Ethiopian Journal of Economics

Volume XXIV Number 2 October 2015

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A Publication of
THE ETHIOPIAN ECONOMICS ASSOCIATION
(EEA)

VOLUME XXIV NUMBER 2 OCTOBER 2015

Note: The First article**,** Marketing System Analysis of Vegetables and Fruits in Amhara Regional State: Survey Evidence from Raya Kobo and Harbu Woredas is winner of the competitive research grant that was established by the Ethiopian Economics Association (EEA) and the International Food Policy Research Institute (IFPRI) with the aim of encouraging economic policy relevant empirical research focusing on price dynamics in Ethiopia.

Published in August 2016

Marketing System Analysis of Vegetables and Fruits in Amhara Regional State: Survey Evidence from Raya Kobo and Harbu Woredas

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Abstract

This study attempted to analyze the different aspects of marketing system of vegetable and fruit in Raya Kobo and Harbu woredas, Amhara regional state using different indicators. Probit estimation for determinant of participation probability in vegetable and fruit production and OLS estimation technique were also applied for examining determinants of market supply and demand for vegetable and fruit products. Accordingly, the results showed that lack of genuine and timely market information, poor institutions and arrangements, poor marketing infrastructures (poor storage, cool chain facilities, packaging, weak pre and post harvest handling practices, non scientific grading and standard, etc), long market channel, high and unfair profit margin distribution among the value chain actors with little share to the farmers were observed in both vegetable and fruit market. These are an indicative of poor marketing efficiency and thereby suboptimal operation of the marketing system. The econometric regression result of this study exhibited almost similar results as previous studies however the determinants were not same for all sample crops (onion, tomato, mango and avocado) rather differs from crop to crop. In general, family size, total size of land, extension service, farmer's experience, average lagged price, distance from main road and age were found to be significant factors (with expected sign) of production participation in vegetables and fruits . Similarly, average current price, distances from main road, age, total size of land, farmers' experience, sex, number of oxen, and access to market information were found to be significant determinants of market supply of vegetables and fruits. Finally, family size, purchase frequency, amount of single purchase lot, average

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The final version of this article was submitted in April 2016.

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The author would like to thank EEA and IFPRI for granting to conduct this study.

current price, income level, average expenditure on food and purchasing, and amount per trip were found to be significant line with expected sign as determinants of demand for vegetables and fruits in the study area. Hence, the results found in this study are clearly an indicative for taking appropriate measures in production side, market infrastructure, arrangements and institutions to improve the inefficient functioning of the marketing system.
Key words: Marketing system, structure, conduct, performance, channel, margin, production participation, market supply, market demand.

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JEL Classification: D04, L01

1. Introduction

Efficient marketing system plays an important role in the economic development as it stimulates production, avoids unnecessary fluctuation in output and prices and reduces costs of production and unfair share of consumer's price. However, for attaining these benefits, marketing system and marketing technology have to keep pace with the production technology and socioeconomic development of the country. The experience of many countries suggests that in the absence of an efficient marketing system strategy, agricultural development cannot go very far to stimulate production and contribute to price stability (Khalon and George, 1985).

Particularly, marketing of vegetable and fruit crops do complex especially owning to its perishability, seasonality and bulkiness nature. This is also leading to high and fluctuating consumer prices and unfair share of the retailer's price. At same time, the livelihood of many smallholder farmers is becoming dependent on the cash income from commerce of agricultural product like vegetables and fruits. As a result, there has been due concern in recent years regarding the efficiency of marketing of fruits and vegetables. Of course, there are many similar studies done in marketing system of agricultural products which employed different approaches. Some of them

focused on the value chain analysis while other relied on market supply merely. However, for proper interventions and strategies in solving those problems and making the playing field more competitive, able suppliers get fair price and consumers pay reasonable price, comprehensive knowledge and empirical evidences on how the current marketing system of vegetables and fruits is operating and to what extent the challenges are prevailed is needed.

Hence, it is relevant to conduct a study on vegetable and fruit' marketing system using holistic approach (employing combinations of different approaches of studying marketing system and incorporating both supply demand aspect of marketing system). This is again believed that it will strengthen evidences for suggesting possible interventions to correct the problem. Realizing of this fact, this study has attempted to assess the marketing system (including determinant of production participation, market supply and demand) of vegetables and fruits in Raya Kobo and Harbu Woredas, Amhara Regional State. To meet the objective of the study, both primary and secondary data sources were employed. For analysis of the collected data, combination of different approaches and methods (both descriptive and econometrics) were used.

2. Literature

This part deals with the basic conceptual frameworks and empirical works on markets, marketing, marketing system and market channel, factors affecting market supply, the approaches and methods to evaluate the marketing system of agricultural products.

2.1 Conceptual Framework

2.1.1 Basic concepts

Agricultural marketing

The term marketing has been a debatable issue and defined in various ways by different intellectuals. Accordingly, marketing can be defined as the performance of all business activities involved in the flow of food products

and services from the point of initial agricultural production until they are in the hands of consumers (Kohls and Uhl, 1985; Bain and Howells, 1988). As of Kotler and Armstrong (2003), marketing is a societal process, by which individuals and groups obtain what they need and want through creating, offering, and freely exchanging products and services and value with others. In general, it is an institutional arrangement for buying and selling of products.

Marketing system

As cited in Andargachew (1990), the concept of marketing system comprises physical distribution of economic input and products as well as the mechanism of process or coordinating production and distribution. Branson and Norvel (1983) defined the marketing system in terms of what is otherwise known as marketing channel. In broad terms, marketing system may be defined as the totality of product channels, market participants and business activities involved in the physical and economic transfer of goods and services from producers to consumers. Marketing system operates through a set of intermediaries performing useful commercial functions in chain formations all the way from the producer to the final consumers (Islam *et al.*, 2001).

Marketing channel

It is a business structure of interdependent organizations from the point of product origin to the consumer with the purpose of moving products to their final consumption destination (Kotler and Armstrong, 2003).The analysis of marketing channels is intended to provide a systematic knowledge of the flow of goods and services from their origin (producer) to their final destination (consumer).

Market chain analysis

A marketing chain is used to describe the numerous links that connect all actors and transactions involved in the movement of agricultural products from the farm to the consumer (Lunndy *et al.*, 2004).

2.1.2 Approaches to the Study of Agricultural Marketing System

Studying agricultural marketing system requires different approaches for analyzing marketing performance, structure, conduct, functioning, challenges etc. The following are major and most commonly used once.

Functional approach

Studying marketing system using functional approach is just to break up the whole marketing process into specialized activities performed in accomplishing the marketing process (Kohls and Uhl, 1985). This approach helps to evaluate marketing costs for similar marketing middlemen and/or different commodities and costs and benefits of marketing functions (Kohls Uhl, 1985; and Andargachew, 1990). The widely accepted functions are: exchange (buying and selling), physical (processing, storage, packing, labeling and transportation), and facilitating (standardizing, financing, risk bearing, promoting and market information). The exchange function involves pricing, buying and selling which is a transfer of title between exchanging parties.

Institutional approach

This approach relies on the description and analysis of different organizations engaged in marketing (producers, wholesalers, agents, retailers, etc) and pays special attention to the operations and problems of each type of marketing institution. The institutional analysis is based on the identification of the major marketing channels and it considers the analysis of marketing costs and margins (Mendoza, 1995).

Commodity approach

In this approach, a specific commodity or groups of commodities are taken and the functions and institutions involved in the marketing process are analyzed (Kohls and Uhl, 1985). This approach is said to be the most practical as it helps to locate specific marketing problems of each commodity and improvement measures. This approach follows the commodity along the path between producer and consumer and is concerned

with describing what is done and how the commodity could be handled more efficiently (Purcell, 1979).

Structure, Conduct and Performance (SCP) model

SCP model is also one of the most common and pragmatic methods for analyzing marketing system. It analyzes the relationship between functionally similar firms and their market behaviour as a group and, it is mainly based on the nature of various sets of market attributes and relations between them and their performance (Scarborough and Kydd, 1992). This analytical method is based on the theory that market structure and market conduct determine the performance of a marketing system.

Market structure[2], conduct[3] and performance[4] (SCP) framework was derived from the neo- classical analysis of markets. The SCP paradigm was the brain child of the Harvard school of thought and popularized during 1940-60 with its empirical work involving the identification of correlations between industry structure and performance. This SCP hypothesis has lead to the implementation of most anti-trust legislation. This was followed by the Chicago school of thought from 1960 (Edwards *et al.*, 2005). Accordingly, there are two competing hypotheses in the SCP paradigm: the traditional "structure performance hypothesis" and "efficient structure hypothesis". The structure performance hypothesis states that the degree of market concentration is inversely related to the degree of competition. This is because market concentration encourages firms to collude. More specifically, the standard SCP paradigm asserts that there is a direct

[2] Includes the characteristics of the organization of a market that appear to exercise a strategic influence on the nature of competition and pricing within the market. This is investigated using tools like market concentration and barriers to entry for potential participant in the market.

[3] There are no agreed up on procedures for analyzing the elements of market conduct Yet, few points are considered to systematically investigate indications of unfair price setting practices and conditions under which such practices are likely to prevail such as formal and informal grouping, availability of price information (Scarborough and Kydd, 1992).

[4] It indicates the effect of structure and conduct on prices, costs, and volume of output. It can be analyzed using market efficiency, costs and margins of marketing agents in different channels.

relationship between the degree of market concentration and the degree of competition among firms. This hypothesis will be supported if positive relationship between market concentration (measured by concentration ratio) and performance (measured by profits) exist, regardless of efficiency of the firm (measured by market share).

Thus, firms in more concentrated industries will earn higher profits than firms operating in less concentrated industries, irrespective of their efficiency. The efficiency structure hypothesis states that performance of the firm is positively related to its efficiency. This is because market concentration emerges from competition where firms with low cost structure increase profits by reducing prices and expanding market share. A positive relationship between firm profits and market structure is attributed to the gains made in market share by more efficient firms (Edwards *et al.*, 2005).

Here, it is worthwhile to mention how much the power of SCP framework is relevant to analyses the marketing system of agricultural products. Accordingly, from its components it is evident that SCP paradigm enables us to study how a given marketing system functions (in terms of the three elements of the model: structure, conduct and performance). It also helps us to identify the participants, size of market, product diversification, behaviour of the market agents and their interactions. Moreover; it deals with the efficiency of the market through its performance aspect of the market.

However, SCP framework is not free from limitations. One drawback can be its assumption of exogenous on market structure which means that it doesn't consider the dynamic aspect of the market, i.e. focuses only the static condition. It also fails to take in account the effects of technology development and economic growth on marketing system. Hence, considering the dynamic aspect of the market using other method is believed that it improves the results and thereby able to make sound inferences. Nonetheless, this is a bit complex and beyond the scope of this paper. Hence, this study only focuses on results obtained using the SCP paradigm. In general, this paper employed a combination of the aforementioned approaches to get better and sound results of analyzing marketing system.

2.1.3 Market supply

Marketed supply refers to the amount actually taken to the markets irrespective of the needs for home consumption and other requirements. Whereas, the marketable surplus is the residual with the producer after meeting the requirement of seed, payment in kind, and consumption by farmer (Wolday, 1994). Marketed surplus is defined as the proportion of output that is marketed (Harris, 1982). Marketed surplus may be equal to marketable surplus, but may be less if the entire marketable surplus is not sold out and the farmers retain some stock and if losses are incurred at the farm or during the transit (Thakur *et al*., 1997). In the case of crops that are wholly or almost wholly marketed, the output and marketed surplus will be the same (Reddy *et al*., 1995). The importance of marketed and marketable surplus has greatly increased owning to the recent changes in agricultural technology as well as social patterns. The decision to supply market is one big question but usually is taken after the product is at hand or if decided earlier some other decisions have to be considered.

Specifically, marketing of horticultural crops is quite complex and risky due to the perishable nature of the product, seasonal production and bulkiness. The range of prices from producer to consumer, which is an outcome of demand and supply of transactions between various intermediaries at different levels in the marketing system, is also unique for fruits and vegetables. Moreover, the marketing arrangements at different stages also play an important role in price levels at various stages (from farm gate to the final user). These features make the marketing system of fruits and vegetables to differ from other agricultural commodities, particularly in providing time, form and space utilities. While the market infrastructure is better developed for food grains, fruits and vegetables markets are not that well developed and markets are congested and unhygienic (Sharan, 1998).

2.2 Empirical literatures on Fruit and Vegetable Marketing system

There are enormous empirical works that shows how the vegetable and fruit marketing system in Ethiopia is functioning and factors that determine

vegetables and fruits production, market supply and demand. However, some of the most relevant are going to be reviewed below.

Bezabih and Hadera (2007) stated that the production of vegetables is seasonal and price is inversely related to supply. The situation is worsened by the perishability of the products and poor storage facilities. Farmers' bargaining power is low due to lack of alternative market outlet. They also found that the most common marketing channel immediately available to the farmer is through brokers i.e. up to three brokers between the producer and the trader which is an indication of long marketing channel. They recommended that the more the farmers organize themselves and access the terminal market, the more they benefit.

Bezabih (2008) also identified that lack of markets to absorb the production, low price for the products, large number of middlemen in the marketing system, lack of marketing institutions safeguarding farmers' interest and rights over their marketable produces (e.g. cooperatives), lack of coordination among producers to increase their bargaining power, poor product handling and packaging, imperfect pricing system and lack of transparency in market information communications as major marketing challenges.

Abraham (2013) stated that limited access to market, low price of product, lack of storage, lack of transport, low quality of product and lack of policy framework to control the illegal Ethio-Somalia trade route are the major marketing problems. Dendena *et al.* (2009) using value chain analysis on mango indicated that highly disorganized and fragmented industry with weak value chain linkages, long and inefficient supply chains, inadequate information flows and lack of appropriate production were explained as the major marketing problems. They recommended that institutional innovation to reduce the above challenges. Adugna (2009) also stated that the vegetable market conduct is characterized by unethical practices of cheating and information collusion that led to uncompetitive market behaviour even though the calculated concentration ratio did not indicate oligoposony

market behaviour (24.56%). He suggested that some corrective measures are required by the government as well as institutions like cooperatives.

Moreover, Abraham (2013) referred in Getachew (2009) has noted that the transition of the small-scale sector towards commercial production will ultimately be determined by the ability and willingness of producers to provide a commodity. Similarly, Mamo (2009) argued that the development of markets, trade and the subsequent market supply that characterize commercialization are fundamental to economic growth. However, this potential benefit is under challenges of imperfect marketing. Furthermore, the marketing system of vegetable was found as poor, limited access to market information and weak market linkage or non-existent. This was exacerbated by inadequate seed regulatory frameworks and supply of seeds of poor quality, poor post harvest handling which are attributed to low capacity and capability for policy implementation as well as unregulated vegetable seed supply (Bezabih *et al*., 2014).

According to Wolday (1994), marketable supply of agricultural product could be affected by different factors including the size of land holding, the output level, family size, market access, price, inputs, formal education, oxen number, accesses to extension and credit services, distance to market, time of selling, access to labor and age. Additionally, Abay (2007) and Adugna (2009) found out that marketable supply of vegetables were significantly affected by family size, age of household, distance from main road, number of oxen owned, extension service and lagged price. Again, Ayelech (2011) using SCP[5] approach and multiple linear regressions found that structure of the market indicates that licensing and years of avocado and mango trade experience did not hinder entry into avocado and mango trade, but capital, education and market information were barriers to enter into the trade. Based on regression model for market supply, she has identified quantity of avocado produced; experience, education and price of avocado in the previous year are factors that significantly affect quantity of avocado supplied to the market positively while lack of market access affects the supply negatively. Similarly, quantity of mango produced, education and

[5] SCP – market structure – conduct – performance

extension contact are factors that significantly affect quantity of mango supplied to the market positively.

Furthermore, Abay A. (2013) stated that the variables that influenced the marketable supply positively were agricultural experience, access to credit, yield, land size, current year and lagged prices and negatively that of low access to improved inputs, collateral problem to get credit, poor storage facilities and low price of produce. In his study on value chain analysis of vegetables in Habro and Kombolcha, Abraham (2013) also found that marketable supply is significantly affected by access to market information and quantity of tomato produced in the case of tomato; access to extension service, access to market information, vegetable farming experience and quantity of potato produced in the case of potato; and Woreda dummy, non/off-farm activities, distance to the nearest market and quantity of cabbage produced in the case of cabbage.

Regarding demand determinants of vegetables and fruits, there is scarcity of literatures while Abay (2007) mentioned that vegetable as a group of crops from the horticulture category has a very wide importance both as a source of food and health care. On the contrary, the level of consumption is very low for reasons of unavailability and market imperfection. Moreover, he found that income, purchase frequency, distance, own price and single purchase lot that were identified to be significant determinant of demand for vegetable.

3. Methodology

3.1 Description of the study area

Northern Wollo which comprises 9 woredas is one of the eleven zones in Amhara National Regional State. The researcher became interested to conduct this study for different reasons. The first is that the researcher is well familiar with the area .Secondly; the areas have great potential of vegetables and fruits production in the region. It is thus among the leading vegetable and fruits crops grown zone in the region. Thirdly, after the first introduction of cash crops such as vegetables and fruits, many farmer have been engaged

in cash cropping in a small land size and their livelihood have been becoming dependent on such activities . However, farmers are frequently claiming that they are facing market problem severely apart from others. It was, thus, having these back ground that the researcher decided to conduct the study on the assessment of marketing system of vegetables and fruits. Specifically, Raya kobo and Harbu woredas were the main focus area of the study due to their major contribution of vegetable and fruit production in the zone.

Raya Kobo is one of the nine woredas found in Northern Wollo. It has a longitude and latitude of 12°09′N 39°38′E with an elevation of 1468 meters above sea level. Its administrative center is Kobo town. It is located along Addis Ababa-Adigrat highway, 570 kilometers away from Addis Ababa in North East direction. This Woreda comprises 43 kebeles; out of those kebeles , five of them (namely Ayub, Aradom, Adisalem, Amaya and Abare) were major producers of vegetables and fruits.

Harbu is also one of the nine woredas found in the Northern Wollo. The altitude of this woreda ranges from 700 meters above sea level where the Mille enters the Afar Region, to 1900 meters at its westernmost point. It is located along the Addis Ababa-Adigrat highway, to North East direction of Addis Ababa. This Woreda includes 34 kebeles: out of those, five kebeles (namely Grana(018), Buhoro(09), Wute(08), Libso(014), Yeabyot and Fre(06)) were main growers of vegetables and fruits.

3.2 Source of data and sampling techniques

To meet the objectives of the study, both qualitative and quantitative approaches to data collection and analysis were employed. This is due to the fact that employing both qualitative and quantitative approaches in the study yields more evidences than the sum of the two approaches used separately.

Secondary data

As a supportive for primary data, secondary data were gathered from different official data sources. This helped the researchers to minimize and cross check the problem occurred during primary data collection. However, the explicit analysis part using those data is excluded just to minimize size of paper but used implicitly for crosschecking, sample selection and observing regional, national picture of vegetables and fruits marketing and production trends. Data on total land size and population types for econometric analysis were used from these sources.

Primary data

Primarily, the data for this study was collected from primary source using multiple data gathering instruments such as structured house hold level survey/questionnaires, In-depth interview, and Focus group discussion, Observation/field visit. It was collected through informal and formal surveys from key informants such as farmers, rural assemblers, brokers, whole sellers, retailers, final users/consumers, experts, development agents, office heads etc. The main data types/information collected include production, buying and selling, pricing, input delivery and distribution, market participation, problem and opportunities, characteristics of the market etc. Besides, secondary data on total land size and population types were consulted.

To ensure data qualities, the data collectors selected and interviewed those actors who have been involved in the activities for long period at least for 2 years. In addition to having quantitative data, especially price and supply data, the data collector crosschecked primary and secondary data. Whenever variation occur further discussion with the respondent was carried out.

Sampling techniques and procedures in each categories

The sampling element covered farmers, rural assemblers, whole sellers, brokers, retailers, consumer, development agents and experts on propionate to size basis.

Farmers sampling

In order to reach at the selection of the final sample households for the study, a combination of different sampling methods were employed. Initially, stratified multistage cluster sampling was used for sample selection. Therefore, at the first stage of sampling, two wordas were chosen from the zone based on purposive sampling which were chosen on the basis of some judgmental criteria such as their significant contribution of vegetables and fruits production in the zone as well as in the region and others justifications mentioned in study area description part). Next, 10 kebeles in total were selected from the two woredas. These 10 Kebeles (five from each woredas) were selected by purposive sampling (chosen on the basis of some judgmental criteria such as agro-climatic conditions, and geographical coverage and intensity of vegetable and fruit production (based on secondary data). The selected sample kebeles were Ayub, Aradom, Adisalem, Amaya and Abare from Raya–Kobo; Grana(018), Buhoro(09), Wute(08), Libso(014), Yeabyot and Fre(06) from that Harbu Woreda.

Finally, from the given list of farmers from those 10 kebeles, 100 households were randomly selected proportional to number of households per kebele. It was just to collect data on farmers' willingness to participate or not in both vegetables and fruits. Here, it was assumed that farmer' participation in both vegetables and fruits production.

Again, the same procedures were followed to choose farmers who supply their products to the market .Accordingly, 100 farmers from the two woredas were selected randomly from the list of farmers who are jointly supply both vegetables and fruits only. Respondent sample size per each Kebele was determined proportionally to the number of total onion and/or tomato, mango and/or avocado growing farmers per Kebele. Moreover, five experts/development agent/ workers were interviewed.

Rural assemblers, wholesalers, and brokers sampling

It was estimated that about 20 rural assemblers, 10 brokers, and 30 wholesalers used to participate in the marketing of the vegetable and fruit crops (based on rough informal assessment from Woredas' trade office).

However, it was believed to take arbitrarily five from each for detail interviewing. In fact, frequent rapid informal and observational surveys were also followed.

Retailers' sampling

The sample frame was developed by taking a count of vegetable retailers in the two main retail markets; Woldia and Dessie (selected due to their significant contribution of the market destination of the two products comes from the study area). Based on rough informal assessment from Woreda's trade office, it was estimated that 80 vegetable and 50 fruit retailers are found at Dessie; 60 and 30 at Woldiya; 20 and 10 at Kobo; 15 and 20 at Mersa central markets. After estimating the number of retailers, a proportion to size was taken and 30 from Dessie, 20 from Woldia, 15 from Kobo and 15 from Mersa were randomly selected. Finally, 80 retailers from the four towns in both vegetable and fruit crops were interviewed.

Consumers' sampling

The consumers' survey was meant to understand the demand behaviour for the products. The survey was taken from four major receiving towns namely, Woldiya, Dessie, Kobo and Mersa. 80 respondents were interviewed in the four towns through proportionate to size sampling technique. Accordingly, 30 respondents from Dessie; 20 from Woldiya; 15 from Kobo and 15 from Mersa for both vegetables and fruit crops were randomly selected and interviewed.

Finally, a total of 380 households in different categories were randomly included in the sample study.

3.2 Methods of data analysis

After collection of relevant data from various actors in vegetable and fruit marketing for each category such as farmers, traders and consumers using various data collection instrument, the data was managed in the following manner. Information collected through key informant interviews, rapid observation and focus group discussions were qualitatively analyzed. The

quantitative household survey data were coded and entered in to a computer for analysis using a computer software program called STATA version 11. Accordingly, the methods of analysis included both descriptive and econometric method.

3.3 Econometric models

This section attempted to cover model specification part of the current study for the analysis of understanding the factors determining production participation, volume of the vegetables and fruits supplied to market and demand analysis. It also devoted to describe the data nature and variable employed to estimate the specified models for this study. For analyzing this, probit estimation for participation probability and multiple regression OLS estimation technique for the rest two (determinant of market supply level and demand for vegetable and fruits) were employed.

A. Econometric model for production participation

Since the dependent variable (production participation is a qualitative with response of "yes" or "no" type. It is customary and appropriate to use discrete choice models dealing with such kind of binary responses are called binary choice models. Empirical works have provided a number of factors that affect farmers in production of vegetable and fruit crops. To analyze factors embedded in deciding participation, eleven variables were proposed for each crop. Accordingly, the basic formulation of model equation of this study is as follows:

$$Y_i = \beta' X_i + U_i - \qquad \textbf{(1)}$$

Y_i – Is unobservable latent variable, $Y_i = 1$ when, i Y >0 (Participated), $Y_i = 0$ Otherwise (Not participated)

Where,

Y_i is dependent variable - Participated or not participated; Xi is the explanatory variables listed under.

Ui: error term

B. Market supply model

A number of factors could influence the volume of vegetable and fruits to be supplied to a Market. Among the different variables that would explain market supply, the most important variables, (according to the reviewed literature) include family size, educational level, sex of household head, extension service, cash income from other crops, oxen number, production level, total size of land holding, distance to market, product prices (both current and previous), market information, the relative importance of the crop in question and others. However, it must be noted that the importance of these variables in explaining market supply level could be different depending on the crop type, region/area of production and degree of commercialization. As a result, taking into account specific situations at Raya Kobo and Mersa (better degree of farmers commercialization, high marketable proportion), it was decided to include age, sex of respondent, total size of land owned, family size, experience, distance from road, oxen ownership, market information, distance from development agent as determinants for volume of market supply for both vegetable and fruit crops.

Table 1: Variable and data description for production participation and market supply in vegetable and fruit

Name of explanatory variable	Variable nomination	Definition	Measurement	Expected sign
Age	ag	Age of respondent which is continuous variable	Continuous variable measured in number years	+ve
Sex	sx	Sex of the respondent	Dummy variable 1 if male and 0 if female	Not expected
No of oxen	no_ox	This is a continuous variable	measured in number oxen a Farmers own	+Ve
Education level	edu	School attainment of the respondent	Measured in number of year in school	+Ve
Total size of land	tot_sl	Land size of the farmer	In hectare	+ve
Family size	fn	a continuous variable	measured in terms of number of family members in the household	+ve
Distance from Development Agent	dis_da	intensity of extension service/frequency of getting them for advise and others	Continuous variable measured in number of frequency of contact with development agent	-Ve
Distance from main road	dismr	It is the distance of the vegetables producer households from the nearest market	it is measured in hours of walking time or number of kilometer	-Ve
Lagged price	af_olp	Last year price /2013/	Measured in kilo and Birr	+ Ve
Extension service	ext_s	dummy variables (get or not) accessibility /coverage	Yes = 1 , No = 0	+Ve
Experience	f_ex	Continuous variable an experience farmers/ years staying on farm production of vegetable and fruits	Measured in number of years	+Ve
Market information	mi	dummy variable	1 if get information other wise 0 if not	+Ve
Income from other crops	in_oc	Continuous variable income earned by a farmer from off farm activity and other sources	Measured in Birr	-Ve/+Ve

In this study, multiple linear regression models was used to analyze factors affecting farm level vegetables and fruit supply to the market in the study areas because of all vegetable and fruit producers participate in the market. Econometric model specification of supply function in matrix notation is the following. The estimation model is given as follows.

$$Y = X'\beta + U \qquad \textbf{(2)}$$

Where, Y = quantity of vegetables supplied to market; X '= a vector of explanatory variables

β= a vector of parameters to be estimated; U = disturbance term

C. Econometric model for demand analysis

Different kinds of models can be used to analyze demand or consumption. These incorporate both single and systems of demand equations (FAO, 2003). The single equation models specify uncompensated demand equations.

The general demand functions can be generalized for a consumer buying *n* goods as:

$$Q = Qi\ (P1, P\ 2, \ldots\ldots\ldots\ldots, P\ n, I) = \qquad \textbf{(3)}$$

Where, Qi is quantity demanded; P is price; i denotes commodities, and I income.

Extending the demand function for individual consumers to that for a group of consumers in most empirical applications requires the inclusion of demographic variables besides prices and income (FAO, 2003). It is generally acknowledged that income and price are by no means the sole determinants of food consumption, although they are normally the easiest to measure. But there are many additional factors influencing food consumption like need, tastes and preference etc.

Elasticity applies to demand equations in which the dependent variable is quantity purchased (or specific use such as consumption) (Ferris, 2005). The log-log demand models enjoy a long history in empirical work. Its coefficients are elasticities (Asche *et al*., 2005; Durham and Eales, 2006). In equations of log-log functional form, the coefficients are elasticities if the dependent variable is quantity purchased or consumed (Ferris, 2005).

$$\ln Y = \alpha + \beta_i \ln Xi + U\,i \qquad \textbf{(4)}$$

Where, lnYi - natural logarithm of vegetable/fruit i consumed;

lnXi –natural logarithm of explanatory variable

Bi – vector of explanatory variables, α -intercept term, Ui- random term

In this model, the advantage of elasticities is that they represent relationships between percentages and the specific units involved do not have to be known.

