Mekelle University

College of Business and Economics

Department of Cooperative Studies

DETERMIINANTS OF VEGETABLE INCOME IN THE SUPPLY CHAIN OF PERSHABLE AGRICULTURAL PRODUCTS
(In the case of irrigation cooperatives – Southern Tigray)

By
Shimeles Negussie

A Thesis

Submitted in the partial fulfillment of the requirements for Master of Arts Degree

In

Cooperative Marketing

Advisor:

Hailay Gebretensay, PhD

September, 2010
Mekelle
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DEDICATION

This piece of work is in memory of my late mother **Negat Bedanie,** who had played major role in nursing and educating me, and who was eager to see my successes. “Mami”, rest in peace.

DECLARATION

This is to certify that this thesis entitled "**Determinants of vegetable income in the supply chain of perishable agricultural products**" in southern zone of Tigray, submitted in partial fulfillment of the requirements for the award of the degree of M.Sc., in Cooperative Marketing to the School of Graduate Studies, Mekelle University, through the Department of Cooperatives, done by Mr. Shimeles Negussie, Id.No. FDA/PS0025/99 is an authentic work carried out by him under my guidance. The matter embodied in this project work has not been submitted earlier for award of any Degree or Diploma to the best of my knowledge and belief.

Name of Supervisor: Dr., Hailay Gebretensay _____

Date : _____

STATEMENT OF THE AUTHOR

I declare that this thesis is my bona fide work and that all sources of material used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements of M.Sc. degree at Mekelle University and is deposited at the University Library to be made available to users under rules of the Library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

Name: Shimeles Negussie _____

Place: Mekelle University

BIOGRAPHY

The author, Shimeles Negussie was born in *Addis Ababa city administration* on May 15, 1973. He attended his elementary and junior secondary school education at *Miazia 23 junior secondary school* and later attended his High-school education at *Higher- 12-comprehensive high school*. After completion of his high school education, he joined Addis Ababa commercial college/Addis Ababa University and completed two years diploma program in purchasing and supplies management.

After graduation he was employed in different governmental and non - governmental organizations for more than 10 years. While serving in different organization he got an opportunity to join at Mekelle University for his degree program in economics from 1998 - 2005.

After completion of the under graduate degree, he served in private company for four years and returned back to Mekelle University to attend his post graduate study in 2009.

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I am exceptionally indebted to my mother Negat, for her love, patience, endurance and encouragement till her life for my success. I also extend my deepest gratitude for my wife Meserete and my daughters Netsuh, Yabsira and Belen for providing me their deepest love throughout my study. My study would not have been possible without their love and support.

Shimeles Negussie
September 2010.

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ACRONYMES

ADLI	Agricultural Development Lead Industrialization
ANOVA	Analysis of Variance
CC	Contingency Coefficient
CSA	Central Statistical Agency of Ethiopia
DCSI	Dedebit Credit and Saving Institution
EEA	Ethiopian Economics Association
EU	European Union
FAO	Food and Agricultural Organization
ICA	International Cooperative Alliance
ISO	International Standard Organization
MoARD	Ministry of Agriculture and Rural Development
NGO	Non Governmental Organization
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
PHTME	Post Harvest Technology and Marketing Economics
PYO	Pick Your Own
SNA	Social Network Analysis
TA	Technical Assistance
TLU	Tropical Livestock Unit
VIF	Variance Inflation Factor
WHO	World Health Organization

ABSTRACT

The main theme of this thesis is to analyze the impact of supply chain of perishable agricultural products on income derived from vegetables. The study is conducted particularly focusing on irrigation cooperatives located in the southern zone of Tigray. This is due to the highest number of irrigation cooperatives members in the region. Among the vegetables the particular emphasis of the study is on income derived from three vegetables. These are onion, potato and tomato. These vegetables are preferred, on one hand for the reason that they are major sources of income in irrigation cooperatives, and on the other hand for the reason that there are so many constraints in relation to the perishable nature of the products which affects the producer's income. A total of 120 households from vegetables producers irrigation cooperatives (16 female headed households and 104 male headed households) drawn from two southern zone Woredas. To collect the necessary data for the analysis structured and pre tested questionnaires are used. Focused group discussion and key informant interview are also conducted. Secondary data on basic agricultural and population is also collected to strengthen the analysis. The analysis is conducted using descriptive statistics and empirically. The analysis of the collected data showed that most of the households are illiterate (40.8%). The average age of the households is 40.03 years. The average family size is about 5.41 of which the active labor force is 3. The average land holding is about 0.47 hectare per household of which 0.25 hectares of land on averages used for vegetable production per household. The average ownership of livestock is 4.34 TLU. The majority of the households in the study area become a member of irrigation cooperative voluntarily. The majority of the households identified that irrigation water management and provision of fertilizer as a major benefit obtained from the cooperative. The average years of experience as a vegetable producer of the households is 6.7 years and as cooperative members the average years are 4.6. The income sources of the households are both from agricultural and non agricultural income sources. The average income the households received in the crop year 2008/09 was 10,672.15 birr. Of the total income the average income from off farm activities was 1,095.25 (10.26%) birr. From agricultural activities the households on average received 1267.45 (11.9%), 6,719.83 (62.97%), 1589.61 (14.9%) and 6.66 birr from crops, vegetables, livestock and bee colony respectively. The

total income received from sold onion, potato and tomatoes were 806,380 birr in the study area. A total of 748 quintal of onion, 662 quintal of potato and 953 quintal of tomatoes were sold in the production year 2008/09. The average price received per quintal for onion, potato and tomatoes were 364.34 birr, 352.65 birr and 315.20 birr respectively. This income was the highest income received by the households from agricultural income sources. From the identified market channels the channel that stretched as producer – wholesaler retailers, *producer – cooperatives – wholesalers - consumers,* and producer – wholesalers - out of region are some of the forms of supply chain used for vegetables by the produces. In the supply chain of vegetables wholesalers are found to be the dominant buyers of vegetables. Among the constraints of income from vegetables land size, fertilizer in terms of its cost, perishable nature of the product, shortage of improved seed, irrigation water shortage, storage, technical assistance both for production and marketing, lack of training from the cooperatives and disease and pests are among the major ten rated constraints of income from vegetables. The econometrics result for the determinants of income from vegetables, among the hypothesized seventeen variables six of them found significant. These are vegetable post harvest loss, crop income, distance from major market, distance from major road, off farm income and livestock income. Livestock income is the only variable which affects vegetable income positively. Post harvest loss and crop income are highly significant factors to affect income from vegetables. Other variables like land size, credit, extension service, price information and improved seeds are not significant as expected though they exhibited positive relationship with vegetable income. Based on the constraints to increase income from vegetables, improving the availability and developing ways in reducing the price of inputs, developing drought resistance varieties of seeds, developing crop insurance schemes with minimum premiums, developing farm plan budget, analyzing the cost benefit of market choice, analyzing the opportunity cost of crop and vegetable production are some of the recommendations suggested to increase income of the households in the production of vegetables.

Key words: perishable agricultural products, income, supply chain,

CHAPTER - ONE

1. Introduction

1.1. Background

Agriculture is the mainstay of the Ethiopian economy, contributing 43% of the gross domestic product, providing 85% of export revenue and employing over 86% of the population. Ethiopia has highly-diversified agro-ecological conditions which are suitable for the production of various types of fruit and vegetables. However, the contribution of horticultural crops both to the diet and income of Ethiopians is insignificant (FAO/WHO, 2004).

With regard to horticultural production, 46% of the vegetable producing area is planted with potato followed by pepper and sweet potato. Small-scale farmers produce 2.1 million tones of vegetables from 261,095 hectare while the state farms produce 18,080 tons from 880 hectare (Rolien and Andre, 2009). Total fruit production is almost 500,000 tones, of which the state farms account for approximately 10% of production. According to Paniluton, estimated 50,000 small-scale farmers are involved in horticulture production. They typically cultivate horticultural crops as supplements to their main crops of cereals, pulses and oilseeds.

Ethiopia exports fresh fruit and vegetables. However, the contribution to export earnings is small; thus horticultural products share in total exports from 1994 to 2001 was 6% in volume and below 2% in value terms. In the year 2005 about 32,000 tons of vegetables that worth about 12 million US dollar were exported mainly to Djibouti and other EU countries. Major vegetable export product of Ethiopia includes potato, beans, white and red onion, shallots, cabbage, leeks, beetroot, carrots, hot pepper (green pod as well dry pod), tomato, asparagus, okra, sweet pepper, and Lettuce (Rolien and Andre, 2009).

However, there are constraints related to the vegetable sector. Constraints related to production, marketing and preservation such as heavy losses that are caused mainly due to price fluctuations, lack of guaranteed prices and unplanned planting patterns are among the major one. Such constraints are aggravated by underdeveloped infrastructure and weak transportation facilities. Vegetable produce to market are yet transported as bad packs on animals and human load. This causes heavy post-harvest losses. Trucks and private buses are also used by traders between local market, regional and terminal markets but they are not also designed for the purpose (Fekadu, et al. 2006).

However, although Ethiopia has great potentials for the production of vegetables due to various reasons related to production, the supply chain development and market development of these products the country did not receive the proper benefit from these products.

With the aim of enhancing agricultural development, the government considers various projects, including small-scale irrigation mainly through rainfall harvesting and home gardening, to be of crucial importance. As a result, vegetable and fruit production is being more widely adopted, primarily to ensure food security and to promote production of high-value crops for the market to improve living conditions of smallholders (FAO/WHO, 2004).

Therefore, the objective of this paper focuses on particularly in irrigation cooperatives to evaluate the determinants of vegetable producer's income in the supply chain of vegetables supplied by irrigation cooperatives. The analysis focus on production, post harvest handling, product characteristics, irrigation cooperatives and marketing channel impact on vegetable producer's income.

1.2. Statement of the problem

Ethiopia is one of the developing countries where food security is a problem in the past several years. To alleviate this problem and to develop the economic growth of the country the government of Ethiopia formulates and implements a range of economic and sectoral policies. One of the strategies implemented by the government was known as Agricultural development lead industrialization (ADLI). The strategy (ADLI) revolves around making the small agricultural farmers the engine of growth (MoFED, 2000). Under ADLI emphasis is given to the transformation of the smallholder farmer from subsistence to a more business and market-oriented agriculture producers.

In line with ADLI's objectives a number of development programmes have been put in place in past years. Among these, Sustainable Development and Poverty Reduction Programme formulated in 2006 and implemented from 2001/02 to 2005/06 and its successor the Plan for Accelerated and Sustained Development to End Poverty (PASDEP), runs from 2006/07 to 2010/11 were major programmes which aims to forward the agricultural sector and the overall economy of the country. In both programmes agricultural development was adopted as a central and strategic direction for poverty eradication in Ethiopia. The programme calls for the rapid growth of agriculture in particular that of the small holder farming with the goal of extricating the economy from dependence on food aid and the generation of rural employment opportunities and income. Under PASDEP, greater emphasis is given for the expansion of medium and large irrigation schemes, commercialization of agriculture, diversification of production and exports, and private sector investment in order to move farmers beyond subsistence farming to small-scale market-oriented agriculture (Haile, 2008).

One of the introduced plans implemented by the government to change the livelihood of small scale holders was irrigation scheme. The development of this programme emphasizes to transform the subsistence level of production system in to market oriented cash crop production system. Accordingly the number of small-scale producers involved in horticulture is estimated at 5.7 million farmers (Rolien and Andre, 2009). The majority

the small scale producer engaged in production of fruits and vegetables. In line with this, to strengthen and to solve problems related to marketing and production the introduction of cooperatives as a producer and marketer of their produce also the concern of the program of the country's development programme.

However, most of the cooperatives due to their experience, the nature of the market related to vegetables and other problems offset the efficiency advantages of small scale producers. There are also so many constraints to achieve the level of expected growth and to change the livelihood of small holders through the development programme. Some of the constraints linked to the required inputs in production factors and some of the factors linked to the structure of agricultural marketing system of the country. According to Mulat (as cited by Haji, 2008), the agricultural output markets in Ethiopia characterized by an inadequate transportation network, limited number of traders with inadequate capital and facilities, high handling costs, inadequate market information system, weak bargaining power of farmers, and underdeveloped agro-industrial sectors. Jaleta (2007), also investigated the role of markets in the smallholder farmers' resource allocation for subsistence food crops and commercial cash production. The results revealed that limited marketing outlets and lack of price information were the major factors that hindered the move from subsistence farming to cash crop production.

Another research by Emana and Gebremedhin (2007), described lack of local markets to absorb supply, low produce prices, excess of intermediaries, and lack of marketing institutions and coordination among farmers as the major constraints in marketing of horticultural crops in Ethiopia. In addition, this research by Emana and Gebremedhin argued that poor product handling and packing, imperfect pricing systems, and lack of transparency in market information are also among the impediments in the marketing of horticultural crops in Ethiopia.

Different studies especially in the marketing of fruits and vegetable for example (Alem, 2008) and (Adugna, 2009) also identified that due to the characteristics of these agricultural products, poor development of marketing channels, infrastructure

development, logistics, storage facilities, poor development of processing industries, market information and the technology of production and post harvest handling, producers usually receive low price of their produce and in turn affects their income from vegetable production.

Therefore, the focus of this paper is linked to the production, marketing and supply chain of vegetables. The paper is particularly focused the factors which affects income of the producers in relation to the supply chain of vegetables. To analyze these factors the irrigation cooperatives found in southern zone of Tigray is sampled for the analysis of this paper.

1.3. Objectives of the study

General objective

The overall objective of the study is to investigate the major factors which influence the producer's income in the supply chain of vegetables in relation to irrigation cooperatives.

SPECIFIC OBJECTIVES

The specific objectives of the study are:

- To identify the factors which influence the producers income in the supply chain of vegetables
- To evaluate the current supply chain of vegetables used by the Irrigation cooperatives
- To evaluate the influence of perishable nature of the product in the producers income

1.4. Significance of the study

Vegetable production play an important role to the household income to those engaged in the sector. In addition to the nutritional value, these crops generate employment opportunities for the poor households. In most irrigated fields, farmers achieved better income by improving the production of vegetable crops. However, to make sustainable income sources and to achieve the objective of food security, due to the perishable nature of the product, the necessary facilities required to the marketing of vegetables and the structure of the market in general producers constrained to increase their income.

Therefore, although the focuses of this paper is in relation to irrigation cooperatives, understanding the main constraints to increase income through the production of vegetable also important to the small holders producers whom engaged in the production of vegetables in general. Further the findings of this paper generate some value to traders, processers, and policy makers to achieve the programme of food security designed as a development goal by the government of Ethiopia.

1.5. Scope of the study

The study restricted to irrigation cooperatives in southern zone of Tigray particularly vegetable producers. Among the vegetables onion, potato and tomatoes are the major focuses of this paper due to their economic importance to the producer's income source. Further these vegetables also important for consumers and traders engaged in marketing of these vegetables. Hence, the ground for choosing of these vegetables is considers the economic importance of the vegetables to the producer, the consumers and traders whom engaged in marketing of vegetables.

1.6. Limitation of the study

The investigation of the whole supply chain of vegetables impact on income is a great task due to lack of required data and the inclusion of many variables which influence the income of the producer in the supply chain of vegetables. The major factors considered to

influence income of the producers are included using primary data source in this study. However, one of the major constraints of this study is availability of recorded data both from the sampled households and the cooperatives. Further, the availability of similar studies to compare the finding results of this paper in the study area is another limitation of this study.

1.7. Organization of the paper

The paper is organized as follows. The next section reviews literatures on basic concepts and definition of supply chain and marketing of agricultural products. Section three deals with the research methodology used in the analysis of this paper. Section four presents results and discussions of the research. The final section summarizes the findings of the study and provides some recommendations based on the findings of this paper.

CHAPTER - TWO

2. Literature Review

In this part of the study the basic concepts of supply chain, agricultural marketing, and factors related to determine income and the approaches to evaluate the supply chain and income have been discussed.

2.1. Basic concepts

2.1.1. Supply chain of agricultural products

The food supply chain is complex with perishable goods and numerous small stake holders. Supply chain is defined by different scholars; however all refers to the movement of the products from production to final consumer. According to Sparling and Duren (As cited in Manalili, 2001), A supply chain is a network of organizations contributing to the design, production and distribution of a product from its inception to its consumption by the final consumer. Supply chains are complex entities that serve many functions. They are institutional arrangements that link producers, processors, marketers and distributors. Supply chains are forms of industrial organization which allow buyers and sellers who are separated by time and space to progressively add and accumulate value as products pass form one member of the chain to the next (Hughes, 1994, Fearne, 1996, Handfield and Nichols, 1999).

Agricultural supply chains are also economic systems which distribute benefits and which apportion risks among participants. Thus, supply chains enforce internal mechanisms and develop chain wide incentives for assuring the timely performance of production and delivery commitments (Iyer & Bergen, 1997, Lambert and Cooper, 2000). According to this supply chains are inter linked processes among the participant in the chain. They are linked and interconnected by virtue of shared information and reciprocal scheduling, product quality assurances and transaction volume commitments. Process

linkages add value to agricultural products and require individual participants to co-ordinate their activities as a continuous improvement process (J. Roekel et al. 2002).

In the supply chain of perishable agricultural products the coordination of the members in the supply chain is vital. Individual suppliers, producers and marketers who are associated through a supply chain coordinate their value creating activities with one another and in the process create greater value than they can when they operate independently. According to Fearne, there are five advantages of supply chain coordination in marketing of agricultural products. (1) improved market access; (2) improved communications; (3) higher profit margins; (4) greater discipline; and (5) the creation of barriers to entry. According to (J. Roekel et al. 2002), supply chain coordination in agricultural products creates synergies. One they create to expand traditional markets beyond their original boundaries and thus increase sales volume. Second they reduce the delivered cost of products below the cost of competing chains and thus increase the gross margin for the working capital and finally they target specific market segments with specific products and they differentiate the service, product quality or brand reputation of the products they deliver to these market segments and thus increase consumer perception of delivered value. In this way, they allow chain members to charge higher prices.

Generally, supply chains increase market comparison both at the producer end and at the consumer ends of the chain at the consumer end. Chains compete primarily through price, differentiated products and services and differentiated terms of sale. At the producer end of the chain, supply chains compete with one another primarily for “producer affiliation” and core vendor commitments.

2.1.2. Marketing of agricultural products

Kotler (2004) proposed the essence of marketing is the transaction (exchange of values actually made between parties) and, thus, marketing is specifically concerned with how transactions are created, simulated, facilitated, and valued. According to the American Marketing Association (1985), marketing is “the process of planning, and executing the

conception, pricing, promotion, and distribution of ideas, goods and services to create exchanges that satisfy individual and organizational goals". In other words, the objective of marketing is creating exchanges, and the output of its customer satisfaction.

Agricultural marketing can best be defined as series of services involved in moving a product from the point of production to the point of consumption. Thus agricultural marketing is a series of inter-connected activities involving: planning production, growing and harvesting, grading, packing, transport, storage, agro- and food processing, distribution and sale. Such activities cannot take place without the exchange of information and are often heavily dependent on the availability of suitable finance. Marketing systems are dynamic. They are competitive and involve continuous change and improvement. Businesses that have lower costs are more efficient and can deliver quality products are those that prosper. Those who have high costs, do not adapt to changes in market demand and provide poorer quality are often forced out of business. Marketing has to be customer oriented and has to provide the farmer, transporter, trader, processor, etc. with a profit. This requires those involved in marketing chains to understand buyer requirements, both in terms of product and business conditions (FAO, 2007).

The marketing of agricultural produce is regarded as unique and deserving of specialised attention due to the perishable and bulkiness of the products involved. The other concern of marketing of agricultural products is the nature extent to which the marketing of agricultural products should be regulated.

Efficient marketing infrastructure such as wholesale, retail and assembly markets and storage facilities is essential for cost-effective marketing, to minimize post-harvest losses and to reduce health risks. Markets play an important role in rural development, income generation, food security, developing rural-market linkages and gender issues (John Tracey, 2003).

Efficient market information can be shown to have positive benefits for farmers and traders. Up-to-date information on prices and other market factors enables farmers to negotiate with traders and also facilitates spatial distribution of products from rural areas to towns and between markets. Most governments in developing countries have tried to provide market information services to farmers, but these have tended to experience problems of sustainability. Moreover, even when they function, the service provided is often insufficient to allow commercial decisions to be made because of time lags between data collection and dissemination (Andrew W. Shepherd, 1997).

Farmers frequently consider marketing as being their major problem. However, while they are able to identify such problems as poor prices, lack of transport and high post-harvest losses, they are often poorly equipped to identify potential solutions. Successful marketing requires learning new skills, new techniques and new ways of obtaining information (Grahame Dixie, 2007).

Agricultural marketing needs to be conducted within a supportive policy, legal, institutional, macro-economic, infrastructural and bureaucratic environment. Traders and others cannot make investments in a climate of arbitrary government policy changes, such as those that restrict imports and exports or internal produce movement. Those in business cannot function if their trading activities are hampered by excessive bureaucracy and form filling (FAO, 2007). Inappropriate law can distort and reduce the efficiency of the market, increase the costs of doing business and retard the development of a competitive private sector. Poor support institutions, such as agricultural extension services, municipalities that operate markets inefficiently and export promotion bodies, can be particularly damaging. Poor roads increase the cost of doing business, reduce payments to farmers and increase prices to consumers.

2.2. Approaches to measure the supply chain

To measure the impact of supply chain of perishable agricultural products impact on income is difficult task due to data requirement. Researchers from various disciplines (e.g. economists, environmentalists, and political scientists) work in the field of value

chain analysis. Hence, many methods for value/supply chain analysis have evolved in recent years. They can be classified into two groups: The first group consists of methods with a more descriptive and qualitative emphasis (Kaplinsky / Morris 2002), and the second group refers to specialized tools with an analytical focus. They deal with modeling and simulation of supply chains in the field of business administration e.g. optimizing chain logistics.

Econometric supply chain analysis is also widespread in the field of impact assessment of supply chains. It can be applied to analyze the effects of standards (e.g. food, social, and environmental) as well as transaction costs on the income of households (micro level) or on trade volumes of countries (macro level). The econometric chain analysis include full range of activities which are required to bring a product or a service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers (Kaplinsky and Morris, 2002). In this paper this approach was utilized by considering some of the factors from production up to the supply of vegetables to the market or the consumer.

Another approach to analyze the supply chain of a given product impact is mapping. According to Chowdhury (2005), for the analysis of supply chain the first step is mapping. In order to do so, the boundaries to other chains need to be defined. The main idea is initially to identify the actors and then to 'map' the traced product flows within the chain including input supply, production, processing, and marketing activities. The objective is to give an illustrative representation of the identified chain actors and the related product flows. A mapped value chain includes the actors, their relationships, and economic activities at each stage with the related physical and monetary flows. In the case of supply chain analysis this could be done by identifying first the relevant supply chains for the analysis (e.g., traditional versus modern, fresh versus processing, traditional retailers versus modern retailers, and processors versus exporters etc.). The next step is to identify the agents involved in each chain.

There are two different kinds of approaches used for mapping. That is functional and institutional analysis presented by FAO and social networking analysis (E. Winter, et al, 2009).

The functional and institutional analysis presented by FAO provides a set of modules, which presents a systematic approach to value chain analysis for agricultural commodities. The mapping is denoted as a functional and institutional analysis (FAO 2005) which starts with constructing a 'preliminary map' of a particular chain to provide an overview of all chain actors (institutional analysis) and the type of interaction between them (functional analysis). The results can be presented either in a table or in a flow chart, which is called the 'preliminary map' of the chain. The FAO methodology includes three essential aspects for developing a preliminary map (FAO 2005). The principal functions of each stage, the agents carrying out these functions, and the principal products in the chain and their various forms into which they are transformed along the entire chain. Once the flow chart has been drawn, these flows are quantified, both in physical and monetary terms; the procedure allows assessing the relative importance of the different stages or segments of the chain. This methodology was applied for example by Rudenko (2008) identifying and mapping the relevant supply chain stages for the cotton and wheat value chain in Uzbekistan. Kaplinsky and Morris (2002) suggest similar procedures for implementing value chain analysis. Their concept consists of two steps in order to map the value chain of interest. The first step includes drawing an 'initial map', which shows the chain boundaries including the main actors, activities, connections and some initial indicators of size and importance. The second step consists of elaborating the refined map by quantifying key variables such as value-added, and by identifying strategic and non-strategic activities. This refined map can be understood as a framework for showing chain statistics (McCormick / Schmitz 2001).

Another approach for mapping value chains is the social network analysis (SNA) originated in social sciences. Similar to the FAO concept, it serves as a tool for mapping and analyzing relationships and flows between people, groups, and organizations. The initial flow chart of the chain consists of various nodes and links arranged in form of a

matrix. The nodes represent the actors while the links describe the relationships and flows between the nodes. SNA is used when the value chain is more characterized by a network than a single vertical chain. Clottey et al. (2007) used SNA to map the small livestock production system in Northern Ghana for a value network analysis. Another example is the study of Kim and Shin (2002). The authors applied SNA to analyze the development of international and interregional trade flows between 1959 and 1996.

In this paper for the analysis of the key factors influence the income of the producer in the supply chain of perishable agricultural products, econometrics analysis first by mapping using institutional and factional analysis utilized.

2.3. Supply chain factors affecting income

Income and wealth are only partial indicators of well-being. In industrialized countries other factors to consider are the ability to control one's own environment, quality of working conditions, independence etc. and in less developed countries these include the more fundamental issues such as life expectancy, food security and health. In this thesis the term income is used as the revenue received by irrigation cooperatives members from vegetable production from onion, potato and tomato. The income data was collected from the sampled households using structured questioners.

Agricultural producers are exposed to a variety of income uncertainties, both market related, such as price variations, and non-market related, such as unstable weather patterns. They are also exposed to a variety of idiosyncratic shocks that affect their income, such as farm household characteristic. Such uncertainties induce substantial income risks that can be particularly detrimental to small and/or poor producers in developing countries. In particular it has been shown that income instability in the presence of liquidity constraints and inadequate assets, which features rather prominent in many developing countries, can create poverty traps (Zimmerman and Carter, 2003). There are so many factors which affects the income of the producer starting from the production up to the producer supply its produce to the market. Some of the factors discussed here under.

2.3.1. Nature of the market and income

One of the factors which determine the income of agricultural producers is the nature of the market. Therefore, in order to determine the income of the producer the nature of the agricultural market should be evaluate. Agricultural markets can play significant roles in reducing poverty in poor economies, especially in countries which have not already achieved significant agricultural growth. (Dorward, et al. 2005) highlight three broad mechanisms through which agricultural growth can drive poverty reduction: (1) Through the direct impacts of increased agricultural productivity and incomes; (2) Through the benefits of cheaper food for both the urban and rural poor; (3) Through agriculture's contribution to growth and the generation of economic opportunity in the non-farm sector. This survey focuses on the factors related to the agricultural productivity and marketing activities.

Economic theory explains that market system functions properly under perfect competition situation. The lack of conditions of perfect competition may lead to market failure or malfunctioning of the market. Rural market in developing countries is imperfect due to interlinked transactions and position of agent-client relationship displays inequality of power of an agent over client. Moreover the clients are less informed about prices, products and production possibilities. Therefore, situation in the rural markets permit exploitation of the weaker party by the stronger party often the creditor.

