

Ethiopian Economics Association (EEA)



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

Edited by

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FOREWORD

The Ethiopian Economic Association (EEA) and its Mekelle Chapter are happy to issue the proceeding of the First Annual Conference on the Tigray Regional State Economic Development which was organized on July 14, 2012 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 First Annual Regional Conference on the Tigray Regional Sate Economic Development attracted about 123 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 participants of the conference expressed their satisfaction on the organization of the conference and the content of the papers presented. They reflected that the papers largely focused on local issue that can contribute to the development of the region. They also recommended that the issues raised in the discussion are critical that need to be taken by policy makers and implementing organs of the regions. In the one day conference five papers that focused on the regional socio-economic condition presented and discussed.

All papers which were presented at the First 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 First 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.

A handwritten signature in black ink, enclosed within a large, horizontal oval. The signature itself is a series of stylized, overlapping loops and lines.

Alemayehu Seyoum Taffesse (DPhil)
President of the Ethiopian Economics Association

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IMPACT OF DEGRADED HILLSIDE PLANTATION ON THE LIVELIHOODS OF LAND-POOR FARMERS IN TIGRAY, ETHIOPIA

Hailemariam Meaza Gebregergs¹

Abstract

Smallholder farmers in the northern highlands of Ethiopia used to face difficulties to sustain their lives. As a response to this situation, degraded hillsides have been allocated to landless farmers for tree planting since the last two decades. The study was therefore aimed at assessing the impact of hillside plantation on the livelihoods of landless farmers in eastern Tigray. Pretested interviews, focus group discussions and transect walks were employed to generate the required information from 103 randomly selected households. Matched-pair design was run on crop yield, TLU and income to test differences between 2001 and 2009. ANOVA was also estimated to investigate the level of variation on same variables among the study villages. Regression analysis, lastly, was used to capture variables determining hillside management. The result showed that beneficiaries obtained between Birr 4,064.64 and Birr 4208.16 per hectare on previously degraded hillsides whose opportunity cost was nearly zero. Benefits of hillside plantation increased crop yield, livestock productivity and cash income significantly. Male-headed household, good TLU size, age of household heads, distance to labour market and land security had a positive impact on management of hillside plantation. However, the study uncovered that hillside plantation was challenged by moisture stress, livestock encroachment and traditional gold mining. In conclusion, tree planting brought a positive impact on the livelihoods of land-poor farmers. Therefore, distribution of degraded hillsides for tree planting can be recommended for other regions where extreme shortage of cultivable land and land degradation persist with certain adjustments on the socio-economic consequence of non-beneficiaries.

Keywords: Land fragmentation, Landlessness, Hillside plantation, Livelihood strategies, Tigray

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1. Introduction

Halving extreme world poverty is the first Millennium Development Goal (Nwonwu 2008) and the goal requires reducing poverty in rural areas (FAO, 2003). In the rural areas' land is a critical factor of agricultural production (Ellis, 2000). However, land degradation along with loss of biodiversity and climate change challenge land resources in dry lands (UNEP, 2008). In Ethiopia, livelihood of the poor who pursue largely a subsistence way of life is increasingly threatened by land degradation. (Hurni et al., 2005). In this context 50% of Tigray has suffered from geographic processes such as sheet, rill and gully formations (Nyssen et al., 2009). The highland part of Ethiopia which accounts for 40% is home for 90% of humans, 80% of livestock and contains 95% of cropped land (Feoli et al., 2002).

The incidence of rural poverty in Tigray is inversely related to the size of landholdings (Holden et al. 2003). Provided the physical limit (Nyssen et al., 2006), the land to person ratio differs between the highland (0.5 ha) and lowland (1.5ha) and the ratio increases in areas with poor land quality (Haward & Smith 2006). The total cultivable land in the region has been fragmented by continued population pressure (Hagos et al. 2002). However, land distribution has stopped since 1991 to reduce fragmentation (Jagger et al, 2003). Consequently, young people whose age is old enough to own land became landless and chronically food insecure. Returnees from migration and demobilized soldiers failed to feed themselves and their extended families (Gebrehiwot 2004). This segment of the population mainly depend on what is naturally available around to sustain their lives and exerted heavy pressure on the environment leading to soil erosion (Munro et al. 2008). This in turn led to declining soil fertility (Corbeels et al. 2000) and deforestation (Gebrehiwot 2004). Hence, land degradation has remained to be a complex web of cause and effect of poverty and bears long term environmental externalities (FAO 2003&UNEP 2004).

The Ethiopian government tried to provide food aid for rural communities via food-for-work and cash-for-work schemes for rural poor (Yirga & Hassan 2006). But, this could not bring an end to food shortage for the marginal farmers. As a response, local communities (e.g. Echimare and Gulomokada) initiated to allocate the degraded hillsides to land-poor farmers for tree planting (Kindeya 2004). Eventually,

allocation of degraded hillsides and gullies for landless and nearly landless farmers was integrated into regional land policy in 1997 (Hooton & Hagos 2007). According to Meaza (2010), landless and nearly-landless farmers were selected by checking if they did not get land during the last redistribution in 1991, and by finding out if they can manage the land well on their own initiative for those with small holdings.

Farmers plant economically attractive tree species along with fodder in order to provide forest products and restore the ecology (Zenebe et al. 2010). Due to moisture stress, *Eucalyptus camaldulensis* and *Eucalyptus globules* have been promoted extensively to cope with the ever-growing demand for fuel and timber (Jagger and Pender 2003). Besides, *Eucalyptus* is the most preferred species by smallholder farmers due to its cumulative advantage (Pohjonen & Pukkala 1991; Yirdaw 2002). Holden et al (2003) added that eucalyptus tree planting on marginal lands bear positive effects on food production and land conservation. A study on the impact of gullies and hillsides allocation (allocation) on livelihoods of landless and nearly-landless farmers (beneficiaries) was scanty with gaps in between. Therefore, this study was initiated to assess the contribution of gullies and hillsides tree planting on the livelihoods of the beneficiaries. The key research questions used to address the stated objective which include: (1) What benefits did the farmers get out of hillside plantation? (2) What variables affect the management of hillside plantation at landscape level?

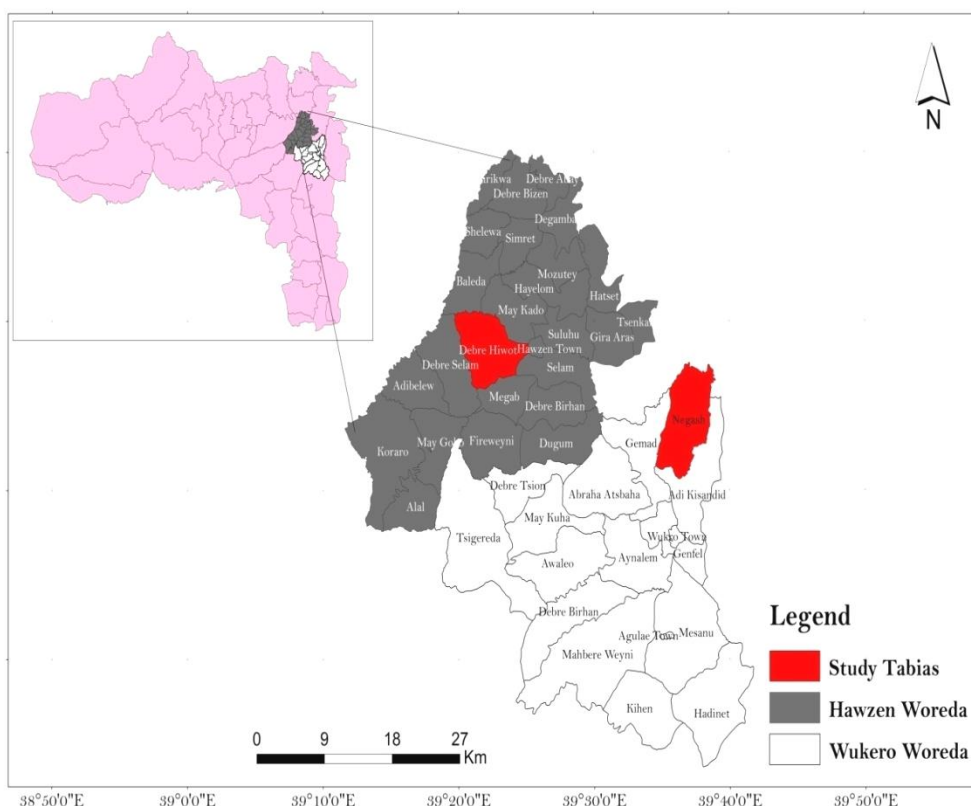
2. Methods

Study areas

The study areas, Hawzien and Negash, are located in eastern Tigray, Northern highlands of Ethiopia (Figure 1). Hawzien is located between 13° 58' 39" N and 39° 25' 45" E with an average altitude of 210m.a.s.l covering a total area of 8576.64 km². With a total area of 58.66 km², Negash is situated 13° 52' 42"N and 39° 35' 52"E and has an average elevation of 2025m a.s.l The topographic feature of the study areas includes flat (40%), sloppy (15%) and hillside (45%). The soil type of Hawzien (Cambisols) and Negash (Fluvisol) are composed of sandy loam and clay loom textures (Efrem 2008).

Rainfall is variable as it is influenced by Inter-Tropical Convergence Zone (Feoli et al. 2002). Hawzien has an average temperature of 21⁰c with annual evapotranspiration of 152mm and mean rainfall of 519mm. According to the traditional agro-climatic classification, the study areas consist of *Degua* (>2300m.a.s.l), *HawusiDegua* (1500-2300m.a.s.l) and *Kolla* (500-1500m.a.s.l), elevations representing 9.5%, 68.5% and 22% respectively, (BoNAR 2009). The dominant stable crops are finger millet (*Eluesinecoracana* L.), wheat (*Triticumaestivum* L.), maize (*Zea mays* L.) and barely (*Hardeumvulgare* L.). Wasteland in Hawzien consists of 41,197.25ha (49.04%) of other land uses and contributes 77.73% of wasteland in Tigray. The study sites are characterized by limited cultivable land and farming on steep slopes (Tesfay 2008). Moreover, eastern Tigray is known for its livestock population. Free grazing, crop residues and grass from the margins of mountains are the main sources of feed for livestock (Efrem 2008).

Figure 1: Map of the study areas



Data collection and analysis

Beneficiaries of hillside plantations were the target households of the study. List of household heads was obtained from Farmers Training Center (FTC). Hawzien (Ahrag & Dongar) and Wukero (Adi-keshi & Kal-habile) representative districts with 103 sample size were selected randomly. Pre-tested interview was utilized to record demographic characteristics, crop yield, livestock size, and income before intervention (2001) and after intervention (2009) to see if the allocation of degraded gully and hillsides to land-poor farmers brought a significant difference. The actual benefits of hillside plantation from 2007 to 2009 were also estimated out of 0.25ha. The benefits were estimated by taking the current price from nearby markets (Jagger & Pender 2003). Eventually, promising economic activities, livelihood strategies, infrastructure accessibilities and challenges of hillside plantation were considered using focus group discussions and transect walks (Wezel & Haigis 2000).

Statistical Package for Social Sciences (SPSS) and MINITAB (version 15.1) softwares were employed to analyze the data. 5% degree of freedom was considered in the entire test of significance. Descriptive statistics was computed on background information of the respondents, grass head-loads and poles. Matched-pair design was run to test the level of significance of crop yield, livestock size and income between 2001 and 2009. Tropical Livestock Unit (TLU) was used in the course of analysis to reduce confusion of livestock composition (cattle, sheep and goats). TLU usually considers 250 kg as live weight of African Zebu cow as standardized unit. Hence, some of the conversion factors commonly used for cattle and small stocks are 0.7 and 0.1 respectively, (Jahnke 1982).

ANOVA was run to observe variations among the study villages on crop yield (in quintal), livestock size (TLU) and income (Birr) between 2001 and 2009. Ordinary Least Squares regression analysis (OLS) was undertaken to capture determinant variables on management of hillside plantation (Meaza, 2010). In this regard, income (proxy indicator of hillside management) from pole and grass was assumed as response variable. Household head, education level, age, family size, size of livestock, land size, distance from labour market, income and land ownership were considered as explanatory variables which influenced (y). The selection of these explanatory variables is based on the researcher's own theory (Meaza, 2010) and on

empirical evidence of other studies (Ellis, 1998& 2000; Gebreegziabher, et al., 2010; Holden et al., 2003).

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \varepsilon,$$

where , Y = Income generated from hillside plantation;

β_0 = intercept;

β_1 to β_9 =regression slope coefficients of the equation;

X_1 to X_9 = household head; age of the household head; education level; family size, TLU, land size, distance to labour market; other source of income and land security, respectively;

ε =other unexplained variables affecting income from hillsides plantation.

The effect of inflation was not overlooked in this study as it erodes the purchasing power of nominal money values by making goods and services more expensive. Failure to take account of this effect could give totally misleading information. Therefore, the farmers' income generated from hillside plantation (2007-2009) was adjusted for the changes of the purchasing power. In this regard, the loss in real income was matched by the rise in smallholders' real income generated from hillside plantation.

3. Results and Discussion

Demographic and socio-economic condition of the respondents

Age, sex, family size, TLU and land size were important variables to understand the demographic and socio-economic conditions of the respondents. Most of the beneficiaries were within the active working group (25 to 44 years) and age was 41.33 ± 10.90 years ($M \pm SE$). Of the target population, female-headed households accounted for 11.6%. The result reveals that most of the respondents were male-headed households as hillside plantation is labour demanding. The result matches with the description "leaving two thirds women out of development" (Haward & Smith 2006). On average, household size in the study areas was 4.44 ± 1.76 and is considered as the main indicator of wealth status in the study villages.

Beneficiaries with larger family size involved in on-farm, off-farm and non-farm activities to diversify their income sources. Similarly the study shows that families with larger family size were better-off (Holden et al. 2004). Though education is considered as determinant human capital affecting the livelihood of the households (Nwonwu 2008), 78 % of the respondents did not get formal education. The respondents (73%) owned mixed livestock species of varied herd sizes. However, some of the respondents owned neither cattle (16%) nor small livestock (12%). Landholding was fragmented and located here and there at an average of 3.5 plots. The majority of respondents (56%) had a land size of 1.75 ± 1.00 *tsimidi* (1*tsimidi*=0.25ha). Though land is the most decisive factor of production by influencing natural, social and economic systems (UNEP 2008), the remaining (44%) of the respondents were landless farmers.

The economic benefits of hillside plantation

Beneficiaries appeared planting exotic (*E.camaldulensis*) and indigenous (*A.etbaic*, *D.angustifoli*, *O.Africa*, etc.) tree species. Various grass species were also seeded. Beneficiaries preferred tree/grass species having the ability to resist moisture stress known silvicultural characteristics, fast growing, ability to coppice and good economic return from the sale of poles. Hillside plots were divided into tree planting and grass production to optimize benefit streams. Surprisingly, beneficiaries had a calendar showing when to plant and frequency of harvest depending on their livelihood strategies. Pursuing sustainable utilization of natural resources for improved livelihood, farmers developed a system of bylaw, locally named as *Serit*, to manage degraded hillsides and gullies. *Serit* was an operational law formulated based on mutual accommodation of different interests of the farmers. Guarding system (forest guard), maintenance of physical structures (fallen stone bunds) and biological measures (grass-tree integration), and use of fodder for livestock production system (cut-and-carry system) were the main rules of *Serit* (Meaza2010).

Poles for sale and self-construction were important timber product. Farmers believe that planting Eucalyptus secures their homesteads. Pole harvest increased from year 2007 to 2009 across villages (Table 1). In this regard, beneficiaries from Ahrag village harvested 18.40 ± 1.15 poles and 35.53 ± 0.82 poles on 0.25ha in 2007 and 2009, respectively. Similarly, beneficiaries from Adi-keshi village harvested 14.48 ± 1.15 poles and 24.70 ± 1.46 poles on 0.25ha in 2007 and 2009, respectively.

Table 1: Liquidated benefits (M±SE) of hillside plantation in Birr per 0.25 Hectare, 2007-2009

Site	Grass			Pole		
	2007	2008	2009	2007	2008	2009
Ahrag	355.6(11.4)	344.4(10.9)	317.8(9.3)	368.8(23.1)	505.6(28.60)	716.4(51.2)
Dongar	357(15.7)	353.5(10.7)	333.1(9.9)	356.70(18.7)	477.3(24)	604.7(33.4)
Adi-keshi	397.2(14.7)	345.4(11.5)	326.1(9.3)	289.60(17.2)	374.8(19.8)	493.9(29.2)
Kal-habile	367.5(17)	326.7(13.8)	320.1(11.2)	173.3(23.4)	356.7(26.4)	450(26)

Moreover, dead trees, branches and barks of woody species were important sources of firewood. Trees planted on 1ha of degraded hillside satisfied 54 to 73% of annual biomass energy requirement for four families. Thus, hillsides plantation satisfied the bio-energy demand of beneficiaries, while saving time for women. In this regard, researchers proved that tree planting increased both economic and ecological returns (Bewket 2003; Zenebe et al. 2010; Berhanu et al. 2003; Pearce et al. 2003).

Grass species for feed, sale and thatch was harvested from hillside plantation. Beneficiaries from Dongar reaped 10.20 ± 0.45 and 9.53 ± 0.23 grass head loads on 0.25ha in 2007 and 2009, respectively. Beneficiaries from Kal-habile also harvested 10.50 ± 0.48 and 9.10 ± 0.32 grass loads on 0.25ha in 2007 and 2009, respectively. Though statistically insignificant ($p < 0.86$), grass harvest reduced from 2007 to 2009 due to erratic rainfall and increased woody species dominance. Moreover, it was observed that hillside tree planting increased vegetation cover, helped the development of spring water and modified local weather conditions. Live and dry fence, fruits and traditional medicine were direct benefits obtained from hillside plantation. Beneficiaries from Ahrag (18%), Dongar (43%), Adi-keshi (25%) and Kal-habile (18%) also integrated beekeeping into hillside plantation. In agreement with Jacobs et al. (2006), beekeeping requires limited land and low technologies and hence beneficiaries should be encouraged to engage in this undertaking.

Hillside plantation was an important source of income in the study areas (Table 1). In this regard, 1034.20 ± 60.20 Birr² was obtained from 1ha in 2009. This number is by

² 1\$ US Dollar was equal to 13.37Birr

far better than the opportunity cost of the stable crop (*Teff*) harvested on 1ha of adjacent cultivable land. Mean crop yield increased in Adi-keshi ($p<0.04$) and Kal-habile ($p<0.02$) from the year 2001 to 2009. The pooled mean crop yield increased significantly ($p<0.04$) by 1.27 ± 0.16 quintals due to beneficiaries' capacity to buy fertilizer and rent- land for crop production. The overall increment in crop production of the beneficiaries was sufficient to conclude that crop yield was increased due to the fact that the smallholder farmers were beneficiaries of hillside plantation. The same result was reached at by many researchers (e.g. see Jagger & Pender 2003; Holden, et al. 2003) on the fact that tree planting at household level enhanced land productivity.

