

Ethiopian Economics Association (EEA)



PROCEEDINGS OF THE SECOND REGIONAL CONFERENCE OF THE TIGRAY REGIONAL STATE ECONOMIC DEVELOPMENT

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FOREWORD

The Ethiopian Economic Association (EEA) and its Mekelle Chapter are happy to issue the proceeding of the Second Annual Conference on the Tigray Regional State Economic Development which was organized on June 29, 2013 at the Axum Hotel Conference Hall. EEA organized this important regional conference as one of its objectives of broadening its activities and coverage at regional level so as to contribute to the economic advancement of regional state through enhancing economic policy formulation capability; the dissemination of economic research findings; promotion of dialogue on critical socio-economic issues; promotion of education in economics in higher learning institutions; enhancing national, continental and global networks of professionals and institutions; and advancement of the professional interests of its members.

The Annual Regional Conferences that the Association has organized in collaboration with its Chapters have created important forums for presenting and discussing development issues that are highly relevant to the Regional Socio-economy. These forums have also provided incentives for researchers to conduct research and present their findings on regular basis. Indeed, the Annual Regional conferences were organized in an interdisciplinary fashion, thereby widening the interactive coverage involving both economists living here in the region and those living outside the region and non- economists who are working and experiences on the region. The 2nd Annual Regional Conference on Tigray Regional State Economic Development has contributed towards a deeper understanding of the regional economy and the complex challenges it faces. It has attracted about 74 participants including members of Regional Parliament, higher officials of the Regional Bureaus and expertise from Regional Bureaus, Universities, NGOs, private sector representative and EEA members in the region. The nine papers which were presented at the conference largely focused on local issue that can contribute to the development of the region.

In this publication, all papers which were presented at the Second Annual Conference were reviewed by external reviewers and comments and suggestions including editorial comments were communicated to authors

for improvement. Finally, those papers which passed all the review and editorial process published in the Proceeding of the Second Annual Conference on the Tigray Regional State Economic Development.

I would like to take this opportunity to express my heartfelt gratitude, on my own behalf and on behalf of the Ethiopian Economic Association, to the many people and organizations that made the conference resounding success. First and foremost, I thank the authors of the papers and the audience whose active participations made the Conference meaningful. The staffs of the Economics Department of the Mekelle University which runs the EEA Mekelle Chapter and the staff of EEA Secretariat deserve a special recognition for their passion and perseverance in managing the conference from inception to completion.

Our special thanks go to our partners who have shared our vision and provided us with generous financial support to materialize the activities of EEA. These include; The Friedrich Ebert Stiftung of Germany, The African Capacity Building Foundation (ACBF), The Think Tank Initiative of International Development Research Center (IDRC) of Canada; Civil Society Support Program (CSSP), The Norwegian Church Aid, The Royal Netherlands Embassy, The Swedish Embassy through SIDA, The Development Cooperation of Ireland (DCI) the Ireland Embassy, and the British Embassy through DFID.

Finally, I would like to extend my sincere gratitude to Ato Daniel Assefa, Head of Tigray BoPaF, and Dr. Abdulkader, Vice President of Mekelle University, for their opening remarks and interest in EEA's activities. I would like also to thank other officials of the regions and Mekelle University for their encouragement for the successful conclusion of the conference and for their continued support for the activities of EEA Mekelle Chapter.



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DOES FAMILY-BASED AGRICULTURAL PACKAGE ENSURE FOOD SECURITY? AN IMPACT EVALUATION IN THE CASE OF WOREDAHINTALO-WAJIRAT

Abrha Gebreslassie¹

Abstract

Since 1980s, the concept of household food security has attracted great interest among research institutions, international aid organizations, government agencies and NGOs involved in social and economic developments. As per the estimates of FAO, one out of every eight people in the world suffers from chronic malnutrition, while the WB estimates that almost 400 million people suffer from severe food deficiency and an additional 350 million cannot afford even the minimum diet necessary for good health. However, in Africa, food security has worsened since 1970 and the proportion of the malnourished population has remained within the 33 to 35 percent range in SSA. Similarly in Ethiopia millions of households, especially in rural areas, suffer from chronic food insecurity and receive food aid on an annual basis. It was admitted that availability, though a necessary element, is not sufficient for food security, because food may be physically existent, but inaccessible, for those who are in need. The government of Ethiopia, in collaboration with a range of donors, has introduced the Food Security Program to reduce poverty. But, does the package or intervention have a significant difference in ensuring food security among participants and non-participants? The main objective of the study is to evaluate the impact of family-based agricultural packages on ensuring food security using data from REST with 320 observations where 73.12 percent of them are package beneficiaries and the other 26.88 percent are non-beneficiaries. Using the ATT estimating methods based on the propensity score matching method, we find that the package has a statistically significant impact on ensuring food security and accordingly we suggest for the continuation of the intervention.

Keywords: Food security, Agricultural package, Impact, Propensity score matching, ATT

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1. Introduction

1.1 Background of the Study

The concept of household food security emerged in 1980s as a potentially essential development objective. Since then it has attracted a great interest among research institutions, international aid organizations, government agencies and NGOs involved in social and economic development (Maxwell and Frankenberger, 1992).

According to Mwanik (n.d), ensuring food security in its totality continues to be a challenge and it is not unique only for the developing nations, but also for the developed world. The difference lies in the magnitude of the problem in terms of its severity and proportion of the population affected. He also identifies a complexity of factors that affect food security. These include unstable social and political environments that impede sustainable economic growth, war and civil-strive, macroeconomic imbalances in trade, natural resource constraints, poor human resource base, gender inequality, inadequate education, poor health, natural disasters, such as floods and locust infestation, and the absence of good governance which leads to either insufficient availability of food at the national level or insufficient access to food by households and individuals.

The FAO estimates that 12.5 percent of the world population suffers from chronic malnutrition, while the World Bank (WB) estimates that almost 400 million people suffer from a severe food deficiency and an additional 350 million cannot afford even the minimum diet necessary for good health (FAO, 1996 cited in Abdalla, 2007). For most of such people, food security depends on the production and income that they receive from agriculture.

Food security, in Africa, has aggravated since 1970 and the proportion of the malnourished population has remained within the 33 to 35 percent range in Sub-Saharan Africa (Mwaniki, n.d). Nevertheless, the prevalence of malnutrition within the continent varies by region which is lowest in Northern Africa (4 percent) and highest in Central Africa (40 percent).

Millions of households in rural areas of Ethiopia suffer from chronic food insecurity and receive food aid on an annual basis (Food Security Coordination Bureau, 2004). According to the Bureau, food insecurity has been increasing since 1960s. Annual food deficit increased from 0.75 million tons in 1979/1980 to 1.4 million tons in 2000 which required 700,000 tons of food aid annually (<http://www.fao.org/tc/tca/wok05/Ethiopia.pdf>). Food supply improved but insufficient and unstable; production increased due to area expansion and good rains. Accordingly, per capita availability increased to 149.33 kg per head in 2001 although it was well below minimum requirement – 225 kg (2,100 calories) (ibid).

In order to find a longer-term solution to the problem, the government of Ethiopia, in cooperation with a number of donors, has designed a Food Security Program (FSP) within the agenda of Ethiopia's Poverty Reduction Strategy (FSCB, 2004). The program combines a variety of interventions that should result in the graduation of a range of households from food insecurity to food security.

Tigray Region is one of the food insecure regions of the country. Prior to 1995 E.C, the regional government had identified 16 woredas as food insecure (WFP-Ethiopia, 2009). However, the number of food insecure woredas increased from 16 to 31 as reported by the food security office of the region. According to recent data obtained from the Bureau of Agriculture, out of the 34 woredas of the region only three woredas (Kafta-Humera, Welkayte and Tsegede) are food secure (ibid). The remaining 31 woredas of the region are classified as food insecure. Integrated family based packages and afforestation are under way to change the situation.

1.2 Statement of the Problem

"Millions of people have been lifted out of poverty, but millions more remain, particularly in rural areas. New approaches to promote agricultural and rural growth, along with innovative social protection measures, are needed to help the poor who have been left behind," (IFPRI & ADB, 2007).

The main source of livelihood for most of the world's poor people is rural-based. In other words, they rely on nonfarm employment and income that depend in one way or another on agriculture even when they are not involved in their own agricultural activities. Moreover, agricultural growth is a stimulus for broad-based economic growth and development in most developing countries (Andersen and Lorch, 1995).

Food security of any region is not simply a matter of producing sufficient food to meet demand but it is affected by a multiple of factors both natural and unnatural. Increased food supply does not automatically mean increased food security for all (Hine and Pretty, 2007). Similarly, Dharmasena (n.d) views that food availability, though a necessary element is not sufficient for food security, because food may be physically available, but inaccessible for those who are in need of it.

However, the primary objective of food security is to achieve reliable access to adequate, reasonable and nutritious food supplies sufficient to avoid chronic hunger, crisis hunger and stunted development (Johnson, 2009).

The poor countries and poor people in the world are always vulnerable in terms of food security (Yubanath, 2007). This is due to the fact that poor people do not possess the means to access and/or produce the food necessary for an active and healthy life. Besides they are more exposed to destitution following extreme events, as they are unable to rebuild assets which constitute the basis of their livelihoods.

Thus, a large number of a population could be living in hunger even if the country had sufficient food during normal times. Similarly, a significant segment of the population could be exposed to hunger during moments of crisis, even if the nation had an adequate aggregate food availability to protect its citizens against hunger. Adequacy at the aggregate level does not necessarily ensure adequacy at the household or individual level.

A number of papers have addressed the issues of determinants of food security and food insecurity as well; how food security can be ensured with different interventions by the governmental and non-governmental agents

or institutions; but a few is written about whether packages or programs have significant impact on the beneficiaries compared to the non-beneficiaries of the interventions, specific to this study is the impact of family-based agricultural packages on ensuring food security. In addition, even if a few is said about these packages or programs impact on ensuring food security, the model they approach is again somewhat different.

1.3 Objective of the Study

General objective of the study: the main objective of the study is to evaluate the impact of family- based agricultural package on ensuring food security.

1.3.1 Specific Objectives

The specific objectives of this study are;

- To point out which family-based agricultural package best ensures food security provided that households are participants,
- To identify whether the female-headed or male-headed families have the higher probability of getting the agricultural package,
- To assess the impact of the package on food and non-food consumption expenditures,
- To draw conclusions and forward possible recommendations for policy implications.

1.4 Research Questions

This research tries to answer these questions:

- Is there any significant impact of programs or interventions on ensuring food security?
- Given that the households are beneficiaries of the family-based agricultural packages, which specific package best ensures food security of the beneficiaries?
- Does the package have a significant impact both on food and non-food consumption expenditures?

2 Literature Review

2.1 Theoretical Review

Food security is a broad concept, consisting of issues related to the nature, quality, and security of the food supply as well as issues of food access. The world has been challenging an absurdity of widespread food insecurity and malnutrition during net food surpluses. Increased food supplies do not automatically enhance access to food by the poorer groups of society. Food security measures alone may have a limited effect on the nutritional well being of individuals, unless the reinforcing detrimental linkages between food insecurity, disease, poor sanitation and inadequate education are addressed (IFAD, 1996; Iram and Butt, 2004). Interestingly, it implies that indicators of food security should be addressed in line with the factors which affect it.

According to Johnson (2009), food security exists when all people, at all times, have affordable access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. He states that unchecked balance between population growth and food production is the root cause for the basic challenge of chronic hunger and its roots in poverty. Yet today only about one-sixth of the world's population—some 900 million—face chronic hunger. How did the rest of the world's people escape this Malthusian trap? They did so essentially through economic development.

The rural world faces overwhelming challenges in the new century. Agriculture is expected to provide a whole range of economic, social, and environmental services. Not least, it is being asked to intensify production from a shrinking natural resource base to feed another three billion people over the next 50 years (Vorley, 2002). Yet the rural world is the home of the majority of the world's poor and economic marginalization is becoming a global rather than a 'developing country' feature of the farming sector (ibid).

What makes agriculture unique as an economic sector is that it directly affects many of the natural, social and economic resources on which it relies for success (Hine and Pretty, 2007).

Agricultural growth and development must be vigorously pursued in low-income developing countries for at least four reasons (Andersen and Lorch, 1995); (1) to alleviate poverty through employment creation and income generation in rural areas; (2) to meet growing food needs driven by rapid population growth and urbanization; (3) to stimulate overall economic growth, given that agriculture is the most viable lead sector for growth and development in many low-income developing countries; and (4) to conserve natural resources.

Hence, reducing poverty and hunger will require encouragement of rural development in general and a prosperous smallholder private agricultural economy in particular (Ayres and McCalla, 1996). Encouraging rural development is the best way because it helps poor farmers and rural dwellers become more productive and improve their living standards.

However, Yubanath (2007) argues that food security is not the question of how much the world produces but it is the issue that requires judicial distribution of food to all and fair access to production resources for the people from the lowest economic section.

In Ethiopia, the FSP was designed to help chronically food insecure households reach a level of food security necessary for an active and healthy life (Food Security Coordination Bureau, 2004). Three components were planned: resettlement, productive safety nets, and other food security interventions. In theory, resettled households would achieve food secure status solely as a result of that component's package of interventions. Safety net beneficiaries, however, usually would require complementary food security activities in order for sustainable impact to be achieved. The third component of the FSP involves the implementation of a range of food security interventions financed by the government and certain international donors. The overall objective of this component was to enable up to five

million chronically food insecure people (essentially PSNP beneficiaries) to attain food security within 3-5 years and improve the food security of 10 million other people within the same period.

2.2 Empirical Evidence

Impact of intervention in the province of Balochistan was estimated at Rs 13,510 per hectare on improved crop seed production and Rs 293 on sheep fattening (Management Systems International, 2008).

Evidence from Lagos state (Nigeria) by Omonona and Agoi (2007) shows that the food security status does not necessarily affect the demand patterns of household for livestock products. From the study, household size, per capita quantity consumed, age and level of education of household head have been found to be the important variables affecting livestock demand among households and therefore, their food security status.

In Nepal, around 45 percent of the population was believed to consume less than the required daily calories (Yubanath, 2007). But approximately 17 percent of the Albanian population was found to be below the calorie threshold level (Guha - Khasnobis et al, 2007) where calorie consumption was greater and higher percentage of households was above the threshold in rural areas.

An estimated 600 million people in Asia, mostly in rural areas, were living on less than \$1 US a day although the region had achieved an exceptional economic growth and poverty reduction during the first three decades of the past 34 years (IFPRI & ADB, 2007).

3. Data Source, Methodology, and Model Specification

3.1 Area Description and Data Source

Tigray is one of the food insecure regions in the country and woreda Hintalo-Wajirat is again amongst the food insecure woredas in Tigray where family-based agricultural package is practiced. The total population of the

woreda during the time of data collection was 152, 219 of which 92.63 percent were living in rural areas where as the rest 7.37 percent were living in urban areas (Federal Democratic Republic of Ethiopia Population Commission, 2007). It is a drought-prone area which lies within the Enderta Dry Midland Livelihood Zone in the *woinadega* agro-ecology, characterized by dry climatic conditions and erratic annual rainfall of 450-600 (REST, 2006).

Consequently, to evaluate the impact of the package on ensuring food security, we use secondary data from REST office which was collected by the Research and Policy Unit in 2008. The sample size is 320 households which includes both beneficiaries and non-beneficiaries of the package. While 73.12 percent of the households are package participants, the other 26.88 percent are non-participants.

3.2 Methodology and Model Specification

To study whether family-based agricultural package ensure food security for the treated, we need to address the potential problem of selection bias. Selection bias stems from the fact that we cannot know what the outcome for a “treated” (i.e., participating) household will be if it does not receive the treatment. If treatment is randomly assigned, the outcome of untreated individuals serves as a good estimate of the counterfactual. However, if households that are treated have characteristics that differ from the ones that are not treated, comparison of the outcome between the two groups will yield biased estimates (Anderson et al, 2009). Hence our estimate will be biased, but matching is a technique of dealing with selection bias by estimating the counterfactual or unobserved outcome of package beneficiaries from the outcome of non-beneficiaries who possess similar traits in terms of observable characteristics. Matching estimators are based on the assumption of conditional independence. According to Thorbecke (1999), identification of the counterfactual is the organizing principle of a good impact evaluation.

In order to explain this behavior, this research was analyzed by employing a suitably estimating method called the Propensity Score Matching (PSM) which helps to randomize the assignment of households to the treatment and it is estimated by applying the cumulative logistic function (the logit model) or instead of the default cumulative distribution function (the probit model).

The average treatment effect on the treated (ATT) based on the PSM was employed to estimate the impact or outcome of the package. Impact is measured by the difference in outcome of interest between what is happening with the package and what would have happened without the package for those benefiting from it which is termed as ATT. Heckman and Vytlacil (2003) supported that the most commonly invoked treatment effect is the average treatment effect on the treated. Moreover, the two most widely studied average causal effects in the treatment effects context are the average treatment effect and the average treatment effect on the treated (Angrist, n.d).

The Propensity score is the conditional probability of assignment to a particular treatment given a vector of observed covariates. Both large and small sample theory show that adjustments for the scalar propensity score is sufficient to remove bias due to all observed covariates (Rosenbaum and Rubin, 1983). Since matching subjects on an n-dimensional vector of characteristics is typically unfeasible for large n, this method proposes to summarize pre-treatment characteristics of each subject into a single-index variable (the propensity score) which makes the matching feasible (Becker and Ichino, n.d).

Accordingly, for non-randomized observations, outcome and treatment are conditionally independent given the propensity score, $P(x)$, which is the probability of receiving treatment given pre-treatment characteristics:

$$(Y_0, Y_1) \perp D/P(x) \quad (1)$$

A balancing condition needs to be satisfied for using the propensity score matching. The balancing condition shows the conditional independence of treatment in terms of control variables given the propensity score:

$$D \perp X/P(x) \quad (2)$$

In dummy regression variable models, it is assumed implicitly that the dependent variable (outcome), Y , is quantitative whereas the explanatory variables are either quantitative or qualitative. There are certain types of regression models in which the dependent or response variable is dichotomous in nature, taking a value 1 or 0 (Vasisht, n.d). In this case, a family is a beneficiary or non-beneficiary of the family-based agricultural package which is a dichotomous dependent variable.

Balancing scores can be used to group treated and control units so that direct comparisons are more meaningful (Dawid, 1979 cited in Rosenbaum and Rubin, 1983). A balancing score, $P(x)$, is a function of the observed covariates X such that the conditional distribution of X given $P(x)$ is the same for treated and control units, that is,

$$X \perp D/P(x) \quad (3)$$

However, if treatment assignment is strongly ignorable given X , then the difference between treatment and control means at each value of a balancing score is an unbiased estimate of the treatment effect at that value, and matching on a balancing score can produce unbiased estimates of the ATT (Rosenbaum and Rubin, 1983).

The propensity score can be modeled using an appropriate logit model. And it follows from Bierens (2008) that:

$$\Pr [D_i = 1 | X_i] = \frac{1}{1 + \exp(-\alpha_0 - \beta_i X_i)}, \text{ and}$$

$$\Pr [D_i = 0 | X_i] = 1 - \Pr [D_i = 1 | X_i]$$

$$= \frac{\exp(-\alpha_0 - \beta_i X_i)}{1 + \exp(-\alpha_0 - \beta_i X_i)} \quad (4)$$

Or $\Pr [D_i = 1 | X_i] = F(\alpha_0 + \beta_i X_i)$, where

$$F(X_i) = \frac{1}{1 + \exp(-\alpha_0 - \beta_i X_i)}$$

Where in equation (4), D_i stands for the dummy variable (in this case the package participation); the X_i 's are the set of explanatory variables; and α_0 and β_0 are parameters to be estimated.

Denoting package beneficiary by D_i , (where $D_i=1$ indicates treated, and $D_i=0$ shows non-beneficiary), ATT for the population can be computed as:

$$ATT = E(Y_{1i} - Y_{0i} | D_i=1) \quad (5)$$

Which is the same as:

$$ATT = E(Y_{1i} | D_i=1) - E(Y_{0i} | D_i=1) \quad (6)$$

The sample equivalence of this is given by:

$$ATT = 1/n \sum_{i=1}^n (Y_{1i} - Y_{0i}) | D_i=1 \quad (7)$$

Which is the same as:

$$ATT = 1/n \sum_{i=1}^n (Y_{1i} | D_i = 1) - (Y_{0i} | D_i=1) \quad (8)$$

Where;

- $(Y_{1i} | D_i=1)$ indicates what has happened with the package, and
- $(Y_{0i} | D_i=1)$ shows what would have happened without the package.

For the robustness of the results, we applied four methods of matching. These are Nearest Neighbor Matching, Radius Matching, Kernel Matching, and the Stratification (or Interval) Matching.

In regard to the specific objectives, we used the Ordinary Least Square regression model for the first objective. To do so, we have the equation from Green (1951), Wooldridge (2000) and Verbeek (2004);

$$Y_i = \alpha_0 + \beta_i X_i + \theta \varepsilon_i \quad (9)$$

Where;

- Y_i is the dependent variable, in this case the total expenditure of the family
- α_0 is the constant term
- β_i is the coefficient parameters
- X_i is a set of explanatory variables
- θ is the magnitude effect of the error term
- ε_i the error term

However, specific objective three is analyzed using the same method as with the general objective, that is, we use ATT based on the propensity score matching method; whereas, the second specific objective is discussed from the marginal effect of the logit estimates. The marginal effect is the partial derivative of the logistics distribution function (logit model) with respect to the variable of interest. And accordingly, it can be derived from equation (4):

$$\begin{aligned} \frac{d \Pr[D_i = 1 | X_i]}{dX_i} &= \beta_i \frac{d}{dX_i} F(\alpha_0 + \beta_i X_i) \\ &= \beta_i \cdot F(\alpha_0 + \beta_i X_i) (1 - F(\alpha_0 + \beta_i X_i)) \end{aligned} \quad (10)$$

4. Discussion and Analysis

4.1 Descriptive Analysis

4.1.1 Household Characteristics²

The total number of observations in this study is 320. These households are composed of different characteristics. These characteristics, among many, include sex/gender, age, family size, marital status, educational background, and occupation of the household. As we can see from Table 4.1, out of 320 households, 263 (82.19%) are male-headed and the remaining 57 (17.81%) are female-headed. Intuitively, it implies that if husbands are alive within the family, they will become the head of the household.

Table 4.1: Sex and marital status

Marital Status	Sex		Total	
	Female	Male	number	%
Single	0	5	5	1.56
Married	8	250	258	80.63
Divorced	20	3	23	7.19
Widowed	23	3	26	8.12
Separate	6	2	8	2.5
Total	57	263	320	100

Source: Own calculation from REST, Research and Policy Unit, Household Survey 2008

Another characteristic is age in which, from the sample, the minimum age is found to be 17 and the maximum age is 80. Accordingly, Table 4.2 depicts that 91.88 percent of the households can participate in the working force of the population, while the rest 8.12 percent households are old aged.

Table 4.2: Age structure

Age in years	Number of households	
	Number	Percent
[17, 64]	294	91.88
65 and above	26	8.12
Total	320	100

Source: Own calculation from REST, Research and Policy Unit, Household Survey 2008

²The researcher interchangeably uses the word 'household' with the word 'family'. And, in this study, the household characteristics refer only to the household head.

The third characteristic is the family size. It is generally defined as the total number of individuals or members who live within the same household. It includes husband, wife, children, relatives, and others. The minimum and maximum family size of the study is found to be 1 individual and 11 individuals, respectively.

Table 4.3: Family size

Family Size	Number of Households				
	Female-headed	Male-headed	Total		
			Number	Percent	Cumulative Percent
1	6	5	11	3.44	3.44
2	12	4	16	5	8.44
3	13	22	35	10.94	19.38
4	15	36	51	15.94	35.32
5	8	50	58	18.13	53.45
6	2	30	32	10	63.45
7	0	54	54	16.87	80.32
8	0	31	31	9.69	90.01
9	1	20	21	6.56	96.57
10	0	10	10	3.12	99.69
11	0	1	1	0.31	100
Total	57	263	32	100	

Source: Own calculation from REST, Research and Policy Unit, Household Survey 2008

The result in Table 4.3 indicates that majority of the households live within a large family size. Interestingly, it implies that there is a need for more food and non-food expenditures by households.

Educational background/status of the households is also another essential factor which affects both the outcome equation and the participation equation. It contributes in improving the level of the households' human capital during their life time. Based on the evidence given in Table 4.4, from the total of 320 households, 53.13 of them are illiterate.

Table 4.4: Level of education

Educational Status	Number of Households			
	Female-headed	Male-headed	Number	Percent
Illiterate	42	128	170	53.13
Religious	1	35	36	11.25
Adult Literacy	2	24	26	8.12
Elementary	5	44	49	15.31
Junior Completed	5	26	31	9.69
10 Completed	1	4	5	1.56
12 Completed	1	2	3	0.93
Total	57	263	320	100

Source: Own calculation from REST, Research and Policy Unit, Household Survey 2008

The study also identifies the type of occupation the household undertakes as another important feature of the families. Occupation refers to the activities and jobs performed by the household. So it is a crucial characteristic because it is one of the decisive factors among which the livelihood of households is dependent.

The information given in Table 4.5 shows that majority of the households depends on farming activities as the main source of their livelihood. Only 8.44 percent of the families perform different activities as listed in Table 4.5.

Table 4.5: Type of occupation

Number of households		Main occupation of the household head						
		Farming	Civil servant	Housewife	Daily laborer	Student	Petty trade	Other
Female-headed		38	4	5	4	0	6	0
Male-headed		255	1	2	2	1	0	2
Total	Number	293	5	7	6	1	6	2
	%	91.56	1.56	2.19	1.88	0.31	1.88	0.63
								100

Source: Own calculation from REST, Research and Policy Unit, Household Survey 2008

4.1.2 Beneficiaries versus Non-Beneficiaries of Agricultural Package

A household is either beneficiary of the agricultural package or non-beneficiary of the package. Hence, we have two groups of households in the study. These are the package beneficiaries and non-beneficiaries. The package beneficiaries are considered as treated (participants) group where as the package non-beneficiaries are taken as a control group in the treatment (non-participants group) – the agricultural package being a treatment variable. In this section, we see three household characteristics, namely, the sex, educational status, and age of the household.

The first characteristic is sex of the household. When we look the package in terms of the sex/gender specific issues, 32.56 percent and 67.44 percent of the non-beneficiaries are female-headed households and male-headed households, respectively. In the treated group, from the same table, the female-headed and male-headed families are 12.39 percent and 87.61 percent, respectively (Table 4.6).