However, experience has shown that markets can fail the poor, especially poorest and marginalized groups, including women. Johnson, (2005) argues that in remote rural areas markets may fail because they maybe too 'thin', or the risks and costs of participating especially for poor people may be too high, and or there maybe social or economic barriers to participation. (Dorward, et al. 2003), identify three main types of markets failures that may affect the poor. The first one is Public good failure: This is where it is not possible to restrict usage of a certain good or service. In this case, there are no incentives for users to pay for these goods or services and anyone who provides them cannot gain any income from these activities through market exchanges. Second

transaction failures: This refers to instances where institutions are weak or over regulated leading to high transaction costs and risks from engaging in the market. Thirdly, Access failures: In many instances markets fail because the poor cannot access them, or can only access them on terms that hamper their participation. Access failure occurs due to lack of resources (capital, labor, and land), active discrimination, or lack of information or power. For example, social or economic barriers to entry may mean that specific groups of the poor are excluded from markets. In this case when farmers prohibit from market access due to different reasons they cannot seal their produce since there are high cost of transaction, lower quality and receive poor price in turn their income reduced.

Producer's income also affected by the type of the market they are involved (Nayga et al. 1994). Farmer to-consumer direct marketing is a means by which farmers sell their produce directly to consumers. Some of the more familiar types of outlets are pick-your-own (PYO) produce farms, roadside stands or tailgate vehicles, and farmers' markets. PYO operations are farms where retail customers harvest their own agricultural products. Roadside stands are mostly temporary structures erected to display produce, while a tailgate vehicle involves the use of a wagon or a pick-up truck to display produce. Farmers' markets, on the other hand, are places where farmers bring their produce to be sold. A regular site and schedule is usually set for a particular farmers' market. Farmers view direct marketing as an alternative market outlet to increase their income, while consumers see it as a means of gaining access to fresher, higher-quality foods at lower costs (Nayga et al. 1994).

2.3.2. Production and income

Another factor which influences the income of the producer is the method of production and the input utilized by the farm unit. The first and most significant factor to increase farmers' incomes is to introduce new technologies, especially improved varieties, seed treatment, and inorganic fertilizers (B.Ouendeba, 2000). These usually related to the amount of production supplied to the market in relation to the cost of production and the quality including organic nature of the product. The use of improved technologies (improved varieties, inorganic fertilizer, fungicide) lead to large yield increases but they

need to be combined with better prices from avoiding sale at the post-harvest low. Otherwise production increases can drive down the prices (B.Ouendeba, 2000). It is also the cost of production for small-scale farmers relative to large farms are very high. Clearly, small farmers will not be able to participate when there are significant economies of scale in production, allowing large farms (including estates and plantations) to produce at a lower cost. Therefore, what is in the production process determine the income of the producer.

The impact of fruits and vegetables income can occur also through the food price mechanism. The effect on food prices mainly results from the substitution effect in production. As land and other resources are shifted towards non-staple-food production, the supply of fruits and vegetables expands, while that of staple foods contracts. This result in more production of fruits and vegetables this result in the reduction of price in this commodities (Little, 1994). In order to solve such a problem production plan is one of the ways out.

2.3.3. Post harvest handling and income

Post harvest handling of agricultural products also another factor which influences the income of the producer. The handling, processing and preservation of crop produce at the time and after harvesting may be identified as “Post- harvest management” (Boxall, R.A. 1998). The phrase agricultural post harvest technology and marketing economics (PHTME) includes all technological and economic transformations that occur to agricultural products between harvest and consumption. PHTME encompasses storage, assembly, processing, packaging, warehousing, transportation, and distribution of agricultural products through the institutional food trade and wholesale and retail outlets.

Measuring the impact of post harvest handling is difficult to put in quantitative form (Bouis, 1996). However, farmers practice in post harvest handling influence the product quality and the shelf life of the product. These related to the farmers received the price in the market and the amount of loss in the production and post harvest (Davis and Lubulwa

1994). Post harvest handling related to increase in market price by adding value and reducing loose of production that is usually affect farm income (Boxall, R.A. 1998).

Improved post harvest management depends on the quality and efficiency of handling, processing and preservation techniques used. Thus, whether the gain in crop yields is marginal or significant; it could be invalidate because of inappropriate or unreliable post-harvest management employed. Moreover, proper storage also helps to ensure household and community food security or to raise income until the next harvest and helps producers not to sell at low price during the excess period that often follows a harvest (FAO, 1994). However, in the case of perishable agricultural products the management of post harvest should be supplemented by processing industries to benefit the producer.

In post harvest handling the issue of product quality emphasized in relation to the impact on price due to the quality of the product and the handling of the product during the marketing process both in good price time and price failure. The issue of quality is usually subjective. However, according to Richard J. Schonberger quality is that like art, everybody praises it, "everybody recognizes it, but each one has its own understanding of what it is". Objectively, quality is the aptitude of a good (product) or service to satisfy the needs of its users. ISO Standard 8402:1987 defines quality as "The totality of features and characteristics of a product or service that bears its ability to satisfy stated or implied needs". This definition implies "consumer's satisfaction", fulfilling their needs and expectations, in an organization committed to continuous improvement and effectiveness. The five important words associated with quality are aptitude, satisfaction, need, user and continuous improvement. It is therefore essential when producing quality products to know who will be the user(s) of the product and what are the specific and constantly changing needs to be addressed?

For agricultural food products, quality may be regarded as a complex characteristic of foods that determines its value and acceptability by consumers. Quality components for foods are related to characteristics of the food (hygienic quality and safety, nutritional

quality, organic quality), use or service quality (convenience or easy to use, conservation) and psychosocial or subjective quality (satisfaction, pleasure) (FAO, 2000).

Therefore, post harvest handling impact on farmer's income through the practice the farmers made in maintaining quality and handling of surplus or marketable product in the production and process of marketing. When quality is maintained proper price will be received if not the reverse will happen and in turn it affects the producer income.

In the case of handling of the product after production and in the process of marketing different facilities required to maintain quality in post harvest handling. Storage facilities, assembling facilities, processing method, packaging and grading, warehousing, and transportation, are the major facilities related to post harvest handling. FAO, (2000), asserts that when the producer marketing their produce what ever happen in this facilities impact their marketing activities and impact in to their income by high marketing cost, product loss or market price. Therefore, post harvest handling facilities are one of the major determinants to see the relationship of marketing of agricultural products and the producer income.

2.3.4. Nature of the product and income

Marketing of agricultural products depend on the type of the product produced by the producer. Agricultural products characterized by their seasonality, perishable nature and their volume. These natures of the agricultural product related to so many aspects of market requirement. In marketing of perishable agricultural products the characteristics of the products require more marketing facilities than other agricultural products. Therefore these requirements in one way or the other related to farm income.

One of the main issues in marketing of perishable agricultural products involves transport. According to Welby and Macgregor (2004), the transportation of perishable produce requires specific care as regards packing, labeling, and transport equipment maintenance. When perishable agricultural products transported to the market they need to be reached keeping their quality in order to gain price and to reduce loose related to

high temperature. One of the requirements in the supply chain of perishable agricultural product is cold chain. Cold chain is a logistic system that provides a series of facilities for maintaining ideal storage conditions for perishables from the point of origin to the point of consumption in the food supply chain. This is a major constrain of farmers in the developing countries due to lack of capital and processing industries support to the producers. A well organized cold chain reduces spoilage, retains the quality of the harvested products and guarantees a cost efficient delivery to the consumer given adequate attention for customer service (Federation of Indian Chambers of Commerce & Industry, October 2004). The cold chain logistics infrastructure consist of Pre-cooling facilities, Cold Storages, Refrigerated Carriers, Packaging, Warehouse and Information Management systems, Traceability and Financial and Insurance Institutions. This usually increases farm income. However, to maintain such cold chain management for small farmers is not viable due to economic performance of small farmers in most developing countries.

Another factors related to the product nature is the complex market nature especially for perishable agricultural products. The seasonal nature, product perishable nature, and range of crops combine to form a complex marketing system for fruits and vegetables. According to Roger A. (1997), location and resources of producer determine limited marketing alternatives in fruits and vegetables marketing. For the growers of these perishable products the complex marketing system results in the increase of cost of transaction to market their produce. This directly related to small farmers income reduction due to high cost of market.

In general the nature of the perishable agricultural products hampered the income of small farmer's income by the requirements of different marketing facilities, like different storage facilities to maintain quality and to handle properly the perishable products. In other case due to their nature and the method of transportation required by perishable agricultural products producers constrained to gain proper price in the market and to avoid post harvest losses. This intern affects the producer income either by reducing supply to the market or by limiting to receive proper price in the market.

2.3.5. Membership and income

The other issue in relation to production and marketing of vegetables is the institution in which the producers involved in developing their advantages. A cooperative is an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations, through a jointly owned and democratically controlled enterprise (ICA, 2005). Cooperatives promote and support entrepreneurial development, creating productive employment, raising incomes and helping to reduce poverty while enhancing social inclusion, social protection and community-building. Thus, while they directly benefit their members, they also offer positive externalities for the rest of society and have a transformational impact on the economy (ICA, 2008).

Successful cooperatives can benefit their farmer members and others in many ways. But even the most successful cannot be all things to all members. Cooperatives marketing farm products and providing farm supplies, credit, and other services vary widely in success. So their benefits and limitations also vary. Cooperatives enable farmers to own and control, on a democratic basis, business enterprises for procuring their supplies and services (inputs), and marketing their products (outputs) (ICA, 2005).

Benefits of cooperatives are difficult to measure. Some are tangible or direct as in the case of net margins or savings. Others are intangible or indirect such as cooperatives' effect on market price levels, quality, and service. Some are most evident at the time the cooperative is organized but become more obscure as the years pass. Benefits are greater for some types of cooperatives or in specific areas. Most benefits are evaluated in economic terms but some also may be social (J. Warren, 1980).

Farm supply cooperatives have been noted for providing supplies giving the greatest value-in-use to the farmer. Their objectives have been to provide the feed, seed, and fertilizer that gave the farmer maximum gains or yields rather than those that returned the largest net margins to the cooperative.

In marketing farm products, cooperatives' pricing practices have been based on differentials for quality. And they have provided information and advice on ways to produce quality products and to maintain that quality in the marketing process. Basically, cooperatives encourage production oriented to market requirements by developing producer payment plans based upon meeting grade, size, time, and other market specifications (American cooperative report I. 1980).

Cooperatives provide members with a dependable source of reasonably priced supplies, especially during shortages or emergencies. This service may require cooperatives to forego larger net margins from other domestic or foreign business to meet the needs of their member-owners.

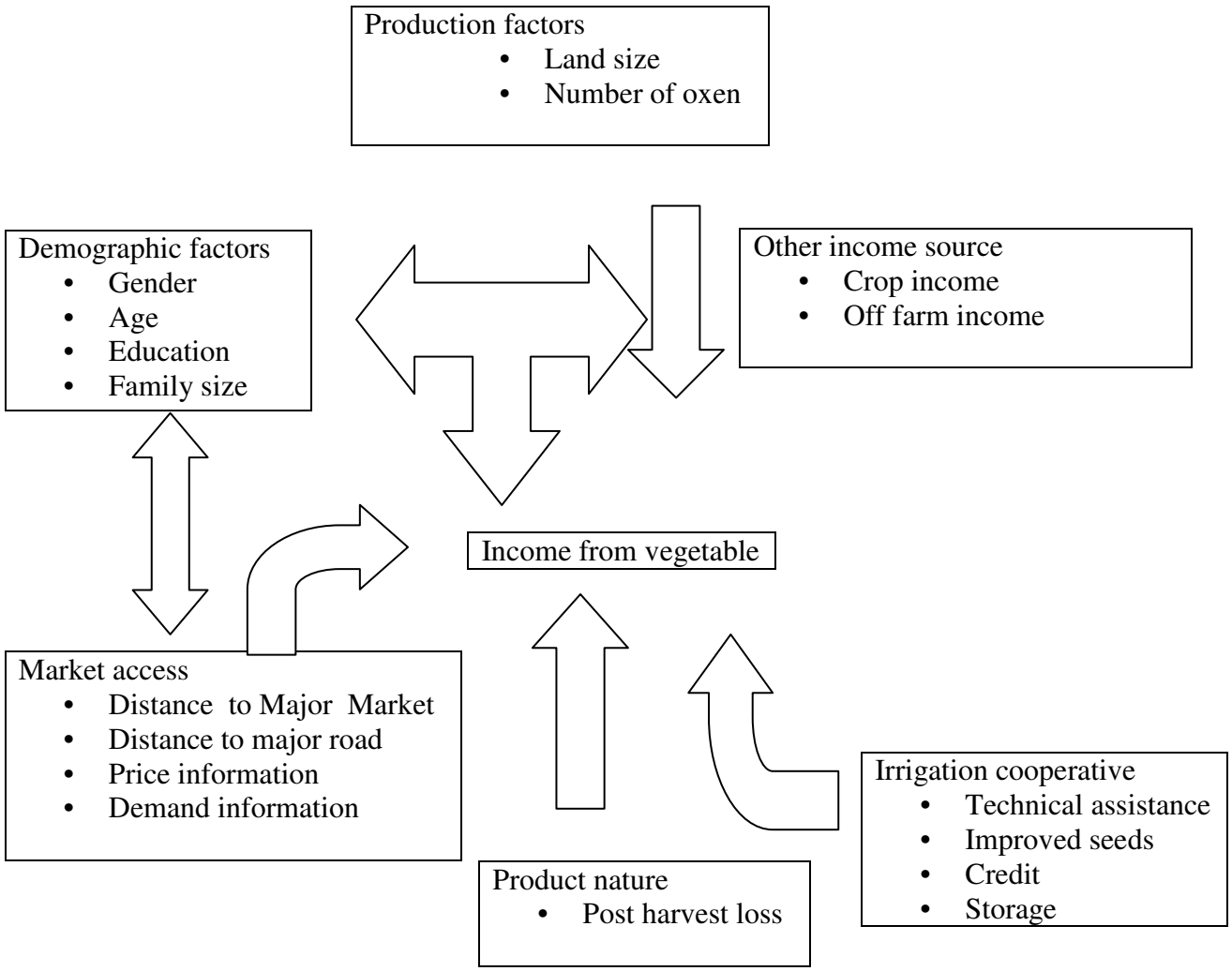
Generally, cooperatives increase farm income in a number of ways. These include: (1) Raising the general price level for products marketed or lowering the level for supplies purchased; (2) reducing per-unit handling or processing costs by assembling large volumes, i.e., economies of size or scale; (3) distributing to farmers any net savings made in handling, processing, and selling operations; (4) upgrading the quality of supplies or farm products handled; and (5) developing new markets for products.

However, although the cooperatives benefit in many ways to their members the situation of the market, the product type in which the cooperatives involved, the management of the cooperatives and the support provided to the cooperatives are determinant factors for the success of the cooperatives. Therefore, cooperatives especially in developing countries and engaged in production of vegetables required high degrees of management, understanding the situation of the market, support in terms of training, access to credit facilities and facilitating the required facilities for marketing of their produce are important factors for benefiting the members.

2.3.6. Conceptual framework of the paper

The frame work of this paper was designed in relation to the major constraints to increase income of producer in the supply chain of vegetables marketing. There are so many constraints to increase income of the producers starting from production up to final market where finally supplied to the consumer. For the analysis of this paper the major constraints in relation to production, factors related to the marketing activities of vegetables and institutional supports are included. The framework of the paper summarized in the following diagram.

Figure 2.1: Conceptual framework



CHAPTER - THREE

3. Methodology

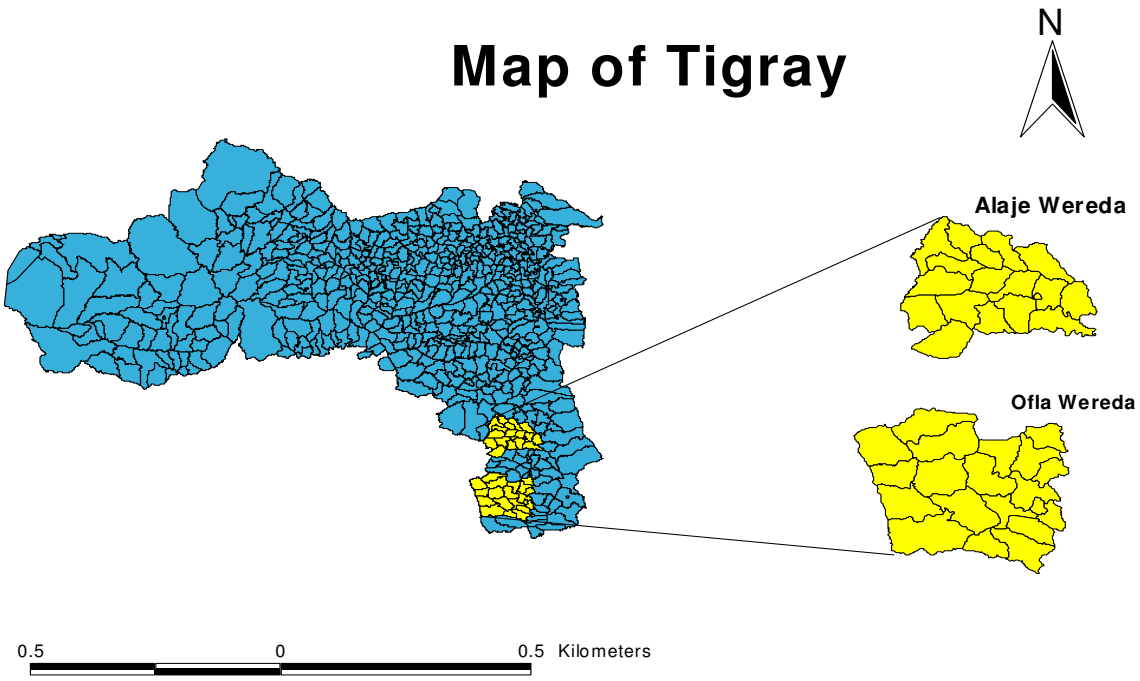
This chapter provides a description of the methodology and data included in this study. Data collection and analysis were carefully planned in order to facilitate the achievement of the objectives set for the research. An overview of the stages of data collection, the geographical scope of the study, and the sample selection is provided.

Both qualitative and quantitative data were collected. Qualitative data was used for making a general characterization of the determinants of income of members in the supply chain of vegetable in the selected Woreda. This information provided essential input for designing a survey for collecting quantitative data. Furthermore, qualitative information becomes very useful for interpreting quantitative results and complementing them.

While qualitative data is interpreted and descriptively presented, quantitative data is analyzed using statistical and multivariate data analysis techniques. All these qualitative and quantitative methods are summarized and discussed in this chapter according to research objectives.

3.1. Description of the study area

Figure 3.1: Map of the study area



3.1.1. Southern Zone of Tigray

Based on the CSA (2007), Tigray Region has a population of 4,314,456 of whom 2,124,853 were men and 2,189,603 were women. Urban inhabitants number 842,723 or 19.53% of the total population. With an estimated area of 50,078.64 square kilometers, this region has an estimated population density of 86.15 people per square kilometer. For the entire region 985,654 households were counted. This results to an average of 4.4 persons per household. The average family size in urban and rural area was 3.4 and 4.6 persons, respectively.

The study was conducted in the southern zone of Tigray region of Ethiopia in two Woredas namely Alaje and Ofla. Southern zone of Tigray is one of the seven administrative zones in the Tigray National Regional State. Southern zone is located in

the southern most boundaries of Tigray Region and bounded by Afar region in the east, Eastern zone of Tigray in the North, Amhara Region in the South and South West and Central zone of Tigray in the North West.

The southern zone has a total population of 1,070,781 of which 51 percent are female. The zone covers about 9286.52 square kilometer with a population density of 115.3 people per sq.km (CSA, 2006). There are six Woredas in the zone. The zone has bimodal with erratic rainfall pattern of rain fall. “Belg” rain is the small rain occurring usually from February to April. The second rainy season “keremt” is from June to early September. Agriculture is the major activity like that of other part of the country in terms of its employment and as a means of income for livelihood. In the Zone in six Woredas there are a total of 46 irrigation cooperatives.

3.1.2. Alaje Woreda

Alaje is one of the 36 Woredas in the Tigray Region of Ethiopia. Part of the Debubawi Zone, Alaje is bordered on the south by Endamehoni, on the west by the Amhara Region, on the northwest by Samre, on the northeast by Hintalo Wajirat, and on the east by Raya Azebo. The administrative center of this Woreda is Adi Shenu; other towns in Alaje include Chelena and Dela.

Based on figures published by the central statistical agency of Ethiopia in 2005, this Woreda has an estimated total population of 113,020, of whom 58,265 are men and 54,755 are women; 10,927 or 9.67% of its population are urban dwellers, which is less than the Zone average of 29.1%. With an estimated area of 755.63 square kilometers, Alaje has an estimated population density of 149.6 people per square kilometer, which is greater than the Zone average of 133.18. Concerning education, 10.46% of the population were considered literate, which is less than the Zone average of 15.71%; 13.46% of children aged 7-12 were in primary school; 0.96% of the children aged 13-14 were in junior secondary school; 0.55% of the inhabitants aged 15-18 were in senior secondary school. Concerning sanitary conditions, about 23% of the urban houses and 13% of all houses had access to safe drinking water at the time of the census.

A sample enumeration performed by the CSA in 2001 interviewed 20,420 farmers in this Woreda, who held an average of 0.5 hectares of land. Of the 10,110 hectares of private land surveyed, 92.87% was in cultivation, 0.28% pasture, 3.03% fallow, 0.24% woodland, and 3.59% was devoted to other uses. For the land under cultivation in this Woreda, 65.39% was planted in cereals, 24.94% in pulses, and 51 hectares in oilseeds; the area planted in vegetables is missing. The area planted in fruit trees was 57 hectares, while 32 were planted in gesho. 65.36% of the farmers both raised crops and livestock, while 33.63% only grew crops and 1.0% only raised livestock. Land tenure in this Woreda is distributed amongst 86.43% owning their land, and 10.73% renting; the number held in other forms of tenure is missing.

3.1.3. Ofla Woreda

Ofla is one of the 36 Woredas in the Tigray Region of Ethiopia. Ofla is located about 620 kms away from Addis Ababa and about 160 kms from Mekelle. The Woreda is located on the geographic coordinates of 12031'North Latitude and 39033' East Longitude. The altitude varies between 1700 - 2800 m.a.s.l and the slope ranges to more than 15 percent. Ofla is bordered on the south by Alamata, on the west by the Amhara Region, on the north by Endamehoni, and on the east by Raya Azebo. Towns in Ofla include Korem and Zikuya.

Based on figures published by the central statistical agency of Ethiopia in 2005, this Woreda has an estimated total population of 171,370, of whom 87,789 are men and 83,581 are women; 29,787 or 17.38% of its population are urban dwellers, which is less than the Zone average of 29.1%. With an estimated area of 1,297.50 square kilometers, Ofla has an estimated population density of 132.1 people per square kilometer, which is less than the Zone average of 133.18. Concerning education, 9.11% of the population were considered literate, which is less than the Zone average of 15.71%; 11.43% of children aged 7-12 were in primary school; 3.85% of the children aged 13-14 were in junior secondary school; 1.92% of the inhabitants aged 15-18 were in senior secondary school. Concerning sanitary condition about 63.5% of the urban houses and 12% of all houses had access to safe drinking water at the time of the census.

Ofla has two (Bimodal) rainy seasons namely; Keremt where the main wet season is from June to September and Belg; the small wet season extends from February to March. The rainfall distribution of the study area is characterized by heavy and erratic in nature, like most highlands of the country. The annual rainfall varies from 450mm to 800mm during keremt and 18mm to 250mm during Belg season (Ofla Woreda BoARD, 2006). The mean annual temperature of the study area is 22^{oc} with minimum and maximum temperature of 6oc and 30^{oc} respectively (Kebede, 2005, Ofla Woreda BoARD, 2006).
Ofla Woreda has about 133, 300 hectare of landmass, which has 25,275 arable, 24,149 ha grazing, 44,635 ha forest, 36,515 useless and 2,726 currently not under cultivation, but suitable for cultivation (Ofla Woreda BoARD, 2006). The average land holding in the Woreda is about 0.5 hectare per household. Ofla Woreda has an estimated total population of 132,491 of which 51.83% are female. From the total 33,944 rural household heads, male headed households account for about 67.93 percent while female-headed households account for about 36.07 percent.

Agriculture is the mainstay of the community. Similar as in the other parts of the country, the farming techniques used by the rural communities are traditional. Ofla Woreda is characterized by a mixed farming system where the livelihood of the rural community depends both on livestock and crop farming. Crop production is mostly rainfall dependent.

3.2. Source and Data Requirements

Both primary and secondary information were utilized to analyze the factors affecting the income of irrigation cooperative members in the supply chain of perishable agricultural products (vegetables) supplied by irrigation cooperatives members. The primary information was collected using interview method based on the structured questionnaire designed for the purpose of the study. Secondary information was collected from the regional cooperative agencies, the irrigation cooperatives documents, members of cooperatives and other similar documents in the region in order to supplement the primary information.

3.2.1. Primary data

Primary data was collected on age of respondents, marital status, sex of the household head, educational level, family size, family income from vegetable, livestock, crop, and other source of income, size of land holding, livestock ownership, duration of membership, availability of credit, source and availability of price information and technical assistance, quantity of vegetables produced, the use of improved seed, constraints of farm inputs, distance of the farm from major road and major market, opinion of members about the cooperative management and other relevant variables from the sample respondents who are members of the irrigation cooperatives were gathered for the study. The primary data was collected both in the form of quantitative and qualitative (focused group discussion).

3.2.2. Secondary data

The researcher collected the required secondary data regarding:

- The number of irrigation cooperative;
- Membership by sex and age;
- The availability of technical assistance in production, pre and post harvest handling and marketing of vegetable ;
- Credit availability and source of credit ;
- The facilities provided by irrigation cooperative ;
- Price of vegetable in the market in different season ;
- Other relevant information related with the research objectives.

3.3. Sample size and method of sampling

The sample frame of the study was the list of irrigation cooperatives members in the region of Tigray registered by the Tigray regional state cooperative agency. In Tigray, there are 226 irrigation cooperatives in 36 Woredas. Most of them engaged in the production of perishable agricultural products. From these the southern Zone irrigation cooperatives are randomly selected. In the southern Zone there are six Woredas with a

total of 46 irrigation cooperatives. From these two Woredas namely Alaje and Ofla selected purposively based on the highest number of irrigation cooperatives existence which produces vegetables. In the selected Woredas there are a total of 18 irrigation cooperatives 9 in each of the Woredas serving a total of 1416 members. From Alaje Woreda 2 irrigation cooperatives and from Ofla 4 irrigation cooperatives randomly selected. From this irrigation cooperatives, "although there is no established rule of thumb it is agreed that the sample size should be five times more than the number of variables (Sultan and Tarafder, 2007:84)" considering the variables used in the model a total of 120 members 80 from Ofla and 20 from Alaje were selected using random sampling method (Using lottery method).