Livestock farming is considered as "living bank" as it entered into varied functions of farmers' livelihood. Beneficiaries have improved their livestock holdings in terms of composition and productivity. In Ahrag village, cattle and small livestock increased with a mean difference (2001 to 2009) of 0.22 and 0.02 TLU, respectively. The increase in TLU of small livestock was significant ($P<0.00$). The decline of cattle ($P=<0.37$) and increase of small livestock ($p=<0.13$) in Adi-keshi village was not, however, statistically significant. The pooled cattle size decreased from 2.42 ± 0.27 to 2.31 ± 0.11 TLU from 2001 to 2009. In this regard, beneficiaries whose age was older than 40 years had more herds (in 2001) but herds rapidly decreased (in 2009) due to splitting livestock to married household members and increased conversion of communal grazing into areas of exclusion. TLU was relatively better in Dongar and Ahrag due to good grazing commons ($r=0.79$). As a response, households preferred small livestock as their adaptive capacity for environmental stresses is better and require small feed. Small livestock increased from 0.35 ± 0.05 TLU to 0.52 ± 0.03 TLU in the villages. Therefore, the result explicitly confirmed that income generated from hillside plantation increased good livestock appearance and productivity. Besides, unlike before 2000, beneficiaries owned reasonable herd size and oxen for ploughing. Similarly, a study undertaken in central Ethiopia revealed that the less availability of feed resource driven by land use changes forced households to shift to small livestock (Tsegaye et al. 2008).

Cash-for-work and *food-for-work*: Daily labor on weeding and crop shearing were primary sources of off-farm income. Daily wage in non-agricultural activities and preparation of local drinks were also non-farm activities. The pooled mean income

differences (2009-2001) showed a significant increase ($p<0.00$) due to access to credit and completion of extension packages (Table 2). In agreement with Barrett et al. (2001), on-farm, off-farm and non-farm activities continued to improve the livelihood of pastoralists.

Table 2: Matched pair-wise comparison of income at household level (Birr)

Site	2001	2009	Difference	P-value
Ahrag (n=50)	322.20(28.6)	872.40(79.10)	550.20	0.00
Dongar (n=30)	446.70(32.10)	1119.00(88.40)	672.33	0.00
Adi-keshi (n=12)	582.50(80.00)	1343.00(227.00)	760.83	0.00
Kal-habile (n=11)	545.80(58.90)	1169.00(124.00)	623.33	0.00

Crop yield was significantly varied ($p<0.00$) among the study villages in the year 2001. But in 2009, the test confirmed that the variation was not significant ($P<0.18$) as benefits shared from hillside plantation decreased the gap through time. Similarly, income variation among the study areas was significant both in 2001 ($P<0.00$) and 2009 ($P<0.02$). However, TLU variation among beneficiaries was significant neither in 2001 ($P=<0.14$) nor in 2009 ($P=<0.44$). The findings proved that the variation in crop production, TLU size and non-farm income among beneficiaries was nearly homogenous in 2009 as compared to the year 2001 due to the income generated from tree planting and other associated advantages. In agreement with Gebremedihin et al. (2003), participation in tree planting is a wise choice to increase sources of income and enhanced agricultural productivity.

Determinants of hillside management

Hillside plantation is an enormously important source of income for smallholder farmers (Table 3). However, inter-and-intra variation of income was observed across the study villages. In this regard, the coefficient determination of education level of the households (-137) was significant ($P=<0.01$) to retard hillside management. Similarly, income other than tree planting at hillsides hampered ($p<0.00$) the management of hillside plantation. This is because households allotted less labour for tree planting and engaged in other nonfarm activities. The fact that benefits from tree planting are long term discouraged investment in the area. The finding is

consistent with the study of Holden et al. (2004) reporting that access to non-farm income reduced household's motivation on long term land investment.

Table 3: Multiple regression of income generation from hillside plantation

Variable	Coefficient	S.E	P-value
Household head (dummy, male =1, female =0)	212	98.52	0.03
Age of household	9.65	3.66	0.01
Education (dummy: illiterate=1, otherwise=0)	-137	86.49	0.01
Family size	16.5	28.89	0.56
Livestock Size (TLU)	11	29.55	0.71
Land size	-8.1	28.79	0.78
Distance to labour market	3.78	0.84	0.00
Non/on/off farm income	-123	82.07	0.00
Land security (yes= 1, otherwise=0)	431	76.00	0.00

Age of the households had a positive impact ($P < 0.01$) on management of hillside plantation due to the acquired better indigenous knowledge and experience on how to manage hillside plantation. Age of the household and income of hillside plantation were positively correlated ($r = 0.91$). This implies that younger beneficiaries generated less income as they were attracted by short term benefits. In this regard, beneficiaries below 37 years migrate seasonally to Humera leaving hillside plantation under managed. Though migration is one of the livelihood strategies (Ellis 1998 & 2000), it caused poor management of hillside plantation. Male-headed households managed hillside plantation properly ($P < 0.03$) due to better access to agricultural technologies, labour power, and TLU size. It was observed that male-headed households had better tree density on their respective hillside plots as compared to women-headed households. Therefore the finding is inconsistent with the result found in Amhara region where female-headed households planted more trees (Holden et al. 2003). Though insignificant ($P < 0.71$), beneficiaries with larger TLU and land size had good harvest of forage for livestock. This reveals that TLU and land size had positive relationship with hillside management.

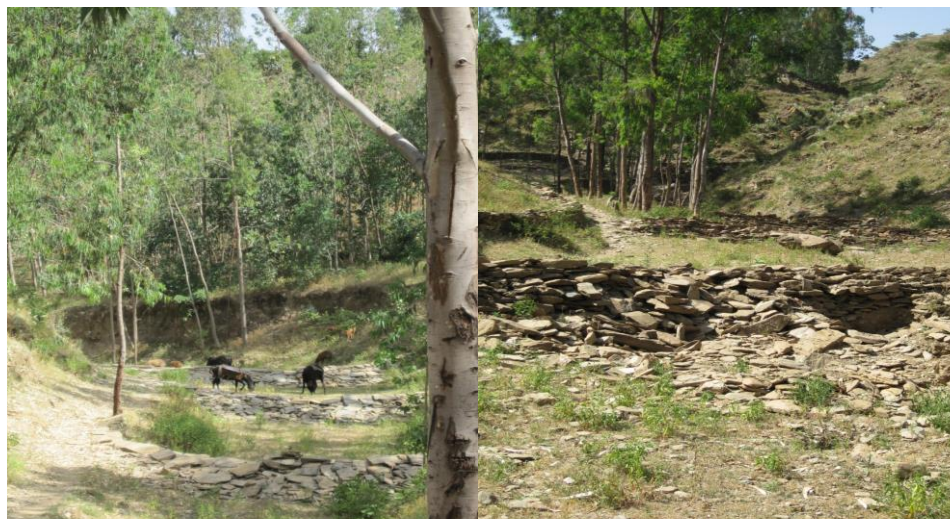
Distance to labour market had a significant positive impact ($P < 0.00$) on management of hillside plantation. Beneficiaries from Adi-keshi and Kal-habile are near Mekelle and thereby reduced the management intensities of hillside plantation as better access in terms of road and market can take some labor away from rehabilitation

activities. Conversely, remote households from the labour market (Ahrage & Dongar) better managed hillside plantations. Hence, it can be inferred that the further the distance is from the labour market, the better hillside plantation is managed. Other studies showed that distance from the negatively affected investment on the land (Gebremedhin et al. 2003; Hagos & Holden 2006). Moreover, sense of ownership of hillside plots had a significant impact on management of tree planting ($P < 0.00$). Beneficiaries perceived that with ownership security, they could invest on hillside plots by using indigenous and introduced technical knowledge to reap short and long-run benefits of tree planting. Similarly, Gebremedhin & Swinton (2003), Hagos & Holden (2006) and Hanjra et al. (2009) supported that the role of land security on farmers' investment has a positive effect for economic and ecological returns in the short and long term.

Emerging challenges of hillside plantation

Enormous conversion of communal grazing land into areas of exclusion, community forest and hillside plantation led farmers to shift to small livestock (sheep and goats) and bee keeping. Small livestock require small feed and browse nutritive shrubs, saplings and shoots in the common resources area freely. Even in the case of illegal encroachment to protected areas, a fine charged for small livestock is insignificant.

Figure 2: Livestock encroachment and traditional gold mining in hillside plantation in Hawzien.



Conflicting interests between beneficiaries and non-beneficiaries were also observed in the study areas. Around the foot-hillsides, water from a spring used for household consumption and livestock. Trespass along the treated hillsides and gullies by livestock was observed. Seedlings and saplings suffered from traditional gold mining and moisture stress (Figure 2). Grimble & Wellard (1997) noted that conflicts linked to environmental resources is common, but better institutional arrangements are needed to settle the issues.

4. Conclusion and Recommendations

The benefits, including timber and non-timber forest products, acquired from hillside plantation were encouraging for improving the livelihoods of landless farmers in eastern Tigray. The income generated from economic trees and access to completed extension packages due to tree planting increased crop yield; livestock productivity and income of the beneficiaries. In line with this, variation in crop production, TLU and income among beneficiaries was almost the same in 2009 (after hillside allocation) compared to 2001 (before hillside allocation). This reveals that economic disparity of households narrowed due to tree plantation at less-favored areas. Male headed households' good livestock size, age of households, longer distance to labor market and ownership of hillside plots increased income generated from hillside plantation. In conclusion, tree planting brought considerable positive impacts on livelihoods of marginal farmers and the following recommendations are made:

1. Women-headed households (11.6%) are excluded from participating in hillside plantation. Considering the rugged terrain, women-headed households should be given affirmative action including delivery of seedlings to the site, site preparation, seedling transplanting and post-planting maintenance to make them participate in hillside tree planting,
2. With the tradition of beekeeping in the region and an attractive market for honey, beekeeping could be a potential component to be integrated into hillside plantation. This is because beekeeping complements and is dependent upon the recovery of the natural environment including the planting of fruit trees and other vegetation. It also provides other means to achieve equity through targeting of landless, youth, women and destitute among the households.
3. Paradoxically, increasing allocation of gullies and degraded hillsides may have a negative consequence as it may pose conflicts with non-beneficiaries in the future. Therefore, a dynamic and judicious system of natural resource management should be implemented.

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URBAN PUBLIC TRANSPORT SERVICE, DEMAND-SUPPLY ANALYSIS: THE CASE OF MEKELLE

Menasbo Gebru¹ and Desta Kidanu²

Abstract

This study examined the demand and supply of urban public transport service in Mekelle city, northern Ethiopia. The results presented were based on primary data collected from a random sample of 140 urban public transport service suppliers and 400 transport users. Descriptive statistics, OLS, and Probit were employed as analytical techniques. Descriptive analysis showed that there was mismatching between demand for and supply of the transport service and residents failed to get the right service at the right time. OLS was used to look at determinants of supply of and demand for urban public transportation service and Probit method helped to address modal choice and factors influencing it. Long distance from the central departure point of transport service affects negatively the average trip per time of the service supply. Similarly, increasing family size by one person and age of household head on average by one year, lead to increase the probability of demand for urban public transport by 17.1 percent and 0.05 percent, respectively. However, for an increase of price of the service by 1 percent, the demand for the service significantly decreases by 19.4 percent. The recommendations of the study note that there is a need to introduce a new system of administering the existing route structure to make it competitive and open ended, and launching an alternative mode of transport would be a sound intervention in solving the persistent supply problem.

Key Words: Demand- Supply, Urban public transport, OLS, Mekelle.

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1. Introduction

A transport system is an essential element of the economic and social activities of urban areas. It consists of transport infrastructure and service that permit economic agents to access activities. The positive relationship between urbanization and per capita income is one of the most obvious and striking “stylized facts” of the development process. In the mean time, the demand for urban transport in many cities of the developing world continues to increase with urbanization (Todaro and Stephen, 2010). One third of the world’s population lived in urban areas between 1975 and 2000 and this figure will be raised to two-thirds by 2025(World Bank, 2000).

Rapid urbanization is taking place in cities of the developing world especially Africa where urban population is growing at an unprecedented rate. For instance, in the 1980s the urbanization growth rate of Kenya, Tanzania and Zimbabwe were 7.7%, 6.6% and 5.9%, respectively (World Bank, 2000).One of the important urban services correlated with high population size is transport. It has an impact on regional patterns of development, economic viability and the environment in maintaining socially acceptable quality of life (Murray et.al, 1998).

However, in developing countries, urban transport has many problems. Inadequate and poor quality infrastructure, mismatch between demand and supply and increasing accidents are some of the problems. These problems are triggered by urban population increase following rapid, unplanned, and uncoordinated growth of cities (Transafety, 1998). As a result, urban areas of developing countries were significantly affected by inappropriate transport service (Yao, 2007). Mekelle is no exception. Subsequent to the introduction of market-oriented economic policy in 1991 in the country and the intensification of private investment, Mekelle has become more urbanized and plays a greater role in reducing urban unemployment as well as urban poverty. Expansion of economic activities in the city including real estate development has led to a huge and increasing demand for urban transport.

Although some organizations in the city provide own transport to their employees during week days, the majority of the civil servants and other residents use public transport to take care economic and social activities. Lack of transport is acute

during the morning and evening peak hours (MTO, 2010) while there was excess supply of transport during non-peak hours.

Moreover, the minibus taxis operated between the center and peripheries of the city, providing, however, no service to the center of the city because they do not pass through it. What is more, loading and unloading en route is prohibited. The city administration is aware of the problems although no solution is provided due to other more pressing socio-economic problems.

This study was carried out for Mekelle, capital of Tigray regional state, which has a population of more than 270,000 (CSA, 2007). The city is divided into seven sub cities each on average having 40,000 inhabitants. The sub cities are further subdivided into seven lower administrative blocks "*Kebelle*" or "*Tabia*". The majority of residents are public servants, the rest being employees of other organizations and self-employed. Out of the residents 27% live below the regional poverty line of 2508 Birr per year per adult equivalent (Hiluf, 2012).

The vision of urban transport plan of Mekelle was "*affordable transport enhanced access to mobility*". In Mekelle, public transport consists of minibus taxis and "*bajajes*" operated by the private sector and buses exclusively serving employees of large organizations. The existing charge is a flat fare depending on the distance from the central departure area and subject to revision periodically according to the fuel price determined by the Ministry of Trade. The minimum service charge of city transport is one Birr per trip, but the poor and students cannot afford to pay this regularly.

Almost in all areas of the city, people walk long distances to reach their destination. In newly developing areas of the city, including, Adi Ha, Debri, Hawilitt, Ayder, Kebele 05, transport is not available most of the time. At peak hours transport users are mainly students and public servants. The minibus taxis provide the service under overcrowded conditions. In general, the system is not suitable especially for children and the elderly, and people spend more time and money on travel. Therefore, network and service deficiency under the current physical, financial and institutional arrangement have to be investigated so as to improve the service to comply with the transport vision of the city "*affordable transport enhanced access to mobility*".

The main objective of this research was to investigate the existing demand for and supply of urban public transport in Mekelle which prevented equal accessibility of the minibus taxis to all groups of people in the city. More specifically, the study has the following objectives. Firstly, to define the existing urban transport supply and its affordability to the people. Secondly, to examine the proximate determinants of the two market forces (SS-DD). Thirdly, to examine the need of the society in demanding alternative mode of transport and fourthly, to suggest improvements to the existing service supply.

Different organizations and individuals can benefit directly or indirectly from the result of this study. The minibus taxi associations can develop better awareness about the spatial distribution, weakness and strength of their service. Besides, they can get ideas on how and where to improve the service. Mekelle city transport office may obtain more awareness about the existing service and can identify where feeder services are required. Individuals can have an opportunity to investigate the possibility of investing in city bus transport service. Finally, it will be a starting point to future independent research by individuals and organizations.

Investigation for the paper was carried out using primary data collected from a random sample of 140 urban public transport service suppliers (100 minibus taxis and 40 bajajes) and 400 residents of the city. Descriptive statistics, OLS, and Probit were employed as analytical techniques and detailed illustration of the methods are incorporated in the methodology part of this paper.

2. Review of Related Literature

Cities are locations having a high level of accumulation and concentration of economic activities and they are complex spatial structures supported by transport systems. Urban productivity is highly dependent on the efficiency of the transport system (Rodriguez, 2010) and its primary function is to carry people from an origin to a destination within the shortest possible time and at the least cost. Urban public transport continues to be a high priority of social obligation of governments throughout the world. In some jurisdictions, it is the prime responsibility of national governments, while in others it is a state or local government responsibility. Public

transport in developing countries is essential for the urban poor who have to rely on walking; cycling and road based public transport to meet their travel needs (Michael, 2010). However, it is constrained by considerable problems. Eschborn (2002) had tried to relate the demand- supply of urban public transport in developing countries of Latin America, Africa and Asian and found out that due to insufficient range of networks, rail-borne mass transport systems often meet just a small share of overall demand. Similarly, although the primary function of urban transport is to mobilize a large number of people at a reasonable price and time to meet the mobility demand, public transport capacities in developing countries do not satisfy the poor for a number of reasons (Abate, 2007). According to a similar finding in China, long waiting time, inconvenient transfer, and low punctuality rate of public transport suppliers created high customer dissatisfaction (FENG et. al, 2009). In Harare (Zimbabwe), urban commuters significantly suffered to travel from home to work daily (SATC, 2006).

Numerous factors persuading the intensification of the urban vehicle mobility include sustained economic growth (increase per capita and quality of life), complex urban mobility patterns, more leisure time and suburbanization. Empirical studies show that Chinese urbanization has increased at a speed of more than one percent per year, and more than 10 million people became urbanized by the end of 2007 and to support the newly urbanized society, transport service was secured (FENG et al, 2009). Consequently, rising urban transport mobility can be perceived as a positive consequence of economic development.

Cities are the most important factor to instigate the mobility of people which leads to inflate the demand for transportation service. Motorized transportation was seen as a powerful symbol of modernity and development. As cities stretch economically and physically, the cost of operating public transportation systems also increased. The outcome changes in the socio-economic environment of human activities such as urbanization which involves new forms of employment, economic activity, lifestyle, and industrialization in the developing world are directly correlated with urban public transport. The relationship between demand for and supply of urban public transportation system is an important component of urban economy. A study conducted in European Union revealed that urban transport service creates diverse satisfaction to the society according to the socio-economic profiles of service

demanders. For that reason, the old age services users were more satisfied by the service provided because they had to walk only a short distance to reach the service (IPSOS INRA, 2007). Modern and updated transport systems have been playing a major role in shaping countries via influencing the location of social and economic activity, and the style and pace of life (Balcombe et al, 2004). However, urban transportation systems are wilting under the pressure of ever growing demand and inadequate street network, non-sustainable transport structures, traffic jams during and even outside the peak traffic times (Jiuh and Sheu, 2003; Eschborn, 2002).