Table 4.6: Agricultural package by sex

Sex of the household head	Non-beneficiary		Beneficiary		Total	
	Number	%	Number	%	Number	%
Female	28	32.56	29	12.39	57	17.81
Male	58	67.44	205	87.61	263	82.19
Total	86	100	234	100	320	100

Source: Own calculation from REST, Research and Policy Unit, Household Survey 2008

The second characteristic is educational level of the household. The largest number of households in the sample is illiterate as we can understand from Table 4.7. These constitute about 53.13 percent of the households. Among the non-beneficiaries, 59.30 %, 13.95 %, 9.30 percent are illiterate, completed their elementary school, and junior education respectively. The figure for package beneficiary households are 50.85 %, 15.81%, and 9.830% of the households are illiterate, completed their elementary educational level, and junior educational level, respectively. Besides, while 8.14 percent and 5.81 percent of the non-beneficiaries have religious education and

adult literacy education, respectively; 12.39 percent and 9.83 percent of the beneficiaries have religious education and in adult literacy education, respectively (see Table 4.7).

Table 4.7: Agricultural package by education

Educational status of the household head	Non-beneficiary		Beneficiary		Total	
	Number	%	Number	%	Number	%
Illiterate	51	59.30	119	50.85	170	53.13
Religious	7	8.14	29	12.39	36	11.25
adult literacy	5	5.81	21	8.97	26	8.12
Elementary	12	13.95	37	15.81	49	15.31
junior completed	8	9.30	23	9.83	31	9.69
10 completed	3	3.49	2	0.85	5	1.56
12 completed	0	0	3	1.28	3	0.93
Total	86	100	234	100	320	100

Source: Own calculation from REST, Research and Policy Unit, Household Survey 2008

The third characteristic is age of the household. Based on our data, the total observations are grouped in to two. Those individuals whose ages are between 17 and 64 are grouped on the one side, while those individuals whose ages are older than 64 on the second group. Table 4.8 depicts that 86.05 % and 13.95 % of the non-beneficiary households lie in the working force and old age groups, respectively; whereas 94.02 percent and 5.98 percent of the beneficiary households lie in the respective age groups specified.

Table 4.8: Agricultural package by age

Age in years	Number of households			
	Non beneficiary		Beneficiary	
	Number	Percent	number	Percent
[17, 64]	74	86.05	220	94.02
65 and above	12	13.95	14	5.98
Total	86	26.88	234	73.12

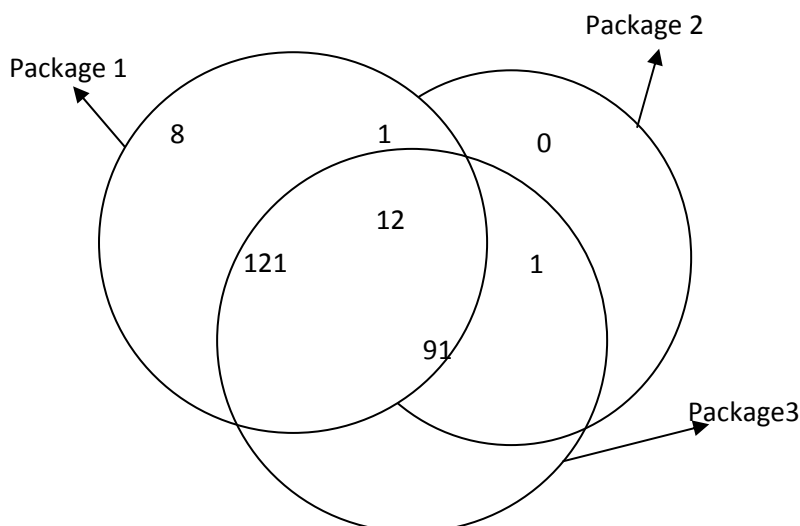
Source: Own calculation from REST, Research and Policy Unit, Household Survey 2008

4.1.3 Types of Agricultural Package³

In this study, only three types of agricultural packages were considered: crop package, fruits and vegetables package, and animal husbandry package. The first two types of the package include provision of improved seeds, fertilizers, farm implements and irrigation. The third type includes dairy cow, sheep and goat, poultry, bee hive, oxen fattening. Figure 4.1 shows that 70.31 percent of the families participate in package3 while 44.06 percent and 4.38 percent of the households respectively participate in package1 and package2.

Figure 4.1 illustrates that 5.13 percent of the beneficiary households participate in all the three package types. Similarly, 51.71 percent of the beneficiaries participate in package1 and package2. However, there is no individual who participates only in fruits and vegetables package. So, these results in Table 4.9 and Figure 4.1 imply that most of the beneficiaries are interested in crop package and animal husbandry package.

Figure 4.1: Pie Chart for package beneficiaries with one or more packages



Source: Generated by the researcher from REST, Research and Policy Unit, Household Survey 2008

³Package1 is for crop package, Package2 is for fruits and vegetables package, and Package3 is for animal husbandry package.

4.1.4 Total Expenditure: An indicator for measuring food security

Total expenditure, in this context, refers to the costs or outlays by a household for food consumption and non-food consumption expenditures. Stating differently, it is the sum of food consumption expenditures and non-food expenditures. The food expenditure items, among many, embody costs of cereals, legumes, edible oil, animal products, spices, and soft drinks which are used for consumption purposes only. On the other hand, the non-food expenditure items include like costs of clothes, hair food and hair care, charcoal and wood, equipments, transportation, rent, medical care, and stationery.

After converting the total expenditure in to its adult equivalence, we can see the number of households who lie above and below a certain level of the total expenditure. This level of expenditure is identified based on the total poverty line (for the basic needs of households which include both food and non food consumption expenditures). And the total poverty line is estimated at birr 1859.75 using consumer price index during the data collection and we use the 1995/96 as a base year during which the total poverty line was estimated at birr 1075 (MoFED, 2002). Moreover, the minimum requirement for basic food needs only is estimated at birr 1342.2416 using the same procedure as we did for total poverty line. We use this poverty line to identify households who are below the poverty line and above it after converting the food consumption expenditure to its adult equivalence. Accordingly, these who are below the poverty line are 120 (37.5 %) households out of the total observations. This is done simply by counting the number of individuals whose annual total expenditure is less than the predetermined total poverty line, that is birr 1859.75. But a large number of households, that is 62.5 percent of the households, meet their basic needs (Table 4.9).

Table 4.9: Total poverty status of households

Agricultural Package	Households below total poverty line		Households above total poverty line	
	Number	Percent	Number	Percent
Non-beneficiary	31	36.05	55	63.95
Beneficiary	89	38.03	145	61.97
Total	120	37.5	200	62.5

Source: Own calculation from REST, Research and Policy Unit, Household Survey 2008

When we look at the basic food consumption only, 25 percent of the individuals are below the food poverty line, that is birr 1342.2416, while 75 percent of them are above it (Table 4.10).

Table 4.10 Food poverty status of households

Agricultural package	Households below food poverty line		Households above food poverty line	
	Number	Percent	Number	Percent
Non-beneficiary	22	25.58	64	74.42
Beneficiary	58	24.79	176	75.21
Total	80	25	240	75

Source: Own calculation from REST, Research and Policy Unit, Household Survey 2008

4.2 Econometrics Results and Analysis

4.2.1 Rationality of Selecting the Independent Variables

We apply the total expenditure which is the sum of food and non-food expenditures as a measure for food security after it has been converted to its adult equivalence. Hence, this indicator is treated as a dependent variable while analyzing the main objective of the study.

Since we use the propensity score matching method to evaluate the impact of agricultural package on ensuring food security, identifying the variables that simultaneously affect both the outcome (total expenditure) and the treatment variable (agricultural package participation) is a crucial point. However, the variables should not be affected by the treatment variable nor should by the anticipation of it. Therefore, these variables are sex of the household head, average age of the whole family, size of own land cultivated, marital status, educational status, and main occupation of the household.

With the first independent variable, sex, it is natural or biological difference that males and females do not have the same expenditure patterns, keeping other things constant. Besides, while determining the adult equivalence conversion rate, sex/gender is taken as one of the factors deemed important. Consequently, this household characteristic affects the

outcome or the dependent variable. In the treatment variable, both male and female are not equally eligible for the assignment of households to the participation. Because the participation in the agricultural package requires somehow physical capabilities; and, these gifts are not the same among them. As a result, gender differences can create differences in the participation of the package.

The second variable is average age of the household. In this context, it refers to the average age of the whole family. In short, it is found by dividing the sum of ages of the family by the family size. So, average age has an effect in the outcome equation as well as the participation equation because persons with different ages do spend different amount of money and at the same time they have different opportunities of participation since the package leads to engagement of active and productive works.

The next is the size of own land cultivated. Obviously, the household's consumption expenditure is affected by the size of own land cultivated. And it may be true that if the family cultivates its land, it will affect the probability of participation in the package as the nature of the package is involvement in agricultural (or farming) activities, especially, for crop package and fruits and vegetables package. Nevertheless, the other type of package (that is, animal husbandry) can initiate landless individuals to participate in the program.

Besides, marital status affects both the dependent and treatment variables. Married and unmarried household heads do have different expenditure patterns. On the one hand, being married changes the family size thereby the total expenditure is changed. On the other hand, they face various social and psychological problems differently. As a result, their productivity will be affected in connection with that the outcome equation is changed. However, in order to solve the problems households can engage in more productive activities and they can be more reactive in social and economic undertakings. If these differences happen, the participation decision will also be changed.

Additionally, educational status affects both equations. That is, people with different educational level do not earn the same amount of income, so their spending on basic needs is not also the same. Moreover, the type, quality and quantity of the basic needs (especially for basic foods) the households consume can be dependent on whether they are illiterate or literate. For the participation equation, literate and illiterate families have their own perspectives while deciding on participating in the package. Therefore, this variable really affects the assignment of individuals into the eligible group. Moreover, the most influential factor is the main occupation of the household. Since, we believe that the primary activity undertaken by the farming households is agricultural practices, they are eligible for the treatment and we call it as an influential factor. In addition to that, if they do involve in non-agricultural activities like some trading activities and working at home, their expenditure is affected. Besides, their produce depends on the time (or effort) they spend on the farming activities which results in a change in their consumption expenditures.

4.2.2 Evaluating the Impact of Agricultural Package on Ensuring Food Security

4.2.2.1 Estimation of the Propensity Score

While evaluating the impact of the package, we use the propensity score matching. After identifying the simultaneity assumption and once we apply the mentioned method, the next step is to check whether the condition of balancing property is satisfied or not from the logit estimates. It is assured that the condition of balancing property is satisfied with the set of variables.

The result shows that three of the covariates, namely age composition (agecomp), the size of own land cultivated (landowned), and main occupation of the household (farm1) are statistically significant at the 1%, 5%, and 10% levels, respectively. With the exception of average age of the family, their effect is positive (Table 4.11).

Indeed, the positive effect of the two variables is reasonable, because households who own and cultivate large land size have higher probability of participating in the package; and those whose main occupation is farming have also greater probability of getting in to the program. However,

average age of the family has a negative effect due to the fact that young households get higher probability of participation compared to the old aged households (Table 4.11).

Table 4.11: logit estimates of the propensity score

Logistic regression				Number of obs. = 320		
				LRchi2(6)=36.46		
Loglikelihood=-168.014				Prob>chi2=0.0000		
				PseudoR2=0.0979		
agri607	Coef.	Std. Err.	Z	P>z	95% Conf.	Interval
Sex	0.832983	0.514667	1.62	0.106	-0.17575	1.841711
Agecomp	-0.04734	0.013848	-3.42	0.001*	-0.07448	-0.0202
Landowned	0.646375	0.320483	2.02	0.044**	0.01824	1.27451
farm1	0.855157	0.478778	1.79	0.074***	-0.08323	1.793544
educ1	-0.0107	0.284086	-0.04	0.97	-0.5675	0.546097
marital2	-0.04667	0.505626	-0.09	0.926	-1.03768	0.944337
_cons	0.134106	0.594293	0.23	0.821	-1.03069	1.298899

Source: Own calculation from REST, Research and Policy Unit, Household Survey 2008

*Significant at the 1% level; **Significant at the 5% level; ***Significant at the 10% level

However, we do not find significant the remaining three variables (sex, educ1, marital2) at any level of significance, 10 % level of significance being the maximum tolerable level for social science (Table 4.11).

In order to see the probability of a household to participate in the program with respect to each regressors, we use the marginal effects from the logit estimates.

Table 4.12 reveals that the marginal effects of average age of the family and the size of own land cultivated is found to be statistically significant. Other things remaining constant, when the average age of the family changes from 21.97 to 22.97 years on average, the probability of participation decreases by around 0.008 percentage points and vice versa; whereas, if the size of own land cultivated increases by one unit, its probability to participate in the agricultural package will increase by almost 0.115 percentage points.

Table 4.12: Marginal effects from logit

y = Pr(agri607) (predict) = .767104							
variable	dy/dx	Std.Err.	Z	P>z	[95%	C.I.]	X
sex(*)	0.168354	0.11479	1.47	0.142	-0.05662	0.393333	0.821875
Agecomp	-0.00846	0.00248	-3.4	0.001*	-0.01333	-0.00359	21.97
landowned	0.115478	0.05341	2.16	0.031**	0.010805	0.220152	1.02168
farm1(*)	0.179796	0.11306	1.59	0.112	-0.0418	0.401393	0.93125
educ1(*)	-0.00191	0.05073	-0.04	0.97	-0.10134	0.097519	0.53125
marital2(*)	-0.00827	0.08892	-0.09	0.926	-0.18256	0.166015	0.80625

Source: Own calculation from REST, Research and Policy Unit, Household Survey, 2008

*Significant at the 1% level; **Significant at the 5% level; (*)dy/dx is for discrete change of dummy variable from 0 to 1

X represents the mean of the corresponding variable

4.2.2.2 Estimation of ATT for Total Expenditure Using Propensity Score Matching Method

After the propensity score is estimated (determined), the next task is to match the treated and control groups based on their scores. This is done by using different matching methods. Amongst, the Nearest Neighbor, Stratification, Radius, and the Kernel Matching methods are employed.

One can use either of the methods, but applying them altogether assures the robustness of results. Still, scholars argue that at least two of the methods can signify robust results.

Therefore, the results depict that the package has a positive and significant impact on ensuring food security from the ATT estimations of Nearest Neighbor, Stratification, and the Kernel matching methods. The impact is statistically significant in these three methods at the 10% level of significance. With each respective method, the average total expenditure on the treated is birr 2415.97, 2354.38, and 2276.38 which is large enough to improve the livelihood of households. However, the results from the estimation of Radius Matching show that the impact of the package is not statistically significant although the treatment effect is positive (box 4.1).

Box 4.1: ATT estimations using four methods of matching

i) ATT estimation with Nearest Neighbor Matching method Number of obs = 320 Replications = 50 Bootstrapped standard errors				
Number of Treated	Number of control	ATT	Std. Err.	t
234	63	2415.97	1298.45	1.861
ii) ATT estimation with the Stratification method Number of obs = 320 Replications = 50 Bootstrapped standard errors				
Number of treatment	Number of control	ATT	Std. Err.	t
233	77	2354.38	1365.04	1.725
iii) ATT estimation with the Kernel Matching method Number of obs = 320 Replications = 50 Bootstrapped standard errors				
Number of treated	Number of control	ATT	Std. Err.	t
234	76	2276.38	1278.82	1.78
iv) ATT estimation with the Radius Matching method Number of obs = 320 Replications = 50 Bootstrapped standard errors				
Number of treated	Number of control	ATT	Std. Err.	t
234	76	1933.239	1291.633	1.497

Source: Own calculation from REST, Research and Policy Unit, Household Survey 2008

4.2.3 Food Consumption versus Non-Food Consumption Expenditures

Is the impact of the package statistically significant on 'both types of expenditures'? To answer this question we segregate the indicator into food and non-food consumption expenditures. Logit estimates of the propensity score used for the ATT estimations on the total expenditure are again taken into account in this section.

According to Box 4.2, there is a positive and significant effect of participation in the food expenditure at the 1% level of significance. Being beneficiary of the package increases the spending of the family on basic food items. The result is also robust because panels A1 and A2 in Box 4.2 prove with two methods of matching that ATT is positive and significant.

Box 4.2: ATT estimations for food and non-food consumption expenditures

A1) ATT estimation with Nearest Neighbor Matching method (food consumption)				
Number of obs = 320				
Bootstrapped standard errors			Replications = 50	
Number of Treatment	Number of control	ATT	Std. Err.	t
234	63	1430.3	551.286	2.594
Source: Generated by the student				
A2) ATT estimation with the Kernel Matching method (food consumption)				
Number of obs = 320				
Bootstrapped standard errors			Replications = 50	
Number of Treated	Number of control	ATT	Std. Err.	t
234	76	1423.24	490.512	2.902
B1) ATT estimation with Nearest for Neighbor Matching method: non-food consumption				
Number of obs = 320				
Bootstrapped standard errors			Replications = 50	
Number of treatment	Number of control	ATT	Std. Err.	t
234	63	-1157.8	535.894	-2.16
Source: Generated by the student				
B2) ATT estimation with the Kernel Matching method (non-food consumption)				
Number of obs = 320				
Bootstrapped standard errors			Replications = 50	
Number of Treated	Number of control	ATT	Std. Err.	t
234	76	-717.5	346.465	-2.071

Source: Own calculation from REST, Research and Policy Unit, Household Survey 2008

4.2.4 Comparing the Effects of Different Agricultural Packages on the Total expenditure of the Beneficiaries

Given that the household is among the beneficiary group of the agricultural package, which specific program is more effective in ensuring food security taking the total expenditure as a measure for the food security? So, here, we are comparing the program effectiveness of the likes with the likes because a household can participate in either one of, both of, or all of the packages. The reason behind the comparison is that all households cannot have the same interests towards getting the packages. As a result, these

differences in interests may lead to differences in the impact of the program(s) they take. However, the regression results show that the magnitude of the impact is not statistically significant among the packages in spite of the existence of directional difference as we can see it in Table 4.13. In a net shell, comparing the effect of participating in one or more of the interventions in ensuring food security with package1 (crop package) does not make a statistical difference.

Table 4.13: Regression estimations of the packages

Number of obs=234						
F(12, 221)=2.8						
Prob> F=0.0014						
R-squared=0.1319						
Adj R-squared=0.0848						
Root MSE=10604						
Totequi	Coef.	Std.Err	tP >	t	[95% Conf.	Interval]
Sex	1400.431	4536.148	0.31	0.758	-7539.211	10340.07
Agecomp	-173.8012	111.3061	-1.56	0.120	-393.1583	45.55596
Migrate	-1202.048	2714.663	-0.44	0.658	-6551.987	4147.892
educ1	-3518.38	1426.724	-2.47	0.014	-6330.106	-706.6544
farm1	-826.0756	3222.997	-0.26	0.798	-7177.817	5525.666
Landowned	-56.38119	273.3131	-0.21	0.837	-595.0147	482.2523
marital2	4596	4259.608	1.08	0.282	-3798.648	12990.65
_lpack_2	-3754.752	3985.576	-0.94	0.347	-11609.35	4099.847
_lpack_3	1193.832	11431.07	0.10	0.917	-21334.01	23721.68
_lpack_4	-223.0231	3921.709	-0.06	0.955	-7951.757	7505.71
_lpack_5	-2758.903	11299.33	-0.24	0.807	-25027.13	19509.33
_lpack_6	1693.119	4903.15	0.35	0.730	-7969.794	11356.03
_cons	26547.32	8220.077	3.23	0.001	10347.55	42747.09

Source: Own calculation from REST, Research and Policy Unit, Household Survey, 2008

5. Conclusion and Recommendation

5.1 Conclusion

The information from the data set reveals that 26.88 percent of the households are agricultural package non-beneficiaries of which 32.56

percent and 67.44 percent are female-headed and male-headed, respectively. Whereas, 73.12 percent of them are beneficiaries of which 87.61 percent are male-headed and 12.39 percent are female-headed households. Moreover, 86.05 percent of the non beneficiaries and 94.02 percent of the beneficiaries are included in the working force. On top of this, since there are no households who involve solely in package2 (fruits and vegetables package), it is clear that they prefer either one of the other two packages or at least two of all the packages.

Additionally, the descriptive results show that 36.05 percent of the control group and 38.03 percent of the beneficiaries are below the total poverty line while 25.58 % and 24.79% of the non-beneficiaries and beneficiaries, respectively, are below the food poverty line.

Total expenditure (because it is used as a measure or indicator of food security and as an outcome variable) is affected by a number of variables, but in impact evaluation employing the propensity score matching method needs identifying variables that simultaneously affect both the outcome equation and the treatment equation. Accordingly, sex, educational status, marital status of the household head, average age of the family, size of own land cultivated, and main occupation of the household are pointed out. The latter three independent variables are found to be statistically significant in affecting the participation of the family-based agricultural package and the effect is positive except that of age composition which is negative. However, we do not find the sex of the household head as statistically significant regressor of our estimates.

The assignment of households in the package results in a positive and statistically significant impact on ensuring food security. Specifically, the impact of the intervention on basic food consumption expenditure is positive and significant while the impact is negative on non-food consumption expenditure though it is statistically significant. Therefore, we conclude that the impact of the package is statistically different from zero on ensuring food security of the beneficiaries and non-beneficiaries. At the

same time, find that there is a statistical difference of the impact of the package on both food and non-food expenditures.

On the other hand, when we compare the impact of the specific packages on ensuring food security for the likes with the likes, we do not find any of the interventions statistically significant although the sign is different among them. That is, taking package1 as a base variable, households who participate in crop package and fruits and vegetables package together and all packages at the same time are positively affected, and otherwise they are negatively affected.

5.2 Recommendation

Based on our findings, therefore, we recommend that the continuation of the intervention on drought-prone areas which have the same characteristics with the study area is supportable because it improves the livelihood of the households. However, emphasis should be given to the interventions which ensure their basic food needs.

Similarly, further researches have to be done on this issue across woredas because it enables to incorporate some important spatial characteristics and cultural differences. Again, it is advisable for such researches if they use panel data so as to evaluate the impact over time.

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THE STATUS AND CHALLENGES OF TECHNOLOGY TRANSFER FROM TVET INSTITUTIONS TO MSEs IN TIGRAY REGIONAL STATE

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Acronyms

AT	Appropriate Technology
GTP	Growth and Transformation Plan
ICT	Information Communications Technology
MSE	Micro and Small Enterprise
R&D	Research and Development
TT	Technology Transfer
TVET	Technical and Vocational Education and Training

Abstract

Technology transfer from Technical and Vocational Education and Training (TVET) institutions to Micro and Small Enterprises (MSEs) in Ethiopia, with the help of TVET strategy, is being implemented for not less than four years. The strategy, in this respect, envisages enhancing the productivity of MSEs. This study, on challenges and progress of TT, was conducted in Mekelle city and Adigrat town of the Tigray Regional State. Three TVET institutions and 262 MSEs were included in the study. Among these MSEs, 42 have received technologies from the sample TVET institutions. Qualitative and quantitative data were gathered with the help of questionnaire and interview and analyzed with the help of SPSS. Findings of this research reveal that technology transfer is at its infancy stage and what has been transferred so far has no significant effect on the productivity of MSEs. Furthermore, the number of human resource in the enterprises was found to affect the success of TT. The research also finds that there is no culture of appropriate quality control of the products in TVET institutions mainly because of the low quality human capital and low capability as a result. In addition, high employee turnover, inefficient procurement process, limited publicity of technologies, limited R&D were found to be some of the main challenges of technology transfer from the side of TVET institutions. From the side of MSEs, shortage of capital, shortage of working premises, and shortage of sales premises are the main barriers of technology transfer.

Keywords: Technology transfer, Technology transfer models, Technology diffusion, Technology capability, MSEs, TVET

1. Introduction

In this era of globalization, a stronger attention is being given to the impact of knowledge and technology as the type of input that drives competitiveness of Nations (OECD, 1996). As stressed by Lundvall (1992), learning is the most important process in the knowledge economy. Accordingly, "the success of organizations and countries today is reflected not only in the accumulated knowledge they hold at a specific moment, but the capability to learn." (Lundvall, Muchie & Gammeltoft, 2003, p.6). Learning is also highly emphasized in international development agenda. For example, the new education strategy of The World Bank promotes learning by investing in People's Knowledge and Skills to Promote Development' (Worldbank, 2011).

Given the low level of industrial development in developing countries, Micro and Small Enterprises (MSEs) are regarded as sources of income and employment (Mano, Iddrisu, Yoshino & Sonobe, 2011) as well as sources of capital and technology for further industrial development. In turn, MSEs require support towards the development of the technological capability and productivity of MSEs. In this respect, the transfer of technology from Technical and Vocational Education and Training (TVET)¹ institutions to MSEs is envisaged as a strategy. For example, the TVET strategy of the African Union holds the promotion of strong linkages and partnerships of national TVET systems with the world of work, including MSEs and other stakeholders in the TVET system (AU, 2007). Broadly, technology transfer refers to the movement of technology from one entity to another (Ramanathan, 1994) where the technology could be in the form of physical assets, know-how, and technical knowledge (Bozeman, 2000).

¹ According to UNESCO, the term 'Technical and Vocational Education and Training' refers to "those aspects of the educational process involving, in addition to general education, the study of technologies and related sciences, and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life" (UNESCO, 2004, p. 7).

As is the case in many other developing countries, Ethiopia's poverty has its roots in the absence of technological capability. In its policy document, the Ethiopian Science and Technology Commission (ECTC, 1993) pointed out that Ethiopia is characterized by a continued dependency on foreign technology and principally, lack of national capability to bring about sustained, self-sufficient and popular-based social and economic development. Consequently, the industrial base of the country remained undeveloped. Evidently, the share of the Industrial sector to the nation's GDP in 2009/10 was only 12.87 per cent, compared to Agriculture (41.56 per cent) and Services (45.58 per cent). Similarly, the MSEs sector has been subject to such low performance. Lack of access to appropriate technology has been one of the main constraints MSEs face in their way to contribute to the economic growth of the country (FDRE, 1997).

Hence, the National TVET Strategy of Ethiopia envisions a positive role for TVET institutions to become centers for technology capability, accumulation and transfer and contribute to the enhancement of productivity and the competitiveness of industries, mainly MSEs (MoE, 2008). The Growth and Transformation Plan (GTP) of the country also envisages that "the growth of MSEs and their integration with TVET system development will be instrumental in providing the necessary skills and education for technological transfer (MoFED, 2010b, p.24). Nevertheless, the transfer of technology from TVETs to MSEs in the context of developing countries such as that of Ethiopia is not going to be an easily achievable outcome. Challenges are expected to emanate from both the demand side and the supply side.