Table 2: Variable and data description for determinant of demand for vegetable and fruit

Name variable	Variable nomination	Definition	Measurement	Expected sign
Monthly average consumption	lncon	dependent variable expressed as an average kilogram of onion or tomato consumed per household taking August 's month as a Representative.	in kilogram	Dependent variable
Family size	lnfn	the total number of family members under a household	a continuous variable expected to take positive coefficient	+ve
Income	lnmin	It is continuous variable expected to influence consumption level positively	Average monthly in terms of Birr	+Ve or -Ve
Price	lngapo	price of specific vegetable/ fruit crops	Current average price per Kilo in Birr	-ve
Purchase frequency	lnpurchfre	a categorical dummy. The more frequent a household purchased, the more quantity would consume	Take continuous numerical value	+Ve
Average expenditure on food	lnavgexpf	continuous variable	measured in Birr	+ve/-ve
Amount of vegetable/fruit purchased per trip	lnapuchpt	the quantity of a vegetable/fruit, a household purchased per single purchase.	It is a continuous variable measured in kilograms	+ Ve

Note: ln represents logarithmic expression

4. Result and Discussion

4.1 Descriptive analysis

4.1.1. Production

Among the total 100 sample respondent farmers, the majority of vegetable growers are joint producer of onion and tomato. The same is true in case of fruit producers, they involved primarily in production of both mango and avocado crops.

Moreover, age of respondents' rages from 20 to 40 and 22 to 70 for vegetable and fruit growers respectively and its average is 40 and 44 for vegetable and fruit growers respectively. Out of 200 sample vegetable and fruit growers, 88 male and 12 female, 75 male and 25 female involved in vegetable and fruit production respectively. The average family size is 4 and 5 vegetable and fruit crop producers. Average educational level of respondents is grade 1 and 2 for vegetable and fruit growers respectively. The respondents' farm size also ranges from 0.3 to 1.5 hectare and 0.2 to 0.75 hectare for vegetable and fruit producers and its mean is 0.5 and 0.3 hectare for vegetable and fruit growers respectively. In terms of allocation for specific crops, majority of the respondents land size is allocated for Teff and Sorghum in Raya Kobo Woreda and Teff and Maize in Harbu woreda. As compare to other non-vegetable and fruit crop land size like Teff, sorghum, maize etc, the land allocated for that vegetable and fruit is smaller in size.

Farmer's access to main road and market was found very limited due to poor road network and limited transport services. Power shortage, limited access and discontinuity were other challenges they face in their production activities. More than 70% of the respondent in both vegetable and fruit production didn't have any market information and considered as a very serious challenges and there by forced them to be exploited and cheated by brokers and other middle men. About 80 % of the respondent replied that they did not have access to credit service in fruit and vegetable producers. However, 88% and 64% of the respondent had access to extension in fruit and vegetable producers respectively.

Furthermore, according to rapid assessment during the survey period and information from Woreda agriculture office, the major suppliers of vegetable and fruit production in the study area are small land size holder farmers. There are some practices of supplying in cooperatives but very limited. The survey result showed that even if there are some improvements in farming system, still most farmers are following traditional system in their vegetable and fruit production process. There are sign of being reluctant to use fertilizer and best variety seeds. Hence, the responses from the respondents lead us to infer that mixed farming system (modern with less level and traditional with significant weight) is common farming practices in the sample study area in both vegetables and fruit productions. Government intervention through extension services has resulted in some improvement in production side but it was observed as limited in coverage and poor in quality due to various reasons.

Using frequent rapid field survey supported with group discussion and key informant survey, various problems were identified either they are production or marketing aspect. These can be summarized as a biotic such as market problem and perishability (high post-harvest loss and biotic (disease, insects and weeds).

Different aspects of marketing infrastructures such as standard and grades[6], packaging[7], handling systems, transportation etc, were also examined during the survey. Sacks are the most widely used packing materials for transporting vegetables. Onion is loaded on trucks using these sacks. Wooden boxes called it locally as' kassa/satara/ satin' that have a carrying capacity of around 50 kg are used for transporting tomatoes. But, onion can be loaded on trucks without any packing materials. Retailers do not apply packing materials when they sell for consumers. Similarly, Wooden boxes called it locally as' kassa/satara/ satin' that have a carrying capacity of

[6] Agronomically, quality and long shelf life starts from production though no clear set quality standards found in study area in both vegetable and fruit growers. The expected vegetable and fruit quality include freshness, visually attractiveness, size, color, variety, neatness (spot free) and so on.

[7] Packaging materials play important role in keeping freshness, reducing loss and damage of produces during transportation and storage

around 50 kg are used for transporting for mango and avocado. In terms of transportation[8] modes, ISUZU, Minibus, animal backs and FSR are commonly used for fruit in descending order in both market destinations *i.e* Woldia and Dessie. While, Minibus, ISUZU and animal backs are the commonly used for vegetables in descending order in Dessie. However, ISUZU, Minibus, animal backs and FSR are the commonly used for vegetables in descending order in Woldia. Yet, shortage of transportation service, poor infrastructure, and power discontinuity were reported as infrastructural facilities constraints in the study area During the survey period, it was also observed that there was no scientific proper post and pre-harvest handling practices partly due to shortage of storage facilities in the study area for both vegetable and fruit growers.

However, some opportunities were also observed in the study area that can be harnessed to improve the marketing system. Among the different opportunities that exist, the trend in the growth of production and marketing tradition in the area, experience (learning effect) and neighborhood effect (much more important in technology adoption), natural advantage of proximity to main road, Woldiya and Dessie, plainness, and excess ground water, conducive climate condition, the existence of good policy framework in agricultural development manifested by deploying development agents at each Kebele (even though its coverage and quality is still limited), and recent infrastructural development, the increasing use of mobile telephone and development of wireless telephone , the opportunity of different buyers come from different areas of the country like Tigray and Afar Regional state, even from Addis Ababa creating a confidence to farmers.

4.1.2 Marketing system

To have full picture and understanding of how a certain market is functioning, the analysis of marketing system of any crops should include three main components of market: namely market structure, market conduct

[8] The transportation facilities in the study area have a great role in every activity of vegetable and fruit growers. They facilitate the conveying of products from farm to market place, source of energy for water supply and generating underground water for irrigation purpose

and market performance which can be again manifested by different indicators explained below in details.

A. Market structure

It can be analyzed based on the numbers and sizes of enterprises within the system, and the potential access of additional participants to it (licensing procedure, lack of capital and know how, and policy barriers) and the degree of transparency (Pender *et al.*, 2004). Accordingly, the structure of the market has been analyzed as follows.

i) Market participants

In this study, different vegetable and fruit market participants were identified in the exchange functions between farmer and final consumer. Hence, producer, local collectors, wholesalers, retailers, processors and final consumers of the product were identified as market participants in the study areas with different character, profit margin, unequal information access and unhealthy marketing interaction from farmers to end users. Market Concentration[9] ratio was not calculated for both vegetable and fruit crops since the number of sampled whole sellers in study were small.

ii) Barrier to entry

According to the rapid appraisal, almost all of the retailers and rural assemblers had no license. Even the wholesalers did not have. The few wholesalers that were with licensing were those that supplied to institutions on bidding. In fact, all paid some amount of money every year as per the Inland Revenue decision. As disclosed from North and South Wollo Zones trade offices, retailers were not claimed to have business license, what was done was to register them in commercial registration. Wholesale market seemed to have no barrier to entry but an indirect blocking by the existing wholesalers to the new entrant not to get buyer (retailing client). In the case of retailers, entry was free but stall was a limiting factor.

[9] Market concentration indicates to the number and relative size distribution of buyers and sellers in the market. For an efficient market, there should be sufficient number of firms (buyers and sellers); firms of appropriate size are needed to fully capture economies of size; there should be no barriers to entry into and exit from the market and should have full market information

The skill to manage customers, skill of lobbying selling and buying customers, 'skill' of cheating protect anybody to enter the business were considered by respondents as limitation in their business. Capital at retailers' level was not observed basic though necessary. In the case of wholesalers, there is a possibility to take credit from banks yet not an easy way and inadequate in size.

B. Market conduct

In this study, market conduct[10] of vegetable and fruit market is analyzed in terms of the traders' and price setting, group forming, purchasing and selling strategies. The buyers' behaviour evaluated based on some selected parameters of loyalty, better price provision, immediate payment behaviour, bulk purchase, and production credit. Misbehaving is common characteristics of buyers. The perishability of the products exposed farmers for a wide range of cheating. The respondent farmers were asked whether they perceived cheating or not and they reported as it was a day-to-day phenomenon. Wholesalers and brokers were the leading cheaters. The cheating type included price, weight, defaulting an agreement, and any combination of these.

Based on the result obtained from group discussion with respondent farmers, their selling strategy was as immediately as to any buyer brought by brokers. They sold to anybody as far as he offered better price. However, the intervention of brokers influenced them to get good buyers directly. There was also no any contract-based marketing.

More than 70 % of respondent farmers had no accesses to market information from different sources on price and buyers. Lack of genuine and timely market information was observed as their critical problem in the study in both vegetable and fruit production which requires appropriate intervention.

[10] Market conduct refers to the patterns of behavior of firms. This implies analysis of human behavioral patterns that are not readily identifiable, obtainable, or quantifiable (Pomeroy and Trinidad, 1995). There are no agreed upon procedures for analyzing the elements of market conduct. Rather, some points are put to detect unfair price setting practices and the conditions under which such practices prevail

Traders' behaviour was also observed as unpredictable because their main objective is profit maximization. They want to buy bulky product with low price .Since the vegetable and fruit products are highly perishable, farmers forced to sell their product with very cheap price which doesn't cover even their cost of production .Sometimes, they may drop it when the product highly spoiled. Furthermore, according to rapid assessment during the survey period, it was observed that there was no explicit forming of legal and illegal grouping among farmers, whole sellers, retailers and brokers rather they prefer to work independently since all are profit oriented which violates rule and regulation of trading system. However, there are some illegal traders who work informally.

C. Market performance

Similarly, marketing performance can be analyzed by different indicators. However, for this study marketing margin and channel comparison were only used.

i) Marketing channel

The analysis of marketing channels was intended to provide a systematic knowledge of the flow of goods and services from its origin, producer, to final user, consumers. Accordingly, the study has tried to identify the different marketing channels or alternative routes the product follow from the point of origin to final destination i.e. Woldiya and Dessie vegetable and fruit market. The main marketing channels identified were:

- ***Vegetable marketing channel (onion and tomato)***

Channel 1: Farmer → consumers (6.5 %)
Channel 2: Producer → Broker → wholesaler → consumers (8%)
Channel 3: Producer → Broker → wholesaler → retailers → consumers (83.5%)

- ***Fruit marketing channel (mango and avocado)***

Channel 1: Farmer → consumers (7.5%)
Channel 2: Producer → Broker → wholesaler → consumers (10%)
Channel 3: Producer → Broker → wholesaler → retailers → consumers (82.5%)

The first channel is used by local smallholders to sell their vegetables and fruits. The mount of vegetables and fruits supplied through these channel account for 6.5% and 7.5 of the total vegetable and fruit transaction of the market respectively. The larger portion of the transaction is conducted using the third channel in both crops case. However, there are additional channels which are rarely practiced in the study area in both vegetable and fruit market. These are Farmer –Rural assembler- Wholesaler – Consumers, Farmer -Wholesaler-Out of region, Farmer – Rural assembler—Retailer—Consumer, Farmer – Rural assembler – Wholesaler—Retailer – Consumers. As a result, the long market channel observed in both vegetable and fruit market which made much of the profit to be taken by whole sellers and other middlemen like brokers and assemblers.

ii) Market margin

Cost and price information was used to construct marketing cost and margin. This is going to be analyzed using marketing costs and benefit share of actors in vegetable and fruit value chain.

As it is indicated in Table 3, in Woldia; in case of onion, the share of profit for farmers, whole sellers and retailers is 11%, 37% and 52% respectively. For Tomato, it shows that 11%, 58% and 31% for farmers, whole sellers and retailers respectively. Moreover, in case of fruit, it exhibits that 29 %; 41%; 30 % and 9%; 26.5%; 64.5% for mango and avocado consecutively.

In a similar fashion, in Dessie as illustrated in Table 4; the share of profit for farmers, whole sellers and retailers is 15%; 57.5%; 27.5% respectively for onion. For Tomato, it shows that 12% 52% and 36% for farmers, whole sellers and retailers respectively. Similarly, in case of fruit, it exhibits that 22 %; 48%; 30 % and 11%; 51.5 %; 37.5% for mango and avocado consecutively. In all cases, it indicates that the loin share of profit is taken by retailers and whole sellers without adding any value to it. This implies that the longer the market channel, the more the farmers are going to be exploited by the unnecessary channels or they get lower price/unfair for their products as compared to other middlemen. Hence, appropriate measures are needed here to enable farmers to get fair price for their products.

Table 3: Shares of actors' cost and benefit for vegetable and fruit marketing in Woldia

Market Name: Woldia
Vegetable type: Onion, Tomato , Mango and Avocado
Channel: 3

Crop type	**Onion**			**Tomato**			**Mango**			**Avocado**		
Actors/ Item (Birr/kilo)	**Producer**	**Whole sellers**	**Retailers**	**Producer**	**Whole sellers**	**Retailers**	**Producer**	**Whole sellers**	**Retailer**	**Producer**	**Whole sellers**	**Retailers**
Production cost	2.50			4			5.20			3.20		
Purchasing price		4	7.50		7	14		8	12		4.20	7
Marketing cost												
Transport	0.4	0.60	0.40	0.80	0.60	0.40	0.20	0.40	0.30	0.20	0.50	0.40
Other costs (loading, unloading, broker fee)	0.3	0.10	0.20	0.50	0.10	0.20	0.10	0.10	0.20	0.10	0.10	0.30
Total marketing cost	0.70	0.70	0.60	1.30	0.70	0.60	0.30	0.50	0.50	0.30	0.60	0.70
Actor's average per unit cost	3.20	4.70	8.10	5.30	7.70	14.60	5.50	8.50	12.50	3.50	4.80	7.70
Average selling price	4	7.50	12	6.50	14	18	8	12	15	4.20	7	13
Marketing margin	7.30	7.30	7.40	10.20	13.70	17.40	7.70	11.50	14.50	3.90	6.40	12.30
Price difference	8			11.50			7			8.80		
Marketing cost as% of price diff	8.75%	8.75%	7.5%	11.30%	6%	5%	4.28%	7%	7%	3.4%	6.8%	8%
Marketing margin as% of price differ	91.5%	91.5%	92.5%	88.7%	94%	95%	96%	93%	93%	96.5%	93%	92%
Actor's profit	0.80	2.80	3.90	1.20	6.30	3.40	2.50	3.50	2.50	0.70	2.20	5.30
Actor's share of total profit	11%	37%	52%	11%	58%	31%	29 %	41%	30 %	9 %	26.5%	64.5 %
Actor's share of average per unit profit	20 %	37%	32.5%	18%	45%	19 %	31%	29%	17%	17%	31%	40%
Producer's share of retailer price on average	33%			36%			53%			32%		

Source: Estimated based on survey data

Efficiency in marketing[11] is also the most used measure of market performance. The marketing efficiency was examined in terms of the price difference[12] (consumer price less price received by producer/farmer), marketing cost, and margin (price difference less marketing cost) for fruits and vegetables in the study. Therefore, the marketing cost and margin have been expressed as percentage to the price difference. The efficiency indicators thus obtained showed that in Woldia markets, the marketing cost for onion, tomato, mango and avocado varied between 7.5% to 8.75%; 5% to 11.30%; 4.28% to 7% and 3.4% to 8% respectively while in Dessie market, the marketing cost for onion, tomato, mango and avocado varied between 10% to 16.7%; 6% to 8%; 3% to 7% and 4% to 9% respectively.

The margin as a percentage of farmer-consumer price difference shows that the margins are very high in many cases but vary across the locations. In both market destinations (Dessie and Woldia), the margins are very high for all actors in the both vegetables and fruit crops market. The high percentage of margin to price difference is indicative of possible large trade profits (or inefficiencies), and poor marketing efficiency in fruits and vegetable (see the details in Table 3 and 4)

[11] Improved marketing efficiency is a common goal of farmers, marketing organizations, consumers and society. It is a commonplace notation that higher efficiency means better performance whereas declining efficiency denotes poor performance. Most of the changes proposed in marketing are justified on the grounds of improved efficiency (Kohls and Uhl, 1985).

[12] Variation in price difference and margin in absolute terms for the same commodity in different markets could be partly attributed to the varieties chosen for the study.

Table 4: Shares of actors' cost and benefit for vegetable and fruit marketing in Dessie

Market Name: Dessie
Channel: 3

Crop Type	**Onion**			**Tomato**			**Mango**			**Avocado**		
Actors/ Item (Birr/kilo)	**Producer**	**Whole sellers**	**Retailers**	**Producer**	**Whole sellers**	**Retailers**	**Producer**	**Whole sellers**	**Retailer**	**Producer**	**Whole sellers**	**Retailers**
Production cost	2.50			1.20			5.20			3.20		
Purchasing price		4	8		2.80	10		8	14		4.20	8
Marketing cost												
Transport	0.4	0.80	0.30	0.60	0.60	0.40	0.20	0.50	0.40	0.20	0.50	0.40
Other costs (loading, Unloading, broker fee	0.3	0.20	0.30	0.20	0.10	0.20	0.10	0.10	0.30	0.10	0.10	0.30
Total marketing cost	0.70	1	0.60	0.80	0.70	0.60	0.30	0.60	0.70	0.30	0.60	0.70
Actor's average per unit cost	3.20	5	8.60	2	3.50	10.60	5.50	8.60	14.70	3.50	4.80	8.70
Selling Price	4	8	10	2.80	10	13	8	14	18	4.20	8	12
Marketing Margin	5.30	5	5.40	9.40	9.50	9.60	9.70	9.40	9.30	7.50	7.20	7.10
Price difference	6			10.20			10			7.80		
Marketing cost as% of price d/ce	11.7%	16.7%	10%	7.8 %	6.9%	6%	3%	6%	7%	4%	7.7%	9%
Marketing margin as% of price d/ce	88%	83 %	90%	92%	93%	94%	96%	94%	93 %	96%	92%	91%
Actor's profit	0.80	3	1.40	0.80	3.50	2.40	2.50	5.40	3.30	0.70	3.20	3.30
Actor's share of total profit	15 %	57.5%	27.5	12%	52%	36%	22%	48%	30%	11%	51.5%	37.5%
Actor's share of average per unit profit	20%	37.5%	14%	28.5%	35%	18.5%	31%	26%	18%	17%	40%	27.5
Producer's share of retailer price on average	40 %			21.5%			44%			35%		

Source: Estimated based on survey data

4.2 Results of Econometric Analysis

In this part, major results and explanations of econometric analysis for production participation, determinants of market supply and demand are given. The estimation and analysis was done separately for each crops (onion, tomato, avocado and mango).

Tests

For each models, various appropriate tests were conducted .Among these, test for multicollinearity; All VIF values are less than 10. This indicates absence of serious multicollinearity problem among independent continuous variables (Table 4). Again, since there is heteroscedasticity common problem in the cross sectional data set, the parameter estimates of the coefficients of the independent variables may not be BLUE (Best Linear Unbiased Estimator). Hence, to overcome the problem, Robust standard error OLS analysis with heteroscedasticity consistent covariance matrix was estimated.

4.2.1 Production participation

Estimation of production participation decisions was made with probit. Hence, the regression result indicated in Table 5 shows that in case of onion, family size, total size of land, extension service, farmer's experience, and average lagged price were found to be significant in line with hypothesized sign. While, total size of land, extension service and distance from main road were the only factors that influence production participation in tomato crops same as hypothesized in the theory.

Age, family size, total size of land, extension service and farmer's experience are the significant factors with expected sign except age factors that affect mango production participation. Yet, total size of land, extension service and farmer's experience were only found to be significant with expected sign for avocado production.

As farmer's experience increased by one year, the probability to participate in onion, mango and avocado production increased by 0.03 (or 3%), 0.01(1%) and 0.01(1%) respectively. As lagged price increased by one Birr per kilogram, the probability to participate in onion production will increases by

0.05 (or 5 %). As farmer get extension service, the probability of participating in onion, tomato, mango and avocado production would increase by 0.67(or 67%), 0.69(or 69%), 0.61(or 61%) and 0.37(or 37%) respectively. Similarly, as total size of land increases by one hectare, the probability of participating in onion, tomato, mango and production would increase by 0.30(or 30%), 0.45(or 45%), 4.1(or 410%) and 0.69(or 69%) respectively.

Table 5: Production participation regression results for of both vegetables and fruits

Variable /coefficient	Onion		Tomato		Mango		Avocado	
	coefficient	Marginal effect	coefficient	Marginal effect	coefficient	Marginal effect	coefficient	Marginal effect
ag	-.04 (-1.57)	-.01	-.03 (-1.08)	-.00	-.07 (-2.85)**	-.02	-.03 (-0.94)	-0.00
fn	.51 (3.3)*	.18	.01 (0.11)	.00	-.19 (1.89)***	-.05	.21 (1.31)	0.01
tot_sl	.85 (1.64)***	.30	2.2 (1.76)***	.45	15.46 (3.53)*	4.1	9.9 (2.28)**	0.69
no_ox	.27 (1.01)	.09	-.06 (-0.41)	-.01	-.01 (-0.06)	-.00	.03 (0.10)	0.00
ext_s	2.02 (2.93)**	.67	2.8 (5.45)*	.69	2.2 (3.78) *	.61	2.6 (3.05)*	.37
dismr	-.00 (-0.76)	-.00	-.01 (-1.92)***	-.00	-.00 (-0.53)	-.00	-.00 (-0.76)	-0.00
f_ex	.10 (2.06)**	.03	-.11 (-0.95)	-.02	.06 (2.00)**	.01	.26 (2.21)**	0.01
dis_da	.27 (1.36)	.10	.10 (1.50)	.02	.06 (1.55)	.01	.05 (0.57)	0.00
af_olp	.14 (2.03)**	.05	.16 (1.07)	.03	.00 (1.33)	.00	.06 (0.57)	0.00
_cons	-3.92 (-2.09)**		.23 (0.23)		-.72 (-0.66)		-5.6 (-2.18)**	
Obs.			99	100		100		99
Wald chi2(9) =			48.05	56.78		42.57		17.66
Prob > chi2 =			0.00	0.00		0.00		0.03
Log pseudo likelihood =			-13.05	-19.75		-21.03		-16.5
Pseudo R2 =			0.80	0.69		0.70		0.74

(Production participation/not for vegetable and fruit for each model as dependent variable)

The numbers in Parentheses are Z-value and *, ** and *** show at 1%, 5% and 10 % significance level respectively.

4.2.2 Market Supply

Eleven explanatory variables were hypothesized to determine the household level marketable supply of onion, tomato, avocado and mango in the study area[13].

Onion & Tomato

Average price, distances from road, age and total size of land were found to be significant determinant of onion with expected sign except age. Possible reasons might be with age retirement, unfamiliar and reluctant to produce cash crops because they usually produce stable food crops like teff, maize and sorghum. In case of tomato, average price, distances from road, access to market information and total size of land were found to be significant with expected sign except for market information.

Table 6: Market Supply Regression results for of both vegetables and fruits
(Volume sold/market supply in kilo as Dependent Variable)

Variable/Coefficient	Onion	Tomato	Mango	Avocado
ag	-.21 (-2.03)**	-0.37 (-1.51)	-.16 (-1.43)	-.03 (-0.60)
sx	3.71 (1.22)	2.38 (0.60)	-4.1 (-2.50)**	-1.92 (-1.50)
fn	-.26 (-0.31)	0.58 (1.23)	0.01 (0.02)	-.07 (-0.26)
edu	-.14 (-0.44)	.23 (0.40)	-.61 (-1.63)	.06 (0.45)
tot_sl	16 (3.26)*	41.73 (2.24)**	36.69 (3.66)*	17.17 (3.04)*
no_ox	-.06 (-0.08)	1.74 (-1.23)	2.24 (1.82)***	.27 (0.64)
dismr	-.18 (-4.59)*	-.22 (-2.06)***	0.02 (0.69)	-.00 (-0.04)
f_ex	0.06 (0.49)	.16 (0.77)	1.08 (3.99)*	1.20 (7.23)*
af_op	4.52 (5.43)*	3.02 (2.98)**	1.33 (2.31)**	.94 (3.35)*
mi	.54 (0.24)	-4.52 (-2.28)**	-.58 (-0.35)	1.14 (1.47)
in_oc	0.00 (1.04)	0.00 (1.69)	0.00 (0.36)	.01 (1.96)***
_cons |	16.53** (2.56)	30.23* (14.78)	-.3.82 (-0.57)	-3.43 (-1.06)
Obs	100	100	100	99
R^2	0.71	.77	.83	0.95

The numbers in Parentheses are t-value and *, **and *** show at 1%, 5% and 10 % significance level respectively.

[13] Onion and Tomato, Avocado and mango are produced mainly for market and all crops are important cash crops in Raya Kobo and Harbu Woreda farmers in general. According to the research report, all sample households are good suppliers of the commodity to the market.

Mango & Avocado

Average price, farmers' experience in fruit production and market supply, number of oxen, sex and total size of land were found to be significant with expected sign in case of mango. While, for avocado demand, average price, distances from road, age and total size of land was found to be significant with expected sign. Here, sex affects the market supply of mango negatively. It might be due to the fact that females are not common producers of fruit crops in the study area, i.e usually it is left for men.

4.2.3 Demand Analysis

The consumption analysis is based August as a representative period. The month was selected for easiness reason to remember that the survey was taken at end of august 2014). As Table 7 below exhibits, in case of onion demand, family members, purchase frequency and single purchase lot were significant with hypothesized sign at 1 percent level of significance. While family members, current average price and purchase frequency were found significant with expected sign for tomato demand.

Table 7: Consumption Regression results for of both vegetables and fruits

(log of consumption of vegetables and fruits for each model as dependent variable)

Variable/Coefficients	Onion	Tomato	Mango	Avocado
lnmin	-.11 (-1.04)	-.24 (-1.32)	.04 (0.53)	-.25*** (-1.95)
lnag	-.19 (-1.07)	.01 (0.10)	.26 (1.07)	.42 (1.01)
lnfn	.38 * (3.92)	.37* (2.83)	-.19* (-2.07)	-.15 (-1.06)
lngapo	.36 (1.55)	58** (2.68)	.74** (2.72)	.09 (0.78)
lnpurchfre	.47 * (4.15)	.44** (2.80)	.43* (3.53)	.00 (0.04)
lnavgexpf	.14 (1.20)	.18 (0.82)	.04 (0.47)	.61 * (3.83)
lnapuchpt	0.44* (4.41)	-.08 (-0.81)	10 (0.47)	.73* (6.64)
_cons	-.20 (-0.18)	-.93 (-0.84)	-3.21* (-2.94)	-.02 (-0.01)
Number of obs =	56	79	54	50
R^2 =	0.84	0.46	0.30	0.75

The numbers in Parentheses are t-value and *, **and *** show at 1%, 5% and 10 % significance level respectively. All variables are in logs.

Similarly, family members, average current price, purchase frequency were found to significant as determinant of mango demand. Income level, average expenditure on food and purchasing amount per trip were found significant in case of avocado demand in the study area. In terms of sign, income level was found to be negative in avocado demand .One possible reason might be avocado is considered as inferior good by the respondent. Family member was also found with negative sign opposite to the hypothesized sign due to the fact that with family members rising, purchasing power of consumers is going to decline and results in falling of demand for mango if they considered it as luxurious good.

5. Conclusion and Policy Implications

5.1 Conclusion

The findings of this study paints to other previous study except in some cases. Major findings of the study exhibited that farmer's access to main road and market was very limited due to poor road network and limited transport services. More than 70% of the respondent in both vegetable and fruit production didn't have any market information. Hence, lack of genuine and timely market information was observed as their critical problem and there by forced them to be exploited and cheated by brokers and other middle men in the study area. Marketing infrastructures such as non scientific proper post and pre-harvest handling practices, poor packaging, inefficient transportation and power service were also observed as hindering factor for proper function of the marketing.

Moreover, marketing system of vegetable and fruit in study can be summarized using different indicators.