Rapid urbanization has increased the demand for motorized transportation (Zuidgeest, 2005). The spatial structure of cities particularly in developing countries is highly variegated. In some areas, transport services were adequately provided while insufficient or no service is accessible in others (Abate, 2007). Similarly, there is variation of service provision for societies with different socio-economic characteristics and location. Moreover, the urban vulnerable groups are located mostly either at the city center, economic heart or at the periphery (John and George, 1998) where cheap transport service rate was demanded (Abate, 2007; Balcombe et al, 2004). The essence of urban service planning is to provide adequate and equitable services to all groups. It has an impact on regional patterns of development, economic viability, environment, and maintaining socially acceptable quality of life (Mahmud et al, 2008).

There are many reasons why people take trips in urban areas like going to school, recreation visits to relatives but trips to work take (40-50) percent in developing countries. In most cases, urban transportation system is the basis by which economic development can occur and the means by which society interact (Souche, 2010). The urban transport sector, however, has many problems in most developing countries, such as inadequate and poor quality infrastructure (FENG et al, 2009), mismatch between demand and supply, and increased rate of accidents (Martin, 2003). These problems are also triggered by interrelated trends such as urban population growth, and rapid, unplanned, and uncoordinated growth of cities (Adekum and J. Aderamo, 2010).

Urban transport planners must consider influences of trends like trip purpose, temporal, spatial distributions of trips, modal splits of travel, and costs of mobility

which fit into a more general interpretation of sustainability in social, economic and environmental factors (Mahmud et al, 2008; Martin, 2003). The inherent characteristics of developing countries such as high population density, low income, spatially separated land uses and lack of resources demand transport service for large numbers of people at low cost (Souche, 2010).

3. Methodology of the Study

3.1 The Data

The study designed to gather information and necessary data from various sources. Primary data was collected through structured questionnaire distributed to urban public transport users through purposive sampling technique and to suppliers of urban public transport by randomly selecting from the entire city service suppliers (Mini bus Taxi and Bajaj). A total of 400 transport service demanders and 140 transport suppliers (vehicle owners) were involved in the survey.

3.2 Method of Analysis

3.2.1 Urban Public Transport: Supply

The supply of urban transport was dealt with the relationship between the input of the service and its capability in satisfying the transportation demand which was termed as transport supply function. This production function was focused to satisfy the normal transportation demand brought by the development of economy. Accordingly, the total number of trips or frequencies operated by the transport suppliers (minibus taxis and bajajs) were considered as common measure of aggregate supply of the urban public transport and considered as a dependent variable against set of independent variables (Michael, 2010).

$$\log Z = \chi_o + \beta X' + U_i \quad (1)$$

Where Z was observable magnitude that considers the log average number of trips per time made by individual suppliers of the transport and X' was vector of variables affecting the supply function of the transport, namely, site of residents, distance, passengers size, off due time of vehicles, trip duration, etc and, β vector

of parameters and ε_i the disturbance term with zero mean and constant variance. The method of estimation was Ordinary Least Square (OLS) because Michael's (2010) research finding in Ghana revealed that a unit measurement change in cost of vehicle contributed about certain percent change to the overall supply situation within the urban transport industry.

i. Urban Public Transport: Demand

According to economic theory, transport users choose among alternative modes of transportation so as to maximize their 'utility'. A general formula of demand function was illustrated as follow (White et al, 2004).

$$D = f(X_1 \dots X_n) \quad (2)$$

Where D was the dependent variable (level of demand) and $X_i(1, \dots, n)$ were explanatory variables. The demand function reflected the behavior of an individual, which preferences dictated the particular functional form of the relationship. Many functions used in demand analysis were based on a linear or a log-linear relationship between the dependent and independent variables. A particular specification of the demand function regularly used to analyze travel demand was expressed in terms of size of group of 'passengers' (Aderamo, 2010).

$$\text{Log } D = \alpha_0 + \Gamma X' + \varepsilon_i \quad (3)$$

Where logD refers group of passengers demanding transport service, X' in particular time set of explanatory variables, like price, income, location, accessibility, rapidity, and etc, ε_i refers to the disturbance term where OLS assumption was assumed to be valid.

3.2.3 Choice of Independent Variables

The literature base set of the independent variables consists of traditional supply side factors, including service start up time, site distant from the central departure area, passengers' size at different locations, off duty during peak time and others.

Variable description and their expected sign in the demand and supply regression analysis were briefly described as follows:

Passengers' size: This variable was included in the regression as the users of the transport service at different locations of the city of any time. In the analysis, it was measured in unit of costumers. One would expect higher passengers' size, a better trip frequency and the sign of the coefficient on average trip per day in the regression to be positive (Michael, 2010).

Site distance from central departure area (Dummy area): The greater distance of residential area from the centre of the taxi departure site, vehicles provide fewer trips and the expected sign becomes negative.

Off duty during peak time: Service suppliers become off operation during peak time due to various reasons and the lesser the trip frequency they would practice.

Income of the passengers: Passengers' socio-economic condition was one of the basic determinant factors for the transportation sector. One can expect a positive correlation between the income of individuals and the probability of demanding the existing mode of transportation.

Price of the transport service: Microeconomics theory reveals that price elasticity of demand and supply of the service are inversely and directly related respectively. This means that high service price attracted the suppliers and discouraged the demanders. Accordingly, it was expected that as the transport tariff was revised and increased, the probability of using the transport service was supposed to be decreased.

4. Result and Discussion

4.1 Descriptive Statistics

As a result of the physical expansion of the city in all directions and beneficial economic activities, the existing transport supply mismatched the demand. Shortage of supply became a great bottleneck to the mobility of the people and seriously affected their activities. The mobility of the people was mostly time based and the supply failed to take care of it during peak time. On the other hand, in nonpeak time there was no significant demand, and supply was in excess. Service operators agreed that efficiency of urban public transport was not improved in accordance with the ever increasing demand. The survey result indicated one crucial

case for less service supply was that benzene user minibuses were withdrawn from the market because their mobility was dynamic and they could not stay for long hours without providing service.

Furthermore, in Mekelle, transport service route management was not open ended from one corner of the city to the other. Rather it was closed and confined with specific route per specific time and the situation was not conducive to sustained operation of benzene user taxis in the market. What is more, the problem allied with the benzene user taxis was shortage of fuel stations which can supply benzene according to the demand. In addition, getting spare parts was a problem to benzene user minibuses.

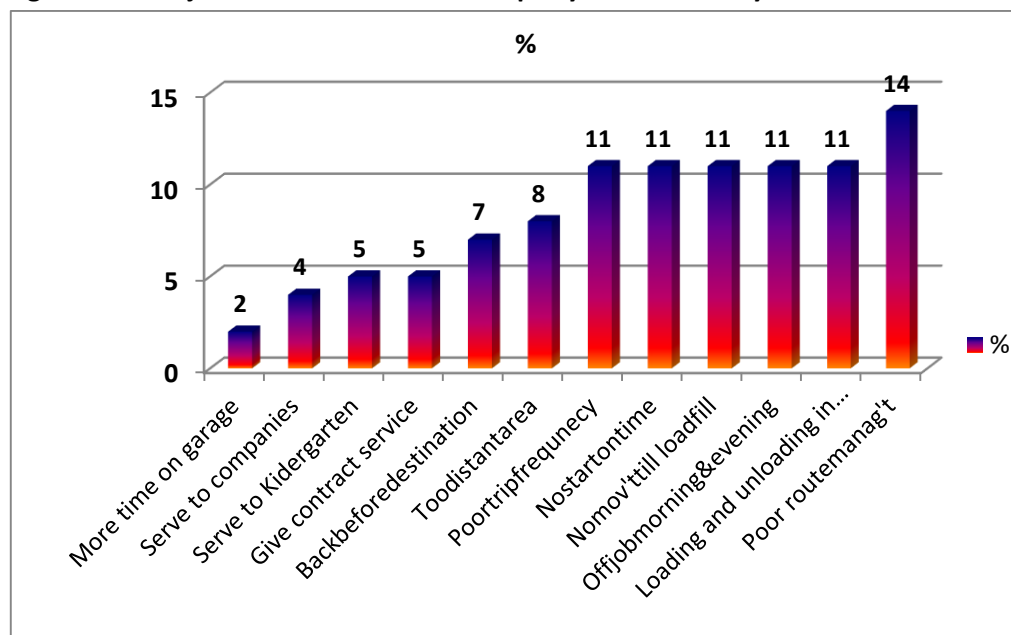
The socioeconomic and personal attributes of travelers consisting of gender, age, occupation, monthly income, educational level, family size sex, family head characteristics etc. affect the ever-increasing demand for transport service. More than 98.8 percent of the respondents were user of the existing mode of urban public transportation within the city. One way expenditure for urban transport ranges from 1.00 Birr to 4.50 Birr depending on the residential area and the distance they travel. The mean monthly expenditure for transport service by a given household was between Birr 4.8 and Birr 1,500. During the survey period, it was recognized that the majority of the respondents began their daily trip at 6.00AM and most of their activity was performed between 7.00AM and 5:30PM. Even though, more passengers were trickling to get the right service almost at any time of the day, the problem becomes persistent at the morning and evening hours which was quite consistent with the peak time characteristics of long queue of passengers and excessively long waiting time in Zimbabwe (Mbara, 2006).

4.1.1 Inadequate Service Supply: Major Causes

The problem of the urban public transportation service in Mekelle may not be lack of end to end service provision and low vehicles supply. The service could not satisfy the demand even within the scope of a single route at a time. Even though the size of vehicles (Taxi and Bajaj) was increased from time to time, nevertheless the efficiency of service provision was still low which resulted from the improper route management of the service. To make clear how far the existing service supply level

was too low, information was gathered from the supply side. Service operators said that the problem rests with inefficient route management at peak times.

Figure 4.1: Major causes of Service inadequacy in Mekelle city



Source: Survey data, 2011

The horizontal line of the above graph depicts the reasons for the existing inadequate service delivery and the vertical line represents size of respondents in percent. In practice the inadequacy of service provision was technically not due to low service supply because all of the reasons were not associated with the natural characteristics of the service supply rather they were largely technical. On average, poor route management, poor frequency trip, failure to start service on time, reluctance to move from departure till car loaded to capacity, off duty during morning and evening hours as well as prohibition to load and unload en route were the main causes for increasing shortage of supply.

Another reason for the inadequacy of urban transport in Mekelle was shortage of fuel. Almost 77.6 percent of service suppliers were affected by fuel shortage as a result of which they became off service at any time. The reason for the prevalence of fuel shortage was caused by dearth of fuel stations in the city. There was only one

fuel station serving all types of vehicles. While other types of vehicles can alternatively buy fuel outside Mekelle, urban public transport service providers do not have this option. If there is no fuel in Mekelle the service providers stop operation until fuel becomes available again. This was particularly true for benzene user minibuses.

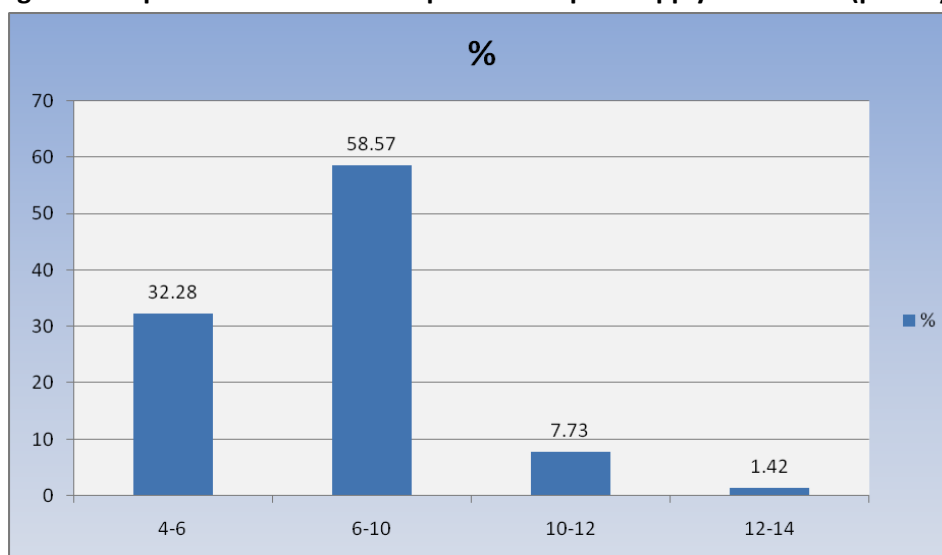
4.1.2 Service Variation by Time of the Day and Days of the Week

The internal structure of the public transport market in Mekelle may also be examined in terms of trip length which differed by the time of the day (at different times of a day) and days of the week. From Monday to Friday, work and education trip tends to be concentrated at peak periods.

Excess supply was mainly during nonpeak time and almost 85 percent of transport service supply was in excess of demand. Only for a few hours supply comes within reach of demand, and during peak hours demand exceeds supply. Theoretically, service oversupply can arise in situations where there was too much competition among operators. However, according to the researchers' observation there was no stiff competition in Mekelle that can affect the individual market significantly. The overall service operation was rather centrally managed by the Taxi Association.

Figure 4.2 below depicts the exact operational time per day based on responses from suppliers. In view of this, 58.6 percent of the operators provide transport to the society on average eight hours per day. However, according to the city transportation office, suppliers of the transport service should be on duty from 6:00AM in the morning to 10:00 PM in the evening. Nonetheless, due to various reasons they operate for limited hours and become idle most of the time.

In the above bar graph, the horizontal line indicates operational hours of service suppliers and the vertical line number of respondents providing service in percent. Result revealed that on average, the supply service becomes effective only for limited operational time because demand for urban transport was volatile and inconsistent in all hours of the day. Almost 65.7 percent of people's movement was in the morning from 7:00 AM to 9:00 AM to go to work and after 7:00 PM in the evening to return home.

Figure 4.2 Operation time of urban public transport supply in Mekelle (per day)

Source: Survey 2011.

4.2 Econometrics Result

4.2.1 Determinants of Urban Public Transport Supply (OLS Result)

Transport service is a technical relationship that deals with the trip/frequency service provided by individual transport service operators against factors affecting to produce the service. We note that the dependent variable of the model was log average trip per day, and the independent variables were in level hence the regression coefficients measure the percentage change of average trip per day for a unit change in the explanatory variable. Different explanatory variables explained the dependent variable in the regression analysis differently.

According to the estimated results in Annex Table1, coefficients with negative sign correlated inversely with the service rendering system and coefficients with positive sign affected the service delivery positively. Holding other variables constant, lagging to start the service operators early in the morning, the probability of average trip per day decreases by 19.5 percent. Short distance from the central departure was conducive for the Bajaj mode transportation and on average their daily trip was 70 times (one way trip) per day while trips decrease with long distance. Accordingly, transport service operators assigned at short distance from the departure area (St,

Gebriel, SOS, Kebelle 17), the probability of making more trips per day accounted for 101.7%, 71%, and 78.1%, respectively at 1% level of significance.

On the other hand, residential areas far away from the central departure of the service suppliers contribute more to delivery of few trips per day. As a result, areas (Hawliti, Adishmidhun and Kuha), the probability of making trips per day decrease by 25.9%, 29.4% 29.6%, respectively, at 5% level of significant *ceterus paribus*. Consequently, people residing at the sites mentioned above suffered significantly to reach the service especially during peak hours. The power of the explanatory variables up on the dependent variable was described by R^2 and revealed that 88 % of average trip per day was explained by the given variables. In a nutshell, besides long distance from the central departure area, quality of the road also contributed to decrease or increase average trips supposed to be undertaken by the existing transport supplier at city level.

The beta coefficients on the fourth columns of Annex Table 1 were used to compare the relative strength of the various predictors within the model. Accordingly, dummy St. Gabriel route has the largest beta coefficient, .43 (in absolute value), and Arid route has the smallest beta, 0.042. Thus, a one standard deviation increase in operation at St. Gabriel route leads to a 0.43 standard deviation increase in predicted the log average trip per day, and , a one standard deviation increase in duty of the service supplier at Arid route, in turn, leads to a 0.042 standard deviation decrease in predicted log average trip per day *ceterus paribus*. At present, supply of urban public transport in Mekelle was mainly by the private sector and there was no government subsidy completely.

4.2.2 Measured Aggregate Demand for Urban Public Transport

There was no general rule or consensus among researchers that many functions used in demand analysis were based on a linear or a log-linear relationship between the dependent and independent variables. A particular specification of the demand function which was often used to analyze travel demand was expressed in terms of size of group of '*passengers*'. This concept was an attempt to summarize the user of a journey by adding together the various components of time or money spent (White et al, 2004; Aderamo, 2010). However, Paul (2001) stated that aggregate

demand was expressed as the total number of trips demanded during a given period of time in terms of a set of explanatory variable.

Table 4.1: Aggregate Demand Measurement of Urban Transport Service (OLS result)

DEPENDENT VARIABLE :LOG DEMAND FOR TRANSPORT SERVICE				
EXPLANATORY VARIABLES	Coef.	Robust Std. Err.	t	Beta
HEAD AGE	.005***	.001	3.56	.131
FAMILY SIZE	.171***	.010	16.05	.674
WORKPURPASE	.011	.033	0.34	.011
PERSONALBI~S	.079**	.030	2.58	.077
DISTANCEHO~E	.011	.009	1.30	.051
LNPRICEPERRO~E	-.149**	.037	-2.21	-.090
HHINCOME	.00003**	.00001	2.31	.084
HHTRAEXPEN~H	.0003***	.0001	3.31	.096
HEADPRIVTA~S	.066*	.036	1.85	.063
HEADCIVILS~T	.025	.0191	1.31	.036
HEAD FARMER	.022***	.006	3.32	.082
DUMY ADSHE	-.022	.032	-0.67	-.016
DUMY HDAM	-.080*	.043	-1.86	-.049
DUMY KUHA	-.025	.090	-0.28	-.010
_CONS	.611***	.095	6.38	-
NUMBER OF OBS = 393			F(14, 378) = 67.53	
PROB > F = 0.0000			R-squared = 0.7171	

*** Significant 1%, **significant 5%, * significant 10%

Source: Survey data, 2011.

Subject to the above qualification, the total number of trips recorded was the most common measures of aggregate demand. As a result, the dependent variable was expressed in logarithmic form in which for a unit change in the explanatory variable leads to the percentage change in the dependent variable at a certain level of significance. All OLS assumptions were tested out and estimates were statistically robust.

The overall model fitness was verified with F value of 67.53 at degree of freedom 14 and the null hypothesis was rejected at 5 percent level of significance. The R square of the regression made was 0.71 which tells us that about 71 percent of the variation of aggregate demand for the urban public transport service was explained by the model.

4.2.2.1 The Price Effect

When price per route increases, the probability of service users size decrease at 5% level of significance. Accordingly, for 1% increase the price of the existing service per given route, the probability of demanding the public transport service decreases by 0.15 percent at 5% level of significance *ceterus paribus* which was quite consistent to the law of demand in microeconomics theory.