Therefore, this applied research aims at contributing to the literature on TVET, MSEs and the linkage between the two and provide empirical evidence pertinent to the status and the challenges regarding technology transfer to policy makers, program managers and TVET providers. It also investigates into the issue of whether or not the transfer has brought about a meaningful effect on the productivity of the MSEs that have received some technologies. The study covers selected TVET institutions in two urban centers of the Tigray Regional State (namely Mekelle city and Adigrat town)

with the assumption that the interaction of MSEs² and TVET institutions is high as these urban centers are the most populated (urbanized) areas in the region (CSA, 2007). The Tigray Regional State was selected due to the fact that a recent study conducted by Atakilt Hagos and Everard van Kemenade (Baraki & Kemenade, 2013) shows that the region is the leading region in terms of TVET learning outcomes of TVET graduates (as measured by competency test results) in the period since the implementation of the 2008 TVET strategy.

This research aims at answering the following specific research questions:

- i) What is the status of technology capability, accumulation and transfer in the selected TVET institutions?
- ii) Are the technologies that are transferred to the MSEs appropriate and affordable? Do the TVET institutions control the quality of the technologies they transfer?
- iii) What factors are significantly correlated with the success of technology transfer from TVET institutions to the MSEs?
- iv) Is there a significant relationship between technology transfer and the productivity level of the sample MSEs? Is there a difference in productivity among the MSEs that have received technology from TVETs and those that have not?
- v) What are the main barriers to the implementation of the TVET strategy with respect to technology capability, accumulation and transfer?

Rest of this paper is organized as follows: section two summarizes the theoretical and conceptual/analytical frameworks while section three elaborates the methodology employed. Section four presents the results and discussion of the results. Finally, the conclusions and recommendations are contained in the last section – section five.

² Following the recent definition provided in the MSEs Development Strategy of the FDRE (2011), we define MSEs based on their capital and labour. A Micro Enterprise operating in the industrial sector comprises of a hired labour of not more than 5 and a capital of not more than 100, 000 Birr while it is less than or equal to 50,000 Birr for Service sector. Small Enterprise is also defined for Industry sector as an enterprise with a hired labour of 6-30 and a capital of not more than 1,500, 000 Birr whereas it is less than or equal to 500,000 Birr for Service sector.

2. Theoretical and Conceptual Frameworks

2.1 Theoretical Framework

In this section, a summary of review of the literature with special emphasis on the theoretical background that guided the development of conceptual/analytical framework is provided.

2.1.1 The conceptualization of successful technology transfer

Technology Transfer (TT), also sometimes called *Transfer of Technology*, has got different meanings due to differences in the conceptualization of *technology*. For instance, Citing Frances Stewart (1977), Szogs (2010, p. 45) defines *technology* as encompassing “all skills, knowledge and procedures required for making, using and doing useful things”. Based on this conceptualization, TT will be the transfer of those skills, knowledge and procedures. For Ramanathan (1994), however, what is transferred also includes physical assets. The transfer of technology is said to be successful if the receiving entity (i.e., the transferee) can effectively utilize the technology transferred and finally diffuse it.

For TT to be successful, the technology that is being transferred should be appropriate. In the context of MSEs, *Appropriate Technology* (AT) is generally recognized as being small-scale, manual, energy-efficient, environmental friendly, and locally controlled (Hazeltine & Bull, 1999). That is, the technology should be suited to the needs of small enterprises (Buainain, 2002 & Ngahu, 1995). Therefore, it is essential to choose from available technologies in order the transfer be successful. According to Bennett (2002), a greater focus should be given to AT in the very late developers. Under the right policy and business conditions, the transfer of AT can contribute to the development of learning and capability, which in turn contribute to competitiveness in domestic and international markets (ibid).

2.1.2 Technology capability, technology transfer, productivity and competitiveness

For productivity and competitiveness of MSEs to develop, not only TVET institutions but also MSEs need to develop technology capabilities. Hence, technological capability is one of the requirements for successful TT (Szongs, 2010; Lundvall, 1992). This in turn depends of the level of learning that takes place in both parties. In this respect, EEA (2005) states that the level and type of education that labour force acquires are the key determinant of technological capability development. Technology capability is the firm's ability or skill to manage its resources so as to achieve competency and better productivity (C. Saha & Islam, n.d). This is closely related to the existing knowledge as the existing knowledge of the firm contributes in coordinating its resources so that it becomes competitive in the market. Thus, TT should be assisted by technological capability for the success of the enterprises' productivity and competitiveness.

Citing Cohen and Levinthal (1990) and Kim (1998), Kim (2003) points out that technological capability can be acquired through the process of technological learning. In turn, effective technological learning needs absorptive capacity from the side of technology recipients where the existing knowledge base and the intensity of effort are the essential elements absorptive capacity. In this respect, existing knowledge or competence is regarded as an important part in technological learning because knowledge today enables individuals or organizations to create more knowledge tomorrow by influencing learning processes and the nature of learning. To his view, accumulated existing knowledge help individuals or organizations make sense of, assimilate, and use new knowledge in a better way.

Without denying the need to continuously develop technology capability, whatever technology is accumulated in TVET institutions should be accessible to MSEs, given it is appropriate. Moyi and Njiraini (2005) also suggest that similar to training, finance and business premises, technology is an essential factor affecting the productivity and competitiveness of

MSEs, however not always accessible to them. Without access to technology, MSEs lack the capability to produce efficiently, develop product quality and innovate new product designs. Furthermore, citing UNIDO (2001), Bennett (2002) argues that the strategy of TT to MSEs should involve extension services to MSEs because of their low technological capability. That is, it is not enough to merely expose firms to the relevant external knowledge without exerting effort to internalize it (Kim, 2003). In this line of argument, when both existing knowledge and the intensity of effort are high, technological capability is high and rapidly rising.

2.1.3 Factors affecting success of technology transfer

To better understand the status of technology transfer and the challenges that hamper the process, it is important to identify the factors that affect technology transfer. In this respect, a more comprehensive technology transfer variables have been suggested by Madu (1989). The variables are: *structural factors* (cultural value system), *education and training, capabilities, stable government and political systems, managerial effectiveness, objectives* (the identification of specific problems and needs that helps the objectives for the technology transfer be formulated), *identification and implementation of appropriate technology*, and *Research and Development (R&D)*. In addition, the management effectiveness is an important element in the process of technology transfer and refers to the management of production processes, of capital and of human resources. Besides, Ashekele and Matengu (2008) pointed out that internal factors, such as *personal commitments, willingness to learn and competency*, and also external factors, such as *access to a variety of services*, strongly influence the success of technology transfer.

The available literatures support that Quality control is one of the main factors of competitiveness. Kumar (n.d, p.128), for instance, states that “In today's competitive environment, the mere success and survival of any enterprise whether it is a small scale unit or large scale enterprise depends upon the achievement and maintenance of a satisfactory level of quality.” Quality control is the organized regulation of all factors affecting the

goodness of the end manufactured goods (Ibid). Thus, to be competitive in local and international market, it is crucial for MSEs to produce better quality goods and services. The TVET institutions could enhance the competitiveness through training as well as transferring better quality technologies and capabilities to MSEs.

2.1.4 Technology level as a driver of productivity growth

Productivity is one of the envisaged transmission mechanism through which technology transfer enhances competitiveness of industries in the long run. Banker, Datar & Kaplan (1989) argue that, in the short run, profits can be raised if output prices are increased faster than input costs. In the long run, however, unless productivity increases, competitive market forces will prevent a firm from passing firm-specific, or even country-specific, cost increases on to customers. Different types of productivity measures are available in economics literatures. These measures include *single factor productivity*, *multi-factor productivity* and *total factor productivity* (TFP). According to Nakamura and Diewert (2005), *single factor productivity* is defined as the ratio of a measure of output quantity to the quantity of a single input used. In the case of *labour productivity* (LP), *the denominator is denoted as* total hours worked. When it comes to *multi-factor productivity*, the denominator refers to the quantity of a bundle of (total) inputs rather than being one input. Finally, TFP is defined as the ratio of a measure of total output quantity to a measure of the quantity of total input (ibid).

Moyi and Njiraini (2005) also suggest that similar to training, finance and business premises, technology transfer is an essential factor affecting the productivity and competitiveness of MSEs, however not always accessible to them. Without access to technology, it is argued that MSEs lack the capability to produce efficiently, develop product quality and innovate new product designs.

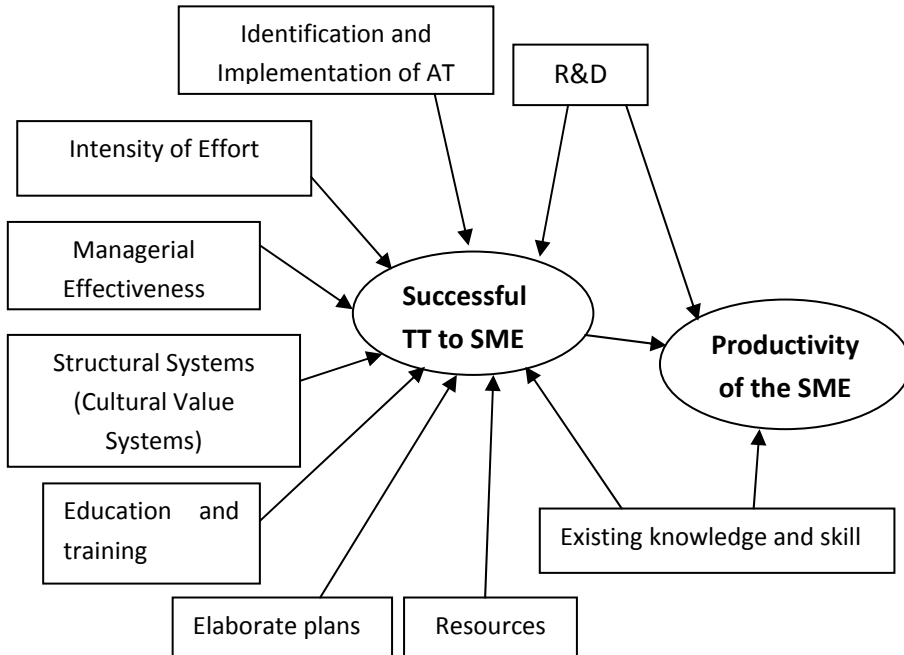
2.2 Conceptual/analytical framework

Based on review of the theoretical literature, we have developed the

conceptual/analytical framework that guided the study. The conceptual/analytical model for this study is depicted in Figure 2.

Following Ramanathan (1994), TT is defined in this research as the process of movement of technology from TVET institutions to MSEs. The transfer is said to be successful if the MSEs can effectively make use of the technology transferred and lastly diffuse it. Following Bozeman (2000), we define technology as involving physical assets, know-how, and technical knowledge. The success of technology transfer has been measured by the number of those appropriate technologies diffused by the MSEs. Following Buainain (2002) & Ngahu (1995), we define AT as technology that is suited to the needs of small enterprises operating manually, low skill levels and using local materials and resources and it is also affordable. **Error! Reference source not found.** provides a summary of the operational definition of the variables for the analysis of the determinants of TT.

Figure 1: The conceptual model



Source: Developed by authors, 2013

Table 1: Operational definitions of variables and their indicators

Variable	Variable definition	Indicator
Education and Training	On job training and education given to workers of the recipient MSEs.	The number of hours of on job education and training received by MSEs (in ratio scale)
Elaborate Plans	The detail plans of MSEs to transfer technologies.	The availability of elaborate plans for technology transfer and diffusion by MSEs (in nominal scale)
Research and Development (R&D)	The ability of the institutions to develop product designs and improve the quality of goods and/or services based on the needs of their customers.	Availability and the expense on R & D in Birr (expenditure on R&D in ratio scale)
Managerial Effectiveness	The ability of MSE managers to be responsive to the environment and committed to the newly transferred technology.	The ability of managers to be responsive to the environment and committed to the newly transferred technology. (Likert scale)
Existing Knowledge/skill	the qualification of the managers of the MSEs and TVET staff	Formal education level: Below/or grade 12; certificate, diploma, Degree, or Above Degree (in ordinal scale)
Intensity of Effort	The extent of effort made by MSEs managers to receive and assimilate technologies.	The number of hours worked for TT. (in ratio scale)
Resources	The human, capital, and land resources.	Availability of enough human, capital, and land resources.(to be measured by Likert scale)
Appropriate Technology	Small scale, made of local resources and relatively simple	Appropriateness and affordability (a 'yes' or 'no' type of question)
Cultural value systems	Identification of appropriate training, taking relevant barriers of language and culture into account during education and training	Identification of appropriate training need: Likert scale
Successful technology transfer	The degree of diffusion of the transferred technologies	Number of diffusions made by MSEs (in ratio scale)

Source: Elaborated by the researcher.

Note: In this research, these factors are hypothesized to have a positive and significant correlation with success of technology transfer.

3. Methodology

This descriptive study has applied a combination of qualitative and quantitative approaches. The sampling units for this study are TVET institutions and MSEs. This study has made use of both primary and secondary data. Secondary data have been collected from websites, Tigray TVET bureau and data base of Tigray MSEs Agency. Primary data were collected using questionnaire and semi-structured interview. The interview has been administered to one key informant from three TVET institutions and one from Tigray TVET bureau. Moreover, personal observation was made in the three institutions of TVET in Mekelle and Adigrat. The three TVET institutions are Adigrat TVET centre, Adigrat Poly Technique College, and Mekelle Poly Technique College. A pilot study has been conducted to test the questionnaire and necessary improvement was made to the questionnaire. Out of the 19,946 MSEs that operate in the study area during the study period (Tigray MSE's Agency data base, 2013), we selected 263 MSEs using the systematic random sampling technique.

The qualitative data obtained through the interviews were reduced to some themes around the factors that affect success of TT. The data obtained through the questionnaire were coded and entered into SPSS software and analyzed by applying descriptive statistics techniques as well as inferential statistics (i.e., correlation analysis and relevant tests of significance).

Table 2: Summary of the methodology

Research questions	Data type & source	Method of data collection	Respondents
Status of TT	Secondary and primary data from TVET institutions, and MSEs	review of reports, Interview, and questionnaire	Managers of MSEs, key informants
Main barriers of TT and capability (question 2)	Primary data From MSEs as well as from TVET employees	Interview and questionnaire	Managers of MSEs and key informants of TVET institutions
Variables that correlated with successful TT	Primary data From MSEs	Questionnaire	Managers of MSEs
Effect of TT on Productivity	Primary data From MSEs	Questionnaire	Managers of MSEs

Source: Elaborated by the researcher.

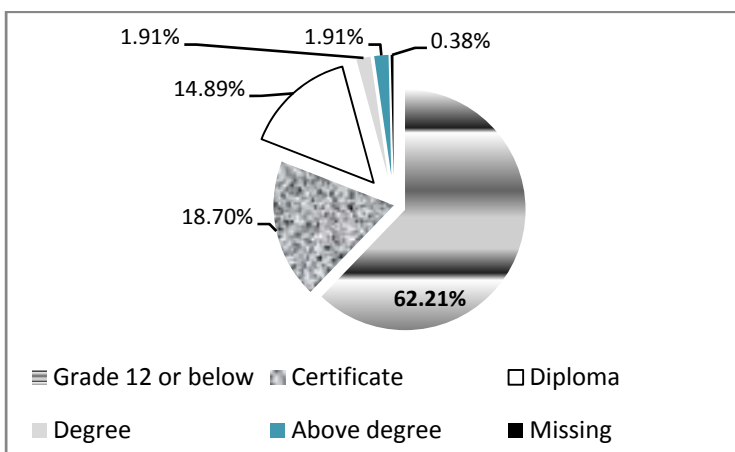
4. Results and Discussion

4.1 The status of technology capability, accumulation and transfer

4.1.1 Technology capability

As mentioned in the theoretical and conceptual framework, high quality and level of education and training is crucial for the labour force in order to develop technological capability (EEA, 2005), which is one of the necessary conditions for technology transfer (Szongs, 2010; Lundvall, 1992). In this study, we used the educational attainment of managers of MSEs as an indicator to measure capability on the side of MSEs. On the side of TVET institutions, we used the education composition of TVET staff. Accordingly, evidence obtained through the survey reveals that the quality and level of education of the managers of MSEs is very low. As depicted in Figure 2, the prevailing highest level of education of the 262 sample MSE managers is grade 12 or below (62.2%) followed by certificate and college diploma. The MSE managers whose educational attainment are first degree or above accounts to only less than 5 per cent. Furthermore, out of 1302 workforce engaged in 262 MSEs, about 91% are below diploma level. These evidences lead us to the conclusion that the sample MSEs have low technological capability.

Figure 2: Highest level of educational attainment by managers of MSEs in 2013



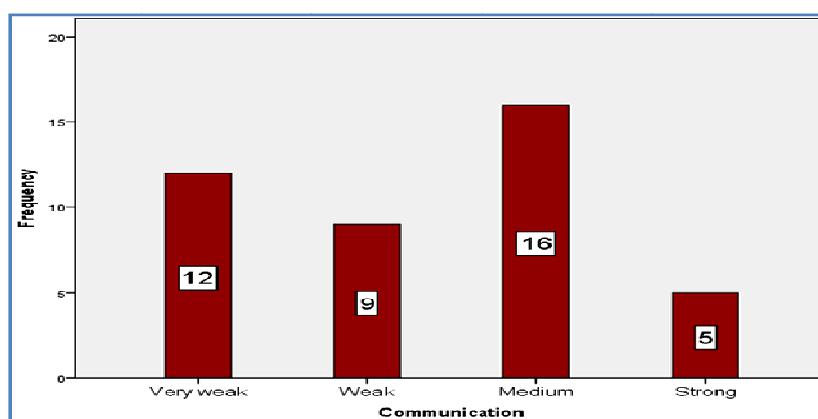
Source: Own survey data

Because of the high turnover of the employees, the capability of the selected TVET institutions is low and continuously decreasing. Nevertheless, there are some trainers upgrading in different universities of the country, Ethiopia, as well as abroad. Hence, it is expected that the capability of the institutions will be increased as they come back to the institutions and start to work for the TVET institutions as long as the institutions manage to retain the trained employees.

4.1.2 Technology accumulation, communication and transfer

For technology transfer to occur there should be strong communication between TVET institutions, on one hand, and the MSEs, on the other. However, 50 percent of the respondents believe the communication between TVET institutions and MSEs (measured in five levels Likert Scale) is weak or very weak (see Figure 3) while only nearly 12 percent believe the communication is strong.

Figure 3: Frequency of communication between MSEs and TVET institutions

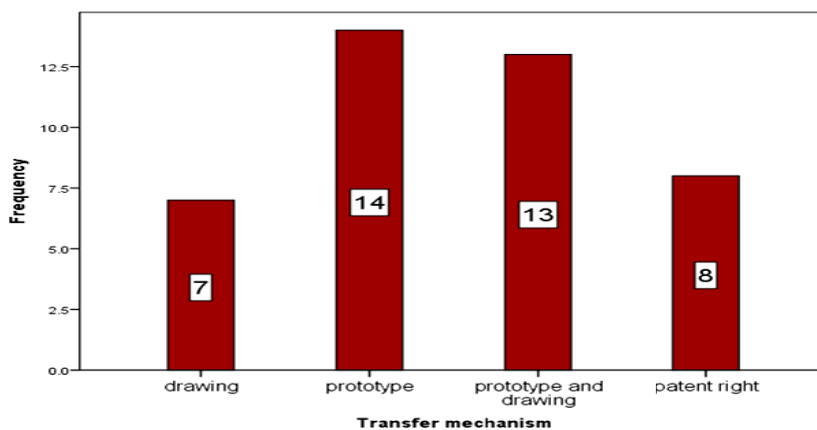


Source: Own survey data

Regarding technology transfer, 26 technologies have been transferred by the three TVET institutions. Regarding the mechanisms of the technology transfer, the results of the survey indicate (see *Figure 4*) that prototype (i.e. the first sample product to test if the product works properly) and blue

print (drawing) are the modes/mechanisms for transfer of technology between TVET institutions and MSEs. In this respect, 27 (64.29%) out of the 42 respondents reported that they received technologies either by prototype (33.3%) or by both prototype and drawing (30.1%). Besides, the interview conducted with the key informants, trainers and industrial extension service agents shows that before technologies are transferred to the enterprises, education and training is provided for those who are eligible to receive technologies.

Figure 4: Type of TT mechanism used in the survey area in 2013



Source: Own survey data, 2013

Some of those technologies are accumulated in those TVET institutions while others are transferred to MSEs without blueprints as the blue prints remained in the respective TVET institutions. Moreover, 18 technologies are accumulated in the three TVET institutions: four in Adigrat TVET Centre, five Mekelle Poly Technique College, and nine Adigrat Poly Technique College, respectively.

In general, the result of the interview shows that only seven technologies have been transferred with the help of blueprints and thus we can contend only 25 (18+7) technologies are accumulated in the three TVET institutions. Miller Machine, Circular Saw, Shearing Machine, Electric Stove, Arc Welding Machine, Incubator, Pipe Bending Machine, and Wood Lathe are some of the

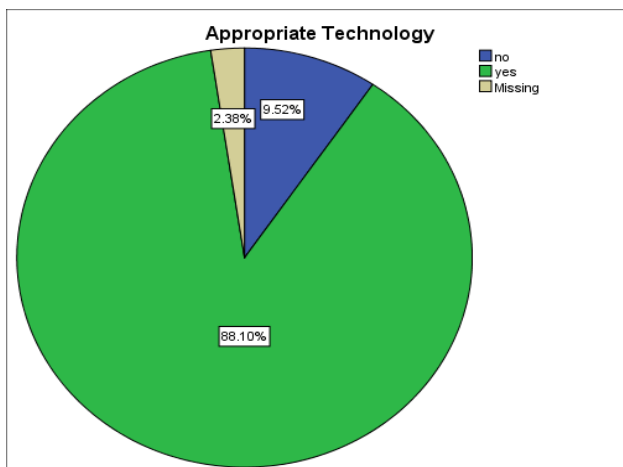
technologies transferred and accumulated in the sample TVET institutions. This status of technology accumulation and transfer seems very low.

4.2 Appropriateness of the transferred technologies and quality control

4.2.1 Appropriateness of the transferred technologies

The appropriateness of technology, though not significantly correlated to the successful TT, has been assessed through interview, questionnaire, as well as by observation on the ground. All the interview respondents agree that the appropriateness affordability of the technologies that are being transferred to MSEs is fair. The proportion of respondents who gave their opinion regarding the appropriateness of the technology transferred to MSEs is depicted in Figure 5.

Figure 5: Respondents' opinion on appropriateness of the transferred technologies



Source: results based on data from own survey

As can be observed from the pie chart, 37 or 88% of MSEs managers think that technologies they receive from TVET institutions are appropriate and affordable.

4.2.2 The practice of quality control on technologies by TVET institutions

It can be argued that if the quality of the prototype developed in TVET institutions is low, the products manufactured by MSEs using those technologies will unquestionably be low. As mentioned in the theoretical framework (see chapter two), it is essential that TVET institutions develop the culture of quality control. The practice on the ground, however, is different. On one hand, almost all the key informants agree that there is no practice of quality control in the aforementioned TVET institutions. Furthermore, the researchers personally observed that the quality of prototypes developed is very low. Evidences also show that the situation is not much different when it comes to quality control in MSEs.

These problems may be attributed to the low skill and knowledge of employees in the institutions, especially among those working in the Research and Technology Transfer Core Process. For instance, the knowledge and skill of technical drawing, a medium by which technicians and technologists communicate is vital for technology transfer. However, the interview result shows the presence of a very low skill and knowledge in the discipline both in the TVET institutions and MSEs. In contrast, some key informants replied that the assembly drawings of the prototypes developed in the center are prepared after the prototypes are produced, which is not scientifically acceptable. In addition, some prototypes are developed and transferred without blueprints to MSEs, according to the key trainers in the institutions. Therefore, we can argue that the progress of quality control, which is one of the main criteria for competitiveness (Kumar, n.d.), is very low not only because of low skill and knowledge in *Technical Drawing* and in other related fields but also because of lack of due attention for quality.

4.3 Factors that are correlated with the quantity of technology transferred

Based on the conceptual framework, data pertinent to the variables that theoretically affect the dependent variable have been collected by administering the questionnaire to the managers of the sample MSEs in Adigrat and Mekelle. The dependent variable is the quantity of transferred

technology measured by *diffusion of technologies (i.e. number of disseminated or replicated technologies)*. The independent variables are that are identified as potential determinants include *education and training, elaborate plans, R&D, managerial effectiveness, existing knowledge, intensity of effort, human resources capital resource, land resource, appropriate technology, and structural cultural value systems,*

Even though it is technically possible to run a regression to identify those variables that significantly affect the dependent variable, we have limited our analysis to correlation analysis due to insufficiency of data to run a regression. This is because, among the 263 MSEs that are included in the sample, only 42 MSEs have received technology. This has limited the variability in the values of the explanatory variables. The SPSS output of the correlation is shown in Table 5, where the number of respondents for the explanatory and dependent variables is 42.

Table 3: Correlation of independent variables with Successful TT (diffusion of technology)

Explanatory Variables	Diffusion of technology	
	Correlation coefficient	Sig. (2-tailed)
Research and development	-.094	.552
Human resource	.410*	.007
Education and training	-.008	.958
Intensity of effort	.018	.911
Elaborate plans	.333*	.031
Capital resource	.413*	.007
Land resource	.491*	.001
Cultural value systems	.129	.416
Existing knowledge	.260**	.096
Managerial effectiveness	-.268**	.086
Appropriateness of technology	.025	.878

Source: own survey data

Note: The variables whose correlation coefficients are marked with (*) are significant at 5% level of significance while the variables with (**) are significant only at 10%.

Results of the correlation analysis revealed that among the explanatory variables, only four variables have been significantly correlated with the dependent variable, success of technology transfer, at 5% level of significance. As depicted on Table 5, human resource, existence of elaborate plans, capital resource, and land resources are the only variables that are positively and significantly correlated to Diffusion of technologies (successful TT) as their *P*-values under sig. are less than 0.05. Though existing knowledge and managerial effectiveness are correlated with the dependent variable, it is only at 10% level of significance. We have found limited variability in the values of the variables that are not found significantly correlated with the successful TT. The fact that we have only a few MSEs that have received technology is also expected to have affected the result.

