should be high production from unit area. To get this high production there should be good agronomic activity and marketing system. Root crops are still providing significant contribution with little attention given through extension and marketing system. Thus there should be significant extension attention to root crops to boost the contribution of root crops even more than the current.
- Root crops are majorly sold at local market. They are not adequately available in major city markets. Because they do not have more consumers as cereals and pulses at big cities. Especially, urban consumers consider it as inferior food. Therefore root crop has to be advertised county wise by explaining its contribution to household food security. In addition market place and market information has to be broadened and become accessible to households and merchants.
- Currently root crops are consumed simply by boiling them. According to many literatures different parts of root crops can be used alone and accompany with other crop categories but in the study area they are used only boiled. If value is added to root crops, they can be preferred widely by consumers and generate

income even more. Thus great attention has to be made on the food processing of root crops.

- The research activities and documentation to root crops are still not sufficient. Therefore development practitioners and researchers has to give due attention to investigate many issues to be researched and advertise its contribution to the household food security.

6. REFERENCE

Adane Tilahun (2009). Effect of Processing on Some Physicochemical and Antinutritional Factors of Taro (*Colocasia Esculenta* (L.)_ Schott.) Grown In, Ethiopia, MA Thesis, Addis Abeba university.

Amsalu Nebiyu (2003). Characterization and divergence analysis in cassava (*Manihot esculenta* Cranz) Genotypes at Jimma. *MSc thesis*, Alemaya University, Ethiopia.

Aschalew sisay & Ahmed Ibrahim (2012). Evaluation Of Some Potential Botanicals To Control Potato Tuber Moth, (*Phthorimaea Operculella*) Under Storage Condition At Bako, Western Ethiopia.

Asfaw Kifle (2005). Characterization and divergence analysis of some Ethiopian Taro (*colocasia esculenta* (L.) Schott.) cultivars. M.Sc. Thesis. Alemaya University.Ethiopia.

Benesi, I.R.M. (2005). Characterisation of Malawian cassava germplasm for diversity, starch extraction and its native and modified properties. PhD Thesis.

Berhanu, A. (2004). The Food Security Role of Agriculture in Ethiopia: Vol. 1, No. 1.

Bezabih Emana & Hadera Gebremedihin (2007). Constraints and Opportunities of Horticulture Production and Marketing in Eastern Ethiopia.

Bohl , W. H., & Johnson, S. B.(2010). Commercial Potato Production in North America.Bloemfontein, South Africa.

Christopher et al., (1995). Adding value to root and tuber crops: a manual on product development, the Netherlands, CITA.

Cochran, W.G. (1977). Sampling Techniques, Wiley, New York.

CSA (2010/11). Agriculture in Figures Key Findings of the 2008/09 – 2010/11 Agricultural Sample Surveys for all sectors and seasons.

CSA (2007). Compilation of Economic Statistics in Ethiopia, Addis Ababa, Ethiopia.

Debebe Habtewold (1995): Food Security: A Brief Review of Concepts and Indicators

Dawit Beyene (2009). Micropropagation of Selected Cassava Varieties (*Manihot esculenta* Crantz) from Meristem Culture: MSc. Thesis, Addis Ababa University.

Degefa Tolossa (2005). Rural livelihoods, poverty and food insecurity in Ethiopia, A case study at Erenssa and Garbi communities in Oromiya Zone, Amhara National Regional State: PhD Thesis, Norway.

Degefa Tolossa (1996). Belg crop production as a strategy of household food security: A comparative study of Belg Grower ab Non-Belg Farmers in Munessa woreda, Arsi zone. MA Thesis: Addise Ababa University.

Dejene Mekonnen(2006). The potentials and prospects of cassava as food security crop in Ethiopia. **In**: Cassava Improvement to Enhance Livelihoods in Sub-Saharan Africa and Northeastern Brazil: First International Meeting on Cassava Breeding, Biotechnology and Ecology. (Ortiz, R. & N.M.A. Nassar eds). Brasilia, Brazil**.**

Delahant, K.A., & Newenhouse, A.c., (1998). Growing carrots, beets, radishes and other root crops in wisconism : a guide for fresh market growers. University of Wisconsin. Cooperative extension publishing.

Dessalegn Rahmato (1997). Manufacturing poverty: Rural poverty and micro agriculture. Unpublished Paper. Addis Ababa.