In both vegetable and fruit marketing, the loin share of profit was taken by retailers and whole sellers without adding any value to it. Channel 3 (Producer → Broker → wholesaler → retailers → consumers) is the dominant market channel in both vegetable and fruit. Moreover, the margins as a percentage of farmer-consumer price difference showed that the margin are very high for all actors in the market but slightly varies across the market

destinations which is an indicative of possible large trade profits (or inefficiencies) and poor marketing efficiency in fruits and vegetable.

The econometric regression result of this study exhibited that in case of onion, family size, total size of land, extension service, farmer's experience, average lagged price, and in tomato; total size of land, extension service and distance from main road were found to be significant in line with expected sign as production participation determinants. Moreover, for mango; age, family size, total size of land, extension service, farmer's experience and in case of avocado; total size of land, extension service and farmer's experience were the significant factors (with expected sign) of production participation determinants.

Similarly, the regression result for market supply determinant showed that for onion; average price, distances from road, age, total size of land and in tomato; average price, distances from road, access to market information and total size of land were found to be significant with except sign except age. Furthermore, in mango; average price, farmers' experience, sex, number of oxen, total size of land and in that of avocado; average price, distances from road, age and total size of land found to be significant with expected sign except sex in case of mango.

Finally, in case of demand for onion, family size, purchase frequency, amount of single purchase lot, and that of tomato; family members, current average price and purchase frequency were found as significant determinants. Besides, family size, average current price and purchase frequency were found to be significant determinate of mango demand. For avocado demand, income level, average expenditure on food and purchasing, and amount per trip found significant in line with expected sign. Hence, the results found in this study are clearly an indicative for taking appropriate measures in production side, market infrastructure, arrangements and institutions or any combination of them to improve the sub optimal functioning of the marketing system.

5.2 Policy Implications

This study's conclusion and inferences indicated that some interventions should be taken at least to improve the inefficient functioning of vegetable and fruit marketing system and enhance the participation of farmers in vegetable and fruit production. Those interventions could be long run or short run solutions. The market system improvements revolve around institutional, legal frames, market linkage, capacity building (education and training), and developing market infrastructure facilities. The following concrete intervention will improve the marketing system and enable fair and equitable distribution of the welfare generated from the marketing system: Market infrastructure should be improved through storage (go-down) facilities, cold storages, cold-chain facilities, road network, loading and weighing facilities. Besides, the market integration and efficiency can be improved by making up-to-date market information available to all participants through various means, including good market information systems and various media which facilities the markets. Additionally, to overcome problems in extension services, capital bottlenecks, business skill gap, lack of proper/scientific grading and standards, pre harvest and post-harvest loss/wastage, increase access to improved inputs, strengthening credit institutions, defining and setting quality parameters, standards, grades, and establishment of storage and processing facilities are possible options. Strengthening of cooperatives, institutionalizing the marketing system and the commission agents' functioning, provision of education and training, improve transparency of price setting and availing market information are the most promising interventions.

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The Determinants of Real Exchange Rate Volatility in Nigeria

AJAO, Mayowa G.[1]

Abstract

The naira exchange rate depreciation and volatility is among the vast macroeconomic maladjustments which have unfolded in the Nigerian economy in the recent past. This paper therefore, investigates the determinants of real exchange rate volatility in Nigeria from 1981 through 2008. Having obtained the volatility of exchange rate through the GARCH (1,1) techniques, the ECM was used to examine the various determinants of exchange rate volatility in Nigeria, while the co-integration analysis reveals the presence of a long term equilibrium relationship between REXRVOL and its various determinants. Our empirical analysis further shows that openness of the economy, government expenditures, interest rate movements as well as the lagged exchange rate are among the major significant variables that influence REXRVOL during this period. This study recommends that the central monetary authority should institute policies that will minimize the magnitude of exchange rate volatility while the federal government exercises control of viable macroeconomic variables which have direct influence on exchange rate fluctuation.

Key Words: Exchange Rate, Volatility, GARCH, ECM, Co integration
JEL Classification: F21, F31

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1. Introduction

Most economies (developed and developing) of the world have experienced high real exchange rate volatility, which translates into high degree of uncertainty in the attainment of major macroeconomics and monetary policy objectives in the area of price stability and economic growth. Volatile real exchange rates are associated with unpredictable movements in the relative prices in the economy. Hence, exchange rate stability is one of the main factors influencing foreign (direct and portfolio) investments, price stability and stable economic growth.

Ever since the breakdown of the Bretton-Woods system in 1973, the exchange rates of many countries have been fluctuating considerably overtime, and there has been more interest in predicting exchange rates. Research related to exchange rate management still remains an area of interest to economists and finance experts, especially in developing countries, despite a relatively enormous body of literature in this area. This is largely because the exchange rate is not only an important relative price of one currency in term of other that connects domestic and world markets for goods and assets, but it also signals the competitiveness of a country's exchange power with the rest of the world in a global market. Besides, it also serves as an anchor which supports sustainable macroeconomic balances in the longrun. There is, therefore, no simple answer to what determine the equilibrium real exchange rate, and estimating the degree of exchange rate volatility and misalignment remains one of the most challenging empirical problems in macroeconomics (Williamson, 1994).

The effect of real exchange rate misalignment on economic decisions has received considerable attention in the literature, not only because of its significant impact on other macroeconomics variables, but also because there has been a number of significant developments in recent time, with substantial contributions being made to both the theory and empirical understanding of exchange rate determination. Important developments in econometrics, together with the increasing availability of high quality data,

have also stimulated a large output of empirical work on exchange rate (Botha and Pretorius, 2009).

Exchange rate has traditionally played a crucial role in Nigerian monetary policy because of its crucial impact on the country trade relation with other countries, first, as a mono-product (oil) export dependent economy and second, as an import dependent (developing) nation; besides the country's competitiveness and overall economic growth. Therefore, the monetary authorities (Central Bank of Nigeria) on several occasions in recent past had engaged in different exchange rate adjustment policies (fixed and flexible) for the main purpose of attaining the macro-economic objective of price stability. However, in line with major industrial economies, greater flexibility of the exchange rate is much needed to allow the real exchange rate to converge easily with its equilibrium level and to contain the real shocks associated with the transition to a market economy and the depletion of oil production, which is considered to be the main source of external and government revenues.

The fundamental difficulty is that the equilibrium value of the exchange rate is not observable. While the exchange rate volatility refers to a situation in which a country's actual exchange rate deviates from such an unobservable equilibrium, an exchange rate is said to be "undervalued" when it depreciates more than its equilibrium, and "overvalued" when it appreciates more than its equilibrium (Aliyu, 2008). The issue is, unless the "equilibrium" is explicitly specified, the concept of exchange rate volatility remains subjective. There is growing agreement in the literature that prolonged and substantial exchange rate volatility can create severe macroeconomic disequilibria and the correction of external balance will require both exchange rate devaluation and demand management policies. The main intuition behind this is that an increase in exchange rate volatility leads to uncertainty which might have a negative impact on trade flows. Baldwin, Skudelny and Taglioni (2005) discover that effect of exchange rate volatility on trade in the European Union (EU) countries is negative; trade increases as volatility falls and gets progressively larger as volatility approaches zero. While numerous studies were conducted on the extent of naira exchange rate

volatility impact on foreign trade in Nigeria (Soludo and Adenikinju, 1997; Obaseki, 2001 and Aliyu, 2008), this study takes a departure from these previous studies by quantitatively measuring the determinants of real exchange rate volatility in Nigeria from 1981 to 2014 and also identify which variable(s) have the most significant influence on exchange rate volatility in Nigeria during the period under study.

2. Literature Review

Currency, like any traded goods, has a price. This price can undergo dramatic changes over a short period of time, as was the case for the Thai baht, which lost 56% of its value in about six months during the Asian financial crisis in 1997. Alternatively a country's currency may remain stable relative to other currencies over a long period. The explanations for sudden extreme currency volatility or prolonged stability are not always so esoteric. However, an understanding of the factors influencing exchange rate daily is more difficult to come by. The foreign exchange market, with roughly 200 participating countries and US $2 trillion in daily turnover is far too complex to be described neatly by a set of theories or formulas (Federal Reserves, 2005). Underscoring the evasiveness of the foreign exchange market, Former U.S. Federal Reserve Board Chairman Alan Greespan once said, "there may be more forecasting of exchange rates with less success than almost any other economic variable."

For decades, the Purchasing Power Parity (PPP) hypothesis has remained a focal point of policy discussions, models and empirical work. the hypothesis postulates an underlying tendency for changes in the nominal exchange rate to be fully offset (at least after some period of time) by changes in the ratio of foreign to domestic price levels. Therefore, even if PPP does not hold at all times, any deviations from it should be eliminated eventually, thus implying that the real exchange rate should be mean-reverting (Gelbard and Nagayasu, 2004). Empirical studies have produced little evidence in favour of this hypothesis, and in those that supported it, the speed of convergence of the actual exchange rate to its PPP level has been found to be very low, with half-lives of three years or more (Phylaktis and Kassimatis, 1994;

Macdonald, 1995). Such slow convergence has been attributed to nominal price rigidities, either related to price-wage stickiness or to market segmentation and pricing to market policies. A well known blend of PPP with the monetary model contends that, since nominal rigidities prevent a quick adjustment of prices and wages in goods markets, monetary innovations are the cause of the temporary deviations from PPP (Dornbusch, 1976). This view, however, which implies that there should be minimal persistence in the real exchange rate (i.e. it could not follow a random walk), is supported mainly by the analysis of high-inflation episodes, where movements in prices appear to dominate other factors that could lead to deviations from PPP (Zhou, 1997).

There are many factors contributing to real exchange rate volatility. Among these factors are: the level of output, inflation, the openness of an economy, interest rates, domestic and foreign money supply, the exchange rate regime and central bank independence (Stancik, 2007). The degree of the impact of each of these factors varies and depends on a particular country's economic condition. Thus, the countries that are in the transition process (such as Nigeria) are more vulnerable to being affected by these factors, which in turn affect the monetary policy decisions. In a different line of research, attempts were made to model and test for deviation from PPP, as a more permanent phenomenon, by highlighting those real exchange rate movements might be caused by changes on the real side of the economy (Neary, 1988). These models vary depending on the factors that are considered to affect the behaviour of the real exchange rate. Models based on productivity differentials were highlighted by Balasa (1994) and Obstfeld (1993), while Chinn and Johnston (1996) analysed the effect of real interest rate differentials and demand shocks respectively. Exogenous changes in terms of trade have also been found to play an important role in determining the real exchange rate behaviour (Edwards, 1994; Ostry 1988). Recently, Juthathip (2009) results for developing Asia showed that real exchange rate is determined by the five key fundamental variables that are medium to long run fundamentals. Productivity differentials, openness, terms of trade, net foreign assets, and government spending. Other variables such as output gap may be included in some countries where such factors play an important role

in determining real exchange rate. Moreover, it can be argued that real exchange rates in developing or rapidly transforming countries are likely to be particularly dependent on these real shocks, and that the extent to which different shocks affect the behaviour of the real exchange rate depends on country-specific factors.

In this respect, there is a consensus on the fact that real exchange rate behaviour at medium to long time horizons can at least be partly explained by fundamentals. Ricci, Ferretti and Lee (2008) introduce the Fundamental Equilibrium Exchange Rate (FEER) which considers one of the most broadly used concepts in determining equilibrium real exchange rate. The FEER is defined as the real exchange rate that simultaneously achieves internal and external balances. Internal balance is reached when the economy is at full employment output and operating in a low inflation environment. External balance is characterized as a sustainable balance of payments position over the medium term ensuring desired net flows of resources and external debt sustainability. The FEER tends to abstract from the short-run cyclical and speculative forces in the foreign exchange market.

Exchange Rate Policy in Nigeria

The most important themes that emerge in the discussion of exchange rates and their management in Nigeria include the high volatility, real exchange rate overvaluation albeit in the context of continuous nominal depreciation, and the search for mechanism for market-determined rate where government is the dominant supplier of foreign exchange. Exchange rate stability is one of the goals of monetary policy in Nigeria, and over the years exchange rate policy has been driven mostly by an obsession to keep the nominal exchange rate ‘stable’. For the general public, the health of the economy is gauged by the nominal exchange rate where a depreciating rate is synonymous with a weakening economy. Table 1 presents some selected exchange rate indices and highlights the extent of distortions in the exchange rate regimes.

Table 1: Selected Exchange Rate Indices 1980-2014

Period	Nominal Exch. Rate N to US$1	Nominal Eff. Exchange Rate (1985=100)	Nominal Exchange Rate Premium (%)	Real Effective Exchange Rate (1985=100)	Parallel Market Exchange Rate
1980-1985	0.70	108.27	164.24	87.81	1.97
1986-1990	5.20	19.24	41.22	100.86	6.91
1991-1995	18.61	3.32	114.73	89.66	42.73
1996-1999	21.89	0.80	289.78	140.50	85.31
2000-2009	105.50	0.20	9.83	79.95	114.31
2010-2014	155.50	0.75	7.2	197	201

Source: Central Bank of Nigeria, Annual Report and Statement of Accounts, various issues

Another key feature of the exchange regime is the huge premium which indicates the extent of distortions in the market. This has been due to the fixed regime until the mid 1980s, the managed float of the SAP era, the re-fixing of the official rate during the Abacha regime (1994-1998) and thus the large disparity between the official and the parallel (free) market rates. Given the huge demand for foreign exchange for imports and sundry reasons, and also the fact that forex at the official rate was rightly regulated with strict documentation requirements, the parallel market boomed (Soludo, 2008).

Real exchange rate (RER) volatility is another feature of the regime. The standard deviation in real exchange rate growth for 1961-70 was 4 per cent. For the period 1991-2000 – a period of greater liberalization, the standard deviation was 35 per cent, with Nigeria having one of the most volatile RER regimes among developing countries. The RER was more stable during the fixed nominal exchange rate regime (1961-1985), and wide volatility started with the emergence of major oil earnings and fiscal imprudence, surging domestic price inflation, and futile efforts to manage the nominal exchange rate.RER uncertainty (proxied by volatility) is of major concern because it inhibits private sector investment. A critical issue faced by policymakers is how to avoid RER overvaluation and exchange rate premia through a market determined nominal exchange rate regime, especially where the government

is the major supplier of foreign exchange. The Central Bank has tried all manner of experiments in determining the official nominal rate which is essentially a managed float. Between 1999 and 2001, the CBN reverted to the pre-reform system of selling foreign exchange in the interbank foreign exchange market (IFEM) at a predetermined rate, and the interbank market split into the IFEM and the open inter-bank market where banks traded among themselves at freely negotiated exchange rates (the NIFEX). The Bureau de Change and the parallel market for foreign exchange constitute the free markets – where no documentations are required for transactions in foreign exchange. In 2000, the exchange rate depreciated in all markets. At the IFEM, the Naira depreciated on the average by 6.5 per cent to ₦101.65 to one US$. This was caused principally by a significant increase in import-driven demand for foreign exchange following the increased government expenditures: total demand for foreign exchange at the IFEM during the year was $6.9 billion compared with $4.9 billion in 1999. The parallel market depreciated by 30 percent between December 1999 and May 2001, and the differential with the IFEM rate widened to 20 percent. Following the excess liquidity triggered off by fiscal expansion, a foreign exchange 'crisis' emerged in April 2001 when the CBN made a small adjustment of the IFEM rate before it had effectively mopped up the excess liquidity. The government sold large amounts of foreign exchange to deal with the crisis thereby depleting foreign reserves. As a consequence of this measure and other tighter monetary policy measures, the parallel market exchange rate appreciated from ₦140 to an average of ₦133 throughout the remainder of 2001, with the gap between the official and parallel market rates at 21 percent. In 2002, the Central Bank reintroduced the Dutch Auction System (DAS) a system which had been tried at the introduction of SAP in the mid 1980s but which later collapsed. Since the current civilian government abolished the fixed (nominal) exchange rate of the Abacha era, the premium between the parallel and the official rates fell sharply from 28.98 per cent to only 9.83 per cent. With the introduction of the DAS, the premium has further reduced to about 7.8 per cent. This is still high compared to the rates in many other developing countries where they are below 2 per cent. Hopefully, the DAS (if allowed to stay and work properly) could significantly reduce or eliminate the exchange rate premium. But the obsession with the stability of the nominal exchange rate by policymakers is

a possible constraint in allowing the rate to find its true market value (Soludo, 2008).

Based on the recent developments in exchange rate policy in Nigeria, the average rate of the naira to US appreciated with an average rate of #128 to a dollar at Dutch Auction System (DAS) in 2006. Exchange rate was generally stable from 2006 until December 2008. Stability and mild appreciation was sustained throughout 2007 and most of 2008 due to large foreign exchange inflows and deliberate policy not to allow rates to appreciate massively, thereby accumulating huge reserves. For the first time there was a convergence of rate among various segments of the foreign exchange market. The exchange rate regime will continue to be a key shock absorber for the economy to keep internal and external balance (Soludo, 2008).

3. Data and Methodology

Data and the Explanatory Variables:

The following key variables have been found to play a theoretical key role in explaining the movement of real exchange rate. These determinants variables vary between economies according to economic and financial conditions of each economy.

Table 2: Definitions and sources of variables used in regression analysis

Variable	Definition and Construction	Source
Nominal Exchange Rate	Bilateral Exchange rate of Nigeria Naira to US Dollar	Central Bank of Nigeria (CBN)
Real Exchange Rate	Nominal Exchange Rate/Consumer Price Index	CBN
Volatility of Nominal Exchange Rate	Standard Deviation of the log differences of real exchange rate	CBN
Productivity	Real Gross Domestic Product	CBN
Trade Openness	OPN = M+X/Real GDP	CBN
Government Expenditure	Government total expenditure (recurrent and capital)	CBN
Real Interest Rate	Prime Lending Rate/Consumer Price Index	CBN
Money Supply	Total Monetary Liabilities (M_2)	CBN

Source: Authors' compilation

Empirical Design

(a) Volatility Estimate

This study focused on the determinants of real exchange rate volatility in Nigeria. The frequency of data is kept at annual level with the time scope taken from 1981 to 2008. Having generated the real exchange rate from the nominal exchange rate, we derived the real exchange rate volatility (REXRVOL) with the aid of the Generalised Autogressive Conditional heteroskedasticity (GARCH 1, 1) which belong to the family of ARCH 'as introduced by Engle (1982) and Bollerslev (1986). The jointly estimated GARCH (1,1) model is given as:

$$\pm_{t}^{2} = \sim_{0} + \sim_{1} \sum_{t-1}^{2} + \quad {}_{t-1}^{2} + «_{t} \qquad \textbf{(1)}$$

Which says that the conditional variance (σ^2) of Σ at time t depends not only on the squared error term in the previous time period (as in ARCH (1)) but also on its conditional variance in the previous time period.

(b) Stationarity Test:

Since the data used in this study are time series, there is need to check the stationarity of the data. The stationarity properties of our data was checked using the Augmented Dickey Fuller (ADF) test (Dickey and Fuller 1979, 1981) and the Phillips Perron (PP) test (Phillips and Perron, 1988). The general form of these tests is estimated in the following forms:

$$\Delta Y_t = b_0 + \beta Y_{t-1} + \mu_1 \Delta Y_{t-1} + \mu_2 \Delta Y_{t-2} + \ldots + \mu_p \Delta Y_{t-p} + e_t \qquad \textbf{(2)}$$

Where, Y_t represents time series to be tested, b_0 is the intercept term, β is the coefficient of interest in the unit root test, μ is the parameter of the augmented lagged first difference of Y_t to represent the p*th* order autoregressive process and et is the white noise error term.

(c) Cointegration Analysis:

In order to solve the spurious regression problem and violation of the assumptions of the classical regression model; cointegration analysis is used

to examine the longrun relationship between real exchange rate volatility (REXRVOL) and its various determinants. As part of the empirical design the basic estimating equation is specified as follows:

$$REXRVOL = \alpha_0 + \alpha_1 GEXP + \alpha_2 MS + \alpha_3 OPN + \alpha_4 PROD + \alpha_5 REXR + \alpha_6 RINTR + e_t \quad \textbf{(3)}$$

Where REXRVOL is the Real Exchange rate volatility, GEXP is the government expenditure, MS is money supply, OPN is the openness of the economy, PROD is the productivity index, REXR is the Real exchange rate, RINTR is the Real interest rate while et is the stochastic error term. To test for cointegration in order to know the disequilibrium error, equation (iii) is rewritten as:

$$e_t = REXVOL - \alpha_0 - \alpha_1 GEXP - \alpha_2 MS - \alpha_3 OPN - \alpha_4 PROD - \alpha_5 REXR - \alpha_6 RINT \quad \textbf{(4)}$$

The presence of cointegration was tested using the Engle and Granger (1987) single test approach. The order of integration of the estimated residual, et is tested and if there is a cointegrating regression, then the disequilibrium errors in equation (iv) form a stationary time series, and have a zero mean, the et should be stationary, I(0) with E(et) = 0. The longrun equilibrium may be rarely observed but there is a tendency to move towards equilibrium. Thus, Error Correction Model is used to represent the longrun (static) and short run (dynamic) relationships between REXRVOL and other variables. Accordingly, Error Correction Model (ECM) is suitable to estimate the effect of determinant variables on REXRVOL. Thus, equation (v) represents Error Correction Model. Besides, the purpose of ECM model is to indicate the speed of adjustment from the short run equilibrium to the long run equilibrium state. The greater the coefficient of the parameter, the higher the speed of adjustment of the model from short runs to long run. Considering our base equation (iii), the ECM model is specified as follows: Thus, equation (v) represents the error correction model

$$\Delta REXRVOL = \sim_0 + \sim_1 \sum_{t=1}^{n} \Delta GEXP_{t-1} + \sim_2 \sum_{t=1}^{n} \Delta MS_{t-1} + \sim_3 \sum_{t=1}^{n} \Delta OPN_{t-1} + \sim_4 \sum_{t=1}^{n} \Delta PROD_{t-1} +$$

$$\sim_5 \sum_{t=1}^{n} \Delta REXR_{t-1} + \sim_6 \sum_{t=1}^{n} \Delta RINTR_{t-1} + ¢ECM(-1) + £t \ldots\ldots\ldots \quad \textbf{(5)}$$

Where εt is the error term, ECM (-1) is the error correction term,δ captures the long run impact. The short run effects are captured through the individual coefficients of the differenced terms (α) while the coefficient of the ECM variable contains information about whether the past values of variables affect the current values. The size and statistical significance of the coefficient of the ECM measure the tendency of each variable to return to the equilibrium. A significant coefficient implies that past equilibrium errors play a role in determining the current outcomes.

4. Results and Findings

Since the application of cointergration technique requires that all the variables should be integrated of the same order, we start the analysis by examining the unit root properties of the variables. The result of both methods (ADF and PP tests) as shown in Table 3 shows that GEXP, MS and PROD are stationary at level under both methods while OPN, REXR and RINTR are non-stationary at level under both methods. As a result, all the variables have been differenced once to check their stationarity. At first differencing the calculated ADF and PP test statistics clearly reject the null hypothesis of unit root when compared with their corresponding critical values hence the ADF and PP tests decisively confirm stationarity of each variable at first difference and depict the same order of integration I (1) behaviour. Thus we can apply Engle and Granger single test cointegration approach to examine the long run relationship among the variables.

Table 3: Stationarity test of the variables

Variable		Unit Root Tests		Conclusion
		ADF	PP	
GEXP	Level	6.456987*	7.75195*	I(1)
	First Diff	2.777591***	-3.01527**	
MS	Level	6.595822*	9.51936*	I(1)
	First Diff	4.709117*	8.00283*	
OPN	Level	2.027181	4.923353*	I(1)
	First Diff	-4.63518*	-4.63112*	
PROD	Level	1.511465	3.411539**	I(1)
	First Diff	-6.83425*	-6.82531*	
REXR	Level	-2.16613	-2.29462	I(1)
	First Diff	-4.61502*	-4.61624*	
RINTR	Level	-1.86364	-1.59491	I(1)
	First Diff	-3.23366**	-8.93096*	
Critical Value	1%	-3.771146	-3.69987	
	5%	-2.98104	-2.97626	
	10%	-2.62991	-2.62742	

NB: *,** & *** represent significant at 1%, 5% and 10% respectively
Source: Author's Computation (2016)

Co-integration Test: The co-integration test results are given in Table 4. Using the Engle and Granger (1987) two stage techniques, the co-integration results reveal that the residuals from the regression result are stationary at 1%level of significant. This implies that Government Expenditure (GEXP), Money Supply (MS), Openness of the economy (OPN), Productivity (PROD), Real exchange rate (REXR), and Real Interest rate (RINTR) are co-integrated with Real Exchange Rate Volatility (REXRVOL) from 1981 to 2014. This indicates that there exists a longrun and stable relationship between the dependent and independent variables. This finding also reveals that any short run deviation in this relationship would return to equilibrium in the long run.

Table 4: Cointegration test of the residual

Null Hypothesis:
ECM has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.305733	0
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(ECM)

Method: Least Squares

Sample (adjusted): 1982 2014

Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECM(-1)	-1.12072	0.177731	-6.305733	0
C	-0.00057	0.00746	-0.0759	0.94
R-squared	0.561913	Mean dependent var		-0.00057
Adjusted R-squared	0.547782	S.D. dependent var		0.063726
S.E. of regression	0.042854	Akaike info criterion		-3.40334
Sum squared resid.	0.056931	Schwarz criterion		-3.31264
Log likelihood	58.15508	Hannan-Quinn criterion		-3.37282
F-statistic	39.76227	Durbin-Watson stat		2.048411
Prob(F-statistic)	0.000001			

Source: Author's Computation (2016)

Error Correction Model: The main output from ECM estimation is as shown in Table 5; the error correction model indicates the degree of adjustments in which the dependent variable adjusts to changes in the independent variables. The results show a well-defined error correction term [ECM (-1)] with an expected negative coefficient value of -0.855155 which

indicates that about 85.5% of the previous periods disequilibrium in Real Exchange Rate Volatility (REXRVOL) is corrected in the long-run. The statistical significance of the ECM at 1% supports our earlier assertion of co-integrated relationship among the variables while the adjusted coefficients of determination (Adj. R^2) value of 0.846 reveals that about 84.6% of the systematic variations in the dependent variable (REXRVOL) is jointly explained by the independent variables all taken together, this further indicates that only about 15% of such systematic variations are not accounted for by these independent variables during the period under consideration. The F-statistics value of 9.98 which is also significant at 1% indicates the existence of statistically significant linear relationships among the variables analysed while the DW statistics of 2.19 is within the acceptable range.

An examination of the coefficients and statistical significant of the variables analysed reveal a varying degree of relationships between the dependent and explanatory variables. In the short run, only Government expenditure (DGEXP) and one period lag Real exchange rate [DREXR(-1)] had positive and significant influence on Real exchange rate volatility (REXRVOL) while Money supply (DMS), Openness of the economy (DOPN) and Real interest rate (DRINTR) all have significant negative relationships with REXRVOL in the short run. In the long run, only GEXP and REXR have significant positive influence on REXRVOL. Among all the explanatory variables, Productivity Index (DPROD) is found to be statistically insignificant determinant of REXRVOL so in explaining the shocks of real exchange rate volatility in Nigeria, the indices of the productive sectors cannot be considered relevant in terms of magnitude and directions during the period covered by this study, this may be attributed to the import dependent nature of the Nigeria economy which almost paralyzed the activities of the manufacturing sector during the period under consideration.