4.4 The relationship between technology transfer and MSE productivity

Analyzing the relationship between technology transfer and average productivity (total factor productivity) of MSEs is one of the objectives of this research. To meet this objective, parametric and non parametric analysis of correlations between the two variables has been conducted using SPSS. The null and alternative hypotheses are:

H_0 : Technology transfer from TVET institutions and productivity of the recipient MSE are uncorrelated.

H_1 : The two variables are correlated.

Table 4: Correlation of TFP with explanatory variables

Explanatory Variables	Total Factor Productivity	
	Correlation coefficient	Sig. (2-tailed)
Transfer of technology	.093**	.138

Source: results based on data from own survey, 2013

As can be observed from the SPSS output in

Table 4, *Transfer of Technology* is not significantly correlated to Total Factor of Productivity at 5% level of significance because its sig. value (0.138) is greater

than 0.05. As a result, we fail to reject the null hypothesis that proposed that the two variables are uncorrelated. Therefore, we conclude that Technology transfer from those selected institutions has no a significant effect on productivity of the sample MSEs in the study area (Mekelle and Adigrat).

This result should not be surprising as technology transfer is at its infancy stage. Technology transfer as part of the 2008 TVET strategy is a recent phenomenon. As discussed earlier in this chapter, among the 263 MSEs, only 42 (nearly 16%) MSEs have received technology from TVET institutions, regardless of its appropriateness and quality. Furthermore, only 26 technologies have been successfully transferred from the three TVET institutions included in the sample. Though the transfer of technology is either in the form of prototypes only or prototypes and drawings together, the quality of prototypes is very low. The personal observation of the researchers and the interview with the key informants and trainers prove the low quality of the prototypes which likely affects the quality of the diffused technologies. Low knowledge of Managers of MSEs about productivity might also be another reason for insignificant effect of TT on TFP. The knowledge of managers about productivity is crucial to see their status and make remedies.

All these evidences lead us to the conclusion that it is too early for TT to have a meaningful effect on productivity of MSEs. This needs to be rechecked after some years have elapsed given that the challenges (see section 4.6) facing technology transfer are addressed by concerned parties. This finding also leads us to a striking question regarding productivity differences among the MSEs: 'Is there a difference in productivity among the MSEs that have received technology from TVETs and those that have not?' To answer this question, the mean productivity of MSEs who have received technology from TVET institutions and that of those MSEs who have not received technology was compared using independent samples T-test. The null and alternative hypotheses regarding equality of mean differences in the productivity of the two groups of MSEs are stated as follows:

H₀: Mean productivity of the MSEs that received technologies is equal to that of the MSEs that did not receive technologies.

H₁: There is a difference in mean productivity among the two groups of MSEs.

The SPSS output of the process is given in Table 9.

Table 5: Independent samples t-test for equality of mean productivities

	Levene's Test for Equality of Variances		T-test for Equality of Means			
	F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference
Equal variances Total Factorassumed	32.204	.000	3.208		.002	2.05498
ProductivityEqual variances not assumed			1.490	41.382	.144	2.05498

Source: results based on data from own survey, 2013.

When we look at the sig. value (.000) of the *Levene's Test for Equality of Variances*, it is less than 5%. Thus, we reject the null hypothesis that proposed equality of variance and consider the sig. value (0.144) under the *Equal variances not assumed*. As shown in Table 5, as sig = 0.144 is greater than 0.05, we fail to reject the null hypothesis regarding equality of means of the two groups. Hence, the average *productivity of the MSEs that received technologies from the sample TVET institutions is not statistically significantly different from the average productivity of the MSEs that did not receive technologies*. This shows that regardless of differences in receiving technology among the two groups of MSEs, productivity remains more or less the same.

4.5 The main barriers of TT from TVET institutions to MSEs

4.5.1 The TVET side barriers of technology transfer

High employee turnover

There are a number of technology transfer barriers or challenges documented with the help of both questionnaire and interview. Based on the responses of the key informant from Tigray TVET bureau, high turnover of the employees from the side of TVET institutions is one of the main

barriers of TT. The respondents attributed it to lack of enough incentives for the employees. Almost all the key informants admitted the problem. This problem, if not solved, will continue to negatively affect TT from the institutions.

Inefficient procurement process

Another serious barrier mentioned by the respondents was the slow purchasing implementation of materials by the respective TVET institutions. Since technology development needs both consumable and non-consumable materials, this can reasonably be critical. The problem may negatively affect TT in a variety of ways. First, it does so by affecting the quality of education and training in the institutions and the competence of their graduates. Second, it does so by adding to the decrease of motivation by TVET employees to develop and transfer technologies to MSEs. Whenever there is a delay of materials purchasing, the employees may be disappointed and reduce their commitment for the job.

Shortage of knowledge and skills

The shortage of skill and knowledge of the trainers is also another barrier of TT between the selected TVET institutions and MSEs. The key respondents replied that most of the trainers that are responsible to transfer technology are C-level (diploma). According to the interview, the skill and knowledge of trainers are hindering the TT because technology development needs enough skill and knowledge. This problem is closely related to the high turnover of the workforce in the selected TVET institutions as the more skilled employees are leaving the institutions and less skilled and less experienced trainers are being employed. There is also a shortage of skilled human capital in the market.

Limited publicity of technologies

As indicated in chapter two, Promotion of technologies is likely to increase the demand of the technologies developed in the TVET institutions selected for this study and thus increasing technology diffusion to the society. However, shortage of promotion on the developed technologies was cited by the key informant as technology transfer obstacle in Tigray Regional State TVET bureau.

Limited R & D and scarce resources

Research and Development in combination with shortage of resources such as labour and enabling generic ICT technologies (Bennet, 2002) is still another main barrier of TT. Madu (1989) asserts that R & D is one of the critical variables that help TT be successful. The response of the interview conducted with the key informants in those institutions is also consistent with this theory. Yet, the institutions have, lack of or no, access of internet which could help the trainers develop their competency as well as prototypes using free patent right websites. The researchers also personally observed that only Adigrat Poly Technique College is better in this regard albeit it has no organized R & D section and it is not conducting R & D. So, we can conclude that the absence of R & D section equipped with competent human and ICT resource is one of the barriers of TT between the selected TVET institutions and MSEs based on both the theories and the response of the key informants.

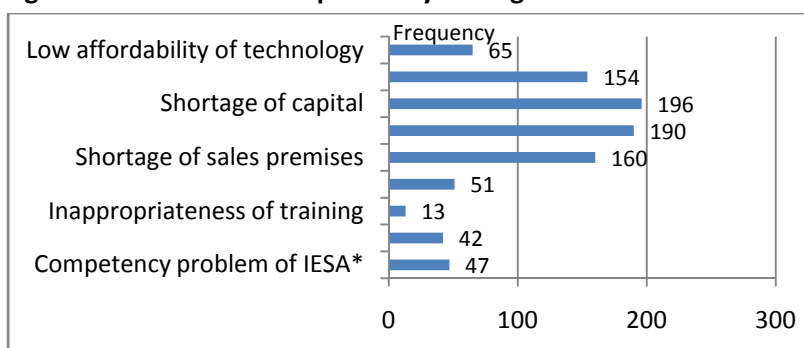
Low quality culture

Lack of due attention for quality from the side of both the TVET institutions and the MSEs has been mentioned by the key informants as a key problem that affects TT.

4.5.2 The MSEs side barriers of technology transfer

Moyi and Njiraini (2005) suggest training, finance, and business premises are essential factors affecting the productivity and competitiveness of MSEs. The shortage of those factors can negatively affect TT. Bennett (2002) also asserts that a greater focus should be given to AT in the very late developers in so that TT becomes successful. Thus, the potential barriers of technology transfer were anticipated (based on the theory) to be: shortage of skill and knowledge, afford-ability of technology, shortage of skilled human resource, shortage of capital, shortage of working premises, shortage of sale area, shortage of education and training, competence problem of trainers and Industrial Extension Service Agents, the appropriateness of training and education, and problem of reading working drawing.

Figure 6: Barriers of TT reported by managers of MSEs



Source: own survey data, 2013

As depicted in *Figure 6*, shortage of capital, shortage of working premises, shortage of sales premises and limited human resource capacity are the most outstanding challenges facing technology transfer on the side of the MSEs. Furthermore, Low affordability of technology, competency of trainers, shortage of trainings, and competency problem of the industrial extension service agents (IESA) are the next important batch of barriers to TT.

5. Conclusion and Recommendations

Based on the findings of our study, we generally conclude that the transfer of technology from TVET institutions to MSEs in the study area is at its lowest status while the implementation of the TVET strategy with respect to technology capability, accumulation and transfer is facing a number of challenges. This section presents the specific conclusions and recommendations.

5.1 Conclusions

Based on the analysis of the empirical evidence, our conclusions with respect to the research questions are stated as follows.

- Based on the highest educational attainment of the managers of MSEs and the staff of the TVET institutions, the status of technology capability in the TVET institutions and the MSEs is low.
- There is no meaningful transfer of technology from the sample TVET

institutions to the MSEs in the study area is taking place so far.

- Limited in number appropriate and affordable technologies have been transferred to the MSEs. Nevertheless, some of the technologies are transferred without their blueprints.
- Attributable to the lack of attention for quality and the limited human resource capacity of the TVET institutions, the practice of quality control on the side of the TVET institutions is not satisfactory.
- The quantity of technology transfer is positively associated significantly with human resource capacity, presence of elaborate plans, amount of capital resources and land resources. And to some extent with existing knowledge and managerial effectiveness.
- Attributable to the low level of technology transfer, technology transferred so far does not have a significant correlation with productivity levels of the MSEs that received the technologies. Furthermore, there is no significant difference in the productivity of the MSEs that received and that did not receive technologies from TVET institutions.
- From the side of the TVET institutions, the challenges to technology transfer include high employee turnover, inefficient procurement process, shortage of knowledge and skills that are necessary for technology accumulation and transfer, limited publicity of technologies, limited research and development and scarce material resources.
- From the side of the MSEs, shortage of capital, shortage of working premises, shortage of sales premises and limited human resource capacity are the most outstanding challenges facing technology transfer on the side of the MSEs.
- Other barriers that deserve attention are low affordability of technology, competency of trainers, shortage of trainings, and competency problem of the industrial extension service agents (IESA) are the next important batch of barriers to TT.

5.2 Recommendations

Based on the results of the study and the conclusions we have arrived at, we forward specific recommendations that may help policy makers and program managers.

- The education and training programs given to TVET staff should not only focus on TVET delivery but also hold the objective enhancing the attitude and capacity of trainers so as to facilitate technology capability, accumulation, quality control and transfer.
- Trainings given to enhance the capacity of TVET leadership, which is a component of the TVET strategy, should also focus on enhancing the awareness of TVET leaders (management) on the objectives and mechanisms of successful technology transfer.
- Trainings given to MSEs should incorporate learning objectives that help enhance the capability to assimilate and modify technologies that are received from TVET institutions and others.
- TVET authorities at federal and regional level should introduce generic systems that ensure quality control on technologies innovated or adapted by TVET institutions and that enhance the package approach to technology transfer. These include guidelines for quality control, the establishment of panel internal and external experts that ensure (control) quality, pilot testing of the technology, and the package. The elements that should be included in the package of the new technology (e.g., the hardware, the fabrication blue print, operating manual, training module, etc).
- TVET institutions should emphasize the need to prepare elaborate plans that contain quantitative and qualitative targets for technologies to be transferred to MSEs in the short-term and medium-term. Such plans should be prepared in a way that involves internal and external stakeholders (including MSE managers) so that necessary support and commitment can be obtained during the implementation of the plans.
- Communication between TVET institutions and MSEs need to be strengthened and technologies be publicized. The establishment of a forum consisting of both parties and other relevant stakeholders and

the preparation and implementation of periodic workshops and exhibitions at regional and city level may help in this respect.

- Strengthening the link between higher education institutions and TVET institutions needs to be stressed. This could be achieved through community service from the side of the universities, joint research programs and the participation of representatives of higher education institutions in the joint forum suggested earlier. TVET authorities could also identify research themes that could be studied by staff and students of higher education institutions and disseminate the findings to all TVET institutions. This in turn requires them to allocate some budget for research projects, which could be beyond the financial capacity of individual TVET institution.
- A discriminatory (results-based) incentive mechanisms need to be devised to motivate TVET staff to innovate and adapt technologies and reduce labour turnover. For example, the staff may be allowed to get a certain proportion of the revenue obtained by selling technologies to MSEs.
- To enhance technology accumulation within TVET institutions, TVET authorities should think of introducing a system whereby new technologies or ideas could be bought from individuals (outside the TVET system) that invent and adapt technologies. This in turn requires the allocation of budget for such purposes.

5.3 Limitations of the study and recommendation for further research

The major limitation of this study is that only three TVET institutions in only two towns have been selected, limiting generalization to the whole region. Furthermore, the fact that only 42 MSEs have received technology from TVET institutions has limited variability in the values of the variables and inhibited the application of regression analysis to effectively deal with the issue of causation. A further limitation is that the questionnaire has been distributed to only managers of MSEs. Therefore, we recommend a broader survey which incorporates more TVET institutions, respondents other than the managers, and more MSEs and the application of relevant econometric techniques.

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ESTIMATING THE LEVEL OF TAX EFFORT OF FOUR MAJOR REGIONAL STATES OF ETHIOPIA; NAMELY, OROMIA, AMHARA, SNNP AND TIGRAY: A REPRESENTATIVE TAX SYSTEM (RTS)

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Abstract

This paper presents a model to determine the tax effort and tax potentials of four major regions of Federal Democratic Republic of Ethiopia namely, Amhara, Oromia, SNNP and Tigray. Representative Tax System is used as analytical tool. Tax potential of each family of tax is figured out as the multiple of tax base of particular tax type by the effective tax rate. Likewise, tax effort index of regions is computed as the ratio of actual tax collection to the tax potential. Personal income tax contributes almost 50% of the overall tax revenue schemes of all regions and business profit tax accounts the least. Using 10 years data of the regions, results show that tax- GDP ratio accounts 7.3 % on average. Representative Tax System examines the tax effort of the regions and Tigray Regional State scores the highest (8.2%) followed by Oromia (7.6%), SNNP (5.7%) and Amhara (5.5%). What is more, the finding revealed that percapita lag tax effort which is additional variable to evaluate tax potential computed as the difference between the region's Percapita tax potential and the national Percapita tax potential. Accordingly, Tigray region takes the first rank followed by SNNP, Amhara, and Oromia regional state respectively. The recommendations raised area to enhance tax effort of the regions from wider base application of the tax administration for non taxed and underground economies. More so, examining the demo-economic variables of the regions sight out to design appropriate tax policy than looking to the nominal tax effort ratio.

Key Words: Tax Potential, Tax effort, Lag Tax Effort, RTS, Amhara, Oromia, SNNP and Tigray.

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1. Introduction

Fiscal capacity is a measure of government's ability to raise revenues for financing social and economics services. Fiscal capacity of a region can be defined as the potential of the regional government to finance standardized basket of public goods and services through raising revenues from its different source. Measuring fiscal capacity is essential to address interregional disparities and implementation of an equitable program. Furthermore, the measure of fiscal capacity of regions guides to the central government in their efforts to equalize resources available to the regions. Fiscal capacity also provides information about sub national governments' relative fiscal strengths and weaknesses on the top of the following points. First, fiscal capacity helps to monitor and compare trends in regional governments' fiscal and economic situation. Second, it provides information about assessing the strength of the regional economy. Third, fiscal capacity guides central government in assisting regional governments so as to implement various grants (World Bank, 2010).

The conventional argument to raise tax revenues as an underpinning for economic and social improvement is being coupled with additional lessons emerging from recent aid effectiveness dialogues. The idea is that attention to tax policy and tax administration is necessary if a country/ region plans to avoid the external aid dependency (Rojchaichaninthorn, et al, 2008). The United Nations report on Financing for Development (2002) highlighted that the importance of mobilizing own-financial resources in vital if nations are willing to grow and develop. Emphasizing on self financing is an adequate level of public expenditure while limiting budget deficits calls for substantial tax revenues and most developing world should undertaken significant tax reforms to raise the required revenues.

An effective tax system is fundamental for successful development. There are large numbers of theoretical and empirical literatures on taxation that attest from both academics and policy makers. The problems of developing countries in raising revenues are twofold. First, they have limited taxable capacity and large share of economic activities are in the informal sector

and are official non registered and difficult to pull to the taxing system. Second, their tax regimes may be riddled with numerous tax relief initiatives and/or tax expenditures, which further deplete the tax base and tends to reduce the efficiency and effectiveness of tax collection efforts. Moreover, though taxation is the best reliable alternative to finance public spending in the long run, developing countries generally experience a chronic gap between the level of revenues collection and the desirable level of public funds.

The first step in understanding revenue system in any economy is to establish some commonly agreed upon performance measures and accompanying benchmarks. The higher the fiscal performance, with tax efforts yielding high service returns, the closer the budget moves towards balance. To achieve high fiscal performance, however, the various facets of revenue and expenditure estimates should be meticulously systematized and minutely analyzed within the general macroeconomic framework. In relation to this frame work, many developing countries face difficulties in generating sufficient revenues to finance public expenditure and faced budget deficit through out.

There are nine regions and two city administrative constituted in Federal Democratic Republic of Ethiopia (FDRE). Except the two city administrative (Addis Ababa and Dire Dawa cities), the remaining regions have autonomous constitution pertaining to fiscal administration (see proclamation No 1/1995, Article 96, 97 &98). Taking good economic momentum (GDP performance) of regions and their contribution to national tax revenue scheme is considered as selecting criteria for this study and mainly concentrates on the four major regions namely; Amhara, Oromia, SNNP and Tigray. Fiscal capacity of regions varies according to families of taxes they practice. However, in all regions, there is a practise of relatively narrow tax base and, in fact only three of them (Personal income tax, Business profit tax and Value Added Tax) seem to be important in terms of revenue generated at the region level and thus, the study contemplates on these source of tax revenue.

The general objective of this study is to investigate empirically the taxable capacity of the four major regional states and compute the tax effort index. More specifically, the study attempts to the following particular objectives

- ✓ Investigating the tax revenue collection performance of the specified regions
- ✓ Estimating the taxable capacity of the specified regions
- ✓ Computing a measure of tax effort for the specified regions

2. The Representative Tax System and the Measurement of Tax Bases

Efficient tax system of a particular economy serves as a milestone for robust funding for the quality of public services that benefit individual members of the community as well as the economy. The purpose of measuring the Representative Tax System is to examine the capacity of a particular tax family in generating better revenue outcome. Accordingly, taxable capacity is defined as the total tax amount that would-be collected if each country or region is applied an identical set of effective rates. The adjective "*representative*" is used here instead of "*average*" only because of tradition, that is, as the yield of a representative tax system (Bahl,1971). This methodology, a "*representative tax system approach*," involves application of average effective rates to a standard set of tax bases. From this approach, it may be deduced a definition of taxable capacity as the level of taxation that would occur (Sobarzo, 2004),

3. Methodology and Data Source

3.1 Methodology

The method of estimating the level of tax effort of the four regions is the Representative Tax System (RTS). Representative tax System is very common instrument for analysing tax effort of different economies. The approach is conceptually simple, unlike to econometrics approach; it focuses in estimating effective **tax rate** for each state and for particular tax type. Effective tax rate is defined as the ratio of tax collection to tax bases

value. The tax base should be a reasonable measure of tax capacity and take a good proxy for tax potential. The next step in calculating RTS is to compute for each tax, ***an average effective tax rate (non-weighted)***. Then, the tax base value (the value of proxy tax base of each type of tax) is multiplied by the average effective tax rate to get an absolute value of tax potential for each family of taxes.

The final step in estimating tax potential of each region is sum up of the absolute value of tax potentials of each tax type (personal income tax business profit and Value Added tax). Dividing the actual tax revenue by the potential tax collected gives the tax effort index and it helps to rank regions on their fiscal performance. In a more formal way, the estimation process of tax potential and tax effort of regions for the data collected (2003-2012) can be described as follows (Sobarzo, 2004).

$$TPIUsj = \frac{TCsj}{TPsj} \quad (1)$$

Where

$TPIUsj$ = tax potential index or tax effort of region s and for tax source j

$TCsj$ = actual tax collection of region s from tax j

$TPsj$ = potential tax collection of region s from tax j

And $TPsj$ is defined as

$$TP_{sj} = t_j (B_{sj}) \quad (2)$$

Where

B_{sj} = tax base value of tax j in region s

t_j = the national average tax rate for tax j

And t_j also estimated as

$$t_j = \sum \frac{t_{si}}{S} \quad (3)$$

Where

S = number of regions which are four

t_{sj} is the effective tax rate i in region s and it is calculated as

$$t_{sj} = \frac{TC_{sj}}{Bs_j} \quad (4)$$

Where

TC_{sj} refers the actual tax collection of particular tax j in region s

Bs_j refers the tax base of particular tax j in region s

This way of estimation refers to relative state tax effort. That is, since there are no absolute measures of tax effort and tax potential, result of particular tax each region is comparing against to the national average. In Representative Tax System, the evaluation of regions tax effort happens frequently that one region may be well on some particular taxes and not that well on other tax types.

3.2 Data Sources

Data for this study are obtained from regional Bureau of Finance and Economic Development, Regional Revenue Customs Agency and similar line bureaus of regions. In addition to these, data have been obtained from, Central Statistical Agency (CSA), Ministry of Finance and Economic Development (MOFED). The study takes data of 10 years running from 2003 right after the introduction of Value Added Tax (VAT) to 2012.

4. Tax-Revenue of the Regions (Amhara, Oromia, SNNP and Tigray)

The overall objective of this sub topic is to compare tax collection effort of the four major regions of the FDRE (Amhara, Oromia, SNNP and Tigray) using the ratio of tax collection as a percentage of regional gross domestic products (RGDP) collected from the Bureau of Finance and Economic Development of each regions. The tax effort index is also computed based on regional tax classification. To give detail analysis of region's tax performance in comparison with its peers, existing tax collection structures

are also assessed using the ratio of each type of tax to GDP. The measurement and interpretation of such indices are relatively simple and straightforward. This section provides an overview of the regional pattern and trend in tax collection, using the conventional tax to GDP ratio.

To specify how the pattern has changed in the past decade (2003-2011), the data on Personal Income Tax, Business Profit Tax and Value Added Tax are used. Excise tax and other indirect taxes are not included in this analysis because their contribution to the overall tax revenue is very low (on average less than 0.02% in all four regions). Table 3.1 below shows the percentage share of tax revenue to regional GDP of the four regions for the years of 2003 to 2011. During the inception of VAT in 2003, Tigray regional state shows better performance. Similarly, in 2008 Tigray regional state outpaces the other regions as 44% of the regional GDP is collected in the form of tax (Direct and indirect taxes). After 2008, Oromia regional state shows a consistently higher tax to GDP ratio while Amhara regional state shows the smallest.

Table: 4.1 Tax-GDP Ratios of Major Regions of FDRE (%)

Year	Amhara	Oromia	SNNP	Tigray
2003	2	2	1.5	2.5
2004	0.7	2	1.7	2.2
2005	3.3	2	2.1	1.9
2006	2.3	1.7	2.1	2.2
2007	2.5	2.3	1.4	6
2008	1.5	2.5	3.8	44
2009	1.5	12.5	2.5	5.4
2010	1	11.1	3.2	6.6
2011	1	20	4.7	8.4
Average	1.8	6.2	2.6	8.8

Source: BOFED and Custom Bureaus of Four regions, 2011

The overall assessment of the tax collection effort of the regions is poor but in relative terms Tigray regional state performs well. On average for the ten years data, Tigray region shows the highest tax –DGP ratio which accounts for 8.8%, followed by Oromia (6.2%), SNNP (2.6%) and Amhara (1.8 %).

There are several reasons for the relatively lower share of tax revenue to GDP for the regions, though any generalization is difficult given the difference in the social and economic structure across the regions. Moreover, the economy of all regions is dependent on subsistent agriculture which is difficult for tax administration.

In order to have much better understanding, the share of the various tax families to the overall tax revenue of the regions is analyzed so as to examine the concentration of the region's tax collection effort. Accordingly, the following Table 3.2 indicates that, in all regions, personal income tax takes the highest share from the overall tax revenue.

Table 4.2: The Share of Different Families of Tax to the Total Tax revenue (%)

Year	Regions											
	AMHARA			OROMIA			SNNP			TIGRAY		
	PIT	BPT	VAT	PIT	BPT	VAT	PIT	BPT	VAT	PIT	BPT	VAT
2003	40	11	20	25	0.77	9	41	11	3	41	66	10
2004	41	16	20	20	7	10	38	12	4.2	46	10	41
2005	47	24	20	25	11	9	34	13	4	33	30	10
2006	43	12	16	40	5	7	56	87	4.7	65	07	10
2007	42	8.9	24	41	7	8	57	78	4	59	07	10
2008	48	11	18	39	6	6	60	8	4.4	119	10	10
2009	43	14	20	47	8	14	61	8	3	68	17	10
2010	36	17	20	47	9	14	60	8.3	4.5	57	18	10
2011	40	21	21	49	12	16	53	13	3	62	24	10
2012	43	43	19	66	2	35	65	20	4	52	18	10
Aver	42	18	20	38	7	11	53	26	4	60.2	21	13

Source: BOFED and Custom Authority of all Regions, 2011/12.

Note: PIT = Personal Income Tax

BPT = Business Profit Tax

VAT = Value Added Tax

A generally established trend shows, on average, tax intakes of the various tax families have not been consistent. In 2003, except SNNP, the remaining three regions collected personal income tax equal or greater than 40 % of the total tax revenue .In general, the four regions practices different

percentage on the three tax families. For instance, on average SNNP regional state collects the lowest (7%) of business profit tax but more than half of the tax revenue is derived from personal income tax (53%). Tigray which accounts 60.2% of personal income tax. To sum up, personal income tax takes the loin share of the region's tax revenue .A numbers of demand and supply factors contributed to the fluctuation in personal income tax. For example, if there is good employment in one fiscal year by the regional governments, tax revenue performance (personal income tax) is good but when there is high employee turnover especially from regional public institutions to non-public institutions where personal income tax is taken care by the federal government, the tax revenue performances falls significantly.

4.2 Taxable Capacity and Tax Effort of Regions

The actual tax to GDP ratio is usually interpreted as a measure of tax effort and used as the basis for cross regions tax effort comparison. The use of such ratio is reasonable if one attempts to establish trends or to compare tax revenue performance across regions with similar economic structure and at the same level of income. The plus side of this approach is simple and provides quick overview of the trends of the region wide tax collection scheme. However, while comparing the effectiveness of revenue mobilization across regions in different income groups, the tax-GDP ratio could provide a “completely distorted” picture which is derived from different economic structures, institutional arrangements, and demographic trends of the regions. Hence, the ratio does not reflect the tax capacity of regions and hence it is impossible to examine whether or not a region is in comparison with its peers in its effort to raise tax revenues.