Table 3.1: Irrigation cooperatives in the southern zone

Woreda	No of irrigation cooperatives	Male	Female	Total
Alamata	8	477	200	677
Ofla	9	785	216	1001
Endamehony	5	38	16	54
Raya azebo	7	304	435	739
Alaje	9	379	36	415
Entalowajirat	8	355	89	444
Total	46	2338	992	3330

Source: Tigray cooperative agency (2008)

Table 3.2: Number of irrigation cooperatives and sample size

Sample Woreda	No of irrigation cooperatives	No of sampled irrigation cooperatives	Male	Female	Total	Sample HH
Ofla	9	4	785	216	1001	80
Alaje	9	2	379	36	415	40
Total	18	6	1164	252	1416	120

3.4. Method of data collection

Primary data were collected from the selected farmer respondents of the two Woredas. The interview schedule was developed in English and later translated in to Tigrigna before administration.

Data collection from farmer respondents was done by two enumerators selected for this purpose. Another interview schedule was developed for collecting responses from the Woreda officials and officials of the irrigation cooperatives societies. This was mainly with the objective of assessing their perception of the constraints in vegetable marketing through the cooperatives, the opportunities and potentials of the irrigation cooperatives in production of vegetable and the major factors affecting income of vegetable producers. This was done based on the check list prepared for this purpose. A total sample size of 5 officials was interviewed by the researcher.

Appropriate training, including field practice, was given to the enumerators to develop their understanding regarding the objectives of the study, the content of the interview schedule, how to approach the respondents and conduct the interview. Pre-testing of the interview schedule was carried out and depending on the results some modification were made on the final version of the interview schedule. Moreover, personal observations and informal discussions with staff of irrigation cooperatives and Tigray cooperative agency offices were made. Secondary data were collected from government offices and Cooperatives. Secondary data was collected from different sources including price of vegetables, total cultivated land, and annual yield/ha, total production, availability of technical assistance, price information, etc.

3.5. Methods of data analysis

Qualitative research differs from quantitative research in many ways. While quantitative research is focused on measuring and analyzing causal relationships between variables, qualitative research is focused on interpreting reality as a process. It seeks to know "how social experience is created and given meaning" (Denzin and Lincoln, 2000, p. 8).

In this research qualitative data are interpreted, described and summarized in tabulation form. Contrary to representing a dilemma the use of qualitative and quantitative analyses, both type of analyses complement each other. Qualitative data is very useful for accomplishing particular objectives where quantitative data is unavailable or insufficient. Some of the objectives of this research heavily rely on qualitative data. Furthermore,

qualitative information is used for interpreting and discussing statistical results as well as to make relevant suggestions. For the quantitative analyses, several methods are used, such as analyses of difference and relationship, specifically t - test, cross-tabulations, and multiple regressions.

Therefore, the analysis of this paper designed in to two parts. The first part includes the descriptive analysis. This analysis relay on the socio economic characteristics of the respondents and other variables descriptions associated with the respondents. The second analysis includes the analysis of the result of the econometric model. This model was used to see the relationship between the dependent variables and independent variables specified in econometric model. These methods are described below.

3.5.1. Descriptive statistics

Descriptive statistics are important to have clear picture of the characteristics of sample units. By applying descriptive statistics one can compare and contrast different categories of sample units (farm households) with respect to the desired characteristics. In this study, descriptive statistics such as mean, standard deviation, percentages and frequency of occurrence were used along the econometric model, to analyze the collected secondary and primary data.

3.5.2. Empirical analysis

3.5.2.1. Model specification

Multiple regression is a flexible method of data analysis that may be appropriate whenever a quantitative variable (the dependent or criterion variable) is to be examined in relationship to any other factors (expressed as independent or predictor variables). Relationships may be nonlinear, independent variables may be quantitative or qualitative, and one can examine the effects of a single variable or multiple variables with or without the effects of other variables taken into account (Cohen, Cohen, West, & Aiken,

2003).Thus, it is appropriate to use multiple regression model for the analysis of the study.

Therefore, multiple regression model was used to see the relationship between income from onion, potato, tomato and the variable which affect income in the supply chain of vegetable products. The multiple regression model used in the study was as follows:

$$Y_o = b_o + b_1x_{1i} + b_2x_{2i} + \ldots + b_kx_{k\,i} + \epsilon \quad \text{.....Eq 1}$$

Where; Y_o = the dependent variable that is income from onion, potato and tomato.

b_o = the intercept of the regression model which is constant

ϵ = the error term or the residual between y value and the expected value of y given by $b_o + b_1x_1 + b_2x_2 + \ldots + b_kx_k$

$x_1, x_2, \ldots x_k$ = the explanatory variable used in the model.

i = the number of observations

In the model the explanatory variables used were:

X_1 = Age of the household head

X_2 = Sex of the household head

X_3 = Family size

X_4 = Education of the household head

X_5 = Total size of land

X_6 = Improved seeds

X_7 = Off farm income

X_8 = Technical assistance

X_9 = Credit

X_{10} = Demand information

X_{11}= Price information

X_{12} = Distance from main road

X_{13} = Distance from major market

X_{14} = Vegetables post harvest loss

X_{15} = Number of oxen

X_{16} = Livestock income

X_{17} = Crop income

3.5.2.2. Assumption of the regression model

When conducting multiple linear regression analysis, the following assumptions must hold for the model to be correct:

Normality: Normality assumes the value of the Y (the dependant variable) must be normally distributed for each value of X (the independent variable). This means that in multiple regressions, variables must have normal distribution. According to Levine, Berenson, and Stephan (1997), regression analysis is fairly robust against departures from the normality assumption. One method of verifying the normality assumption is to construct and examine a Normal Probability Plot for the dependant variable.

Homoscedasticity: Homoscedasticity assumes variation or error around the regression line should be similar for low and high values of the independent variable. This means that in multiple regression, the variance is constant across all levels of the predicted variable. This can be verified by examining the residual plots for each independent variable.

Independence of Errors: Autocorrelation, or the likelihood that a certain type of error precedes or follows another type of error, violates the independence of errors assumption. If errors are correlated, there will be a pattern of positive errors following positive errors and negative errors following negative errors. The simplest way to rule out autocorrelation is to plot the residuals over time.

Linearity: Linearity is one of the assumptions in multiple regression model**.** This is the relationship between the dependent variable and independent variable should be linear in nature

3.5.2.3. Test for regression model

F-test

When using Multiple Regression, the objective is to utilize only those variables that have a significant relationship with the dependant variable. The first step in determining a significant relationship between the dependant and independent variable is to conduct an F test. The F test is used to determine if there was a significant relationship between the dependant variable and the chosen independent variables. The null hypothesis is that there is no linear relationship between the dependent variable and independent variables; while the alternative hypothesis is that at least one regression coefficient is not equal to zero. The null hypothesis is rejected at a certain level of significance if the estimated value F is greater than the critical value of F.

The appropriate hypotheses are:

$$\text{Ho: } b_1 = b_2 = \dots b_k = 0$$

$$H_1: b_j \neq 0 \text{ for at least one j} \quad \text{..... Eq 2}$$

Rejection of Ho in the above hypothesis implies that at least one of the regressors x_1, x_2 **…** x_k contributes significantly to the model.

An F-test is also used in analysis of variance (ANOVA), where it tests the hypothesis of equality of means for two or more groups. For instance, in an ANOVA test, the F statistic is usually a ratio of the Mean Square for the effect of interest and Mean Square Error. The F-statistic is very large when MS for the factor is much larger than the MS for error. In such cases, reject the null hypothesis that group means are equal. The p-value helps to determine statistical significance of the F-statistic (Gujarati, 2004).

The F test is used to test the significance of R, which is the same as testing the significance of R^2, which is the same as testing the significance of the regression model as a whole. If prob(F) < .05, then the model is considered significantly better than would be expected by chance and we reject the null hypothesis of no linear relationship of y to

the independents. F is a function of R^2, the number of independents, and the number of cases. F is computed with k and (n - k - 1) degrees of freedom, where k = number of terms in the equation not counting the constant. The mathematical form can be written in the form of:

$F = [R^2/k]/[(1 - R^2)/(n - k - 1)]$. ……...……. Eq 3

Alternatively, F is the ratio of mean square for the model (labeled Regression) divided by mean square for error (labeled Residual), where the mean square are the respective sums of squares divided by the degrees of freedom ($F = R^2/(k-1)/(1-R^2)/(n-k)$).

Coefficient of determination R – square ($R^{2)}$

The other test was used in multiple regression model was the coefficient determination. The correlation between a set of obtained scores and same score obtained from the multiple regression equation is called coefficient of multiple correlation. It is designated R^2. R– Square is the proportion of the variation in the dependent variable explained by the regression model, and is a measure of the goodness of fit of the model (how the model explain the relationship between the dependent and independent variable). It can range from 0 to 1. The fit of the model is said to be "better'' the closer is R^2 to 1 (Gujarati, 2004).The mathematical form of R – squared can be written in the form of:

$R^2 = ESS/TSS = SUM([Y - \hat{e}] - \mu Y)^2 / SUM(Y - \mu Y)^2$ ……Eq 4

Where, ESS is the summation of the squared values of the difference between the predicted Ys (Y - ê) and the mean of Y (μ_Y, a naive estimate of Y) and TSS is the summation of the squared values of the difference between the actual Ys and the mean of Y.

R^2-adjusted:

R^2-adjusted is the coefficient of determination adjusted for the number of independent variables in the regression model. Unlike the coefficient of determination, R^2-adjusted may decrease if variables are entered in the models that do not add significantly to the model fit. The adjusted R^2 statistic is the same as the R^2 except that it takes into account the number of independent variables (k). The will increase, decrease or stay the same when a variable is added to an equation depending on whether the improvement in fit the explained sum of square (ESS) outweighs the loss of the degree of freedom (n-k-1). This is used to see how the variables explain the model. That is, adjusted R^2 is a measure of the linear association between y and x_1, x_2, **…** x_k.

Adjusted $R^2 = 1 - (1 - R^2) \times [(n - 1)/(n - k - 1)]$……...Eq 5

The adjusted R^2 is most useful when comparing regression models with different numbers of independent variables. R^2 adjusted will always be lower than R^2 if there are more than one regresses (Gujarati, 2004).

Variance inflation Factor

Before running the multiple regression model it is important to verify there is no multicollinearity between the independent variables. According to Levine et al (1997), when two independent variables are highly collinear they can cause the regression coefficients to fluctuate drastically if one or both are included in the model. It is difficult to separate the effect of to two collinear independent variables on the dependant variable. There are two measures that are often suggested to test the existence of mulitcollineality. These are: Variance Inflation Factor (VIF) for association among the continuous explanatory variables and contingency coefficients for dummy variables. In this study, variance inflation factor (VIF) or detection of tolerance and contingency coefficients are used to test multicollinearity problem for continuous and dummy variables respectively.

The mathematical notation for tolerance = 1- R_i^2 ..... Eq 6

The mathematical notation for tolerance VIF = 1/ 1 - R_i^2..... Eq 7

Where R_i^2, is the multiple correlation coefficient between X_i and the other explanatory variables,

If sets of variables are uncorrelated the VIF will equal 1. For highly intercorelated variables, the VIF can exceed 10. According to Gujarati (2004), a VIF greater than 10 indicates there is too much correlation between the independent variables. Similarly, contingency coefficients are computed for dummy variables using contingency coefficients formula.

The mathematical notation for contingency coefficients:

$$C = \sqrt{\frac{\chi^2}{n+\chi^2}}$$ ..... Eq 8

Where, C is contingency coefficient, χ^2 is chi-square value and n = total sample size. For dummy variables if the value of contingency coefficient is greater than 0.75, the variable is said to be collinear (Healy, 1984 as cited in Mesfin, 2005).

3.6. Description of variables used in model

3.6.1. Explained variable

The explained variable used in this model is the gross income a household received from sell of vegetable (Onion, potato, tomato) in the year 2008/09 in birr. It is a continuous variable consequent from the survey.

3.6.2. Explanatory variable

Different variables in the supply chain are expected to determine income from vegetable in irrigation cooperatives. The explanatory variables used for the analysis of the model include those factors which influence the supply of vegetable production as irrigation cooperative producer and those factors which influence income related to product characteristics and in marketing of vegetable products. The following are hypothesized variables to influence income from vegetable.

Age of the household head: Age of the household is a continuous variable measured in years included in the model as one of the explanatory variables. The expected influence of age is assumed positive taking the presumption that as farmers' gets older they could acquire skills to produce surplus that could supply for the market and also develop skills to produce a product with high market demand and sold at higher price. According to Ali (1995) and Bravo-et al (1994), Age is one of the factors that affect the efficiency of carrying out farm activities. Hence incomes from farm production increase. The expected sing of this variable is positive.

Sex of the household head: Sex of the household is another variable included in the model which influences income of the household from vegetable production. It is a dummy variable; both men and women participate in production of vegetable in irrigation cooperative. In most studies in developing countries male headed households have been observed to have a better tendency than female headed households to increase their income from farm production. For this variable, in this study also it is expected positive influence on income from vegetable for male headed households. It is coded 1 for male and 0, otherwise.

Family size: It is a continuous variable, measured in man equivalent i.e. the availability of active labor force in the household, which affects vegetable income. In many studies, family size increases production if the proportion of dependents minimum. However, in most developing countries there are more dependents and it affects income since

dependents do not contribute for the labor force of the family that is required for farm production. Hence, negative sign is presume for this variable.

Education of the household head: It is a discrete variable and refereed to the level of education the household head achieved. Where 1 represents illiterate, 2 represents read and write, 3 represents primary education, 4 represents secondary school and 5 represents above secondary school. It is believed that those household heads with higher education have a better advantage in accessing information in the market and accept new ideas and innovation to increase their production. Hence, they are in a better position to receive higher price and to supply surplus production to the market. Therefore, the expected influence on income is positive.

Size of land: The total size of land the household has is a continuous variable used in the model and measured in hectare. The more land the household has leads to allocate the household more for vegetable production. This also leads to have more production of vegetables to the household and intern to receive more income from vegetable production. Thus, more land size ownership is expected to have direct influence on income from vegetable.

Number of oxen: This is a continuous variable used in the model measured in numbers of oxen the households have in the year 2008/09. The number of oxen usually related to the capacity of the households production, since oxen are one of the factors in small scale agricultural production in most developing countries. Hence, based on the number of oxen the production of vegetable expected to increase the household production capacity and in turn the household receive higher income. The expected sign for this variable is positive.

Use of improved seed: Use of improved seeds is one of a dummy variable used to explain the dependent variable. If the farmer used improved seeds for vegetable production it was assigned 1 if not 0. The use of improved seeds increases production and

farmers will have surplus production supplied to market hence they will have more income from their produce. Therefore, the expected sign is positive.

Off farm income: It is a continuous variable used in the model measured in birr. It is part of the total amount of income earned from off farm activities which are not related to agriculture. Off farm income has two impacts on income of producer from agriculture. Either it reduces the producer working hours in his farm this lead to decrease farm production or it increases farm production by investing income generated from other non agricultural sector in to his farm production in form of inputs, new technologies and other form. As described by Reardon (1999), off farm income is important source of cash for farm households especially to purchase fertilizer. However, in certain cases the effect is ambiguous. Teressa (1997) reported that farm households who were involved in the generation of off-farm income tend to intensify less their crop production. There are cases when off-farm income looks relatively attractive compared to income generation in farm sector, which attracts the attention of households. Therefore, it is expected that off-farm income would have either positive or negative impact on income from vegetable production.

Livestock income: This is another variable included in the model measured in the amount of money the household receive in crop year 2008/09. Livestock income is one of the sources of income in agricultural society. The activity of livestock production land requirement commonly is not related with crop production or vegetable production unless the household specialized in the production of livestock since common grazing land is used for the society. However, since livestock income is another source for income of the household this related with the production of another farm production either by investing to re bust a given farm production or other purposes. Hence, the relationship with production of vegetable income depends on the household livestock income and his investment in vegetable production. Therefore, it is difficult to assign its expected sign a prior.

Technical assistance/extension service: Technical assistance is another dummy variable used in the model. It is a dummy variable coded 1 if a farmer receives a technical assistance for his vegetable production, if not 0. If a farmer receives technical assistance in solving problems related to production, he has a better chance in increasing income from his produce. This contributes the increase in income from marketable vegetable. Hence, the expected sign is positive.

Credit received for vegetable production: Credit is a dummy variable used in the model. It is coded 1 if the farmer receives credit for his vegetable production if not 0. In most studies credit help producers to purchase farm inputs and other requirements in the process of their production. These usually affect farm production positively if the credit is utilized for its purpose and if it is with required amount and fair interest rate. Hence, it is difficult to assign its expected sign a prior.

Crop income: This is a continuous variable used in the model. The amounts of gross income received from crops in 2008/09 considered. Land is a scarce resource in most developing countries. This is also true in the study area. Hence, a producer remain to allocate his land based on the opportunity costs and related risks. Based on the decision of the household the income received from vegetable can decrease or increases. Therefore, it is difficult to assign its expected sign a prior.

Price information: This is a dummy variable used in the model which influences income from vegetable. If a farmer received price information prior to sell of his vegetable it is assigned 1 if not 0. Price information is one of the factor to decide how much to produce and how much to sell. If there is a right price producers usually willing to sell more if not they reduce marketable supplies. Hence, if producer have this information his income will be increased. Therefore, its expected sign is positive.

Distance from main road: This is another continuous variable included in the model measured in kilometer. The more the distance from the major road producers discourage to produce more since it require transport and other facilities to supply to the market. This

also discourages to produce more in relation to cost of transport hence income from vegetable production reduced. Hence, the expected sign of this variable is negative.

Distance from major market: This is also another continuous variable included in the model measured in kilometer. As the producer far from major market the producer have less information about market price and related to transportation cost and losses due to in appropriate transport method for his product. Hence, producer discourage to supply more to the market or there is higher chance to receive whatever the price in the market and income from his production will be reduced either by selling with wrong price or by limiting his supply to the market. Thus, the expected sign is negative.

Demand forecast: This is a dummy variable used in the model. If a producer has information prior to the future market he has a better option to produce marketable vegetables with higher demand. This is important also to reduce post harvest losses in relation to the losses due to market demand. Hence, this led to increase his income by reducing post harvest loss and receiving right price. It is coded 1 if the producer has this information if not 0. The expected sign is positive.

Vegetables post harvest loss: This is a continuous variable used in the model and measured the amount of post harvest losses in quintal. The amount of losses in vegetables production during harvest, post harvest and process of marketing are higher than other agricultural products. Depending on the measures taken by the producer these losses affect income of the producer. If a producer has a good experience in handling post harvest losses the loss can be minimized. Hence, the post harvest loss affects income of the household especially income from vegetables either positively or negatively. Hence, the expected sign for this variable is not determine a prior.

CHAPTER - FOUR

4. Result and Discussions

This chapter presents the results and discussion of descriptive and econometric analysis of the study. Descriptive analysis is employed to describe the socio-demographic characteristics of sampled farm households, irrigation cooperatives characteristics, income from production of vegetables, post harvest handling, marketing method and the supply chain characteristics of vegetable product in the study area. Multiple regression analysis is employed to identify determinants of income from onion, potato and tomato in their supply chain.

4.1. Farm characteristics

In this part of the study, socio demographic characteristics of farmers, production, supply chain and marketing of vegetable, income of irrigation cooperative members, constraints of income from vegetable, availability of credit, information and technical assistance, resource ownership, etc. are discussed.

4.1.1. Demographic characteristic of the household

The demographic characteristics of sampled households of irrigation cooperatives members engaged in the production of vegetables are distinct in terms of sex, marital status, education level, age, and family size of the household head.

4.1.1.1. Gender of the household head

The gender of the household head is one of the variables considered in the model. This variable is used to see the relationship with the household income from vegetable (Onion, potato, tomato).

As described in Table 4.1 below, in the study area, only a few percentages of female headed households are found as a member of cooperatives (13.4%). This indicates that the majority of the households in agricultural sector headed by males in the study area. This further implies that few female households have limited access to land and other resources to increase their income from agricultural production.

The chi – square test conducted for the gender of the household head is significant at less than 1 percent. This implies that the participation of male and female households in the irrigation cooperatives is significantly different. This also further strengthens the idea that the inclusion of female headed households as a member is low in the study area. This indicates that female headed households have so many constraints to participate in the most important economic activities like irrigation cooperatives. This can affect the female headed household's economic performance and further impacts the household's economic situation.

Therefore, the gender status of the household in this thesis is presumed to have impact on income from vegetable. To see the gender of the household impact particularly on income derived from vegetable the income of the households between the two groups assessed. The average income received from vegetable particularly from onion, potato and tomato is 6719.8 birr in the production year 2008/09 in the study area. The average income received by the male and female headed households is 6713.8 and 6758.7 respectively.

The t – test conducted between the male headed and female headed households income derived from vegetables is not significant. This indicates that there is no significant difference on income received between the two groups of the household head. This is due to though the participation of female households are low as a member of irrigation cooperative, as a result of the expected benefit of the cooperative there is no significant difference between the two group of household heads income received from vegetable.

Table 4.1: Gender of household head (%, average, t and χ2 - Value)

Variable	Household head	N = 40		N = 80		N = 120		t- value /χ^2
Woreda		Alaje		Ofla		Total		
		No	%	No	%	No	%	
Sex	Male	35	29.2	69	57.5	104	86.7	64.53***
	Female	5	4.2	11	9.2	16	13.4	
Male (Average income)		-	-	-	-	-	6713.8 (462)	0.061
Female(Average income)		-	-	-	-	-	6758.7 (500)	

N = Sample size, ***, significant at less than 1% significant level, Figure in parenthesis indicate standard deviation

Source: Own field survey (2010)

4.1.1.2. Age of the household

Age of the family is presumed as the determinant factor of income of the household. According to Ali (1995) and Bravo-et al (1994), (as cited in Juliana, 2007), Age is one of the factors that affect the efficiency of carrying out farm activities. Age is also associated with farmer experience in farming practices as farmers gain experience over time the farm management and planning of farm production facilitated.

As presented in table 4.2, in this survey, the average age of the household head is 40.03. The youngest head was 25 years old, while the eldest is 64 years of age. The computed results also demonstrate that the average age of the household head from Alaje Woreda is 41.3 years. In the Woreda the youngest head is 25 years old which is also the youngest of the study area, while the eldest was 62 years of age. In Ofla Woreda the mean age of the head is 39.32 years. In the Woreda the youngest head is 25 years old, while the eldest is 64 years of age which is also the eldest of the study area.

The chi – square test conducted for the age of the household heads is highly significant at less than 1 percent. This refers that there is significant differences in the age of the households in the study area. This indicates that in terms of experience to increase their income from production of vegetable the households have significant differences in the study area.

When we see the age category of the household heads in the study area, 49.2 percent of the household heads are categorized under the age group of between 30 to 39 years. Similarly next to this group 34.2 percent of the households categorized under the age category of 40 to 49. The percentage of the households categorized under the age category of younger than 30 and older than 60 is 3.3 and 3.4 percent respectively. Relatively a few percentage of the households included in the age group of younger than 30 and older than 60.

The chi- square test conducted on the category of the households in the study area also significant at less than 1 percent significant level. This indicates that the households included in the irrigation cooperatives varies from younger to older group of the households. Therefore, this implies that the inclusion of members in the irrigation cooperatives has no limit with regard to age of the member. Hence, in order to achieve the objective of food security the inclusion of members in the irrigation cooperative has no limit with the member's age status. However, as indicated in the table below relatively the highest number of younger households (49.2%) are included as member of irrigation cooperative. Therefore, though age is one of the determinant factors in terms of experience to increase income of the households in so many ways, inclusion of younger group of members can benefit to increase productivity and further benefit the households since younger group are active and energetic in the process of agricultural activities.

Hence, the age of the household in this paper is presumed to have impact on income from vegetable. To see the impact of age on income of the household from vegetable, independent sample t - test is conducted on the household's income between less than the mean age group (less than 40 years) and above the mean age (above 40 years). Though, age is a significant variable to affect income of the households, the computed t – test shows that there is no significant difference between the household's income relatively considered younger (below the mean age) group of the households and the older one (above the mean age). Therefore, from this it can be conclude that age does not have any impact in the household income in the study area.

Table 4.2: Age characteristics of household (%/average and t and χ2 - value)

Variables	Household head	N = 40		N = 80		N = 120		t – value/ χ^2
Woreda		**Alaje**	**Average**	**Ofla**	**Average**	**Total**	**Average**	
Age of HH		Min. 25 Max. 62	41.3 (9.212)	Min. 29 Max. 57	39.32 (6.889)	Min. 25 Max. 64	40.03 (7.766)	103.467***
< the mean age		-	17.5%	-	45%	62.5	6832.6 (667)	0.582
> the mean age		-	15.8%	-	21.7%	37.5	6531.7 (778)	
Age group of HH	Younger than 30	3.3		.8		4.2		105***
	30 - 39	12.5		36.7		49.2		
	40 - 49	10.8		23.3		34.2		
	50 - 59	5		4.2		9.2		
	60 and older	1.7		1.7		3.4		

N = Sample size, ***, significant at less than 1% significant level, Figures in parenthesis indicate standard deviation

Source: Own field survey (2010)

4.1.1.3. Marital status of the household head

This variable is considered to see the household heads demography in relation to his marital status. According to Table 4.3 below, the majority of the household heads are (80.8%) married. The other households are either widowed or divorced or single.

The chi – square - test conducted in relation to the marital status of the household head is significant at less than 1 percent significant level. This refers as there are significant differences in the household's marital status situation in the study area. This indicates that though the majority of the households are married other groups like singles and widowed are also included as a member of irrigation cooperative. Therefore, from the descriptive statistics result the majority of the members of the irrigation cooperatives in the study area are married family households. This implies that the number of household who are widowed, single and divorced inclusion in the member of irrigation cooperative is low, or this further implies that the social crises especially result from divorce, and widowers are not be observed since the inclusion of this group in the irrigation cooperatives are low. To assert the impact of marital status on income particularly from vegetable the t – test is conducted between married and other than married group of the households based on the average income received by the two groups. The average income of the married households is 6815.8 birr and the average income of other than married group is 6314.7

birr. The conducted t – test result shows that there is no significant difference among the income of the two groups. Therefore, though the inclusion of divorced, widowed and single households is low, marital status of the households has no relationship with income of the households in the member of irrigation cooperatives in the study area.

Table 4.3: Marital status of household head (%, t- value and χ^2 – value)

Variables	**Household head**	**N = 40**		**N = 80**		**N = 120**		**t – value/ χ^2**
Woreda		**Alaje**		**Ofla**		**Total**		
		No	%	No	%	No	%	
Marital status	Married	32	26.7	65	54.2	97	80.8	45***
	Other than married	8	6.7	15	12.5	23	19.17	
Married average income							6815.8 (763)	.789
Other than married average income							6314.7 (826)	

N = Sample size, ***, significant at less than 1% significance level, Figure in parenthesis indicate standard deviation
Source: Own field survey (2010)

4.1.1.4. Educational level of the household head

The educational level of the household head is also another important factors considered to affect household income. Education related to the acceptance of new modern technologies in the process of farm production and to analyze the cost benefit nature of the activities in the farm. It also helps in the way farmers choose their marketing strategies and farm planning. Therefore, the better the education level of the household head the better chance to increase his farm production income remaining other things constant.