Table 5: Error Correction Model (ECM) results

Dependent Variable:
DREXRVOL
Method: Least Squares
Sample (adjusted): 1983 2014
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.157512	0.095224	-1.654113	0.124
GEXP	-0.000363	0.000148	-2.453297	0.0304
DGEXP	0.000721	0.00013	5.52366	0.0001
DGEXP(-1)	8.86E-05	9.12E-05	0.971856	0.3503
MS	4.23E-08	2.88E-08	1.467942	0.1678
DMS	-1.08E-07	3.41E-08	-3.165161	0.0081
DMS(-1)	8.58E-09	3.23E-08	0.265522	0.7951
OPN	0.015691	0.013849	1.132988	0.2793
DOPN	-0.033593	0.009171	-3.663003	0.0032
DOPN(-1)	-0.003926	0.00711	-0.552174	0.591
PROD	8.07E-07	4.68E-07	1.726369	0.1099
DPROD	-5.17E-07	6.26E-07	-0.826429	0.4247
DPROD(-1)	-5.02E-08	7.34E-07	-0.068388	0.9466
REXR	-0.071804	0.034171	-2.101281	0.0574
DREXR	0.042179	0.040737	1.035402	0.3209
DREXR(-1)	0.20558	0.040787	5.040348	0.0003
RINTR	-0.001298	0.00529	-0.245416	0.8103
DRINTR	-0.053439	0.011181	-4.779335	0.0004
DRINTR(-1)	-0.028875	0.009719	-2.970903	0.0117
ECM(-1)	-0.855155	0.185235	-4.616604	0.0006

R-squared	0.940482	Mean dependent var	-0.00308
Adjusted R-squared	0.846246	S.D. dependent var	0.0808
S.E. of regression	0.031683	Akaike info criterion	-3.79691
Sum squared resid	0.012046	Schwarz criterion	-2.88082
Log likelihood	80.75049	Hannan-Quinn criterion	-3.49325
F-statistic	9.980035	Durbin-Watson stat	2.19067
Prob(F-statistic)	0.000111		

Source: Author's computation (2016)

5. Conclusion

Exchange rate shocks and instability is a common feature of emerging economies especially the import dependent one like Nigeria, this is because there will always be an increasing demand for foreign currencies in exchange for imported goods by the teeming populace. It is in this perspective that this paper examined the determinants of real exchange rate volatility in Nigeria using the Generalised Autoregressive Conditional Heteroskedasticity (GARCH) and Error Correction Model. Based on the extant literatures, we identify relevant variables that influence real exchange rate volatility (Government Expenditure, Money Supply, Real interest rate, productivity index and openness of the economy), which we include in our model estimation.

The empirical results of the cointegration analysis shows that there is long run equilibrium relationship among the variables, while our error correction model coefficients from the estimated short run dynamic model showed reasonable speed of adjustment towards the long run equilibrium. Analyzing the direction and magnitude of the explanatory variable coefficients, we observed that government expenditure, money supply, openness of the economy, real exchange rate and real interest rate are significant determinants of real exchange rate volatility during the period 1981-2014, though they all have different magnitude of influence on the volatility of exchange rate. While productivity index has no significant influence on real exchange rate volatility during this period. These findings is partly consistent with the findings of Aliyu (2008); and Al-Samara (2009) who investigated the determinant of exchange rate volatility in Nigeria and Syrian economy respectively.

The strive by central monetary authority to ensure a stable exchange rate regime and policy will continue to exist as there continue to be openness of Nigerian economy to foreign trade especially as an import dependent economy. Therefore this paper recommends that the monetary authority should institute a policy that will ensure the limit within which exchange rate can fluctuate within a given time period. Besides, the government should

exercise direct control of viable macroeconomic variables (inflation rate, interest rate and GDP) which have direct influence on exchange rate. Success in this regard will further limit the fluctuation of exchange rate in the economy.

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The Determinants of Agricultural Productivity and Rural Household Income in Ethiopia

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Abstract

This paper aims at investigating the determinants of agricultural productivity and rural household income in Ethiopia. Three econometric models namely: Pooled ordinary least square (POLS), fixed effects (FE) and random effects (RE) model were used to examine the relationship between productivity and income; using Ethiopian socio-economic survey of 2011/12 and 2013/14 data, collected by CSA of Ethiopia in collaboration with the World Bank.

Results showed that, Land-labor ratio, use of fertilizer, use of pesticide, manure and household size are found to be the most significant variables that affect agricultural labor and land productivity. However, drought has statistically significant and has negative effect on both labor and land productivity by the same magnitude. Labor productivity, non-farm income and land productivity are found to be the most determinants of household income. However, number of dependency ratio is significantly and negatively affects the rural household income. Sex of the household head is the main socio-economic factor for the variation of income among the rural households. The study also concludes that, Labor productivity is the most potent for factor of production and rural household income enhancement. The policy implication of the study is that, increasing land-labor ratio is important for agricultural productivity enhancement and promotion of both farm labor and non-farm income are best focusing to speed up for the enhancement of rural household income.

Key Words: Labor productivity, Land productivity; Rural household income, Rural household panel data, Fixed effect model.

JEL Classification: A02, A23

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1. Introduction

Ethiopia is one of the Sub-Saharan African countries which liberalize its economy to maintain in all sectors a sustained economic growth and reduce poverty. Over the last ten years the sustainable economic growth brought with it positive trends in reducing poverty in urban and rural areas: While 38.7% of Ethiopian lived in absolute poverty in 2004/05. However, five years later this was declining to 29.6% in 2010/11. Moreover, poverty head count is still more prevalent in rural 30.4 percent than urban areas 25.7percent in Ethiopia (CSA, 2010/11).

In Ethiopia, about 83.9 % of total population is lives in rural area and agriculture is main source of their livelihood. Since 2010, Agriculture become the second most dominant next to service sector of the country's economy, by providing employment for 80 % of the total labors force and contributes 42.7 % to Gross Domestic Product and 70 percent of foreign exchange earnings (NBE, 2013; CSA, 2013).

Due to its importance, the government of Ethiopia gives high priority to the agriculture sector by setting a strategy of agricultural development led industrialization (ADLI). The main goal of the agricultural policy is not only achieving the sustainable increase in agricultural production and productivity of small holder farmers but also accelerate agricultural commercialization and agro industrial development in the country (PIF, 2010-2020). Agricultural productivity can be increased by using two ways. The first method is through improvement in technology given some level of input and the other option of improving productivity is to enhance the output per household labor ratio of rural household farmers, given fixed level of inputs and technology. This study was mainly concerned about the second option of increasing productivity i.e. output per labor input and output per cultivated area of land.

Land productivity is used by national policy makers to evaluate agricultural production intended to meet national food security needs. But, output per agricultural worker, on the other hand, may be a more important indicator of

rural household standards of living and their welfare (Block, 1995). Therefore, enhancement of agricultural productivity is thus an important condition for alleviating rural poverty, and due to it increases household income and stimulating the growth of non-farm activities among rural households.

However, due to the agriculture sector of Ethiopia is mostly susceptible in seasonal rain fall, the rural households are generating their family income from difference sources to averse the risk associated in agricultural farm sector. As a result the main source of income in most rural household of Ethiopia is derived from farm and non-farm activities. Agriculture is the primary source of rural income as 80% percent of the rural labor force is engaged in this sector (CSA, 2013). Non-farm income of the rural household referred to an income that the rural households generate from none of crop or livestock production during a one year of agriculture production period. Non-agricultural activities are not getting prevalence in rural Ethiopia because households are rarely practicing dominated by a subsistence agriculture sector. As a result of this, the income from nonfarm activity is also very low.

This subsistence agriculture and low level of rural household income is socially and economically could make unstable the rural society. Therefore, it is significantly important to identify the factors that affect agricultural productivity and find the methods of the rural household income improvements.

1.2 Objective of the study

The main objective of this study was to examine the determinants of Agricultural productivity and rural household income in Ethiopia and more specifically the study was:

- To determine the agricultural farm productivity/output per unit of labor input and output per unit of cultivated area of land

- To examine socioeconomic factors which can best predictor for the variation in agricultural productivity and income among rural households
- To examine the most potent productivity to enhance the rural household income
- To recommend possible policy implication based on the research findings.

2. Research Methodology

2.1 Source of data and the type of data used

The data for this research paper is comes from the two round of panel survey of Ethiopian Rural Socioeconomic survey (ERSS), conducted by Central Statistical Agency (CSA) with the collaboration of the World Bank Living Standard Measurement Study (ISLM) team. The survey was conducted in 2011/12 for the first time in Ethiopia in full sample coverage at National level and second round was conducted after two years later in 2013/14.

2.2 Methods of data analysis

Quantitative methods were used to analysis the data. Mean tabulation and frequency distribution was used to analyze in detail. On top of that F-test and Chi-square statistics is implemented to measure the mean and percentage difference between productivity and income of the rural households. The log-linear of Cobb_Dauglas production function of the within-group or LSDV, the random effect (RE) and the fixed effect (FE) model was used for the determinants of agricultural productivity and the IVreg2 (2SLS), the random effect (RE) as well as the fixed effect (FE) model was employed for the estimation of the determinants of rural household income.

2.3 Empirical productivity model specification

The current Cobb-Douglas production function analysis consider all the factors of production such as cultivated area of land, chemical fertilizer, number of oxen as proxy for capital input, etc are considered.

$$y_{it} = \alpha(L_{it}^{\beta_1} K_{it}^{\beta_2}) e^{\mu_{it}} \quad \textbf{(1)}$$

Where: Y_{it} = is the value of the ith household's all farm output in Ethiopian birr during Period t

L_{it} = is the ith labor inputs used during period t
K_{it} = is the ith capital inputs at a time t
μ_{it} = the disturbance or an error term
β_1 and β_2 = output elasticity of labor and capital

If we transform equation (1) in its log-transformation form, it will give us:

$$\ln Y_{it} = \beta_i + \beta_1 \ln L_{it} + \beta_2 \ln K_{it} + \mu_{it} \quad \textbf{(2)}$$

Therefore, in the case of our several dependant variables the ln-linear model would be:

$$\ln Y_{it} = \beta_{0i} + \beta_1 \ln Al_{it} + \beta_2 \ln A_{it} + \beta_3 \ln RAV_{it} + \beta_4 \ln FET_{it} + \beta_5 \ln OX_{it} + \beta_6 AG_{it} + \beta_7 EDU_{it} + \beta_8 HHS_{it} + \gamma_1 SEX_{it} + \gamma_2 PES_{it} + \gamma_3 DRT_{it} + \gamma_4 CRD_{it} + \gamma_5 EXTN_{it} + \gamma_6 IRRN_{it} + \gamma_7 MANURE_{it} + \varepsilon_{it} \quad \textbf{(3)}$$

Where,
$\ln Y_{it}$ = the log of total farm output produced by i^{th} household during period t
$\ln Al_{it}$ = the log of ith household agricultural labor inputs during period t
$\ln A_{it}$ = the log of cultivated land area of the ith household during period t
$\ln RAV_{it}$ = the log of real asset value of the ith household during period t
FET_{it} = the amount of chemical fertilizer used by i^{th} household during period t
OX_{it} = the number of oxen used for plough by i^{th} household during period t
AG_{it} = The Age of the household head during period t
EDU_{it} = Educational level of the ith household head during the period t
HHS_{it} = family size of the ith household during period t
SEX_{it} = Sex of the ith household head during period t
PES_{it} = if the ith household were used pesticide or not during period t
DRT_{it} = if drought was happened to the ith household farms during the pried t

CRD_{it} = if the ith household was got credit during period t
$EXTN_{it}$ = if the household used extension service during the period t
$IRRN_{it}$ = if the household used irrigation during the period t
$MANURE_{it}$ = if the household used animal manure during the period t

But our interest is to come up with the labor and Land productivity equation and hence, let us first divide both sides of equation (3) by agricultural farm labor force (AL), to determine the labor productivity equation. According to Ramirez (2006), we will have aggregated output per unit of labor as a measure of labor productivity and taking log of both sides of the equation it will gives us;

$$\ln\left(\frac{Y}{AL}\right)_{it} = \beta_{0i} + \beta_1 \ln\left(\frac{AL}{AL}\right)_{it} + \beta_2 \ln\left(\frac{A}{AL}\right)_{it} + \beta_3 \ln\left(\frac{RAV}{AL}\right)_{it} + \beta_4\left(\frac{FET}{AL}\right)_{it} + \beta_5\left(\frac{OX}{AL}\right)_{it} + \beta_6 AG_{it} + \beta_7 EDU_{it} + \beta_8 HHS_{it} + \gamma_1 SEX_{it} + \gamma_2 PES_{it} + \gamma_3 DRT_{it} + \gamma_4 CRD_{it} + \gamma_5 EXTN_{it} + \gamma_6 IRRN_{it} + \gamma_7 MANURE_{it} + \varepsilon_{it} \quad \textbf{(4)}$$

Where $\ln\left(\frac{Y}{AL}\right)$ = is a measure of partial labor productivity. It is worth to mention that our productivity measurement is partial.
If we put equation (4) in a compact or reduced form in the following method:

$$\ln\left(\frac{Y}{AL}\right)_{it} = \boldsymbol{\beta_{0i}} + \boldsymbol{\beta_i} \sum_{j=1}^{n} \boldsymbol{X_{it}} + \gamma_i \sum_{k=1}^{n} \mathbf{D_{it}} + \mathbf{e_{it}} \quad \textbf{(5)}$$

Where, j = 1, 2, ..., 8 and
K = 1, 2, ..., 7

Similarly we compute the Land productivity equation based on equation (3) above by dividing the right and the left hand sides by cultivated area of land (A). Then, we will have aggregated output per cultivated area of land as a measure of land productivity will gives us;

$$\ln\left(\frac{Y}{A}\right)_{it} = \beta_{0i} + \beta_1 \ln\left(\frac{AL}{A}\right)_{it} + \beta_2 \ln\left(\frac{A}{A}\right)_{it} + \beta_3 \ln\left(\frac{RAV}{A}\right)_{it} + \beta_4\left(\frac{FET}{A}\right)_{it} + \beta_5\left(\frac{OX}{A}\right)_{it} + \beta_6 AG_{it} + \beta_7 EDU_{it} + \gamma_1 SEX_{it} + \gamma_2 PES_{it} + \gamma_3 DRT_{it} + \gamma_4 CRD_{it} + \gamma_5 EXTN_{it} + \gamma_6 IRRN_{it} + \gamma_7 MANURE_{it} + \varepsilon_{it} \quad \textbf{(6)}$$

Therefore, the reduced form of equation (6) will gives us the following equation (7):

$$\ln\left(\frac{Y}{A}\right)_{it} = \beta_{0i} + \beta_i \sum_{j=1}^{n} X_{it} + \gamma_i \sum_{k=1}^{n} D_{it} + e_{it} \quad \textbf{(7)}$$

Where, $\ln\left(\frac{Y}{A}\right)$ = is a measure of partial land productivity and, j =1, 2, ….. 3

i= 1, 2, ….. 7

During the pooled OLS model is employed a random variable ε_{it} are assumed to be iidN(0, δ_{ε}^{2}).

2.4 Estimation technique

We use equation (8) and (9) to estimate the labor and land partial factor productivity measurement specified under equation (5) and (7) respectively. For the model estimation, we were employ panel data estimation technique. Following Baltagi (2001), Gujarati and Porter (2009), and Greene (2003) panel data regression model presented below.

$$Y_{it} = \alpha_{it} + \beta X_{it} + U_{it}, \quad i = 1\ldots\ldots, N \;\&\; t = 1, \ldots\ldots\ldots\ldots, T. \quad \textbf{(8)}$$

Where,

Y_{it} = is the dependant variable

X_{it} = is the independent variable

α_{it} = is the unobserved individual heterogeneity or the individual fixed effect

β = is the parameter to be estimated

U_{it} = is the residual

In order to test the pooled OLS model is fitted or not, we will be employee the standard F-test by using equation 11. The F-test will be used to check fixed effect against Pooled OLS Method (Common constant). The null hypothesis (equation 10) is that all the intercepts are the same and the Pooled OLS Method is applicable.

$$H_0: \alpha_1 = \alpha_2 = \ldots = \alpha_N \quad \textbf{(10)}$$

$$F = \frac{(R^2_{UR} - R^2_R)/J}{(1-R^2_{UR})/(n-k)} \quad \textbf{(11)}$$

Where, R^2_{UR} = Unrestricted R squared

R^2_R = Restricted R squared

J = Number of restrictions

n = Total number of observations

k = number of parameters in the unrestricted regression

We also use the Houseman test to select the best efficient model among the random effect and the fixed effect model in order to meet our objective.

2.5 Empirical model specification for rural household income

By following Simler *et al.* (2004) and Demeke *et al.* (2003), we try to estimate the determinants of the rural household per capita income. The framework is the unobserved effects model which is adapted from Wooldridge (2009) and Greene (2003).

$$\ln(I_{it}) = \beta_i + \gamma prod_{it} + \beta X_{it} + \varepsilon_{it}, \quad i = 1, ---, N, \quad t = 1, .., T \quad \textbf{(12)}$$

Where, $\ln(I_{it})$ = is the natural logarithm of the rural household income per capita of the i-th household

β_i = is an individual-specific or unobserved effects which is fixed over time.

βX_{it} = are vectors of explanatory variables which serve as control.

$\gamma prod_{it}$ = represents the agricultural productivity of farm households.

ε_{it} = the error terms which are assumed to be uncorrelated with the exogenous Variables X_{it} with mean zero and variance δ^2_ε

There are also dummy variables in our regression model. According to Verbeek, (2004) equation (11) will be specified with dummy variable as follows:

$$I_{it} = \sum_{j=1}^{N} \alpha_j d_{ij} + \gamma prod_{it} + x'_{it}\beta + \varepsilon_{it} \qquad \textbf{(13)}$$

Where, d_{ij} = is a dummy variables which takes 1or 0 for j = (1, ---, N)

However, the agricultural labor productivity and land productivity were characterized by endogenity problems. Therefore, to overcome these endogenity problems, we use z_{it} as instrumental variables (IV's) for the productivity variables.

The productivity of X_{it} was instrumented by:

$$prod_{it} = \pi_1 z_{it} + \pi_2 x_{it} + v_{it} \qquad \textbf{(14)}$$

Where, The agricultural productivity and instrumental variables (IV's) z_{it} are correlated, i.e **Cov** $(z_{it}, prod_{it}) \neq 0$ but the idiosyncratic error term is uncorrelated with the instrumental variables (IV's), thus **cov** $(z_{it}, \varepsilon_{it}) = 0$

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2.5.1 Estimation technique

The estimation technique of the determinants of the rural household income were used the IVreg2 or two stages least square (2SLS), fixed effect (FE) and the random effect (RE) estimator based on equation (13) and (14) above.

This equation also enables us to investigate the change in income per-capita per-household by applying the fixed effect estimation.

3. Econometric Results and Discussion

3.1 Econometric results of the agricultural labor productivity

There were different demographic and socio-economic factors that were contributing in the determinants of agricultural labor productivity of the rural farm household's in Ethiopia. In order to identify the significant factors, we employ the pooled OLS, the within-group, the fixed effect and the random effect models are applied on the panel data set which we could choose the best among them. However, an F-test of the null hypothesis that all household-specific intercepts are identical rejected the pooled OLS in favor of the fixed effect model and also the random effect model was rejected by the Hausman test.

F-test for labor productivity

Test for differing group intercepts:-
Null hypothesis: The groups have a common intercept
Test statistic: F (14, 2124) = 110.84
With p-value = P (F (14, 2124) > 110.84) = 3.38

On the basis of the F-statistics test, we decided to use the fixed effect model, and therefore, only the fixed effect model results will be presented and discussed. The model is also tested for the possible appearances of Heteroscedasticity and multicollinearity problems. The Heteroskedasticity problem was adjusted by regressing all model used for estimation with robust standard, and the multicollinearity problem was also checked and tested using the observed information matrix (OIM) during the estimation of the variance–covariance matrix. As a result we don't find any multicollinearity problem during the estimation for the determinants of labor productivity.

To determine the agricultural labor productivity in rural households of Ethiopia, the fixes effect model was applied. The parameters of the fixed effect estimation model of the partial factor labor Productivity of farm household indicates that, most variables were statistically significant. However, real asset value per unit of labor, number of oxen per unit of labor, educational level of the household head, sex of the household head, credit access and irrigation were not significant for the determinants of labor productivity.

One known reason for educational level of the household heads do not significant is that, out of 2,236 household head there were only about 700 household heads were educated in the survey data set and off these 700 households only 111 household heads were completes grade 8 and above. Regarding to irrigation user, out of the total 2236 sampled household, there were only 308 households were used irrigation during the survey period.

The result of the fixed effect estimation model shows that, cultivated area of land per unit of labor, the use of chemical fertilizer inputs, the use of pesticide, use of extension program, the use of manure, the number of household size and age of the household head are found to be the determinants of the agricultural labor productivity. However, the drought variable was significantly and negatively affects the agricultural labor productivity of the sampled rural households. More specifically, cultivated area of land per unit of farm labor input was a significant contribution for the positive change of labor productivity during period of analysis; as the cultivated area of land per unit of agricultural labor increases by one percent, the labor productivity increases by 0.83 percent. This finding is consistence with the finding of Joseph Owuor's in Kenya. He was concluded that, labor productivity and land productivity are consistent, positively correlated and significant. The result implies that, the availability of agricultural cultivated land increases labor productivity in the sampled area of rural households. Therefore, it could be good if the government facilitate the access of land to landless, especially for the youngsters those who are within the household.

The fixed effect result shows that, there is a significant labor productivity difference between chemical fertilize user household and non user. As the household are increases the use of chemical fertilizer inputs by one unit the labor productivity increases by about 0.25 units and vis-versal for non user households. The use of pesticide input in farm production processes was also statistically significant at 1 percent level of significant, which means, as the household increases the use of pesticide by one unit, the labor productivity also increases by about 0.12 units. Therefore, accessing and advising the rural household to the use of pesticide inputs during their farm production processes would enhance labor productivity in rural households.

One of the important finding of this study was that, when the drought occurs in one agricultural season in Ethiopia, the labor productivity of the rural household declines by about 0.25 units and it is statistically significant at 1 percent level. This implies that the rain dependant agriculture is risky for the farm household labor productivity enhancement. Therefore, promotion of the use of irrigation system or any other source of water is useful during the drought season so as to increase the labor productivity of rural farm households.

Surprisingly, as the number of household member increases by one unit the labor productivity of the household increases by 0.21 units and it is also significant at one percent level of significant. One known reason behind this is that, the rural household of Ethiopia uses more family labor than hired labor in their farm production processes. As a result having more labor with in a household would be able to a high possibility of farm management work to increase farm output.

Table 1: The labor productivity of with-group, fixed-effect & random-effect estimates

Explanatory Variables	Coefficients		
	Within-group	Fixed-effect	Random-effect
Log of Land in hectare per unit of labor	0.826*	0.831*	0.721*
	(0.023)	(0.032)	(0.023)
Log of Real Asset Value (in birr) per unit of labor	0.019	0.013	0.037**
	(0.018)	(0.025)	(0.017)
Chemical fertilizer (in Kg) per unit of labor	-0.123*	-0.249*	-0.334*
	(0.021)	(0.052)	(0.040)
Number of ploughed oxen per unit of labor	0.061	0.097	-0.255***
	(0.161)	(0.233)	(0.145)
Age of household head	0.025*	0.024*	0.002
	(0.003)	(0.005)	(0.002)
Educational status of household head	0.013	0.017	0.165*
	(0.037)	(0.053)	(0.035)
Household size	0.220*	0.205*	0.018
	(0.014)	(0.020)	(0.058)
Sex of household head (male =1)	-0.012	-0.135	0.042*
	(0.0245)	(0.129)	(0.010)
Pesticide (use =1)	0.046**	0.119*	0.161*
	(0.021)	(0.044)	(0.037)
Drought (yes =1)	-0.098*	-0.247*	-0.240*
	(0.036)	(0.071)	(0.061)
Credit access (yes =1)	0.016	0.063	-0.013
	(0.019)	(0.047)	(0.037)
Extension service (yes =1)	0.033***	0.142*	-0.004
	(0.018)	(0.048)	(0.035)
Irrigation (use =1)	0.0178104	0.057	0.185*
	(0.025)	(0.075)	(0.055)
Manure (use =1)	0.032***	0.074**	0.193*
	(0.018)	(0.045)	(0.036)
Constant	-0.015*	7.252*	8.459*
	(0.026)	(0.294)	(0.158)5
Number of Observations	4353	4353	4353
Prob>F	0.0000	0.0000	0.000
R-squared	0.4128	0.4222	0.3872
corr(a i , X b)		-0.3916	0
			(assumed)
sigma_u		1.266	0.879
sigma_e		0.815	0.815
Rho		0.707	0.538

Source: Computed from Ethiopian socio economic survey data.

Note: Hausman test choose fixed-effect over the random-effects estimation; Standard errors in robust standard to adjust Heteroskedasticity problem: Dependent variable is log of labor productivity measured in output per man-day; *, ** and *** represents the coefficients are significant at 1, 5 and 10 percent level respectively.

Another variable, the use of extension service and manure was also statistically significant at 1 and 10 percent significant level respectively. The use of extension service increases the farm household labor productivity significantly by 0.14 units as the households were got the service during one production seasons of the survey period. It is also consistence with the finding of Asres Elias *et.al* (2013) in Ethiopia, during their study of the Effect of agricultural extension program on small holder's farm productivity. There for, by expanding and encouraging the farm household participation rate for the use of extension program is still important for the labor productivity enhancement since the extension user households are more productive than non users.

Using manure is also important variables for the rural household labor productivity enhancement, which shows that, the labor productivity increases by 0.07 units as the farm household's uses manure for their farm production process in one production period. This implies that, animal dung is very important as the chemical fertilizer may not affordable for some poor rural farm households. The finding is also consistent with Wassie (2012) in Ethiopia indicated that, manure maintains soil fertility.

There was also age of the household head is statistically significant at 1 percent level. This implies that as the age of the household head increases by one more year the labor productivity of the rural household also shows slight increments by 0.02 units. One reason would be the mean of the household head age was around 45 years and more than 47 percent of the household head age was less than 40 years old as a result the possibility of young household head to be matured and increases his/her farm practicing experience would be high which able to increase household's farm labor productivity.

Hausman-test:

Test: Ho: difference in coefficients not systematic

chi2 (14) = 251.46

Prob>chi2 = 0.0000

Therefore, we reject the random effect model in favor of fixed effect. Due to the fact that, the analysis of this study is made on the bases of the result of the within-group and the fixed effect model, due to the random effect model was rejected in favor of fixed effect model by Hausman test.

3.2 Econometric results of the agricultural land productivity

Here also there are different demographic and socio-economic factors that were contributing in the determinants of agricultural land productivity of the rural farm household's in Ethiopia. In order to identify the significant factors, we employ the pooled OLS, the within-group, the fixed effect and the random effect models were applied on the panel data set which we could choose the best among them. However, an F-test of the null hypothesis that all household-specific intercepts are identical rejected the pooled OLS in favor of the fixed effect model and also the random effect model was rejected by the Hausman test.

F-test for land productivity
Test for differing group intercepts -
Null hypothesis: The groups have a common intercept
Test statistic: $F(14, 2124) = 20.26$
With p-value = $P(F(14, 2124) > 20.26) = 3.41$

On the basis of the F-statistics test, we decided to use the fixed effect model. And hence, only the fixed effect model result will be presented and discussed. The model is also tested for the possible appearances of Heteroscedasticity and multicollinearity problems. The Heteroskedasticity problem was adjusted by regresses of the entire model used for estimation, with robust standard and the multicollinearity problem was also checked and tested using the observed information matrix (OIM) during the estimation of the variance–covariance matrix. As a result we don't find any multicollinearity problem during the estimation for the determinants of land productivity.

To determine the agricultural land productivity in rural households of Ethiopia, the fixes effect model was applied. The parameters of the fixed effect estimation model of the partial factor land productivity of the Ethiopian rural farm household indicate that, most of the variables were statistically significant during the survey period of 2012-2014 (Table 2 above). However, real asset value per unit of land, educational status of the household head, sex of the household head, credit access and irrigation were not significant for the determinants of land productivity.

One known reason for educational level of the household heads do not significant is that, out of 2,236 household heads, there were only about 700 household heads were educated in the survey data set and off these 700 households, only 111 household heads were completes grade 8 and above. Regarding to irrigation user, out of the total 2236 sampled household, there were only 308 households were used irrigation during the survey period.

Despite the fact that, the finding of the fixed effect estimation model shows that, agricultural labor per unit of cultivated area of land, the use of pesticides and extension service, the number of household member size, the number of oxen used for ploughed and the age of the household head were found to be the determinants of agricultural land productivity of rural households.

However, the cause of drought during the production season was significantly and negatively affects the rural households land productivity. The land productivity shows a slight change when it compares to labor productivity changes during the same period of analysis. It indicates that, as the agricultural labor per unit of cultivated area of land was increases by one percent, land productivity increases by 0.14 percent. This output was almost the same with the within-group estimation output. The result implies that, the increase of labor-land ratio increases land productivity of rural households. Therefore, it could be good if the government facilitate the access of land to landless, especially for the youngsters those who are within the household. The finding is also consistence with Joseph Owuor in Kenya.

The result of this study in both, the within-group estimation and fixed effect model, exactly answers the question of the most potent of agricultural productivity so as labor productivity is the most potent for agricultural productivity than land productivity in the rural households.