To determine the taxable capacity and tax effort of the regions, we used the method of representative tax system (**RTS**) as described in the methodology section. For the successful implementation of this method, it would be important to estimate tax base values of the various taxes families under consideration. However, in all regions data on the base values of the respective tax type is not organized and published, then we obliged to find

proxy variable that can represent for the tax base reasonably to measure the taxable capacity of a given tax type.

We take three families of taxes; namely, Personal Income Tax, Business Profit Tax and Values Added Taxes. The base for personal income tax is taken to be recurrent expenditure of regions because the largest chunk of recurrent expenditure is channeled to salaries of employees. Private investment (operational investment) is taken as a proxy for the tax base of business profit tax. Regarding to VAT, the base is taken to regional consumption spending since it is pretty known that VAT is paid ultimately by the consumer and it is proportional to the level of private consumption spending computed from the difference of disposal income minus the personal saving and aggregated at regional level.

According to the principle of RTS, the tax potential of each region is computed by multiplying the tax base of each tax type by the average effective tax rate. The average effective tax rate is the un-weighted mean value of the ratio of actual tax collection to its tax base of the respective tax type for each fiscal year. Addressing the tax potential of each type of tax in the respective regions reveals the taxable capacity of the region and the tax effort as well. However, before examining the taxable capacity and effort, it becomes imperative to address the tax base of each tax type in the respective regions. In view of that, the next discussion deals with the trend of tax bases and the corresponding tax potential of each tax types of regions.

A) Tax Base and Tax Potential of Amhara Region

Taxation system of Personal income of Amhara region is similar to Federal system of progressive tax rate as personal income increase, the personal income tax rate also increases. The potential of generating regional tax revenue from personal income emanates from recurrent expenditure of the region in the respective fiscal years. The higher the recurrent budget allocated, the better the potential of personal income tax and the greater the size of personal income tax channeled to the regional direct tax

revenue. Table 3.3 depicts the actual tax and potential tax of the three tax types of Amhara regional state.

Table 4.3: Actual vs Potential tax of three types of taxes: Amhara Regional State (ETB)

Year	Actual tax(PIT)	Potential tax(PIT)	Actual Business tax(BPT)	Potential business tax(BPT)	Actual VAT	Potential VAT
2003	7.22E+07	7.61E+08	1.17E+08	1.10E+09	2.90E+07	2.63E+09
2004	8.08E+07	6.66E+08	1.80E+08	1.15E+09	7.20E+07	2.74E+09
2005	9.06E+07	5.79E+08	8.23E+07	1.26E+09	2.73E+07	3.02E+09
2006	1.26E+08	5.42E+08	1.48E+07	1.39E+09	1.94E+07	3.32E+09
2007	1.55E+08	1.00E+09	2.01E+07	1.53E+09	2.59E+07	3.65E+09
2008	2.81E+08	1.69E+09	2.62E+07	1.68E+09	2.49E+07	4.02E+09
2009	3.26E+08	1.98E+09	8.36E+07	1.85E+09	4.73E+07	4.42E+09
2010	4.22E+08	3.39E+09	1.33E+08	2.04E+09	7.36E+07	4.86E+09
2011	6.24E+08	4.54E+09	2.42E+08	2.24E+09	9.92E+07	5.35E+09
2012	9.36E+08	4.54E+09	3.20E+08	2.24E+09	1.78E+08	5.35E+09
Average	3.11E+08	1.97E+09	1.22E+08	1.65E+09	5.97E+07	3.94E+09

Source: Region's Custom Agency, 2012.

Table 3.3 above shows, there is good tax base for Personal income tax in Amhara regional state. As the tax base (recurrent expenditure) has been increasing from time to time, it is visible that the potential for personal income tax becomes higher also.

The proxy tax base for business profit tax is regional private investment that measures taxable capacity of the sector. Investment engaged in agriculture at regions generates low tax revenue for two reasons. First, the sector is tax exempted and second it is difficult to manage in relation to tax administration. However, investment in manufacturing and construction as well as services will contribute a lot to the tax revenue collection effort of the region. Business profit tax in all regions from 2003- 2004 were relatively low in relation to its base. However, in 2011/12 tax base is extremely huge but taxed only a small portion of it. In relative terms, the year 2012 is a year of good business profit tax for the region. Tax base for VAT is the level of regional consumption of goods and service. More than

75% of regional income is channeled to consumption of agricultural and industrial products which is subject to VAT. Thus, it is a good proxy base for VAT. However, Table 3.3 (above) depicts VAT collection is limited in contrast to its base. This might be due to poor administration of VAT in all goods and services and overlooked to participate the non-registered firms to VAT scheme.

Similar to Amhara regional state, it is also applicable to examine the tax base and tax potential of the families of taxes under investigation in the remaining states (Oromia, SNNP and Tigray) and the tabular illustration is displayed in the annex part. In general, the tax potential of the regions from the entire regional tax collection scheme is obtained by aggregating the actual and base value of different tax types.

4.4 Estimating Tax potential and Tax Effort Indices of the major Regions

The measure of tax effort of the respective regions is constructed as the ratio of the actual tax revenue to predicted (potential) tax. There are two approaches used to make regional comparison of tax potential and tax effort. These are the econometric approach and the Representative Tax System. Both approaches assume that the tax base is a proper measure of taxable capacity. As it is indicated in the methodological part, RTS employs to estimate the tax effort of the regions. The main reason of choosing RTS method is due to its popularity and simplicity to capture data for any tax bases entirely. The average effective tax rate is computed by dividing actual tax collection of a particular tax family to its tax base value. This is done for each tax type and is given in the following table.

Table 4.5: Average Effective Tax Rate of Each Tax Family (unweighted)

Tax Family	Amhara	Oromia	SNNP	Tigray	Average Effective tax rate
PIT	3.5971	2.2707	2.1015	1.2620	2.3075
VAT	0.4253	0.1616	0.0119	0.2340	0.2082
BPT	0.0297	0.4279	0.2302	1.6274	0.5838

Source: Own computation based on MOFED, 2012

The next step is computing the tax potential of each tax type in each region. It is calculated by multiplying the respective tax base of each tax by the average effective tax rate. The result of the total actually tax collected and tax potential by region are presented in Table 3.6 below. It is constructed by adding up all the three types of taxes under investigation. So, the resulting tax potential index in the respective region is an indicator of total regional tax effort. That is, it refers to the tax system as a whole for each region and not a particular tax, as the case in the previous discussion. Results are very similar to the Personal income tax, which is not surprising given the share of personal income tax takes the lion share in terms of tax revenue generation of regions.

Table 4.6: Actual tax Revenue Vs Tax potential of four major Regions of FDRE (In Billion Birr)

Year	Regions							
	Amhara		Oromia		SNNP		Tigray	
	Tax (Actual)	Tax (Potential)	Tax (Actual)	Tax (Potential)	Tax (Actual)	Tax (Potential)	Tax (Actual)	Tax (Potential)
2003	0.17	4.500	0.444	9.50	0.152	4.50	0.10	1.900
2004	0.175	4.560	0.186	10.60	0.174	5.01	0.10	2.200
2005	0.273	4.860	0.265	11.80	0.208	5.56	0.10	2.700
2006	0.194	5.200	0.291	14.20	0.205	5.92	0.16	3.300
2007	0.259	6.180	0.395	16.40	0.265	6.77	0.21	2.600
2008	0.249	7.400	0.591	19.90	0.375	5.10	0.29	2.650
2009	0.473	8.200	0.845	15.20	0.514	8.33	0.40	4.780
2010	0.736	8.400	1.091	6.20	0.626	9.33	0.53	5.300
2011	0.992	12.100	1.633	7.80	0.931	10.50	0.76	6.700
2012	0.992	12.10	1.362	8.60	1.173	11.93	1.04	6.90
Aver.	0.453	7.35	.7103	12.02	0.4623	7.295	0.37	3.9

Source: Custom Bureau of Regions, 2012.

Table 3.6 above depicts the actual tax revenue collected and the potential of tax supposed to be collected by the regions for the fiscal year of 2003-2012. Finally, actual tax revenue is divided by its tax potential to get the tax effort index. The overall performance of the tax system of the regions confirms that the best tax performance occurs when a region records higher tax effort. Table 3.6 shows the tax effort of each region and on average Tigray region scores the highest and its tax effort index is 8.2%. Next

Oromia with tax effort index of 7.6% while SNNP ranks third with tax effort index of 5.5 %, and Amhara accounts lowest tax effort index which is 6.1%.

Table 4.7: Tax effort of Major regions of FDRE (%)

Year	Amhara	Oromia	SNNP	Tigray
2003	3.8	4.7	3.4	5.5
2004	3.8	1.8	3.5	4.7
2005	5.6	2.2	3.7	3.9
2006	3.7	2.0	3.5	4.8
2007	4.2	2.4	3.9	7.9
2008	3.4	3.0	7.4	10.9
2009	5.8	5.6	6.2	8.4
2010	8.8	17.6	6.7	10.0
2011	8.2	20.9	8.9	11.3
2012	8.2	15.8	9.8	15
Average	5.5	7.6	5.7	8.2

Source: Custom Bureau of the four regions, 2012.

By and large, the tax effort index of the regions is small. There may be three possible causes for the low tax effort of regions. First, the consequence of low economic growth and poor fiscal performance of the last ten years and increasing of economic activity in the informal sector which is unnoticed in tax collection, but brings high tax evasion and tax avoidance. The second important reason could be the fact that tax revenue collection is quite difficult in areas that have relatively medium and larger size capital cities (at least the capital of regions). Third, since the economic structure of each region is backed up by agriculture while tax exempted. Moreover, analysis of taxes in regions is more complex since all types of taxes are not imposed consistently. What's more, it is likely that a particular region may perform differently depending on its main economic activities and degree of economic development.

3.3 Comparison of National and Regional Tax potential and Tax effort

Representative tax system examines only regional tax potential and tax effort comparison of regions against their peers. However, to see the

efficiency of tax collection effort of any region within the framework of the country, it becomes important to compare each region tax potential with the national tax potential level. Table 3.8 below shows what we call the per capita lag tax effort, which is additional variable to evaluate tax potential. This variable is computed for each region as the difference between the region's per capita tax potential and the national per capita tax potential. Positive number indicates the region per capita potential is above the national average and negative number refers on average the region lags behind the per capita of national tax potential. Accordingly, the per capita tax potential of the country and the regions is computed using the RTS method for 10 years data and the following table depicts the result.

Table 4.8: Per capita Tax Potential of the Country and the Regions (ETP)

Year	Per capital potential				
	Country	Amhara	Oromia	SNNP	Tigray
2003	250	292	393	347	462
2004	267	289	427	378	524
2005	317	300	461	284	620
2006	325	315	538	299	724
2007	580	361	605	340	577
2008	397	420	713	328	565
2009	426	457	541	437	992
2010	459	555	214	508	1079
2011	500	637	255	1026	1311
2012	532	620	268	1367	1329
Average	405.3	424.6	441.5	531.4	818.3

Source: computed based on data from MOFED, Federal Revenue and Customs and Regional Revenue Authorities, 2012.

The result in the above table brings an additional perspective to the analysis. If tax potential is adjusted by population, the ranking result changes dramatically. This suggests that apart from efficiency in collection of tax revenue of regions, other regional macro economic variables have to be taken into account when taxes are decentralized.

On average, Tigray region has high per capita tax potential, and when this potential is adjusted to the national per capita tax potential still it maintains its rank. For that matter, the lag tax effort of all regions when compared to the national lag tax effort gives different ranking level which is in contrast to RTS regional tax effort estimation. The potential reason for low and high lag tax effort of regions is mainly derived from the population size of the respective region. Therefore, higher per capita tax potential reflects high tax effort of the region and the reverse is also true. This point is particularly relevant in a country like Ethiopia which is characterized by a marked regional heterogeneity in terms of population, income, administrative capacities, and education levels as well as other difference.

Table 3.9 shows the lag tax effort of regions. For instance, Amhara region, the efficiency of tax collection effort is below the national level for the years 2005-2007. In the rest of the period, its tax collection effort is above the national level.

Table 4.9: Lag Tax Effort of the Regions

Year	Amhara	Oromia	SNNP	Tigray
2003	42	143	97	212
2004	22	160	111	257
2005	-17	144	-33	303
2006	-10	213	-26	399
2007	-219	25	-240	-3
2008	23	316	-69	168
2009	31	115	11	566
2010	96	-245	49	620
2011	137	-245	526	811
2012	88	-264	835	797
Average	19.3	36	126.1	413

Source: MoFED, Federal Custom, Regions Custom, 2012

Likewise, Oromia regional state scores below national tax effort during 2010-2012. But SNNP scores lower than national level of tax effort consistently for four fiscal years (2005-2008). Tigray regional state exhibited

higher tax collection effort when compared with the national level except for the year 2007.

5. Conclusion and Recommendation

5.1 Conclusion

The initial step that a region should follow prior to implementing new tax system or increasing the rate of revenue through the existing tax policy is to examine the tax effort, how far its actual tax revenue from its tax capacity, and examining the base for the various classes of tax. If region's tax effort is above unity would appear to be making use of its tax base to increase revenue. However, high tax effort of region may not be associated with high tax capacity since finding a composite index for measuring and benchmarking performance in taxation is both theoretically and practically challenging. The use of tax effort index which relates the actual tax collection of a country or region to its estimated taxable capacity is tempting because it takes into account the region's specific fiscal, demographic, and institutional characteristics as compared to its peers and hence provides a fuller picture of regions' tax performance in comparative terms.

The overall objective of this study is to investigate tax effort and tax potential of the four major regions of Ethiopia namely, Amhara, Oromia, SNNP, and Tigray using Representative Tax System. We were selective enough to incorporate the type of taxes revenue in the RTS analysis given their share on the overall regional tax revenue is taken as criteria. Personal income tax, Business profit tax and Value added tax are mainly the main source of tax revenue of the respective regions and the analysis explores about the nature and effect of such taxes on the overall fiscal performance of regions. In determining taxable capacity of the regions, greater emphasis rests on selection of proxy variables for base value of each tax family.

These estimates compare across four major regional governments of Ethiopia to ascertain the relative revenue-raising ability of each region. For that matter, Tigray regional state takes the leading power of high tax effort

and the least one is Amhara region and this resulted may not be derived from their tax potential feature rather from the intensity of tax collection schemes even with narrow tax base of the region. Finally, RTS enables policy-makers to estimate and compare the relative amounts of revenue that each sub-national government could derive from its own sources.

5.2 Recommendation

Tax effort is the ratio of actual tax collection to regional GDP and it measures how it takes from the entire economy in contributing to finance the public expenditure. However, the spending nature of the regions is by far greater than the revenue and great emphasis should be given to the tax revenue collection schemes at regional level. The findings demonstrate some possible options having sound contribution to enhance the tax revenue of the regions as well. Hence, we forward some policy implication to apply for attaining the self finance development strategy of the particular region.

First, at regional level, on average, tax-GDP ratio is extremely low which less than 10%. Then, greater attention should be given to expand the tax base for the existing informal and underground economic activities.

Second, even though higher level of recurrent expenditure might have an increasing effect to personal income tax, but this type of tax is institutionalized and doesn't have multiplier effect to the economy and its potential to generate future tax revenue is not significant. Then, minimize the trade off recurrent expenditure on tax revenue effort and better to incline to capital expenditure.

Third, indirect or commodity tax contributes more to the region's over all tax revenue schemes, but it lacks to incorporate all goods and service transacted within the region. Therefore, transaction like livestock in most regions is not included in tax column except SNNP and designing appropriate strategy to entertain in the tax administration system.

Fifth, the existing business profit tax is not promising, but expected to contribute more. Then, a lot should be done to the detail scientific investigation of the nature and performance of this type of tax revenue and act accordingly.

Sixth, using RTS examination of tax capacity and tax effort of the regions provides sound input for policy makers regarding the potential of regions in self financing. However, single peer's evaluation of tax effort might be mislead to concluded on ranking criteria for fiscal administration of country like Ethiopia having different socio-economic, geographic, cultural and ethnicity of regions. Hence, Per capita tax potential of regions should be compare with the national Per capita tax potential given population size plays great role in adjusting the tax effort.

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Appendices

Annex Table 1: Potential tax Vs Actual tax of families of taxes: SNNP (In Birr)

Year	PIT	tax potential(PIT)	BPT	tax potential(BPT)	VAT	Tax potential (VAT)
2003	6.29E+07	2.00E+09	1.80E+07	1.17E+09	5.23E+06	2.43E+08
2004	6.74E+07	2.26E+09	2.25E+07	1.32E+09	7.48E+06	2.75E+08
2005	7.22E+07	7.59E+08	2.82E+07	4.43E+08	8.47E+06	9.22E+07
2006	1.15E+08	8.93E+08	1.80E+07	5.21E+08	9.70E+06	1.09E+08
2007	1.54E+08	1.14E+09	2.09E+07	6.67E+08	1.22E+07	1.39E+08
2008	2.37E+08	2.09E+09	3.16E+07	1.22E+09	1.68E+07	2.53E+08
2009	3.17E+08	2.07E+09	4.51E+07	1.21E+09	1.91E+07	2.52E+08
2010	3.77E+08	2.85E+09	5.20E+07	1.66E+09	2.84E+07	3.46E+08
2011	5.01E+08	1.11E+10	1.24E+08	6.48E+09	3.67E+07	1.35E+09
2012	7.64E+08	1.66E+10	2.35E+08	9.72E+09	4.70E+07	2.02E+09

Annex Table 2: Potential tax Vs Actual tax of families of taxes: Roomier (In Birr)

Year	PIT	Tax potential(PIT)	BPT	Taxpotential (BPT)	VAT (000')	Tax potential (VAT)
2003	3.82E+07	8.31E+08	1.20E+07	1.90E+09	2.09E+07	3.96E+08
2004	4.36E+07	1.01E+09	1.76E+07	2.21E+09	2.10E+07	4.61E+08
2005	4.99E+07	1.24E+09	2.57E+07	2.69E+09	2.09E+07	5.60E+08
2006	6.70E+07	1.50E+09	1.90E+07	3.31E+09	2.66E+07	6.88E+08
2007	8.87E+07	1.75E+09	1.87E+07	2.64E+09	5.18E+07	5.50E+08
2008	1.39E+08	2.49E+09	3.25E+07	2.66E+09	5.20E+07	5.53E+08
2009	1.73E+08	2.91E+09	5.62E+07	4.78E+09	8.21E+07	9.96E+08
2010	1.97E+08	3.27E+09	8.96E+07	5.34E+09	1.11E+08	1.11E+09
2011	3.04E+08	4.38E+09	1.56E+08	6.67E+09	1.57E+08	1.39E+09
2012	4.56E+08	5.87E+09	4.42E+08	6.94E+09	2.05E+08	1.44E+09

Annex Table 3: Potential Vs Actual tax families of taxes: Tigray (In Birr)

Year	PIT	Tax potential(PIT)	BPT	tax potential(Bpt)	VAT(000')	Tax potential(VAT)
2003	3.82E+07	8.31E+08	1.20E+07	4.85E+08	2.09E+07	1.01E+08
2004	4.36E+07	1.01E+09	1.76E+07	5.92E+08	2.10E+07	1.23E+08
2005	4.99E+07	1.24E+09	2.57E+07	7.26E+08	2.09E+07	1.51E+08
2006	6.70E+07	1.50E+09	1.90E+07	8.76E+08	2.66E+07	1.82E+08
2007	8.87E+07	1.75E+09	1.87E+07	1.02E+09	5.18E+07	2.13E+08
2008	1.39E+08	2.49E+09	3.25E+07	1.45E+09	5.20E+07	3.02E+08
2009	1.73E+08	2.91E+09	5.62E+07	1.70E+09	8.21E+07	3.53E+08
2010	1.97E+08	3.27E+09	8.96E+07	1.91E+09	1.11E+08	3.98E+08
2011	3.04E+08	4.38E+09	1.56E+08	2.56E+09	1.57E+08	5.33E+08
2012	4.56E+08	5.87E+09	4.42E+08	3.43E+09	2.05E+08	7.13E+08

URBAN FOOD DEMAND IN TIGRAI, NORTHERN ETHIOPIA: AN ALMOST-IDEAL DEMAND SYSTEMS APPROACH

Zenebe Gebreegziabher^{1 2} and Kibrewossen Abay³

Abstract

This paper investigates urban food demand, using a dataset of 350 households in urban Tigray in northern Ethiopia. We applied an almost-ideal demand system to food. We analyze almost-ideal food demand systems of various consumption groups of food as cereals, vegetables and fruits, milk and milk products, meat, and stimulants and determine factors underlying urban food demand. More specifically, we empirically analyzed consumer's food choice especially in relation to cereals, vegetables and fruits, milk and milk products, meat, and stimulants as well as the level of demand for various food commodities of urban households'. We find strong expenditure elasticity of demand for vegetables and fruits, milk and milk products, and stimulants. However, the demand for cereals is unitary elastic and meat turned to be a necessity. We also find that vegetables and fruits, milk and milk products, and meat are own-price elastic. Moreover, we also find that a one birr reduction in price of vegetables improves calorie intake by 6954.3 calories while the gain from similar reduction in price of meat is 6901.5 calories.

Keywords: own price elasticities, expenditure elasticities, calorie elasticity, almost-ideal food demand systems, Tigray, Ethiopia

JEL Classification: D1, D12, R22

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1. Introduction

There is wide range of policy questions for which knowledge of consumer behavior or empirical food demand analysis is of importance (Sadoulet and de Janvry 1995). Firstly, the levels and composition of food consumption are major determinants of the nutritional well-being of individuals, which in turn, have important implications for health, productivity, and income of citizens. Therefore, analyzing food demand (consumption patterns) is important for definition of policy interventions to improve the nutritional status of citizens (i.e., individuals, households or individuals within households as infants and pregnant women) and food security. This is particularly pivotal in poor countries such as Ethiopia. Secondly, empirical food demand analysis is important for a country's strategy of food subsidies especially in determining which commodities to subsidize in order to minimize the budgetary cost of nutritional improvement and food security programs. For example, as a result of the inflation that started increasing since 2005 and the apparent increased food insecurity in urban areas, the Government of Ethiopia (GoE) initiated an urban grain market stabilization program in 2007. The program initially started in Addis Ababa and was expanded to cover 12 urban centers. Since April 2007, the GoE has sold over 420,000 MT of wheat to urban consumers at a subsidized price and has continued with the program in 2008 and 2009 with further grain imports for the program (WFP 2009). So, the determination of which commodities to subsidize in such programs should be based on proper knowledge of the food demand structure in particular region/ context.

More importantly, vulnerability to shocks is believed to be more serious in urban areas than in rural areas (MoFED, 2006). This was partly due to the fact that urban households lack asset such as land and livestock, which are available in rural areas. Rural people have more social and economic networks and traditional values to mitigate vulnerability compared to rural people. For example, the GoE also took some fiscal and monetary measures in 2008 by lifting certain taxes from food commodities (especially oil), as well as measures to curb the excess supply of money (WFP 2009). With further increases in cereal, pulses and oil prices expected as a result of the

general global price increases and reduced production from imminent climate change, it is becoming even more important to understand and monitor urban people's vulnerability to these changing circumstances and recommending sustainable interventions is of paramount importance as shocks and hazards affecting urban food insecurity may ultimately lead to famine in the extreme, as some call it 'the new face of hunger' (Sheeran, 2008a,b). Moreover, over the last few years urban areas become prone to social unrest, as has been highlighted by the food riots and unrest in some countries (Adam, 2008). Empirical food demand analysis is pivotal to understanding the drivers of urban vulnerability and food insecurity.

Moreover, unlike many other countries (e.g., rice in most of East Asia, maize in Latin America, or cassava in Central Africa) no single commodity dominates the national food basket of Ethiopia and food demand patterns are diverse. That is, the Ethiopian food basket consists of a wide variety of grains and other staples although consumption levels and mixes of these grains vary widely according to differences in region/agro-ecology, socioeconomic status, livelihood strategies including rural versus urban. Besides, like in many other traditional societies, dietary preferences and consumption patterns are heavily influenced by cultural values and traditions and may not necessarily reflect availability or the nutritional quality of specific food items (Berhane et al 2012). Hence, regional studies such as this would enhance our understanding of the factors underlying such diverse dietary preferences.

However, more importantly, urban households' food choices are expected to involve considerable interdependencies among the various food items consumed. Therefore, understanding of the interdependencies, i.e., complementarities or substitution among the various foods consumed is a key to several questions of policy interest. For instance, questions of optimal policy or mix of policy instruments. Specifically, suppose that there are two food commodities in question, i.e., food A and food B. So, if the two foods are related or interdependent, then a unilaterally conceived food policy will obviously be a failure. But, more importantly, the nature of the interdependencies or relationship among/between the foods also matters

in terms of shaping food policy. For example, if food A and B are 'perfect' complements, then a food policy focusing/targeting on B might do the trick. However, if the relationship, i.e., complementarities between the two food commodities is only tenuous or weak, then, such a food policy instrument targeting only on food B would also give rise to a distortion in the use of B, besides to the corrective effect. So, in such cases, the use of an additional policy instrument might be required to improve on the allocation. A similar parallel analogy could also be made when the two food commodities are substitutes instead of complements. Therefore, understanding of the interdependencies i.e., complementarities or substitution among the various fuels used by urban households would inform policy in terms of what should an optimal one and what should it involve/contain? Moreover, the fact that the choices might be interdependent also calls for a theoretically consistent empirical framework that allows for or captures these interdependencies.

There have been some encouraging developments since early 1990s with the end of the civil war and a change of government. Since early 1990s, the current government has embarked an aggressive economic reform programs to revive the economy and accelerate growth as rapidly as possible including big push on social and physical infrastructure, opening up the economy and building institutions and decentralizing fiscal and political decision power to lower tiers of government. In this process, the government has placed due attention to eradicate rural and urban poverty and attempts has been in place to cut current widespread rural and urban poverty by half in 2015 (World Bank, 2005; Gebremedhin, 2006; MoFED, 2006). As recent official government statistics revealed, economic reform in Ethiopia has brought about significant changes in economic growth at national level. Ethiopia has witnessed a double digit growth (i.e., 11.2% growth in real GDP) (MoFED, 2010) and this growth performance effectively surpasses the 7 % annual rate required for attaining the MDG of halving poverty by 2015 (ADB, 2010). Understanding the impact of these economic growth on urban consumption pattern provide valuable policy information on the effectiveness of policies designed to promote nutrition, food security and poverty alleviation.