As presented in Table 4.4, in the study area the highest proportion of the household head are illiterate which accounts to 40.8%. Out of this 13(10.8%) and 36(30%) are found in Alaje and Ofala Woreda respectively. The households, who are able to write and read, are 22.5 percent and 34 percent of the households attended their primary education. Only a few percentage of the households have attended their secondary education and above. Of the total 0.8 and 1.7 percent of the households are attended their secondary and above secondary education respectively. From this it can be understood that higher proportion

of the households in agricultural sector is dominated by illiterate households in the study area.

The chi- square - test conducted for the education level of the household in the study area is significant at 1 percent significant level. This indicates that, though the highest proportion of the households is illiterate in terms of education there is significant difference between the household's education statuses in the study area.

In order to see the impact of education on income of the households the t – test is conducted between the illiterate households and other than illiterate group of the households considering the average income of the two groups. The average income of the households in the illiterate group is 6,525.3 birr and the other than illiterate group is 6,854 birr. The computed t – test is not significant. This indicates that, though education is the decisive factor, contrary to the assumption there is no significant difference on their income between the household groups illiterate and the others. This further implies that the educational status of the household's impact on production activity and marketing of vegetable is low in the study area. Hence, it can be say that education seems to have no impact on the household's income from vegetable production.

Table 4.4: Educational level of household head (% and t - value)

Variables	**Household head**	**N = 40**		**N = 80**		**N = 120**		**t-value**
Woreda		**Alaje**		**Ofla**		**Total**		
		No	%	No	%	No	%	
Education level	Illiterate	13	10.8	36	30	49	40.8	1.607
	Read and write	9	7.5	18	15	27	22.5	
	Primary school	16	13.3	25	20.8	41	34.2	
	Secondary school	1	0.8	0	0	1	0.08	
	Above Secondary school	1	0.8	1	0.8	2	0.017	
Average income Illiterate		-	-	-	-	-	6525.3 (61)	.646
Average income other than illiterates		-	-	-	-	-	6854 (845)	

N = Sample size, Figure in parenthesis indicates standard deviation
Source: Own field survey (2010)

4.1.1.5. Family size and dependency ratio

Family size of the household head is one of the variables considered to see the relationship with the income derived from vegetable (Onion, potato, tomato). According to Edriss and Simtowe (as cited in Julian 2007), the average household size has a bearing on availability of labor, especially considering that most smallholder farmers depend on family labor. The more the number of people in a household, the more the family labor supply is, all other things held constant. This implicitly affects the amount of hired labor that a farmer uses on his farm to undertake farming activities. However, this is true when we are considering the households family members regardless of their age. In order to see the real impact of family size in relation to its contribution to the household labor participation in farm activities the number of dependents in the household should be considered. Hence, family size should be converted in to man equivalent family size. Therefore, it is better to consider the man equivalent family size of the house hold to see the real impact of family size in relation to income considering the number of dependents in the household. The conversion factor for family size to man equivalent attached on appendix 2.

As presented in Table 4.5 below, the average family size is 5.41 with a minimum of 1 and maximum of 8 with standard deviation of 1.40. In Alaje Woreda the irrigation cooperative members' household head average family size is 5.22 with a minimum of 1 and a maximum of 8 per household. In Ofla the average irrigation cooperative members' household head family size is 5.50 with a minimum of 3 and a maximum of 8. The chi – squared test conducted for the family size of the households is significant. This shows that as there is significant different in the family size of the households. Thus, depending on the participation of the family member in farm activity the income of the household could vary.

In order to see the impact of family size on household income, the t – test is conducted dividing the households in to two groups based on the average family size. This further assumes the households average income received by the two groups. The average income

received by the households below the average and above the average family size is 7218.6 and 6223.8 birr respectively. The t – test conducted between these two groups income derived from vegetable is significant at less than 5 percent. This implies that the income received by the households below the average and above the average family size group is significantly different. From the descriptive statistics result the average income of the households below the average family size is higher than the average income received by the above average family size. These indicate that as the number of the family size increases the household's income received from vegetable reduced. This is due to higher dependents in higher family size households.

Further to see the characteristics of family size of the household's family size, as indicated in Table 4.5 below, the average man equivalent family size of the households in the study area is 3 with a minimum of 1.0 and a maximum of 5.6.

The chi –square test conducted for man equivalent is significant at less than 1 percent. This implies as there is a significant difference in the number of available labor for farm activity in the households. Therefore, this further implies that among households the available labor to participate in production of vegetable significantly different in the study area. This also indicates that those households with higher number of man equivalent family size tend to increase their vegetable income if the family labor is involved in the production of vegetable, since the problem related to the availability of labor for farm production is low in higher man equivalent group.

Table 4.5: Family size and man equivalent (%, average and t and χ^2 – value)

Variables		**N = 40**		**N = 80**		**N = 120**		**t-value/ χ^2**
Woreda		**Alaje**		**Ofla**		**Total**		
Average family size		5.22 (1.73)	Min. - 1 Max. - 8	5.5 (1.21)	Min. - 3 Max. - 8	5.41 (1.40)	Min. - 1 Max. - 8	66.317***
< average family size average income						7216.8 (333)		2.012**
> average family size average income						6223.8 (333)		
Average man equivalent		2.84 (.80)	Min. - 1 Max. – 4.2	3.18 (.68)	Min. - 2 Max. – 5.6	3.0 (.74)	Min. – 1.0 Max. – 5.6	91.217***
Man equivalent group	1.0 - 2.0	5.8%		2.5%		8.3%		
	2.0 - 4.0	25.0%		59.2%		84.2%		
	4.1 – 6.0	2.5%		5%		7.5%		
	> 6.0	0%		0%		0%		
Total		33.3		66.7		100		

N = Sample size, *** and **, 1% and 5% significance level, respectively, Figures in parenthesis indicate standard deviation

Source: Own field survey (2010)

4.1.2. Farm characteristics

4.1.2.1. Land holding

Access to land is an important issue for the majority of Ethiopian people who, one way or the other, depend on agricultural production for their income and subsistence. Land tenure issues therefore continue to be of central political and economic importance, as they have been at several junctures in Ethiopia's history (Samuel G. 2006). Land tenure system is the law or custom that relates to control and use of land by an individual or group of people. The tenure system greatly influences the organization and efficiency of agricultural production and the efficient allocation of production resources (Ahmed et al., 2002). According to CSA (2003), farm holdings is referred to all land or livestock holdings which are mainly used for both crop and livestock production. Depending on the type of activities, and agricultural holders engaged with farm holding has been categorized into three groups. These are crop only, livestock only and both crop and livestock.

According to the focused group discussion land inheritance from parents and rented land was a common practice in the study area. As presented in Table 4.6 below, the majority of the households (96%) owned their own land. This is due to the fact that land ownership was one of the criteria to be a member of irrigation cooperative. This indicates that the vulnerable groups (those without land) were not included in the irrigation cooperative society.

The average land holding size of the households is 0.47 hectare with the minimum of the households held no land and the maximum of 1 hectare of land. The average land size of the household in the study area is close to the average land holding size per household studied by CSA in 2001 and 2005 in the study area (0.5 hectare). The average land size allocated for vegetable is 0.252 hectare per households. The average land size allocated for vegetable from the total land held by the households is on average half of the land owned by the households allocated for vegetable. This indicates that how farmers are risk averter and diversifying crop production in their land allocation decision strategies.

The chi - square – test conducted for ownership of land and land holding size in the crop year 2008/09 shows that highly significant at 1% significant level. This implies that as there is a significant difference in terms of land ownership and land holding size among the households. This further implies that based on the ownership of land and size of land the households income received from vegetable could significantly different. To assert or to disprove this empirically the analysis result discussed in the last paragraph of this analysis.

The chi - square – test conducted for the allocation of land for vegetable also highly significant at 1 percent significant level. This indicates that the household's allocated land for production of vegetable in the crop year of 2008/09 is significantly different. This further can be explained by the strategies followed by the households in allocation of land for vegetables are significantly different in the study area. Therefore, based on the strategy followed by the households the income received from vegetable will be varied.

However, land size owned by the households is considered as a base for the allocation of land for vegetable. Therefore, in this study the relationship between size of land the household owned and income from vegetable analyzed based on the average land size. Hence, households categorized in to two groups. These are households owned below the average land size and households owned above the average land size.

Accordingly, the average income of the households owned below the average land size and above the average land size is 7749.8 and 5905 birr respectively. The t – test conducted between the two groups of the households is significant at 1 percent significant level. This indicates that the income received from vegetable production between the households group significantly different. As per the descriptive statistics result, contrary to the assumption, the average income of the households who owned land size below the average land size is higher than the households who owned above the average land size. This is due to the variation in the household's allocation of land for vegetable and other agricultural crops. This further implies that the size of land is only significant in the income of the households from vegetable only if the households allocate more land for the proportion land owned by the household other things remain constant. Hence, it is possible to conclude that large amount of land size owned by the household has no correlation with the households' income from vegetable in the study area remaining other things constant.

Table 4.6: Land holding and allocated land for vegetable (%, average and t and χ^2 – value)

Variables	Household head	N = 40		N = 80		N = 120		t- value/χ2
Woreda		**Alaje**		**Ofla**		**Total**		
		No	%	No	%	No	%	
Land owned	Yes	35	29%	80	67%	115	96%	90.133***
	No	5	4%	0	0	5	4%	
Total		40	33%	25	67%	120	100%	
Average land holding		-	0.18 (0.154)	-	0.61 (0.27)	-	0.47 (0.313)	112.13***
Land allocated for vegetable		-	0.26 (0.213)	-	0.248 (0.013)	-	0.25 (0.123)	323.6***
Average income below average land size		36	30%	17	14.2%	53 44.2%	7749.8 (113)	3.881***
Average income above average land size		4	3.3%	63	52.5%	67 55.8%	5905 (746)	

N = Sample size, ***, significant at less than 1% significance level, Figures in parenthesis indicate standard deviation

Source: Own field survey (2010)

4.1.2.2. Ownership of livestock

The population of livestock plays a major role in the economic benefit of the household. Farm animals serve several purposes in rural economy. They are sources of cash income, animal power and animal dung (as an organic fertilizer and fuel). In addition, farm animals serve as a measure of wealth and prestige in rural areas.

As presented in Table 4.7 below, the livestock species found in the study area are cattle, sheep, donkey, poultry, and including bee colony. Livestock was kept both for the purpose of generating income and traction power in the study area. To assess the status of the livestock holding of each household in the study area and so as to facilitate comparison among the households based on Storck et al. (1991), the livestock population number is converted into tropical livestock unit (TLU/250kg). The conversion factor for the TLU attached on appendix - 1. In terms of TLU, the total livestock owned by the households in the study area is 702.95 and the average livestock ownership is 5.85 TLU per household head.

In Alaje Woreda the total livestock population the households owned is 173.7 TLU and the average household livestock ownership is 4.399 TLU per household head. In Ofla Woreda the total livestock population the households owned was 529.26 TLU with an average of 6.617 per household head. In terms of bee colony a total of 8 bee colony owned by the household heads in Ofla Woreda only.

Table 4.7: Livestock ownership of household (%, average, and t - value)

Variables	**Livestock**	**N = 40**		**N = 80**		**N = 120**		**t-value**
Woreda		**Alaje**		**Ofla**		**Total**		
		TLU	Average	TLU	Average	TLU	Average	
	Cow	65	1.62 (0.103)	205	2.56 (1.077)	270	2.25 (1.147)	4.559***
	Oxen	56	1.4 (0.788)	179	2.24 (0.945)	235	2.5 (1.96)	4.843***
	Sheep	29.9	0.7475 (0.594)	58.24	0.728 (0.894)	88.14	0.734 (0.804)	0.125
	Donkey	20.3	0.51 (0.672)	74.9	0.938 (0.847)	95.2	0.8 (0.791)	2.788***
	Poultry	2.496	0.0624 (0.052)	12.116	0.151 (0.1245)	14.61	0.122 (0.114)	4.332***
	Total TLU	173.7	4.399 (2.209)	529.26	6.617 (3.887)	702.95	5.85 (4.816)	
	Bee colony In No	0	0	8	0.1 (0.565)	8	0.07 (0.463)	1.117
Average income below average oxen		-	-	-	-	-	6637.3 (958)	0.659
Average income above average oxen		-	-	-	-	-	7049.5 (833)	

N = Sample size, ***, significance at less than 1%, Figures in parenthesis indicate standard deviation

Source: Own field survey (2010)

From the table above in Ofla Woreda households have more number of oxen and cows than those in Alaje Woreda. This further implies that households in Ofla Woreda tend to have more in production of these two livestock categories than the other Woreda.

The t – test conducted for bee colony shows that there is no significant difference in terms of number of bee colony owned by households although most of the households did not focus for this sector in the study area. This implies that the production of honey in the

study area is not practiced due to different reasons related to the sector. Hence, it can be conclude that bee colony contributes low to the household total income in the study area.

The t – test conducted for livestock ownership in the categories of livestock is highly significant for cows, oxen, donkeys and poultry population at less than 1 percent significant level. This refers that there is significant difference in terms of ownership for these livestock categories in the two Woredas. Therefore, since the number of oxen highly related in the production of agricultural products as an input, this farther implies that the availability of oxen as an input for the production of vegetables significantly different in the study area. Hence, the impact results from the availability of oxen in the production activity of vegetables significantly different among households. Further to see the relationship between the numbers of oxen owned by the household and income from vegetable the households categorized in to two groups based on the average number of oxen acquired by the households. The average income received from vegetable by the households below the average and above the average number of oxen are 6637.3 and 7049.5 birr respectively. The t – test conducted between the two groups are not significant. This indicates that as there is no significant difference between the households who owned below the average and above the average number of oxen on income received from vegetable. This is due to, though the number of oxen important in the production of vegetable most of the households has the required number of oxen for production of vegetable. Hence, it can be conclude that, the highest number of oxen acquiring is not directly correlate with the income received from vegetable if the household has the minimum required number of oxen for the production of vegetable remaining other things constant.

4.2. Income source of the household

4.2.1. Income of the household

As presented in Table 4.8 below, the total income the households received in the crop year of 2008/09 generated from two major sources. These are from farm income and off farm income sources. The income received by the household's in the year ranges from a

minimum of 3,300 birr to a maximum of 20,890 birr. The average income received for the same year is 10,672.15 birr with standard deviation of 3,436.05 birr. In Alaje Woreda the average income the household head received ranges from a minimum of 4,900 to a maximum of 18,070 birr. In this Woreda the average income of the household received in the year 2008/09 is 10,150 birr with standard deviation of 3,040.83. In Ofla Woreda the minimum income is 3,300 birr with a maximum of 20,890. The average income in this Woreda is 10932.94 birr with the standard devotion of 3607.35.

The chi - square – test computed for the household's income shows that, there is no significant difference among the households. This further implies that the economic situation of the households in the study area is similar. However, to conclude based on the average income one of the limitation of average affected the general conclusion. Hence, to see the general economic situation of the household's and to facilitate comparison, categorizing the household income based on the average income in to different groups can draw a better conclusion to assess the economic status of the households.

Table 4.8: Income of the household (%, average, t – value and χ^2 – value)

Variables		**N = 40**	**N = 80**	**N = 120**	**t- value/χ^2**
Woreda		**Alaje**	**Ofla**	**Total**	
Average income		10150.6 (3040.83)	10932.93 (3607.35)	10672.15 (3436.05)	7.65
Minimum income		4900	3300	3300	
Maximum income		18070	20890	20890	
Very Low	< 3685	0%	1.7%	1.7%	0.492
Low	3686 - 7370	5.8%	10%	15.8%	
Average	7371 - 12480	16.7%	38.3%	55%	
High	12481 - 17590	10%	10.3%	23.3%	
Very High	> 17591	0.8%	3.3%	4.2%	
Total		33.3	66.7	100	

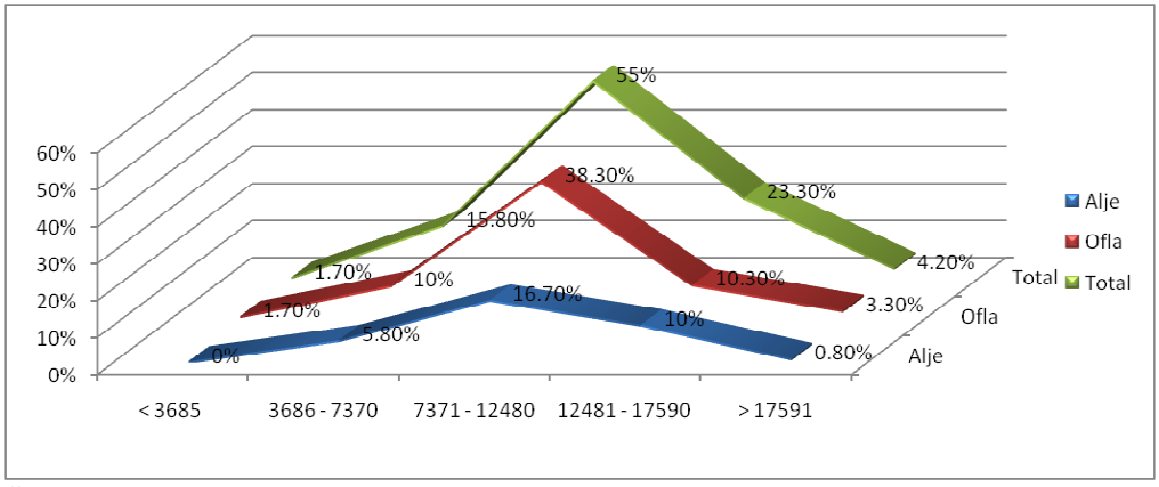
N = Sample size, Figures in parenthesis indicate standard deviation
Source: Own field survey (2010)

Therefore, in order to see the general economic status of the sampled households and to facilitate comparison among the household's, the income of the households categorized in to very low, low, average, high and very high categories based on the average income

received in crop year 2008/09. The majority of the households (55%) received between 7,371 and 12,480 birr. This shows that the majority of the households received average income in the study area. The households received income below 3,685 is 1.7 percent. This indicates that small percentage of the households categorized under very low income category in the study area. The household's income received from birr 12,481 to 17,590 which is higher income category is 23.3 percent. Under the income category of above 17,591 birr, which is classified as highest income category only a few percentages of households, that is only 4.2% of the household head found in this group. Out of the lowest income category of the household, all of them are found in Ofla Woreda. The majority of the highest income group is found also in Ofla Woreda.

In order to see the income distribution of the households, the conducted t – test for the category of income shows no significant difference. This refers that there is no variation in the number of households which belong to the categories from low to very high income categories in the study area. This further implies that the income distribution found in the study area has no significant difference. Hence, from this it can be conclude that there is fair income distribution between the sampled households in the study. In figure 4.1 the income distribution of the sampled households presented.

Figure 4.1: Income category of households



Source: Own field survey (2010)

4.2.2. Income by gender group

In this paper, one of the assumption is gender of the household head affects the income of the household particularly income from vegetable (Onion, potato, tomato). As discussed in earlier section the majority of the household heads in the irrigation cooperative are male headed households.

In Table 4.9 below, the total income of the household received in the year 2008/09 computed by gender group. According to the sampled households from the study area, the minimum income of the female headed households is 3,300 birr with a maximum of 17,830 birr per annum. The average income of the female headed households is 10,937 birr per annum; this is close to the average income received by the households in the study area. The average female headed households income in Alaje Woreda is 12,099 birr with 10,875 and 12,875 minimum and maximum respectively with standard deviation of 885.87 birr per annum. The average female headed households income in Ofla Woreda is 10,410 birr with 3,300 and 17,830 minimum and maximum respectively with standard deviation of 4346.87 birr per annum.

The male household's average income in Alaje Woreda is 9,872.25 birr with a minimum income of 4,900 and maximum of 18,070 birr with standard deviation of 3142.63 per annum. The average income of male headed households in Ofla Woreda is 11,016.30 birr with a minimum of 4,540 birr and a maximum of 20,890 birr with standard deviation of 3419.48 per annum. When we compare the average income received by the household heads in both Woredas the female household's average income in the year 2008/09 greater than the average income received by male headed households.

The t - test conducted for the income received by male households and female households shows that no significant difference between female headed households and male headed households in the study area. The implication of this can be explained; though the inclusion of females in the irrigation society is low, cooperatives are one of the mechanisms in which helps to reduce the income gap usually appears in most developing

countries between women and male group. Therefore, in order to reduce the gap between the two groups the inclusion of more female in the irrigation cooperatives or other economic institutions can benefit the female households and overall can reduce the economic problems of the society in general.

Table 4.9: Income by gender group (average, t - value)

Variables	Gender	N = 40			N = 80			N = 120			t-value
Woreda		Alaje			Ofla			Total			
		Min.	Max.	Average	Min.	Max.	Average	Min.	Max.	Average	
Income	Male	4900	18070	9872.25 (3142.63)	4540	20890	11016.30 (3510.87)	4540	20890	10631.28 (3419.49)	.331
	Female	10875	12875	12099 (885.79)	3300	17830	10410.81 (4316.87)	3300	17830	10937.81 (3645.07)	

N = Sample size, Figures in parenthesis indicate standard deviation
Source: Own field survey (2010)

4.2.3. Source of household income

According to the information provided by the sampled households and summarized in Table 4.10 below, in the crop year 2008/2009 the majority of the households in the study area (about 72.5 percent) having a family income of less than 12,480 Birr per year. To assess how much the farm income and vegetable production in particular contributes to the farm income, the farmers are asked to attribute their income in to five categories: income from crops, income from livestock, income from vegetable, income from bee colony and off-farm income. The descriptive result shows that on average vegetable income contributed the largest share of family income with 62.97 percent or around 6,719.83 birr per year, while livestock income ranked second with 14.9 percent of the total family income or an average income of 1589.61 birr per year. Crop income played a third role in household income with the percentage of 11.88 or 1267.45 birr per year. Off farm income ranked the forth income source of the household, on average it contributes 10.26 percent of the total income or 1095.25 birr per year. Other income source, bee colony played a minor role, it contributes with only 0.0914 percent on average or 6.66 birr per year to the households total income. From this it can be conclude that vegetable income is the important source of income to the households in the study area.

When considering the type of off-farm activities, work as a casual laborer in off farm sector is the most important off-farm activity for family members in the study area.

The chi- square – test conducted for each category of income source shows that, income from crop, livestock, bee - colony and off farm income are highly significant at 1 percent significant level. These dignify that as there is income differences among the households from crop, livestock, bee - colony and off farm income sources. This implies that the households participate in to different economic activities to increase their income. However, based on the opportunity available in the area and the type of activities the households involved, the income of the households significantly varies from each source. This further, implies that there is no specialization in this group of source of income. Hence, it can be conclude that unless the households specialized in one type of activity in the area the income from different sources can be varied.

The chi – square - test conducted for vegetable is not significant. This implies that the households received income from vegetable is not significantly different in the study area. This implies that the role of this income sources to the household income is not different in the study area. This further indicates that as there is a specialization of vegetable production. However, as described above vegetable income is the major source of income to the households compared to other agricultural and non agricultural income sources and contrary to income received from bee colony.

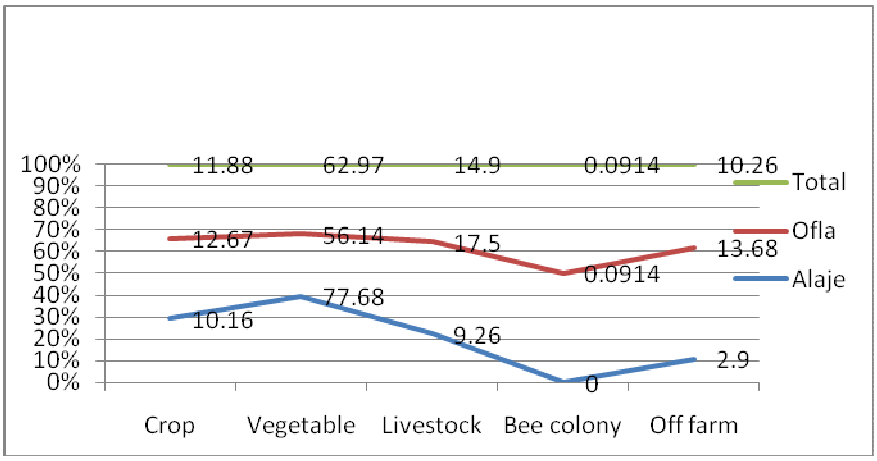
Table 4.10: Income source of the household head (%, average, χ2 - value)

Variables	**Source of income**	**N = 40**		**N = 80**		**N = 120**		**χ^2- Value**
Woreda		**Alaje**		**Ofla**		**Total**		
		Average	%	Average	%	Average	%	
	Crop	1031.25 (1597.46)	10.16%	1385.55 (795.46)	12.67%	1267.45 (1133.37)	11.88%	430***
	Vegetable	7884.75 (2643.2)	77.68%	6137.37 (2604.17)	56.14%	6719.83 (2734.24)	62.97%	31
	Livestock	940.22 (1019.45)	9.26%	1914.31 (1600.49)	17.5%	1589.61 (1501.26)	14.9%	218***
	Bee colony	0	0	10 (89.44)	0.0914%	6.66 (73.02)	0.0914%	89***
	Off farm	294.37 (667.64)	2.9%	1495.70 (1526.95)	13.68%	1095.25 (1420.34)	10.26%	148***

N = Sample size, *** significant at less than 1%, Figures in parenthesis indicate standard deviation

Source: Own field survey (2010)

Figure 4.2: Source of household income



Source: Own field survey (2010)

4.2.4. Irrigation cooperatives and income

Agricultural cooperatives are one of the institutions established by farmers to tackle the problems in relation to production, inputs and output marketing. However, for the success of their objective active participation of members, the management of the institution and institutional support play a major role. Therefore, in order to see particularly the institution impact on income the situation of members and the institution is vital. In the study area there are 18 irrigation cooperatives engaged in the production of vegetable products. In this section the importance of the irrigation cooperative in relation to marketing of vegetable, its importance to increase income from vegetable, and income change after membership are discussed.

To assess the situation of the cooperatives, households are asked about different issues with regard to their institution. These include causes to join irrigation cooperative, whether they joined voluntarily or not, years of membership, how their institution was important for vegetable marketing, what proportion of their vegetable produce is sold through irrigation cooperatives, management of the cooperative and the change in income particularly from onion, potato and tomato since membership. These issues are discussed in the following section.

4.2.4.1. Causes to join membership

In small scale agriculture farmers have so many constraints to increase surplus production and to sell their surplus production at reasonable price. This usually forces to take group action in order to solve their problems. Either they form a formal organization or act as a group informally. According to FAO corporate document (1997) the motives to form a cooperative has three particular aspects. These are the need for protection against exploitation by economic forces too strong for the individual to with stand alone, the impulse for self-improvement by making the best use of often scarce resources and the concern to secure the best possible return from whatever form of economic activity within which the individual engages as a producer, intermediary or consumer.

As per the focused group discussion from sampled households before they form cooperative they act as a group in the production of their produce in the area of harvesting and assembling. The first initiator to form their cooperative was government. The government suggested forming cooperative to solve their problem in relation to irrigation water management, marketing of outputs, availability of inputs and other constraints.