Edossa, E., Zenebe, W. & Abate, G.(1995). Effect of different planting material on tuber Yield and yield components of taro (*colocasia esculenta*) at Melko (Jmma). Proceedings of the sixth annual conference of the Crop Science Society of Ethiopia. Addis Ababa, Ethiopia

EHNRI/FAO (1998). Food composition Table.

Eshetu Bekele (2000) The underying causes of household food security and coping strategies. The case of Ligambo woreda, south wollo zone, Amhara Region, Northern Ethiopia. MA Thesis: Addis Ababa University.

FAO/WFP (2010). Crop and Food Security Assessment Mission To Ethiopia, Special Report.

FAO/WFP (2012). Crop and Food Security Assessment Mission to Ethiopia, Special Report.

Ford, T.G., Bogash S.M., Orzolek M.D., Kime L.F., Harper J.K. (2006). AGRICULTURAL ALTERNATIVES.The Pennsylvania State University.

Gebremedihin Woldegiorgis, Endale Gebre and Berga Lemaga, (2008). Variety development for other root and tuber crops (taro, cassava and yam), In: Root and Tuber Crops: the untapped resources, Amsalu, N., Weyessa, G., Asefa, T., Wubshet, A., Asfaw, K., & Edossa, E. eds, EIAR, Addis Ababa Ethiopia.

Getachew Tabor & Mohammed Yesuf (2012). Mapping the Current Knowledge of Carrot Cultivation in Ethiopia: Denmark.

Getahune, B., (2002). The food security challenges in Ethiopia: Proceeding of the workshop on challenges and prospects of food security, UNCC.

Hahn, S.K. (1989). An overview of African traditional cassava processing and utilization.Outlook in Agriculture.

Hillocks,R.J. (2002) Cassava in Africa. In: Hillocks, R.J., Thresh, J.M. & Bellotti, A.C. (eds.) Cassava: Biology, Production and Utilization. CABI, Oxon, UK and New York, USA.

Hoddinott, J., (2002). Food security in practice: Methods for rural development projects. International Food Policy Research Institute. Washington, D.C.

http//www.wikpedia retrieved on 27/11/2012.

http://www. fao.org

http://www.faostat.fao.org., (2007).

http://www.uspotatoes.com.

IFPRI (2009). Discussion paper.

IITA (1990). Cassava in Tropical Africa: A reference manual. United Kingdom.

Jennings, D.L., & Hershey, C.H. (1985). Cassava breeding: A decade of progress from international programmes. In: Russell GE (ed.) Progress in Plant Breeding. Butterworths. London, Boston.

Kenyon L., Anandajayasekeram P., & Ochieng C. (2006). A synthesis / lesson-learning study of the research carried out on root and tuber crops commissioned through the DFID RNRRS research programmes between 1995 and 2005**.**

Maxwell, S., (2003). Household Food Security: Conceptual indicators and measurements; A technical review. UNICEF, New York and IFAD, Rome.

Messay Mulugeta (2001). Rural household's food security status: The case of kuyyu woreda, oromia regional state. MA Thesis, Addis Abeba university.

Messay Mulugeta (2012) Resettlement and food security. PhD Dissertation.

Nigussie Taffesse (2001): The Productivity and Profitability of Wheat and Teff Technologies in research department of National Bank of Ethiopia, Addis Ababa.

Nweke, F.I, Dixon, A.G.O., Asiedu, R., & Folayan, S.A. (1994). Attributes of cassava varieties desired by farmers in sub-Saharan Africa. In: Akoroda MO (ed.) Root Crops for Food Security in Africa. Proceedings of the 5th Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch (ISTRC—AB), Kampala, Uganda, ISTRC-AB/CTA, Wageningen/IITA, Ibadan, Nigeria.

Nweke, F.I., Spencer, D.S.C., & Lynam, J.K. (2002). The cassava transformation: Africa's

best kept secret. Michigan State University Press, Lansing, Michigan, USA.

Onubuogu, G.C & Onyeneke, R.U. (2012). Market Orientation of Root and Tuber Crops Production in Imo State, Nigeria, Agricultural Science Research Journals Vol. 2(5); http://www.resjournals.com/arj , ISSN-L:2026-6073

Onwueme, I.C. & Charles, W.B. (1994). Cultivation of cocoyam. In: Tropical root and tuber crops. Production, perspectives and future prospects. FAO Plant Production and Protection Paper 126, Rome.