4.2.2.2 The Socio-Demographic Effect

Households consume the transport service just like other goods and service and from Keynesian consumption function, as income of the consumer increases, demand for various goods also increase (Keynes, 1936). On the other hand, family size was one factor to stimulate more demand for the services and for an average increase by one person in a household, the probability of demanding urban public transport increases by 17.1 percent keeping other variable effect constant and it was the strongest variable with beta value of 0.67. This study becomes consistent with the finding of (McFadden, 1974) and (Souche, 2010) that transport demand was even more correlated with socio-demographic variables than the other variables. Then again, budget allocated by household for the transport services also leads to kick off the demand for the service and statistically significant at 1 percent level of significance.

Work status of the household also affects the demand for public transport service in the study area. If a household head was engaged in private business, the probability of demanding the transport service increased by 6.6 percent as compared to other job categories of household heads like pensioners with constant income. Similarly being a household head in farming activities, the probability of demanding the transport service increased by 2.2 percent. This might be from the increasing price of agricultural products price which generates a bigger margin of cash income to the farmers than other activities as higher income drives to demand modern mode of transportation.

4.2.2.3. The Spatial Effect

Travelers' demand was also affected by spatial factors. Lave (1970) considered urban development as measured by the population density in each zone and the socioeconomic characteristics of the households and the location of their jobs and residential areas in order to explain their modal choice. Dargay and Hanly (2004) highlighted the need to consider the relationship between urban public transport demand and the use of space/ location of residents from the work place. Accordingly, travel decisions were influenced by the distance of working area and type of activity.

4.3 Modal Choice

Starting with the observation that urban public transport demand in Mekelle was the result of aggregation over the city population and number of travelers decisions based on his/ her personal needs/environment. Individual decisions are complex; the choice should be analyzed in the context of simultaneous choice of mode, housing location, and end of trip activities. In Mekelle, there were only two modes of urban public transportation i.e., minibus taxi and bajaje. The chance of getting alternative mode of transportation was too limited. To characterize the inclination of users' modes of urban public transportation system, a binary choice model (Probit model) was carried out.

The finding of this study helped to assess the preference of the user and the factors that forced to choose the specific mode. The Probit model can be exploited by the maximum likelihood method and under some data formats by modified minimum Chi-square. The use of Pseudo R^2 index was similar to the multiple correlation coefficients in OLS. The likelihood index was a more stable and statistically satisfactory measure for the estimation method used. Testing individual slope coefficient was the same with OLS by looking at the t- value and for the cumulative effect of the estimates of the Probit model based on the generalized likelihood-ratio. In view of that, the chi-square statistics of the Likelihood Ratio (LR), for modal (if taxi was choice with value 1 and 0, otherwise) was computed by comparing the log likelihood from the full model to the restrictive model and shown the overall model as a good fit with LR of 107.6 and typified that at least some of the slope

coefficients were significantly different from zero. The following Table 4. 2 shows modal choice and factors influence is of the choice.

Table 4.2: Binary Probit response: dependent variable minibus taxi-bajaje mode choice (one if choice is usually or frequently taxi, zero otherwise). Estimation method: Maximum likelihood, sample size 400.

Explanatory variable	Coef.	Robust Std. Err.	dF/dx
Family size	-.131	.109	-.022
Work purpose	-.309	.447	-.054
Distance home-work	.207	.193	.0361
Price per route	2.07***	.526	.3620
HH dincome	.0009	.0003	.00006
Head primary	.336	.293	.0587
Head secondary	-.120	.200	-.021
Head tertiary	.051	.153	.009
Headprivta~s	.393	.484	.062
Head civil servant	.244	.262	.042
Head farmer	.076	.109	.013
Dummy Lachi	-2.734***	.832	-.789
Dummy Ayder	.109	.997	.018
Dummy SOS	-2.54***	.866	-.774
Dummy G.churhc	-2.37***	.959	-.713
Dummy K05	-2.41***	.862	-.751
_cons	-2.38	1.45	-
LR chi2(16) =	107.16	Prob > chi2 = .000	Pseudo R2 = 0.5794

*** 1% significance

Source: Survey, 2011

Positive coefficients indicate, when the remaining variables were zero, the respondents' choice was minibus taxi not bajaje and coefficients with negative sign show keeping the other variables effectively constant, people's choice was bajaje not minibus taxi. It was quite consistent with the inequitable assignment of bajajes and minibus taxis throughout the city. For the dummy locations, transport service provision was dominated by bajajes rather than minibus taxis. For instance, sites SOS, St Gabriel, Kebelle 05, are not far from the central departure area, and residents prefer the bajaje to minibus taxi to reach their work place and return

home on time. The probability of reaching on time for the three sites is 77.4%, 75.1% and 71.3%, respectively, at 1% level of significance *ceterus paribus*.

5. Summary of Major Findings

This study focused on analyzing the demand and supply of urban public transportation service in Mekelle city, Ethiopia. A total of 540 people (400 service users and 140 service suppliers) were selected from the entire city. Generally, the findings of this study revealed that:

- a. There were only two modes of urban public transportation in Mekelle with a share of 56.2 percent for minibus taxis and 47.8 percent for bajajes. But the people do not get the right service at the right time and place due to low efficiency of the existing service supply
- b. Benzene user taxis withdraw from the market as a result of poor route management, lack of spare parts, fuel problem, thus making the limitations of the supply sector acute.
- c. Major causes for the limited service supply at city level were technical and managerial problems like failure to start on time, off duty during peak time, serving companies and schools at peak time and one way route management.
- d. Regression result showed that long distance from the central departure area affect negatively the average trip supposed to be provided by the service operator. For one percent increase of the existing price, the probability of demanding transport service decreases by 0.15 percent. On the other hand, increasing family size by one person and age of household head on average by one year lead to increase the probability of demand for urban public transport by 17.1 percent and 0.05 percent respectively.
- e. More than 98.6 percent of respondents say they need alternative modes of urban public transportation service.

6. Conclusion and Recommendations

From the foregoing discussion, there was a mismatch between the demand for and supply of the existing urban public transport service. As a result, travelers do not get

the right service at the right time and right place. The demand for an alternative mode of transport especially city bus at lower than the existing tariff increased significantly. Based on the findings, the following recommendations were made to help solve the chronic urban public transport problem in the long run.

- a. The existing route management system should be revised and administered by the market instead of interference by third party. This might solve the problem of service supply inequity at different areas of the city during peak time.
- b. Travelers prefer minibuses to bajajes because the latter's service provision is limited only to short distances. Upgrading the road condition will help the bajajes to serve long distance areas of the city.
- c. Route management should be open from end to end so as to attract the benzene user taxis to consider their share in solving the chronic problem of the transport service.
- d. Periodic assessment of the sector should be conducted by the city administration to solve the inequitable service distribution easily.
- d. Lastly, since there is a huge demand for alternative mode of public transportation service, introducing city bus use either by the city administration or private sector will be an indispensable solution in the long run.

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Table A.1: OLS Results (Modeling in Average trip function)

Dependent Variable: ln Average trip.				
Explanatory Variables	Coef	t	P> t 	Beta
Passengers size	.00008 (.00019)	0.45	0.656	.015
No start ontime	-.195 *** (0.083)	-2.33	0.021	-.139
Off job morning-evening	.1592 (0.098)	1.61	0.110	.113
Back before destination	.119 (0.077)	1.54	0.127	.070
More time garage	.301 *** (.100)	2.99	0.003	.110
No sudden parking	.007 (0.076)	0.09	0.925	.005
Dummy Adiha	-.227 *** (0.099)	-2.30	0.023	-.134
Dummy Adihwisi	-.167 (.107)	-1.56	0.120	-.101
Dummy Adishinduhun	-.294 *** (0.131)	-2.23	0.027	-.108
Dummy Hawilitt	-.259 *** (0.104)	-2.49	0.014	-.221
Dummy Kebelle17	.781 *** (.142)	5.50	0.000	.236
DummyKebelle03	-.343** (.173)	-1.98	0.050	-.073
Dummy SOS	.710*** (.104)	6.83	0.000	-.073
Dummy Arid	-.141 (.141)	-1.01	0.317	-.042
DummyKebelle18	.893 *** (.133)	6.72	0.000	.301
Dummy Kuha	-.296*** (0.111)	-2.66	0.009	-.124
Dummy G.church	1.017 *** (9.120)	8.47	0.000	.428
_cons	2.629*** (.106)	24.59	0.000	-
R-squared = 0.8806				
AdjR-squared = 0.8653				
F(22, 115) = 55.40				
Number of obs = 138				
Prob > F = 0.0000				

*** significance 1%, ** significance 5%,
St. Er are in parenthesis

DECENTRALIZATION AS AN INSTITUTIONAL SYSTEM, PROSPECTS AND RETROSPECT: CASE OF FOUR WEREDAS OF TIGRAY

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Abstract

Following the demise of the Derg regime in 1991, the most important reform agenda of Ethiopia was to restructure the country and its civil administration along ethnic lines, and to establish ethnicity as the defining principle of political, social and economic discourse. Consequently the country's political map was redrawn along ethnic lines, which gave way to "Regional states". The regional states secured administrative and legislative power within a federal framework. Success stories of decentralization encouraged policy makers to launch fiscal decentralization which extended the regions' planning and resource allocation powers to each district (wereda) level. This apparently enabled them to improve service expansion and development.

Despite this general perception on the effects of decentralization this study seeks to critically review the impacts of decentralization (both fiscal and administrative) on districts considering four weredas of Tigray regional state (northern part of Ethiopia). Both primary and secondary data sources were collected and analyzed using simple descriptive and statistical method of analysis. Results obtained based

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on the three variables (measures effect of decentralization on community participation good governance, and minimizing revenue expenditure gap show signs of positive progress. Indeed, there are promising changes related to administrative matters and of community participation in designing and implementation of development plans. Not only do these changes enhanced individuals' participation in productivity but also expedited poverty reduction as well, as indicated by the growing improvements in local livelihoods. However, the gains of decentralization on governance and minimizing revenue expenditure gap are far from satisfactory. As long as the real participation of locals and problems of local capacity remains at stake and where local districts still suffered more from resource limitations. This study recommends to solve the procedural and skill related problems to make decentralization work out more effectively.

1. Decentralization as a Context

1.1 Introduction

The concept of 'power devolution' is attracting a growing attention over recent times. Since the 1980's, centralization system is losing ground while transferring part of the power of the central government to regional or local authorities become a common political formula (practice) around the globe. Consequently, several countries established national commissions to assess the impacts of decentralization while many more others made decentralization or fiscal federalism as the center piece of their political agendas (campaign) without making detailed investigations on its effects. The meanings of decentralization differ from scholars to scholars; it embraces varieties of concepts, which must be carefully analyzed in any particular country before determining that national projects should be geared towards o the reorganization of financial, administrative, or services delivery system (World Bank, 2003). The more widely accepted definition of 'decentralization' entails the sharing of central government powers with other institutions, especially those geographically separated or responsible for specific functions, or those given jurisdiction over specific physical locations (Ndegwa, 2002). Decentralization is defined as the transfers of responsibility and authority from the central government to field units are closer to the public to be served (Turner and Mulme, 1997).

Generally, the notion of 'decentralization' shares two common functions. The first function is territorial where authority power and responsibility are transferred down to lower levels in territorial hierarchy while the second function concerns where authority and responsibility are transferred to lower agencies that are functionally specialized.

Based on these definitions and functions decentralization was introduced to correct institutional performance, which effect to undo the problems of poverty and unemployment of developing countries. Subsequently, by the mid-1980s, international financial institutions began putting pressures on African national governments to reform centralized political systems and economic planning. Directly or indirectly all these institutions influenced many of the African economic system, adopt economic measures such as market liberalization, state decentralization, and move towards political pluralism (B. Stohr, 2001). If we consider the view of the government officials the situation sounds somewhat different. Though is subject to different criticisms. According to the head of the Tigray region institutional policy officer and head of the four study *weredas* decentralization was introduced not only because of imposition from different international institutions but was also considering the political and development advantage of the nation and/or the region. When their view is paraphrased it goes as follows.

Imposition from international organizations might not be the sole reason that forced Ethiopia to go through profound economic and political changes. In pre 1990s, these prescribed socio-economic principle and administration roles had much influence on the overall development paces of the country lead to the creation of different institutional system which dominantly practiced by the EPRDF (then called Guerrilla fighters), and was operated in most of the rural areas of Tigray, where power was on people, decision was mainly community based. Therefore, to these informants the current government (EPRDF) knew that improving locals' participation in power politics and in economic affairs maximizes the overall level of efficiency and welfare of the country and sounds as if learned on process. Seems the move towards decentralization in Ethiopia is part of an unfolding process in that country that goes to the heart of its political economy and sounds as if inborn than imported type.

1.2 Statement of the Problem

In most developing countries in general and of Ethiopia in particular the issue of institution building has gained much currency (weight). It is now generally recognized that 'institutions matter'. And that the associated incentive structures substantially influence economic performance (Bardhan and Udry, 1999). Even though which institution affects economic progress and how is too complex, institutional failure impedes development.

Since the term 'institution' is so vague, for the purposes of this paper it simply refers to the change in structural frameworks and administrative systems. Considering several cases of institutional changes in Ethiopia, decentralization can be taken as one among many others. The decentralization drive in Ethiopia went through two phases. The first wave of decentralization occurred in the period 1991-2000, and the second wave refers to the decade since 2001 on ward which is often named as District Level Decentralization Program (DLDP). In adopting decentralization policy, the government focused on creating and empowering National/Regional Governments geared towards the reduction of poverty and of inequality. Many of the recent studies and reports (MOFED, 2010, MOFED 2012), suggests that poverty has been considerably reduced on the other hand; there are different criticisms pertinent to the links between poverty and inequality, which shows an increasing trend (MOFED 2010)⁹, and on the links between state actors and communities. Related to this the Country Governance Profile assessment shows compliance with formal rules and regulations in the Ethiopian civil service is high and control system is strong (ADB & ADF, 2009). All these tended to exacerbate problems of poverty and inequality.

In spite of many years of development efforts involving several factors including the government, donors, international financial institutions, local and international non-state actors, OXFAM declared that poverty has grown much deeper and wider in Ethiopia over the recent years (OXFAM, 2005). Although many of the natural shocks are part of the core reasons for poverty to be invasive, development problems of the

⁹ The inequality as measured by the Gini coefficient shows a moderate rise at national level while sharply rising in urban areas.

country are also related more to structural issues, with root causes that include inappropriate implementation of policies and practices. For instance, progresses related to public resource allocation, governance and gender are still far below the expectations. The performance of institution is always criticized for not addressing the prescribed principles.

The strategic plan of the country over the last decades focuses on improving the country's economic and institutional development; as priority policy issues designed to bring about meaningful changes in the lives of the poor (marginalized). Nevertheless, failure to implement these pertinent policies appropriately produced much unexpected results which made poverty to be still pervasive. Of all, good governance and vibrant civil society are among the priority issues identified in the framework of its "Right to the Heard Program". Further, narrowing the theme of governance decentralization policy as an issue of development is believed to be a major feature of the current governance system (OXFAM, 2005).

The fundamentals associated with decentralization and local governance are consistent from country to country. National governments often practice such policies to achieve objectives associated with adverse array of political governance, service delivery, economic development, and public sector management. It is a system mainly designed to improve efficiency and effectiveness of administration procedures, planning and budget allocation decision processes, and implementation of various policies or program.

Since decentralization is a system interrelated to administration, and resource use it motivate officials to design programs from a more cross sectoral perspectives that could led to achievement of economic progresses. However, unlike these stated advantages, there is an extended argument and continuous debate that emerged from dubious procedures of overall implementation, where the availability of skilled manpower is very limited (Tegegne, 2007 and Meheret, 2004).

A study on decentralization and its effect in Ethiopia (based on experience of different regions) also supports the stated argument. They argued: achievements were far lower than expectations as the smallest administrative units' hardly exercised degree of political power granted by the EFEDRE Constitution. In relation

to this, Tegegne (2007) argues: “while the first wave of decentralization (administrative decentralization) has registered significant achievements in local governance and regional self rule, it was not capable of bringing genuine self rule particularly at lower level of administration where governance and decentralization matter most.” Tegegne’s study is in line to the study conducted by (Dom and Mussa, 2006), all these confirm similar fact but there is no specific study conducted in the way that it shows its actual ramification, lacks statistical evidence. Thus, our main argument is that empirical information on implementation of decentralization policy in Ethiopia and particularly in the study *weredas* is largely missing.

Therefore, this study was conducted to investigate the effects of decentralization in Tigray region, and examine the specific achievements and its challenges.¹⁰ It also seeks to investigate whether findings by previous authors are consistent with the Tigrayan experiences; after all decentralization, good governance and institutionalization are developments closely intertwined to each other. With this in mind, it seeks to answer the following questions:

- To what extent does decentralization empower small administrative units?
- What are the opportunities and challenges of implementing fiscal and administrative decentralization?

1.3 Objective

The main objective of this study is to investigate the effect of decentralization in improving livelihood of the rural communities that can be attained as a result of having better institutional performances taking the case of four *weredas* of Tigray (Keleteawelaelo, Atsebi, Tankuabergele, and Hagereselam), northern part of Ethiopia. The specific objectives are:

- To examine the progresses attained related to administration implementation system after the launching of decentralization in Tigray

¹⁰ Tigray is one of the regional states in the northern part of Ethiopia. The researchers were very much interested on identifying decentralization and its specific relevance to poverty reduction of the rural areas, which mainly falls within the Giba catchment

- To compare and contrast the implication of fiscal and administrative decentralization in Tigray, investigate the easiness to implement as per expected in enhancing participation and good governance.

1.4 Hypothesis

By applying the methodology, which is discussed below this study has tried to verify or nullify the following.

H₀: Decentralization led to the improvement of the administrative performance of small administrative unit.

H₁: Decentralization did not have much effect either on the locals' participation and good governance.

1.5 Instruments and Methodology of the Study

1.5.1 Methodologies

To conduct this study both primary and secondary data sources have been used. Primary data was collected through both focus group discussion and distributing questionnaire to a sample of randomly and purposively selected respondents in two rounds in 2010 and in 2011. Moreover, the secondary data were obtained from reviewing different related studies and annual reports of the region and the concerned *weredas*'.

1.5.2 The Study Area

The study was conducted in Tigray (Northern part of Ethiopia). Tigray is located in the northern part of Ethiopia. In Tigray ,there are six zonal administration regions: the Southern ,the Central, the Eastern, the Western, the North Western and one urban zone around the regional capital of Mekelle and the region comprises of a total of 46 *Weredas* (districts), 12 urban *weredas* and 660 *Tabias* (sub-districts).