Some of ten major problems caused to join as a member of irrigation cooperative are illustrated in Table 4.11. As indicated in the Table 4.11 below, lack of storage, irrigation water management and input supply were highly identified causes to join irrigation cooperative. All of the households in the study area identified that these were the major problems to join the irrigation cooperative. Market problem (95%), lack of skill in marketing (75%), lack of capital (96.7%), quality maintenance (93.3%), price control (91.2%), transport of vegetable (74.2%) and Size of land (76.7) were indicated as the major reasons to join irrigation cooperatives. These indicate that farmers in the study area were lacking basic support in terms of market facilities, like storage and transport, training in marketing of their produce and improvement of their income by developing quality and quantity of their production before membership.

The chi- square- test conducted for the cases of membership, like for market problem, lack of skill in marketing, lack of capital, quality maintenance, transport and price control were highly significant at one percent significant level in the study area. This implies that the problem level of these variables were significantly different in the study area. This implies that, households to increase their income from production of vegetable, the degree of the problem varied from one household to another. This further indicates that as there was no formal or informal institutions which can help to solve the problems related to production of vegetable.

Table 4.11: Cause to join irrigation cooperative (%, and χ2 -value)

Causes	**N = 40**		**N = 80**		**N = 120**		**χ^2 -value**
Woreda	**Alaje**		**Ofla**		**Total**		
	Yes	No	Yes	No	Yes	No	
Input supply	45	0	55	0	100	0	0
Market problem	24.3	5	60.7	0	95	5	97***
Irrigation water management	33.3	0	66.7	0	100	0	0
Lack of skill in marketing	9.2	24.2	65.8	.8	75	25	30***
Lack of capital	30	3.3	66	0	96.7	3.3	104***
Lack of storage	38.3	0	61	0	100	0	0
Quality maintenance	26.7	6.7	66.7	0	93.3	6.7	90***
Price control	35.2	8.3	56.5	0	91.2	8.3	122***
Transport of vegetable	24.2	9.2	50	16.2	74.2	25.8	28***
Size of land	29.2	4.2	47.5	19.2	76.7	23.3	34.13***

N = Sample size, ***, significant at less than1% significance level
Source: Own field survey (2010)

4.2.4.2. Management of the irrigation cooperative

As described in Table 4.12, the majority (87%) of the households joined the irrigation cooperative society voluntarily. In Alaje Woreda 27.5 percent and in Ofla Woreda 59.2 percent of the sampled household joined voluntarily. The t - test conducted with the matter, is not significant. This indicates that, equal proportion of the majority of the households join the irrigation society voluntarily in both Ofla and Alaje Woreda. This further explained by the problems existed in the production and marketing of vegetable believed by the households to take group action rather than acting as individual producer. With regard to the management of the cooperative 85 percent of the households rated their cooperative as regular and 0.08 percent and 14.2 percent rated very good and good

respectively. This implies that the management of the cooperatives in the study area was not satisfying the member's needs as per the expectation of the members. The t – test conducted for the management of the cooperative shows that as there was no significant difference. This further implies that the management of the cooperatives was not significantly difference in the two study areas. This indicates also, though cooperatives are an important institution for the production and marketing of vegetables the support provided to strengthen the cooperative particularly in the area of management of cooperative is low. Therefore, to further benefit the members through cooperative and to increase the income of the households, it needs to support the management through training and structural adjustment in the study area.

Table 4.12: Irrigation cooperative member's status and management (%, average, t – value and χ2 -value)

Variables		**N = 40**		**N = 80**		**N = 120**		**t- value/χ2**
Woreda		**Alaje**		**Ofla**		**Total**		
		Average	%	Average	%	Average	%	
Status	Voluntarily		27.5		59.2		86.7	.347
	Non - Voluntarily		5.8		7.5		13.3	
Years in irrigation cooperative		5.6 (1.661)	Min.- 2 Max. -8	4.2 (1.717)	Min.- 1 Max. -8	4.67 (1.81)	Min. - 1 Max.- 8	34.13***
Years of experience as vegetable producer		8.02 (3)	Min.- 2 Max. - 14	6.02 (1.961)	Min. - 2 Max. - 13	6.69 (2.533)	Min.- 2 Max.- 14	80.85***
Management		2.8 (.405)	-	2.9 (.341)	-	2.87 (.365)	-	1.42
	Good	-	6.7	-	7.5	-	14.2	
	Regular		26.7		58.3		85	
	Very good		0		.08		.08	

N = Sample size, ***, significant at less than 1% significance level, Figures in parenthesis indicate standard deviation
Source: Own field survey (2010)

4.2.4.3. Years in irrigation cooperative

As in the above Table 4.12 indicated, the average years of membership in the study area was 4.6 years with a minimum of 1 year and a maximum of 8 years of membership. In Alaje Woreda the average years of a household as a cooperative member are 5.6 with a minimum of 2 years and a maximum of 8 years as a cooperative member. In Ofla Woreda

4.2 years of membership are the average years of membership. The minimum and the maximum years of households as a member are one year and 8 years respectively.

The chi – square - test conducted for this variable is significant at 1 percent significant level. This implies that the years of members in the irrigation cooperatives vary from new recently joined to the members whom participate from the establishment of the cooperatives. This further implies that people from the study area understands the use of cooperative and attracted to join as a member of irrigation cooperative. This also indicates that, members can benefit through diversified experience of the members acquired either from formal trainings or the experience acquired through practice. In this sense, especially new member's households can benefit by sharing the best experience of the senior members of the cooperatives that could acquire through training or practice.

4.2.4.4. Years of experience as a vegetable producer

As indicated in the above Table 4.12, the sampled households are also asked about their experience as a vegetable producer. According to the sampled households the average years of experience as a vegetable producer is 6.69 years of experience with a minimum of 2 years of experience and a maximum of 14 years as a vegetable producer. In Alaje Woreda, the minimum is 2 years of experience and the maximum is 14 years with average years of 8 years experience as a vegetable producer. In Ofla Woreda, the average sampled household experience is 6.02 years as a vegetable producer. The minimum and the maximum are 2 years and 13 years respectively.

The chi – square - test conducted for the years of experience as a vegetable producer is highly significant at less than 1 percent in the study area. This implies that as there is highly significant difference among the households in terms of their experience as a vegetable producer. This also indicates that vegetable production was not a recent phenomenon in the study area. This further implies that the members of irrigation cooperatives experience varies from recently practicing irrigation as a way of production to those who develops their experience using irrigation scheme as a way of scheme for

the production of vegetable. Hence, based on the experience of the household this could have an impact on the income of the producer.

4.2.4.5. Importance of cooperative for vegetable marketing

The importance of the cooperatives benefit to members measured based on the level of services received by members. Cooperatives, based on the objectives of their establishment provide different services to members. In agricultural cooperatives, the provision of service include farm inputs, marketing of produce and credit facilities. In the study area the irrigation cooperative basically provides services of marketing of produce, input distribution and management of irrigation water. Out of marketing activities only selling function is provided by the irrigation cooperatives. In relation to this study, households are asked how important their cooperative is for marketing of vegetable products, the amount of vegetable particularly onion, potato and tomato supplied to the market through their cooperatives and the price offered by their cooperatives compared to other traders. According to the focused group discussion marketing of vegetable were not a common activity performed by the cooperatives although it was one of the initial objectives of the establishment of the institution in the study area. Out of marketing activities only selling function was performed by the cooperative. Other facilities like transport and storage were not provided by the irrigation cooperatives in the study area.

As presented in Table 4. 13 below, according to the sampled households, 46.7 percent of the households rated their organization as neither unimportant nor important for vegetable marketing, and 27.5 percent and 25.8 percent of the households rated important and unimportant respectively. From this it can be concluded that as their organization was not important for the marketing of vegetable. For instance when we see the total percentage of the households rated neither unimportant nor important (46.7%) and unimportant (25.8%) revealed that the cooperatives were not active in relation to marketing of vegetables in the crop year 2008/09. According to the focused group discussion, this was due to the lack of provision of storage facilities by the cooperatives. This implies that in order to make active participants of marketing, provision of appropriate storage facility especially for vegetables play a major role. The chi –square –

test conducted for this variable is significant at 1 percent significant level. This implies that the importance of the cooperatives in marketing of vegetable different from cooperative to cooperatives. This further implies that, in some of the cooperatives their role in marketing of vegetable is vital. Hence, to develop the roles of cooperatives in marketing of vegetables provision of storage including other facilities like transport plays vital role.

4.2.4.6. Vegetables sold through cooperatives

As per the information from the sampled households and summarized in Table 4.13, the majority of the households do not sell their vegetable produce through their cooperatives. Onion, potato and tomato were not sold through cooperatives by 62.5, 70.8, and 71.7 percent of the households in the crop year 2008/09 respectively. Among the households sold their vegetables through their cooperatives, the majority of the households are supplied to the market only a few proportion of vegetables. Of the amount of onions sold through cooperatives 0.8% of the households supplied ¼ of their onions through cooperatives. The percentage of households supplied onion 1/3 and ½ of sold onions are 10.8 and 11.7 percent respectively. Of the amount of potatoes sold through cooperatives 14.2% and 13.3% of the households supplied 1/3 and ½ of their potatoes through cooperatives respectively. Of the amount of tomatoes sold through cooperatives only 15% of the households supplied 1/3 of their tomatoes through cooperatives. From this as indicated above only few percent of the households sold through cooperatives. This implies that the cooperatives in the study area are not performing enough marketing activity for vegetables. Especially when we see the percentage of tomatoes supplied through cooperatives it is only a few percentage of the households supplied 1/3 of their produce. This further implies that, apart from the problems of the cooperatives in marketing, the perishable nature of the product highly influence to use producers through their own choice for marketing of vegetables. This also explained by, if cooperatives involved in marketing for perishable agricultural products, in order to benefit members the facilities required in marketing of perishable agricultural products are required.

The t – test conducted for the amount of onion and tomato is significant at less than 5 percent. This indicates that there is a significant difference in the amount of onion and tomatoes supplied to the market through cooperatives. This further indicates that the variability of the amount of vegetables supplied to the market through cooperatives. According to the focused group discussion this is due to different reasons like price in the market, storage facilities, product nature, the ability of the producer in marketing skill, the amount of produced vegetable by the members and the management of cooperatives in marketing. Hence, apart from production of perishable agricultural products, the marketing activities of perishable agricultural products are complex. Therefore, training in marketing scheme is one of the ways out to avoid the complex marketing nature of vegetables and to benefit the members.

4.4.2.7. Vegetable price offered by cooperative

As discussed above the importance of the cooperatives for vegetables marketing and the amount of vegetables supplied to the market is not significant in the study area. According to the respondents and indicated in Table 4.13, the price offered by the cooperatives also rated low by the majority of the households (54.2%) and 45.8 percent of the households rated average the price offered by the cooperatives when they compared to the price offered by other traders.

The t – test conducted for the rate of price offered by the cooperatives are highly significant at less than 1 percent in the study area. This indicates that there are significant differences with regard to the price offered by the cooperatives. According to the sampled households, this is due to based on searching better market price by the cooperative, the location of the cooperatives from major market of the producer and the product nature the price offered by the cooperatives varies in the study area.

Table 4.13: Importance of cooperative (average, percentage and t – value)

Variables		**N = 40**		**N = 80**		**N = 120**		**t-value**
Woreda		**Alaje**		**Ofla**		**Total**		
		Average	%	Average	%	Average	%	
Importance of cooperative for vegetable marketing	Unimportant		9.2		16.7		25.8	1.415
	Neither		10		36.7		46.7	
	Important		14.2		13.3		27.5	
Onion sold through cooperative		2.72 (.452)		2.32 (.471)		2.46 (.5)		1.983**
	Not sold		19.2		43.3		62.5	
	1/4		0		.8		.8	
	1/3		.8		10.8		11.6	
	1/2		8.3		11.7		20	
	3/4		5		0		5	
Potato sold through cooperative		1.4 (1.692)		.86 (1.23)		1.04 (1.417)		.475
	Not sold		22.2		46.7		70.8	
	1/3		1.7		12.5		14.2	
	1/2		5.8		7.5		13.3	
	3/4		1.7		0		1.7	
Tomato sold through cooperative		.82 (1.394)		.71 (1.127)		.75 (1.218)		2.546**
	Not sold	20.8			50.8		71.7	
	1/3	4.2			10.8		15	
	1/2	4.2			5.0		9.2	
	3/4	2.5			0		2.5	
	1	1.7			0		1.7	
Price offered by cooperative	Low		9.2		45		54.2	4.441***
	Average		4.2		21.7		45.8	

N = Sample size, ***, and ** significant at less than 1% and 5% significance level respectively, Figures in parenthesis indicate standard deviation

Source: Own field survey (2010)

4.4.2.8. Change in income and production after membership

a). Vegetable income change after membership

To see the changes on income derived from vegetable an attempt is made to refer the recorded data both from the cooperative and the households. Despite poor and lack of recording system both from cooperatives and the households the data are collected and organized based on the estimate of the sampled households. The base income households received before membership was based on the income the households figured out before

their membership. The base income considered after membership was the income households received in the production year 2008/09.

As per the sampled household's and indicated in Table 4.14, the average income the households received before membership from vegetables, particularly from onion, potato and tomato were 1786.79, 1073.6 and 1585.04 birr respectively. For the same vegetables the average income the households received for the crop year 2008/09 was 3960.20, 3620.62, and 3437.91 birr respectively. The average income changes after membership for these three products were 2173.42, 2547.04, and 2209.87 birr respectively. From these it can be inferred that there are changes in the income received from these three vegetables after membership.

The chi –square - test conducted for these three vegetables in the case of before membership is significant at less than 1 percent significant level. This indicates that there is a significant difference among households income received from three of the vegetables. This implies the contribution of three of the vegetables to the household income is significantly different before membership. Hence, before membership households participate in production of any of the three of the vegetables to increase their income. The chi – square – test conducted after membership also significant at less than 1 percent for onion and potato only. This indicates that the contribution of these vegetables to the income of the household significantly different in the study area. This further implies that there is no specialization of these vegetables in the study area. The chi – square – test conducted for income received from tomato is not significant. This indicates that the contribution of this vegetable to the household income is similar. From this it can be understood that households more tend to in the production of tomatoes than any of other vegetables in the study area.

However, the chi – square – test conducted for the income change after membership among households is not significant. This indicates that though there is significant difference in the household's income from vegetables the change in income of the households is not significantly different among households. This further implies that after

membership households encouraged more to participate in the production of vegetable than before.

Table 4.14: Change in income after membership (average and χ^2 – value)

Variables	**N = 40**			**N = 80**			**N = 120**			**χ^2- Value**
Woreda	**Alaje**			**Ofla**			**Total**			
	Before	After	Change	Before	After	change	Before	After	Change	
Onion	4040.37 (3634.4)	6678.40 (3877.7)	2836 (1838.4)	660 (968.5)	2502.12 (1023.5)	1842.12 (1127.3)	1786.79 (2740.9)	3960.20 (3148.2)	2173.42 (1474)	[b]326*** [a]84*** [c]89.3
Potato	1914.75 (2007.9)	5111.37 (2243.2)	3196.6 (1983.8)	653 (811.2)	2875.25 (1222.1)	2222.25 (1117.4)	1073.6 (1454.3)	3620.62 (1939.4)	2547.04 (1526.9)	[b]385*** [a]97*** [c]73.8
Tomato	3559 (3095.5)	6462.25 (3325.9)	2903.25 (2628)	598.06 (779.9)	2461.25 (1233.9)	1863.18 (1059.3)	1585.04 (2348.1)	3437.91 (2867.7)	2209.87 (1803)	[b]362*** [a]61 [c]78.3

N = Sample size, b = before, a = after, c = total change, ***, significant at less than 1%, significance level, Figures in parenthesis indicate standard deviation,
Source: Own field survey (2010)

b). Vegetable production change after membership

As per the sampled household's indicated in Table 4.15, the average production the household's produced before membership for vegetables particularly from onion, potato and tomato were 10.04, 7.2 and 9.6 quintal respectively. For the same vegetables the average production the households produced for the crop year 2008/09 was 6.97, 6.1, and 9.45 quintal respectively. The average changes before and after membership for these three products were -3.062, -1.1, and -0.146 quintal respectively. From the discussion under income change it is indicated that there are changes in the income of the households from vegetables after membership. However, the production change computed shows that there is reduction for three of the vegetables after membership. According to the sampled households, this was due to the reduction of productivity particularly from the households of Alaje Woreda due to diseases and climatic factors in the comparison crop year 2008/09. This indicates that how vegetables productions are highly affected by diseases and climatic factors. Therefore, from this it can be conclude that, some of the constraints on income of the household from the production of vegetables related to climatic factors and disease and pests.

Table 4.15: Production after membership (average in quintal)

Variables	N = 40			N = 80			N = 120		
Woreda	Alaje			Ofla			Total		
	Before	After	Change	Before	After	change	Before	After	Change
Onion	22.69 (20.41)	9.426 (3.943)	-13.27 (19.05)	3.707 (5.441)	5.75 (3.51)	2.042 (5.302)	10.0382 (15.398)	6.975 (3.512)	-3.062 (13.79)
Potato	12.85 (13.475)	4.442 (4.36)	-8.408 (13)	4.382 (5.444)	6.942 (3.418)	2.56 (5.3)	7.205 (9.760)	6.109 (3.924)	-1.1 (10)
Tomato	21.57 (18.76)	12.36 (7.92)	-9.207 (22.07)	3.624 (4.726)	8.0 (8.40)	4.37 (9.25)	9.606 (14.224)	9.456 (8.635)	-0.1496 (16.06)

N = Sample size, Figures in parenthesis indicate standard deviation
Source: Own field survey (2010)

4.4.5. Vegetable income (onion, potato, tomato)

4.4.5.1. Change in production and quantity sold

The study of this paper focuses on the constraints of vegetable products particularly income from onion, potato and tomato. For this reason the general nature of these products in terms of the household income is separately discussed. Income is dependent on the production of the amount of produced volume if the produced item is supplied for market. In the case of agricultural products the actual income received may not depend on the amount of produced in the production year. This is true especially in the products which are perishable in nature. There are so many factors which limit to supply all the produced to the market. Some of the factors are natural and some of the factors are related to appropriate handling of before and after harvest. As per this study this found to be true in the study area. In this section the comparison between the produced amount of the vegetables and the quantity sold in the production year 2008/09 is discussed.

According to the sampled households and presented in Table 4.16, on average 6.97 quintal of onion, 6.1 quintal of potato and 9.45 quintal of tomato were produced. The amount of onion, potato and tomato quantity sold was 6.23, 5.51, and 7.94 quintal respectively in the production year 2008/09. The average change between quantity produced and sold for onion, potato and tomato were 0.742, 0.6, and 1.52 quintal respectively. These changes include the quantity of post harvest losses on average per quintal and used for consumption. According to the households the majority of the

changes in production and quantity sold represent the post harvest loss during marketing and post harvest process. From the descriptive statistics result the highest amount of change in quantity produced and sold higher in tomatoes than the other vegetables. The descriptive result also shows that when the amount of the vegetables produced increases the amount of changes between quantities produced and sold also increases. From this it can be conclude that when the vegetable is highly perishable and the amount of quantity produced increases the change between quantities produced and quantity sold also increase. This implies that when the product is highly perishable, as the amount of the production of that product increases the post harvest loss of that product also increases remaining other things constant. Therefore, the production of vegetable since the products are highly perishable, in order to increase income from these products it required to handle the post harvest loss through different mechanism like facilitating cold storage and appropriate transport, processing and other mechanisms to reduce the post harvest losses.

Table 4.16: Change in production and sold (average in quintal)

Variables	**N = 40**			**N = 80**			**N = 120**		
Woreda	**Alaje**			**Ofla**			**Total**		
	Produced	Sold	Change	Produced	Sold	Change	Produced	Sold	Change
Onion	9.426 (3.943)	8.12 (3.53)	1.301 (0.641)	5.75 (3.51)	5.29 (2.39)	0.462 (0.455)	6.975 (3.512)	6.23 (3.11)	0.742 (0.655)
Potato	4.442 (4.36)	4.05 (4.0)	0.392 (0.45)	6.942 (3.418)	6.25 (3.24)	0.692 (0.972)	6.109 (3.924)	5.51 (3.65)	0.6 (0.844)
Tomato	12.36 (7.92)	11.32 (7.92)	1.037 (0.836)	8.0 (8.40)	6.25 (2.33)	1.75 (7.95)	9.456 (8.635)	7.94 (5.94)	1.52 (6.50)

N = Sample size, Figures in parenthesis indicate standard deviation
Source: Own field survey (2010)

4.4.5.2. Total income from onion, potato and tomato

According to the households and summarized in Table 4.17, in the study area the total income received from sold onion, potato and tomato were 806,380 birr. To receive this income a total of 748 quintal of onion, 662 quintal of potato and 953 quintal of tomato were sold in the production year 2008/09 in the study area. The average price received per quintal for onion, potato and tomato were 364.34 birr, 352.65 birr and 315.20 birr respectively for each product per quintal. From this it can be conclude that among

vegetables the contribution of tomato in the household income is higher than the other vegetables. This further implies that, despite highly perishable nature of the product compared to onion and potato, households engaged in the production of tomato than the other vegetables. According to the households, this is due to apart from the advantage of its market demand once tomatoes are planted it can be harvested more than one or two times.

Table 4.17: Vegetable quantity sold and average price received in 2008/09

Vegetable	**N = 40**			**N = 80**			**N = 120**		
Woreda	**Alaje**			**Ofla**			**Total**		
	Quantity in qt	Price/ quintal	Total income	Quantity in quintal	Price/ quintal	Total income	Quantity in quintal	Price/quintal	Total income
Onion	325	384.46	124950	423	348.89	147580	748	364.34	272530
Potato	162	370.92	60090	500	346.74	173370	662	352.65	233460
Tomato	453	287.85	130350	500	340.08	170040	953	315.20	300390
Total	940		315390	1423		490990	2363		806380

Source: Own field survey (2010)

4.4.5.3. Onion income

According to the sampled households and analyzed in Table 4.17 and 4.18 the average income the households received from onion in the crop year 2008/09 was 2271.08 birr. The income received by the households from onion ranges from no income received from onion to a maximum income of 5600 birr. The average onion quantity sold is 6.23 quintal per households with average price of 364.53 per quintal. In Alaje Woreda the average income from onion is 3123.75 birr. The minimum and maximum income received are the households who did not sold onion and received no income from it in the production year and the households who received 5600 birr respectively with standard deviation of 1351.25. To receive this average income 8.12 quintal of onion is sold at an average price of 384.46 per quintal. In the other Woreda of the study the average income for this product is 1844.75 birr with a minimum of none income received households from onion and a maximum of 4000 birr with standard deviation of 860.47 birr from an average of 5.29 quintal of onion sold at an average price of 348.89 per quintal.

The t – test conducted for onion quantity sold and the revenue received from onion are highly significant at less than 1%. This implies that the amount of onion sold and the revenue received from onion were highly varied in the study area. This implies that the variation in terms of quantity sold and revenue received result from due to the difference in onion quantity produced by the households. The t - test conducted for the price of onion also significant at less than 5 percent in the study area. This indicates that the price received by the households is varied in the study area. This further implies that based on the experience of the households in terms of better market price search and the amount of quantity produced the price of onion varied in the study area.

4.4.5.4. Potato income

As indicated in Table 4.17and 4.18, the average income the households received from potato in the crop year 2008/09 is 1945.5 birr. The minimum income is none income received households from potato and with a maximum of 6500 birr. The average potato quantity sold per household is 5.51 quintal with average price of 352.65 per quintal with a standard deviation of 1347.92. In Alaje Woreda the average income from potato is 1502.25 birr. The minimum and a maximum income received are none income received households from potato and 4500 birr respectively with standard deviation of 1469.05 from an average 4.05 quintal of potatoes sold at a an average price of 370.92 per quintal. In Ofla Woreda the average income for this vegetable is 2167.12 birr with a minimum of zero income received from potato and a maximum of 6500 birr with standard deviation of 1233.77 birr from an average 6.25 quintal of potato sold at an average price of 346.74 per quintal.

The t – test conducted for quantity sold and the revenue received from potato are highly significant at less than 1 percent. This indicates that the amount of potato sold and the revenue received varied in the study area. This implies that due to the variation in production factors, price received for the product and marketing activities performed by the households, the amount of quantity sold and the revenue received varied. The t - test conducted for price of potato is not significant in the study area. This implies that, there is no significant difference in the price of potato received by the households. This implies

that the price of vegetable relatively constant than the two of other vegetables. This further implies that the households supply potato to the market through the wholesalers with the same price in the study area.

4.4.5.5. Tomato income

According to the sampled households and analyzed in Table 4.17 and 4.18, the average income the households received from tomatoes in the crop year 2008/09 is 2530.25 birr. The minimum income received from tomato sold is no income received by the households in the production year and the maximum income is 8500 birr. The average tomato quantity sold is 7.94 quintal with an average price of 315.20 per quintal with a standard deviation of 1603.77 birr. In Alaje Woreda the average income from tomato is 3258.75 birr with an average 11.32 quintal of tomato sold at a price of 287.74 per quintal. The minimum income received from potato is the households who received no income from tomato and the maximum is the households who received 8500 birr from tomato in the production year of 2008/09. In Ofla Woreda the average income for this product is 2,125.50 birr with a minimum of no income received households from tomato and a maximum of 5,200 birr received households in the production year 2008/09. The average quantity sold is 6.25 quintal of tomato at an average price of 340.08 per quintal.

The t – test conducted for quantity sold and the revenue received from tomato is highly significant at less than 1 percent significant level. The same implication like that of onion and tomato the amount of quantity sold and the revenue received from tomato also significantly difference in the study area.

The t – test conducted for the price of tomato is significant at less than 5 percent significant level. This indicates that the price of tomato is significantly different in the study area. This also further implies that based on the experience in marketing skill of the households, the product nature, the production amount of tomatoes in the area and the seasons which tomatoes were sold, the price received for tomatoes varied.

Table 4.18: Income from onion, potato and tomato (Average and t - value)

Variables	N = 40	N = 80	N = 120	t-value
Woreda	**Alaje**	**Ofla**	**Total**	
	Average	Average	Average	
Onion sold in qt.	8.12 (3.53)	5.29 (2.39)	6.23 (3.11)	5.195 ***
Price of onion/qt	384.46 (69.8)	348.89 (62)	364.34 (66)	2.60**
Income from onion	3123.75 (1351.25)	1844.75 (860.47)	2271.08 (1206.86)	6.3***
Potato sold in qt.	4.05 (4.0)	6.25 (3.24)	5.51 (3.65)	3.233***
Price of potato/qt	370.92 (85.9)	346.74 (55)	352.65 (69)	0.442
Income from potato	1502.25 (1469.04)	2167.12 (1233.77)	1945.50 (1347.91)	2.609***
Tomato sold in qt.	11.32 (7.92)	6.25 (2.33)	7.94 (5.94)	5.309***
Price of tomato/qt	287.74 (107)	340.08 (54)	315.20 (80)	2.127**
Income from tomato	3258.75 (2290.14)	2125.5 (922.9)	2530.25 (1603.77)	3.865***

N = Sample size, ***, and ** significant at less than 1%, and 5% significance level respectively, Figures in parenthesis indicate standard deviation
Source: Own field survey (2010)

4.4.5.6. Comparison of vegetables income

As per the data collected from the sampled households the total income received from sold onion, potato and tomato and the total income of the households in the crop year 2008/09 were revealed in the previous section. In this part of the survey the total income received from these three vegetables in terms of their importance and their share from the total income received and each vegetable income received from vegetable income will be analyzed to see the importance of the vegetables to the households' total income.