Osiru, D.S., Porto, M.C.M., & Ekanayake, I.J. (1996). Morphology of cassava plant. IITA, Research Guide. Ibadan, Nigeria (CMD). Theoretical and Applied Genetics.

Popoola, T.O.S., & Yangomodou, O.D. (2006). Extraction, properties and utilization potential of cassava seed oil.

Purseglove, J. W. (1972). Tropical Crops. Monocotyledons. London and New York, Longman.

Riley, B., Church, P., Downer, G., Faux, D. & Ulrich, P. (2002). The impact of Title II Food Aid on Food Security in Ethiopia. United States Agency for International Development. USAID/Ethiopia.

Roza Berhanu (2011). Factors influencing micropropagation and somatic embryogenesis of two, Kello and Qulle, cassava varieties: MA Thesis, Addis Ababa University .

Schulz S. (2012). Tackling food insecurity and malnutrition in Ethiopia through diversification: Sweet potato for profit and health initiative. CIP.

Sen, A. (1982). Poverty and famines: and essay on entitlement and deprivation. New York: oxford university press.

Simon Adebo (1992). Taro root in North Omo. FPR Technical Pamphlet No.2. FARM Africa. Addis Ababa, Ethiopia.

Tadesse Adgo Mihretu (2008). Farmers' Evaluation and Adoption of Improved Onion Production Package in Fogera District, South Gondar, Ethiopia M.Sc.Thesis, Haramaya University.

Tadese Teweldebrehan (2009). Participatory Varietal Evaluation and Faremer Based Seed Production: A Sustainable Approach to Garlic Seed Delivery in Atsbi Womberta Wereda, Eastern Tigray. MA Thesis, Mekelle University. Ethiopia.

Tamiru, M., Becker, H.C, & Maass, B.L. (2007). Genetic Diversity in yam germplasm (Dioscorea spp.) from Ethiopia and their relatedness to the main cultivated Dioscorea species assessed by AFLP Markers.

Tamiru, M., Maass, B.L., & Becker, H.C. (2005). Traditional management and use of yams (Dioscorea spp.) inWolayita, Southern Ethiopia.

Tamiru, M. (2006). Assessing diversity in yams (Dioscorea spp.) from Ethiopia based on morphology, AFLP markers and tuber quality, and farmers' management of landraces. PhD thesis, Germany.

Tenaw workayehu, Waga, M., & Legesse, H. (2011). Awassa Growth habit, plant density and weed control on weed and root yield of sweet potato (*Ipomoea batatas* L.): Awassa, Ethiopia.

Teshome Tesfaye (2003). Agricultural knowledge of students and their Awereness about the role of universities in development: regional and local development studies. MA thesis, Addis Ababa university.

Tewodros Muluneh & Biruk Ayenew (2012). Correlation and path coefficient analysis of Cassava (*Manihot esculenta* Crantz) at Jimma, Southwestern, Ethiopia.

Tewodros Mulualem Beyene (2013). Morpho- agronomical Characterization of Taro

(*Colocasia esculenta)* accessions in Ethiopia: Jimma, Ethiopia

Tewodros Tesfaye (2010). Survey and Serological Detection of Sweet Potato (*Ipomoea Batatas* (L.) Lam.)Infecting Viruses In Ethiopia: MA Thesis, Addis Ababa University.

Yared Dagne (2007). Studies on Indigenous Production and Evaluation for Tuber Yield of Taro (*Colocasia Esculenta* L. (Schott)); Cultivars at Dalbo Watershed, Wolaita Zone, South Ethiopia. M. Sc. Thesis, Hawassa University.

Yared Dagne (2012). Demonstration and scaling up of improved cassava cultivars in moisture Stressed areas of the Southern region: Areka, Ethiopia.

Yeshitila Mekbib (2007). Phenotypic variation and local customary use of Ethiopian potato (Plectranthus edulis (Vatke) Agnew**):** MA Thesis, International Master Programme at the Swedish Biodiversity Centre.

Yonas Worku & Mashilla Dejene (2007). Effects of Garlic Rust (Puccinia allii) on Yield and Yield Components of Garlic in Bale Highlands, South Eastern Ethiopia, Dire Dawa, Ethiopia.

Walsund, E. (2011). Food Security and Food Sufficiency in Ethiopia and Eastern Africa.

Woolfe, J.A. (ed.) (1992). Sweet potato: an untapped food resource. Cambridge universal press and the International potato center (CIP). Cambridge, uk.