There is also a need for carefully monitoring urbanization in Ethiopia. As in many developing countries rapid urbanization is placing heavy demands on urban marketing systems. Investment in these systems has been woefully inadequate, and understanding urban expenditure patterns is a first step in addressing these problems. Second, government policy is heavily focused on cereal production. But if there is change in consumption and expenditure patterns over time policy needs to reflect this changes mainly stimulating production of food items with high demand. Therefore, understanding consumption expenditure on different food items provides an insight into status of welfare changes and is helpful in planning future investment decisions.

For this paper, we investigated urban food demand, using a cross-sectional data of 350 urban households, drawn from stratified samples of seven urban centers in Tigray, northern Ethiopia, in the year 2004. We applied an almost-ideal demand system to food. We analyze almost-ideal food demand systems of various categories of food as cereals, pulses, vegetables, livestock products, etc and determine factors underlying urban food demand. Object is to, describe and empirically analyze urban food demand in Tigray. More specifically, we empirically analyzed consumer's food choice especially in relation to vegetables and livestock products and the level of demand for various food commodities of urban households'. In doing so, we looked at substitution or complementarities between/ among various food commodities and draw insights (implications) that may be useful for public policy. Finally, we looked at the implications of our findings in terms of key policy questions.

The remaining of the paper is organized as follows. In the next section, we briefly review urban food demand, calorie intake and food policy. Section 3 presents the model for fuel demand and the implications, using comparative static analysis. Section 4 presents the econometric model and section 5 describes the study area and the data. In sections 6, we discuss the results, and section 7 concludes.

2. Urban Food Demand, Calorie Intake and Food Policy: Review

In order to examine food consumption pattern and its determinants, it is useful to begin with a review of the economic theory of consumer behavior. In a standard household model, households use their resources (e.g., labor, skills, land and equipments) to achieve the highest level of intended utility (satisfaction) possible. This decision could be determined by the income level, preference and market prices (Deaton and Muellbauer 1980a, b; Sadoulet and de Janvry 1995) (Ruel, Minot, Smith, 2005). Preferences also affected by household composition, its members' knowledge and education habit and cultural norms, personal experience, and by biological factors that affect hunger.

The assumption that households pool resources and have a single set of preferences has been questioned by research on the intrahousehold allocation of resources and gender role within the household (unitary versus collective models). Empirical researches have shown that the husbands and wives have often unequal control over resources, that they may not pool income, and that their consumption priority may differ. Some alternative household models assume a cooperative solution in which distribution of benefits depends on the bargaining position of each based household. In general, the consumption patterns may vary with legal and socio-economic status of each partner and their ability to monitor each other's behavior (Ouisumbing, 2003).

Economic theory of consumer behavior postulates that the demand for high value food items (e.g., meat, milk, vegetables and fruits) increases with increase in income. These food items are also expensive sources of calorie. This also implies that poor households are unlikely to access them. This is mainly because high-value foods tend to be expensive source of calorie intake for them. Hence, poor households must prioritize to fulfill their basic calorie requirement to avoid hunger. Obviously, households with income near to subsistence level, consume large quantities of grains and starchy staples and few fruits, vegetables, meat, milk and milk products (Minot 1992).

On the other hand, consumer preferences shape the decision of consumer what to consume. Poor households, until they meet physiological needs to satisfy hunger, they have little choice but to focus on cheap sources of energy such as grains and starchy staples. Once they satisfied their basic calorie requirements, then, household start to diversifying their diets by including more expensive animal food sources, dairy products and fruits and vegetables (Ruel, Minot, Smith, 2005). Bopape and Myers (2007) analyzes food expenditure patterns in South Africa, taking into account differences in demand behavior across rural and urban households, as well as across income groups using the QUAIDS model. They find that demand behavior differs significantly between rural and urban households as well as across income groups, suggesting that an accurate analysis of expenditure patterns in South Africa requires a disaggregated analysis that takes into account these differences in demand behavior.

There are few earlier studies of poverty in Ethiopia mainly focused on rural rather than urban areas (Bigsten *et al*, 2003). Neither of these studies analysed change in consumption pattern in the urban Ethiopia. There are few studies that explored the poverty situation of urban households in Ethiopia both in a static and dynamic context. However, they centered on assessing the poverty-impact of growth in the spirit of a series of similar studies elsewhere. None of them were focus on changes in consumption patterns of urban areas. No previous study in the context of Tigray.

Berhane et al (2012) analyze consumption patterns and calorie intake of selected food grains across rural and urban locations, agro-ecological zones, and income groups in Ethiopia. Their research focuses on the six principal staples in the country: teff, wheat, maize, sorghum, barley, and enset – often called “False Banana.” They find that, In general, calorie consumption across Ethiopia is low, but a high percentage of this consumption is coming from cereals. That the purchase of processed cereals and non-cereal food is low and the proportion of income spent on (raw) cereals is high perhaps due to the underdeveloped food processing sector in the country. Moreover, due to the wide diversity geographical and socio-cultural contexts, there is much variation in Ethiopia’s food consumption patterns.

They emphasize that it is important for policymakers to consider the cultural aspects to consumption besides to mere price and location-related factors. In terms of regional preferences, they find that Afar, Somali, Harari, and SNNP consume the lowest amounts of cereals. *Teff* is found to have highest income elasticity among cereals in both urban and rural areas, implying the demand *teff* will increase as incomes grows. The demand for sorghum is In contrast, due to the negative income elasticity of sorghum in urban environments, likely to decrease as incomes increase.

Tafere and Worku (2012) estimate elasticities of livestock products using CSA's (Central Statistical Agency's) Household Income, Consumption, and Expenditure Survey (HICES), the Welfare Monitoring Survey (WMS), and Retail Prices of Goods and Services of 2004/05 datasets. They used Quadratic Almost Ideal Demand System (QUAIDS) model for their econometric analysis. They find that livestock products account for a very small share of total household expenditure and food expenditure, even by African standards. They also find a remarkable difference in the composition of livestock products consumed across rural and urban areas. Not surprisingly, their study also reveals that relatively wealthier households tend to consume higher amount of livestock products. We chose for its efficiency and reliability of results. Their estimated elasticities reveal that there is a considerable expenditure and price response for livestock products in Ethiopia and those rural areas have higher expenditure elasticities than urban areas. Furthermore, price responses are higher in rural areas than urban areas. Similarly, own-price responses exhibit wide variation across commodities. We also found a strong substitution relationship among most livestock products. Kuma (2009) investigate the phenomenon of changes in consumption expenditure in urban Ethiopia, i.e., Addis Ababa city and six major towns, using two rounds (1994 and 2004) household survey data from the Ethiopian Urban Household survey (EUHS) for ten food categories. He employed Working-Lesser expenditure share model to estimate income elasticity of demand and determinants of urban household consumption. He finds that urban household consumption patterns started to shift from staple food grains to high value food products, as exemplified by a much lower estimated income elasticity of

demand for cereals, pulses and spices as compared to those of non-staple high value products. This ongoing transition in food consumption pattern will affect domestic food market that supply side policy intervention highly recommended to meet increasing demand for high value food items.

3. Theory of Consumer Behavior: Comparative Static Analysis

The intention of this section is to explain how a rational consumer chooses what to consume when confronted with constraints imposed by prices and limited income.

Consider a consumer who derives utility from consumption of a vector of n commodities denoted by q . Furthermore, assume that vector q includes broader categories of consumption goods, such as food, fuel, and non-fuel non-food. Let u denote the utility the consumer derives from consuming these goods. Following the standard formulation of utility function (see Deaton and Muellbauer 1980; Sadoulet and de Janvry 1995), the household's utility function can be written as:

$$u(q; z), \quad (1)$$

where z stands for the vector of individual characteristics of the household (consumer). The budget constraint is:

$$p'q = y, \quad (2)$$

where p' is an n -dimensional row vector of prices; and y is the amount of income that can be spent on the different commodities. Note that our analysis focuses on food commodities. Assuming preferences are weakly separable across the broad category of consumption goods as food, fuel, and non-food non-fuel. Then, q can be viewed as a vector food commodities consumed by the family and p vector of food prices and y is the expenditure or amount of income that can be spent on the different commodities. The objective of the consumer is to maximize utility by choosing q , subject to the budget constraint given in equation (2). Therefore, the Lagrangean of the consumer's maximization problem can be rewritten as:

$$L = u(q, z) + \lambda(y - p'q) , \quad (3)$$

where q , z , y and p are as in above and λ is a Lagrange multiplier. Solving for the Lagrangean function in equation (3), we get a set of $i = 1, \dots, n$ observed food demand equations as:

$$q_i = q_i(p, y; z) . \quad (4)$$

Upon partially differentiating equation (4) with respect to income y , and prices p_j , we get n income and n^2 price slopes. Then, multiplying the income slopes and price slopes by their respective income/quantity and price/quantity ratios, we get n income elasticities and n^2 price elasticities that are useful for comparative statics:

$$\frac{\partial q_i}{\partial y} \frac{y}{q_i} = \eta_i , \text{ and} \quad (5)$$

$$\frac{\partial q_i}{\partial p_j} \frac{p_j}{q_i} = \varepsilon_{ij} . \quad (6)$$

In comparative-static analysis, the objective is to determine how an economic variable of interest—for example, quantity demand of food in our case—responds to changes in the value of some parameter or exogenous variables. Simply put, we want to know how the optimal choice changes as a parameter changes.

Deaton (1990) assumed that “geographically clustered households,” (i.e., households residing in the same area) face the “same prices.” While the sign of the cross-price variables might not be predicted beforehand, own-price variables are expected to have negative signs.

4. Econometric Model, Data and Study Area

4.1 Econometric model

The econometric model or empirical framework outlined here is used with demand equations and budget shares of specific food commodities (such as cereals, pulses, vegetables, livestock products, stimulants as coffee and processed food), in relation to a household's total expenditure. In general, food expenditure accounts for about 60% of a household's total budget.

Models that help analyze consumption pattern include linear expenditure system, Trans log model, and Almost Ideal Demand System (AIDS). For the empirical demand analysis, we used the almost-ideal demand system. This demand system derives from a utility function specified as a second-order approximation to any utility function (Sadoulet and de Janvry 1995). Many empiricists favor the AIDS model for some desirable features and it is the widely used model of analyzing expenditure patterns. One of the desirable features of AIDS model is that it is locally flexible. That is, a commodity luxurious for one household can be a necessity for the other depending on share of expenditure for that commodity group. Another important feature of AIDS model is that it is possible to impose restrictions on the parameters; depending on local context or principles of economics. Due to these reasons we have use the AIDS model in this study as well. The specific model used in this study for estimation is specified as:

$$w_j = \alpha_j + \sum_{i=1}^m \gamma_{ij} \ln P_i + \beta_j \ln(PCE) + \delta Z + u \quad (7)$$

Where;

w_j is expenditure share of consumption group 'j';

P_i is price index of consumption group 'j' (see the discussion below on how price indices are calculated);

m- total number of consumption groups (in our study there are five consumption groups);

PCE- per capita expenditure⁴;

Z- represents household level variables that may influence decision on expenditures.

Price index of each commodity is calculated by Stone Geary formula which is given by:

$$P_i = \prod_{x=1}^n (P_x)^{\epsilon_x} \quad (8)$$

Where;

P_i - price index of consumption group 'i';

X- each commodity in consumption group 'i';

P_x - price of commodity 'x' in consumption group 'i';

ϵ_x - expenditure share of commodity 'x' from total expenditure of group 'i'.

After estimation of the parameters in the model, expenditure and price elasticity of demand can be calculated as follows:

$$\text{Expenditure elasticity} = \eta_j = \frac{\beta_j}{w_j} + 1 \quad (9)$$

$$\text{Own price elasticity} = \epsilon_{j,j} = -1 + \frac{(Y_{jj} - \beta_j w_j)}{w_j} \quad (10)$$

4.2 Data, sampling, and study area

One period data is collected in from a stratified sample of 350 urban households in Tigray.

A questionnaire was developed and used to collect data on food and non-food non-fuel expenditures. Data include expenditure on the different foods consumed (cereals, pulses, vegetables, animal products, stimulants as

⁴ If a study uses a panel data real per capita expenditure (RPCE) should be used instead of PCE so as to account for inflation or deflation. In this study, however, we have used a cross section data and there is no-need of using real per capita expenditure.

coffee, sugar, processed food as bread, macaroni and pasta), family size, employment type, age and education of head of household. Table A1 in the Appendices presents summary statistics of variables considered especially in relation to the food items consumed and their budget shares.

Urban centers in the study area are categorized as four settlement types: city, large, medium, and small towns, based on their population ($>100 \times 10^3$, $25-100 \times 10^3$, $5-25 \times 10^3$, and $<5 \times 10^3$, respectively) (see Table A2 in the Appendices). The 1994 Population and Housing Census (CSA 1995) identified a total number of 74 towns in Tigray. Focal towns were identified, subject to time and budget constraints.

To get an idea of the current population, and basing the sample on this figure, the population of the focal towns was projected to 2000 and 2003. Then, proportionate sampling by importance of town size by population share was applied to this estimate of the current population.

Tigray is the most northern region of Ethiopia bordering with Eritrea in the north, Sudan in the west, Afar in the east and Amhara in the southwest. The region had an estimated population of over 4.3 million at the end of 2007, of which about 19.5% lived in urban areas (CSA census report, 2007). More than 58% of the total population were living in absolute poverty (earning less than a dollar a day), which makes the region's situation more serious compared to the national average (44.4%).

5. Discussion of Results

5.1 Descriptive analysis

i) Demography

The sample covers five cities in Tigray. Table 1 below summarizes average family size, age of household head, and the higher level of education achieved by the head.

Table 1: Sample mean of family size, age and education level of household head by town category

City/ Town	Family size	Age of household head	Education level of household head
1	5.3	49.8	2.85
2	5.1	48.8	1.9
3	4.9	51.7	2.5
4	4.7	55.6	2.34
5	4.4	47.7	1.25
6	4.1	47.8	1.28
7	4.4	44	1.64
Average among cities	4.9	49.3	2.2
Correlation with family size	---	0.223*** (0.000)⁵	0.27*** (0.000)

Average family size in the sample is 4.9 and average age of head of households is 49.3 years. There is a positive and significant relationship between age and family size. This result is not surprising for the reason that aging households have relatively longer reproductive period. Family size also has positive and significant correlation with household head's level of education.

ii) Expenditure groups and household characteristics

Consumption items are divided in to five⁶ groups; cereals, vegetables and fruits, milk and milk products, meat, and stimulants. The main criteria used for classification is that there should not be substitutability or complementarities among groups. Rather consumption items that have such relationship should be included in one group.

Table 2 summarizes different household characteristics and expenditure share of consumption groups.

⁵ The term in parentheses is level of significance

⁶ The classification is adopted from EDRI (I need proper citation)

Table 2 Household characteristics and expenditure share of consumption groups by town category

City/ Town	Percentage of households			Per capita expenditure	Expenditure share of	
	With female head	with literate head	Who own livestock		vegetables and fruits	Milk and milk products
1	39	69	5.8	1049	6.1	3.6
2	52	54	5.4	775	6.4	2.5
3	56	44	9.4	892	5.9	3.1
4	42	71	4.2	987	6	2.2
5	58	42	0	728	5.5	0.8
6	44	38	6.25	850	6.4	4
7	50	42	11.1	855	6.4	3.6
Average	46	56	6.29	907	6.2	3.1
<i>Effect of head's sex on</i>					Insig.	**
<i>Effect of literacy on</i>					Insig.	**
<i>Participation in urban agriculture (livestock)</i>					**	***
<i>Per capita expenditure</i>					Insig.	**

Sex of household head has a positive and significant (at 5%) effect on expenditure share of milk and milk products. Other household characteristics including literacy of household head, participation in urban agriculture (approximated by ownership of livestock), and per capita expenditure have positive and significant effect on expenditure share of milk and milk products.

As could be clear from Table 2 in above the only variable that has a significant effect on expenditure share of vegetables and fruits is participation in urban agriculture.

iii) Price index of consumption groups across cities

Table 3 presents expenditure share and price index of consumption groups by town category. As could be seen from the table price of a kilogram of cereals and vegetables turns out to be more or less similar.

Table 3: Expenditure share and price index of consumption groups by town category

City/ Town	Cereals		Meat		Vegetables and fruits	
	Expenditure share (in percent)	Price index (in birr)	Expenditure share (in percent)	Price index (in birr)	Expenditure share (in percent)	Price index (in birr)
1	65.7	2.91	17.3	61.6	6.1	2.47
2	69.8	2.4	13.1	39.1	6.4	2.7
3	70.4	2.49	12.5	40.3	5.9	2.18
4	66.7	2.61	16.5	52.5	6	2.48
5	71.7	2.44	13.1	34.4	5.5	2.27
6	61.8	2.65	16.9	41.9	6.4	2.75
7	66.2	2.4	14.3	36.6	6.4	2.69
Average	67.2	2.62	15.2	47.76	6.2	2.55

As is evident, a lion's share of consumption expenditure, i.e., 67.2% also goes to cereals. Cities with relatively lower expenditure share on cereals have relatively higher expenditure share of meat. The two cities with higher expenditure share of meat also have higher price index of meat. This suggests higher expenditure share on meat comes more from higher price than consuming higher amount.

Expenditure share on vegetables doesn't show variation with cereals and meat which indicates there is some degree of substitutability between cereals and meat but not with vegetables. Share of vegetables is fairly similar across cities as well and it doesn't suggest correlation with price.

5.2 Econometric analysis

Effect of per capita expenditure on expenditure pattern

One of the key variables in understanding consumption pattern is per capita expenditure. Measuring the effect of this variable helps us understand how extra expenditure made on consumption is allocated among different consumption groups and predict effect of increment on per capita expenditure (growth in income) on demand of different commodities.

Table 4: Per capita expenditure elasticity of demand for commodity groups

Consumption groups	Effect of a 1% increment in PCE on expenditure share of (%)		Per capita expenditure elasticity
<i>Cereals</i>	1.8		1.03
<i>Vegetables and fruits</i>	-0.74	(*)	0.88
<i>Milk and milk products</i>	4.7	(***)	2.5
<i>Meat</i>	-1.3		0.46
<i>Stimulants</i>	-4.5	(***)	0.92

(*)- Significant at 10%; (**) - Significant at 5%; (***) - Significant at 1%

Expenditure share of cereals is insensitive to changes in per capita expenditure. Relatively poorer and richer households have fairly similar pattern of expenditure on cereals. Technically, this means expenditure elasticity of cereals is unitary elastic; consumption expenditure on cereals increases at the same rate with rise in per capita expenditure such that share of this commodity group remains unchanged.

The result is the same for meat items (beef, mutton, and chicken) as well. From these results we can conclude that cereals and meat are treated as necessity items.

Per capita expenditure has a significant (at 10% level of significance) and negative effect on consumption share of vegetables and fruits. Calculated expenditure elasticity of vegetables (the second column) shows that as expenditure increases by one 1%, expenditure on vegetables also increases by 0.88 %. This value of elasticity is inelastic, which means expenditure on vegetables responds less proportionately than total expenditure. This results in decrement of budget share of vegetables as income expenditure increases.

The commodity group that has a positive and significant impact is milk and milk products (like butter and cheese). Expenditure elasticity of milk is 2.5 (very elastic) which suggests this commodity group is a luxury. A 1% increment in per capita consumption expenditure leads to a 4.7% increment on expenditure share of this commodity group.

Changes in price and expenditure pattern

In this section we investigate changes in consumption pattern due to price variations. Own price elasticity for each commodity group is also calculated which will enable us to have a clear picture of how price influences consumption behavior.

Table 5: Price elasticity of own expenditure and own price elasticity

Commodity group	Effect of a 1% increment in price index of each commodity group on its own expenditure share (%)		Own price elasticity
<i>Cereals</i>	4.4 ⁷		-0.95
<i>Vegetables and fruits</i>	2.5	(***)	-0.58
<i>Milk and milk products</i>	0.28		-0.96
<i>Meat</i>	-2.4	(**)	-1.15
<i>Stimulants</i>	4.0	(***)	-0.47

(*)- Significant at 10%; (**) - Significant at 5%; (***) - Significant at 1%

Expenditure share of cereals is not sensitive to changes in price of cereals. Expenditure on cereals is unitary elastic to price changes; absolute expenditure changes proportionately with changes in price, that share of cereals remain the same irrespective of level of price.

Commodity groups that show significant variation in their expenditure share due to changes in their own price are vegetables, meat, and stimulants. Own price elasticity of vegetables is inelastic (-0.58); which means expenditure on vegetables responds less proportionately than price increments. As a result expenditure share of vegetables increases with increment of price of vegetables.

Own price elasticity of meat, on the other hand is elastic. Respective decrement on expenditure of meat is higher than the increment in its price. Due to this expenditure share of meat decreases as price of meat increases.

⁷ This column indicates own price elasticity of each consumption group. The first row in this column, for example, shows price elasticity of consumption of cereals to changes in price of cereals, and the second row price elasticity of vegetables to changes in price of vegetables, etc.

Stimulants have inelastic price elasticity. The result is understandable from the fact that stimulants are usually addictive, that people will find it difficult to cut expenditure on these items despite increases in price. The result on the expenditure share column shows expenditure share of stimulants increases with price.

Calorie elasticity

We have considered only two consumption group as for discussion on calorie elasticity. From the section above we can see that there are three consumption groups (vegetables, meat, and stimulants) with significant own price elasticity. Stimulants (which include coffee, tobacco, chat etc) have very little or no calorie at all. Hence, we have decided to drop this group and focus on other groups in this section.

Table 6: Calorie elasticity and calorie gain to price reduction

Consumption group	Calorie elasticity (Gains in calorie intake from a percentage reduction of price)	Calorie gain from a birr (Extra calorie gained from a 1 birr reduction in price)
<i>Vegetables and fruits</i>	0.58% (176.9 calories)	6954.3 calories
<i>Meat</i>	1.15% (3293 calories)	6901.5

A one percent reduction in price of vegetables and fruits improves calorie intake from vegetables by 176.9 calories. An equal percentage decrement (1%) in price of meat improves calorie intake of an individual by 3293 calories.

An important point to be mentioned from the table is that price of meat is expensive; which means a 1% reduction in price of meat entails a larger expense (as an example large amount of money required to be spend as subsidy) than a similar percentage reduction on price of vegetables. Results in column two are results of such a calculation. We can see from the table that a one birr reduction in price of vegetables improves calorie intake by

6954.3 calories while the gain from similar reduction in price of meat is 6901.5 calories.

7. Conclusions

The study aims to understand the determinants of urban food demand in Tigray. More specifically, the objectives of the study are to describe food consumption patterns in urban Tigray and to empirically analyzed consumers' food choice and demand for various food commodities of urban households in the region. The following conclusions can be drawn.

First, that food consumption patterns in urban Tigray is dominated by cereals with teff and wheat accounting for 50% of food expenditure. Consumption of animal products (high value proteins) is limited and accounts for 10% of food expenditure. Moreover, price of related good, household income, characteristics as employment type and education of head important in the decision to consume.

Second, we find strong expenditure elasticity of demand for vegetables and fruits, milk and milk products, and stimulants. However, the demand for cereals is unitary elastic and meat turned to be a necessity. We also find that vegetables and fruits, milk and milk products, and meat are own-price elastic. Moreover, we also find that a one birr reduction in price of vegetables improves calorie intake by 6954.3 calories while the gain from similar reduction in price of meat is 6901.5 calories.