Tirgay covers an area of approximately 54,572sq km. It has a total population of 4,314,456; out of which 49.2 and 50.8 are females and males, respectively. About 80.5% of the population live in rural areas (census of 1999 E.C), while another 19.5%

are urban residents. The altitude of the region varies from about 500 meters above sea level (masl) in the north-east to almost 4000 (masl) in the north-east and about 4000 masl in the south-west. The agro-ecology of the region is broadly categorized into lowland (*Kola*- less than 150 masl), medium highland (*Weinadega* – 1500 to 2300 masl), and upper highland (*Dega* – 2300 to 3000). About 53% of the region is lowland, 39% medium highland, and 8% upper highland (BoFED 1995).

This study is specifically conducted in the four Tegrayan *weredas* of –Kilteawelaelo (*Weinadega*), Atsebi (*Dega*), Tankuabergele (*Kola*), and Hagereselam (*Dega*) - here after will be denoted as the 'study *weredas* which were selected by considering different issues into account. First, these localities are within the spheres of Giba catchment (basin?), where MU-IUC project¹¹ is operating, and the study is supposed to be within these boundaries. The second selection criterion was based on ecological or geographical basis. Accordingly, Kilteawelaelo, Hagereselam, Atsebi and Tankuabergele were chosen.

1.5.3 Data collection

One rationale of collecting data through survey is to obtain a specific answer to the research questions, following a normative approach which is aimed at making some estimation of a certain parameters of a study.

In order to conduct this study initially (in 2010) a total number of 200 samples were randomly collected from each *weredas*. The sample size has been limited due to the financial shortages. This compelled the researchers to set a proportional sample from each wereda. However, data collected using questionnaire distribution has been enriched through FGD, a total of 8 FGD was made with the population of the *weredas* (two FGD from each).

The selection of equal sample size from the four study area was done purposely; it was appropriate procedure to compare some parameters of the study. In selecting the desired samples from four of the *weredas* multistage random sampling

¹¹ MU-IUC is Belgium sponsored project based in Mekelle University mainly involving in development and capacity building development programs.

technique was used. Hence, sampling of the subjects started from preparing the list of Tabias¹² in each weredas. At the third stage all the households from the selected Kushet were listed and sample sizes of 50 from each stratum (Kushet) were taken using simple random sampling technique.

In the second round survey (2011) another 200 sample were collected from four weredas using simple random and purposive sampling approach. The sample was proportionally distributed to 100 communities and 100 administrators each (four) tabias. To examine the effect of decentralization scale measurement was used.

1.5.4 Data Analysis

The collected information was analyzed using two method of analysis. Simple descriptive statistics such as percentage, table, ratio, and statistical method; MANOVA was used. MANOVA, a statistical technique designed by (R.A Fisher, 1925).¹³ ANOVA can be one factor; the model assumes that the mean of a variable depends on only one factor, namely the sample from which the observation is taken. For a simple one-way MANOVA, the data set should have one independent variable (grouping variable) and at least two dependent variables. If the model is a type in which it is assumed that two factor determine the mean value of a variable it is called two factor analysis of variance, two ways MANOVA (Chatfield, 1995). ANOVA tests for differences among group means, MANOVA tests for differences among the multivariate at effects on the inference based on the resulting linear model.

In both cases (One way MANOVA and two ways MANOVA) it is assumed that the data are normally distributed with the same variance, σ^2 . The analysis of variance approach for testing a null hypothesis (H_0) concerning multiple parameters is based on driving two estimator of the common variance, σ^2 . The first estimator is valid estimator of σ^2 whether the null hypothesis is true or not, while the second one is a valid estimator only when H_0 is true.

¹² Tabia is smallest administrative unit, which is the same as to sub-district

¹³ ANOVA was developed by R.A. Fisher in the mid of 1920s', and become widely known after being included in Fisher's 1925 book Statistical Methods for Research Works, cited in Efron, B. 1998, *Journal of Statistical Science*, Vol. 13, No. 2.

In addition when H_0 is not true, this latter estimator will over estimate H_0 , in that estimator will tend to exceed it. Since the two estimators should be close to each other when H_0 is true, where as the second estimator should tend to be larger than the first. When H_0 is not true, it is natural to reject H_0 when the second estimator is significantly larger than the first. In this study since the dependent and independent variable are more than two, two-way MANOVA (the model has more than two dependant and independent variables) was used.

In this case these two independent variable (place and code) are generated as a result of categorizing respondents based on space and responsibility. Space refers to the area of resident (*wereda*). Since the targeted *wereda* are not having the same access and agro ecological zone, we deem this could have different impact in implementing decentralization. Similarly, the interviewed individuals have different status (administrative position coded as 1, and representatives of the community coded as zero) it is still believed that these two categories are supposed to have the same reply about the effect of decentralization, if decentralization outcomes is as expected, if not it is an indication of variance, which could be effect of differences in level of satisfaction.

Given these categorization in this study MANOVA is preferred to multiple ANOVAs (or regressions with dummy variables) because

- Multiple ANOVA/OLS runs can capitalize on chance. For example, if you have 20 dependent variables, you expect X to have a “significant” effect on one of them if $\alpha = 0.05$. MANOVA does a global test of whether group means differ for any of the variables.
- ANOVA/OLS ignore the inter-correlations between the independent variables (IVs). Because MANOVA takes them into account, it can provide a more powerful statistical test. MANOVA uses more information about the data than ANOVA does.

Another common use of MANOVA is in a repeated measures design, where the same variable is measured at different points in time (J. Faraway, 2002). Generally MANOVA used instead of a series of one-at-a-time ANOVAs for two main reasons. Supposedly to reduce the experiment-wise level of Type I error (rejecting the null hypothesis when it is in fact true). The so-called overall test or omnibus test protects

against this inflated error probability only when the null hypothesis is true. If you follow up a significant multivariate test with a bunch of ANOVAs on the individual variables without adjusting the error rates for the individual tests, there's no "protection". Another reason to do MANOVA is ANOVAs may produce a significant main effect on the dependent variable (Dependant Variable), but in combination they might, which suggests that the variables are more meaningful taken together than considered separately. MANOVA takes into account the inter-correlations among the DVs.

Hence, given this methodology, which is applied to examine effect of decentralization on public participation in economic and political affairs various questions related to governance and locals participation was solicited and respondents were expected to answer in the form of scale in both periods (before and after decentralization). The relative terms used to compare (measure) includes very good, good, average, and poor. For instance, of the various questions used to generate both qualitative and quantitative data the following were asked for empirical base to examine the effects of decentralization, such as:

- What are the effects of decentralization on peoples' participation in planning, decision making, and evaluation¹⁴?
- How about the impacts of decentralization on enhancing inter-office (bureaus) relationship, and facilitating discussions related to development?
- Does decentralization strengthened wereda - region coordination and networking?
- To what extent was decentralization enhancing top-bottom versus bottom-top relationships?

Likewise, the causal interlinks between decentralization and good governance was captured by posing the following questions:

- Does decentralization improve power politics and power relationship?
- Does decentralization enhanced accountability?

¹⁴ Evaluation in this case is equivalent to the local term called *gemgam*, which is frequently held to evaluate the overall administrative and political procedures, mainly used to check the implementation procedure.

- Do people exercise a mandate of correction and/or demotion of their administrators when they found them guilty?
- Does decentralization empower locals to the extent of removing administrators from power when they try to miss utilize public resource?
- Does decentralization lead to the creation of good governance? and
- What is the effect of decentralization in minimizing nepotism and corruptions?

After applying the simple descriptive statistical analysis result was discussed by comparing the level of satisfaction of the respondents in after with that of before decentralization. Likewise while analyzing using MANOVA first we look at the overall *F* test (over all four dependent variables). What we are most interested in is a statistic called Wilks' lambda (λ), and the *F* value associated with that. Lambda is a measure of the percent of variance in the DVs that is 'not explained' by differences in the level of the independent variable. Lambda varies between 1 and zero, and we want it to be near zero (e. g, no variance that is not explained by the IV).

2. Review of Related Studies

2.1 Related Theoretical and Empirical Reviews

"Decentralization" generally means the devolution of decision-making powers. Countries exercise decentralization processes for different reasons. Some do it in the quest for a more efficient and cleaner—public sector, while others are disenchanted with the performance of planning and centralized policies (e.g., socialist economies). There are often grassroots demands to achieve democratic ideals. On the other hand, some movements are designed to contain or to appease centrifugal forces, ethnic conflicts, and/or separatism, and to diffuse social and political tensions by allowing local cultural and political autonomy. There may even be some political opportunism using decentralization for electoral objectives and/or just a desire to not be left behind in this popular form of institutional reform. Given these controversial and diverse goals, it is widely recognized that over recent years one can see worldwide interest in fiscal decentralization. Decentralization being a recent event and often politically motivated, there is a preconceived idea that it will result in an efficient allocation of public resources. In Ethiopia, decentralization has been

explicitly launched to enhance community participation in local decision-making and community empowerment in general, and increase local governments' responsiveness and accountability, thereby improving overall efficiency and reducing inequalities among the states.¹⁵

Although this is the general expectation of this reform (decentralization system), the debate on the subject continues to invite controversy. While proponents of decentralization (Shah, 1994, 1998) consider it as a panacea for adjusting the institutional system, improving service delivery, and expanding of public sector in developing countries, to the opponents decentralization is a road to wrecks and ruins. These disagreements primarily arise from perspectives on the potential impacts of such policies in the institutional environment of developing countries.

Of all, studies conducted by Abay et al., (2004) indicate the positive outcome of political decentralization, but was conditional, indicates how fiscal decentralization helped to reduce infant mortality rates in India. Likewise, (Asfaw et. al., 2004) study explains the positive achievements, if there are no obstacles in its implementation of the civil service reform.

Evaluation pertinent to the impacts of decentralization on governance concurs with these positive findings, i.e. the positive effect of federalism on governance. However, (Nupia, 2006) study is quite different; it reveals how decentralization failed to attain its target. Accordingly, in developing countries, the existence of a relatively poor and rich region coupled with a weak accountability system proved to be among the major factors that disabled decentralization from working appropriately. Nevertheless, a study conducted in Nigeria (2009 to 2010) confirms some theoretical predications of the fiscal federalism literature. Empirical evidence shows how spending made by local governments helped to foster the reduction of infant mortality, especially in countries with high level of ethnic diversity and where revenue mobilization had been well decentralized, Elhiraika (2007).

Juan C. (2001) shows the evolution of spending among different levels of government. The main result reveals that the real "winners" of the decentralization

process has been the autonomous communities than the lower corporations. Decentralization helped Spain to establish a democratic spirit and move through the centralization phase. Elhiraika (2007) indicates the impact of decentralization (intergovernmental transfer system) on improving small administrative units (provinces) accountability to central government in South Africa. The author argues that despite the emphasis of the intergovernmental transfer system on redistribution and equity, richer provinces in South Africa still enjoy higher levels of revenue per capita and have higher per capita expenditure on education and health. Both own-source revenue and transfers from central government have no significant impacts on education services across provinces.

A model of household choice of dwelling and local public has been studied by Colombino and Locatelli (2002). It shows simulation effects upon consumers' welfare of a hypothetical fiscal decentralization reform. In the simulation, the expenditure for town services represents the same proportion of the (national) income taxes paid by households living in that town. Institutional system and residential choice decisions of individual households are affected by the actions of local government, through its expenditure and tax decisions, which can influence the socio-economic composition of its population and consequently the size of its tax base.

Unlike these positive findings, studies conducted in Ethiopia (Meheret, 2006), (Tesfay, 2006) tried to prove the problem of decentralization for not contributing either to the empowerment of the small administrative unit or improvement of the socio-economic of these states. In relation to this, Mehret strongly argues, "over the past couple of years... the process of pushing down authority, responsibility and resources to *wereda* has not been successfully carried out" (Meheret, 2006, 96). Unlike other economic related topics, there are no much empirical studies on the topic of decentralization. Only recently have there been several studies that analyses the direct roles of decentralization on economic growth.

A significant feature of the current state of the fiscal decentralization literature is the paucity of empirical information regarding the effect of fiscal decentralization on economic efficiency, income redistribution, and macroeconomic stability (Martinez-Vazquez, 2001:8). This is mainly addressed by measuring the share of expenditures or revenues of sub-national governments in the general government budget.

Outcome of these reveals fiscal decentralization (devolution) reforms are producing an ongoing restructuring of the public sector all over the world. Most of these studies underline that decentralization as a system was mainly employed as a political alternative to the central planning failures. Even though major development plans (provision of public goods) are still shouldered on the central government, providing local governments with subsidies may encourage efficient levels of health services to the point where the marginal social benefits for society as a whole from the provision of health care equals marginal costs. One of the main justifications (arguments) for this postulate is: decentralizing decision making in health is that local decision makers have greater knowledge of the health needs of their populations and of local conditions that affect the production of health care than national policy makers.

An assessment on the relationship between decentralization and health outcomes has been examined by Dolores Jiménez¹, Peter C. Smith^{1, 2} (2006), which identified whether decentralization stimulated the growth of the health sector through the flypaper effect. Analysis was made using panel of the ten provinces of Canada for the period 1979-1995. Infant mortality has been considered as the single most exhaustive indicator of health in a society.¹⁶ In the result 1 per cent increase in decentralization is associated with approximately 4 per cent reduction in infant mortality. In addition, finding of the model provides clue related to the advantages of shifts from a matching grant to a block-funding grant seems to have been successful in containing health costs at both the federal and the provincial government levels.

A study by Oskar (2006) on whether decentralization promote good governance and persuade politicians against corruption proved how decentralization grants citizens of each region with the power to decide or reelect a government, which is directly

¹⁶ In this study infant mortality is used as an alternative measure of health status, for two main reasons. Firstly, because infant mortality is more reliably measured than life expectancy. Infant mortality figures are based on actual data, whereas life expectancy figures are based on extrapolations from child mortality data and assumed life tables. Secondly, because infant mortality is more sensitive to policy reforms such as decentralisation than life expectancy.

related to the high probability of choosing best government that minimizes corruption, nepotism, etc.

Corruption in this is to mean that the use of public resources for private gains. Similarly by political accountability refers to the capacity of citizens to detect a corrupt incumbent and to remove him from office. Based on the estimations made, it follows that in developing countries decentralization reduces corruption significantly, but that effect is totally reversed in low income countries. This result supports the idea that decentralization has not been decisive in reducing corruption in these economies. The power of local elites in these countries is one of the aspects that reduces political accountability and encourages bad governance. The other factors which impeded decentralization to work appropriately in developing countries is the existence of relative poor and rich regions with a weak accountability sector, and the high between jurisdiction income inequality in these countries, which intensify the use of transfers in order to finance the poorest regions. Martinez-Vazquez, and M. McNab (2001) tried to examine impacts of fiscal decentralization on economic growth, assess to what extent synergies appear to exist between fiscal decentralization and economic growth. Unlike the arguments of the traditional economist fiscal decentralization may provide greater economic efficiency in the allocation of resources in the public sector.

Expenditure or revenue of sub national governments in the general government budget are positively correlated with the level of economic development. Though the relationship between decentralization and economic growth is not as such direct (it is mixed). This is similar to the concern of the public sector economists, paid indirect attention to the objective of economic growth focusing on how taxation distort economic incentive towards saving and investment, how to evaluate relative worthiness of public investment projects or how to improve the performance of private market through better education and health system or investment in basic infrastructure.

Both theoretical and empirical analyses discussed tend to be inconclusive and come up with ambiguous and differing results and empirical study related to the country (Ethiopia) or the study region is not much. Based on what has been discussed above one can conclude that this is the outcome of the theoretical trade-off construction,

which reflects the various pros and cons of a decentralized government structure. But we shall also consider that direct empirical estimations are still scarce and do not sufficiently involve new results of economic growth theory and empiricism. In addition, different methodological approaches and diverse designs for decentralization have been applied.

3. Data Analysis and Discussions

3.1 Decentralization and Locals participation

Immediately, after its seizure of government power, the Ethiopian People's Revolutionary Democratic Front (EPRDF) organized a national conference to create the charter that asserted the right of nationalities to self-determination up to secession. This has opened the door for the creation of local and regional councils along ethnic lines.

The form of the federal government is defined based on Articles 45 - 49 of the Ethiopian constitution, the government is made up of ethnically based regional state; administration structure of the country was revamped into (9) regional states and two special administration cities (Addis Ababa and Dire Dawa). The regional states were also further divided into 66 zones comprising 556 *weredas*. The regional states are: Tigray; Afar; Amhara; Oromo; Benishangul-Gumuz; Somali; Southern Nations Nationalities and peoples (SNNP); Gambella Peoples; Harari Peoples; and Welayeta People. Moreover, within the state, people have the right to create their own decision provided that it is within the will and approval of the regional state (Getachew, 2001).

Decentralization at regional and wereda level is firmly established through foundational provisions in the Federal Constitution, giving Regional States the power to establish "other administrative levels that they find necessary." (Art 50(4)). It is on the basis of this article all regions, and specifically the study region (Tigray) implemented both decentralization (administrative decentralization, which was introduced from 1991), and then fiscal decentralization (launched in 2001).

The second decentralization is different from the first as the second was introduced to empower small administrative regions about their development needs and resource allocations. Though these are the general principles of both decentralization there are arguments on its actual effect, while some acknowledged about its effect, stating it's up to the stated ideological principle, some are criticizing stating weredas don't have full mandate and power either about their administrative decision and/or resource allocation. Therefore this study tried to examine what the actual circumstances posing some important questions.

Demographic character of the respondents shows that of the total number of respondents 50% are administrators and 50% are from the community. Of these proportional sampled groups 31.5% are female and the remaining (68.5) are male. All these are with the age range of productive and dependent, were 70.8% were productive and the remaining are dependent population, are higher than age 65 years.

While the data was collected e discussions made, interviews conducted (administrative, community, and key informants) individuals were asked about the administrative system practiced since they born. Most of them replied that they are familiar about both, centralized (they referred *Derg* system) and decentralized system. When they asked about the differences they appreciated the second, , stating it encourages individuals to reflect their view, motivates to participate in different development activities, and grants alternatives (to mean opportunity to participate in different economic activity). Both communities and administrators (99%) have positive perceptions about the institutional system. They said introduction of decentralization in general and fiscal decentralization in particular enhanced service delivery, which led to increasing of income. In all the study *weredas* informants confirmed about their mandate, acknowledged the changes; after decentralization they have full power and responsibility of taking part in each and every community, based development activities even if there are some limitations on the progresses observed. Respondents did not hide their reservation on its implementation procedure. Even during the focus group discussion, this was the idea raised by most (more than 80%) of the participants. Though the general guiding principle about the development plan is still locally top-down, locals

participation in implementation has progressively increased especially after the introduction of Integrated Community Based Participatory Planning in 2009.

Of the total interviewed administrators in the study *weredas* (94.5%) said regional government is making strenuous efforts to strengthen *wereda* and *tabia* generic (i.e. non sector specific) planning capacities. Training on strategic planning has been provided to selected experts for limited number of days, and the strategic framework of designing plan and implementing procedure is also drafted. This has enabled them to get an insight regarding the process of developing *wereda* strategic plans, and implementations. In addition, the strategic plan is expected to fit to the regional planning that BOEFD adopts, mainly called core agenda of the regional development which is mainly same as the regional development plan.. generally from the discussion conducted document analysis made we have learned that little consideration is given to the problems in *weredas* that needs serious attention but not within the ambit of the regional strategic framework This can be one of the limitations that needs to be corrected as local knowledge related to development need and development problem is important.