World Bank, (1986). Poverty and Hunger: Issues and Options for Food Security in Developing Countries. A World Bank Policy Study. Washington, D.C

7 . APPENDIX

Annex 1. Questionnaire Designed for HH Survey

Part I. Household Head Background Information

1	Name of kebele
2	Name of interviewer __ Occupation __ Education background_____
3	Date of interview
House hold Background information	
4	Name of household head
4.1	Sex of the farm household head: 1.Male 2.Female
4.2	Age of the household head: 1.0-14 2.15-64 3.65 and above
4.3	Religion of the household head: 1. Orthodox 2.Protestant 3.Musilm 4.Catholic 5. Hawariat 6. Jova 7.Others specify_____
4.4	Ethnicity of the household head: 1.Oromo 2.Amhara 3.Guraghe 4.wolita 5. Gamo 6. Hadia 7. Kembata 8. Sidama 9. Others specify_____
4.5	Marital status of the household head: 1. Single 2. Married 3. Divorced 4. Widowed 5.Others specify_____
4.6	Education status attained by the head: 1.Illitrate 2. Read and Write 3. Grade 1-4 4. Grade 5-10 5. Grade >10 6.Others_____
4.7	Household size (it includes the household): 1.Male_ 2.Female_ 3.Total___
4.8	House roof type: 1.Grass/straw 2. Corrugated iron sheet 3.Others ,specify
5	Do you have your own landholding? 1. Yes 2. No
6	If your response is “yes” how did you get? 1. Land redistribution 2.

	Inheritance 3. Others____
7	Size of own landholding in timad ____ (refer to the land certificate, if available)
8	Size of rented land (if any) in 2010/11(in ha/timad). Explain for how long it is rented.
9	Number of livestock owned by the household. 1. Oxen _____ 2. Cow _____ 3.Sheep _____ 4.Goat _____ 5. Others, explain_____

Crop production

10. How do you categorize cultivation lands for crops? ----------

11. Please describe the planting date, no of weeding, harvesting date, number of harvest per year and situation, length of growing period of each crop type you grown for the year 2010/2011.

No	Crop type	No of plough	Planting date	No of weeding	Harvesting date	inputs used				
						organic	DAP	UREA	Improved seed	Pesticide, herbicide,
1	**Cereals crops**									
1.1	Maize									
1.2	Wheat									
1.3	Teff									
1.4	Barely									
2	**pulses**									
2.1	Pea									
2.2	Chickpea									
2.3	Bean									
2.4	H/bean									
3	**Root**									

	crops									
3.1	S/potato									
3.2	Potato									
3.3	Cassava									
3.4	Yam									
3.5	Taro									
3.6	Carrot									
3.7	Onion									
3.8	Garlic									
3.9	Beet									

12. If there are crop types harvested or eaten before maturation, describe the reason.

_____.

13. Would you tell me the size of crop lands, amount produced, productivity, consumed, sold, reserved for seed, given to other's (as a gift or for social cases) and amount purchase in the year 2010/2011.

No	Crop type	Farm size (ha)	Amount produced (kg)	Productivity per hectare (kg)	Amount consumed (kg)	Amount sold (kg)	Reserved for seed(kg)	Given to other's	Amount Purchased (kg)
1	**Cereals crops**								
1.1	Maize								
1.2	Wheat								
1.3	Teff								
1.4	Barely								
2	**pulses**								
2.1	Pea								
2.2	Chickpea								
2.3	Bean								
2.4	H/bean								
3	**Root crops**								
3.1	S/potato								
3.2	Potato								

3.3	Cassava								
3.4	Yam								
3.5	Taro								
3.6	Carrot								
3.7	Onion								
3.8	Garlic								
3.9	Beet								

14. For how long did you cultivate crops? 1. 1 to 5 year 2. 6 to 10 year 3. 11 to 15 year 4. >16 years

15. For how long did you cultivate root crops? 1. 1 to 5 year 2. 6 to 10 year 3. 11 to 15 year 4. >16 years

16. How was your trend of root crop production for the last 10 (Ten) years? 1. Increasing 2. Decreasing 3. Variable 4. Not known

17. Describe the trend of production for each crop category during the last 10(Ten) years? In addition explain the reasons, if you interrupted to cultivate root crops during these years. _____.

18. If the trend is increasing or decreasing, explain the reason. Understand if there is shifting of cultivation from one crop to other. ----------.