Table 4.19: Comparison of vegetable income from total income (%, average, and t - value)

Variables	N = 40			N = 80			N = 120			t-value
Woreda	Alaje			Ofla			Total			
	% of vegetable	% of total income	Average income	% of vegetable	% of total income	Average income	% of vegetable	% of total income	Average income	
Onion	15.51	9.75	3123.75 (1351.26)	18.25	11.52	1844.75 (860.47)	33.8	21.28	2271.08 (1206.86)	6.3***
Potato	7.45	4.69	1502.25 (1469.05)	21.5	13.53	2167.12 (1233.77)	28.95	18.22	1945.5 (1347.91)	2.609***
Tomato	16.16	10.17	3258.75 (2290.13)	21.1	13.27	2125.5 (922.9)	37.25	23.45	2503.25 (1603.77)	3.856***
Total	39.12	24.51		60.85	38.32		100	62.95		

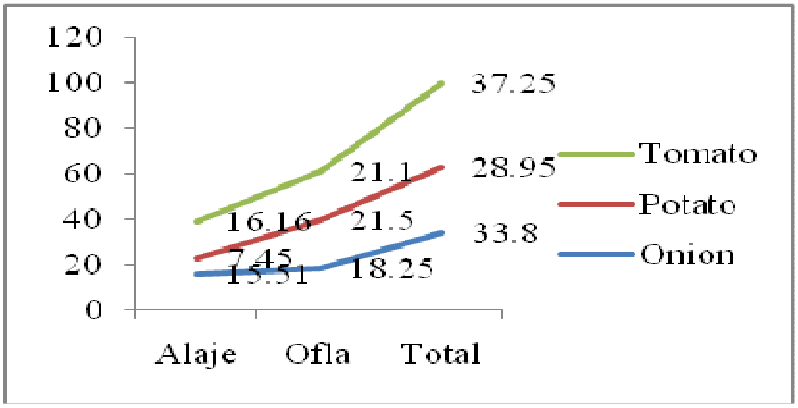
N = Sample size, ***, significant at less than 1%, Figures in parenthesis indicate standard deviation

Source: Own field survey (2010)

a). Comparison of onion, potato and tomato from vegetable income

As indicated in the above Table 4.19, the share of onion, from the total sold three of the vegetables in the production year 2008/09 is 33.8 percent. The share of potato and tomato from the total income received in the same year is 28.95 and 37.25 percent respectively. Among these three products tomato is the major source of income of the households from vegetables. As the second major source of income onion play a major role for the income of the households from vegetables. In third place potato contributed 28.95 percent of the household income. These imply that among three of the vegetables, tomatoes are the major source of household's income. In figure 3 the share of three of the vegetables compared from the total income of the households received from vegetable depicted.

Figure 4.3: Share of onion, potato and tomato from vegetables income

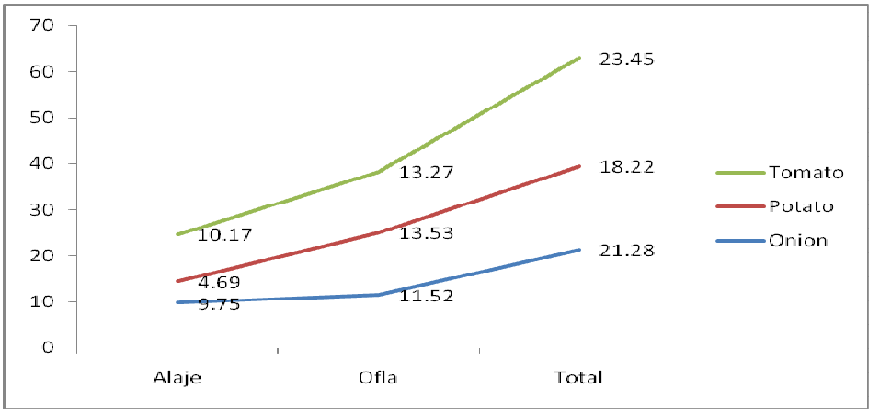


Source: Own field survey (2010)

b). Comparison of onion, potato and tomato from total income

As indicated in the above Table 4.19, from the total of the households received income onion contributed 21.28 percent of the income received from all source of income in the crop year 2008/09. Potato and tomato contributed 18.22 and 23.45 percent respectively. From this it can be conclude that tomato is one of the major sources of income among the vegetables based on its contribution to vegetables income and to the household income. This further implies that despite highly perishable nature of the vegetable, tomato production in the study area is favorable by the households. In figure 4 the contribution of each vegetable to the household income compared from the total income received by the households and their share of income from vegetables depicted.

Figure 4.4: Share of onion, potato and tomato from total income



Source: Own field survey (2010)

c). Comparison of onion, potato and tomato income at Woreda level

As indicated in the above table 4.19, in Alaje Woreda vegetable represents 39.12 percent of the income received from vegetable and 24.51 percent for the total income. Among the vegetables, tomato is the major source of income when we compare from the vegetables income received by the households and of total income with the percentage of 16.16 and 10.17 respectively in the crop year 2008/09. Onion and potato ranked second and third from total income from vegetables the household received at 15.51 and 7.45 percent in the same crop year. From the overall household income the contribution of the two vegetables to the vegetable income and total income is 9.75 and 4.69 respectively. In Ofla Woreda vegetable contributes 38.32 percent of the total income. Among the vegetables potato played as a major source of income when we compare both from vegetable income and total income received by the households. The percentage shares of potato from the total vegetable income and of the total income of the households are 21.5 and 13.53 respectively. Tomato and onion played as second and third major source of income. The percentage share of tomato from vegetables and of total income is 21.1 percent and 13.27 percent respectively. The percentage share of onion of vegetable income and total household income is 18.25 and 11.52 percent respectively in the crops year of 2008/09.

The t – test conducted for each type of vegetables with regard to their contributions of the total income is highly significant at less than 1 percent in the study area. This indicates

that the contribution of onion, potato and tomato to the total income of the household significantly different in the study area. This further implies that based on the demand, market price, and other reasons households produced one of the vegetable which benefit more the households.

4.5. Opportunities and constraints of farm income

There are so many factors which affect income of households from the sale of vegetable. As per the information provided in the response of the questioner almost all of the households head indicated that they have a problem to increase their income from sale of vegetables in the crop year 2008/09. According to the focused group discussion constraints are sometimes specific to certain vegetables. For instance, most farmers indicated that diseases and frost are the most prioritized problems of producing potato and tomato. On the other hand land size and shortage of water are top constraints of production of onion and tomato. Water shortage or drought, fertilizer shortage, improved seeds, capital and storage are common major problems for three of the vegetables.

4.5.1. Constraints to increase income

In this part of the paper only constraints related to production of vegetables which impact income from vegetable particularly from production factors of vegetables are discussed. In the questioner among the constraints related to production factors land size, fertilizer, method of production, labor, disease and pests, irrigation water, climate, improved seed, accesses to credit and technical assistance for production were the major presupposed constraints to the sampled households.

According to the sampled households and indicated in Table 4.20, the majority of the constraints are highly limiting factors to increase income from production of vegetables. For example improved seeds (90.8%), disease and pests (92.5%), Irrigation water (94.2%), climatic factors (100%), and access to credit (90%) are among the major highly limiting factors which hindered to increase vegetable income.

The t – test conducted for irrigation water is significant at less than 1%. This implies that irrigation water problem is significantly different in the study area. This further implies that the problem of irrigation water is less a problem in Alaje Woreda due to the availability of spring waters which is less affected during drought periods.

Table 4.20: Production constraints to increase income (% and t - value)

Variables	**N = 40**		**N = 80**		**N = 120**		**t-value**
Woreda	**Alaje**		**Ofla**		**Total**		
	Yes	No	Yes	No	Yes	No	
Land size	33.3	0	54.2	12.5	87.5	12.5	3.013
Fertilizer	30	3.3	59.2	7.5	89.2	10.8	.206
Improved seeds	30	3.3	60.8	5.8	90.8	9.1	.222
Labor	21.7	11.7	29.2	37.5	50.8	49.2	2.222
Disease and pests	29.2	4.2	63.3	3.3	92.5	7.5	1.471
Irrigation water	27.5	5.8	66.7	0	94.2	5.8	4.085***
Climate	33.3	0	67.7	0	100	0	1.183
Method of production	28.3	5.2	45.8	24.2	70.8	29.2	2.454
Access to extension service	25.8	7.5	51.7	15	77.5	22.5	000
Access to credit	28.3	5	61.7	5	90	10	1.289

N = Sample size, ***, significant at less than 1% significance level
Source: Own field survey (2010)

4.5.2. Opportunities of vegetable production

The opportunities of the vegetable product were restricted in past several years due to lack of demand, purchasing capacity of the consumer, economic growth of the country and other factors throughout the country. Recently due to the change in the economic growth of the country and the population growth in general these products turn out to be one of the major sources of income for those engaged in the production of vegetables (Greenhalgh and Havis, 2005). However, due to their perishable nature there are so many constraints as discussed in section constraints for vegetable. According to the focused group discussion, regardless of the constraints, sampled households identified few opportunities to increase income from vegetables in the study area. The major opportunities identified by sampled households in relation to vegetable products are, relatively higher price compare to from the past time and better market demand, government policy support facilities like road, telephone are the major opportunities indicated by most of the households to increase income from the vegetable. Most of the households also identify that the suitability of their land for production of vegetable as

opportunity except that the problems related to size of land, disease and pests, water and weather that limit the production of vegetable.

4.6. Post harvest handling of vegetable production

4.6.1. Post harvest loss

One of the major problems related to vegetable production is post harvest loss. In small scale production the post harvest loss of vegetables is estimated 25 to 40 percent of the production. This affects household income in terms of its opportunity cost and by reducing the expected income. In this study the post harvest loss estimated based on what the households produced and supplied to the market. The assumption is the difference between produced and supplied to the market left either the household is forced to consume or considered as a loss during production and marketing process.

As per the information from sampled households and summarized in Table 4.21, depending on the type of vegetable, the post harvest loss on average ranges from 7 to 16 percent. The estimated post harvest loss for onion, potato and tomatoes are 7 percent, 11 percent and 16 percent respectively. Especially, for tomato the post harvest loss is higher than that of the two vegetable types namely onion and potato.

The t – test conducted for post harvest loss for onion and potato are significant at less than 5 percent and 10 percent respectively. This implies that there is significant difference in post harvest loss of these vegetables in the study area. This further implies, the impact of the pos harvest loss in the household income is significantly different from these vegetables.

The t – test conducted for tomato post harvest loss shows that there is no significant difference. This further implies that regardless of the amount of quantity produced the post harvest losses of tomatoes are not deferent in the study area. This further implies highly perishable nature of the product affects the household's income equally in the study area.

Table 4.21: Estimate of post harvest loss (average and t - value)

Variables	N = 40			N = 80			N = 120			t-value
Woreda	Alaje			Ofla			Total			
	Produced	Sold	Post harvest loss	Produced	Sold	Post harvest loss	Produced	Sold	Post harvest loss	
Onion	9.426 (3.94)	8.125 (3.538)	1.301 (0.640)	5.75 (2.52)	5.29 (2.387)	0.462 (0.455)	6.975 (3.512)	6.233 (3.113)	0.742 (0.655)	^{p}6.195*** ^{s}5.195*** ^{ph}8.265***
Potato	4.44 (4.36)	4.05 (4)	0.392 (0.448)	6.94 (3.42)	6.25 (3.243)	0.692 (0.972)	6.11 (3.92)	5.2 (3.65)	0.592 (0.844)	^{p}3.436* ^{s}3.233*** ^{ph}1.853*
Tomato	12.36 (8.45)	11.32 (7.197)	1.0375 (0.836)	8 (8.4)	6.25 (2.335)	1.753 (7.95)	9.46 (8.635)	7.94 (5.472)	1.515 (6.509)	^{p}2.673** ^{s}5.309*** ^{ph}0.567

N = Sample size, p = produced, s = sold, ph = post harvest loss, ***, ** and * significant at less than 1%, 5% and 10% significance level respectively, Figures in parenthesis indicate standard deviation

Source: Own field survey (2010)

4.6.2. Transport and packaging

4.6.2.1. Transport

Transport is one of the facilities used to supply farm production to the market. Depending on the type of transport, road, distance from major road and market the amount of the production supplied to the market affected by the transport facilities. Post harvest losses also inevitable when there is inappropriate transport facilities and packaging used depending on the type of transport method and packaging used. Particularly vegetable products require appropriate transport and packaging materials to reach the market whenever the market is located long distance from production center.

The study area is located around the major asphalt road that links Addis Ababa and Mekelle. To reach the main roads that connect Addis Ababa and Mekelle they are also served by a gravel and all-weather secondary road that connects their production center and the major road. Most of the production sites in the study areas are accessible by car. This is an opportunity to supply at least the nearby major road collection center (team leader house) or to supply the major market. However, depending on the households production capacity and capital to transport their vegetable produce to the market and

collection centers households use light vehicles, human labor, ISUZU trucks, buses and pack animals. In farm area most of the households used human labor and pack animals to transport their produce to their storage.

As per focused group discussion, as to the appropriateness of the method of the transport households responded that, when they used like light vehicles and public buses they had problems related to costs, accessibility and appropriateness of these method of transportation for vegetable products. Households also identified that the use of ISUZU tracks by hiring in group for their vegetable marketing. In this case households indicate that the commission paid for brokers in search of ISZU cars is as a problem.

Particularly for the purpose of this study to assess the transportation problems in relation to market access households are asked about the distance where their vegetable production center is located and the major market identified by farmers. Households are also asked about the distance where their production center located from major road.

According to the households and presented in Table 4.22, on average the households are located 41.908 and 5.086 km far from major market and major road respectively.

The chi – square - test conducted for distance from major market and distances from major road are significant at less than 1 percent significant level. This indicates that there are significant differences both in terms of distance from major market and from major road from production center in the study area. This implies that based on their location the cost of transport, the problems arise in marketing activities due to the product nature, post harvest losses and other constraints result from distance varies among producers. Therefore, in order to increase the income of the household from production of vegetable the households in the study area differently affected by distance from major road and major market.

4.2.6.2. Packaging

The type of material (packages) used to transport vegetable by the producers varies based on the type of vegetables. Commonly wooden boxes used for tomatoes and commonly available sacks used for onion and potato. Although, the majority of the households (64%) identified as they have appropriate packaging materials for their vegetable produce they also identified that packaging materials used for onion and potato are problems during transportation. Relatively the packaging material used for tomato better than that of the two products. With regard to packaging problems households also identify that the availability and price of wooden boxes for their tomato production.

To assess the appropriateness of packaging materials used for vegetables households are asked whether they have appropriate packaging materials for their vegetables or not. Accordingly, as presented in Table 4.22 below, 64.2 percent of the households identified that as they have appropriate packaging materials for their vegetable production.

The chi – square - test conducted for the use of appropriate packaging is significant at 1 percent significant level. This implies that there is significant difference in the use of appropriate packaging system in the study area. Therefore, this further implies that, the packaging materials used for vegetables impact on household vegetables marketing activities is significantly different.

Table 4.22: Distance to major road, market and packaging (%, average and χ2 - value)

Variables		**N = 40**	**N = 80**	**N = 120**	**χ^2- value**
Woreda		**Alaje**	**Ofla**	**Total**	
		Average	Average	Average	
Distance from major market		29.95 (42.36)	47.887 (11.308)	41.908 (27.296)	83.7***
Distance from major road		2.5312 (.851)	6.364 (8.206)	5.086 (6.945)	312.9***
Packaging	Yes	19.2%	45%	64.2%	9.63***
	No	14.2%	21.7%	35.8%	

N = Sample size, ***, significant at less than 1%, significance level, Figures in parenthesis indicate standard deviation

Source: Own field survey (2010)

4.6.3. Storage

Storing vegetables in tropical and subtropical climates can be difficult without cold storage. Sometimes fast marketing is the only solution (S. Naika, 2005). In the study area the storage facilities used by the majority of the households used for their vegetable are ordinary rooms with cemented or soil floor in their own houses or team leader house. There are only few storage facilities available in Ofla Woreda which has cooling and preservation systems constructed by government and NGO. This storage facility is mostly used for onions and potatoes only. However most of the households sold their vegetables immediately after harvest. According to the sampled households, some of the households, whom stored their vegetable, stored vegetable with a maximum of five to seven days especially for onion and potato in search of traders whom purchased vegetables. Tomatoes are usually sold after harvest within 1 to 2 days by most of the households in the study area.

Particularly for the purpose of this study households are asked whether they have appropriate storage facilities or not and their source of storage facility. Accordingly as presented in Table 4.23, 55 percent of the households revealed that as they have appropriate storage facilities and the majority of the households identify that the stores constructed by government and NGO are their source of storage for vegetables.

The chi - square - test conducted for the availability of storage is not significant. This refers that there is no significant difference in the use of appropriate storage. This implies that the availability of appropriate storage facilities in the study area is not significantly different. Therefore, this indicates that based on the availability of appropriate storage facilities the impact of storage on the households marketing activities of vegetable is not differently affect the households in the study area.

In order to see further the impact of storage on the households income, the income of the household between the households who have appropriate storages for vegetables and who do not have computed. Accordingly average income from vegetable the households who

have appropriate storage facilities and the other groups are 6453.2 birr and 7044.1 birr respectively.

The t – test conducted between the two groups is not significant. This indicates that the average income received between those who have storage facilities and who do not have, not significantly different. This further implies that, the strategy followed by the households to avoid the requirement of storage for their vegetable is similar, that is to sell the vegetables immediately after the vegetables harvested. Therefore, one of the mechanisms to avoid, the requirement of storage in the production of vegetables when there are no appropriate storage facilities in the case of perishable agricultural products is to sell immediately after harvest.

Table 4.23: Storage facility and source of storage (%, average and χ^2 -value)

Variables		**N = 40**		**N = 80**		**N = 120**		**t- value/χ^2**
Woreda		**Alaje**		**Ofla**		**Total**		
		Freq.	%	Freq.	%	Freq.	%	
Have appropriate storage	Yes	13	10.8	54	45	67	55.8	1.63
	No	37	22.5	26	21.7	53	44.2	
HH with appropriate storage average income		-	-	-	-	-	6463.2 (836)	1.157
HH without appropriate storage average income		-	-	-	-	-	7044.1 (509)	
Source	Government	0	0	27	22.5	27	55.8	
	NGO	0	0	26	21.7	26	22.5	
	Self	40	33.3	27	22.5	67	21.7	

N = Sample size, Figure in parenthesis indicate that standard deviation
Source: Own field survey (2010)

4.6.4. Grading, standardizing and selection/sorting

Setting standard for agricultural products is important for the producer, consumer and for those who are in the chain. Perishable agricultural products like vegetables; their market is highly affected by the product nature. Setting grades and producing standardized products, perform selection or sorting based on product quality and supply standardized products in the market help to generate higher income for the producer. For the consumer also it can help to have safe and quality products through market distribution outlets.

Especially for perishable products like vegetables producing standardized production along with proper facilities reduces the risk of market related problems in perishable products.

As per the discussion from the Woreda expert in vegetable production, in the study area there are no standards set for the produced vegetables based on size, weight, quality, etc that is to be supplied to the market. According to the focused group discussion with households, there are common practices of sorting vegetables based on physical condition, in terms of size, weight, pest and disease damage, physical injury during harvest and production. Those products, as per the perception of the households in good conditions are supplied to their major customers (wholesalers) and the remaining sold at village market and used for home consumption. The majority of the households had no knowledge with regard to standardizing and selection or sorting of their vegetable production except that they are practicing the common exercise with physical centered identification of their vegetable produce.

For the purpose of this study to assess the impact of perishable nature of vegetables impact on marketing activities, households were asked to rate how the perishable nature of the product affect their marketing activity (1 = Very low to 5 = Very high), whether purposively graded their marketed vegetable products or not and select their products in terms of product size, weight, pest and disease damage and physical damage.

According to the respondents and presented in Table 4.24, 18.3 percent of the households indicated that perishable nature of the products very highly affect their marketing activities. The households whom indicated that, perishable nature of the product affects high and averagely are 32.5% and 45.8% respectively. With regard to grading and selection of vegetable products 53.3% of the sampled households perform grading (most of the producer graded in terms of size) and 74.2% of the households perform sorting in terms of size, weight, physical injury and pest and disease damage for their marketed vegetable products.

The chi - square – test conducted for perishable nature of the product effect on marketing of vegetable are significant at less than 1 percent. This indicates that the effect of perishable nature of the product is different in the sampled households in the study area. This implies that also the majority of the households followed the strategy that to sell their vegetables immediately after harvest some of the households consider the impact of perishable nature hindered to maximize price due to lack of storage and further lack of processing industries. The chi – test conducted for grading of vegetable product is not significant. This indicates that there is no significant difference among sampled households in terms of grading of vegetable products in the study area. This implies that the majority of households commonly practice the same strategies to grade in terms of size and supply to their major customers (wholesalers).

The chi – test conducted for performance of sorting vegetables in terms of size, weight, pest and disease damage and physical injury is significant at less than 1 percent significant level. This implies that the performance of sorting vegetable based on the basic requirement is significantly different among households in the study area. This further indicates that, although households are engaged in the production of vegetables for long periods in the study area, some of the households are not sorting their products intentionally to maximize their vegetable income. It further implies lack of basic trainings in the production of vegetables in the study area.

Table 4.24: Households perform grading and selection (% and t – value and χ^2- value)

Variables		**N = 40**		**N = 80**		**N = 120**		**χ^2- value**
Woreda		**Alaje**		**Ofla**		**Total**		
		Freq.	%	Freq.	%	Freq.	%	
Impact of perishable nature of the product in marketing	Low	4	3.3	0	0	4	3.3	48.2***
	Average	20	16.7	35	29.2	55	45.8	
	High	10	8.3	29	24.2	39	32.5	
	Very high	6	5	16	13.3	22	18.3	
Grading	Yes	21	17.5	23	35.8	64	53.3	.533
	No	19	15.8	37	30.8	56	46.7	
Perform selection/sorting in terms of size, weight, pest and disease damage and physical injury	Yes	32	26.7	57	47.5	89	74.2	28.33***
	No	8	6.7	23	19.2	31	25.8	

N = Sample size, ***, significant at less than 1% significance level
Source: Own field survey (2010)

4.7. Access to services

4.7.1. Access to farm inputs

The use of farm inputs determines the productivity of the particular product and the amount of supply of farm produce to the market. In the study area, given land and animal power constant the household's uses family labor, hired labor, improved seeds, fertilizers, and pesticides for the production of vegetable.

According to the focused group discussion with the sampled household's, fertilizers, improved seeds and pesticides were distributed through their cooperatives in most of the times. However, most of the time cooperatives provide fertilizers only. Due to this reason the use of these farm inputs varies among the households.

According to the response from the farm households and presented in Table 4.25, 67.5 percent used family labor and 32.5 percent of the households are used both family labor and hired labor for the production of vegetable. Improved seeds and pesticides are used by 61.7, and 66.7 percent of the households respectively. With regard to the use of fertilizer 69.2 percent of the households are implemented for production of vegetable in the crop year 2008/09.

The chi – square - test conducted for the use of labor, fertilizer, improved seeds and pesticides is significant at less than 1 percent significant level. These indicate that as there are significant differences the implementation of these farm inputs in the production of vegetables in the study area. This implies that the availability of these farm inputs in the study area is quite different. This further also implies that the use of this farm inputs by the households significantly different in the study area. Hence, the impacts of these farm inputs in the amount of produced vegetable differently affect the households. Therefore, households in the production of vegetables due to varies reasons like price, the availability of the inputs limited to use these farm inputs for the production of vegetable.

Further, one of the major inputs to increase the productivity of vegetable, improved seeds considers seeing its impact on income of the households from vegetable. Hence, households categorized in to two groups to see the impact of improved seeds in the household income. The average income received by the households who uses improved seeds and do not apply improved seeds for their vegetable production is 6,837 and 6,531birr respectively.

The t – test computed between these groups are not significant. This implies that there is no significant difference between the incomes received from vegetables between the two groups. This implies that the use of improved seeds alone cannot determine the income of the households from vegetables. In order to increase income of the households other required inputs, like land and fertilizers, irrigation water, the post harvest handling of vegetables by the household, the marketing activities and etc, should also fulfilled remaining other things constant. Therefore, in order to increase income of the household from production of vegetables integrated approaches in the requirements of inputs, postharvest handling and marketing activities should be implemented.

Table 4.25: Farm inputs used for vegetable (%, t – value and χ^2- value)

Variables		**N = 40**		**N = 80**		**N = 120**		**t- value/χ^2**
Woreda		**Alaje**		**Ofla**		**Total**		
		Freq.	%	Freq.	%	Freq.	%	
Family labor only		27	22.5	54	45	81	67.5	14.7***
Both family and hired		13	10.8	26	21.7	39	32.5	
Fertilizer	Yes	24	20	59	49.2	83	69.2	17.63***
	No	16	13.3	21	17.5	37	30.8	
Improved seeds	Yes	24	20	50	41.7	74	61.7	6.53***
	No	16	13.3	30	25	46	38.3	
HH used improved seeds average income		-	-	-	-	-	6837 (2537)	.594
HH used improved seeds average income		-	-	-	-	-	6531.3 (2863)	
Pesticides	Yes	28	23.3	52	43.3	80	66.7	13.33***
	No	12	10	28	23.3	40	33.3	

N = Sample size, ***, significant at less than 1% significance level
Source: Own field survey (2010)

4.7.2. Access to extension service/technical assistance

In small scale vegetable production farmers usually constrained both in production and marketing of vegetable skills comparable to stable crop production. Production of vegetables is a new experience for the majority of small holders in Ethiopia. Therefore, support to develop small scale vegetable producers in the areas of production and marketing are vital.

The type of technical assistance provided to the households by the government varies in terms of production and marketing of agricultural products. As per the discussion with the Woreda experts for vegetable, the government provides technical assistance for households emphasizing on production aspects of vegetable.

As one of the focus of this paper, sampled households are asked in terms of provision of technical assistance, source and adequacy of technical assistance for crop year 2008/09. Accordingly, as presented in Table 4.26, the percentage of households received technical assistance in the production year 2008/09 for their vegetable production from government and NGO is 65 and 21.8 percent respectively. From the households received technical assistance for vegetable production 44 percent of the households responded that the technical assistance received were adequate.

The t – test conducted for provision of technical assistance and the adequacy of technical assistance are not significant. This implies that there is no significant difference in the number of households received technical assistance and the response given adequacy of technical assistance in the study area. This further implies that the existence of provision of technical assistance for production of vegetable, since the majority of the households (65%) received technical assistance in the study area. However, among the households whom received technical assistance less than fifty percent (44.87) of the households only indicate that the technical assistance received was adequate. According to the households this was due to the number of technical assistance service contact was a onetime activity by the experts and it lacks follow up. This further implies that although the technical

assistance provision was there it lacks the required level of contacts that should be provided in the study area. According to the Woreda expert this was due to limited number of extension workers in the area.

The t – test conducted for the source of technical assistance is significant at less than 10 percent. This indicates that there is a significant difference in the source of technical assistance in the study area. This was due to especially from Ofla Woreda the households are provided technical assistance from NGO. Therefore, in the study area the majority of the households have access to technical assistance though it is not sufficient and coordinated in a manner that the households required level of interest due to various reasons like shortage of experts.