Respondents were asked about the differences between fiscal and administrative decentralization system. Almost all said while the administrative decentralization is mere of political fiscal decentralization has encouraged grass roots participation in designing their own development plans and allocation of their budget thereby checking the potential strengths and constraints, a progress observed after DLDP launched. However, the mandate is a matter of identifying the priori need given the core plan which often comes from the nation (region), and the allocation process refers to efficient allocation of resource given the budget from the region.

In fact, this approach was expected to bring all sectors and other bureaus of the *wereda* in one domain, facilitating closer integration of community, all sectors, and bureaus of the *wereda*. Nevertheless, unlike what is prescribed in the document sectors are not much concerned about their achievements but focuses are still on their accomplishments, which effect to less integration of development plans, which open rooms for resource miss-utilization and increasing of wastage. But, from the interviews and FGD conducted with the communities and head of the administrators of the *weredas* we have learned that even with all these limitations decentralization

system has enhanced administrative efficiency, improved community participation in planning and development, it enabled communities to own. Their development plan and share the cost of development¹⁷, which implies that fiscal decentralization created an incentive for people to discuss on economic affairs and about the local governments performance, which is more relevant to them.

However, regarding implementation process when these two (fiscal and administrative) are compared the satisfaction of most (70%) informants on the procedure of implementing administrative decentralization was higher. Related to fiscal decentralization respondents appreciate the initiative but there are some problems raised. They said that now a days communities have increased their participation in plan implementations, which in turn inspired them to engage in the various development activities launched in their respective localities and/or at household level. But, this view is not free of challenge; some (43.5%) if not most resented the burdens of continuous meeting and free labor services that they often rendered whenever schools or health centers are constructed through the orders of executives (administrators). This discloses how grass root communities and their associations lack sufficient awareness with regard to the on-going decentralization drives while prospects for entrenching accountability of service providers remains low, which is similar to the study made by (Kasshaun and Tegegne, 2004 cited in FSS).

Besides the quantitative and qualitative analysis made after conducting the interview and FGD), to examine the specific impacts of decentralization on rural institutional progress, several but specific questions that believed can capture the relationship have been forwarded to local communities and administrators as illuminated in the simple quantitative analysis presented in the table below (Table 1).

Analysis result of Table₁ indicates the effects of decentralization on locals participation, which was made by comparing the respondents reply after

¹⁷ Almost all discussants stated: “decentralization helped to avoid delays and dependency, grants power to administer and to own the development activities” (June-august 2010). Unlike the past, local administrative units are becoming the decision maker of their own development progress is their main justification for the above answer.

decentralization with that of before. Comparison of respondents reply was made by o the level of their satisfaction (measured by the scale), sort of Likert Scale.

Table1: Summary result of the questions related to the effects of decentralization on local community participations (The number in the table refers to percentage).

No	Indicator of Participation	period	Measurements			
			Very good	Good	average	Poor
1	Peoples participation in planning, decision making, and evaluation	before	1.05	13.09	34.03	51.83
		After	11.52	48.69	30.37	9.42
2	Enhancing inter-sectoral (inter-office) relationship, and facilitating discussions related to development	Before	0.52	15.71	42.93	40.84
		after	13.61	51.31	26.70	8.38
3	Strengthening wereda- region coordination and networking	before	2.62	13.09	27.23	56.54
		after	8.36	53.40	27.75	10.47
4	Enhancing top-bottom versus bottom-top relationships	Before	2,62	20.94	30.37	46.0
		After	11,52	37.70	35.60	15.18

Sources: own computed from collected data

Likert Scale is often used to get an overall measurement of a particular topic, opinion, or experience and also collect specific data on contributing factors. Measuring the satisfaction (the trait) of a policy, or package or any development intervention, in this case we used it to identify the level of dis/satisfaction of the respondents. The term good very good, average and poor are valued as 4, 3, 2, and 1 which is similar to the words of strongly agree, agree, moderately agree and disagree. Considering all questions given in the table above comparison of respondents satisfaction in after with that of before clearly shows the positive impacts of the measures undertaken related to decentralization. This is confirmed by the gaining of more percentage of votes of good (agree) and reduction of percentage of votes of poor (disagree). In other word respondents are satisfied of system of decentralization which is indicated by their response level were in after, they agree that decentralization enhanced locals participation m which is indicated by their level of satisfaction.¹⁸

¹⁸ The respondents perception reveals while the percentage of good for indicators of number 1 to 4 in after have increased from 13.09 to 48.69, 15.71 to 51.3, 13.09 to 53.04 and 20.94 to 37.7 the percentage of votes for poor in after has reduced from 51.83 to 9.42, 40.84 to 8.3, 56.54 to 10.47 and 46.0 to 15.18 (for more details see Table 1).

Therefore, based on both, qualitative and quantitative analysis made it can be said that decentralization, created an incentive for people and civic society organizations to discuss about the local governments and local developments relevant to them. This implies that localities are increasingly thrown onto themselves to create place for prosperity (UNCDF:15). Localization in this regard implies home or domestic (state) rule i.e. decision making and administration procedures that are mainly locally driven and owned. However when the implication of the system on each questions given in table 1 is compared decentralization effect in (level of satisfaction) related to strengthening *wereda*- region coordination and networking is highest but decentralization impact in enhancing top-bottom versus bottom-top relationship still requires much effort.

Moreover, an attempt was made to look at this question disaggregating respondents reply into community and administrator, with the aim to examine whether there is a difference in perception about decentralization and its effects, mainly made by summing the respondents' level of satisfaction corresponding to each question. Readers might suspect that there is double counting, but it is just a matter of obtaining cumulative sums (obtained by using Stata), which helped to capture the effect and compare the differences of the counts obtained by both these two categories.

Table2: Summary results of the respondents (number) related to effects of decentralization on locals participation, disaggregating respondents on the basis of their position (administrator and community). The number refers to counts and captures the change in level of satisfaction.

No	Administrators Response				Community Response			
	Measurement (Scale base)	Periods			Measurement (Scale base)	periods		
	Variable	Before	After	Difference	Variable	Before	After	Difference
1	Very good	24	123.5	100	Very good	7.5	66	58.5
2	Good	152.9	423	270	Good	103.6	221	153
3	Average	329	159	-170	Average	145	173	28
4	Poor	91	50	-41	Poor	68	66	2
	Total	203	260	57	Total	286	504	218

Sources: own computed from the data collected

Result of the analysis in Table 2 shows first the level of satisfaction by the two groups. Referring this result it can be said that there is no much difference. Decentralization creates an environment for decision makers to have up-to-date information about the preferences and problems of the local people, an effective channel for the people to express their wants and priorities, and a motivating environment for the local decision makers to respond to the local needs quickly and effectively, which is similar to the previously conducted study (Khaleghian, 2003). Both groups perceived decentralization to have positive effect on participation, which also spur economic advantages (Guess community respondents varied and diverse response, not same to take it as a unit of analysis).

This was confirmed by their level of responses for the scales given, very good, good, average and poor in after, which is higher than before for both groups. The level of responses by administrators for the scales of very good, good, average and poor for after was 123.5, 423, 159, and 50, which is higher than before and was given as 24, 152.9, 329, and 91. Likewise the level of response given by the communities for the same scale in after was 66, 335, 262, and 100, which is higher than before, which was given as 7.5, 103.6, 219, and 103. Second, comparison of level of satisfaction of both these groups reveals that administrators have high level of satisfaction about the system.

Whether the effects of decentralization vary across places (spatial location) and in between the local communities and the officials further investigation was made by applying statistical analysis. MANOVA. This used because both, the dependent and independent variables are more than two.

Table 3: Decentralization Effect on Locals participation computed MANOVA*Manova y1 y2 y3 y4 y5 y6 l = code place code#place*

Number of observations:191						
W = Wilks' lambda L = Lawley-Hotelling trace						
P = Pillai's trace R = Roy's largest root						
Source/	Statistic	df	df F(df1, df2) = F			
Source	Statistic	df	F(df1)	df2	F	Prob>F
model	W 0.5890	4	24.0	632.6	4.32	0.0000 a
	P 0.4713		24.0	736.0	4.10	0.0000 a
	L 0.5997		24.0	718.0	4.48	0.0000 a
	R 0.3842		6.0	184.0	11.78	0.0000 u
Residuals		186				
Code	W 0.8428	1	6.0	181.0	5.62	0.0000 e
	P 0.1572		6.0	181.0	5.62	0.0000 e
	L 0.1865		6.0	181.0	5.62	0.0000 e
	R 0.1865		6.0	181.0	5.62	0.0000a
Place	W 0.6879	3	18.0	512.4	4.03	0.0000 a
	P 0.3373		18.0	549.0	3.86	0.0000 a
	L 0.4179		18.0	539.0	4.17	0.0000 a
	R 0.3139		6.0	183.0	9.58	0.0000 u
Code#Place	W 0.6890	1	18.0	512.4	5.62	0.0034 a
	P 0.3713		18.0	549.0	5.62	0.0019 a
	L 0.5997		18.0	539.0	5.62	0.0420 a
	R 0.2842		6.0	183.0	5.62	0.0081u
Residual		185				
Total		190				

Sources: own computed from the data

Above the table, it lists the number of observations used in the estimation. It also gives a key indicating that *W* stands for Wilks' lambda, *P* stands for Pillai's trace, *L* stands for Lawley–Hotelling trace, and *R* indicates Roy's largest root.

The first column of the table gives the source. Here we are testing decentralization effect (the only term in the model), and we are using residual error for the denominator of the test. Four lines of output are presented for decentralization, one line for each of the four multivariate tests, as indicated by the *W*, *P*, *L*, and *R* in the second column of the table.

The next column gives the multivariate statistics, which is indicated by the corresponding result of the letter W, P, L, and R. Some authors report λ and other use θ , given by $\theta = \lambda / (\lambda - 1)$, for Roy's largest root but Stata uses λ .

The column labeled "df" gives the hypothesis degrees of freedom, the residual degrees of freedom, and the total degrees of freedom. Within the given model, there are 5 degrees of freedom, and 185 residual degrees of freedom, and 190 total degrees of freedom.

The next three columns are labeled "F(df1, df2) = F", and for each of the four multivariate tests. The degrees of freedom and F statistic are listed. The following column gives the associated p-values for the F statistics. Since this is MANOVA two way, we consider the result of the interaction of the terms. Result for the interaction of the variables indicates that Wilks' lambda has an F statistic of 5.62 with 18 and 512.4 degrees of freedom, which produces a p-value small enough that 0.0034 is reported. The F statistics and p-values for the other three multivariate tests follow on the three lines after Wilks' lambda.

The final column indicates whether the F statistic is exactly F distributed, is approximately F distributed, or is an upper bound. The letters e, a, and u indicate these three possibilities.

For this example, the F statistics for all the variables are approximate except the F statistic for Roy's largest root, which is an upper bound, means that the p-value is a lower bound.

In order to examine whether there are variations first we will look at the overall F test (over all three dependent variables). But in these cases the researcher most interested in is a statistic called Wilks' lambda (λ), and the F value associated with that. Lambda is a measure of the percent of variance in the DVs that is 'not explained' by differences in the level of the independent variable. Lambda varies between 1 and zero, and it is expected to be near zero (e.g. no variance that is not explained by the IV), but Lambda value indicates there is a variance.

From the result depicted in table₃ MANOVA models with more than one term, shows test results for the overall model, which is given by the interaction of the term code and place, followed by results for each term in W, P, L, & R. The interaction term, code#place is significant at the 0.001 level. Wilks' lambda for the interaction has an exact F that produces a p-value of 0.0034, implies the existence of variance. Even though the satisfaction obtained by both respondents in all the study *weredas* seems positive there is difference (variation) in their level of satisfaction.

This could be due to two important reasons. First, because of their position the administrators might answer as if they are satisfied and pretend. This seems rather speculative) the impact of decentralization considering the implication of this investigation. Second, the variation observed in *weredas* (place) could be due to the economic performance (effect of ecology) and access to infrastructural facilities like road and other networking. For decentralization impact to be better or not it is mattered by the institutional system and location, which matters most, can be one of the justifications.

3.2 Decentralization and Good Governance

The second part of the analysis focuses on effects of decentralization and good governance in Tigray regional state.

Decentralization and governance are two of the political economy principles devised to improve institutional administration and if it goes as designed it can improve livelihood of the local. If locals are main decision makers of the state economic, political, and social affairs it can be said decentralized system (of what?) enables to the emergence of new form of local economy. However, in the region where this study is conducted it is questionable whether decentralization enhanced full participation of locals in the economic, political, and social affairs, and helped to the creation of accountable and responsible leaders that minimize corruption and nepotism. Therefore, this paper tries to answer the question of: does decentralization enhanced proper utilization of resources to the extent that the region (Tigray) freed out of the problems that existed as a result of centralized political and administrative strangleholds that perpetuated miss utilization of public

resources? Although statistics on corruption are often questionable, corruption accounts for a significant proportion of economic activity.¹⁹

Corruption refers to exercise of official powers against public interest or the abuse of public office for private gains. Governance is defined as the norms, traditions, and institutions by which power and authority in a country are exercised. These norms, traditions, and institutions include the institutions of participation and accountability in governance, mechanisms of citizen voice and exit, and norms and networks of civic engagement (Shah, 2004). In one way or the other all the variables are determinants of governance, which are directly related.

Thus, to see effect of decentralization on good governance in Tigray this paper adopted some of the institutional principles used in Shah. To examine the link between decentralization (mainly judged by the indicators) and governance the questions given in Table₄) were asked. Over all perception of the respondents related to governance were positive even though some key informants expressed their (qualitative analysis) dissatisfaction as it is indicated by the results of the descriptive and statistical analysis (expressed in percentage change).

¹⁹ A 2004 World Bank study of the ramifications of corruption for service delivery concludes that an improvement of one standard deviation in the International Country Risk Guide corruption index leads to a 29 percent decrease in infant mortality rates, a 52 percent increase in satisfaction among recipients of public health care, and a 30–60 percent increase in public satisfaction stemming from

Table 4: Effect of Decentralization on Governance (the number in the table refers to percentage)

No	Governance Indicators	period	Measurement			
			Very good	Good	Average	Poor
1	Does decentralization lead to improving of power politics relationship;	before	3.14	27.23.09	28.27	41.36
		After	9.95	35.60	31.41	32.04
2	To what extent does decentralization increased administrators' accountability to their citizen?	Before	2.03	13.8	33.1	51.07
		After	5.0	16.8	33.9	44.3
3	After decentralization does people have the mandate of correcting their administrators?	Before	4.2	9.3	29.4	57.1
		After	7.3	12.5	30.9	52.8
4	Does Decentralization empower citizens to the extent of demotion their administrators when they found guilty	Before	1.98	7.9	37.3	47.18
		After	6.31	9.3	34.21	49.82
5	Does decentralization empower locals to the extent of removing administrators form power when they try to miss utilize public resource?	Before	4.71	18.85	31.94	44.5
		after	9.42	36.13	24.08	30.37
6	Does decentralization lead to the creation of good governance?	before	1.05	16.32	34.74	47.89
		after	5.76	28.27	34.55	31.41
7	Does decentralization effect to minimizing nepotism and corruptions?	Before	2.62	15.18	35.08	47.12
		After	5.24	27.75	35.0	31.94

Source: own computed from the data

Table 4 indicates the changes obtained related to governance after introduction of decentralization.

Effect of decentralization on governance was identified using similar approach as that of participation. The questions posed so as to see the changes on governance

after introduction of administrative and district level of decentralization are given in table 4 (considered as indicators). Progresses related to governance were captured based on the responses given by the respondents for each question, indicated by the gaining of percentage for the indicator of very good and good and reduction of percentage of gains for average and poor in after than before. *n*, Result of the descriptive analysis shows for the governance indicators of 1 and 5 there is an increasing trend of very good and good and reduction of average and poor, implies when it is compared with pre-decentralization respondents satisfaction about its effect is better in after *th*. However, for indicator number 2, 3, 4, 6 and 7 even though it still reveal the positive change the level of satisfaction indicated by the percentage of changes in the scale measurements are very little and becomes less especially when it is compared with the gains in participation.

Result of the descriptive statistics is inline with some of the view of the communities forwarded during FGD. Therefore having the responses given in table 4, and considering the views raised during FGD and key informant interviews, which was analyzed using content analysis it is clear that in the study areas impact of decentralization on locals participation is better than on governance. Thus, it can be said that since the inception of DLDP, 'Tigray' (similar to any other regions) has got the autonomy of administering its area. Administrative decentralization had better effects on local community participation but proved to be little effect on governance, indicated by the little reduction of responses for average and poor for all indicators given in table4, except indicator number 1 and 2. This has become a current source of concern among certain academic communities' and policy making circles who feared the implication of implementing such system on resource utilization and improving accountability might not be as it is expected. Instead localization may adversely affect the quality of public governance through an increase in the incidence of miss utilization of resources which could also be effect of poor capacity and lack of technical skill, repeatedly mentioned by all stakeholders (administrators realize the limit in their capacity, and locals also acknowledge this problem) in the study *weredas*. There are individuals who claim its effect is less, this finding reflected during the discussion made with the communities, which we called them as the first group. But there are also some from the interviewed (second group), praise decentralization program stating: "it helped to avoid corruption, dependency, and grants power to communities to elect and appoint their

administrators.” To these who praised the system it seems that unlike the past, local administrative units are becoming accountable, responsible, and committed after decentralization. Their main justification was the incidence of community participation in election, appointing of their leaders, the increasing number of women representatives in the *wereda* council, and the expansion of service, which can help in one way or the other. Contextually this expression is true because the political dynamism in the region shows the appointing of leaders elected by people and the increasing of women’s participation in the *wereda* council but has several problems on its procedure and at the same time it is less effective in addressing the question of the community

Our critical argument was supported by the first groups who acknowledge the undergoing changes but have wider reservations on the overall framework, system design and process, and manners of implementation. They questioned the views forwarded by the second groups. These groups critically commented on the process of centralization itself. Further, by drawing comparisons of governance before and after 2001, they concurred that decentralization reduced corruption and nepotism. On the contrary, the same critics still argue far from enhancing development, decentralization is actually curtailing sustainable development.-. Based on the content analysis made their criticism (first groups) was not on the rules (system) rather it is on the technicalities of the implementation procedures as laws are miss interpreted and power miss utilized.

For instance, the process of appointing (recruiting) civil servants to staff bureaus was critically criticized: “almost in all *weredas* citizens complain about access to information; they said important information is accessible only to those who are very close to the decision makers”. To cite a case, when there is job opportunity (vacancy) the advertisement tends to become open for a single day or two when it is supposed to be open for a week or more working days. This is intentionally made with the aim of offering the job to these who are very close or..., others may not be applied for a job missing the requirements and is not because they don’t fulfill but unable to meet deadline (informants view obtained during FGD in Tankaabergele, August, 2011).