19. For what purpose do you cultivate root crops? 1. As normal food 2. To get food and nutrition during food gap 3 . To generate income 4. For medicinal value 5. For fodder 6. For others, explain 7. For the combination of two or more (explain)

20. What is your source of water to produce root crops? 1. Rainfall 2. Flood 3. Irrigation 4. Water harvesting scheme 5. Other, explain 6. From the combination of the two or more mentioned (explain).

21. Did you intercrop root crops with other crop type? 1. Yes 2. No

22. If yes, did you get more production from the intercropping? 1. Yes 2. No

23. What type of crop did you intercrop with root crops? Why? ----------

24. Did you rotate crop after harvest of root crops? 1. Yes 2. No

25. Which type of crop did you plant after root crops? Why? ----------

26. Explain the productivity for each crop category?

27. Did you observe any pest, disease etc that attack crops during last five years?

1. Yes 2. No

28. Did the infestation /out break/ of pest and disease affect the root crops during the last five years? 1. Yes 2. No

29. If yes, how do you measure it's severity in comparison to other crop categories?

1. Low 2. Moderate 3. Severe

30. Does root crop resist pest or disease than other crops? 1. Yes 2. No

31. If yes, which root crop? What do you think is the reason? ----------.

32. Did you use pesticide/insecticide or others to prevent the infestation/outbreak for root crops? 1.yes 2. No

33. If No, why? 1. Lack of money 2. Lack of knowledge 3. Lack of access 4.other, specify. 5. From the combination of the two or more mentioned(explain).

34. How did you store root crops? 1. Store in pit 2. Store in well prepared bed 3. Live at the field until consumption 4. Spreading the yield under the bed in the house 5. Store in separate storage house 6. In combination of two or above (explain).

35. Which crop category/ies is/are majorly used for consumption? 1. Cereals 2. pulses 3. Root crops 4. The combination of two or more (explain).

36. From where did you get the planting material for root crops? 1. From last year harvest 2. From own multiplication center 3. From government bodies/explain/ 4. From NGO'S/explain/ 5. From neighbors 6. From market 7. From research center 8. Combination of mentioned/explain/

37**.** Have you faced shortage of work force while performing the farming activities during the last five years? 1. Yes 2. No

38. If yes, how did you overcome the problems of labor shortage? 1. Friends and relatives 2. By hiring laborer 3. Others specify 4. From the combination of the two or more mentioned (explain).

39. If your response is "by hiring laborer", what is the source of money you paid for wage labor? 1. Sale of cereals 2. Sell of pulses 3. Sell of root crops 4. Sale of livestock and live stock product 5.Sale of other asset explain 6. The combination of two or more of the mentioned (explain)

40. How is the participation of your children in your farming activity? 1. Full time 2. Part time 3. Not participate

41. If your children do not participate in full time in what other activities do they participate? 1. Schooling 2. Wage labor 3. Trade 4. Other, specify 5. From the combination of the two or more mentioned (explain).

42. How many children do you send to school? 1. Male _____ 2.female ___

43. Majority of your income you used to cover expenditure of your children comes from: 1. Sale of cereals 2. Sale of pulses 3. Sale of root crops 4. Sale of livestock and their product 5. Other source (specify) 6. From the combination of the two or more mentioned (explain).

44. Did the agricultural extension agent or woreda agricultural experts frequently advices you? 1. Yes 2. No

45. If yes, how often did they come to your farm? 1. Always 2. Twice per week 3. Once per week 4. Twice per month 5. Once per month 6. others (explain)

46. How is the extension service given for root crops comparing to other crop categories? 1. None 2. low 3. Medium 4. High

47. If they did not come, from whom did you get any consultation about technical agricultural issues? 1. From my relative 2. NGO's 3. Yet I did not get

48. Did you get any credit during last five years for purchasing inputs to produce crops? 1. Yes 2. No

49. If yes, from which institution/body/ did you get the services? 1. From local individuals 2. Credit and saving institutions 3. NGO's 4. Banks 5. Others, specify.

50. During last five years for which crop category did you used the credit? 1. Cereals 2. Pulses 3. Roots 4. For the combination of two or three.

51. What are the major constraints that hinder root crop production? 1. Disease and pests 2. Land shortages 3.Water shortage 4.Labor shortage 5.Inadequate/lack of inputs 6.Inadequate/lack of extension 7.lack of technologies and innovation 8.Others, specify 9. From the combination of the two or more mentioned (explain).