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Appendices

**Table A1: Summary Statistics of Variables Considered in the Analysis
(n = 350), 2003**

Variable	Mean	Std. dev.	Min.	Max.
Family size	4.925	2.196	1	10
Age of household head	49	14	18	95
Education of household head/highest grade completed				
<i>Illiterate (percent)</i>	39%			
Grade 1-3	15			
Grade 4-6	18			
Grade 7-8	11			
Grade 9-11	5			
Grade 12 and above	12			
Employment type/occupation of household head				
<i>Self employed (in percent)</i>	69%			
Public employee	16			
Private employee	15			
Total expenditure (in ETB)	6,910	5,087	1,045	46,398
Budget share of food	0.620	0.112	0.085	0.875
Budget share of fuel	0.206	0.080	0.018	0.469
Budget share of other goods and services	0.174	0.117	0	0.878

Table 1: Food consumption patterns (kg per capita/year)

variable	City	Large towns	Medium towns	Small towns
Cereals				
Teff	140.22	92.90	127.10	108.75
Wheat	55.52	75.19	69.57	59.54
Barley	2.89	10.33	14.89	12.14
Bread	5.30	6.23	1.84	2.93
Rice	0.17	0	0.6	0
Pulses				
Beans	4.19	5.37	5.06	2.47
Peas	5.61	5.53	6.60	5.91
Vetch	5.57	0	1.64	10.46
Lentils	3.19	2.43	2.70	4.19
Chickpeas	1.18	1.01	2.17	2.01

Table 1 continued

variable	City	Large towns	Medium towns	Small towns
Vegetables				
Potatoes	6.42	7.03	9.39	7.85
Tomatoes	10.83	10.51	15.14	9.82
Onions	14.07	11.02	13.37	12.13
Animal Product				
Milk	3.56	4.10	0.658	2.19
Beef	4.11	3.17	3.46	3.34
Mutton	0.55	.30	0.52	0.56
Other meat	1.90	1.31	1.34	2.15
Butter	0.85	0.61	0.75	0.50
Eggs	1.73	1.13	1.18	1.72

Table 1 Continued

variable	City	Large towns	Medium towns	Small towns
Oilseeds				
Linseed	0.12	0.31	0.14	0.05
Sesame	0.09	0	0	0.32
Others				
Coffee	3.35	3.26	3.41	4.58
Sugar	5.92	3.63	4.52	4.41
Macaroni	5.92	2.86	1.46	1.36
Pasta	1.52	1.66	1.00	0.82

Table 1 continued

Variable	Obs	Mean	Std. Dev	Min	Max
Consumption of particular food item					
Cereals					
Teff	350	.9342857	.2481367	0	1
Wheat	350	.8457143	.3617396	0	1
Barley	350	.2714286	.4453333	0	1
Rice	350	.0257143	.1585082	0	1
Bread	350	.4514286	.4983477	0	1
Pulses					
Lentils	350	.6314286	.483108	0	1
Beans	350	.4971429	.5007076	0	1
Peas	350	.6189112	.4863516	0	1
Vetch	350	.4057143	.4917327	0	1
Chickpea	350	.1257143	.3320017	0	1
Oilseeds					
Linseed	350	.0857143	.2803425	0	1
Sesame	350	.02	.1402004	0	1

Table 1 continued

Vegetables					
Potatoes	350	.8371429	.3697639	0	1
Tomatoes	350	.9542857	.2091638	0	1
Onions	350	.9742857	.1585082	0	1
Animal					
Milk	350	.1742857	.3798981	0	1
Butter	350	.3828571	.4867798	0	1
Beef	350	.8857143	.3186135	0	1
Mutton	350	.5828571	.4937928	0	1
Other meat	350	.9314286	.2530857	0	1
Eggs	350	.6657143	.4724155	0	1
Processed					
Macaroni	350	.3685714	.483108	0	1
Pasta	350	.2628571	.4408157	0	1
Stimulants					
Coffee	350	.9485714	.2211865	0	1
Sugar	350	.9628571	.1893825	0	1

Variable	Obs	Mean	Std. Dev	Min	Max
Consumption of particular food item					
Cereals					
Teff	350	.9342857	.2481367	0	1
Wheat	350	.8457143	.3617396	0	1
Barley	350	.2714286	.4453333	0	1
Rice	350	.0257143	.1585082	0	1
Bread	350	.4514286	.4983477	0	1
Pulses					
Lentils	350	.6314286	.483108	0	1
Beans	350	.4971429	.5007076	0	1
Peas	350	.6189112	.4863516	0	1
Vetch	350	.4057143	.4917327	0	1
Chickpea	350	.1257143	.3320017	0	1
Oilseeds					
Linseed	350	.0857143	.2803425	0	1
Sesame	350	.02	.1402004	0	1

Table A1: Continued Budget shares of particular food item

Variable	Obs	Mean	Std. Dev.	Min	Max
Cereals					
bshateff	350	.2194296	.1082829	0	7360552
bshawhea	350	.0959749	.0862137	0	.6158525
bshabarl	350	.013817	.0308719	0	.2035319
bsharise	350	.0003335	.0029911	0	.0490961
bshabrea	350	.0045538	.0164883	0	.2021336
Pulses					
bshalent	350	.0075949	.0086066	0	.0442059
bshabean	350	.0117897	.0173461	0	.0795404
-----+-----					
bshapeas	350	.0113548	.0132673	0	.0752666
bshalins	350	.0006159	.0024912	0	.0234911
bshasesa	350	.0002389	.0018409	0	.0207684
bshafetch	350	.0082359	.014379	0	.1179812
bshacheapeas	350	.0019977	.0068963	0	.0665041
-----+-----					
bshapota	350	.0099101	.0081573	0	.0638978
bshatoma	350	.0153487	.0102296	0	.0653381
bshaonio	350	.0219825	.0120656	0	.090703
bshamilk	350	.0043403	.0131238	0	.1152215
bshabutt	350	.0077937	.013035	0	.085676
-----+-----					
bshameat	350	.030072	.0220734	0	.1633987
bshamutt	350	.0451775	.0493816	0	.2186323
bshachic	350	.0152726	.0094281	0	.0582581
bshaeggs	350	.0028302	.0033685	0	.0240525
bshamaca	350	.0054013	.010463	0	.1029866
-----+-----					
bshapast	350	.0033346	.0084532	0	.1098524
bshacoffee	350	.0307691	.0203127	0	.1273435
bshasugar	350	.0194739	.0115752	0	.0668524

^a Unit values were used as proxies for prices.

Note: ETB = Ethiopian birr; ETB 1 = US\$ 0.116 during the survey period.

Table A2: Criterion for Classification of Urban Area(s) into Settlement Typologies

Settlement typology	Criterion (population or number of inhabitants)
City	$> 100 \times 10^3$
Large town	$25 - 100 \times 10^3$
Medium town	$5 - 25 \times 10^3$
Small town	$< 5 \times 10^3$
<i>Source:</i> Gebreegziabher (2007)	

DETERMINANTS OF CHILD LABOUR: THE CASE OF ENDERTAWOREDAO TIGRAY REGION

Teame Baraki¹

Abstract

This study was conducted with the objectives of identifying the main determinants of rural child labour based on data evidence from Enderta woreda, in Tigray national regional state. A survey data of 200 rural households was collected from 8 tabias based on two stage stratified probability sampling method using the distance of each tabia from Mekelle city as a stratum. The multinomial logit model was used to identify the socioeconomic and demographic factors that determine households' decisions on child time allocation based on four probable statuses of child's time use. Gender disaggregated bivariate probit model was used to identify the impact of the socioeconomic factors according to sex of the children. The results of the analyses showed that maternal literacy, financial assets, proximity to urban area encourage child's school attendance while number of livestock, distance to water and fuel source areas, engagement in off farm activities and large farm size worsen the demand for child labour. The findings of the study revealed that there is a gender bias in the impacts of the factors on the probabilities of child's working and his/her school attendance. The study suggested the need for enforcement of policies that encourage rural family planning, increasing adult education in rural areas, increasing urban rural linkages, promoting legally organized community based grazing system and the expansion of water supply and use of biofuel technologies in rural areas.

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1. Introduction

Many economists argue that child labour is a symptom of an existing poverty and a cause for future poverty. The ILO conventions of 138/1973 and 182/1999 stress that child labour is a work that deprives children from having healthy childhood, their dignity, their physical and mental development. The global magnitude of the spread of the problem is still large although there are some improvements. For instance, the number of child laborers has slowly declined from 222 million in 2004 to 215 million in 2010 (ILO, 2010). However, the problem is still alarming as 115 million of the child laborers are engaged in works hazardous to their safety. Moreover, Despite of the decline in the number of child labourers between the ages of 5 to 17 has fallen by 7 million between the years between 2004 to 2010, the number of child labourers between age 15 to 17 years has increased by 20% in the same period (ILO, 2010). The problem is worse in sub-Saharan African countries where about 24% of the children between the age of 5 to 14 are economically active (ILO, 2010).

The last national standalone child labour survey by the Central Statistics Agency (CSA, 2002) showed that the incidence of child labour in Tigray region was very high. Out of total child population under the age of 17 in the region, 526,237(41.99%) of the children were engaged in economic activities while 420,132 (33.53 %) of them specialized in household activities for the same age group. The fact that only 5.63 % of the children were specializing in school activities without significant work indicates that there was a potential setback to proper human capital formation through child education. Although the data on the extent of the incidence of child labour for Enderta woreda is unavailable, the high proportion of the population below the age 17 years is nearly 53% of the total population of the woreda and the relative poor socioeconomic indicators in the woreda raise a concern over the existence of child labour (CSA, 2005) The total literacy rate of the woreda was only 13.64% (CSA, 2005) which is less than even the zone's average of 15.71% with only 21.31% of the children between the age 7 to 12 attending primary school; only 1.71% of the

children aged 13-14 were in junior secondary school; and 2.62% of the inhabitants aged 15-18 were in senior secondary school (CSA, 2005).

The major objective of the study is to identify the main determinants of rural child labour with evidence from Enderta woreda. The study has tried to address the following specific objectives:

1. To show the incidence, nature and type of child labour in Enderta woreda.
2. To identify the key factors behind child labour and their direction of effect.
3. To show the impacts of socioeconomic factors on child labour from gender perspective.

2. Concepts of child labor and *trends in developing countries*

2.1 Concepts of child labor

The decision of households in allocation of their children's time to school and child labour activities is related to their objective of maximization of their utility. The utility of the households is expected to be derived from the consumption of goods and services and leisure time (Assefa, 2002; Cockburn, 2000). The assumption is that child labour and school activities are part of the household resource allocation decisions including child labour and time, decision in pursuit of maximization of consumption and leisure time that will be derived from the consumption of goods and services and the leisure time with given time, budget and production constraints.

$$\text{Maximize } U = U(C, H)$$

$$PM \cdot QM = PH (QH - XH) - w (LT - LF)$$

Where PM = Price of consumable goods purchased from market

QM =Quantity of the consumable goods purchased from market at market price PM

PH = Price of household produced goods sold at markets left from consumption

QH = total quantity of household produced goods

XH = the quantity of household own produced goods sold at market price PH .

$(QH - XH)$ = is the amount product which is own produced and own consumed

$PH (QH - XH)$ = the monetary value of the household own produced and consumable goods

PM QM = is the monetary value of market purchased consumable goods

$(LT - LF)$ = The total non family hired labour stock

w = the market wage rate

$W (LT - LF)$ = the total amount of expenditure for hired labour with implicit assumption of time of every labour inside. The implication of the equation is that households allocate their time and available labour supply in order to maximize their production which will cover the household own consumption, the expenditures on household purchases of consumption goods, the expenditure for hired labour. As the households also maximize utility by increasing their leisure time, there will be a tradeoff between time to allocate for maximizing household production and of time for leisure.

The maximization of the utility function subject to the household income or expenditure constraint and the time constraints of each household provide the shadow price of each commodity and the first order conditions for profit maximization. Thus it is widely assumed that children as household economic members that are involved in household consumption and production with their time for work and leisure available, which will be allotted to the state of working only, combining work and school, getting idle or attending school only with very minimal work or school attendance based on the decision of household leader.

2.2 Trends of child labor in developing countries and Ethiopia

Given the fact that child labour is poverty related phenomenon, developing countries in general and African countries in particular have higher incidence of child labour (see Table 1 and Table 2).

Table 1: Average rate of child labour participation rate of world regions (1990-2008) for children between age of 5-14 years old (%)

No.	Region	Male	Female	Total
1	Middle East and North Africa	11	9	10
2	Eastern and South Africa	36	32	34
3	West and Central Africa	34	35	35
4	East Asia and the pacific	10	10	10
5	Asia	13	12	12
6	Africa	30	28	29
7	South Asia	13	12	13
8	Developing Countries	37	16	36

Source: UNICEF (2010)

The data from UNICEF (2010) report on Table 1 shows that child labor participation rate for developing countries were 36% between the years of 1990 to 2008 for children between the ages of 5 to 14 years from this, male child labor participation accounted for 37% while for female it was 16%. As Table 1 shows the rates for Asia, East Asia & the Pacific and Middle East & North Africa had child labor participation rates of 12 %, 10% and 10%, respectively. On the other hand, Africa had the far higher rate of child labor participation of 29% of which male and female rates accounted for 30% and 28%, respectively.

On the other hand, a comparison of child labour participation rate among some poor developing countries on Table 2 shows that African countries have higher incidence of child labour participation rate (UNICEF, 2010).

As shown on Table 2, The data also stress that child labor is significantly higher in Africa than the rest of developing countries with higher rates of 53%, 47%, 34%, 32% and 31% for Sub Sahara African countries of Ethiopia, Central African Republic, Ghana, Congo Democratic Republic and Cameroon while Egypt has relatively lower rate of 7%. The Child labor participation rate for Ethiopia was 53% of which male and female rates count 59% and 49%, respectively. This is far higher than that of the average of the least developing countries. .

Table 2: Child labour participation rates of some few developing (1990-2008)

Country	Male %	Female %	Total %
Bangladesh	18	8	13
Bolivia	22	22	22
Burundi	19	19	19
Cameron	31	30	31
Central Africa Republic	44	49	47
Congo Dem. Rep.	29	34	32
Côte d'Ivoire	36	34	35
Egypt	8	5	7
Ethiopia	59	46	53
Ghana	34	34	34
India	12	12	12

Source: own computation of data from UNICEF (2010)

The national survey on child labour conducted by the Ethiopian CSA (2002) indicated that over 85 % of the surveyed children between the ages of 5 to 17 years were engaged in both economic and non-economic activities that affected their school attendance performance negatively. Moreover, 52 % of them engaged in productive activities of which 7.4 million (49 %) being between the age years of 5 to 14. The survey further depicts that 33 % of them were engaged in non-economic activities like house keeping with half of them totally absent from attending school. While the 89 % of rural children were engaged in agricultural related works, those dwelling in urban were found engaged in supporting themselves or their siblings. Males' participation rate was 62 % which is higher as compared to the females', 41.9 %. But an inclusion of domestic household activities showed that females' participation was 44.3 % exceeding 22.8% of males'. A report on Ethiopian child labour by UNICEF (2010) show that child labour participation rate in Ethiopia has increased to 53 % between the years of 1999 to 2008. The same report revealed that male children have higher participation rate of 59% as compared to females 46 %. Given the majority Ethiopian population is rural inhabitant, 92.2 % of the child workers of the age group 5 to 14 years were engaged in agricultural activity, while the manufacturing (1.3 %), service (3.14 %) and other activities (0.2 %) participation rate of the same age group accounted for 4.64 percent only (UNHCR, 2010). Thus, the child labour is basically a rural phenomenon in Ethiopia.

3. Data Sources and Methodology

Analytical Model

3.1 Theoretical framework

This study is theoretically based on the following assumptions regarding the household and its decision on child time allocation:

1. The ideal household with household head deciding resource allocation patterns and with joint decision of members in the absence of intra household bargaining differentials. Thus it is assumed that household members completely agree on the decisions of household head.
2. Household income is equal to household expenditures (Income constraint)
3. Total available time equals to sum of time allocated to each activity (Time constraint)
4. Household's utility depends on the level of consumption of purchased and own-produced goods.

The total time of a child will be allocated to work, to school or to leisure or combination of school and work according to household decisions on utility maximizing. It is assumed that households maximize their utility based on the existing child, household and community factors.

$$U = U(Q, TS, TH; V, e), \text{ Where}$$

Q = Consumption of purchased and produced goods TS = School child time
 TH = School leisure time V = A vector exogenous variables that includes factors of child, household, community characteristics and e = A stochastic term for factors that are not captured by the analysis

3.2 The empirical model

Since the Ordinary Least Square (OLS) is inappropriate to use for multi response qualitative dependent analysis, the multinomial choice probability based assumption is appropriate to capture the four mutually exclusive states which are decided jointly at the same time. The basic assumption of

the multinomial model is the log Waibull distribution of identical and independent utility error terms. The great advantage of this model is that it is easy to compute and the probability of a given household's child time allocation is easily expressed by formation and maximization of likelihood function straight forwardly (Kennedy, 1994). Despite the attractiveness of the analytical expressions in the multinomial logit model, it has one big drawback, which is due to the assumption that all alternative categories are independent. This implies that (conditional upon observed characteristics) utility levels of any two alternatives are independent. This would mean that the probability ratio of two alternatives does not depend upon the nature of any of the other alternatives so that application in the presence of highly close substitutes being in appropriate. McFadden (cited in Verbeek, 2002) called this property of the multinomial logit model independence of irrelevant alternatives (IIA). Hausman and McFadden (1984) proposed a test for the IIA restriction based on the result that the model parameters can be estimated consistently by applying a multinomial logit model to any subset of alternatives. The test compares the estimates from the model with all alternatives to estimates using a subset of alternatives (Kennedy, 1994; Verbeek, 2002). In this study, the problem of interdependence was identified using the Hausman test compelling merging of the two categories of children combining school and work with children working without school. The maximum likelihood method is used to estimate the estimators; conditional on the explanatory variables (Wooldridge, 2000). The multinomial logit model is used for the econometric analysis part.

$$P \{Y_{ij} = m\} = \frac{\exp \{\alpha_{ij} + \beta x_{ijm}\}}{\exp \{\alpha_{ij0} + \beta x_{ij0}\} + \dots + \exp \{\alpha_{ij} + \beta x_{ijm}\}}$$

or in simplified form

$$P \{Y_{ij} = m\} = \frac{\exp \{\alpha_{ijm} + \beta_{ijm} x_{ijm}\}}{\sum_{n=0}^3 \exp \{\alpha_{ijn} + \beta_{ijn} x_{ijn}\}} = \frac{e^{\alpha_{ijm} + \beta_{ijm} x_{ijm}}}{\sum_{n=0}^3 e^{\alpha_{ijn} + \beta_{ijn} x_{ijn}}}$$

Where $m, n \dots 0, 1, 2, 3$

j is represents the j^{th} household $j = 1, 2, 3, \dots, 200$

i is represents the i^{th} child from household j $i = 1, 2, 3, \dots, k$

k is the total number of sampled children.

The iterative differentiation of the likelihood with respect to respective category β yields the value of the maximum likelihood estimators. The marginal effect approach also can be used to obtain marginal effect of explanatory variables on respective probability occurrence. This is obtainable by differentiating the specified multinomial logit model; we find the marginal effects of the explanatory variables on the probabilities as:

$$\delta_m = \frac{\partial P_m}{\partial X_i}$$

The method of result reporting and analysis can also take the form of Odds Ratio reporting. The ratio reporting stems from computing the ratio of probability of occurrence of a category choice to its probability of nonoccurrence. For a given linear quality response function: $Z_i = \alpha_i + \beta x_i$,

If the probability of a choice category to be chosen by a given household is:
Then the probability of its not being chosen will be:

$$1 - P_i = \frac{1}{1 + e^{Z_i}}$$

The odd of a category choice is then found by the ratio of the two probabilities (Gujarati, 2004).

$$\text{Odds} = \frac{P_i}{1 - P_i} = \frac{1 + e^{Z_i}}{1 + e^{-Z_i}}$$

The natural logarithm of the odds is the subtle form of the linear model as can be shown below:

The odds ratio can also be used to compare the probabilities of two different when extra variable categorization is used. For instance, for computing the probability of a child's working to not working, we can compare male versus female by taking the ratios of the odds.

$$L_i = \ln \left(\frac{P_i}{1 - P_i} \right) = Z_i = \alpha_i + \beta x_{i,j} \quad \text{Where } L \text{ is the resulting Logit}$$

But this method does not show the absolute comparative significance change in probabilities in different categories like in the multinomial logit. Thus, the marginal effect approach is suitable to show the overall significance of the variables in affecting the probability of occurrence (a choice being chosen by households) marginally.

Bivariate probit model

The bivariate probit model is used to specify the probabilities of child works and his school attendance as follows;

$$Y_{iw} = f(X_i) + e_i \sim e(0, 1) \dots \quad (1)$$

$$Y_w = 1 \text{ if } Y_w > 0, \quad Y_w = 0 \text{ otherwise,}$$

The specification for school attendance is

$$Y_{is} = f(X_i) + \gamma_i \sim \gamma(0, 1) \dots \quad (2)$$

$$Y_s = 1 \text{ if } Y_s > 0 \text{ and } Y_s = 0 \text{ otherwise}$$

Where Y_w = the status of child work

Y_s = the status of child school attendance, $i = i^{\text{th}}$ child of the sample

X_i = child, household and village characteristics of child i

4. Results of Econometric Data Analysis

4.1 Determinants of child work and school

The multinomial logit was used to analyze the probability of a child falling in the specified outcome categories for status of child work and school attendance. Before undertaking estimation of the model, a test for the problem of multicollinearity was undertaken. Gujarati (2004) establishes a rule of thumb, which says that multicollinearity is a serious problem when the values of variance inflation factor VIF are greater than 10. The values of VIF for the continuous variables of the data for both sexes are below 10 so that multicollinearity is not a problem. The test of pair wise correlation

results for the dummy variables similarly signifying that there is no series correlation among the dummy variables as all the correlation coefficients are below 0.5. The Breusch-Pagan / Cook-Weisberg test for the problem of heteroskedasticity showed that the data have no problem of heteroskedasticity ($0.301 > 0.05$). Hausman test for the assumption of independence of irrelevant alternatives (IIA) shows that the null hypothesis for the assumption of independence of the alternative categories is accepted. This shows that the four categories of child work / school attendance were independent of each other.

The summary statistics of the multinomial logit specification on Table 12 show that the model adequately fitted the data. The Log likelihood ratio is -267.93 and statistically significant at 1% level of significance indicating the existence of an overall significant relationship between (at least with one of) the independent variables and the status of child work / school attendance. The Wald chi2 value for the model is 864.83 and significant at 1% level of significance implying that at least one of the independent variables is significant in differentiating the status of a child in the three categories.

Gender disaggregated bivariate probit model was used to analyze the impact of the socioeconomic factors on child work and school attendance from the perspective of gender (Beliyu, 2007; Yunita, 2006). The test for multicollinearity and heteroskedasticity showed the continuous independent variables in the data of female and male children have no series problem of multicollinearity as all the continuous variables have VIF values less than 10. The pairwise correlation test for the dummy independent variables show the absence of serial correlation for the females' and males' child data, respectively. The Breusch-Pagan/Cook-Weisberg test for male child's data showed that heteroskedasticity is not a problem as the null hypothesis is accepted. However, the test for female child's data showed heteroskedasticity was a problem. The robust standard errors regression option was used to minimize the problem. Table 13 and Table 14 show that the correlation parameter ρ is significant at 1% and at 5% level of significances for the male and female bivariate regression

results, respectively. This justifies that bivariate probit analysis is valid in both child sexes' data. The significance of the correlation parameter also indicate that households' decisions of sending children to school and assigning children to work jointly decided and that it is probable they are mutually inclusive for both sexes. As shown on Table 13 of the bivariate regression for male children, the Wald chi 2 value of the model is 136.89 which is significance at 1% level of significance. This implies that there was a significant relationship between the hypothesized socioeconomic characteristics and the probabilities of male child's work and his school attendance. Similarly the test for the correlation parameter (ρ) showed that ρ is significantly different from zero showing that the decisions of male child for attending school and work are jointly decided. Similarly, the bivariate regression for female data on Table 14 shows that the Wald ch2 value 204.81 is significant at 1% level of significance implying there is a significant relationship between the independent variables and the probability of child school attendance/works. The test of significance of the correlation parameter's being significantly from zero showed that ρ is significantly different from zero at 5% level of significance. This has similar implication that decisions for female child allocation for school attendance and for child work are jointly decided and mutually inclusive.

4.1.1 Impact of child characteristics

According to the results, the age of a child has a negative and significant association with the likelihood that a child specializes in school attendance at 1% level of significance. An increase in the age of child by a year decreases the relative risk ratio (RRR) of being in the category of attending school only by 49%, holding other factors constant. This is in conformity with the initial hypothesis (Table 10). Yunita (2006) found similar finding in Indonesia. An increase in the age of child by a year decreases the RRR of being in the inactive category by 77%, holding other factors constant. This is also in agreement with the initial hypothesis. Yunita (2006) found similar results that an increase in age increases probability of child work in Indonesia.

The gender disaggregated results show that the age of a child has a positive and significant association with the probabilities of child school attendance and child work at 1% level of significance for both sexes. An increase in the age of male child by a year increases the probabilities of school attendance and child work by 3.3% and 10.7%, respectively, holding other factors constant. Similarly, an increase of female child's age by a year increases the probabilities of her school attendance and work by 3.9% by 8.9%, respectively. The results also indicate that an increase in age of children of both sexes leads to higher probability of work than the probability of attending school. This perhaps indicates that the factors that hinder child school attendance and that increases child labour become increasingly more significant as the age of children advances. This may be related to the fact that an increase in age is associated with an increase in marginal productivity of a child which leads to higher demand for child labour for the accomplishment of household related and other works (see Table IV and V Annex part).

4.1.2 Impact of household characteristics

It can be noted from the findings that household's characteristics could also have a significant impact on the decisions of child time allocation. The results show that household size has a significant impact on decision of households' on child time allocation. Holding other factors constant, an increase in household size by a person decreases the RRR of being in the category of school only by 30.3 % at 10% level of significance. This shows that an increase of an additional household member leads to higher probability of child work than the magnitude of reduction in the probability of school attendance. On the other hand, other factors constant, an increase in household size by a person increases the RRR of being in the category of working only by 75% at 1% level of significance. This is in conformity to the initial hypothesis that children from households of higher size have an increased likelihood to work. This could be due to the fact that an increase in family size increases the number of dependent people so that children tend to work more with lesser opportunities for school attendance. The impact of household size on the likelihood of child's being inactive is

insignificant. The results conform to the findings of Masood et al (n. d) where they found larger household size is associated with an increase in the probability of child's working and a decrease in the probability of his/her school attendance in Pakistan.

Bivariate probit results reveal that holding other factors constant, an increase of a household size by one person decreases male child's probability of school attendance by 6.2% at 5% level of significance, while the impact the probability his probability of working is insignificant. The impact of household size increase on probabilities of female child's work and her school attendance is insignificant.

According to the findings, there is a significant association between the number and respective age level of other children in the household and the status of work/school attendance of a child living within that household. Other things being constant, an increase of another child below the age of 5 years decreases the RRR of being in the category of school only by 19.6% at 1% level of significance. Similarly, presence of additional child below the age of 5 years decreases the RRR of being in the category of inactive by 39.8% at 1% level of significance (Table 12). On the other hand, addition of a child aged below 5 years in the household increases the RRR of being in category working only by 68% at 10% level of significance, holding other factors constant. The first two results show that childcare care activities decrease child's specialization in school activities. On the other hand, the third finding perhaps implies that presence of more dependent family members increases the likelihood that children specialize in work. The bivariate results indicated presence of additional child below the age of 5 years decreases the probability of female school attendance by 5.8% at 10% level of significance, holding others constant. However the impact on probability of work was stronger as the increase in the same child increases the probability of female child work by 8.1% at 1% level of significance, holding other factors constant. However the number of other children aged below 5 years is insignificant on affecting the probabilities working and attending school for male children. This implies that child care tasks are most likely associated with female child work. The results are consistent

with the findings of Cockburn (1999) where he found evidence from Ethiopia that presence of infants increases female child work.

Other things being equal, presence of additional child aged between 5 to 15 years decreases the probability female child work by 6.7% at 1% level of significance. This could be because additional child of this age category lends more hand to household tasks decreasing the intensity of work on a female child.

The results show the number of children aged above 15 years has a significant impact on the likelihood that children specialize both in school and work at 1% level of significance. Keeping other factors constant, an increase of a child aged above 15 years increases the RRR of being in the category of school only by 58% while it decreases the RRR of being in the category of working only by 44%. This gives an insight that although an increase in household size has an overall impact of decreasing child specialization in school, the presence of other productive children who can render labour for household related and other tasks has a positive effect on child's specialization in school activities and a decreasing effect in child's specialization in work.