The use of pesticide input in farm production processes was also statistically significant at one percent level of significant, which means, as the household increases the use of pesticide by one unit, land productivity increases by 0.12 units. Therefore, accessing and advising the rural household to use the pesticide inputs during their farm production processes would enhance the land productivity of rural households.

One of the important finding of this study is that, when the drought occurs in one agricultural season in Ethiopia, the land productivity of the rural household declines by 0.25 units and statistically significant at l percent level. This implies that the rain dependant agriculture is risky for the farm household land productivity enhancement. Therefore, promotion of the use of irrigation system or any other source of water is useful during the drought season so as to increase the land productivity of rural farm households.

Surprisingly, as the number of household member increases by one unit, land productivity increases by 0.21 units and it is also significant at one percent level of significant. One known reason behind this is that, the rural household of Ethiopia uses more family labor than hired labor in their farm production processes. As a result having more labor with in a household would be able to a high possibility of farm management work like timely land preparation to increase farm output.

Using manure is also important variables for the rural household's land productivity enhancement, which shows that, the land productivity increases by 0.09 units as the farm household's uses manure for their farm production process in one production period. This implies that, animal dung is very important as the chemical fertilizer may not affordable for some poor rural farm households. The finding is also consistent with Wassie (2012) in Ethiopia indicated that, manure maintains soil fertility.

The use of extension service increases the farm household land productivity by 0.14 units as the households were got the extension service during one production seasons of the survey period. There for, by expanding and encouraging the farm household participation rate for the use of extension program is still important for the land productivity enhancement since the extension user households are more productive than non user. This result is consistent with Asres Elias *et. al* (2013) in Ethiopia.

The number of ploughed oxen variable is statistically significant at 1 percent level shows that, a little positive change in land productivity as the household use the one extra more ploughed ox, land productivity changes by 0.00073 units. This implies that land productivity is not associated more cultivating area of land but use of farm practicing is important for land productivity enhancement in rural farm households of Ethiopia.

There was also age of the household head is statistically significant at one percent level. It implies that as the age of the household was increases by one more year the land productivity of the rural household shows a slight increment by 0.02 units. One reason would be the mean of the household head age was 45 years, as a result the possibility of yang household head to be matured and increases his/her farm practicing experience would be high which able to increase household's farm land productivity.

Table 2: The land Productivity of with-group, fixed-effect & random-effect estimates

Explanatory Variables	Coefficients		
	Within-group	Fixed effect	Random effect
Log of labor per unit of land in hectare	0.149*	0.144*	0.253*
	(0.023)	(0.032)	(0.023)
Log of Real Asset Value per unit land in hectare	0.014	0.013	0.032**
	(0.017)	(0.024)	(0.017)
Chemical fertilizer per unit of land in hectare	-0.125*	-0.250*	-0.335*
	(0.021)	(0.052)	(0.040)
Number of ploughed oxen per unit of land	0.0007*	0.0007*	0.0003*
	(0.0001)	(0.0001)	(0.0001)
Age of household head	0.025*	0.024*	0.002
	(0.003)	(0.005)	(0.002)
Educational status of household head	0.0003	0.018	0.167*
	(0.038)	(0.053)	(0.035)
Household size	0.223*	0.205*	0.043*
	(0.014)	(0.020)	(0.010)
Sex of household head (male =1)	-0.009	-0.179	0.012
	(0.026)	(0.125)	(0.058)
Pesticide (use =1)	0.046**	0.120*	0.162*
	(0.021)	(0.044)	(0.037)
Drought (yes =1)	-0.097*	-0.248*	-0.244*
	(0.036)	(0.071)	(0.061)
Credit access (yes =1)	0.015	0.058	-0.010
	(0.019)	(0.047)	(0.037)
Extension service (yes =1)	0.035**	0.142*	-0.002
	(0.018)	(0.048)	(0.035)
Irrigation (use =1)	0.019	0.056	0.188*
	(0.025)	(0.075)	(0.055)
Manure (use =1)	0.035***	0.088**	0.194*
	(0.018)	(0.045)	(0.036)
Constant	-0.023*	7.340*	8.445*
	(0.027)	(0.289)	(0.159)
Number of Observations	4353	4353	4353
Prob>F	0.0000	0.000	0.000
R-squared	0.1070	0.118	0.062
corr(a i , X b)		-0.401	0 (assumed)
sigma_u		1.265	0.885
sigma_e		0.814	0.814
Rho		0.707	0.541

Source: Computed from Ethiopian Socio economic survey data.

Note: Hausman test choose fixed-effect over the random-effects estimation; Standard errors in robust standard to adjust Heteroskedasticity problem: Dependent variable is log of land productivity measured in output per land-hectare; * and ** represents the coefficients are significant at 1 and 5 percent level respectively.

Hausman-test:

Test: Ho: difference in coefficients not systematic

chi2 (14) = 248.21

Prob>chi2 = 0.0000

Therefore, we reject the random effect model in favor of fixed effect. As a result, the analysis of this study was made bases on the result of the fixed effect model.

3.3 Econometric Results of Rural household Income

There were different demographic and socio-economic factors that were contributing in the determinants of rural household income. In order to identify the significant factors, we employ the pooled OLS, the 2SLS, the fixed effect and the random effect models were applied on the panel data set which we could choose the best among them. However, an F-test of the null hypothesis that all household-specific intercepts are identical rejected the pooled OLS in favor of the fixed effect model and also the random effect model was rejected by the Hausman test.

The model is also tested for the possible appearances of Heteroscedasticity and multicollinearity problems. The Heteroskedasticity problem is adjusted by regresses all model used for estimation, with robust standard and the multicollinearity problem was also checked and tested using the observed information matrix (OIM) during the estimation of the variance–covariance matrix. We were found an endogenity problem during the estimation of rural household income per-capita among the variables of productivity. To obtain unbiased and consistent estimators, we applied IVreg2 Two Stage Least Squares (2SLS) approach with it's the two conditions of a valid instruments i.e. instrument relevance: $corr(z_i, x_i) \neq 0$ and instrument exogeniety: $corr(z_i, v_i)=0$ were fulfilled.

In the 2SLS (IVreg2) regression, due to the two explanatory variables of agricultural productivity was causing an endogenity problem, we used two instrumental variables (a dummy variable if crop was affected due to some

household members were got chronic disease (CDS) and a dummy variable if crops were damaged to instrument both the agricultural labor & land productivity. The identification criteria for all instruments are also fulfilled. After controlling for the endogenity problem for the productivity variables, in the fixed effect regression result; most of the parameters used to determine the rural household income shows statistically significant during the period of 2012-2014. However, age of the household head, educational status of the household head, number of household size and credit access were not found to significant for the determinants of rural household income in sampled area of Ethiopia.

The IV-fixed effect regression output indicates that, labor productivity, farm land productivity, owing number of livestock (in tropical livestock unit), non-farm income, sex of the household head and number of dependant in the household are found to be significant determinants of the rural household income. But, the number of the household members those who are dependant was found to significantly and negatively affects the household income in rural households. This study output is consistence with the finding of Vincent Leyaro and Oliver Morrissey in Tanzania during their study of the "Protection and the determinants of household income in Tanzania 1991 – 2007."

The agricultural labor productivity which is the farm output per unit of labor input is statistically significant at 1 percent level. The result of the fixed effect model shows that, increasing the labor productivity by one percent, the rural household income increases by 0.86 percent. The output of the fixed effect model shows that, the labor productivity is the most potent than the land productivity variable used in the regression for the household income in the rural Ethiopia. Therefore, the government and other stake holder should give more attention for farther improvements of labor productivity to enhance rural household income.

Table 3: Rural Household Income OLS, IVreg2, Fixed-effect & IV_fixed effect estimates

Explanatory Variables	Coefficients			
	Pooled OLS	IV-reg	Fixed	IV-Fixed
Log of Labor productivity	0.588*	5.295**	0.598*	0.856*
	(0.017)	(2.573)	(0.015)	(0.213)
Log of Land productivity	0.346*	3.317***	0.262*	0.146**
	(0.019)	(2.008)	(0.019)	(0.179)
Total Livestock Units	0.066*	0.199	0.023*	0.022*
	(0.006)	(0.147)	(0.007)	(0.007)
Number of dependant	-0.588*	-1.928*	-0.221*	-0.229*
	(0.064)	(0.825)	(0.092)	(0.098)
Age of the household head	0.004*	0.016***	0.002	0.002
	(0.0009)	(0.008)	(0.003)	(0.003)
Educational status of household head	0.026	0.160	0.031	0.033
	(0.023)	(0.149)	(0.039)	(0.042)
Household size	0.083*	0.222*	0.006*	0.004
	(0.007)	(0.088)	(0.015)	(0.016)
Sex of household head (male =1)	0.317*	0.913	0.231**	0.156*
	(0.039)	(0.709)	(0.102)	(0.125)
Non-farm income	0.202*	0.975**	0.279*	0.283*
	(0.030)	(0.467)	(0.029)	(0.032)
Credit access (yes =1)	0.234*	0.796*	0.041	0.048
	(0.027)	(0.339)	(0.030)	(0.033)
Constant	1.097*	4.481*	2.719*	3.083*
	(0.157)	(2.067)	(.204)	(0.370)
Number of Observations	4309	4309	4309	4309
Prob>F	0.0000	0.0000	0.0000	0.0000
R-square	0.681			
corr(a i , X b)			0.119	-0.033
sigma_u			0.842	0.871
sigma_e			0.535	0.570
Rho			0.712	0.700
Centered R-square		0.898		
Uncentered R-square		0.7714		
Under identification test (Kleibergen-Paap rk LM statistic):		3.333		
P-value of under identification LM statistics		0.018		
Hansen J statistics		0.153		
P-value of Hansen J statistics		0.6953		

Source: Computed from Ethiopian Socio economic survey data.

Note: Hausman test choose fixed-effect over the random-effects estimation; Standard errors in robust standard to adjust Heteroskedasticity problem: Dependent variable is log of Income in birr value; *, * and *** represents the coefficients are significant at 1, 5 and 10 percent level respectively.

The agricultural land productivity which is the farm output per unit of cultivated area of farm input was statistically significant at 10 percent level. The result of the fixed effect model shows that, increasing the land productivity by one percent, the rural household income also increases by 0.15 percent. The finding of the fixed effect model shows that, the land productivity is the third contributor for the enhancement of per-capita income next to labor productivity and non farm income in the sampled rural households. Therefore, the government will give more attention to increase the land productivity in rural farm household to farther per capital income.

Productivity enhancements

Another variable used for the determinants of rural household income was the number of dependency ratio per households also significant at 1 level stated that, it is negatively affects the household income. More specifically, if the number of dependency ratio increases by one unit, income of rural household declines by 0.23 units. This tells us limiting the number of dependant family member in the household is important to increase the wealth status of the rural household.

The household generated their income from nonfarm activity for their livelihood is also statistically significant at one percent level, which means, as the household got one additional units of nonfarm income the entire household income was significantly increases by 0.28 units. However, the income from the nonfarm was very few when it compares with the agricultural farm labor productivity. Fully concentrating only on farm activity will limit the rural household income and wealth development. The fixed effect result shows that, the labor of the rural household was fully engaged with drought affected farm activity in rural Ethiopia. Therefore, the government should have to be harmonizing the wide gap between farm and non farm income to increase the nonfarm income generating activity, since the farm production is usually associated by drought risk. Extension worker and other stockholder should advise the rural farm household to generate the nonfarm income parallel to their farm production process.

Another variable, the sex of the household head also significant at 1 percent level shows that, there is a difference in income among male headed and female headed household. The result indicated that per-capital income was higher for male-headed households than female headed household by 0.16 units. This implies that empowering of women will be crucial for the household wealth improving in rural Ethiopia.

Owning of livestock at tropical livestock unit also statistically significant at 1 level shows that, as the number of livestock owing (in tropical livestock unit) increases by one unit the income of the rural household raises by 0.02 units.

Hausman-test

Test: Ho: difference in coefficients not systematic

chi2 (9) = 2.91

Prob>chi2 = 0.0000

Therefore, we reject the random effect model in favor of fixed effect. As a result of this, the analysis of this study is made on the bases of the result of the fixed effect model.

4 Summary and Conclusions

Using the panel data of Ethiopian Rural Socio-economic Survey (ERSS), this study investigated the determinants of agricultural labor productivity and rural household income in Ethiopia during the period of 2012 - 2014. Three panel data analysis methods are used: the pooled ordinary least square method (POLS), fixed effects (FE) method and random effects (RE) method. Based on Hausman test, fixed effect (FE) method was found the most appropriate model.

The determinants of agricultural productivity in rural households do not much vary across labor productivity and land productivity. Cultivated area of land per unit of labor ratio, the number of household member size, the use of fertilizer, the use of extension service, the use of pesticide, the use of manure

and age of the household head are the main determinants of the agricultural labor productivity. The fixed effect results show that, land-labor ratio, use of fertilizer, use of pesticide and extension service variables are the most significant variables through which we may improve farm labor productivity of rural households. This could imply that, households' labor productivity gain could be attained if we focus on improving the land-labor ratio, use of fertilizer, use of pesticide and extension service. However, land-labor ratio is more challenging than improving the use of fertilizer, pesticide and extension service with increased rural yang agricultural labor force population pressure. But it is possible by mobilizing the farm labor force to the other potential cultivable area of land.

Similarly, labor-land ratio, use of fertilizer, the number of household member size, the use of extension service, the use of pesticide, the use of manure, the number of oxen used and age of the household head are the main determinants of agricultural land productivity. The fixed effect results show that, labor-land ratio, the use of fertilizer, the number of household member size, the use of manure, use of pesticide and extension service variables are the most significant variables through which we may improve farm land productivity of rural households. This also could imply that, households' land productivity gain could be attained if we focus on improving the labor-land ratio, the use of fertilizer, pesticide inputs and extension service. However, improving labor-land ratio is more challenging than improving the use of pesticide and extension service with increased rural yang population pressure. But it is possible by mobilizing farm labor force to the other potential cultivable area of land.

Off all the variables used in the regression of agricultural productivity, cultivated area of land perunit of labor is the most significant effect on the determinants of labor productivity and fertilizer inputs and the number of household size is found to the most significant effect on the determinants of land productivity in the rural household's of Ethiopia. Therefore this study concludes that, the agricultural labor productivity is the most potent factor of production than land productivity for the change of agricultural productivity in rural households. However, drought variable included in the regression

also significantly and negatively affects both labor and land productivity of rural farm households in Ethiopia.

The fixed effect result shows that, both labor and land productivity, household's non farm income, the livestock owning in tropical livestock units and sex of the household head are the main determinates of rural household income in Ethiopia. However, the number of dependant household member significantly and negatively affects rural household income. The result also shows that, labor productivity has the major effect among the variable used in the regression for the change of rural household per capita income enhancement. The finding of the fixed effect regression model supports the view that improvements in agricultural productivity can have substantial positive impacts on household income per capita. Especially improvements in labor productivity of household through better resource allocation and use of necessary inputs can increase the per capita income of the rural households.

There were also a socioeconomic factors that explain the variation in income among the rural households.

4.1 Policy implications

This study has tried to identify the determinants of agricultural productivity and rural household incomes in Ethiopia. Based on the results obtained from the study, we suggest some policy intervention areas should be required. The policy implications that can be derived from this empirical study are:

- To increase the agricultural productivity of farm household's, by reducing the drought risk through rural environmental protection, increase land-labor ratio. The possible ways of application could be through different methods like arranging financial sources that can used for the purchase of different variable inputs and developing a work frame for non farm income employment opportunities in the rural labor market as well as shift the excessive farm labor force to the other potential cultivable area.

- To increase the rural household income, needs improvements in land-labor ratio of farmers through better allocation of financial resource.
- The combined effort is needed to design policy interventions for not only increasing labor productivity but also reducing number of dependency ratio of the household and drought risk which adversely affects labor productivity growth.
- Both agricultural labor and land productivity are important for rural household income enhancement but agricultural labor and land productivity alone does not increased rural household per capita income. Increasing the non farm income was also important for the increasing of rural household per capita income.
- Promotion of both farm labor productivity and non farm income are best focusing to speed up the enhancement of rural household per capita income.
- It is better to strengthening the capacity of the local and federal administrative level, about the environmental protection system and rehabilitation program to protect the variations of climate over time, especially in areas adversely affected by a drought factor.

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Growth of Youth-owned MSEs in Ethiopia: Characteristics, Determinants and Challenges[1]

Wolday Amha[2]

Abstract

The study examines the factors that influence the growth of youth-owned MSEs in Ethiopia using a sample survey of 909 operators which were selected through a multi-stage random sampling techniques. The result of the cross-tabulated descriptive statistics showed that the personal attributes, firm characteristics, inter-firm cooperation and policy predictability affected the growth of the MSE operators. Growth rate was also influenced by the diverse and heterogeneous character of the youth-owned MSEs. Unlike many other studies, the findings of this study reveal that the average growth rates of microenterprises are much lower than the small enterprises. Female-owned firms registered relatively lower growth rate compared to their male counterpart. The results obtained from the regression indicate that among the personal attributes of youth MSE owners: education, sole ownership form of business organization, small enterprise category, experience in similar business, and gender (male MSE owners) are significant variables which positively influence the growth of the youth operators. Out of the firm-level attributes, access to training before starting business, social networking and access to loan are statistically significant variables which negatively affect growth rate. On the other hand, access to product markets, future plan of the enterprises, saving culture, size of start-up capital and current capital are found as significant variables influencing the growth of youth-owned MSEs. The predictability of policies and inter-firm cooperation are also found to be significant variables affecting growth and expansion of youth-owned MSEs. Since the growth rate of microenterprises and women-owned enterprises are lower, the study suggests revisiting the current support program by crafting tailored interventions. Moreover, although inter-firm cooperation and policy predictability affect the growth of youth-owned MSEs, due focus should be given to improve social networking and building the trust and confidence of the operators on government policies and strategies.

Key words: Youth-owned micro and small enterprises (MSEs), Growth rate of firms
JEL code: L 11; L 25; O 17

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1. Introduction

1.1 Statement of the problem

Micro and small enterprises (MSEs) are catalysts in the socio-economic development of any country. In the Ethiopian context, they are the key vehicles to achieve the objectives of inclusive Growth and Transformation Plan (GTP). On top of creating employment opportunities at low cost (labor intensive) and training entrepreneurs (encouraging indigenous entrepreneurship), MSEs in Ethiopia have huge potential to add value in the manufacturing sector and to GDP, export earning, increase in per capita income and output, enhance regional economic balance (equitable distribution), create competitive price structure, promote effective resource utilization, providing a source of livelihoods for the majority of low income households and ensuring equitable distribution of income. MSEs also play an intermediary role in the development of medium and large scale enterprises and diversification of the industrial structure and contribute towards the transformation of the rural economy. Although the proposition that small firms offer unique development advantage is as old as the concept of economic development itself, there is a high correlation between the degree of poverty, hunger, unemployment, and economic well being of the citizens of countries and the degree of vibrancy of the respective countries' MSE development (Osotimehin *et al.,* 2012).

Creating an enabling policy environment and providing support services for the youth to engage in self-employment has been a priority intervention by the Ethiopian government, particularly in the last five years. However, the youth in Ethiopia have specific profiles and usually labeled as people with high mobility, lacking the experience and motivation to be self-employed, prefer white-collar job, abandon their group (initially organized with the support of government to create their own business) whenever they find wage employment, and lack marketable skills. When they lack other alternatives, they tend engage in MSEs or self-employment as a result of necessity (not driven by opportunities and capabilities) and lack proper technical and business development training. On the other hand, in addition to the constraints faced by all MSE operators, female-owned enterprises have specific challenges in both the start up and operational phases. There

are also constraints that stem from culture or upbringing (which is usually gender biased), limited access to educational and skill training, limited information and mobility as a result of their dual roles as mothers and home keepers. Moreover, though many women own and manage their own business, few are successful in graduating their businesses to small, medium and large-scale enterprise levels (Haftu Berihun *et al.*, 2009).

The policies, strategies and support programs of the Ethiopian government have prioritized the development of MSEs as a tool to expand employment, create the foundation for medium enterprises, promote private sector development and contribute to the growth and transformation process. The implementation of the support program through the MSE development strategy has been successful in creating employment to millions of people and enterprises in the country. According to the report of FeMSEDA (2015), in the first four year of GTP (2010/11 - 2013/14), about 5,535,556 people obtained job opportunities through the MSE regular program, while about 1,158,556 jobs were created by the public mega projects. In the same years, about 495,441 MSEs were established engaging 1,874,807 operators. In spite of the institutional support provided through the five-year MSE strategy and GTP to enhance the capacity and opportunities for MSEs, there has been hardly any detail quantitative and qualitative survey findings which show the characteristics of the firms/owners and how the support programs of government has contributed to the expansion of MSEs and the factors that influence the growth of enterprises. Examining and measuring the growth and dynamism within the MSEs[3] can provide evidence to the policymakers on the effectiveness of the implementation of the five-year MSE development strategy and the support programs.

[3] The definitions of MSEs vary from country to country. However, as per Ethiopians' five-year MSE development strategy (2011), microenterprise category includes firms which have up to 5 employees (including the owner or family) and their total asset is less than or equal to 100,000 Birr for industrial sector and less than or equal to 50,000 Birr for service sector. On the other hand, small enterprises are firms which have between 6-30 workers and their total asset is between 100,001 Birr - 1,500,000 Birr for industrial sector and between 100,001 Birr - 500,000 Birr for service sector. Font needs to be the same as above.

Studying the key factors behind growth of MSEs, such as owners' and enterprise attributes, horizontal and vertical cooperation among enterprises, and policy and regulatory environment, can provide valuable evidence for policymakers and development partners to make knowledge-based decisions. It can also provide useful information for the owners of MSEs interested to address their growth challenges. The study has the intension of adding to the limited body of advanced analytical knowledge in Ethiopia by analyzing the relationship between numbers of variables that have direct or indirect effect on the growth of MSEs. The finding of study is also expected to provide primary information which can stimulate the establishment of new enterprises and enable the existing MSEs to grow and become more competitive and dynamic.

1.2 Objectives of the study

The study focuses on understanding the profile and heterogeneous characteristics of youth-owned MSEs which influence their growth process. The specific objectives include:

- Assess the personal attributes of youth owners that influence the growth of their MSEs;
- Examine how the enterprise-level characteristics influence the growth of youth MSE operators
- Analyze the relationship between inter-enterprise relationship cooperation and growth of youth-owned MSEs
- Identify the effect of policy predictability on the growth of MSE operators
- Investigate the factors that determine the growth of youth-owned MSEs
- Propose specific interventions to address growth challenges

1.3 Sampling and method of data collection

Given the limited resources, a total of 909 youth-owned MSEs were selected using stratified simple random sampling. Since the focus of the study is to understand the growth and challenges of youth-owned enterprises (which are heterogeneous in nature), attempts were made to stratify the sample into size (micro and small enterprises), gender (male and female enterprise owners)

and enterprise type (manufacturing, construction, urban agriculture, service and trade). The sampled youth-owned MSEs were interviewed using structured questionnaire in five regional states (Oromia, Amhara, SNNPR, Tigray and Harari), and two city administrations (Addis Ababa and Dire Dawa). Out of the total sample existing of youth-owned MSEs, 543 were micro and 366 were small enterprises. To adequately understand and study the gender dimension, 153 and 57 women owners were sampled from micro and small enterprises respectively. The proportion of male MSE owners were relatively higher; 256 from microenterprises and 107 from small enterprises. The remaining 341 samples (134 micro and 207 small) were owned by a mix of male and female entrepreneurs.

2 Conceptual Framework

MSE operators in different sectors and stages in the enterprise's life cycle are diverse and heterogeneous in character. MSE operators, at start up phase, face problems that are different from those of existing firms seeking to expand. Thus, classifying MSEs on the basis of their level of development and age (such as new, start ups, zero growth, small growth and graduates) would assist policymakers to design tailored MSE support programs, which recognize their differences and craft targeted interventions, that are most appropriate to the needs of a specific group of MSE operators.

Most of the new enterprises at start-up phases are one-person firms, which are typically the least efficient and least remunerative. They tend to start up in greater numbers, particularly in low-return activities with minimal barriers to entry, when the overall economy is languishing (Mead and Liedholm 1998). On the other hand, growth oriented enterprises have mainly profit motive and re-invest their surplus to ensure sustained growth. They have the potential to contribute substantially to value chain productivity and, ultimately, to economic growth. Relatively they have higher capital, access to credit, more paid employees and engage often people with higher educational levels and skills/experiences.

Attempt is made here to use a broader conceptual framework, which focuses on how opportunities and host of capabilities which influence the growth of

MSEs. Opportunities are directly related with the availability of local, regional, and external markets to run profitable business activities and shape the ability of the MSE operators to expand their firms. Capabilities include skills, knowledge, resources or technology possessed by the operators which are necessary to improving productivity. If a business has the capabilities and opportunities in the local community, the prospect for growth is high. However, in reality, MSE operators lack either capability or opportunity or both. To illustrate on how opportunities and capabilities influence MSE growth, Nichter and Goldmark (2005) used four "ideal types" of MSE profile, which is indicated in Figure 1.

Figure 1: Typology of MSE growth profiles

Opportunities	Low Capabilities	High Capabilities
High	***"Ponies"*** Lack Capabilities to Harness Existing Opportunities	***"Gazelles"*** Fast Growth Enabled by Opportunities and Capabilities
Low	***" Tortoises"*** Lack Opportunities and Capabilities	***"Caterpillars"*** Lack Opportunities to Apply Existing Capabilities

As indicated in Figure 1, MSEs that have profitable business opportunities and appropriate capabilities to harness these opportunities are termed "gazelles." However, only a minority of the firms become "gazelles", which drive overall growth in the MSE sector. Gazelles have received increasing attention by policymakers in the last decade. The special interests on these firms, such as Google, Apple and Microsoft, are motivated by the fact that they are perceived as important drivers of economic dynamics, diffusion of innovations and employment generation. But available evidence shows that high growth firms are found in all sectors of the economy and there is no clustering in specific industries (Coad and Holzl 2010). Henrekson and Johansson (2010) also indicated that Gazelles, the few most rapidly growing firms, create most new jobs within cohorts of firms of the same age. Although most Gazelles are small and medium enterprises, there is also an important subset of large Gazelles. However, being a Gazelle is a temporary phenomenon in the life of an enterprise, especially if they are small firms.

Coad and Holzl (2009) found significantly higher growth persistence for larger high growth firms.

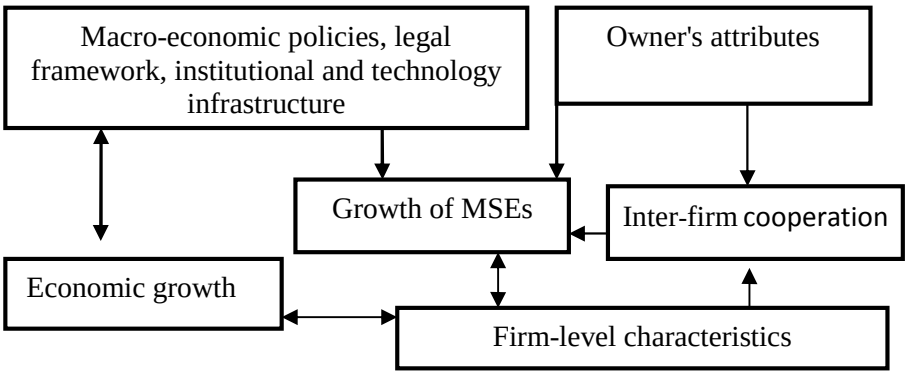
Henrekson and Johansson (2010) indicated that although job creation must be considered in the broader context of industrial dynamics, a smaller number of high-growth firms have high impact on the economy. Nichter and Goldmark (2005) indicated that the overall growth rates are often fueled by rapid expansion of a narrow group of highly performing MSEs. In the GEMINI surveys, just one-quarter of MSEs generated all of the remarkable employment growth, while the reminder of the firms stagnated or contracted (Mead and Liedholm 1998). As a result, only 1% of the MSEs which started with four or fewer workers "graduated" from the MSEs category by growing to more than 10 workers.

"Ponies" are MSEs that have potentially lucrative business opportunities, but are unable to take full advantage of them due to inadequate capabilities. Although "ponies" may expand quickly for short duration, while trying to harness these opportunities, they often lack endurance as they do not have the requisite capabilities for sustained growth. "caterpillars" are MSEs that have substantial capabilities, but lack viable opportunities to capitalize on them. "tortoises" are MSEs that lack both profitable business opportunities and a host of capabilities such as skills, resources and technology. These enterprises may not have the drive to growth due to lack of opportunities and capabilities. Despite their lack of growth, these MSEs play a critical role in reducing poverty by focusing of income diversification and survival strategy.