Moreover, there are complaints on the delivery or disbursement of safety net program, as observed in two study wereda (Atsebi and Tankaabergele) where communities indicated how benefits provided by the public are hijacked or misappropriated.

Issues related to purchase of materials through bidding was also another problem area criticized by the responses obtained from administrators. Related to this, the *wereda* administrator(s) stated²⁰ that purchasing of office equipments and other office materials has become more complex and centralized. Due to such hectic procedures, often dominated by the regional executives the *weredas* could not utilize their annual budgets fully. Hence, returning unused *wereda* budgets or rushing to purchase goods at the end of the budget year is a common practice, leading to an increasing of wastage of public resources. In this regard, decentralization seems reversing the progresses, unless solved may increased fragmentation of political arenas.

Likewise, communities perception on evaluation (locally called *gimgema*) is controversial. It was surprising; almost all communities in all *weredas* appreciated the pre 2001 evaluation system. They said that the pre 2001 evaluation tradition was very critical and extremely effective to address the prevalent limitations related to resource miss utilization and misallocation, bad performance, and other corrections related to administration and miss-implementations But now a day's this traditional evaluation (*gimgema*) is extremely lose and is for the sake of formalities followed by unexpected repercussions, their expression goes as follows:

“based on the experiences we have from the *weyane* system and believing that evaluation will bring change we often evaluate and discuss the problems, evaluating the concerned officials but it had hardly any effect on correcting previous pit falls; it remains heard but not implemented. In return, either the person who evaluated or the relatives might face the cost (harassed, marginalized from all necessary benefits and tortured). All such acts made us to not evaluate the incumbents (Informants, 2009; August, 2011).

²⁰ View of woreda administrators (2009)

Following the above analysis further check were made disaggregating respondents based on their responsibilities (administrators and normal citizens), their dis/satisfaction was evaluated based on the answers given to the indicators, which are given in table₄.

Table 5: Summery result of the descriptive statistics related to governance disaggregating respondents. The numbers are the total counts used to identify the variations in between these.

No	Response from Administrators				Response from Community			
	Variable	Before	After	Difference	Variable	Before	After	Difference
1	Very good	26	120	94	Very good	19.6	25	181.9
2	Good	138	364	226	Good	153.1	181.9	318
3	Average	470.5	258	-211	Average	145.5	413.8	115.2
4	Poor before	476	141	335	Poor	636	465.4	-171

Sources: own computed

The change in after with that of before was observed based on the level of satisfaction of the respondents in after than before ; number of votes obtained for all the question of indicators (question 1 upto 7 stated above) of governance. The procedure used was estimating the number of counts or scores for all responses (v good, good, average and poor) by each category (community and administrator). After the counts made a comparison was made, estimating the rate of changes (percentage of gains after) which also shows the level of satisfaction by these two categories. This enable us to see the effect using the approach applied above. As it is indicated in the table (Table 5) we observed change but not for all indicator. This indicates that the governance reform agenda is strong, but its success will largely depend on the adequacy of implementation capacity, political commitment, and incentives of the different actors In addition the level of satisfaction of the community is far lower than the administrators. Indicated by the administrators' response of having highest score differences of very good and good and lowest score differences of average and poor in after. But statistical results of community responses show highest score of average followed by poor. Despite the general logic that both categories acknowledge the challenges of DLDP their perception related to its intensity is not the same. Administrators' response seems exaggerated about decentralization outcome, which could be effect of different reason, political

commitment not able to recognize its actual effect as they are the owners of the process implementation, and or pretending about its effect feeling the consequences.

Findings presented in Table 5 confirmed the achievements of decentralization on governance; but interviewed individual's perceptions still differ considerably. To examine the variations among respondents and in between the study *weredas*, we applied multivariate analysis of variance (MANOVA) and results have been discussed below (Table 6).

Table 6: MANOVA result of good governance

Number of observations: 191						
manova y1 y2 = place code		W = Wilks' lambda		L = Lawley-Hotelling trace		
		P = Pillai's trace		R = Roy's largest root		
Source/	Statistic	df	df	F(df1, df2) =	F	Prob>F
Source	Statistic	df	F(df1	df2	F	Prob>F
model	W 0.8097	4	8.0	370.6	5.15	0.0000 e
	P 0.1944	8	372.0	5.01		0.0000 a
	L 0.2300	8	368.0	5.29		0.0000 a
	R 0.2054	4	186.0	9.55		0.0000 u
Residuals		186				
Code	W 0.9197	1	2.0	185.0	13.59	0.0000 e
	P 0.0807		2.0	185.0	13.59	0.0000 e
	L 0.1469		2.0	185.0	13.59	0.0000 e
	R 0.1469		2.0	185.0	13.59	0.0000e
Place	W 0.9197	3	6.0	370.04	2.63	0.0163 e
	P 0.0807		6.0	372.0	2.61	0.0173 a
	L 0.0868		6.0	368.0	2.66	0.0154 a
	R 0.0807		3.0	186.0	5.01	0.0023 u
Residual		186				
Total		190				

Source: own computed using Stata

The letter given refers to, e = exact, a = approximate, u = upper bound on F

Unfortunately, MANOVA used to examine decentralization effect on governance could not generate answer for the interaction variable, code#place (. This enforce

the researcher to rely on the results obtained using the model without the interaction, which has meaning like that of ANOVA. Applying similar procedure as decentralization effect on participation (table 3), result reveals that all four multivariate tests reject the null hypothesis, indicating some kind of difference between the four-dimensional mean vectors of the model given by the level of significance 'Landa' value, Wilks' lambda, which is exactly significant for both independent variables.

This implies that communities perception is different from that of administrators and at the same time one *wereda* view (what?) regarding governance is not the same as the other. Our justification is still the same to what had been stated. Related to code, Landa variance might have been caused because of the differences in perception in between the administrator and the community. On the other hand land variance for place might be effect of differences in access to services and infrastructural facilities.

For instance, governance tends to be better in the *weredas* that are closer to the urban areas (such as in the case of Kkelteawelaelo than the farther ones, like Tankuaabergele. This seems in line with the study conducted by Nupia (2006) and Juan C. (2001) even though what is considered here is small administrative unit not countries. In his study he stated in developing countries where the existence of relative poor and rich with a weak accountability sector is a factor which dis allowed decentralization to work appropriately. Likewise in the four study *weredas*²¹ there are progresses but advancement is said to be mixed with regard to citizens' empowerment and the strengthening of local governance as confirmed by MANOVA result.

3.3 Region to Wereda Resource Transfer: Local Revenue and Expenditure Mixes

District Level of Decentralization Program was expected to improve the resource allocation practices to the small administrative region (*wereda*), and improving of locals' participation in development. It was an institutional system introduced to narrow the vertical and horizontal imbalances. Consequently, peripheries (small

²¹ Atsebi, Wekero, Hagereslam, and Tankaabergele

administrative units) are expected to increase their efficiency, and scaling up productivity and wellbeing, which is supposed to be reflected by the increasing of revenue of each *wereda*, (collected in the form of tax). This study tried to look at the revenue and expenditure mixes of the study *weredas* after fiscal decentralization (DLDP) launched.

The concept of 'periphery' in this paper denotes 'space', used to discuss about *wereda* development budget, which represents the core element of local government financial management system. Local government plan, implement, and evaluate local development policies through the budget (Gianakis and Mc Cuem, 1999). It is the principal instrument by which government translates into action the policies and programs set out in its development plans, and it plays a pivotal role in the financial management of the economy (Melesse, 2003). It underlines on the necessity of public sector intervention to attain fair distribution of resources (distribution function) and maintain stable prices (stabilization). This is in line with the conventional literature of fiscal federalism conceded by Richard Musgrave (1959).

If a nation is following decentralization system in the process of achieving development, sub national governments are expected to play a dominant role as they are expected to have access to better information about the local circumstances. In Ethiopia, regions transfer subsidies to peripheries (small administrative units of the region) expected to enable the latter to effectively undertake their development activities properly. This was done on the basis of formula (which is already revised now) which is similar to that used for federal region. This formula varies from region to region but often consists of population (55%), development level (30%), and own revenue (15%). But, now a days this has been slightly revised and the budget allocation criteria is different but small administrative units did not have enough knowledge about what are the criteria's and how it works. The budget allocations follow both budget formula and expenditure and are used to implement the instrument of block grant. Nevertheless there are also other transfers from region to *weredas* which are not part of the grant transfer system. These includes consolidate budget adjustment, contingency assistance, training support, selected cash transfer for capital and operating purposes, food security and food aid, asset transfer, etc (Hymens and Moahmed, 2004 cited in Tegegne, 2004). However, the budget formula is too fragmented and

might be less responsive to reduction of inequality because of the access and opportunities existed in that area some *weredas* might have the opportunity of having high budget than the other, which comes straight as budget support and supports made by NGOs.

From the discussion conducted with key informants it was noted that *weredas* did not have clear information related to how the revenue is collected and shared though all revenue collected is utilized within that area (*wereda*). This is mainly due to the information asymmetry, even if there is a clear procedure regarding how budget is distributed to the *weredas* there are only few individuals who knew about it and second these who knew did not try to create awareness about it. Then the differences in total budget in between the *weredas* are differing because of the income obtained by the individuals, which effect to collection of high or low revenue. The main source of revenue is the income collected in the form of tax, which varies from place to place and is related to each *weredas* agriculture or other economic activities, which includes income tax, business tax, rental tax, sales tax, agricultural land use charges, and rural land utilization charges, but agricultural tax is the main source, which contributes close to 80 of the *wereda* revenue. This could be one of the facts for *wereda* economic performances to vary differences in institutional capacity and infrastructural facilities. In this regard, decentralization is not offsetting inequalities between rich and poor areas. Local authorities in rich areas and with better facilities has the competitive advantage, and can mobilize substantial resources to attract qualified labor and to deliver high quality and efficient services compared to poor areas. The other factors which dis allowed decentralization to work appropriately in developing countries in general and in the study *weredas* in particular is the existence of relative poor and rich regions with a weak accountability sector, and the high between jurisdiction income inequality, which intensify the use of transfers in order to finance the poorest regions, similar to the finding of Oskar (2006). Moreover, the existed opportunities; access to services, and skilled manpower also contributes to the increasing of development variations among these *weredas*.

Because of all these there are horizontal imbalances; all *weredas* are neither in the state of rising high revenue nor the prevalent condition let them to do so, which led to the huge gap between revenue and spending. Moreover, the existed

opportunities; access to services and skilled manpower also contributes to the increasing of development variations among these *weredas*. Similar to other countries experiences, small administrative units have very little room to maneuver in terms of the link between sources of revenue and expenditure allocations Elhiraika (2007). Accordingly, the poor *weredas* are less responsive to the preferences of the local people and they are less accountable to them. This is exactly what we observed in one of the study *weredas*, compared to kileteawelaelo in Tankuabergele, administrators were complaining about resource shortage (both, revenue collected and budget received from region) and communities were also less satisfied.

The actual experience in the study *weredas* shows the above instance, all *wereda* don't have equal access and potential, which accounts for the relative differences in resource availability and implementation capacity. All *weredas* were complaining about budget but these who are far from the main road, like Tankaabergle, felt worse. Peri-urban *wereda* (like Kileteawelaelo) is better off in rising revenue and at the same time their reliance on regional subsidy is lesser than the remote *weredas* (Tankuabergele). In line with this, the *wereda* officials (key informants) of Tankuabergele indicated reservations about their *wereda's* performance and their main justification hinges on the budget formula and the *wereda* resource potentials.

The experiences of all *weredas*, except Kileteawelaelo, were similar related to budget allocation. First, they did not have enough information on how the budget is allocated. Second, they stress on the larger amount of subsidy they require from the region stating: our *wereda* is so remote and we should not be expected to raise larger amount of revenue as other *weredas* did. In general one of the main problem we observed, which becomes concern is that the budget formulas which are used as a means of equalization program and its allocation are no longer tied to fiscal disparities among provinces.

All this implies that *weredas* are not contented with the current resource allocation system. The resource transfer system is extremely fragmented and might affect the performance of *weredas*, points on the necessity of combining the non-block grants to the block grant so as to increase accountability, efficient utilization of public resources and reducing of horizontal imbalances. In addition, the financial capacity

of the *weredas* is too weak and local administrators were given many responsibilities that overlap each other and are without sufficient amount of budget. Likewise, related to the current budget allocation (slightly modified one) neither they are satisfied nor they have full knowledge on how the procedure works. The diagram below indicates the imbalances, considering two of the study *weredas* (Kilteawelaelo and Atsebi), shows the relationship between total revenue and total expenditure of the two *weredas*, which is denoted as TRK and TEK, which refers to the total revenue and total expenditure of kilteawelaelo , and TRA and TEA, total revue and total expenditure of Atsebi. The intent was to see the trend of total expenditure, total revenue, and the differences between these two.

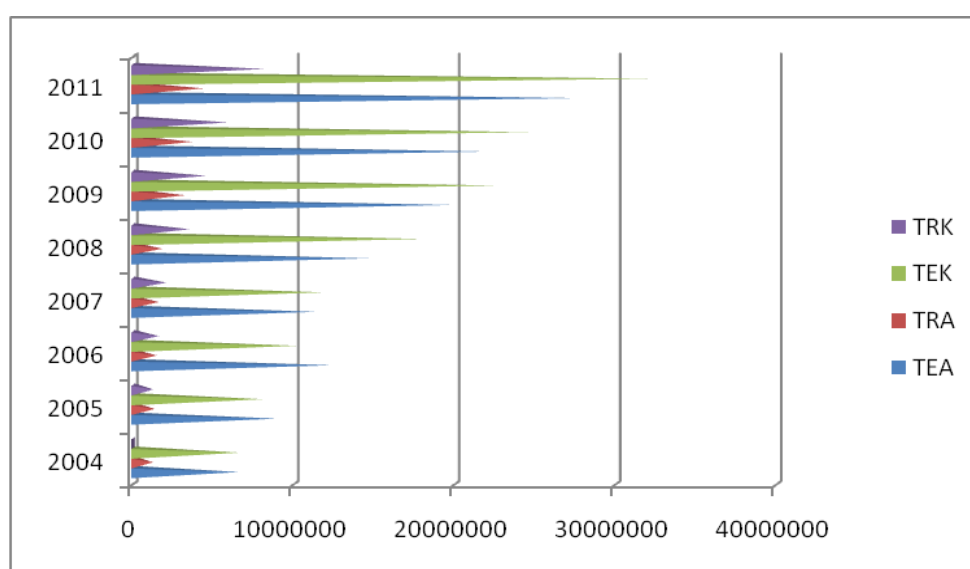


Figure 1 shows the revenue and expenditure of Kelteawelaelo and Atsebi used just to indicate the instance of decentralization impact on reducing resource gap and inequality in between these two weredas. From the chart the points discussed above becomes clearer, first *weredas* that are having access to infrastructural facilities are having high revenue and expenditure than the far ones, comparison of Wekero with Atsebi shows this. Second the problem of expenditure revenue gaps is still a major barrier for small administrative *weredas* to don't perform as per they expected, resource shortage could be the main factor for their poor performance. Moreover the gap in between these two *weredas* still indicates the horizontal imbalances, which could also remain as main reason for *wereda* inequality to remain visible.

In nutshell the above figure also indicates the not yet solved problem, horizontal imbalance, which is affecting *weredas* performances. In both *weredas* the total expenditure is higher than the total amount of revenue collected, and the gap is very large. (Apparently, decentralization managed to increase community participation in development, and community communication for development. However, its effects on maintaining of equality (reducing difference in between the *weredas*), its response in narrowing horizontal imbalances is really less significant. As a result, it is not surprising that DLDP, the equalization program (budget formula) has been subject to constant criticism and demands for change over the years. Fiscal disparities between the provinces will widen, placing even greater pressures on their ability to deliver adequate public services. This effect of poor technical capacity, led to the increasing of dependants as, which hindered *weredas* to don't be independent decision makers, which pushes sub-national governments to seek more subsidy and grants from the central government (Meheret, 2007). The civil service lacked autonomy while accountability to citizens was weak. These institutional shortcomings, in turn, hindered the effectiveness and responsiveness of the state in public service delivery. In spite of the appreciation of their newly gained autonomy, there is a general recognition that *weredas* still depend (e.g. personnel deployment, guidelines, training, etc) much on the region. It was also noticed that the loose cooperation between region and these *weredas*, region did not have strong supervision that can help to solve the technical and skill related problem of these *weredas*. All these paucities are hindering *weredas* not to realize their development objectives, which in turn may still affect their socio-economic performances.

Conclusion and Recommendation

This study has tried to examine the impacts of decentralization on rural development considering some of the rural towns of Tigray; Kelteawelaelo, Atsebi, Hageresealm, and Tankuabergele.

In the rural part of Tigray decentralization was launched in the 1980s, during the Derg era. By then, the rural areas were not fully governed by the Derg system but by the EPRDF, then called Guerrilla fighters, who had asserted full power on the people on matters of political and administrative decisions albeit their system was not

institutionalized (informal). This has been strengthening when the EPRDF became a ruling party of the Ethiopian state and various economic reform programs were introduced since 1992/93. After implementing political and/or administrative decentralization almost for nearly a decade the necessity of fiscal decentralization was underlined and district level decentralization (DLDP) was launched in 2001. Decentralization was expected to bring about tremendous changes that contribute to the growth of the economy by transforming the institutional system. Decentralization is expected to enhance individuals' participation in economic, political and social affairs, and improving the governance system.

Even though this was the general expectation in order to identify effect of decentralization on locals' participation and governance this study was conducted. While conducting this study, both primary and secondary data sources were collected and were analyzed using both, qualitative and quantitative analysis technique. Findings show decentralization led to improvements in participation, and governance, and, which in turn led to increasing economic efficiency. However, its relative effects are higher in terms of enhancing public participation than improving governance and narrowing revenue expenditure gaps and horizontal imbalances. Besides, findings reveal the effect of fiscal decentralization to be higher in improving locals participation on political and development matters than on governance.

Decentralization also helped well in minimizing revenue expenditure gap. In fact, when decentralization is evaluated on the basis of resource (budget) obtained, it is possible to say that the essence of centralization still exists. The Tigray region often gets block grant and subsidy from the federal state and in turn the Region extends the same resources to the *weredas* in the real spirit of decentralization.

Since all development activities of small administrative units is depending on the resource they obtain then their full independence remains questionable. Of all the remarkable changes we observed from implementing decentralization (*wereda* participation in implementing of regional planning and community based development activities, their mandate of coordinating community based development activities (CBO) and in deciding community contributions to development became better.

However, many stakeholders, especially *wereda* officials and elected representatives feel that more support is needed (including repeated short and long term training). They deem that lack of skill and technical application is making them to be less responsive to the calls (development related) made by the region. This view is similar to Poverty Participatory Assessment 2005 (MOFED 2005 (a)).