Table 4.26: Technical assistance source and sufficiency (% and t – value)

Variables		**N = 40**		**N = 80**		**N = 120**		**t-value**
Woreda		**Alaje**		**Ofla**		**Total**		
		Freq.	%	Freq.	%	Freq.	%	
Received technical assistance	Yes	24	20	54	45	78	65	.807
	No	11	13.3	26	21.7	42	35	
Source of TA	NGO	0	0	17	21.8	17	21.8	1.694*
	Government	24	30.76	37	47.43	61	78.2	
Sufficient	Yes	18	23.07	17	21.8	35	44.87	.244
	No	6	7.7	37	47.43	43	55.13	

N = Sample size, ***, significant at less than 1% significance level
Source: Own field survey (2010)

4.7.3. Access to credit

Credit is one of the important financing mechanisms where there is shortage of capital. Usually farmers finance their need of capital either from their own savings or borrowing from formal institutions, other menses like from relatives or other sources. In most developing countries producers face shortage of capital to finance their need of inputs to farm production.

In the study area there are two major sources of credit. These are cooperatives and Dedebit Credit and Saving Institution (DCSI). However, there are so many constraints in

relation to credit according to the respondents. Some of the constraints like group collateral, bureaucratic procedures and the amount of credit offered are some of the constraints indicated by the households.

For the purpose of this study to assess the impact of credit in vegetable income the approach used is whether the households have received credit or not for their vegetable production in the crop year 2008/09.

Accordingly households are asked whether they received credit or not, to indicate the source of credit and adequacy of the amount of credit received for vegetable production in the crop year 2008/09. Accordingly, as presented in Table 4.27, 56.7 percent of the households received credit for vegetable production. From the households received credit, 10.29% of the households from cooperative, 55.9% of the households from Dedebit Credit and Saving Institution (DCSI) and 33.82 % of the households from friends and relatives are received credit. With regard to adequacy of the credit 36.76 percent of the households responded that the credit received were sufficient. The majority of the households (63.23) indicated that the credit received was not sufficient. This indicates that though there is access for credit, due to varies reasons like bureaucratic procedures and its adequacy producers limited to have the needs of credit for the production of vegetables.

Table 4.27: Credit source and sufficiency (%)

Variables		**N = 40**		**N = 80**		**N = 120**	
Woreda		**Alaje**		**Ofla**		**Total**	
		Freq.	%	Freq.	%	Freq.	%
Received credit	Yes	24	20	44	36.7	68	56.7
	No	16	13.3	36	30	52	43.3
Source of Credit	Cooperative	0	0	7	10.29	7	10.29
	Dedebit (MIS)	9	13.23	29	42.64	38	55.9
	Friends	15	20.05	8	11.76	23	33.82
Sufficient	Yes	7	10.29	18	26.5	25	36.76
	No	17	25	26	38.2	43	63.23

N = Sample size,
Source: Own field survey (2010)

4.7.4. Access to market information

4.7.4.1. Price, demand and supply information

One of the major inputs in agricultural products marketing is information. Market information is required for farm planning and marketing of production at a better price. Those who have the reliable information are at a better position in selling their produce at a better market price and planning of production at the early stage**.** The types of market information which are necessary for farm planning and marketing of a particular product basically depend on the type of market a particular product involved. Fundamentally, information about market price, demand and supply for a particular product are essential to achieve the objective.

For the purpose of this study sampled households are asked about the accessibility of necessary market information. This information includes the type of information received and the source of information. As per the focused group discussion from sampled household's government, cooperative, friends and wholesalers and commission agents are the major source of market price, demand (what type of vegetables to plant before production), and supply information.

According to the sampled households and presented in Table 4.28, 71.7 and 43.3 percent of the households received price and demand (what type of vegetable to plant before production) information respectively. With regard to supply 67.5 percent of the households received supply information. This indicates that the majority of the households received the necessary information required for marketing of vegetables. However, according to the households most of the times the information received particularly with regard to demand information the reality in the market quite different what is happened. Therefore, this information usually affects the producers making fluctuating the price of vegetable in the market.

Table 4.28: Price, demand, and supply information (%)

Variables		**N = 40**		**N = 80**		**N = 120**	
Woreda		**Alaje**		**Ofla**		**Total**	
		Freq.	%	Freq.	%	Freq.	%
Price information	Yes	28	23.3	58	48.3	86	71.7
	No	12	10	22	18.3	34	28.3
Demand information	Yes	22	18.3	30	25	52	43.3
	No	18	15	50	41.7	68	56.7
Supply information	Yes	21	17.5	60	50	81	67.5
	No	19	15.8	20	16.7	39	32.5

N = Sample size,
Source: Own field survey (2010)

4.8. Supply chain of vegetable

4.8.1. Actors and markets of vegetable supply chain

Agricultural products pass through different intermediaries until they reach to the final consumer. This process delivering products to the final consumer starting from production is termed as the supply chain of a given product. According to Folkert and Koehorst (1998, p.385) a supply chain is a set of interdependent companies that work closely together to manage the flow of goods and services along the value-added chain of agricultural and food products, in order to realize superior customer value at the lowest possible costs. Depending on where the production center is located and where the products are sold the management of the supply chain becomes complex and exploited by few actors along the supply chain. Actors in the supply chain are any person or organization along the supply chain has the autonomy to change the evolution of the network by changing its behavior.

In the study area there are different actors in the supply chain of vegetable. The major actors in the supply chain of vegetables are government, cooperatives, NGO, wholesalers, retailers, commission agents, brokers (including for transporting vegetables), transport operators and input supplier.

The market of vegetables produced by the sample households varies based on the location of the Woreda. As per focused group discussion with households the nearby

town like Alamta which is far from Ofla 18 km and Sekota (Amhra national regional state) which is far 68 km are important market for Ofla Woreda vegetable producer's irrigation cooperatives. In the case of Alaje Woreda Mekelle market is an important market area for marketing of vegetables from the Woreda.

In the study area the vegetable marketing supply chain is dominated by wholesalers. Producers access wholesalers through commission agents especially in Mekelle market or wholesalers accessing the producer through cooperatives, brokers or directly to the producer. Retailers and consumers are an optional market for immediate cash needs of the producer and most of the vegetables are sold to wholesalers.

For the purpose of this study households are asked the type of supply chain used for each product to supply the vegetable produce. Based on the distance from market, product and market nature the following supply chains involved by the producer are identified in the crop year 2008/09.

Figure 4.5: Form of supply chain

I. Producers - Retailers – consumer
II. Producers - Cooperative – Wholesaler – consumer
III. Producers - Wholesalers- Consumer
IV. Producers - Wholesalers- Retailers – Consumer
V. Producers - Wholesaler - Out of the region through wholesaler – Consumer
VI. Producers – Commission agents - Wholesaler – consumer

4.8.2. Supply chain of onion, potato and tomato

The supply chain of vegetables in the study area varies based on the product type, the nature of the market, the type of vegetable and the amount of vegetables produced in the production year. As per the focused group discussion whenever there is more production producers tend to search for an alternative market in search of better price especially for onion and potato which are relatively less perishable than tomato otherwise they sell it in their own town through commission agents to wholesalers or cooperatives. In Alaje

Woreda households practice to sell vegetables by hiring ISZU tracks in groups and supply to Mekelle market and relatively higher price is obtained from wholesalers.

4.8.2.1. Onion supply chain

As explained earlier, in the use of cooperatives only a small percentage of vegetables are sold through cooperatives due to market price and other factors. Accordingly as presented in Table 4.29, 61.7 percent of the households supplied onion through commission agents (Chanel VI) the majority of onion produced and 37.5 percent of the households supply onion through cooperatives (Channel II) for small proportion of onion.

The t - test conducted for supply chain of onion by households is not significant. This indicates that as there is no difference in the supply chain used by the households for onion in the study area. This is due to most of the households supply onion to the market through wholesalers.

4.8.2.2. Potato supply chain

According to Table 4.29, Potato is supplied by 68.3 percent of the households through wholesalers to consumers (Channel III) and 31.7 percent of the households supplied potato through cooperative (Channel II). The percentage of the households supply potato through wholesalers; retailers and to consumer (Channel IV) is 1.7.

The t – test conducted for potato is significant at less than 10 percent. This implies that there is significant difference in the supply chain used for vegetable production. This implies that, though the percentage of amount of potato supplied is small, potato is supplied to the market through cooperatives and the wholesalers.

4.8.2.3. Tomato supply chain

Tomato is relatively supplied to consumer through different channels of supply chain. This is due to high perishable nature of the vegetable compared to onion and potato and the production nature of the vegetable. As presented in Table 4.19, 7.5 and 57.5 percent

of the households supplied tomato through retailers (Channel I) and wholesalers (Channel III) respectively. There are households only from Ofla Woreda supplied tomato to consumer out of the region through wholesalers (Channel V). The percentages of households who supplied tomato through wholesaler out of the region is 5.8. The percentage of households supplied tomato through cooperative (Channel II) is 27.5.

The t – test conducted for tomato is significant at less than 5 percent respectively. This indicates that there is a significant difference of the supply chain used for tomatoes by the households. This further can be explained by due to the harvesting time of the vegetable, perishable nature of the product and market price the supply chain used for this vegetable varies in the study area.

Table 4.29: Types of supply chain used for vegetable (% and t - value)

Variables	**N = 40**		**N = 80**		**N = 120**		**t-value**
Woreda	**Alaje**		**Ofla**		**Total**		
	Freq.	%	Freq.	%	Freq.	%	
Onion supply chain							.000
Producers – Commission agents -Wholesalers - Consumer	25	20.8	50	41.7	75	61.7	
Producers - Cooperative -Wholesaler - Consumer	15	12.5	30	25	45	37.5	
Potato supply chain							1.814*
Producers – Wholesalers - Consumer	23	19.2	59	49.2	82	68.3	
Producers - Cooperative - Wholesaler - Consumer	17	14.2	21	17.5	38	31.7	
Tomato supply chain							2.284**
Producers – Retailers - Consumer	0	0	9	7.5.	9	7.5	
Producers - Wholesalers- Consumer	22	18.5	47	39	69	57.5	
Producers – Wholesalers - Retailers - Consumer	0	0	2	1.7	2	1.7	
Producers - Wholesaler - Out of the region - Consumer	0	0	7	5.8	7	5.8	
Producers - Cooperative -Wholesaler	18	15	15	12.5	33	27.5	

N = Sample size, ** and * significantly at less than 1%, 5% and 10% significance level respectively,
Source: Own field survey (2010)

4.9. Determinants of income from vegetables

4.9.1. Summary of variables used in the model

The hypothesized determinants of income from vegetable are summarized in Table 4.30. The variables included in the model are grouped in to two parts. Out of a total of seventeen hypothesized variables seven of them are dummies (discrete) variables. The rest of the variables are continuous variables.

Table 4.30: Summary and description of explained and explanatory variables

Variables	Category	Value	Expected sign
Explained variable Income from sold vegetable (Onion, potato, tomato) in 2008/09	Continuous	In Birr	
Explanatory variable			
Age HH	Continuous	Number of years	+
Sex HH	Dummy	1 = Male 0 = Female	+
Family size HH	Continuous	Man equivalent	-
Education HH	Discrete variable	1 = Illiterate 2 = Read and write 3 = Primary education 4 = Secondary school 5 = Above secondary	+
Size of land	Continuous	In hectare	+
Improved seed	Dummy	1 = Used improved seed 0 = Not used	+
Off farm income	Continuous	In Birr	??
Technical assistance/extension service	Dummy	1 = Received TA for vegetable production 0 = Not received	+
Credit received for vegetable production	Dummy	1 = Received credit for vegetable production 0 = Not received	??
Crop income	Continuous	Income received from	-

		crop in 2008/09	
Livestock income	Continuous	Income received from livestock in 2008/09	??
Price information	Dummy	1 = Received price information for vegetable 0 = Not received	+
Demand forecast	Dummy	1 = Received information what to produce 0 = Not received	??
Distance from main road	Continuous	In kilometer	-
Distance from major market	Continuous	In kilometer	-
Vegetables post harvest loss	Continuous	In quintal	??
No of oxen	Continuous	Number of oxen	+

Vegetable is the primary source of income for irrigation cooperative member's households compared to the households received the total income during the crop year 2008/09. From the total of 748 quintal of onion, 662 quintal of potato and 953 quintal of tomato households received a total income of 806, 380 birr in the production year of 2008/09. As discussed in the previous sections of this study as per the households there are so many constraints particularly in relation to production, vegetables product nature, marketing and facilities required particularly for vegetable production and marketing. Most of the constraints indicated by the households are related to the hypothesized variables which constraint income from vegetables.

As summarized in Table 4.30 above, the explained variable is the generation of income from the vegetables (onion, potato, and tomato) sold in the crop year 2008/09, and seventeen explanatory variables which affect income from vegetables are presumed. To test the relationship between factors affecting income from vegetable and explanatory variables the multiple regression model which is mostly used to see relationships and prediction is used. For the analysis a statistical package known as statistical package for social science (SPSS – version 16) is employed.

4.9.2. Test for co linearity

Before running the multiple regression model all the hypothesized explanatory variables were checked for the existence of multi-co linearity problems. The study used Variance Inflation factor to investigate the degree of multi-co linearity among continuous explanatory variables and Contingency Coefficient among discrete (dummy) variables. A statistical package known as statistical package for social sciences (SPSS version 16) is employed to compute the VIF and CC values. The results for all continuous variables VIF values range between 1.171 and 2.730. Similarly, for discrete or dummy variables the CC values are ranging between 0.001 and 0.265. In both cases the rules for the existence of multicolinearity (VIF < 10) and (CC < 1) are not violated. Hence, multi-co linearity effect is not exhibited. Therefore, multi-co linearity is not a problem for both among the continuous and discrete variables. The test for multicollinearity is given on appendix 3 and 4. The existence of violation of normality and autocorrelation also checked by looking at the histogram of the dependent variable and the standard residual plot, and no serious violation of the assumptions are encountered (See appendix 5 and 6). The multiple determination coefficient of the model is 0.930. The model explained 93 percent of the variation in the explained variable income from vegetables.

4.9.3. The model result

The regression model result is presented in Table 4.31 below. Among seventeen variables, six variables are found to be significantly affecting income from vegetable. These are crop income, off farm income, livestock income, and post harvest loss in vegetables, distance from major market and distance from major road. Out of these variables only livestock income positively affect income from vegetable. The others five variables affect vegetable income negatively.

Table 4.31: Estimated regression model of factors affecting income from vegetable

Factors	Standard error	Beta	t	Sig. p
(Constant)	739.227		1.173	.244
Gender of HH	229.954	-.008	-.291	.771
Age of HH	11.536	-.037	-1.134	.259
Education level of HH	84.852	.030	.995	.322
Family size of HH	120.232	.016	.492	.624
Oxen owned in 2008/09	88.944	-.005	-.158	.875
Off farm income in 2008/09	.055	-.055*	-1.927	.057
Demand forecast	150.625	-.027	-.990	.325
Credit 2008/09	156.829	.014	.507	.613
Extension service 2008/09	160.623	.036	1.276	.205
Price information	172.787	.002	.061	.951
Used improved seeds	162.443	.003	.115	.908
Distance from major market	2.958	-.059**	-1.991	.049
Distance from major road	12.669	-.054*	-1.663	.099
Livestock income in 2008/09	.059	.072**	2.242	.027
vegetable post harvest loss	16.801	-.773***	-19.336	.000
Crop income in 2008/09	11.219	-.267***	-9.177	.000
Size of land in hectares in 2008/09	282.270	.019	.572	.569
R	0.964			
R^2	0.930			
Adj. R^2	0.918			
F	79.164			
N	120			

N = Sample size, R^2 = R square, Adj. R^2 = Adjusted R square ***, ** and * significant at less than 1%, 5% and 10% significance level respectively,
Source: Own computation (2010)

Post harvest loss in vegetable: For this variable the relationship with the income of the households from vegetable is not indicted in a prior. The result of the regression model, for the coefficient of the variable shows that there is negative relationship with income of the household from vegetable. The p-value of the explanatory variable vegetables post harvest loss was highly significant at less than 1 percent significant level ($0 < 0.01$). This indicates that a one percent increase in post harvest loss in vegetables reduces the income of the household from vegetable by 77.3 percent. This shows that how as the vegetable income increases the post harvest loss from vegetables also increases. This is due to lack of proper handling in post harvest loss and diseases and pests.

Crop income: As hypothesized the regression coefficient of crop income variable is negatively related with income of the household from vegetable. The p-value of the explanatory variable crop income is also highly significant at less than 1 percent significant level ($0 < 0.01$). This indicates that a one percent increase of crop income reduces income from vegetables by 26.7 percent. This shows that if the household chooses to produce vegetable its income from vegetable increase and the income from crop reduce. This also indicates the allocation of land in farm production since land is a scarce resource in most developing countries remaining other things constant. Therefore, the household decision should remain based on the opportunity cost of choosing either of the products.

Distance from major market: As hypothesized, distance from major market affects negatively total income from vegetable. The p-value of the explanatory variable is less than the chosen 5 percent ($0.049 < 0.05$). This indicates that one additional kilometer move from the production center to the market reduces vegetable income by 6 percent. This shows that if the producers market is far from the production center, either the producer is not willing to produce or it sales at the price offered in the immediate market. This can be also explained as when the producer interacts with intermediaries in areas far from his production center, either his income reduces due to cost of transport and post harvest related factors during marketing process or sell and receive at whatever the price in the market due to the lower bargaining power of producer which is further minimized by the perishable nature of the product.

Distance from farm to major road: This was another variable expected to influence income from vegetables. As hypothesized, the regression coefficient of vegetables quantity produced variable is negatively related with income of the household from vegetable. The p-value of the explanatory variable distance to major road is less than the chosen 10 percent significant level ($0.099 < 0.1$). This indicates that one kilometer additional move from the major road to the production center decreases income from vegetable by 5.4 percent. The same explanation like that of distance from major market, as the distance from a vegetable producer area increases by one kilometer to major road,

either the producer may not be willing to produce vegetables, or due to post harvest and other product feature of vegetable which make the income of the household from vegetable to be reduced.

Off farm income: For this variable the relationship with the income of the households from vegetable was not indicted in a prior. The result of the regression model, for the coefficient of the variable shows that there is negative relationship with income of the household from vegetable. The p-value of the explanatory variable off farm income is significant at less than 10 percent significant level ($0.057 < 0.1$). This indicates that one additional birr income from off farm activity reduces the income of the households from vegetable by 5.5 percent. This indicates that off farm income and vegetable income has a negative relationship. This is an indication that when the producer income increases from nonfarm activity the amount of labor involved in production of vegetable reduces.

Livestock income: For this variable also the relationship with the income of the households from vegetable was not indicted in a prior. However, this is the only variable found to affect income from vegetables positively. The result of the regression model, for the coefficient of the variable shows that there is positive relationship with income of the household from vegetable. The p-value of the explanatory variable livestock income is significant at less than 5 percent significant level ($0.027 < 0.05$). This indicates that one additional birr income from off farm activity increases the income of the households from vegetable by 7.2 percent. This can be explained as the livestock income increases the producer of vegetable can invest income from livestock to his vegetable farm in the form of inputs and other necessary requirements for vegetable production. This is also an indication that the production of livestock and vegetable can be implemented side by side.

The other variables like size of land, credit, extension service, price information and improved seeds were not significant as expected. However, they exhibited positive relationship with vegetable income.

CHAPTER - FIVE

5. Conclusion and Recommendations

5.1. Conclusion

The main theme of this thesis is to analyze the impact of supply chain of perishable agricultural products (vegetables) on income derived from vegetables. The study is conducted particularly focusing on irrigation cooperatives located in the southern zone of Tigray. This is due to the highest number of irrigation cooperatives members in the region. Among the vegetables the particular emphasis of the study is on income derived from three vegetables. These are onion, potato and tomato. These vegetables are preferred, on one hand for the reason that they are major sources of income in irrigation cooperatives, and on the other hand for the reason that there are so many constraints in relation to the perishable nature of the products which affects the producer's income. Therefore, the study of this paper focused in these vegetables.

A total of 120 households from vegetables producers irrigation cooperatives (16 female headed households and 104 male headed households) drawn from two southern zone Woredas. To collect the necessary data for the analysis structured and pre tested questionnaires are used. Focused group discussion and key informant interview are also conducted. Secondary data on basic agricultural and population is also collected to strengthen the analysis. The analysis is conducted using descriptive statistics and empirically.

The analysis of the collected data showed that most of the households are illiterate (40.8%). The average age of the households is 40.03 years. The average family size is about 5.41 of which the active labor force is 3. The average land holding is about 0.47 hectare per household of which 0.25 hectares of land on averages used for vegetable production per household. The average ownership of livestock is 4.34 TLU.

The majority of the households in the study area become a member of irrigation cooperative voluntarily. The majority of the households identified that irrigation water management and provision of fertilizer as a major benefit obtained from the cooperative. The average years of experience as a vegetable producer of the households is 6.7 years and as cooperative members the average years are 4.6.

The income sources of the households are both from agricultural and non agricultural income sources. The average income the households received in the crop year 2008/09 was 10,672.15 birr. Of the total income the average income from off farm activities was 1,095.25 (10.26%) birr. From agricultural activities the households on average received 1267.45 (11.9%), 6,719.83 (62.97%), 1589.61 (14.9%) and 6.66 birr from crops, vegetables, livestock and bee colony respectively.

The total income received from sold onion, potato and tomatoes were 806,380 birr in the study area. A total of 748 quintal of onion, 662 quintal of potato and 953 quintal of tomatoes were sold in the production year 2008/09. The average price received per quintal for onion, potato and tomatoes were 364.34 birr, 352.65 birr and 315.20 birr respectively. This income was the highest income received by the households from agricultural income sources.

From the identified market channels the channel that stretched as producer – wholesaler retailers, *producer – cooperatives – wholesalers - consumers,* and producer – wholesalers - out of region are some of the forms of supply chain used for vegetables by the produces. In the supply chain of the vegetables wholesalers are found to be the dominant buyers of vegetables.

Among the constraints of income from vegetables land size, fertilizer in terms of its cost, perishable nature of the product, shortage of improved seed, irrigation water shortage, storage, technical assistance both for production and marketing, lack of training from the cooperatives and disease and pests are among the major ten rated constraints of income from vegetables.

The econometric result for the determinants of income from vegetables shows that among the hypothesized seventeen variables six of them were found significant. These are vegetable post harvest loss, crop income, distance from major market, distance from major road, off farm income and livestock income. Livestock income was the only variable which affects vegetable income positively. Post harvest loss and crop income were highly significant factors to affect income from vegetables. Other variables like land size, credit, extension service, price information and improved seeds are not significant as expected though, they exhibited positive relationship with vegetable income.

5.2. Recommendations

Based on the result of descriptive statistics, focused group discussion and econometrics model analysis the following recommendations are suggested to improve in general the income of the households and particularly income from vegetables in the study area.

Production related: Income from vegetable is found to be the household's major source of income in the study area. However, there were constraints like shortage of land, improved seeds, disease and pests, frost, irrigation water and post harvest losses during production and marketing processes to increase income from vegetables.

The problems related to the shortage of land cannot be resolved with policy measures like land redistribution since land is a scarce resource in general and particularly to the study area. Instead it can be substituted by implementing high yield improved seeds and implementing fertilizers in order to increase the productivity of land with limited land size. For this cooperatives, stakeholders in marketing of inputs system and research institutions in the field should be encourage by government to combat the problems related to productivity with a given land size.

The other constraint related to weather in vegetable production is frost. This constraint can be resolved either by shifting the production period when the existence of frosts are high or by implementing frost resistance seeds and other mechanisms like shifting other crops which may not be affect by frosts in order to combat the losses due to frost related

problems. The problem of weather extends also in the case of droughts and irrigation water shortage. In the case of drought developing crop insurance scheme with a minimum premium is an option to compensate the vegetables income loss during drought period. Developing alternative water sources apart from the current spring and small tributary rivers; drilling ground water, constructing dams and using ponds analyzing the cost benefits and environmental aspects could be an option to combat irrigation water shortages.

Implementing disease resistance verities of vegetables or implementing pesticides can resolve the constraints related to diseases and pests. However, one of the constraints to implement disease resistance verities and pesticides are their costs and availability in the input marketing system. In order to solve such problems government should work more the availability of such verities by encouraging those stakeholders in the input marketing system and agricultural institutions should work in research and developments in developing disease resistance verities in order to minimize the costs.

Post harvest losses in perishable products during production and marketing process are very high. This is also identified in the study area. The post harvest losses during production process can be resolved by the provision of appropriate trainings in post harvest handling to minimize the lost level. The post harvest losses in the process of marketing can be also solved by provision of appropriate trainings. In addition to provision of trainings, developing appropriate storage facilities, transport and packaging system by government considering costs of marketing facilities could be an option in order to minimize problems related to post harvest losses during marketing process. Processing of vegetables, especially for tomatoes is another option to solve the post harvest constrain in the production of vegetable.

Market related: Market related problems are also another problems found to reduce the income from vegetable. During this study this is measured both in terms distance to major market and off road distance from production center. Producers travel to sell their vegetable produce like markets in Mekelle and Sekota, the border town between Tigray

and Amhara regional states in search of better market price. The result shows negative correlation with income from vegetable. Therefore, such market decision should be based on the cost and benefit analysis of the producer. In order to solve such instances government bodies should give training in farm budget planning. This also helps to transform the traditional marketing performance to the level of modern marketing system.

According to the focused group result brokers, commission agents play a major role both in marketing and transporting vegetables. However, the margin of benefit received by brokers and commission agents are affected the producer's income. This could be resolved by strengthening cooperatives management system in general and developing market searching scheme in particular with provision of trainings related to the problems. If the existence of brokers in the supply chain of vegetables is vital setting standards for the margin of benefit by brokers and legalizing the role of brokerage in the supply system of vegetable is an option to resolve the offset margin and other related problems.

Gender related: As per the descriptive result the inclusion of women in the cooperatives is minimum. The econometrics model results although it is not significant it shows that negative relationship with the household income from vegetable. Therefore, the inclusion of female members should be encouraged by the government. Woman also should be encouraged by providing more access to credit, more technical assistance and farm inputs in order to improve the economic status of the female headed households.

Income related: The income source like off farm income and crop income are correlated negatively with vegetable income. This is an indication t to see the opportunity cost of production of vegetables in the study area. Therefore, opportunity cost of crops income and off farm income should be under investigation in order to resolve unnecessary production of crops or vegetables and times involved in off farm activities rather than vegetable production considering the socio economic and environmental aspect of the area. This invite for another investigation to decide the opportunity cost of vegetable production in the study area. Universities, the rural development office of the study area

and other concerned bodies should work to supplement or draw clear remark in the finding of this paper in the study area.

Lastly, according to the descriptive statistics, market information related to price, demand and supply information are transmitted in production period (2008/09) in the study area. There is no significant deference with price and supply information. With regard to demand information the analysis shows that significant difference in the study area. Further in the model, although the variable is not significant it shows negative correlation with the income of the producer in the study area. According to the sampled households, the information is forecasted based on the previous production period with the highest demand and highest price. This information is collected based on their own experience and the information from simple observation in the market. Therefore, farmers tend to produce the vegetable with higher demand and price in the previous crop year. In this regard farmers sell their vegetable product with minimum price than expected due to high supply in the market for particular vegetable product and others vegetable products price tend to increase due to shortages in market supply. Therefore, central demand forecasting information considering the vegetable production in the region in specific period should be provided for farmers by the regional bureau of rural development and other concerned bodies.