A range of factors play an important role in shaping the growth performance of a particular MSE, by influencing the opportunities available to owners and employees and their capabilities to take advantage of such opportunities. Moreover, value chain linkages (inter-firm cooperation) have direct effects on firm opportunities, capabilities and growth. The literature on firm growth dynamics and determinants adopt the approach that divides firm growth determinants into macro and micro dimension, which can be further divided into broad categories as business climate and firm-specific characteristics. Nichter and Goldmark (2005) grouped the factors influencing firm growth into four categories: (i) Business environment which include: performance of

macro economy; policies, strategies, regulation and institutional set up; local and sector; infrastructure; and value chain; (ii) Social factors such as inter-firm cooperation and social networks; (iii) Firm characteristics including: firm age; formality; technology; and finance; and (iv) Individual characteristics including: education; work experience; gender, etc.

Figure 2: Conceptual framework to study the growth of youth-owned MSEs in Ethiopia



We used the existing literature on MSE growth to construct a simple conceptual framework for the study (Figure 2). The literature and the objective conditions in Ethiopia indicate that MSEs' growth is affected by number of variable which include owners' attribute (sex, age, business experience, educational level, training, etc) and firm-level attributes (size, age of enterprise, sector, access to financial services, location, type of premises, etc), inter-firm cooperation, and policies, particularly its predictability.

3. Survey Results

Although there are various approaches to measure growth of youth MSE operators, the most commonly used enterprise growth indicators are: changes in total sales, assets, and employment. Measuring growth in assets may be problematic where intangible assets are important and where MSEs in the sample have different capital intensities. On the other hand, while sales growth may seem to be a useful indicator of growth, it may overstate the size of MSEs as sales does not only reflect the value-added of an enterprise but

also input prices (Coad and Holzl 2010). There is also a tendency of reducing sales or profit by MSEs in order to evade taxes. This study uses change in employment size in order to measure the growth of youth-owned MSEs because the indicator reduces measurement problems compared to financial measures (assets, sales and profit). According to Mead and Liedholm (1998), employment growth metric is frequently employed in research on MSEs primarily because using employment levels is believed to yield the most accurate and comparable data. MSE owners are also able to remember their number of employees over time (compared to other indicators), even if they fail to maintain reliable written records. In addition, using the number of employees circumvent the need to deflate or otherwise adjust currency figures, which is necessary when using revenue, asset, or profit indicators. Moreover, although there are a number of subjective and qualitative attributes that also directly or indirectly influence the characteristics and growth of youth MSE operators, this study focuses on examining the relationship between personal attributes, firm-level characteristics, inter-firm cooperation, and policy predictability, and growth of youth-owned MSEs.

3.1 Relationships between individual -level attributes and growth of youth-owned MSEs

Attempt is made here to cross tabulate the personal attributes of youth operators against their growth rates. The variables which describe the attributes of youth MSE owners include: sex, age, level of education, business experience before starting business, access to training before and after starting business, reasons to engage in self-employment, and aspiration to expand business.

i) Gender of enterprise owners

It has been argued in several empirical studies that women-owned enterprises are concentrated in under-performing sectors or activities, which are less likely to expand or upgrade their business. Women MSE operators have relatively less access to financial services and operate their business from their homestead. They are usually more risk averse and afraid of being taken over by their male counterparts. Hence, many of the women tend to

engage in low risk and low return business. Consistent to the experience of other countries, women in Ethiopia tend to have strong tendency of involving in relatively narrow range of activities such as food processing, clothing, hairdressing, and selling milk, yogurt or vegetables from roadside market stalls (Zewdie and Associates, 2002 as quoted by Haftu *et al*., 2009). Gender-biases in the technical training support also induce them to be confined in relatively risk free businesses where there is ease entry and limited opportunities. Limited mobility (mainly due to family and household responsibilities) coupled with lack of ability to secure proper business premises restricts women MSE owners to work most often home-based businesses which prevent them from seeding out in markets, getting information on better economic opportunities and business assistance (Stevenson and St-Onge 2005).

The male youth-owned microenterprises grew by 49% per (annum? Or?, while the female owned microenterprises grew by 21% (Table 1). Similarly, the male-owned small enterprises grew twice compared to female-owned enterprises. Out of the small enterprises owned by women, the highest growth was observed in textile and clothing (170%), followed by metal and woodwork (89%). On the other hand, from the microenterprise category, a higher growth rate was reported in metal and woodwork (72%) followed by food and food products (56%). However, the results of this survey are quite different compared to Mulu's (2007) study, where the annual average growth of MSEs engaged in manufacturing was 13%, followed by service (11%). In the same study, the trade sector, however, grew by only 6.2% annual average, which was almost half of the growth rate of other two sectors.

The results in Table 1 are consistent with other empirical studies in developing countries, where MSEs led by female entrepreneurs experienced lower growth rate and employment in male-headed MSEs grew, on average, by 11% per year, versus 7% for female-headed MSEs (Mead and Liedholm 1998). Downing and Daniels (1992) indicated that employment growth differences between MSEs owned by men and women were particularly significant in firms with fewer than five workers. Mulu (2007), using the survey dataset of Gebrehiwot and Wolday (2004), also found that male-

owned MSEs in Ethiopia grew by 10.6% annual average, while that of female-owned grew by only 4.5%.

Table 1: Average growth rate of employment by gender

	Micro				Small				
Sectors	**Female**	**Male**	**Mixed**	**Total**	**Female**	**Male**	**Mixed**	**Total**	**Whole sample**
Food and food product	0.56	0.81	0.16	0.48	-0.24	2.50	1.35	0.57	0.53
Metal and wood work	0.72	0.95	0.57	0.84	0.89	2.13	0.75	1.47	1.09
Leather and leather products	0.00	0.88	0.13	0.54	-0.38	2.50	1.23	1.16	0.80
Textile and clothing	0.21	0.57	0.17	0.33	1.70	4.94	0.75	1.85	0.97
Construction	-0.31	0.42	-0.08	0.19	0.10	-0.11	0.28	0.16	0.17
Urban agriculture	0.07	0.34	0.04	0.15	-0.12	2.33	0.09	0.12	0.14
Trade	0.04	-0.01	0.11	0.04	0.33	-0.28	0.54	0.35	0.09
Services	0.24	0.25	0.21	0.24	0.34	0.28	-0.25	0.10	0.20
Others	0.33	0.32	0.71	0.42	0.84	0.23	1.03	0.81	0.61
Total	0.21	0.59	0.26	0.40	0.38	1.32	0.55	0.75	0.54

Source: AEMFI, Survey on Youth-owned MSE in Ethiopia (2014)

(ii) Age of MSE owners

The age of the MSE owners is usually associated with experience and the relatively older MSE owners are expected to have higher growth and performance than younger operators. However, this particular study deliberately focused on youth MSE owners between the age of 18 and 34. The average age of the sample youth MSE owners was 27 years, which was almost similar for both micro and small enterprise operators and female and male owners. The findings of the study reveal that there was a positive relationship between the age of the owners of MSEs and growth rate. Although age was directly related with the increase in the growth rate of both male and female owners of microenterprises, the result was different for small enterprises. Growth rate of small enterprise owners (both male and female) increased up to the age of 29 and started declining after the age of

29. Moreover, the growth rate of MSEs owned by married youth (65%) was higher than MSEs owned by operators who were singe (54%) and divorced (35%).

(iii) Education

On top of the technical skills, MSEs require a minimum schooling in order to plan, manage and monitor their operational and financial performance. In other words, youth MSE owners who attended schools, universities, and TVETs will have greater capacity to learn about new production processes and products, easily capture the technical knowledge to expand the firm hand, easily access information and have flexible mind to access new technology and innovation will register higher growth rate than those who have less access to education. Most empirical studies confirm that MSEs with better-educated owners and managers tend to be more productive (Little 1987; Burki and Terrell 1998; Tan and Batra 1995). This implies that higher level of education can spur MSE growth by enhancing firm capabilities. On the other hand, despite the potential benefits, education may harm MSE growth, where highly educated owners lack focus on the growth and expansion of their enterprises by diverting their attention to other attractive wage employment opportunities. For example, if the youth, particularly the university graduates organized with the support of government, are engaged in self-employment because they lacked alternative wage employment opportunities, this mindset or attitude will have a negative impact on the growth rate of the enterprise.

The finding of the survey (Table 2) indicates that the growth rate of youth-owned MSEs was directly related with their level of education. The growth rate of illiterate MSE owners was 5%, while the highest growth rate (62%) is registered by respondents who attended high school (9-12) and TVETs. The growth rates of MSEs owners, who attended lower and upper primary, are 37% and 40% respectively. However, the rate of growth of female operators was lower than their male counterpart. The results are consistent with the empirical study of Wolday *et al.* (2014) which reveals that the perceived entrepreneurial opportunity and capability of the adult population in Ethiopia increases as one's education level increases.

Table 2: Average growth rate of employment by education level

Level of education	Micro				Small				Whole sample
	Female	Male	Mixed	Total	Female	Male	Mixed	Total	
None	0.00	0.00	0.18	0.05	-0.38	-0.09	0.72	0.06	0.05
Lower primary (1-4)	0.17	0.45	0.08	0.28	-0.06	0.45	0.82	0.47	0.37
Upper primary (5-8)	0.21	0.34	-0.04	0.24	-0.06	1.50	0.47	0.69	0.40
High school (9-12)*	0.27	0.68	0.30	0.46	0.81	1.27	0.60	0.84	0.62
Higher education (Above 12)	0.09	0.75	0.42	0.50	0.46	1.72	0.39	0.74	0.59
Total	0.21	0.59	0.26	0.40	0.38	1.32	0.55	0.75	0.54

Source: AEMFI, Survey on Youth-owned MSE in Ethiopia (2014)
**includes vocational and TVET*

Although many of empirical studies indicate that there is direct relationship between education and growth of MSEs, evidences from other studies report contradictory results. The findings of the survey (Table 2) shows that the growth rate of youth MSE owners who attended higher education (59%) is relatively lower than those who attended high school and TVET (62%) which is consistent with the study of Alvarez and Crespi (2003) on small manufacturing firms in Chile, which found that university education, did not induce higher efficiency, because the highly educated owners paid little attention to monitoring their labor force. An Inter-American Development Bank (IDB) study also found that secondary school attainment had no discernible impact on firm growth in Latin America (Kantis *et al.* 2004 as quoted by Nicher and Goldmark). On the other hand, GEMINI studies in Sub-Saharan Africa revealed that entrepreneurs completing secondary school are more likely to grow in Kenya and Zimbabwe but found no sufficient effect of primary education on MSE expansion (Mead and Liedhold 1998).

(iv) Experience before starting the business

Owners of MSEs benefit from production, marketing, administration, and negotiation skills gained from previous jobs (before starting their own business) which serve them as a valuable training ground, identify potential business opportunities, gain business contact and obtain financing and other resources. As a result, owners of MSEs with more years of work experience before starting their own business have relatively faster growth than those without experience. The empirical study of Mead and Liedhold (1998) and Parker (1995) found that Kenyan entrepreneurs with at least seven years of experience expanded their firms more rapidly than those without such experience.

The finding of the survey reveals that about 50.3% of the MSEs owners were engaged in different types of business before starting their own enterprise. About 36.5% of the respondents in the survey have the opportunity to manage a business while about 34.4% have the experience as an apprentice in similar business before establishing their own MSEs. The result of the study also indicates that business experience before starting business has a significant impact on the growth MSEs. The growth rate of youth MSE owners, who had experience (83%), is much higher compared to MSE owners without experience before establishing their own business (39%). While the micro and small enterprise owners who had business experience before starting their own business grow by 60% and 91% respectively, the micro and small enterprise owners without business experience grow by 19% and 60% respectively. However, the growth rates of female MSE owners are much lower compared to their male counterpart.

(v) Access to training before and after starting the business

Training focuses on any transfer of knowledge, skill or attribute which is organized to prepare MSEs for more productive activities or to changes their working environment and mindset. Unlike formal educational programs, accessing skills such as technical training, business development services, business and economic literacy, and entrepreneurship training constitute the foundation to improve the performance and growth of youth-owned MSEs. The finding of the study in Table 3 shows that there are no differences in the growth rate between the youth-owned MSEs who accessed training and who

did not receive training before starting their business. This implies that the training given to the youth MSE owners before starting business didn't add value or contribute to the growth of the enterprises and need to be revisited. On the other hand the training given to youth-owned MSEs after starting business has increased the growth rate of enterprises. The growth rate of MSE owners, who took training after starting business (80%), is much higher compared those MSE owners who didn't take training (42%). The impact of training on the growth rate was much higher for small enterprise owners compared to microenterprise owners. However, growth rate of female MSE owners who accessed training after starting business was relatively lower compared to male MSE owners.

Table 3: Average growth rate of employment and training before and after starting business

Did you have business experience before?	Micro				Small				Whole sample
	Female	Male	Mixed	Total	Female	Male	Mixed	Total	
Before starting business									
Had training	0.16	0.67	0.19	0.35	0.63	1.32	0.42	0.65	0.50
Had no training	0.24	0.57	0.32	0.43	0.13	1.34	0.72	0.86	0.58
Had but did not complete	.	.	.	.	.	-0.09	-0.44	-0.27	-0.27
Total	0.21	0.59	0.26	0.40	0.38	1.32	0.55	0.75	0.54
After starting business									
Had training	0.51	0.82	0.15	0.54	0.83	1.67	0.76	0.99	0.80
Had no training	0.13	0.52	0.30	0.36	-0.05	1.10	0.32	0.53	0.42
Had but did not complete	-0.50	.	.	-0.50	.	.	.	.	-0.50
Taking training now	.	0.50	.	0.50	.	.	.	.	0.50
Total	0.21	0.59	0.26	0.40	0.38	1.32	0.55	0.75	0.54

Source: AEMFI, Survey on Youth-owned MSE in Ethiopia (2014)

(vi) Reasons to engage in self-employment

The literature on entrepreneurship reveals that the growth and performance of MSEs is related with the owners' motivation to establish a business. If the

owners' motivation to establish the business is to be a successful entrepreneur through self-employment, there is a higher probability to grow, innovate and perform well compared to individuals who engage in business out of necessity to meet her/his household's subsistence needs. The findings of the sample survey show that the majority of the youth were engaged in the MSE sector, expecting higher profit and income through self-employment. The perception of the youth that they are capable and have the skill to start new business is the second reason to engage in self-employment. However, there are some respondents who indicate that they were forced to start their own business because they lacked other options (necessity-driven entrepreneurs). Surprisingly, the reasons behind engaging in self-employment for both micro and small enterprise owners are similar.

About 49.5% of the youth MSE owners revealed that self-motivation was the main reason behind stating their own business. Parents (17.3%) and friends (14.3%) also influenced the decision of the youth to engage in business. The influence of government support program to start new business was relatively lower. Expecting higher profit/income through self-employment and having the required skills were the motives behind the engagement of the majority of the female-youth owners of MSEs in self-employment. However, the proportion of women owners who indicated that they started their own business as result of necessity (no other options) was relatively higher than their male counterpart. The finding of the sample survey is consistent with the study by Wolday *et al.* (2014) where female respondents (19%) had relatively lower entrepreneurial intensions compared to male respondents (24%). Table 4 shows that those youth MSE operators, who perceive that they were engaged in their dream job and had the skill to run a business (opportunity-driven) registered relatively higher growth rate in employment. The respondents who reported that they took other people's advice also registered higher growth rate. However, those MSE owners who started their business as their last option of getting employment or income (necessity-driven) had the lowest growth rates. Moreover, the aspiration of the youth to be employed in government offices has gradually changed towards self-employment.

Table 4: Average growth rate of employment and reasons for engagement in the existing business

Reasons	Micro				Small				Whole sample
	Female	Male	Mixed	Total	Female	Male	Mixed	Total	
Skilled in this activity	0.15	0.65	0.45	0.49	0.14	1.54	0.80	1.04	0.68
Parents/relatives in this business	0.11	0.55	0.33	0.38	0.41	1.60	0.55	0.86	0.57
Thought it would be profitable	0.23	0.63	0.25	0.42	0.21	1.41	0.50	0.73	0.55
Capital requirement matches with what I had	0.10	0.52	0.43	0.38	0.26	1.54	0.68	0.92	0.56
Little or no regulatory restrictions to get into this line of business	0.22	1.39	-0.06	0.71	-0.47	0.09	0.40	0.27	0.53
I had no alternative	0.10	0.45	0.12	0.27	0.41	1.16	0.38	0.57	0.38
Other people's advice	0.08	0.75	0.22	0.41	1.52	1.07	0.83	0.96	0.65
It was my preference (Dream)	0.11	0.89	0.41	0.59	0.48	2.10	0.65	1.17	0.77
Related with my level education	-0.12	0.72	0.00	0.42	-0.41	0.96	0.78	0.77	0.54
Others	0.04	2.00	0.58	0.38	0.02	.	0.00	0.01	0.17

Source: AEMFI, Survey on Youth-owned MSE in Ethiopia (2014)

(vii) Aspiration to expand existing business

The youth who aspire to expand their business tend to spend their time in looking for different options of finance, technology, market, skills etc. In other words, although there is a possibility of dynamic development of enterprises by remaining small or without vertical growth, there may be a direct relationship between having a plan to expand and growth rate of MSEs. The youth MSE owners were asked to indicate their future plan regarding their business. About 81.4% of the respondents reported that they have an intension to expand their investment in the future by staying in the same business. While about 10% of the respondents plan to change job, about 7.7% have the intension to establish additional new business.

The finding of the study reveals that those youth MSE owners who have the intension of staying in the same business and expanding it registered higher

growth rate (61%) compared to those who intend to change jobs (15%) and start additional new business (40%). The impact of aspiration to expand existing business and starting additional new business is much higher for small enterprise owners compared to microenterprise owners. The result of this study is comparable to the empirical study of Wiklund and Shepherd (2003) which found that a small positive relationship between growth aspiration and growth rate, but the magnitude of this effect rises somewhat if growth aspiration are interacted with the entrepreneur's education and experience. Stam and Wennberg (2009) also found that growth aspirations are positively and significantly associated with the growth of low-tech firms, but not for high-tech firms.

3.2 Firm-level characteristics and growth youth-owned MSEs

Youth-owned MSEs, with the internal capacity to hire skilled workers, use higher level technologies, access external finance, implanted efficient management and performance management systems have relatively higher probability of growth and expansion of their businesses than those without the above attributes. Attempt is made here to examine the relationship between firm-level characteristics (the size of the enterprise (micro or small), ownership structure, age of the firm, region, location of the firm within the city/town) and growth of youth-owned MSEs.

(i) Employment and type of enterprise size within a sector

The survey result reveals that average size of employment varies by size of enterprise (micro and small), gender and region. Although the average size of employment for MSEs is 8.1 persons, the average employments for small enterprises and microenterprises are 13.5 and 4.4 persons respectively. The average size of employment for male-owned microenterprises (4.1 persons) is higher compared to female-owned microenterprises (2.3 persons). However, the average size of employment in the female-owned small enterprises (12.8 persons) is higher compared to male-owned small enterprise (9.82 persons). Moreover, the youth-owned MSEs in Dire Dawa have the highest average employment (10.4 persons), followed by Amhara region (9.1 persons), Addis Ababa (8.4 persons), SNNP (8.1 persons) and

Oromia (7.4%). On the other hand, MSEs in Tigray and Harari have the lowest average employments, 6.3 and 6.9 persons respectively.

The result reveals that a significant proportion of the youth MSE owners (28.7%) are engaged in metal and woodwork, followed by construction (19.5%), services (10%), trade (9.8%), urban agriculture (9.5), food and food products (7.8%) and textile and clothing (7.2%). However, many women microenterprise operators were involved in trade (23.5%), services (22.2%), urban agriculture (15.7%), food and food products (13.7%) and textile and clothing (13.7%), while the male microenterprise owners were mainly involved in metal and woodwork (41.8%) and construction (17.8%). On the other hand, the female small enterprise owners are mainly engaged in the production of food and food products (33.3%), textile and clothing (15.8%), urban agriculture (10.5%) and trade (10.5%) activities. Although the average growth rate of the youth owned MSEs (the entire sample) was 54%, the growth rate of microenterprise owners (40%) was much lower compared to small enterprise owner (75%). However, the highest growth was observed in the metal and woodwork sub-sector (109%), followed by textile and clothing (97%), leather and leather products (80%), and food and food products (53%). The lowest growth rate was registered in trade (9%), urban agriculture (14%), construction (17%) and service (20%).

Unlike the results of this study, Mulu (2007) found that the annual average growth for one-worker establishments in Ethiopia was 19% tripled of the next size (2-4) and above 12 times than the 5-10 workers category. Hart and Oulton 1996, Coad 2009, Lotti *et al.* (2003) found that smaller firms (micro enterprises) have relatively higher expected growth rates than larger firms (small enterprise). [4] It should also be noted that high growth rate of MSEs is generally not a process of gradual growth but rather a process of radical change in the development of enterprises which are innovative and have the competence to learn and to act in a flexible way (Coad and Holzl 2010). The

[4] When firms' growth rates are calculated as growth rates, small firms are observed to grow particularly fast, with a higher growth rate variance than for larger firms. For example, it is easier for a firm of 5 employees to experience a growth rate of 100% (i.e. grow to 10 employees in the following year), than for a firm of 500 employees to grow by 100% by taking on additional 500 employees (Coad and Holzl 2010).

provision of support services is one possible explanation for higher growth of small enterprises in Ethiopia, where the government provides support priority to the youth who are organized in groups or cooperatives to form an MSE. In other words, those businesses organized in group (employing more than 5 workers) and accessing support services from government (categorized as small enterprises) and have higher likelihood of faster growth compared to microenterprises. On the other hand, although it is difficult to give convincing reasons, the growth rate difference of youth-owned MSEs among regions is quite alarming. For example, MSEs in Amhara region and Dire Dawa registered the highest growth rates: 86% and 82% respectively. The growth rate of MSEs in Tigray, Oromia and Harari varied between 48% and 62%. The lowest growths were reported in SNNP (29%) and Addis Ababa (33%).

(ii) Type of ownership

Ownership structure is expected to have an impact on the growth rate of MSEs. In the Ethiopian context, priority of accessing government support services is given to the youth, who are organized in a group or a cooperative. However, the cohesiveness of the members of the group or cooperative has been posing a challenge on the development of youth-owned MSEs in Ethiopia. On the other hand, India offers attractive incentives to small enterprises, but by some accounts, these measures backfire because growth beyond a specified level entails losing valuable benefits (Mitra and Pingali 1999; Little 1987). Since manufacturing certain products in India is restricted for small firms, some owners even split up their MSEs into several enterprises in an effort to make them look smaller (Kashyap 1988) instead of growing vertically, from micro to small or medium levels.

The majority of the youth-owned MSEs (42.1%) in the study were organized in the form of sole proprietorship. MSEs established under partnership and cooperative form of organization accounted for 28.4% and 24.5% of the sample respectively. Only 3.2% and 1.5% of the MSEs were established under the legal framework of Private Limited Company and Share Company respectively. However, sole proprietorship is by far the dominant form of ownership in the microenterprise sub-sector (56.7%) compared to small enterprises (20.5%). About 42.6% of the youth engaged in small enterprises

have a cooperative legal status, while about 31.4% are established under partnership arrangement.

Table 5 clearly shows that MSEs in the category of private limited company (PLC) and sole proprietorship had, by far, higher growth rate compared to the other form of ownership structures. However, even among sole proprietorship and PLC category, the growth rate between micro and small enterprises vary significantly. For example, the small enterprises owned by the youth grew by 221% compared to microenterprise owners (50%). Moreover, the growth rate of enterprises owned by women (under the sole ownership category) is lower compared to male-owned MSEs. Cooperative form of ownership has registered the lowest growth rate compared to the other forms of ownership which is the result of adverse selection and moral hazard problems reflected as weak cohesiveness and lack of shared vision.

Table 5: Average growth rate of employment and type of ownership

Legal status	Micro				Small				Whole sample
	Female	Male	Mixed	Total	Female	Male	Mixed	Total	
Sole proprietorship	0.24	0.68	0.51	0.50	1.69	2.38	2.01	2.21	0.84
Partnership	0.13	0.48	0.38	0.37	0.14	0.37	0.49	0.41	0.39
Private Limited (PLC)	2.00	1.15	0.17	0.92	.	-0.46	3.01	2.66	1.54
Cooperative Company	-0.17	-0.11	-0.09	-0.11	-0.06	0.36	0.18	0.18	0.09
Share company	.	1.42	-0.04	0.44	0.08	0.00	0.90	0.69	0.58
Other	.	1.00	.	1.00	.	.	1.30	1.30	1.15
Total	0.21	0.59	0.26	0.40	0.38	1.32	0.55	0.75	0.54

Source: AEMFI, Survey on Youth-owned MSE in Ethiopia (2014)

(iii) Age of the MSEs

The theoretical paper by Jovanovic (1982) predicts that a firm will expand quickly at first, but then growth will taper off as the firm approaches its optimal size. While growth slows, productivity is expected to improve as the age of the firm increases because its owners learn about the optimal size of operation. Consistent to the theory, the study of Mulu (2007) indicated that the younger MSEs with 5 and fewer years old grew by annual average rate of

about 14%. This was more than double the 6-12 age group and more than four times the age group 13-29. The empirical evidences from GEMINI studies found that younger MSEs tend to exhibit faster growth than older MSEs (Mead and Liedholm 1998). The study of Burki and Terrell (1998) indicated that the major expansion of dynamic enterprises occurs during their third year of operation and the average growth rate of firms decrease with age. On the other hand, studies in India and Pakistan suggest that firms actually suffer productivity losses as they become older (Burki and Terrell 1998). This is partly the result of low investment in technology, leaving them with relatively outmoded equipment and hindering productivity levels relative to younger firms. However, the survey results of this study didn't find any pattern between the age of MSEs and growth rate. In other words, the results were not comparable with the theory and empirical studies by other researchers.

(iv) Location of MSEs within a city or town

The youth-owned MSEs working from homestead may benefit from resources such as family labor and electricity, but may also reinvest few profits, as funds are tapped for daily household needs. At lower income levels and with smaller firm sizes, the line that distinguishes the MSEs from the household is frequently blurred (Nichter and Goldmark, 2005). In the Ethiopian context, given the challenges of obtaining production and marketing premises at affordable prices, about 25.1% of the sample youth-owned MSEs operated from their homestead. While about 25.3% of the MSEs have their premises in commercial districts, about 12.3% are located in commercial districts, without having a permanent shop. About 9.9% of the respondents are located in cluster developed by the city administrations for MSE operators and the business of the 9.6% of the MSEs are located on the road side. However, the microenterprises working from homestead are much higher than small enterprises. Out of the microenterprise owners, higher proportion of women operating from their home and have shops in commercial districts compared to male microenterprise owners.

The result of the survey reveals that the youth MSE owners working from there, had a growth rate of 68%, while MSEs located at non-commercial district and commercial district registered 73% and 59% growth rate

respectively. The survey results were not consistent with other studies such as Mead and Liedhold (1998) who indicated that MSEs located in the household are not only significantly smaller on average, but also are less likely to grow than other MSEs. Moreover, unlike the results of Mead and Liedhold (1998), the survey results showed that the small and male-owned enterprises located at home had much higher growth rate compared to micro and female-owned enterprises.

(v) Access to finance

Youth-owned MSEs require finance to invest in infrastructure (machinery and equipment), cover operation costs, expand business and optimally use the available opportunities. Initially, MSE operators use their own financial resources, and then move to debt finance and/or venture and equity capital. Even after the start-up hurdles was overcome, lack of credit frequently hinders growth during MSEs' earlier years, because younger firms tend to find financing even more difficult than older firms. The findings of the survey shows that lack of access to finance (64.9%), lack of market for their products (56.1%), limited access to land for production (52.8%), and lack of marketing premises (52.4%) are major factors limiting the growth and expansion of youth-owned MSEs. The survey result of this study is consistent with other empirical studies, where credit constraints were mentioned frequently as key factors limiting the growth of MSEs (Burki and Terrell 1998).