Marketing of crops

52. Have you sold crops in the past five years? 1. Yes 2.No

53. If your response is yes, how many quintals sold in the last five years? And how much (In Birr)? Fill the table below (if they do not remember far years, adjust the number of years asked.)

No	Crop type	1999		2000		2001		2002		2003	
		q/t	birr	q/t	birr	q/t	birr	q/t	birr	q/t	birr
1	**Cereals crops**										
1.1	Maize										
1.2	Wheat										
1.3	Teff										
1.4	Barely										
2	**pulses**										
2.1	Pea										

2.2	Chickpea										
2.3	Bean										
2.4	H/bean										
3	**Root crops**										
3.1	S/potato										
3.2	Potato										
3.3	Cassava										
3.4	Yam										
3.5	Taro										
3.6	Carrot										
3.7	Onion										
3.8	Garlic										
3.9	Beet										

54. If you have not sold, why? _____

55. Where did you sell your root crops mostly? 1. At farmers gate 2. At local or nearby market 3. At small town markets far from nearby market 4.others, specify 5. From the combination of the two or more mentioned (explain).

56. When do you prefer to sell root crops? 1. During food shortage 2. During Festival 3. During Crop Harvesting 4. During Crop Planting 5. Others, Specify 6. From the combination of the two or more mentioned (explain).

57. Did you get crop price and market information? Specially for root crops? 1. Yes 2.No

58. If your response is “yes” from where you get? 1. DAS 2.NGOS 3. From local trader 4. other specify 5. From the combination of the two or more mentioned (explain).

59. During last five (5) did you face any problem in Marketing of crops? How do you see it for root crops? Explain. 1. Yes 2. No

60. If “yes” what is the problems? 1. Tax burden 2. Poor market road 3. Lack of market and price information 4. Seasonal price fluctuation 5. Lack of buyers 6. Others, specify 7. From the combination of the two or more mentioned (explain).

61. How do you transport root crops? Explain ----------.

62. How do you see the infrastructure (road, tele, storage etc) facilities available at nearby? Are they favorable for the characteristics of root crops? Compare with other crop categories? ----------.

Household Food Security

63. Did you consume crop and livestock products in your home in the previous year?

1. Yes 2.No

64. Tell us the type and estimated amount of crop and livestock products consumed mostly in the last 12 months?

No	Types of crop and livestock product	Amount Consumed from					
		Home production	Food aid	Purchase	Borrow	Gift	Other/specify
1	Cereals crops						
1.1	Maize						

1.2	Wheat						
1.3	Teff						
1.4	Barely						
2	**pulses**						
2.1	Pea						
2.2	Chickpea						
2.3	Bean						
2.4	H/bean						
3	**Root crops**						
3.1	S/potato						
3.2	Potato						
3.3	Cassava						
3.4	Yam						
3.5	Taro						
3.6	Carrot						
3.7	Onion						
3.8	Garlic						
3.9	Beet						

65. Which food stuffs are you consumed at your home?

Food stuffs	Pattern of consumption
	A, frequently B, sometimes C, not at all
Teff- *injera , Porridge*	
Wheat - *injera, bread, porridge , Nefro, qollo*	
Barely - *injera, qollo*	
Millet - *injera*	
Pulses **–** *kik, nifro,watt*	
Root crops – *s/potato,yam,taro,cassava etc*	
Milk –*raw milk, cheese, irgo, others* Meat (beef, mutton, goat*)-raw meat, watt, tibs*	
Eggs –*qeqle, tibs*	
Others	

66. Do you meet the all-year round food requirement of your household members from own production? 1. Yes 2. No

67. If your response is No, what did you do to fill food shortage? 1. Purchase from the market 2. Borrow from their relatives 3. Food aid 4. Reducing the number of meals 5. Consuming wild foods 6. Other specify 7. From the combination of the two or more mentioned (explain).

68. Which crop type do you purchase more during the food shortage? 1. Cereals 2. pulses 3. Root crops.

69. If root crops or not, explain the reason? ----------

70. According to your own self-assessment, is your household:

1. Food self sufficient 2. Food self sufficient 3. Varies from year to year 4. Varies from season to season 5. Do not known

71. If the response for Q// 70, is food self insecure, what do you think are the main reasons for being food insecure_____

72. How many times your families eat per day? 1. One times 2. Two times 3. Three times 4. Four times

73. Do you think you and your family have got adequate food, clothes and shoes? 1. Yes 2. No

74. If "Yes", where do you get the money for purchasing of different variety of food items and clothing? 1. Sale of cereals 2. Sale of pulses 3. Sale of root crops 4.Sale of livestock and livestock product 5. Other income sources (explain) 6. From the combination of the two or more mentioned (explain).