To conclude and to include final remarks problems for the analysis of income particularly from vegetables related to this paper, the recorded information from households cooperatives, and other concerned bodies were not available in proper recording system. In these regard producers particularly cooperatives should be encouraged to develop recording systems in the process of production, marketing and farm budget plan of producers by government. So that producers can perform better farm planning and strategies, researchers in the area also can draw better analysis results and further investigation can be facilitated. Hence, more appropriate measures, strategies and policies can be facilitated which benefit particularly to alleviate the overall economic statues of the producer.

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Appendices

Appendix 1: Conversion factors used to compute tropical livestock units

Animal category	TLU
Calf	0.25
Weaned calf	0.34
Heifer	0.75
Cow or ox	1.00
Horse/mule	1.10
Donkey adult)	0.70
Donkey young)	0.35
Camel	1.25
Sheep or goat adult)	0.13
Sheep or goat young)	0.06
Chicken	0.013
Bull	0.75

Source: Storck *et al*., 1991

Appendix 2: Conversion factors used to estimate man equivalent

Age group	Male	Female
< 10	0	0
10-13	0.2	0.2
14-16	0.5	0.4
17-60	1	0.8
>60	0.7	0.5

Source: Bekele Hundie, 2001

Appendix 3: Variance inflation factor for continuous explanatory variable

Variables	Tolerance	VIF
Age of HH	.643	1.554
Family size	.648	1.544
Oxen owned in 2008/09	.689	1.452
Off farm income in 2008/09	.854	1.171
Distance to major market of vegetable km	.792	1.262
Distance from farm to major road in km	.667	1.500
Livestock income in 2008/09	.660	1.515
vegetable post harvest loss	.432	2.316
Crop income in 2008/09	.366	2.730
Size of land in hectares in 2008/09	.666	1.503

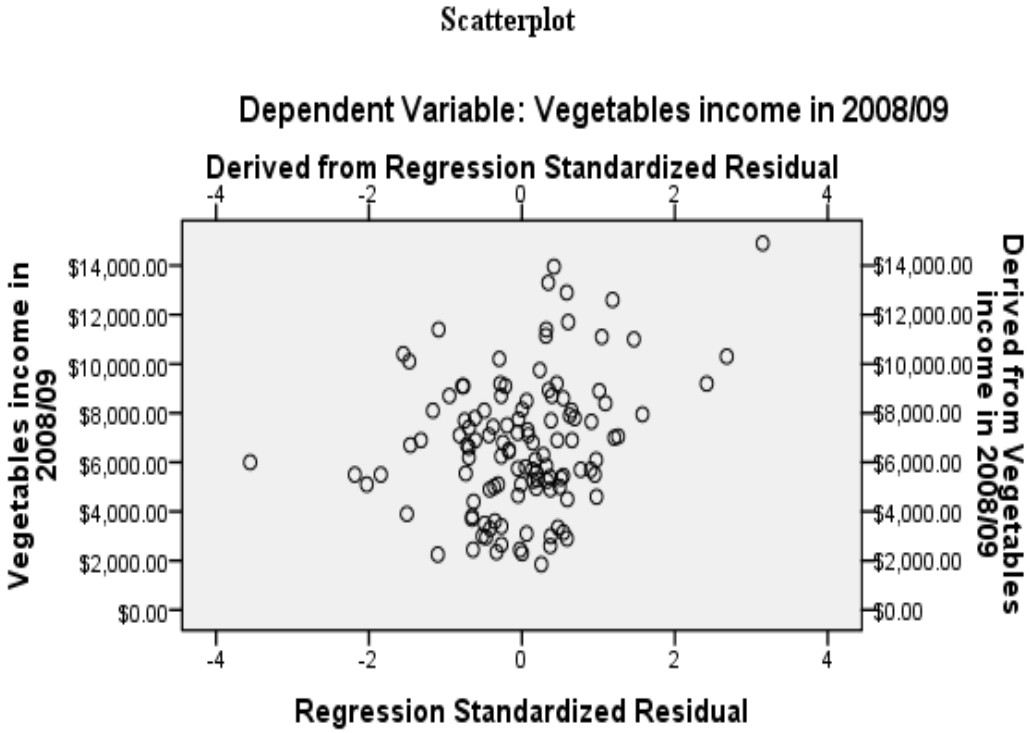
Source: Own computation (2010)

Appendix 4: Contingency coefficients for dummy (discrete) variables

	Sex	Education	Demand forecast	Credit	Extension	Price information	Improved seeds
Sex	1						
Education	0.265	1					
Demand forecast	0.003	0.152	1				
Credit	0.053	0.230	0.052	1			
Extension	0.082	0.227	0.007	0.098	1		
Price information	0.083	0.173	0.010	0.101	0.157	1	
Improved seeds	0.057	0.212	0.032	0.201	0.104	0.112	1

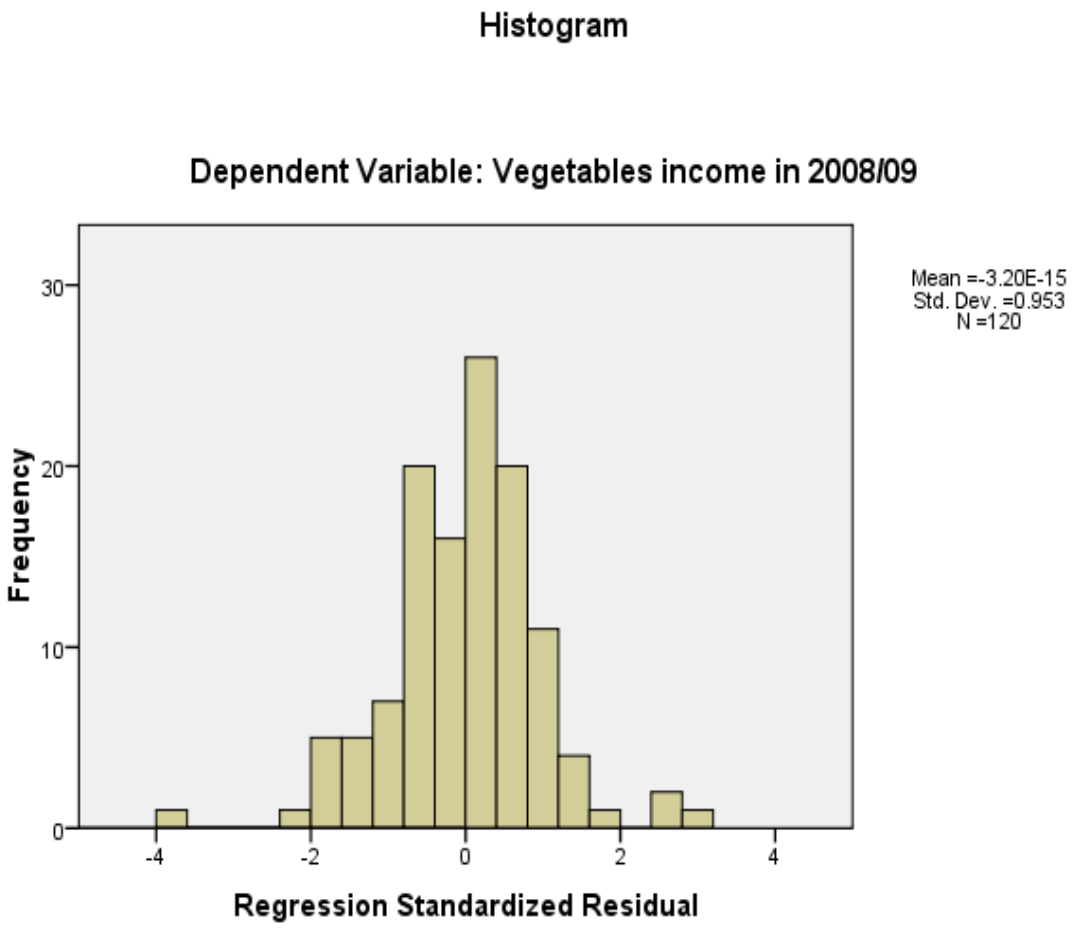
Source: Own computation (2010)

Appendix 5: standardized residual for dependent variable



Source: SPSS result (2010)

Appendix 6: Histogram for dependent variable standardized residual



Source: SPSS result (2010)

Appendix 7: Questionnaire

"Determinants of the income from vegetables in the supply chain of perishable agricultural products" in southern Tigray survey questionnaire

By Shimeles Negussie.

Questionnaire number: _____

Name of enumerator: _____ Date: _____/_____/_____

I. Area information

1. Woreda Alaje =1, Offla =2

2. Name of Irrigation cooperative _____

II. Demographic characteristics

3. Name of household head _____

4. Sex of household head Male = 1, Female = 2

5. Age of household head _____year

6. Marital status household head

1. Single 2. Married 3. Divorced 4. Widowed

7. Education level of household head / indicate also your years of education _____

1. Illiterate 2. Read and write 3. Primary school

4. Secondary school 5. Above secondary education

8. Age, sex & education level of family members including household head.

Use the code	Age	M = Male F = Female	Education level. use code from Q.7)
Code: 1 = Husband 2 = Wife 3 = Son 4 = Daughter 5 = Other family member			

II. Resource ownership and tenure

9. Do you own land? Yes = 1, No = 0

10. If yes what was the size of your land in production year 2008/09? _____hectares.

11. How many hectares of land are used for the production of vegetable? _____

12. Livestock, poultry and apiculture ownership

Type of ownership		Number owned in 2008/09	No. of sold	Cash income from sold (Birr) 2008/09
Cows				
Oxen				
Heifers				
Yearling				
Calves				
Bulls				
Sheep	mature			
	lamb			
Goats	mature			
	kids			
Donkeys	mature			
	kid			
Horses				
Mules				
Poultry				
Bee colony				
Other (specify)				

III. Membership of Irrigation cooperative

13. How long you stay as a member in irrigation cooperative? _____

14. Do you become a cooperative member voluntarily? Yes = 1, No = 0

15. Are you also a member of other cooperatives? Yes = 1, No = 0

16. Did you use irrigation system for your farming before you become a member?

Yes = 1, No = 0

17. What is your year of experience as a vegetable producer? _____

18. Did you have constraints to increase your income from sell of vegetables in 2008/09 as a cooperative member with regard to the following?

Item No.	Constraints		Yes = 1 No = 0	Rate the problems 1 = Not limiting 2 = Limiting 3 = Average 4 = Highly limiting 5 = Very highly limiting	Impacts on income 1= Very low 2= Low 3= Average 4= High 5 = Very high
1	Production factors	Land size			
		Fertilizer			
		Method of production			
		Labor			
		Disease and pests			
		Irrigation water			
		Climate			
		Improved seed			
		Access to credit			
		Technical assistance in production			
2	The nature of the product	Perish ability			
		Size of the product			
		Seasonality			
		Organic Nature/free of chemicals			
3	Harvesting and Post harvest handling	Method of assembling			
		Inappropriate storage			
		Method of transport			
		Lack of grading			
		In appropriate Packing			
		Lack of processing			
4	Membership	Lack of training			
		Management problem			
5	Market access	Distance to major market			
		Distance to major road			
		Lack of price information			
		Price of vegetable			
		Low demand			
		High supply			
6	Others				

19. Was the following problems caused you to join irrigation cooperative?

Problems	Yes = 1	No = 0	If yes rate the problem 1 = Very low 2 = Low 3 = Average 4 = High 5 = Very high
1. Availability of inputs			
2. Marketing of outputs			
3. Irrigation water management			
4. Lack of skill in marketing			
5. Lack of capital			
6. Lack of Storage			
7. Quality maintenance			
8. Price control of your product			
9. Transporting your product			
10. Size of land owned			

20. Do you sale your agricultural product to the cooperative? Yes = 1, No = 0

21. If yes what percentage of your marketable products do you sale through your cooperative society? Use the following local measurement of percentage 0, ¼, 1/3, ½, ¾; please list the products in the table below.

Item No	Type of product	0	¼	1/3	½	¾	1

22. What is your opinion (perception) on the price offered by cooperative to your agricultural produce as compared to other private traders?

Item No	Type of product	Very Low (1)	Low (2)	Average(3)	High (4)	Very high (5)

23. What are the major benefits received from your cooperatives in marketing of your vegetable product?

Benefits	Yes = 1	No = 0	If yes, rate the benefit 1 = Very Low 2 = Low 3 = Average 4 = High 5 = Very high
Supply of inputs			
Out puts marketing			
Irrigation water management			
Training			
Storage facility			
Quality maintenance			
Price control			
Credit facility			
Bargaining power			

24. Has the income from your vegetable production changed since your membership?

Yes = 1 No = 0

25. If yes, what was the change of production in quintals and income from vegetable in Birr?

Item No	Type of product	Before membership production in quintals	After membership production in quintals	Before membership income in Birr	After membership income in Birr
1	Onion				
2	Tomato				
3	Potato				

26. If there is a change, what do you think the cause of improvement in your income from vegetable?

Item No	Cause of improvement	Not Increased (1)	Increased(2)	Average (3)	Highly increased (4)	Very highly increased (5)
1	Input price					
2	Output price					
3	Quality					
4	Bargaining power					
5	Transport price					
6	Intermediaries					
7	Others (specify)					

27. How important is this organization for the marketing of vegetable?

1. Very unimportant 2. Unimportant 3. Neither important nor unimportant

4. Important 5. Very important

28. How do you consider the management of the organization that you belong to?

1. Not good 2. Good 3. Regular 4. Very good 5. Excellent

IV. Income of the Irrigation Members

29. What were your major sources of income as a member of cooperative in 2008/09 and rate the importance?

Activity	Average Annual income in Birr	Rate the importance 1-5
Crops		
Livestock		
Vegetable		
Poultry		
Bee keeping		
Off farm		

30. Which vegetables cultivate mostly in your land and specify annual income earned in 2008/09 production year?

Item No	Type of vegetable	Yes = 1, No = 0	Land used in hectare	Produced in quintal	Annual revenue (Birr)
1	Potato				
2	Onion				
3	Tomato				
4	Others (specify)				

V. Production

31. How do you describe the fertility of your land?

1. Very low 2. Low 3. Adequate 4. High 5. Very high

32. Was your land suitable for production of vegetables in 2008/09? Yes = 1, No = 0

33. How many times produce vegetables per year in 2008/09? _____

34. If you produce once in the year what were the problems to produce the vegetables more than once in the year?

Item No	Factors limited to produce more than once in the year	Yes = 1,	No = 0
1	Market demand		
2	Lack of capacity		
3	Shortage of water		
4	Price of vegetable		
5	Other (Specify)		

35. How frequently do you normally sell your vegetable production and what was your revenue in 2008/09?

Item No	Type of product	1. Less than once a month 2. Once a month 3. Every two weeks 4. Once a week 5. Twice a week	Total quantity supplied for market /quintal	Unit price/kg
1	Onion			
2	Potato			
3	Tomato			

36. What type of inputs were used and costs incurred for your production and marketing of vegetables in 2008/09?

Item No.	Type of input		Yes = 1	No = 0	Cost of farm input in Birr
1	Land				
2	Family labor				
3	Hired Labor				
4	Fertilizers				
5	Pesticides				
6	Improved seeds				
8	Farming harvesting equipment	Plowed by Tractor			
		Plowed by Animal			
9	Irrigation equipment and water				
10	Packaging				
11	Storage				
12	Grading				
12	Transport	Field to storage			
		Field to market			
13	Negotiation/brokerage				
14	Custom fee				
15	Loading unloading				
16	Others (Specify)				

37. Does the cost of production limit your vegetable income in 2008/09?

Yes = 1 No = 0

38. How did you evaluate your costs of production, harvesting, post harvesting and marketing of vegetable in 2008/09?

Item No.	Type of cost	Evaluation of costs 1= Very low 2= Low 3= Not relevant 4= High 5 = Very high	Impacts of costs on income 1= Very low 2= Low 3= Average 4= High 5 = Very high
1	Production		
2	Harvesting		
3	Post harvest handling		
4	Marketing		

39. Did you receive information before you plant what type of vegetable to produce in 2008/09?

Yes = 1, No = 0

40. Did you receive credit for your vegetable production in 2008/09? Yes = 1, No = 0

41. If yes from where do you get credit in 2008/09?

1. From cooperative 2. Banks 3. NGO

4. DCSI (Dedebit) 5. Using other sources (Specify)_____

42. Did you receive technical assistance for your production and marketing of vegetable in 2008/09?

Yes = 1, No = 0

43. If yes,

Item No	Technical assistance available	Yes = 1 No = 0	Source of technical assistance	Technical assistance is sufficient	
				Yes = 1	No = 0
1	Production				
2	Post harvest handling				
3	Marketing				
4	Processing				
5	Other (Specify)				

VI. Nature of the product

44. How do you characterize most of the products you cultivate from your irrigation in 2008/09?

    1. Perishable 2. Non perishable

45. If they were perishable do they influence your marketing?

    Yes = 1 No = 0

46. If yes, how do they affect your marketing?

Item No	Reason	Yes = 1 No = 0	Impact on marketing 1= Very low 2= Low 3= Average 4= High 5 = Very high
1.	Because they require different facilities.		
2.	Because they require high cost of harvesting.		
3.	Because they require high cost of post harvest handling		
4.	Because they require high cost of transport		
5.	Other (Specify)		

47. Has the size of the vegetable produced in 2008/09 creates a problem in your market demand?

    Yes = 1 No = 0

48. If yes, how do they affect your marketing?

    1 = Very low 2 = Low 3 = Average 4 = High 5 = Very high

49. Were your vegetable product produced in 2008/9 organic (free of chemicals)?

    Yes = 1 No = 0

50. What other factors influence your income in relation to the product characteristics in 2008/9? (Specify) _____

VII. Post harvest handling

51. Did you use selection in the form of product injury, weight, pest and disease damage and physical injury for your vegetable product? 1 = Yes 0 = No

51. Did you take any action in the post harvest system where some form of selection impacts your income of vegetable in the year 2008/09?

Item No	Type of selection	Type of product selection performed Yes = 1 No = 0			Impacts on income 1 = Very low 2 = Low 3 = Average 4 = High 5 = Very high		
		Onion	Potato	Tomato	Onion	Potato	Tomato
1	Product shape						
2	Product size						
3	Product weight						
4	Maturity						
5	Color						
6	Pest/disease damage						
7	Physical injury						
8	Other (Specify)						

52. Were any grading standards used for your vegetable product?

Yes = 1 No = 0

53. If yes, identify and describe the grading standard _____

54. Did you use any type of package for marketing of your vegetable products in 2008/09?

Yes = 1 No = 0

55. If yes, what was the packaging material used identify and describe? _____

56. Did you have appropriate storage facilities for your vegetable products?

Yes = 1 No = 0

57. From where did you get storage facilities?

1. Cooperatives 2. Government 3. NGO 4. Other (Specify) _____

58. What type of transportation method were used for your pre and post harvest and marketing of your vegetable products in 2008/09?

Where Transportation Takes place (Examples)	Method of transport	Who is responsible?	Who own the product during transportation?	Distance/Km	Duration Hours
Farm to store					
Farm to wholesaler					
Store to wholesaler					
Store to retailer					
Farm to consumer					
Wholesaler to retailer					
Other (Specify)					

59. Did the vegetable product undergo any type of processing or semi-processing at any point in the post harvest system in 2008/09?

Item No	Type of product	Yes = 1 No = 0	Type of process
1	Onion		
2	Potato		
3	Tomato		

VIII. Market access

60. When and where did you sale your vegetable product in the year 2008/09 and who were your major customers?

Item No	Type of product	When 1. Before harvest 2. At harvest 3. At store 4. Other (Specify)	Major Market 1. Village market 2. Mekelle 3. Alamata 4. On farm 5. Out of the region 6. Other (Specify)	Customers 1. Consumers 2. Wholesalers 3. Retailers 4. Assemblers 5. Processors 6. Other (Specify)
1	Onion			
2	Potato			
3	Tomato			

61. Did you receive market price information before you sell your vegetable in the same year?

Yes = 1 No = 0

62. If yes, what was the source of information?

1. From cooperative 2. Radio 3. NGO

4. Government 5. Using other sources (Specify)_____

63. Was, the information, 1. Reliable 2. Questionable 3. Based on guess

64. What was the demand of vegetable in your major market in the production year 2008/09?

Item No	Type of product	Very low	Low	Average	High	Very high
1	Onion					
2	Potato					
3	Tomato					

65. Was there total demand of vegetable information before you sell in your major market?

Yes = 1 No = 0

66. If yes, what was the source of information?

1. From cooperative 2. Radio 3. NGO

4. Government 5. Using other sources (Specify)_____

67. Was, the information, 1. Reliable 2. Questionable 3. Based on guess

68. What was the supply of vegetable in your major market in the production year 2008/09?

Item No	Type of product	Very low	Low	Average	High	Very high
1	Onion					
2	Potato					
3	Tomato					

69. Was there a total supply of vegetable information before you sell in your major market? Yes = 1 No = 0

70. If yes, what was the source of information? Specify _____

71. Was, the information, 1. Reliable 2. Questionable 3. Based on guess

72. Did you produce for all vegetable quantity demanded in your major market in the year 2008/09?

Item No	Type of product	Produce for market quantity demanded	
		Yes = 1	No = 0
1	Onion		
2	Tomato		
3	Potato		

73. If your answer is No, what were the reasons? Specify _____

74. Did you produce these products for export market in 2008/09? Yes = 1, No = 0

75. If No, What were the major problems?

Item No	Problems related to export	Yes = 1	No = 0
1	Lack of capacity for export market		
2	Poor quality		
3	Not meeting standards for export market		
4	Lack of facilities/storage		
5	Transport		
5	Other (Specify)		

76. Did you sale your vegetable products through brokers in 2008/09?

Yes = 1, No = 0

77. If yes, what was /were problem/s created by brokers in 2008/09 and their impact on your income?

Item No	Problem created by brokers	Type of product			Impact of income 1 = Very low 2 = Low 3 = Average 4 = High 5 = Very high		
		Onion	Potato	Tomato	Onion	Potato	Tomato
1	Took to limited client						
2	Cheating scaling (weighing)						
3	Charged high brokerage fee						
4	Wrong price (market) information						
5	Others (specify)-						

78. Did you use contract farming for your vegetables in 2008/09?

Yes = 1, No = 0

79. If yes, from whom do you receive contract?

1. Wholesalers 2. Retailers 3. Processors 4. Consumers

5. Assemblers 6. Others (Specify) _____

80. What were the impacts of contract farming on your income?

Item No	Type of product	Contract farming impact 1 = Very low 2 = Low 3 = Not relevant 4 = High 5 = Very high		Impact on income 1 = Very low 2 = Low 3 = Not relevant 4 = High 5 = Very high
		Price	Quantity	
1	Onion			
2	Potato			
3	Tomato			

81. If, not used what were the reasons?

1. Lack of production capacity 2. Price received is not like market price

3. Lack of quality 4. Other (Specify) _____

82. Which were the actors of supply chain in your vegetable supply in 2008/09?

Item No	Actors in supply chain of vegetable products	Onion		Tomato		Potato	
		Yes = 1	No = 0	Yes = 1	No = 0	Yes = 1	No = 0
1	Producer						
2	Wholesalers						
3	Retailers						
4	Consumers						
5	Cooperatives						
7	Government						
8	Others(Specify)						

83. Which form of supply chain describes to sale your vegetable product in 2008/09?

Item No	Type of supply chain	Type of product (✓)		
		Tomato	Onion	Potato
1	Producers - Consumer			
2	Producers - Retailers			
3	Producers - Wholesalers- Consumer			
4	Producers - Wholesalers- Retailers - Consumer			
5	Producers - Wholesaler - Out of region			
6	Producers - Rural assembler – Wholesaler – Retailer - Consumer			
7	Other (Specify)			

84. What was the overall relevance/share of the farmers of vegetable producer in the supply chains in 2008/09?

Item No	Type of product	Relevance of farmers 1 = Very low 2 = Low 3 = Average 4 = High 5 = Very high
1	Onion	
2	Potato	
3	Tomato	

85. What was the relationship you have with actors of supply chain of your vegetable products and their impact on your income in 2008/09?

Item No	Type of product	Type of relationship		Effect of relationship on income 1 = Very low 2 = Low 3 = Average 4 = High 5 = Very high
		Strong ties	Weak ties	
1	Onion			
2	Tomato			
3	Potato			

86. To which customers were the vegetable products sold to in the supply chain and what were their importance as customers and their share of vegetable sold 2008/09?

Item No	Type of customer	Level of importance 1 = Very low 2 = Low 3 = Average 4 = High 5 = Very high	Share of quantity sold in quintal		
			Onion	Potato	Tomato
1	Wholesalers				
2	Retailers				
3	Consumers				
4	Processors				
5	Rural assemblers				
6	Brokers				
7	Supermarkets/Hotels				
6	Others (Specify)				

87. Who was determining price in your vegetable marketing in 2008/09 and what was the influence level on price?

Item No	Actors	Type of product			Influence level on price 1 = Very low 2 = Low 3 = Average 4 = High 5 = Very high
		Onion	Potato	Tomato	
1	Producers				
2	Wholesalers				
3	Retailers				
4	Consumers				
5	Processors				
6	Rural assemblers				
7	Others (Specify)				

88. What was the selling price per unit of the product to the next stage of the supply chain of vegetable product in 2008/09?

Item No	Type of product	Stages 1.Wholsalers 2. Retailers 3.Consumers 4.Other (Specify)	Maximum (Birr/kg)	Average (Birr/kg)	Minimum (Birr/kg)
1	Onion				
2	Potato				
3	Tomato				

89. What was the estimated profit per unit of the vegetable product in 2008/09?

Item No	Type of product	Maximum (Birr/kg)	Average (Birr/kg)	Minimum (Birr/kg)	Average profit
1	Onion				
2	Potato				
3	Tomato				

90. What was the maximum geographical distance to transport product to the major vegetable customers? _____ Km.

91. What is the maximum geographical distance your production center of vegetable from major road? _____ Km.

92. Can you list as much as possible the major problems in your vegetable marketing in relation to production, post harvest handling, product nature, and membership and market performance in 2008/09? Use a separate paper:

Thank you,

Check list for Experts and administrative

1. What is your title? _____
2. What is the potential of the area in the production for vegetable product?
3. What is the potential of the area for export of vegetable?
4. What are the major constraints in production of vegetable?
5. What are the major assistance provide for irrigation cooperatives?
6. Is vegetable production the main source of income for farmers?
7. If not, what are the problems?
8. What efforts were made to increase production of vegetable in the area?
9. Does irrigation cooperative have the potential for export market?
10. If not what are the constraints for export market?
11. What is the potential area for irrigation?
12. What is the major source of irrigation water in the area?
13. Is there any mechanism to solve market problem when there is high production?
14. Do farmers get continuous information with regard to price?
15. Do farmers encouraged producing vegetable for market?
16. Is there any facility provided for vegetable producers to decrease losses since vegetable products perishable?
17. Is there any vegetable processor industry in the area?
18. If not, what are the reasons?