Since the youth-owned MSEs in Ethiopia have a serious challenge of accessing loan, they tend to rely on other sources. About 71.3% and 70.1% of the youth owning MSEs used own saving/retained earnings to meet their working and investment capital needs respectively. About 8.7% of the respondents reported that they used borrowing from the formal sector to finance their working and investment capital needs, while about 6% used borrowing from the informal sector. Relatively, the proportion of the small enterprise owners (13.4%- 13.9%) who used borrowing from formal financial institution was higher compared to the microenterprise owners (5.2% -5.5%). The findings are consistent with the studies of Gebrehiwot and Wolday (2006); and Vandenburg (2003).

Table 6: Average growth rate of employment for those who took and who didn't take loans

Status	Micro				Small				Whole sample
	Female	Male	Mixed	Total	Female	Male	Mixed	Total	
Took credit									
Formal banks	0.00	3.00	-0.21	1.11	0.50	1.99	2.32	1.94	1.64
Microfinance institutions	0.43	0.49	-0.11	0.32	0.51	1.65	0.52	0.83	0.62
Government projects	0.00	.	-0.19	-0.08	-0.07	0.03	-0.32	-0.21	-0.17
NGOs	-0.10	0.00	-0.13	-0.09	0.98		-0.37	0.64	0.33
Iqub	-0.44	0.60		-0.10	.	0.17	2.07	1.12	0.60
Moneylenders	.	2.00	.	2.00	.	0.00	0.10	0.08	0.40
Suppliers	0.33	0.81	0.54	0.62	0.00	1.26	0.22	0.73	0.68
Saving and credit association	0.07	1.83	0.06	0.30	-0.21	0.41	0.64	0.52	0.43
Friends/relatives	0.12	0.88	0.69	0.63	0.40	1.87	0.66	1.03	0.75
Didn't take credit									
Formal banks	0.21	0.58	0.26	0.40	0.38	1.29	0.52	0.72	0.53
Microfinance institutions	0.18	0.61	0.32	0.42	0.32	1.19	0.56	0.71	0.52
Government projects	0.22	0.59	0.26	0.41	0.39	1.35	0.57	0.77	0.55
NGOs	0.22	0.60	0.27	0.41	0.27	1.32	0.56	0.75	0.55
Iqub	0.22	0.59	0.26	0.41	0.38	1.34	0.53	0.74	0.54
Moneylenders	0.21	0.59	0.26	0.40	0.38	1.33	0.56	0.76	0.54
Suppliers	0.21	0.58	0.23	0.39	0.41	1.33	0.56	0.75	0.53
Saving and credit association	0.22	0.58	0.28	0.41	0.42	1.41	0.53	0.77	0.55
Friends/relatives	0.23	0.52	0.19	0.35	0.38	1.24	0.53	0.71	0.51

Source: AEMFI, Survey on Youth-owned MSE in Ethiopia (2014)

In the Ethiopian context, commercial banks mainly channel loan to large or corporate businesses while microfinance institutions (MFIs) are given the

responsibility by government to deliver financial services to MSEs in order to meet the targets of the five-year MSE development. However, although the proportion of youth MSE owners who accessed loan from the banking sector was less than 2%, the MSE operators which took loan from banks grow by 164% compared to those who didn't take loan (53%). The growth rate of small enterprise owners who took loan from banks (194%) is higher compared to the microenterprise owners (111%). Youth MSE owners who accessed loan from MFIs, Iqub and suppliers, friends/relatives registered higher growth rate compared to those who didn't take loan. Although the female-MSE operators who took loan from banks, MFIs, suppliers, and friends/relatives grow at a lower growth rate compared to their male counterpart, the growth rate of female owning microenterprises who took credit from saving and credit associations registered relatively higher growth rate. Contrary to the findings this study (Table 6), Wolday *et al*. (2013) found that bank or MFI credit in Ethiopia has had hardly any impact on growth and business expansion of grain traders and millers.

3.3 Inter-firm cooperation

The horizontal and vertical cooperation play a critical role in the growth and performance of youth-owned MSEs. The horizontal cooperation allows MSE owners to sub-contract activities, involve in joint actions and venture such as joint purchase of inputs, joint output marketing, joint training of their labor force, etc. The vertical cooperation involves backward and forward linkages such as supplier-producer cooperation or input-output activities and sub-contracting of phases of cycles through vertical linkage. Improving vertical cooperation increases price competitiveness, reduce transaction cost, facilitate information transfer, provide opportunities for learning, innovation and collective action within a market system (USAID 2008). Vertical linkages are needed because the lead firms at the top of the value chain have the closest contact with end market and they are the ones which understand the demand condition and the market. Cluster or geographic and sectoral agglomerations of MSEs are also instruments to promote horizontal linkages and growth. When MSEs are organized in a cluster, they can share machinery and production premises and developing a product together. Although the MSEs in the cluster compete with each other, they can

cooperate and ensure that one firm's investments spill over to other firms. By facilitating linkages with other firms, dynamic clusters have the potential to foster the youth-owned MSEs growth through expanded opportunities and capabilities. Moreover, services provided through supporting markets can also facilitate the improvement in the capacity of youth MSE operators.

The results of the study reveal that exchange information and experience, sharing and borrowing machinery, jointly market products and purchase inputs are the most important form of cooperation among youth-owned MSEs. The finding also indicate that those youth MSE owners, who reported they have the experience of cooperation among themselves, registered higher growth rate (69%) compared to respondents who didn't have the experience of inter-firm cooperation (49%). The contribution of inter-firm cooperation on growth rate is much higher in small enterprise owners compared to microenterprise operators. The role of inter-firm cooperation on growth rate was much lower in the MSEs owned by female compared to the male owners.

3.4 Policy predictability

MSEs are relatively more vulnerable to the impact of volatility that an unstable macroeconomic compared to large enterprises. For example, at the times of price instability, interest-rate volatility and foreign-exchange uncertainty, the number of bankruptcies generally rises, and MSEs bear the brunt of such adverse conditions (Falkena *et al.* 2002). Creating an enabling policy environment is also one of the critical interventions to promote competition, production and productivity and growth of youth-owned MSEs. Moreover, the MSEs require a higher degree of predictability, particularly with regard to price movement (inflation), interest rates, availability of credit, ensuring property right, contract enforcement, etc., which will have impact on the costs and revenue side of their operations and mange their asset categories appropriately.

The credibility and perceived predictability of the policies of the government are important factors that influence the decisions of the MSE operators to expand their activities. The results of the survey showed that about 8.5% and

17.7% of the youth MSE owners reported that the policies of the government are completely and highly predictable respectively; while about 35% indicated the policies of the government are fairly predictable. About 24.5% of the respondents revealed that government policies are highly or completely unpredictable. On the other hand, Gebrehiwot and Wolday (2004) showed that about 35% of the MSE operators (42% for small and 32% for microenterprises) in Ethiopia had to cope, on regular basis, with "unexpected changes in rules, laws or policies" which materially affect their enterprises. Moreover, there are divergence between stated policies and directives at federal and regional levels and the outcome on the ground, which would have an impact on the credibility and predictability of government policies and strategies. Comparing the findings of Geberhiwot and Wolday (2004) with sample survey results of this particular study, predictability and credibility of government polices has shown an improvement in the last ten years.

The findings of the survey indicates that those youth MSE owners who reported that the policies of government were completely, highly or fairly predictable registered higher growth rate, while those who reported highly or completely unpredictable experienced lower growth rate. In other words, the owners of MSEs who have the trust and confidence on the policies show higher growth rate, while those who are uncertain about the policies lacked the confidence to invest and make all efforts to expand their business.

4. Factors influencing the growth of youth-owned MSEs

Based on the conceptual relationships described in various sections of this study, an attempt is made to examine determinants of growth of youth-owned MSEs by using an econometric approach. The growth of MSEs is influenced by a number of independent variables which could be internal and external factors. The dependent variable, firm growth, is measured in terms of changes in employment between time of establishment and survey period. In other words, the growth of youth-owned MSEs (Y) is a function of a vector of (X) which includes individual-level characteristics, firm characteristics, inter-firm relationship, and policy predictability variables.

The objective of examining the relationship is to test whether or not firm growth is positively associated with internal and external factors.

A linear regression model was used to estimate the relationship between growth of youth-owned MSEs and various arrays of independent variables. To capture the problem of heteroscedasticity, which is common in most cross sectional datasets, the regression was estimated with robust standard errors. Using the robust option, the point estimates of the coefficients were exactly the same as in ordinary OLS, but the standard errors were taken into account to address issues concerning heterogeneity and lack of normality. However, using robust standard errors does not change any of the conclusions from the original OLS regression (Bruin, 2006). Moreover, a multicollinearity test, using the Variance inflation factors (VIF), was run to address the issue of multicollinearity among the explanatory variables. (VIF) measure how much the variance of the estimated regression coefficients are inflated as compared to when the predictor variables are not linearly related, which is used to describe how much multicollinearity exists in a regression analysis (O'Brien, 2007). The result shows the VIF for all variables, which was found to be less than 5, implying that there is no statistically significant level of multicollinearity among the independent variables.

Table 7 shows the regression results of employment growth of youth-owned MSEs on a set of explanatory variables. It is found that among the individual-level attributes: MSEs operators who are illiterate, sole owner of the business, enterprise owners under the category of microenterprise, have experience in similar business (before starting their own business), and male MSE owners are found to have significant effects on the employment growth. Specifically, the illiterate MSE owners are found to have lower employment growth compared to owners who attended higher educational level, other things remaining constant. MSE operators, who are sole owners, have also registered a higher employment growth than other types of ownership structure. However, the variable microenterprise dummy was found to have a negative and significant effect on employment growth, implying that microenterprises have lower employment growth compare to small enterprises. Individuals who had experience in similar business before starting the business are found to have a higher growth in employment than

those who didn't have experience. Besides, male MSE owner are also found to have a higher employment growth than their female counterpart.

Enterprise-level attributes of youth-owned MSEs: availability of stable product market, access to training before starting business, develop future plan, access to loan, developed the culture of saving, size of start-up capital, and current capital are found to be significant variables influencing the employment growth of MSEs. Youth MSE owners who have better access to market for their products are found to have a higher employment growth, whereas MSE owners who had accessed training before starting business were found to have a negative impact on employment growth, may be due to generic training given to all MSE operators which were not related to the business they are currently engaged in. Those youth MSE owners, who have future plan to expand the current business, have a positively affect on the growth of employment. Even though amount of saving is found to have a positive effect on employment growth, the amount of loan is found to have a negative effect on employment growth. One possible explanation is saving requirement of MFIs, before accessing loan, and liquidity challenges of MFIs which limited access to loan to MSE operators affects the expansions of MSEs. Having relatively higher current capital is found to have a positive effect on employment growth of MSEs, implying that access to capital is very critical to growth and expansion of youth-owned MSEs.

The policy variable (predictability of government policies) is found to be a significant variable affecting the employment growth of MSEs, implying that as the policies, laws and regulations become more predictable (showing the trust and confidence of the MSE operators on government), the MSE operators are likely to be motivated in expanding their business by increasing employment. On the other hand, the inter-firm relationship, which is captured by variables such as social networking and working in cluster, is found to be an insignificant factor in affecting employment growth in the youth-owned MSEs.

Table 7: Regression results: Factors affecting growth of employment

Explanatory variables	Coefficient	T-value
Illiterate/with no formal education dummy	-0.427*	(-1.694)
Grade 1-4 level of education dummy	-0.065	(-0.256)
Grade 5-8 level of education dummy	-0.075	(-0.317)
Grade 9-12 level of education dummy	0.153	(0.991)
Sole ownership dummy	0.534***	(3.041)
Micro enterprise dummy	-0.465***	(-2.666)
Migrant dummy	0.070	(0.550)
Single dummy	-0.096	(-0.564)
Divorced dummy	0.051	(0.271)
Widowed/Widower dummy	-0.259	(-1.438)
Access to vocational training before starting the business dummy	0.191	(0.991)
Experience in similar business	0.301**	(2.427)
Engage in MSE because it provide better opportunity dummy	0.019	(0.139)
Location of the enterprise dummy	-0.094	(-0.761)
Having adequate market for one's products dummy	0.196*	(1.778)
Status of machinery or equipment dummy	-0.024	(-0.190)
Preparing annual budget dummy	0.111	(0.463)
Use of other income to support the business dummy	0.060	(0.294)
Availability of additional source of income dummy	0.045	(0.252)
Access to training to the owner before starting the business dummy	-0.363*	(-1.831)
Access to training to the owner after starting the business dummy	0.204	(1.223)
Access to training to the workers after starting the business dummy	-0.247	(-1.401)
Access to business extension dummy	0.114	(0.776)
Social networking dummy	-0.076	(-0.468)
Working in a cluster dummy	-0.234	(-1.427)
Policy predictability dummy	0.267**	(2.282)
Future plan to stay and expand in the business dummy	0.352***	(3.045)
Amount of credit in birr	-0.000*	(-1.782)
Saving of MSE operators in birr	0.000*	(1.853)
Sales in past week in birr	0.000	(0.643)
Start-up capital if started from scratch in birr	-0.000*	(-1.721)
Years of experience in this business	0.002	(0.803)
Experience in other types of small businesses	-0.000	(-0.052)
Estimated current total capital in birr	0.000**	(2.331)
Approximate average sales per month for whole business period	-0.000	(-1.138)
Current capacity utilization (%)	0.001	(0.524)
Age of the owner/manager in years	0.003	(0.193)
Household size in number	0.011	(0.293)
Male dummy	0.314***	(2.664)
Constant	-0.451	(-0.940)
Number of observations	859	
Adjusted R2	0.161	

Note: *** p<0.01, ** p<0.05, * p<0.1; and t-value in parentheses

5. Conclusion and Proposed Interventions

The main objective of this study was to examine the key factors which influence the growth of youth-owned MSEs, including owners' and firm-level attributes, vertical and horizontal cooperation, and policy and regulatory environment. Unlike the results in other empirical studies, the finding of this study reveals that the average growth rate of small enterprises is higher than the microenterprises. The results show that youth-owned MSEs grow by about 54%, but vary by sector, size (micro and small) and gender. The highest growth is observed in the metal and woodwork sub-sector, followed by textile and clothing, leather and leather products, and food and food products. The lowest growth rates are reported in trade, urban agriculture, construction and service. Consistent with the findings of other studies, the growth rates of female youth owned enterprises in Ethiopia are found to be lower compared to male-owned MSEs. There is also a positive relationship between the age of the owners of MSEs and growth rate. The growth rate of youth-owned MSEs was directly related with level of education of the owners.

The survey result shows that there are no differences in the growth rate between the youth MSE operators who took training and those who did not receive training before starting their business. This implies that the training given to the youth before starting business has failed to add value and need to be revisited. On the other hand, the training given after starting business to the youth MSE owners has had a positive impact on the growth of MSEs. The respondents who perceived that they are engaged in their dream job and have the skills to run the business (opportunity-driven) registered higher growth rate compared to those who started their business as their last option of getting employment or income (necessity-driven). Moreover, the MSE owners who have the intension of expanding and staying in the same business had also higher growth rate.

Youth-owned MSEs in registered as private limited company (PLC) and sole proprietorship form of business organization have had by far the higher growth rate compared to the other forms of ownership. However, the solely owned small enterprises have higher growth rate than microenterprise under

the same category. The growth rate of female owned enterprises (under the sole ownership category) is lower compared to their male counterpart. Although the government has been providing significant support to those MSEs organized in the cooperatives or groups, their growth rates are found to be lower compared to the other form of ownership arrangements.

The growth rate of youth MSE owners MSEs who took loan from banks grow by much higher rate compared to those who didn't take loan. MSEs which have access to loan from MFIs, Iqub and suppliers, friends/relatives registered higher growth rate compared to those who didn't take loan. Moreover, youth MSE operators who saved in cash or in kind and invest in other businesses had higher growth rate than those who spend their income for household consumption. The finding of the survey reveals that those youth MSE owners, who reported they had the experience of cooperation among themselves, register higher growth rate compared to respondents who had no inter-firm cooperation experience. Moreover, MSEs who perceive that the policies of government were completely and highly or fairly predictable registered much higher growth rate, while those who reported highly or completely unpredictable experienced lower growth rate.

Consistent with the descriptive statistics, the regression results indicate that among the personal attributes of youth MSE owners: education, sole ownership form of business organization, small enterprise category, experience in similar business, and gender (male MSE owners) are significant variables which positively influenced the employment growth of youth-owned MSEs. Out of the firm-level attributes, access to training before starting business, social networking and access to loan were significant variables which negatively affected growth rate. On the other hand, access to product markets, future plan of the enterprises, saving culture, size of start-up capital and current capital were found to be significant variables in influencing the growth of youth-owned MSEs. Moreover, the predictability of policies was also found to a significant variable affecting growth and expansion of youth-owned MSEs.

Since the growth of microenterprises and women-owned enterprises were low, there is a need to revisit the support program and develop tailored

interventions for microenterprises and women MSE owners. Inter-firm cooperation and policy predictability were found to influence the growth of youth-owned MSEs. Improving cooperation and policy predictability should start by conducting a detailed study on why many of the MSE operators have weak social networking and skeptical on the consistency of government in executing its policies. Based on the output the research, there is a need identify the interventions needed to build the trust and confidence of the operators on the policies and strategies of government and promote inter-firm cooperation. Limited access to finance, lack of production and marketing premises, and inadequate market development came up as the top three challenges to expand and establish MSEs. However, the magnitude of the above problems vary by size of the enterprises (micro and small), gender, sector, type of ownership, location, etc. Given the heterogeneous characteristics of MSEs, there is a need to formulate more defined targeted strategies and programs to influence business opportunities, capabilities and productivity, particularly for the growth-oriented or priority sub-sectors. On the other hand, growth is one of the most important performance indicators of MSEs. However, MSEs could be dynamic, innovative and perform well without growing vertically from micro to small or small to medium enterprise. This is another performance dimension of MSEs which require upgrading and increasing the capacity micro or small enterprises, without necessarily requiring them to grow vertically. Moreover, government and development partners should take the initial lead to support research and development activities in the MSE sector by allocating fund and providing technical assistance, particularly for the priority sectors.

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Single versus Multiple Objective(s) Decision Making: An Application to Subsistence Farms in Northern Ethiopia

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Abstract

Single objective approach is most widely used whereas consideration of multiple objectives is the rule rather than an exception in many real life decision-making circumstances. This paper, therefore, investigates whether or not single and multiple criteria/objective approaches necessarily lead to differing conclusions. The central questions are could the single objective approach be a reasonable approximation for subsistence farm settings or does the multiple objectives approach has anything to add? Does the pattern of resource allocation change when priorities attached to the different objectives/ goals change? The study employs linear and goal programming techniques on a dataset from a stratified sample of 200 farm households drawn from Tigrai regional state, Northern Ethiopia, for 2001 and 2002 production years. Findings reveal that the two approaches might not necessarily lead to differing conclusions.

Keywords: Single versus Multiple Criteria/Objectives; Linear Programming, Goal Programming; Subsistence Farms; Northern Ethiopia.

JEL classification: C1; C6; C61; D10

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1. Introduction

It appears that, in reality, decision makers purse several objectives and therefore, the traditional paradigm of choice involving single-criterion might be inadequate for dealing with such situations or decision environments (Romero and Rehman, 2003). In fact, multiple objectives tend to be the rule rather than exception in many real life decision-making circumstances. For example, subsistence farmers might be interested in achieving security of family food supplies, maximizing cash income, increasing leisure, avoiding risk, etc. Moreover, most decisions might not only involve multiple-objectives (goals), but also hierarchy of objectives (goals) which might be potentially conflicting with each other and need to be reconciled (Harper and Eastman, 1980).

In the traditional 'single' objective approach, such as in the classic linear programming framework, one must assume that there is exactly one objective that is to be optimized subject to the absolute satisfaction of a number of 'constraints' (Ignizio, 1976). Often one of the objectives is optimized while the others are specified as constraints. For example, maximization of profit (or gross margin) or minimization of costs is considered the single most objective to be optimized. Proponents of multiple objective approaches argue that although logically sound, the single objective approach fails to faithfully reflect the real life decision situation for two reasons. Firstly, it assumes that the constraints that define the feasible set are so rigid that they cannot be violated. Secondly, decision-makers are usually not interested in ordering the feasible set according to just a single criterion but would rather find an optimal compromise involving several objectives. Moreover, a decision maker or a farmer, for instance, might be involved in diversity of occupations or activities such as farm and non-farm activities. Therefore, does the maximization of profit for the decision maker or a farmer refer to the farm, the non-farm or the two in conjunction also poses another dilemma. Particularly in the case of subsistence or family farms, the fact that the farm is a complete economic unit which exhibits interdependence between income and consumption casts some doubts upon the assumption of profit maximization as the only ultimate goal, which

family farms strive to achieve. Indeed some of the motives might not be purely economic, although some are relevant than others for economic behaviour (Gasson, 1973). So, it would be of interest investigating the issue.
Regardless of all these divergence of opinions, studies that applied multiple objective/criteria decision analysis to subsistence farm settings especially in the African context are very scanty. Barnett *et al.*, (1982) applied goal programming with multidimensional scaling to Senegalese subsistence farms. Bazaraa and Bouzaher (1981) applied linear goal programming model to Egypt's agricultural sector particularly at the regional level. Moreover, whereas subsistence farm settings tend to be well suited for multiple objective/criteria analysis, previous studies in Ethiopia and elsewhere in Africa have employed linear programming, implying addressing single objective only. For example, Belete *et al.* (1993) tried to explore the possibilities for improving production and income of small farmers through better allocation of resources under alternative cultivation (work oxen acquisition) practices using linear programming model. Heyer (1971) applied linear programming to maximize market value of output as the single objective given constraints on peasant farms in the case of Kenya. She found out that cotton and drought resistant maize alone might not necessarily provide substantial increase in income. Kassie *et al.* (1999) also used linear programming to analyze the benefits of integration of cereals and forage legumes with and without crossbred cows in mixed farms for highland Ethiopia. They found out that introduction of cereal-forage legume intercropping significantly increases gross margin and cash income. They also found that the introduction of crossbred cows further enhances these returns.

Studies that used multiple objectives approach include Barnett *et al.*, (1982), Bazaraa and Bouzaher (1981), Lee *et al.* (1995), Okoruwa *et al.* (1996), Hayashi (2000), Romero (2004), Manos *et al.* (2006), Krcmar and van Kooten (2008), Latinopaulos (2008), Sintori *et al.* (2009) and Rozakis *et al.* (2012). Barnett *et al.*, (1982) applied goal programming with multidimensional scaling to Senegalese subsistence farms. They found out that the multi-objective model did not exhibit superiority over a similarly structured profit maximizing model. Bazaraa and Bouzaher (1981) applied linear goal programming model to Egypt's agricultural sector particularly at

the regional level, in relation to income distribution and regional employment goals. They concluded that a relatively higher degree of specialization and a relatively lower cotton production could be achieved through using improved farming techniques and labour-intensive means. Lee *et al.* (1995) applied multiple objectives programming to subsistence farming cropping decisions in Western Samoa. Their findings showed that the imputed non-market value of an important exportable crop is three to five times greater than the market price. Okoruwa *et al.* (1996) also used a multi-objective programming model to analyze crop-livestock competition in West African derived savannah. Their results indicated that farm and herd sizes will become smaller and the degree of crop-livestock integration will increase significantly, as population pressure and cropping intensity severely limit access to grazing land. Hayashi (2000) provides detailed review of multi-criteria analysis as applied to agricultural resource management. By way of assessing the criteria (i.e., attributes, objectives) used for modeling agricultural systems, it summarizes pros and cons involved applying the methodology. Manos *et al.* (2006) and Latinopaulos (2008) assess the impact of irrigation water pricing in Greece using multi-criteria decision analysis. Romero (2004) also provides a general structure, i.e., three alternative formulations of achievement function for a goal programming model, one of which is weighted goal programming. Krcmar and van Kooten examine whether the current policy of ensuring a stable timber supply is an effective rule-of-thumb for balancing environmental, employment and other objectives or is non-optimal, leading to unacceptable trade-offs? They develop multiple-objective programming that employs compromise and fuzzy programming for balancing conflicting objectives, and compares results from these approaches with those of the current policy of maintaining an even-flow of timber to mills. They find that outcomes obtained using multiple-objective programming greatly improve upon those associated with the rule-of-thumb policy of even-flow of timber.

The following outstanding issues turn out quite apparent from the review existing literature. Firstly, particularly in the case of subsistence or family farms, the fact that the farm is a complete economic unit which exhibits interdependence between income and consumption casts some doubts upon

the assumption of profit maximization as the ultimate goal, which family farms strive to achieve. Indeed some of the motives might not be purely economic, although some are relevant than others for economic behaviour (Gasson, 1973; Lee *et al.*, 1995). Secondly, whereas subsistence farm settings might be viewed to be well suited for multiple objective/criteria analysis, previous studies particularly in the case of Ethiopia have employed linear programming, implying addressing single objective only. Therefore, it would be of interest understanding whether the multiple objectives approach has anything to add.

In this paper, we analyse single versus multiple criteria/objective approaches. Using linear and goal programming techniques, the paper tries to investigate whether the two approaches necessarily lead to differing conclusions. More specifically, the paper addresses such questions as: could the single objective approach be a reasonable approximation, particularly for subsistence farm settings or does the multiple objectives approach has anything to add? How does the pattern of resource allocation change when priorities attached to the different objectives/ goals change? If indeed the multiple objectives approach has something to add, then understanding the behaviour of economic agents in decision contexts involving multiple criteria would sharpen our prediction.

The remaining part of the paper is organized as follows. In section two provides definition of the subsistence farm household problem setting. Section three presents the model formulation and section four presents study area and data description. Section 5 deals with discussion of results, followed by concluding remarks in section 6.

2. Subsistence Farm Household: Definition of Problem Setting

The most defining feature of subsistence farmers is mainly the subsistence nature of their livelihoods. They are simultaneously engaged in both production and consumption and a larger proportion of the produce is directly consumed by the household (Ellis, 1993). They are distinguished

from the landless laborers in that they have access to (own) certain amount of land, which by combining with other family resources such as labor and perhaps hiring in of land and/or labor produce farm output mainly for own (family) consumption.

We consider a representative farm household, which is assumed to have three objectives: attaining security of family food supplies, maximizing cash income and meeting fuel or energy needs of the household. This household faces a problem of making decisions on land and labor use by taking into account his/her objectives, available resources (constraints), institutional arrangements and access to markets/opportunities.

2.1 Activities

The typical subsistence farm household has on the one hand diversity of activities to which the scarce resources can be allocated and on the other hand available resource supplies or limits. These activities among others include production of various crop and livestock products. In this study we distinguish four broad categories of activities; crop or production activities, consumption activities, fuel gathering, and sales activities.

Crop or production activities: Crop choice or crop production can be subdivided into numerous activities. For simplicity we limit ourselves to four most important crops in order of their importance in production: barley, wheat, teff, and legumes. The decision problem facing the farm household is how much of land to allocate to the production of each of these crops given his objectives, resources and other constraints. Farmers in the area also maintain livestock for draft power and other purposes. The draft power aspect of livestock activities has been considered in this study. Looking after cattle is mainly the activity of children (Woldehanna, 2000). This implies that livestock doesn't compete for labor with other activities given that participation of children in other major activities is minimal.

Consumption activities: Subsistence farmers put emphasis on security of family subsistence or food supplies through own production. Consumption

activities considered in this study include consumption of teff, wheat, barley and legumes. .

Fuel gathering: Fuel gathering essentially refers to the collection of fuelwood from the nearby sources for meeting fuel or energy needs of the representative household for baking, preparing meals and warming the house in cases of coldness.

Sales activities: When requirements for subsistence are met, subsistence farms often generate income by selling the available surplus output which, in turn, might be used to buy some items or products which they do not produce or cannot produce enough for subsistence. In the model, therefore, sales of teff, wheat, barley, and legumes were included as separate activities to balance production and utilization of these crops. Moreover, off-farm employment plays an important role in the farm household economy and counts up to 35 percent of total farm household income in the area (Woldehanna, 2000). Therefore, hiring out of labor has been considered as part of the sales activities.

2.2 Resource supplies and other constraints

The amount of scarce farm resources and other constraints such as subsistence/family food requirements, fuel requirements and cash needs determine the optimal allocation of resources to various activities. Average values in the dataset were taken/assumed resources currently available for the representative farm household and were used to derive the restrictions. Resources and other constraints specified in the model include labour, working capital, oxen-power, land, fuel/energy need, teff balance, wheat balance, barley balance, legumes balance, cereals, legumes, and cash needs or income.