75. Was any member of your family affected by disease in the past 12 months and treated? 1. Yes 2. No

76. If "Yes", from where did you get the money for medical treatment? 1. Sale of cereals 2. Sale of pulses 3. Sale of root crops 4. Sale of small ruminant 5. Sale of livestock product 6. Other sources of income specify 7. From the combination of the two or more mentioned (explain).

77. During the last year, would you tell us the amount of income that you earn and expenditure you expend from the following activities and sources?

No.	Source of Income	Estimated income earned (in Birr)	Estimated expenditure in birr			Difference between Total income and expenditure
			food	Non-food	Total	
1	Sale of cereals					
2	Sale of pulses					
3	Sale of root crop					
4	livestock and livestock products sale					
5	Remittance					
6	Petty Trade					
7	Others specify					

78. Explain about social institutions available at this kebeles

No	Institutes	Distance from residence		Utilization frequency			Knowledge acquired from			Income source			
		In Km	In H/r	1/ Always or when get sick	2/ seldom	3/ do not use	1/ Government	2/ NGO	3/ Gov't and Ngo	1/ cereals	2/ pulses	3/ roots	4/ two or more of the mentioned
1	Water												
2	Health												
3	Sanitation												
4	Education												
5	Energy												

Part II , Checklists for FGD and KII

Checklists for Focus Group Discussion

1. How is the trend of root crops production in the kebele?

2. How do you relate the contribution of root crops with cereals and pulses in terms of availability (production, market, storage etc) and income earned?

3. Explain the timely and sufficient availability, price of inputs (improved seed, fertilizer etc) for each crop types.

4. Explain the availability, accessibility and stability of credit and other extension services.

5. What are the major problems/ constraints of root crops production (During land preparation, planting, growth, harvesting, storing, transporting and marketing)?

6. Is there a living situation difference between root crop producing and non producing farmers?

7. When do you face food shortage and how do you cop it?

8. Which crop types, does the community produce more during food gap or drought?

Checklist for Key Informant Interview

1. How is the trend of root crops production?

2. Explain the timely and sufficient availability, price of inputs (improved seed, fertilizer etc) for each crop types.

3. Explain the availability, accessibility and stability of credit and other extension services.

4. What are the roles of root crop production for food security at household and community level?

5. How is the marketing situation (price and supply stability) storage and transport etc) for root crops?

6. What are the challenge and opportunities for root crop production in the area? (Discuss the two cases separately)

7. When does the woreda (selected kebeles) face food insecurity? What will happen during drought seasons?

8. What do you suggest to promote root crop production and reduce food insecurity of the community

Annex 2 Amount of Energy, Macro and Micro nutrients available per 100 gram.

No	Energy, macro and micro nutrients	Cereals	Pulses	Root crops
1	Food energy	251.9	267.5	92.14
2	Moisture (%)	34.1	25.075	49.91
3	Nitrogen(grams)	1.1	1.71	0.16
4	Protein (grams)	6.6	17.23	2.04
5	Fat (grams)	2.1	1.98	0.22
6	CHO (including fibers(grams)	56.1	50.05	21.37
7	Fibers (grams)	2.1	10.68	1.37
8	Ash (grams)	1.2	1.9	0.74
9	Calcium (milligrams)	32.1	103.08	21.82
10	Phosphorus (milligrams)	180.5	249.76	60.68

11	Iron (milligrams)	13.2	7	1.7
12	Zinc (milligrams)	1.2	2.055	0.57
13	Copper (milligrams)	0.2	0.39	0.22
14	Sodium (milligrams)	39.4	63.95	28.75
15	Potassium (milligrams)	266.9	654.95	366.23
16	RE (milligrams)	6.7	8.63	118.75
17	Thiamin (milligrams)	0.1	0.20	0.04
18	Riboflavin (milligrams)	0.1	0.14	0.06
19	Ascorbic acid (milligrams)	0.0	0.35	6.34

Source:- EHNRI/FAO (1998) Food Composition Table

Declaration

I, the undersigned, declare that this thesis is my original work. It has never been presented for a degree in any other institution and that all sources of materials used in it have been duly acknowledged.

Name: _____

Signature: _____

Date: _____