The results from gender disaggregated bivariate probit analysis show that an increase in the number of children above the age of 15 years has an increasing effect on the probability of child's school attendance and a decreasing on the probability of female child's work. The presence of an additional child aged above 15 years increases the probability of female child's school attendance by 63% while it decrease the probably female child's work by 3.7% at 1% level of significance, holding other factors constant. On the other side, having an additional child aged above 15 years increases the probability of male child's school attendance by 9.4%, at 1% level of significance, holding other factors constant. The impact on probability of male child work is insignificant. The results imply that as compared to males, the probabilities of female child work and school attendance are more elastic to the changes in the number of children in the respective age group while male children are affected by the size of the

household. It can be noted also from the findings that there is a significant relationship between sex of household head and the decisions of households on child time allocation. Keeping other factors constant, children from male headed households are 19.67 times more likely to specialize in school attendance than those from female headed households at 5% level of significance. This may be because households with male heads have fewer burdens in managing farm and other activities getting more opportunity to specialize on school attendance. On the contrary children from female households may face more responsibilities in helping their family in those activities. Holding other factors constant, male household headship increases the RRR of a child's children remain inactive to school and work by 3.6 fold than those from female headed households at 10% level of significance. This may be because children stay out of school as they are expected to engage in cattle herding or other activities in the future.

It is customary in rural areas like Enderta to use rotational pattern of sending children to school with younger children waiting to serve their family before they could hand over the task to the other younger child. The bivariate analyses show that female children from male headed households are 10.5% less likely to work than those from female headed households at 5% level of significance, holding other factors constant. This is perhaps because mothers rely more on female children for household chores.

On the other hand, male children from male headed households are 14.1 % more likely to work than those from female headed. The reason could be because male household heads associate their male children on farm, cattle herding and other activities. The impact of sex of household on probability on male school attendance is found insignificant.

Age of household head has a positive and significant effect on the likelihood that a child specializes in work at 1% level of significance. This conforms to the initial hypothesis that children may be used as an old age insurance to fill the gap of family labour demand for household chores and other outdoor tasks. However, the findings show there is no significant

association between the age of household head and the likelihoods of child's specialization in school and child's being inactive is insignificant. The bivariate probit analyses show that changes in the age of household head affect probabilities of female child school attendance. An increase of age of household head by a year decreases the probability of female child's school attendance by 0.5% at 1% level of significance, holding other factors constant. The impact on probability of work is insignificant (see Table V Annex part). On the other hand, boys are unaffected by the changes in the age of household heads. This shows that female children take household responsibilities at the cost of their school attendance as age of household heads increase.

Children from households with literate mothers are 36 times more likely to specialize in school attending than those from with illiterate mothers at significance level of 1%. This is in agreement with the initial hypothesis. On the other hand, children from households with literate mothers are 4.7 times less likely to specialize in work, holding other factors constant. This may be perhaps due to the fact that literate mothers have strong tendency to send their children than literate fathers. The results are consistent with the findings Yunita (2006) where he found maternal literacy is more important than father's literacy. Other things being equal, female children from households with literate mothers are 33.4% less likely to work than those from with illiterate mothers at 1% level of significance. The results also show evidence on the importance of mother's literacy as a determinant factor to the probability of male child's work and school attendance at 1% level of significance. Other factors remaining constant, male children from households with literate mothers are 14.9% more likely to attend school and 31.7% less likely to work. On the other hand, male children from households with literate fathers are 21.8% more likely to attend school, at 10% level of significance, holding other factors constant. The impact on child work status was found insignificant.

It can also be noted from the findings that there is a strong association between ownership of livestock and the decisions of households on child time allocation for work and school activities. A unit increase in a unit of

tropical livestock decreases the RRR of being in the category of school only by 21% at 1% level of significance, holding other factors constant. This shows the impact of ownership of livestock on child time allocation decisions is more dominated by wealth effect than by income effect where it is more likely to increase the likelihood that children spend more time accomplishing tasks related to cattle herding and decreasing their time available for school related activities. On the other side, an increase in a unit of tropical livestock increases the RRR of being in the category of working only by 8.5 % at 5% level of significance, holding other factors constant. This is in agreement with the initial hypothesis. The implication is that the impact of ownership of higher number of livestock is strong enough to consume child time on tasks related to cattle herding at the cost of child school attendance. The impact on the likelihood that a child is inactive is insignificant.

Holding other factors constant an increase in a unit tropical livestock increases the probability of male child's working by 3.6% at 5% level of significance, while the impact on his probability of school attendance is insignificant. On the other hand, ownership of more livestock has negative and significant effect on the probability of female child's school attendance. The findings also suggest that farm size also could have an impact on the pattern of child time allocation. An increase in a unit hectare of size of farms decreases the RRR of being in the category of school only by 62% at 1% level of significance, holding other factors constant. This conforms to the initial hypothesis that higher farm size leads to more likelihood that a child works. This confirms the reality that rural children are part of household labour that engages in farming activities (Table 10). The impact of farm size on child's specializing in work and on child's being inactive is insignificant.

From gender perspective, size of farm land has significant and positive effect on the probability of female child's work. An increase in a unit hectare of farm size increases the probability of female child work by 12.7%, holding other factors constant. This may imply that larger farm size leads to more spending of male child time on farming activities increasing

the responsibility of female children to take care of household chores. The impact of farm size on the probability of male child's time allocation on school and work is insignificant. This is consistent with the finding of Bhalotra (2003) where she found impact of farm size is significant for female children than for male in Ghana and Pakistan.

Engagement in off farm activities is also found an important factor on child time allocation decisions. Children from households that are engaged in off farm activities are 7 times less likely to specialize on school activities at 1% level of significance, holding other factors constant. This is contrary to the initial hypothesis as it was assumed income derived from the engagement in off farm activities would encourage household decision in favour of sending children to school decreasing child time for work. This shows that the production effects from engagements in off-farm activities outweigh the impacts of encouraging households to send their children to school (Table 10). Similarly, children from households engaged in off farm activities are 5.39 times more likely to specialize in work than those who are not engaged in off farm activities. This could be because households in Enderta woreda are engaged in off-farm activities like firewood selling, stone mining, charcoal production, and other tasks that demand the child labour. The impact of engagements in off-farm activities on the likelihood of child's being inactive is insignificant.

The bivariate regression results show Engagement in off farm activities was found to have strong significance in impacting on both probabilities for child school attendance and work. Male children from households engaged in off farm activities are 16% less likely to attend school and 26.7% more likely to work. This may be because male children in Enderta woreda are active in the off-farm activities of charcoal producing, firewood sale, stone mining and other activities that are common in the woreda. An increase in 1% of household annual livelihood expenditure Birr per adult equivalent increases the probability of child school attendance by 21.8%, at 1% level of significance, holding other factors constant. The impact on child work is found to be insignificant. This implies an increase in income increases the

probability of male child work but does not guarantee a reduction of child labour (see Table I Annex part).

Other things being equal, female children from households engaged in off farm activities are 9.1% less likely to attend school at 1% level of significance. On the other hand, a female from households engaged in off farm activities are 8.2% more likely to work than a female from a household that does not engage in off farm activities. This may signify another tradeoff for policies in encouraging household engagement in off-farm activities and its simultaneous impact in relation to of increasing female child labour and decreasing female child's school attendance (see Table IV Annex part).

The impact of households' access to rural credit service is negative and significant at 10% level of significance on the likelihood that a child specializes in work. A child from a household that has an access to credit service is 16 times less likely to be in the category of working only. This is in conformity with the initial hypothesis. The impact on the child's specialization school and child's being inactive is insignificant. This implies that access to credit services can reduce child's specialization in work leading to a shift of child time allocation decisions that will lead at least to combining work and school attendance (see Table I and Table II, Annex part).

Other things being equal, female children from households of customers of rural credit are 22.3% times more likely to attend school and 26.8% more likely to work than females from non-customers of rural credit service. This signifies that there is trade off on the impact of credit where income effect from access to credit increases the possibility for more school attendance while the productivity and ownership of more assets like livestock increases the prospects of demand for more female child labour time. Male children from households that are customers of rural credit service are 17.8% more likely to attend school than those from households that are not customers of credit at 5% level of significance holding other factors constant. This may imply that access to credit service affects the probability of male child school attendance through its income effect. The impact on male child work is found insignificant (see Table IV Annex part).

Annual family livelihood expenditure per adult equivalent has positive and significant association with the likelihood that a child specializes in school attendance at 5% level of significance. A 1% increase in a unit birr per adult equivalent annual expenditure increases the RRR of being in the category of school only by 59%, holding other factors constant. This implies that income effect from accumulation of financial assets encourages child specialization in school attendance (see Table I Annex part).

4.1.3 Impact of village characteristics

The findings also indicate that village characteristics like distance to nearby water and fuel sources, distance to school and proximity of child village to urban areas could have significant impacts on decisions of households on child time allocation.

The distance to water source has a negative and significant association at 5% level of significance with the likelihood that a child specializes in school. An increase in one minute walk distance by 1% to water source area decreases the RRR of being in the category school only by 43%, holding other factors constant. The impact of distance to water source area on the status of child's being inactive and on the likelihood of specialization in work is shown to be insignificant. From the perspective of gender analysis, keeping other things constant, an increase in one minute walk distance by 1% to the water source area decreases the probability of male school attendance by 6.7% while it increases the probability of his working by 6.9% at 1% level of significance for both effects. On the other hand, an increase the same increase in distance to water source area increases the probability of female child work by 5.6% at 10% level of significance. The implication of the findings is that distance to water source areas affect whether children specializes in school activities or combine work with school but not compromise child school attendance at all.

Similarly, the distance to the area of fuel sources like animal dung areas and firewood collection areas is negatively significant at 5% level of significance. An increase in one minute walk distance to fuel source area by 1%

decreases the RRR of being in the category of school only by 45%, holding other factors constant. An increase in one minute walk distance to fuel source area by 1% decreases the probability of female child school attendance by 3.2% at 5% level of significance, holding other factors constant. The impact on the probability of female child work is insignificant. Similarly, other things being equal, an increase in the distance of one minute walk to fuel source area reduces the probability of male child's working by 6.9% at 1% level of significance, The impact on probability of his school attendance is insignificant. The implication of those results may be a need for hastening buildup of water, electricity, school infrastructural assets to increase the probabilities of school attendance, reduce male child labour or either (see Table III Annex part).

An increase in a distance of a kilometer from child village to Mekelle city increases the odds of RRR of being in the category of school only by 10% at 1% level of significance, holding other factors constant. This is also in contrast to the initial hypothesis as impact of urban proximity was expected to increase child work in off farm activities in the urban in nearby urban towns. This could be related to the fact that more proximity to urban rural linkage has an outweighing positive impact of increasing of awareness of rural households on benefits of education than its pulling effect to off farm tasks engagements.

The impact of an increase in distance from the village of a child to distance to Mekelle city was found negative on probability of school attendance at 1% level of significance .An increase of a kilometer to Mekelle city decreases the probability of female child school attendance by 7%, holding other factors constant. This is higher than for boys implying there is gender bias in giving priority to investing to female education relative to boys. This may also indicate that more urban-rural linkage increases opportunities for households to send their female children to school as they have more income and information opportunities on the benefits from education (Table 14).An increase in a distance of male child's residence to Mekelle city reduces the probability of child school attendance by 1%, holding other

factors constant. The impact on probability of male child's work was insignificant.

5. Conclusions and Recommendations

5.1 Summary of findings and Conclusions:

This study was conducted with the notion that policies that focus on minimizing the problem of child labour in poor countries should better take into account the underlying root causes of child labour which are prevalent at household level. As most child laborers in poor countries are engaged in household chores or family farm activities, solving rural household socioeconomic problems is indispensable ways to solve child labour. Consequently, this study was designed to identify the main socioeconomic and geographical factors that affect the incidence of child labour with their gender implications based on rural household data from Enderta woreda in the south eastern zone of Tigray National regional state. From the analysis of the obtained data, the study has tried to draw few policy implications that could contribute to alleviate the problem of child labour at household level.

The findings of this study showed that the root causes of child labour are many, complex and interrelated. The characteristics of child, households and the village of residence were found to be important determinant factors that have impacts on the status and probabilities of child labour. The multinomial logit was used to identify the determinants of child school attendance and work. Additionally, gender disaggregated bivariate probit analysis was used to analyze the factors that determine the probabilities of child work and school attendance. This was done with the aim of identifying gender implications in type and direction of impact of the determinant factors. It can be concluded from the results that maternal literacy, more access to financial assets and increase in number of elder children above age of 15 years are factors that increase the likelihood of children specializing in school activities. On the other hand, household characteristics like an increase in age of household head, engagement in

off-farm activities, number of livestock, and number of children below age of 5 years decrease child time allocation to school and study.

The impact of access to credit service was found to decrease specialization of a child on school attendance. This implies that it is not the access of the rural loan services but the net effect from financial and asset accumulation effects that determine the direction and nature of the impact on child work and school attendance. The results also show lack of adequate social infrastructures like, water supply, fuel energy sources increase child work and reduced child time for school. This implies that solving child labour and enhancing effective child education require solving the social and livelihood infrastructural supply inadequacies.

The findings also note that higher family size, an increase in ownership of livestock, engagement in off-farm activities increased the likelihood of child work without school attendance. From this it can be concluded that although child labour may be associated with poor livelihood conditions, rural poverty reduction and income generation schemes through income diversification and asset accumulation does not have a direct and predictable impact on child labour. On the contrary, access to rural credit decreases children specialization to working alone. The combined implication is that access of credit service increases the likelihood of children combining school and work avoiding the two extremes. Proximity to urban areas was also found to decrease the likelihood that children specialize in work. The key determinants for the probability of a child to be inactive were child age and sex of household head. Children from male headed households were more likely to be inactive.

The multinomial logit results have shown that the impact of sex of a child has no impact on the status of child work and school attendance. However, gender disaggregated bi-probit regression results implied the existence of gender wise disparities on the direction and degree of impact from child, household, village characteristics on the probability of work and school attendance on male and female children. An increase in age of a child increases the probability of work and school for both sexes. An increase in

age of child increases the probability of male child work with greater margin while females have higher probability of school attendance. Higher number of family size reduces the probability of male school attendance while higher number of children below the age of 5 years increases the probability of work and reduces the probability of school attendance for females. The impact of increases in number of children above the age of 15 was increasing school attendance for male children while it decreases the work burden for females. Maternal literacy increases the probability of school attendance and reduces probability of work for both sexes. The impact is however higher on female children. On the other hand, father's literacy increases male children school attendance. Male headship of households increases the probability of male child work while it has a decreasing effect on probability of female work.

The findings on impact of village and household economic characteristics on incidence of child labour imply the existence of gender bias against female children. An increase in number of livestock increases the probability of male child work while it decreases the probability of school attendance for female. Access to credit increases the probability of male school attendance while it decreases female school attendance and increases female child work. The impact of household engagement in off farm activities increases the probability of male and female child work, while it decreases the probability of female school attendance. An increase in farm size decreases the probability of female school attendance. The impact of higher per capita expenditure, which is a proxy for household income, is in favour of male child school attendance. This means that an increase in amount of asset ownership affects the probability of male child labour while female bear the negative consequences both from increased work and school attendance. An increase in distance of tabia from Mekelle city decreases the probability of school attendance of both sexes. However, the negative impact on school attendance is more vocal on female children. An increase in school distance decreases the probability of child work. Although this is contrary to common expectations, school distance may not guarantee children's engagement in more works. This may be because children who

are located very near to their school are have more time and are easily accessible for work than those who walk longer minutes to reach school.

Finally the study has concluded that solving household socioeconomic problems need to consider the implicit impacts of sex of children if child labour is to be solved. The study also concludes that there could be tradeoff between policies that reduce child labour and enhancing rural livelihood so that a reconciliatory approaches should be followed to achieve an optimal solution.

5.2 Recommendations:

Based on the findings from this analysis, the study has tried to draw the following policy implications:

- Policies that aim at encouraging family planning system should be aggressively pushed in rural areas. This may require aggressive family planning campaigns and introducing contraceptive usage to the rural mass.
- The expansion of rural credit service which is designed to increase livestock ownership should also account for the impacts on increasing child labour. Thus, increasing legal and organized community grazing land use with community paid employees who is in charge of cattle herding could set free children with more time for school and study.
- Mother's literacy should be encouraged through rural adult education illiteracy campaigns and through aggressively enforcing the law against early marriage which increases mothers' illiteracy.
- Rural households should be encouraged to use bio fuel technologies such as bio-gas to lessen their dependence on firewood. Rural electrification should be hastened although this also requires raising income of rural households to cover the costs.
- The linkage between urban and rural areas should be enhanced by improving access to infrastructures like road, information systems like telecommunications, and other services which increase rural households' awareness on educating their children.

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Annex

Table I: Results of multinomial regression for school only category (Relative risk ratio)

School only	Coefficient	Std. Errors	Relative risk ratio	
Age of child	-0.663***	0.093	0.514***	0.048
Sex of child (Male)	0.141	0.436	1.151	0.503
Household size	-0.360*	0.198	0.697*	0.138
Sex of household head(Male)	2.979**	1.215	19.67**	23.90
Literacy status of mother (Literate)	3.59 ***	0.556	36.40***	20.24
Literacy status of father (Literate)	-0.629	0.445	0.532	0.237
Number of tropical livestock units	-0.228***	0.064	0.795***	0.051
Size of farm	-0.973***	0.374	0.377***	0.141
Safety net work	-0.631	0.472	0.532	0.251
Credit use	-0.207	0.648	0.812	0.526
Number of children below age of 5 years	-0.092***	0.329	1.196***	0.360
Number of children between the age of 5 to 15 years	1.002	0.231	2.726	0.628
Number of children above 15 years	0.457 ***	0.213	1.580***	0.337
Engagement in off farm activity	-1.948 ***	0.547	0.143***	0.078
Distance of tabia to Mekelle	-0.013	0.024	0.986	0.025
Log of annual per adult equivalent expenditure	1.59**	0.781	4.90 **	3.830
Log of distance to fuel source area	-0.564***	0.133	0.569 ***	0.076
Log of distance to water source area	-0.595***	0.203	0.551***	0.112
Log of distance to school	0.452	0.296	1.572	0.466
Age of household head	0.035	0.024	1.036	0.025
Constant	-8.090	7.231	-	

Combining school and work or working only is a reference category, ***, ** and * indicate 1%, 5% and 10% level of significance respectively

Table II: Results of multinomial regression for working only category (Relative risk ratio)

Working only	Coefficient	Std. Errors	Relative risk ratio	
Age of child	-0.005	0.054	0.994	0.054
Sex of child (Male)	0.316	0.352	1.375	0.482
Household size	0.561***	0.192	1.75***	0.337
Sex of household head (Male)	0.462	1.109	1.586	1.759
Literacy status of mother (Literate)	-0.797*	0.472	0.451*	0.213
Literacy status of father (Literate)	0.065	0.370	1.068	0.395
Number of tropical livestock units	0.081**	0.042	1.085**	0.046
Size of farm	0.197	0.179	1.218	0.218
Safety net work	0.085	0.396	1.089	0.432
Credit use	-1.01*	0.538	0.363*	0.196
Number of children aged below of 5 years	0.519*	0.274	1.681*	0.461
Number of children aged between the age of 5 to 15 years	-0.196	0.222	0.821	0.182
Number of children above 15 years	-0.578***	0.199	0.561***	0.112
Engagement in off farm activity	1.684**	0.664	5.391**	3.581
Distance of tabia to Mekelle	0.105***	0.022	1.112***	0.025
Log of annual per adult equivalent expenditure	-0.197	0.684	0.021	0.562
Log of distance to fuel source area	0.102	(0.117	1.107	0.130
Log of distance to water source area	0.183	0.192	1.201	0.230
Log of distance to school	0.267	0.256	1.306	0.335
Age of household head	0.074***	0.020	1.076***	0.021
Constant	-13.07**	6.839	-	

Category of combining school and work or working only is a reference category

***, ** and * indicate level of significance at 1%, 5% and 10% level of significance respectively

Table III: Results of multinomial regression for inactive category (Relative risk ratio)

Inactive	coefficient	S.Er	RRR	S.Er
Age of child	-1.517***	0.203	0.219***	0.044
Sex of child (Male)	0.581	0.509	0.787	0.911
Household size	0.216	0.290	1.241	0.360
Sex of household head (Male)	3.604*	1.933	3.673*	1.101
Literacy status of mother (Literate)	-0.298	0.577	0.742	0.428
Literacy status of father (Literate)	-0.623	0.554	0.536	0.297
Number of tropical livestock units	-0.015	0.069	0.984	0.068
Size of farm	-0.200	0.343	0.818	0.280
Safety net work	0.449	0.559	0.568	0.877
Credit use	-1.090	0.665	0.336	0.223
Number of children below age of 5 years	-0.919**	0.429	0.398**	0.171
Number of children between the age of 5 to 15 years	-0.330	0.347	0.718	0.249
Number of children above 15 years	-0.216	0.321	0.805	0.258
Engagement in off farm activity	0.400	0.649	1.491	0.968
Distance of tabia to Mekelle	0.013	0.028	1.013	0.288
Log of annual per adult equivalent expenditure	-0.649	0.784	0.522	0.409
Log of distance to fuel source area	0.136	0.145	1.145	0.166
Log of distance to water source area	-0.019	0.251	0.980	0.246
Log of distance to school	0.289	0.408	1.335	0.545
Age of household head	-0.033	0.032	0.967	0.031
Constant	13.362	7.385	-	
Model summary statistics				
Number of observations	577			
Log likelihood function	267.93			
Wald Chi squared	864.83			
Significance level	0.000			
Pseudo R2	0.6174			
Percentage of correctly classified	59.62%			

***, ** and * indicate level of significance at 1%, 5% and 10% level of significance respectively

Table IV: Determinants of male child's work and school attendance (bivariate analysis)

Variable	School				Work			
	Coefficients	S.E	dy/dx	S.E	coefficients	S.E	dy/dx	S.E
Age of child	0.131***	0.029	0.033	0.007	0.466***	0.070	0.107	0.016
Family size	-0.241**	0.114	-0.062	0.028	-1.273	0.936	-0.075	0.035
Sex of household head	0.947	0.700	0.325	0.275	0.329**	0.143	0.141	0.049
Literacy status of mother	0.648***	0.223	0.149	0.047	-1.182***	0.339	-0.317	0.093
Literacy status of father	0.359*	0.218	0.089	0.052	0.354	0.328	0.079	0.071
Number of livestock	-0.018	0.024	-0.004	0.006	0.160**	0.041	0.036	0.011
Size of farm land	-0.101	0.120	-0.025	0.031	0.148	0.241	0.034	0.054
Safety net work	-0.056	0.218	-0.014	0.055	0.266	0.325	0.006	0.075
Credit use	0.593**	0.270	0.178	0.092	0.393	0.322	0.103	0.094
Number of children below age of 5	0.065	0.156	0.016	0.039	-0.261	0.214	-0.059	0.049
Number of children between the age of 5 to 15 years	0.224*	0.122	0.057	0.031	-0.186	0.161	-0.042	0.038
Number of children above 15	0.369***	0.126	0.094	0.031	-0.038	0.158	-0.008	0.037
Engagement in off farm activity	-0.701***	0.271	-0.160	0.054	1.01***	0.342	0.267	0.102
Distance of tabia to Mekelle city	-0.040***	0.012	-0.010	0.003	0.005	0.017	0.001	0.004
Log of per capita annual expenditure	0.888**	0.376	0.260	0.093	-0.094	0.500	-0.022	0.114
Log of distance to fuel source area	-0.071	0.056	-0.018	0.014	0.304***	0.084	0.069	0.021
Log of distance to water source area	-0.264 ***	0.089	-0.067	0.022	0.303***	0.118	0.069	0.026
Log of distance to school	-0.115	0.123	-0.029	0.031	-0.314**	0.152	-0.072	0.038
Age of household head	-0.019	0.116	-0.004	0.003	-0.022	0.019	-0.005	0.004
Constant	-5.35	3.542	-	-	-5.520	4.931	-	-
Number of obs = 318 Wald chi2(38) = 136.89 Prob> chi2 = 0.0000 Log likelihood = -156.182 Likelihood-ratio test of rho=0: chi2(1) = 24.2846 Prob> chi2 = 0.0000								

***, ** and * indicate level of significance at 1%, 5% and 10% level of significance respectively

Table V: Determinants of female child's work and school attendance (bivariate analysis)

Variable	School				Work			
	Coefficients	S.E	dy/dx	S.E	Coefficients	S.E	dy/dx	S.E
Age of child	0.131***	0.029	0.033	0.007	0.466***	0.070	0.107	0.016
Family size	-0.241**	0.114	-0.062	0.028	-1.273	0.936	-0.075	0.035
Sex of household head	0.947	0.700	0.325	0.275	0.329**	0.143	0.141	0.049
Literacy status of mother	0.648***	0.223	0.149	0.047	-1.182***	0.339	-0.317	0.093
Literacy status of father	0.359*	0.218	0.089	0.052	0.354	0.328	0.079	0.071
Number of livestock	-0.018	0.024	-0.004	0.006	0.160**	0.041	0.036	0.011
Size of farm land	-0.101	0.120	-0.025	0.031	0.148	0.241	0.034	0.054
Safety net work	-0.056	0.218	-0.014	0.055	0.266	0.325	0.006	0.075
Credit use	0.593**	0.270	0.178	0.092	0.393	0.322	0.103	0.094
Number of children below age of 5	0.065	0.156	0.016	0.039	-0.261	0.214	-0.059	0.049
Number of children between the age of 5 to 15 years	0.224*	0.122	0.057	0.031	-0.186	0.161	-0.042	0.038
Number of children above 15	0.369***	0.126	0.094	0.031	-0.038	0.158	-0.008	0.037
Engagement in off farm activity	-0.701***	0.271	-0.160	0.054	1.01***	0.342	0.267	0.102
Distance of tabia to Mekelle city	-0.040***	0.012	-0.010	0.003	0.005	0.017	0.001	0.004
Log of per capita annual expenditure	0.888**	0.376	0.260	0.093	-0.094	0.500	-0.022	0.114
Log of distance to fuel source area	-0.071	0.056	-0.018	0.014	0.304***	0.084	0.069	0.021
Log of distance to water source area	-0.264 ***	0.089	-0.067	0.022	0.303***	0.118	0.069	0.026
Log of distance to school	-0.115	0.123	-0.029	0.031	-0.314**	0.152	-0.072	0.038
Age of household head	-0.019	0.116	-0.004	0.003	-0.022	0.019	-0.005	0.004
Constant	-5.35	3.542	-	-	-5.520	4.931	-	-

Number of obs = 318 Wald chi2(38) = 136.89 Prob> chi2 = 0.0000 Log likelihood = -156.182

Likelihood-ratio test of rho=0: chi2(1) = 24.2846 Prob> chi2 = 0.0000

***, ** and * indicate level of significance at 1%, 5% and 10% level of significance respectively