Labour (hours): Total labour supply is approximated based on demographic characteristics of representative farm household and local circumstances such as number of nonworking or holidays. The representative farm household is assumed to have a family of 6 persons with 3 working persons

(head, spouse and one other male member) and 3 dependants. The total labour supply is derived by aggregating total working time of each of the three working persons. Only one-third of the total working time for the spouse and the other male member of family have been considered in the total labour supply. Thus, the total labour supply is constrained to be less or equal to 2764 hours.

Working capital (Birr): Working capital is considered to be operating expenses of the farm in terms of purchasing farm inputs seed, fertilizer, pesticides, etc. The total amount of working capital requirement has been determined from the dataset and constrained to be less or equal to 529 Birr.

Ox-power: Per tsmdi or (pair day) ox-power requirement for the production of crops has been determined from the dataset. The representative farm household is assumed to have a pair of oxen. Taking into account local circumstances such as holidays and biological requirements of oxen, the total ox-power supply per year is assumed to be less or equal to 90 pair days.

Land (tsmdi): Households usually rent in land and total cultivated land constitute own land and rent in land. Total cultivated land minus rent in land is constrained to be less or equal to 6 tsmdi.

Fuel or energy needs: Fuelwood and dung are the most important fuel sources in the study area. Own sources such as own cattle barn and backyard account for major part of the dung used as fuel (see Appendix Table A.5). Most of the fuelwood is collected from adjacent woodlands and communal grazing areas. Therefore, fuelwood gathering is considered as an important activity competing for labour resource of the representative household. A total fuel or energy need of the household is determined from the dataset on the basis of fuel wood need and it is constrained to be greater or equal to 771 kilo grams.

Crop balances: As it could be shown from Table 1 below, four commodity balances namely teff, wheat, barley and legumes are specified assuming that

production of each of these crops less consumption and sales should be greater or equal to 0.

Subsistence requirement of cereals: The representative farm household is assumed to be of 5.0 (persons) adult equivalents. Following Gryseels (1988) and Kassie *et al.* (1999), 200 kilo grams of cereals is considered to be the average annual subsistence requirement per adult equivalent. The minimum subsistence cereals requirement for our representative farm household is constrained to be greater or equal to 1000 kilo grams. It is assumed that the representative household consumes for subsistence requirements from one or more cereals among teff, wheat and barley depending on the optimal crop choice.

Legumes (kg): An average of 50 kilo grams of legumes or pulses was considered as the annual subsistence requirement per adult equivalent (Gryseels, 1988; Kassie *et al.*, 1999). Hence, subsistence legumes requirement is constrained to be greater or equal to 250 kilo grams.

Cash income or cash needs: Total cash income or cash needs of farm household includes working capital, expenses of marketable items such as salt, pepper and spices, coffee, tea and sugar and expenditures on non-food items such as soap, cosmetics, etc. Moreover, cash requirement to pay taxes and fees as well as cash needs to meet social obligations are also considered. The total cash income or cash need of household is constrained to be greater or equal to 1256 Birr. The total cash income is assumed to come from sales of teff, wheat, barley, and legumes as well as off-farm labour income. Average prices of the different products and of off-farm labour income observed during the survey period are considered in determining the amount.

3. Model Formulation

3.1 Classic Linear Programming Framework

Table 1 below presents a linear programming (LP) problem representation of the above problem. In this formulation, columns stand for activities or decision variables and rows stand for resource limits or supplies and other

constraints. The first row in the table represents the objective function to be optimized. In such a classic LP model, a single most objective or goal, such as maximizing gross return or discounted value of net returns is often assumed. More technically speaking, in such an LP framework, the decision maker maximizes the objective function such as total gross margin subject to constraints (i)-(xii). Only one objective is optimized while the rest has to be treated as constraints. The coefficients of variables (x_i), for i=1,2,3, and 4, entering the objective function stand for gross margin (in Birr) per unit area (*tsmdi)* per annum of *teff*, wheat, barley, and legumes respectively. The coefficient of x_5 is the rental price/cost (in Birr) per unit area (*tsmdi)* of rent in land whereas the coefficient of x_{15} is return from a unit of off-farm labor.

In this setting, other objectives, for example, achieving food security or meeting fuel needs are considered as constraints and they are not by themselves taken as objective functions. However, such way of handling decision problems involving multiple objectives may not be satisfactory for various reasons. Firstly, representing goals by standard linear programming constraints is very rigid, whereas the decision-maker may have some flexibility say, for example, in the amount of cash income he/she wants to achieve. The amount need not necessarily be exactly constant. Imposing strict constancy is not only unrealistic but also easily leads to infeasibility of problems. Moreover, locating the constraint that might have caused the infeasibility could also be difficult in the case of large problems with many constraints. Secondly, since the objective function is optimized within the feasible region defined by the constraints, which could have been goals by themselves implies that priority of one over the other goal.

Goal programming tries to correct these limitations of linear programming while retaining its useful basic structure and numerical solution. Goal programming differs from the traditional single objective approach in two important respects. First, it stresses the satisfaction of multiple objectives instead of optimization of a single objective. Second, it realizes that it is highly unlikely that all of the constraints are truly absolute (Ignizio, 1976).

Table 1: Matrix of the Farm Household Problem in the classic LP (single objective) framework

Production activities						Consumption activities					Sales activities							
Teff (tsmdi)[1]	Wheat (tsmdi)	Barley (tsmdi)	Legumes (tsmdi)	Rent in Land (tsmdi)		Teff (kg)	Wheat (kg)	Barley (kg)	Legume (kg)	Fuel wood (kg)	Sales of Teff (kg)	Sales of Wheat (kg)	Sales of Barley (kg)	Sales of Legume (kg)	Off-farm work (hour)			
(x_{-1-})	(x_{-2-})	(x_{-3-})	(x_{-4-})	(x_{-5-})		(x_{-6-})	(x_{-7-})	(x_{-8-})	(x_{-9-})	(x_{-10-})	(x_{-11-})	(x_{-12-})	(x_{-13-})	(x_{-14-})	(x_{-15-})			
241.33	298.05	279.34	104.92	-115.45											1.18	=	Z max (Birr)	
167.94	76.42	71.05	70.64							0.11					-1	≤	2764 Labor (hours)	(i)
34.70	87.46	77.13	48.24													≤	529 Working capital (Birr)[2]	(ii)
4	3	3	2							0					0	≤	90 Ox-power (pair day)	(iii)
1.0	1.0	1.0	1.0	-1.0						0					0	≤	6 Land (tsmdi)	(iv)
										1						≥	771 Fuel need (kg)	(v)
113.31						-1					-1					≥	0 *Teff*[3] balance	(vi)
	146.73						-1					-1				≥	0 Wheat balance	(vii)
		199.72						-1					-1			≥	0 Barley balance	(viii)
			195.77						-1					-1		≥	0 Legumes balance	(ix)
						1	1	1								≥	1000 MSRTPF[4] cereals (kg)	(x)
									1							≥	250 MSR Legumes (kg)	(xi)
				-115.45							2.13	2.03	1.40	0.54	1.18	≥	1256 Cash need (Birr)	(xii)

[1] *Tsmdi* is local unit for land area -1 *tsmdi*=0.25 hectare
[2] Birr is Ethiopian currency 1USD = 12.7010 Birr (July, 2009)
[3] *Teff* is a staple crop it belongs to the grass family *Eragrostistef*
[4] MSR is an abbreviation for minimum subsistence requirement

3.2 Multi-objective or Goal Programming Model

In goal programming (GP), any problem involving multiple objectives is solved in such a way that the solution ensures the simultaneous satisfaction of many of the objectives. It attempts to include all pertinent objectives. However, not all objectives can or should be optimized and GP establishes aspired levels of achievement or goals for each of these objectives. Weighted goal programming (WGP), in particular, provides a way of striving towards all objectives simultaneously (Romero, 2004).

Mathematically, the goal programming problem in the general case could be specified as (Ignizio, 1976; Patrick and Blake, 1980; Barnett *et al*., 1982):

Minimize

$$\sum_i (W_i^+ \cdot p_i + W_i^- \cdot n_i) \qquad \textbf{(1)}$$

subject to

$$\sum_j G_{ij} X_j + n_i - p_i = g_i \qquad \textbf{(2)}$$

for all i,

$$\sum_j a_{kj} X_j \le b_k \qquad \textbf{(3)}$$

for all k, and

$$X_j, p_i, n_i \ge 0 \qquad \textbf{(4)}$$

for all j and i,

where p_i refers to the amount of positive deviation or overachievement from target level of the ith goal (g_i); n_i B refers the amount of negative deviation or underachievement of the ith goal; W_i^+, W_i^- are weights or relative importance attached to the deviation from targets, with the positive and negative superscripts respectively standing for overachievement and underachievement. G_{ij} are the coefficients of the goal constraints, i.e., the marginal achievement of goal i due to the production of X_j; a_{kj} is a matrix of technical coefficients for resources and other constraints; and b_k are the resource limits or right hand side.

To set up the GP model of our representative subsistence farm household, the set of inequalities (v) and (x)-(xii) in Table 1 are treated as goals, g_{-i-}, instead of constraints. This is done by introducing two associated variables, *n* and *p*, called the deviational variables, for each goal that convert inequalities to equalities (Romero and Rehman, 2003). Before we specify the WGP model for the subsistence farm household in question as in below, we present the formulation of the goals. Note that the four equations, i.e., equations (6)-(9) below represent the goal constraints, g_{-i-}, for i=1,…,4.

Goal g_{-1-}

The first constraint or goal (equation (6)) stands for household's consumption of cereals. The deviational variable n_{-1-} measures the under-achievement of goal g_{-1-} whilst p_{-1-} captures the amount by which goal g_{-1-} has surpassed its target. Because consumption of cereals should not be smaller than 1000 kilo grams, the deviational variable n_{-1-}must be minimized.

Goals g_{-2-}, g_{-3-} and g_{-4-}

Goals g_{-2-} (equations (7)) stands for consumption of legumes; goalsg_{-1-} and g_{-2-} in combination represent the food security objective of our representative subsistence farm household. Goal g_{-3-}(equation (8)) stands for the goal of the representative farm household for fuel or energy needs. Consumption of legumes and fuel or energy needs should not be lower than 250 and 771 kilo grams respectively. Goal g_{-4-}(equation (9)) represents the total cash income goal in Birr of the representative farm household. To achieve the desired level of g_{-2-}, $g_{-3-}$and $g_{-4-}$the respective values for $n_{-2-}n_{-3-}$ *and* n_{-4-} must be minimized.

It does not make sense minimizing absolute deviations especially when each goal is measured in different units. Hence, the variables of the objective function must represent percentage deviations from the targets. Therefore, the elements of the objective function have been standardized for the WGP model to give the objective function as in (equation (5)) below. Weights

(W_{-i-}, for i=1,…,4,) now express the relative importance of deviating by one percentage point from the respective goals. For example, if we assume that the farm household feels that it is indifferent from any of the four goals, then, this is equivalent to setting all weights equal to 1.

Therefore, the weighted goal programming (WGP) model for the representative farm household problem in consideration can now be specified as:

Minimize

$$0.1W_{-1-}n_{-1-}+W_{-2-}n_{-2-}+W_{-3-}n_{-3-}+0.08W_{-4-}n_{-4-} \quad \textbf{(5)}$$

subject to

$$1.0x_{-6-}+1.0x_{-7-}+1.0x_{-8-}+n_{-1-}-p_{-1-}=1000(\text{cereals}) \quad \textbf{(6)}$$

$$1x_{-9-}+n_{-2-}-p_{-2-}=250(\text{legumes}) \quad \textbf{(7)}$$

$$1x_{-10-}+n_{-3-}-p_{-3-}=771(\text{fuelwood}) \quad \textbf{(8)}$$

$$2.13x_{-11-}+2.03x_{-12-}+1.4x_{-13-}+0.54x_{-14-}+1.18x_{-15-}+n_{-4-}-p_{-4-}=1256 \quad \textbf{(9)}$$

(cash income)

and

$$\boldsymbol{Ax} \begin{matrix} \leq \\ \geq \end{matrix} \boldsymbol{b} \text{ (technical constraints from Table 1)}$$

$$\boldsymbol{x}\geq 0,\ \boldsymbol{n}\geq 0,\ \boldsymbol{p}\geq 0$$

Computer package (software) GAMS (General Algebraic Modelling System) was used to solve the weighted goal programming problem of our representative farm household.

4. Data and Study Area Description

The dataset used in this study come from Tigrai. Specifically, the farm dataset used in this paper was obtained from a stratified sample of 200 cross-sections of peasant farmers drawn from Enderta and Hintalo-Wajerat districts in the Southern zone of Tigrai region, for 2001 and 2002 production years. In addition, some findings of an earlier study by Woldehanna (2000) on same farm households were also used in the analysis. For instance,

selection of most important crops was based on this earlier work. Our interest is to test and validate the models specified above whether these result in differing conclusions. Therefore, we use this dataset because we believe that the recentness of the dataset does not change the conclusions. Description of the data and summary statistics of the characteristics defining the representative subsistence farm household are provided in Tables A.2, A.3 and A.4 in the Appendices.

Tigrai is the most northern region of Ethiopia. It is situated between $12^0 15^1$ and $14^0 57^1$ N latitude and $36^0 27^1$ and $39^0 59^1$ E longitude. It is bordered to the North by Eritrea, to the West by the Sudan, to the South by Amhara and to the East by Afar Regional States of Ethiopia. The Tigrai region covers a total land area of about 50,000km^2 with a total population of 4.3 million (FDRE PCC, 2008). Of the total landmass of the region about 25 per cent is cultivated, and forest/grazing lands constitute about 37 per cent (Gebreegziabher, 2007). It belongs to the African drylands (African Sahel), which are often referred to as the Sudano-Sahelian Region (BoPED, 1998; Hunting, 1976). Administratively, the region is divided into six zones as Western, Northwestern, Central, Eastern, Southern zones and the Mekelle Metropolitan Zone. Included in these six zones are 45 districts of which 33 are rural and 12 are urban (see Figure 1). A tabia[26] is the lowest administrative unit below Woreda/district.

Agriculture and allied activities (crop, livestock and forestry) play an important role in the economy of the region. The average share of agriculture in the regional GDP (Gross Domestic Product) over the last four to five years, i.e., between 2005/06 to 2008/09 has been 38% in real terms. The service sector share accounted for about 39 percent and industry about 21 percent (BoFED, 2009).

[26]*Tabia* is the name for lowest local administration unit which constitutes about 1000 to 1500 households.

Figure 1: Location map of Tigrai

The specific study sites considered in the study are located in the range of 17 to 40 km south of Mekelle city (the regional capital) with an altitude ranging from 1760 to 2350 meters above sea level. The study area is characterized by erratic and low rainfall with an average of 460 mm per annum. This is considered as one of the limiting factors for crop production as most of the farming activities are performed under rain-fed condition.

Mixed crop-livestock is the dominant farming system in the area. In addition, about 36 percent of the peasant households were found involved in off-farm activities (Woldehanna, 2000). Besides barley, wheat, teff, and legumes as the four most important crops, farmers grow lentils, vetch, linseed, and vegetables.

Farm, off-farm and home activities might be distinguished as regards to labor allocation in the study area. Ploughing, sowing, weeding, harvesting as well as cattle keeping appear to be the major farm activities. Most of these major farm activities are carried out by the male members of the household,

while female household members participate, mainly, in weeding and harvesting. Off-farm labor income accounts up to 35 percent of total farm household income and about 81 percent of the farm households are involved in off-farm activities (Woldehanna, 2000). Wage employment and self employment are the two types of off-farm activities in the area. Off-farm self employment constitute own-businesses such as petty trading, transporting by pack animals, fuel wood selling, charcoal making, selling fruits, pottery/ handicrafts, and stone-mining or quarrying. Home time activities include food preparation, child caring, and water and fuel wood fetching, which are generally undertaken by the wife or female members of the household.

5. Results and Discussion

Note that the purpose at hand is to investigate single versus multiple criteria/objective approaches. Specifically, we investigate whether the two approaches necessarily lead to differing conclusions using linear and goal programming techniques. The paper strives to answer key questions: could the single objective approach be a reasonable approximation, particularly for subsistence farm settings or does the multiple objectives approach has anything to add? Does the pattern of resource allocation change when priorities attached to the different objectives/ goals change? In what follows first we present the results of the linear programming model and then we present the results of the multi-objective or goal programming model.

5.1 Linear programming model

First we solved for the linear programming (single objective) model. Note that In the traditional ‘single’ objective approach one must assume that there is exactly one objective that is to be optimized subject to the absolute satisfaction of a number of ‘constraints’ (Ignizio, 1976). In our case, we assume maximization of gross margin (Z) as the single most objective to be optimized with all else treated as constraints. Then, we obtain the model solutions are:

x_{-1-} = 2.677 *tsmdi* x_{-6-} = 30.280 kg x_{-11-} = 0
x_{-2-} = 0 x_{-7-} = 0 x_{-12-} = 0
x_{-3-} = 4.855 *tsmdi* x_{-8-} = 969.720 kg x_{-13-} = 0
x_{-4-} = 1.277 *tsmdi* x_{-9-} = 250.000 kg x_{-14-} = 0
x_{-5-} = 2.810 *tsmdi* x_{-10-} = 771.000 kg x_{-15-} = 1339.3 hours and the value of the objective function is Z=3397.7431 Birr.

Model results suggest that the farm household will allocate resources in such a way that production is mainly for own consumption and no sells of output. It also suggests that the cash income of the farm household solely comes from hiring out of labour for off-farm activities. It also shows that the subsistence farm household has to rent in about three tsmdi of land.

However, as already noted, the single objective approach fails to faithfully reflect the real life decision situation for two reasons. Firstly, it assumes that the constraints that define the feasible set are so rigid that they cannot be violated, whereas the decision-maker may have some flexibility. For example, the amount of cash income he/she wants to achieve need not necessarily be exactly constant. Hence, imposing such strict constancy is not only unrealistic but also easily leads to infeasibility of problems. Moreover, locating the constraint that might have caused the infeasibility could also be difficult in the case of large problems with many constraints. Secondly, decision-makers are usually not interested in ordering the feasible set according to just a single criterion but would rather find an optimal compromise involving several objectives. Moreover, especially in circumstances where the decision maker, say a farmer, is involved in diversity of occupations or activities such as farm and non-farm activities, it is not obvious whether the maximization of profit for the decision maker or a farmer refer to the farm, the non-farm, or the two in conjunction. In addition, since the objective function is optimized within the feasible region defined by the constraints (i.e., which could have been goals by themselves), it implies priority of one over the other goal that rendering inconsistency. Therefore, a more robust approach which addresses these failings of the traditional single objective approach would be needed.

5.2 Multi-objective or goal programming model

Goal programming model was used to test whether or if indeed the multiple objectives approach has something to add to our understanding of decision circumstances in subsistence farm settings. One way to solving a MOP (multiple-objective programming) optimization problem is to construct an aggregated objective function to be optimized (Krcmar and van Kooten, 2008). Romero (2004) provides alternative formulations of achievement function for a goal programming model of which weighted goal programming is one. This is done by combining the various objectives into a single objective expression, through attaching fixed weights to represent stakeholders' relative importance of various attributes in the utility function (Steuer 1986). Note that different solutions can be obtained by attaching different values to the weight (W) parameter. For example, in our case, first we run the initial algorithm in GAMS for $W_{-1-}=W_{-2-}=W_{-3-}=W_{-4-}=1$, that we, where each of the goals given equal weight and generated optimal solutions (see first row, Table 3):

x_{-1-} = 2.667 *tsmdi*	x_{-6-} = 30.280 kg	x_{-11-} = 0
x_{-2-} = 0	x_{-7-} = 0	x_{-12-} = 0
x_{-3-} = 4.855 *tsmdi*	x_{-8-} = 969.720 kg	x_{-13-} = 0
x_{-4-} = 1.277 *tsmdi*	x_{-9-} = 250.000 kg	x_{-14-} = 0
x_{-5-} = 2.810 *tsmdi*	x_{-10-} = 771.000 kg	x_{-15-} = 1339.3 hours

And the optimum values for the deviational variables were:

n_{-1-} = 0	p_{-1-} = 0
n_{-2-} = 0	p_{-2-} = 0
n_{-3-} = 0	p_{-3-} = 0
n_{-4-} = 0	p_{-4-} = 0

As could be clear from above, we found the initial solution permits full or complete achievement of all the farm household's goals. Solution suggests that the farm household will achieve family subsistence food supplies of 1000 kilo grams of cereals mainly from production of barley with teff contributing about 30 kilograms (4.4 percent). The household achieves the

minimum subsistence requirement of legumes or pulses. The household also meets all of its fuel or energy needs. Besides, the household achieves the target level cash income Birr 1256. More importantly, the cash income was found to come solely from hiring out or supply of labour for off-farm activities. Moreover, the solution also suggest the farm household has to rent in land in order to be food secure.

Table 2: Sets of Weights used in the Sensitivity Analysis of WGP Solution

Run	W_{-1-} (Cereals)	W_{-2} _(Legumes)	W_{-3-} (Fuelwood)	W_{-4-} (Cash income)
1	1	1	1	1
2	2	2	1	1
3	1	1	1	2
4	3	3	1	1
5	1	1	1	3
6	4	4	1	1
7	1	1	1	4
8	5	5	1	1
9	1	1	1	5
10	10	10	1	1
11	1	1	1	10
12	100	100	1	1
13	1	1	1	100
14	1000	1000	1	1
15	1	1	1	1000

Sensitivity analysis was carried out to draw meaningful insights about the farm household's problem. Fifteen sets or iterations of weights (Table 2 above), were considered to test the sensitivity of the WGP solution to reordering of priority levels or weights. Table 3 presents results of sensitivity analysis of the WGP solution. In doing so, the intention was to obtain or

generate proximate measure of the tradeoffs between goals. Specifically, the tradeoffs between two goals; achieving family food security and maximizing cash income of household were considered. This was done by altering the relative weights of these two goals while holding the relative weight or priority level for fuel or energy needs goal of household unchanged. Nonetheless, very surprisingly, all the iterations of reordering of priority levels or weights yielded exactly identical results.

Table 3: Results of sensitivity analysis of WGP solution

Run	Production activities					Consumption activities				Fuel wood	Sales activities					Goals			
	(x_{-1-})	(x_{-2-})	(x_{-3-})	(x_{-4-})	(x_{-5-})	(x_{-6-})	(x_{-7-})	(x_{-8-})	(x_{-9-})	(x_{-10-})	(x_{-11-})	(x_{-12-})	(x_{-13-})	(x_{-14-})	(x_{-15-})	Cereals (kg)	Legumes (kg)	Feulwood (kg)	Cash income (Birr)
1	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
2	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
3	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
4	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
5	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
6	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
7	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
8	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
9	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
10	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
11	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
12	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
13	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
14	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
15	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256

The fact that the multi-objective or goal programming model was insensitive to objective weighting might reveal that it has little, if not nothing, to add and that it might not be superior to the traditional paradigm of choice involving single-objective, particularly in the context of subsistence farm settings. It might suggests that the problem at hand is a classic case of decision-making environment that could be approximated, fairly reasonably, by a similarly structured model but with profit or gross margin maximization as the single most objective. The overall result of our model was also consistent with findings of Barnett *et al*. (1982) for Senegalese subsistence farms but inconsistent with findings in the European context. For example, Rozakis *et al.* (2012) conclude that the structure and management of sheep farms in western Greece are better approximated through the use of the multicriteria model thereby questioning the relevance of the traditional single objective model as a policy tool, as this significantly deviates from the actual behaviour of the farmers. Sintori *et al.* (2009) also argue that the multicriteria model is superior to the singlecriteria model and the superior quality of the multicriteria model relative to the single-objective (gross margin) maximization model is more easily vivid in the case of the small family farms. This might suggest that context matters

We argue the fact that the multi-objective or goal programming model result was insensitive to objective weighting cannot and need not be attributed model assumption, given the premise that assumption that simplify calculations do not alter the qualitative conclusions Milgrom (1994).

6. Conclusions

Using linear and goal programming techniques, this paper tried to investigate whether single and multiple criteria/objective approaches necessarily lead to differing conclusions based on farm dataset from a stratified sample of 200 farm households from Tigrai regional state, Northern Ethiopia. The key questions considered were: could the single objective approach be a reasonable approximation or does the multiple objectives approach has anything to add? How does the pattern of resource allocation change when priorities attached to the different objectives/ goals change? The multiple

criteria or goal programming technique, in particular, was applied to investigate the tradeoffs between two objectives; (i) achieving family food security, and (ii) maximizing cash income or cash needs of subsistence farms in the allocation of scarce resources. The following concluding remarks could be drawn.

The result reveals unique solution that permits full or complete achievement of all the farm household's goals. It also suggests that cash income of household comes solely from hiring out or supplying labour for off-farm activities. Moreover, the result also suggests the farm household has to rent in land in order to be food secure. The initial solution permits full or a complete achievement of all the goals of the farm household..

Sensitivity analysis was carried out to draw meaningful insights about the farm household's problem. Fifteen sets or iterations of weights were considered to test the sensitivity of the WGP solution to reordering of priority levels or the tradeoffs between goals of achieving family food security and maximizing cash income of households. Surprisingly, model solution was also found insensitive to reordering of priority levels or weights of the goals in question.

The fact that the multi-objective or goal programming model was insensitive to objective weighting might reveal that it has little, if not nothing, to add and that it might not be superior to the traditional paradigm of choice involving single-criterion. It might suggests that the problem at hand is a classic case of decision-making environment that could be approximated, fairly reasonably, by a similarly structured model but with profit or gross margin maximization as the single most objective. However, our study is a first attempt to build a multicriteria model at least in the Ethiopian context to explain the behaviour of subsistence farm households. Therefore, further research is called for to be more conclusive.

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Appendices

Table A.1: Cropping pattern: Percent of farm households growing crops

Crop type	Enderta	Adigudem	Total
Teff	63.5	65.4	64.4
Wheat	71.0	64.4	67.7
Barley	78.5	82.7	80.6
Sorghum and finger millet	6.0	22.3	14.2
Legumes	42.5	39.1	40.8
Oil crops	7.5	10.9	9.2
Vegetables	9.5	4.9	7.2

Source: Woldehanna (2000)

Table A.2: Inputs allocation and output per tsmdi by crop type of a representative/average farm household (1 tsmdi=one-fourth of hectare)

Crop type	Oxen-power (Oxen day/tsmdi)	Labor input (hours/tsmdi)	Capital inputs (Birr/tsmdi)	Yield (kg/tsmdi)	Yield (Birr/tsmdi)
Teff	4	167.94	34.70	113.31	241.33
Wheat	3	76.42	87.46	146.73	298.05
Barley	3	71.05	77.13	199.72	279.34
Legumes	2	70.64	48.24	195.77	104.92

Source: Own Calculation (Dataset of 2001 and 2002) and Woldehanna (2000)

Table A.3: Summary statistics of characteristics defining the representative farm household (n=402)

	Mean	Std. Dev.	Min	Max
Family size	6	2	1	11
Number of dependents	3	2	0	7
Age of the household head	48	11.83	25	76
Area of land cultivated (tsmdi)	7.06	4.7	0	24
Number of plots cultivated	3.65	2.11	0	14
Area of land owned (tsmdi)	5.88	2.42	1	15
Number of plots owned	3.06	0.95	1	7
Market wage rate (Birr/ hour)	1.18	1.61	0.10	14.73

Source: Woldehanna (2000)

Table A.4: Summary statistics of other characteristics considered in the analysis

Variable name	n	Mean	Std. Dev.	Min	Max
Quantity of dung consumed in kg	199	1364.588	790.707	0	3951.36
Quantity of wood consumed in kg	199	624.26	743.994	0	4129.92
(Time spent collecting dung in hour)	199	22.5	26.26	0	221.10
(Time spent collecting wood in hour)	199	5.27	19.997	0	163.35
Variable farm inputs in birr (barley)	398	234.228	282.558	30	2080
Variable farm inputs in birr (teff)	398	46.603	59.768	6	375
Variable farm inputs in birr (wheat)	398	219.614	281.563	24	2989
Variable farm inputs in birr (legumes)	398	28.53	80.246	0	500
Number of cattle	398	5	5	0	32

Source: Own Calculation (Dataset of 2001 and 2002)

Table A.5: Distribution of sample households by mode of fuel acquisition by fuel type (in %) (n=199)

Mode of acquisition	Fuel type	
	Fuel wood	Dung
Free collection	61.4	30.9
Buying	13.2	0.0
Own source (tree/cattle manure)	3.6	51.3
Free collection + own source		17.8
Do not use fuel wood	17.8	
Total	100.0	100.0