Another important issue we have observed was the trade off in the implementation of institutional system, differences between decentralization and Business Process Reengineering (BPR), where the head (leader) works in a team and has to pull his type (teaming) but the community might not be in favor of that person. It is always difficult to coordinate team making and respect individuals choices but when the individual (the community) have a bad feeling towards that person; it may led to unexpected results that affect the institutional stability and other developments.

Unfair Resource (budget) transfer and allocation is one of the core points of emphasis in all *weredas* studied, reveal decentralization never offset the problem of resource allocation and inequality in between the small administrative regions. For instance, the better *weredas* like the better Regions (Eg: Southern Region), which has locatioal advantage have an opportunity in attracting more donors which led to better budget endowments than the others. Therefore, the structural imbalances in geographic, material, socio-economic and natural situation of the *weredas* has to be balanced by making certain adjustments in such a way that solves inequalities.

Finally, the issue of governance seems changing but still requires wider attention. This can come up as a result of appointing accountable individuals and creating concerned citizens thorough time. But strong supervision by the regions, and conducting of semiannual monitoring and evaluation might help to understand and know the nature and character of the administrators in the small administrative unit that make easier to take corrections.

Over all, even though the achievements made so far are quite encouraging, the fruits of decentralization are yet to be reaped overcoming some of the current limitations singled out in each study *wereda*, which included miss implementation of institutional laws, shortage of resource (budget), poor technical capacity and information asymmetry.

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SOURCES OF TECHNICAL EFFICIENCY DIFFERENTIALS AMONG SMALLHOLDER FARMERS IN TIGRAY, NORTHERN ETHIOPIA: PANEL DATA EVIDENCE AND IMPLICATIONS FOR FOOD SECURITY

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Abstract

This paper attempts to derive farmer-specific technical efficiency and simultaneously determine the socioeconomic factors affecting inefficiency for a sample of smallholder farmers from northern Ethiopia using a random-effect stochastic frontier model. The coefficient estimates of the β parameters (i.e., conventional inputs) showed that the all variables land, labor, modern inputs, and value of owned farm implements are significant all with positive signs except for number of oxen. ML estimates of the γ parameters (factors of inefficiency) also showed that among all the variables considered education (read and write1), involvement in off-farm activities and access to irrigation are most significant. Individual year estimates imply that the discrepancy between the observed level of output and the maximum attainable level of output is dominated by factors of technical inefficiency rather than random factors outside the control of the seemingly suggesting for the scope (opportunities) for increased productivity through more efficient use of farmers' resources and inputs with current technology. However, panel estimates imply that the discrepancy is dominated by random factors outside the control of the farmer suggesting that increase in productivity (i.e., enhancing food security) largely requires investment new inputs and technology to shift the production possibility frontier upwards.

Key words: technical efficiency/inefficiency; food security, random-effect stochastic frontier model; panel data; smallholder farmers; Ethiopia.

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1. Introduction

Ethiopia has witnessed a double digit growth (i.e., 11.2% growth in real GDP) (MoFED, 2010) and impressive gains both in agriculture and export crops production over the last few years (Debello, 2007; NBE, 2010). This growth performance effectively surpasses the 7 % annual rate required for attaining the MDG of halving poverty by 2015 (ADBG, 2010). However, despite these impressive gains, the performance of the country's agricultural sector, and in particular its food production has been low and a significant proportion of the population still depend on food aid. For example, nearly 10 percent of the population was relying on emergency food aid in the previous year (2009) and food aid accounted about 10% of domestic food production, over the last two decades. Therefore, there is a lot to be done to change this image of the country and give dignity to its people. Hence, understanding efficiency and productivity of smallholder (peasant) farmers and identifying the constraints they face (as well as soliciting the way out) would add value to enhancing food security.

The concept of efficiency has its origin with Farrel (1957). Most of the research on efficiency of small farmers, however, has been triggered by Schultz's (1964) popular '*poor-but-efficient hypothesis*'; the idea that peasant (small) farmers in traditional agricultural settings are reasonably efficient in allocating their resources and respond positively to price incentives. As the choice of development strategy, even if not fully, at least partly rests on the policy makers' conceptions of farm/ farmer-level performances; the level of efficiency of peasant (small) farmers indeed has important implications for choice of development strategy. If farmers are reasonably efficient, then increases in productivity require new inputs and technology to shift the production possibility frontier upward. But, on the other hand, if there are significant opportunities to increase productivity through more efficient use of farmers' resources and inputs with current technology, a stronger case could be made for productivity improvement through overcoming factors causing the inefficiency. The majority of the empirical works, however, appear to be supporting Schultz's hypothesis which presumably led to increasing emphasis by policy-makers on investments in new technologies and inputs rather than efforts aimed at improving the efficiency of less efficient farmers. Nevertheless, the extent to which

peasant farmers in traditional agriculture settings behave consistently according to basic economic rationale still appears controversial (Woldehanna, 2000).

In Ethiopia agriculture still plays a major role in the economy of the country and considerable resources are invested on modern inputs and technology packages delivery under the agricultural development led industrialization (ADLI) especially during the last two decades.

Ethiopia is typically an agrarian country. Agriculture contributes about 40 percent of GDP, about 80 percent of employment, over 80 percent of commodity export earnings and 70 percent of raw materials supply for agro based industries. Except for the lowlands and nomadic areas, mixed crop-livestock farming appear to be the dominant farming strategy in the country. Eighty-one percent of the peasant farmers particularly in the Ethiopian highlands practice mixed farming. Crop production contributes over 50 percent to agricultural GDP and the rest comes mainly from livestock sub-sector. The bulk of the agricultural output, i.e., about 95 percent of the total agricultural output, comes from around 11.7 million individual peasant / smallholder farmers (MoARD, 2010). Cereals mainly *teff*, barley, wheat, maize, and sorghum are the most important crops in the country in terms of land area allocated. For example, they accounted for over 75 percent of the total area under crops in 2010/11 (CSA, 2011).

Ethiopia was a net exporter of grain until the early 1960s and was once regarded as the “*breadbasket*” of the Middle East (Amha, 1994; Habtewold, 2001). However, this has been changed particularly during the last four decades of the twentieth century. Per capita food production has been far from sufficient. As a result, domestic supply problems and “*dependence on food aid*” have been typical manifestations of the country. Table A1 in the appendix presents imports of food aid in relation to domestic production in the country during the last two decades. Amid continued improvements both in terms of a declining trend in food aid and an increasing trend in domestic food grain production, food self-sufficiency still remains a challenge. The fact that agriculture is largely traditional and rain-fed so that weather conditions play an important role could be one reason for the low performance in domestic food production (Diao and Pratt, 2007) with nearly 10 percent of the population relying on emergency food aid during the previous year (i.e., 2009). Besides to the

negative image of the country, food aid is also blamed to have a disincentive effect on smallholder producers (Tadese and Shively, 2009; Gebreselasie, 2006).

Given this huge role of smallholder farmers in the economy, there is tremendous scope for increased food production (or mitigating shortfalls) enhancing efficiency or lifting the production frontier upward through use of new inputs and technologies. The motivations of this paper are, therefore, twofold: one, to measure technical efficiency of peasant farmers in northern Ethiopia using stochastic frontier approach; and, two, to determine factors causing inefficiency. The novelty in here is that, firstly, it broadens our knowledge about farmer-level technical efficiency by providing panel data insights from northern Ethiopia. Secondly, it tries to analyze both technical efficiency and factors of inefficiency simultaneously which happen to be a rare case in the literature. The rest of the paper is organized as follows. The next section reviews the literature on smallholder technical efficiency and food security. Section three presents the conceptual model/ framework employed in the study. Section four empirical procedure and data. Section five provides empirical results. Section six draws some concluding remarks.

Smallholder Technical Efficiency and Food Security: Review

Empirical evidence on farmer-level efficiency is very scanty and little work has been done in that respect in Ethiopia. Belete et al (1993), Admassie and Heidhues (1996), and Hailu et al. (1998) appear to be among the few to mention. Belete et al (1993) and Admassie and Heidhues (1996) both pertain to central highlands of Ethiopia. Belete et al. (1993) tried to explore the possibilities for improving production and income of small farmers through better allocation of resources under alternative animal cultivation (work oxen acquisition) practices. The study, however, considered a deterministic setting. Such a specification ignores the fact that output can be affected by random shocks outside the control of the farmer. The problem with this approach is that the entire shortfall of observed output from maximum feasible output is attributed to technical inefficiency.

Admassie and Heidhues (1996) tried to separately determine and compare the level of technical efficiency of two groups, one representing modern technology users and other consisting of relatively traditional farmers that do not use modern technology

using a stochastic frontier production function. The fact that both Admassie and Heidhues (1996) and Hailu et al. (1998) used stochastic frontier approach gives them similarity. Hailu et al. (1998) was different from the former two in a sense that it tried to investigate the level of inter-farm technical efficiency gap for sample smallholder farmers representing eastern highlands (Oromiya region) of Ethiopia. However, there is dearth of information especially determining the factors of inefficiency. Belete et al (1993) also considered only the problem of draft power despite that peasant farmers in Ethiopia and elsewhere in the developing world are constrained by a host of factors including capital shortage, problem of draft power, as well as small and fragmented land holding. Hence, it would be more appealing, however, when all these factors are incorporated into the model and let the model determine as to which of these host of factors are most important ones. Gebeyehu (2000) also investigated the impact of type of tenure on technical efficiency of farmers, i.e., by considered owner-operations versus tenants. He concluded that type of tenure did not bring about an observable difference in mean technical efficiency across the two groups.

In the context of Tigray, Gebreegziabher et al (2004) analyzed both technical efficiency and factors of inefficiency of peasant farmers in Tigray, northern Ethiopia. Their findings showed productivity differences among farmers are dominated by the symmetric error term rather than the one-sided error term, suggesting the discrepancy between the observed level of output and the maximum attainable level of output is dominated by random factors outside the control of the farmer rather than technical inefficiency. Tesfay (2006) analyzed resource use efficiency differentials on tenants' own and sharecropped-in plots using stochastic frontier analysis. Contrary to Marshallian expectation, he finds that there was not any significant efficiency differential by tenancy status of plot. He also finds that resource use efficiency is positively associated with population density in the area and livestock holding of tenant households. Gebrezgi (2008) analyzed technical efficiency of smallholder irrigated and rain-fed agriculture in Tigray combining stochastic frontier analysis with non-parametric matching method. He finds that the production frontier of irrigated plots is higher than that of rain-fed plots whereas the average technical efficiency of irrigated agriculture is less than that of rain-fed agriculture.

Food security is such a complex and multi-faceted/dimensional issue and the analysis of it calls for considerations of various aspects involved. Two general theories/approaches to the understanding of the problem of food insecurity/crisis could be identified from the growing literature, i.e., the 'food availability decline (FAD) theory (approach) and the 'food entitlement decline (FED) theory (approach) (Aae, 2009; Lakew, 2006). This first approach, i.e., FAD theory, looks at the relationship between population and overall food supply. It asks the questions: will there be enough food for this number of people? According to this approach, food availability in an economy is equal to total production, plus imports minus exports of food. The ideas (arguments) underlying the FAD theory are those of the supply side shocks. For example, that a flood or a drought, or a harvest failure for one reason or another is the direct and important cause of food insecurity. Nonetheless, this approach fails to consider the other factors which would be equally responsible for food insecurity. The second approach, i.e., FED theory, emphasizes on the ways in which individuals and households gain command over food. The second approach is one that is currently gaining momentum replacing the FAD theory for it provides greater (better) understanding of what happens during food insecurity and why people may go food insecure (hungry).

This FED theory identifies two basic characteristics '**endowments**' and '**entitlements**' which give access to livelihoods and food. For example, a peasant farmer has his/her land, labor power and a few other resources which together make up his/her endowments. Given these endowments, he/she can produce a bundle of food that will be his or her. Or by selling his/her labor power, s/he can get a wage and with that buy commodities including food. Or, alternatively, he/she may grow some cash crops to which his/her environment is suited and sell them to buy food and other commodities. Hence, **endowments** are the owned assets and personal capacities which an individual or a household can use to establish entitlement. And **entitlements** are the relationships by trade, direct production (from own resources) or sale of labor power, through which an individual/household gains access to food. Access to food gained through own production and consumption is the '**direct entitlement**'. '**Exchange entitlement**' is that command over food which is achieved by selling labor power in order to buy food. '**Trade entitlement**' is the sale of produce to buy food (Bernstein et al 1992).

Therefore, from the second approach one can easily realize that the factors underlying food insecurity/crisis or the risk of constrained access to food are not only those of the **supply side shocks** accruing from natural disaster or any other but also that it could arise from constraints to direct entitlement from endowments. It could also arise from trade and terms of trade induced problems in the food system. For example, it can be driven from the supply-side shocks, that is, through collapse in food production, trade induced decline in food production, etc. It can be driven by constraints or inefficiencies involved in fully utilizing own endowments. Or, alternatively, it can come from the income-side, such as when price explosions occur or terms of trade between key commodities are sharply altered.

2. Conceptual Model

Several different methods could be applied for measuring and computing efficiency and productivity of farmers.³ However, the two most important approaches particularly to the measurement of technical efficiency are: the output-oriented approach (often referred to as primal approach) and input-oriented approach (often referred as dual approach). In the primal approach the interest is by how much output could be expanded from a given level of inputs, hence known as output-shortfall. Whereas in the input-oriented approach the concern is the amount by which all inputs could be proportionately reduced to achieve technically efficient level of production, hence, known as input over-use. We prefer the primal approach because output short-fall is most characteristic for agriculture in developing countries.

Consider a situation where we have observations on I smallholder farmers indexed $i=1, \dots, I$, with $x = (x_1, \dots, x_N) \geq 0$ vector of inputs used to produce an aggregate output $y \geq 0$. Then, the stochastic production frontier model could be specified as:

$$y_{it} = f(x_{it}; \beta) \cdot e^{\phi} \quad (1)$$

where y_{it} is aggregate output of farmer i at period t ; $f(\cdot)$ is the function or process that transforms inputs into outputs with $f(x_{it}; \beta)$ and e^{ϕ} , respectively, standing for

³ See e.g. Fried, Lovell and Schmidt (eds), 1993 for an overview.

the deterministic part and stochastic part of the production frontier, ϕ represents the total error term, and β is a vector of parameters to be estimated.

Besides allowing for technical inefficiency such stochastic production frontier models also acknowledge the fact that random shocks outside the control of the farm operator can affect output. But more importantly, the stochastic production frontier models provide a great virtue that the impact on output of shocks due to variations like in weed infestation, etc can at least in principle be separated from the contribution of variation in technical efficiency (Kumbhakar and Lovell, 2000).

The total error term in (1) could be decomposed into its respective two components as:

$$\phi_{it} = v_{it} + u_{it} \quad (2)$$

where v is the symmetric error term accounting for random variations in output due to factors outside the control of the farmer such as weather, disease, plain bad luck, measurement error, etc. Whereas u represents the technical in/efficiency relative to the stochastic frontier and assumes only positive values.

The distribution of the symmetric error component v is assumed to be independently and identically distributed as $N(0, \sigma_v^2)$. Such normal error term provides the production frontier to be stochastic and, hence, allows the frontier to vary across producers or over time for the same producer. However, the distribution of the one sided component u is assumed to be half normal. That is, it is assumed to be identically and independently distributed as $N^E(0, \sigma_u^2)$ and it follows that:

$$\sigma^2 = \sigma_v^2 + \sigma_u^2 \quad (3)$$

where σ^2 is variance of the composed error term ϕ and it says that the variance of the composed error term is the sum of the variances of symmetric error term v and the one sided component u .

Following Kumbhakar and Lovell (2000), the *stochastic* production frontier in (1) could also be rewritten as

$$y_{it} = f(x_{it}; \beta) \cdot \exp\{v_{it}\} \cdot TE_{it} \quad (4)$$

where the stochastic production frontier $[f(x_{it}; \beta) \cdot \exp\{v_{it}\}]$ consists of two parts: a deterministic part common to all producers and a producer specific part $\exp\{v_{it}\}$, which captures the effect of random noise or shock on each producer. Therefore, the expression:

$$TE_{it} = \frac{y_{it}}{f(x_{it}; \beta) \cdot \exp\{v_{it}\}} \quad (5)$$

defines technical efficiency as the ratio of observed output to maximum feasible output in an environment characterized by $\exp\{v_{it}\}$. Equation (5) implies that y_{it} achieves its maximum feasible value of $[f(x_{it}; \beta) \cdot \exp\{v_{it}\}]$ if and only if $TE_{it} = 1$. Otherwise, $TE_{it} < 1$ provides a measure of the short-fall of observed output from maximum feasible output in an environment characterized by $\exp\{v_{it}\}$ which varies across peasant farmers and β , as in above, is vector of parameters to be estimated.

Assuming that $f(x_{it}; \beta)$ takes the log-linear Cobb-Douglas form, then the stochastic production frontier model in Equation (1) could be rewritten as

$$\ln y_{it} = \ln f(x_{it}; \beta) + v_{it} - u_{it} \quad (6)$$

where $\phi_i = v_i - u_i$ is the composed error term (Aigner et al, 1977) which is asymmetric. The two-sided 'noise' component v_i ($v \sim N(0, \sigma_v^2)$) and the one-sided efficiency component $u_i \geq 0$ with half-normal distribution ($u \sim |N(0, \sigma_u^2)|$) are assumed to be independent of each other. Once the model is specified, maximum likelihood estimation of Equation (6) or using the Corrected Ordinary Least Square

(COLS), yields estimators for β and λ , where β is as defined earlier, $\lambda = \sigma_u^2 / \sigma_v^2$ and $\sigma^2 = \sigma_u^2 + \sigma_v^2$ as defined in Equation (3).

As it could be envisages, the parameter λ is an indicator of the relative variability of the two sources of variations. If λ is closer to zero the symmetric error term dominates the variation between the frontier/ maximum attainable level of output and the observed level of output. Or put differently, a value of λ close to zero implies that the discrepancy between the observed and the maximum attainable levels output is dominated by random factors outside the control of the producer. Otherwise, the more λ is greater than one the more the production is dominated by variability emanating from technical inefficiency.

Once the parameters of the stochastic frontier model are estimated using ML, or OLS, then the Jondrow et al (1982) decomposition technique/ estimators can be used to obtain farmer-specific estimates, $\hat{u}_i$. That is, following Jondrow et al (1982), the above mentioned assumptions on the statistical distributions of v and u would allow us to generate the conditional mean of u_i given ϕ_i as:

$$E(u_i / \phi_i) = \sigma * \left[\frac{f^*(\phi_i \lambda / \sigma)}{1 - F^*(\phi_i \lambda / \sigma)} - \frac{\phi_i \lambda}{\sigma} \right] \quad (7)$$

where $F^*(.)$ and $f^*(.)$ respectively, are the standard normal cumulative and standard normal density functions, evaluated at $\phi_i \lambda / \sigma$, for λ as defined in above. So that, Equations (6) and (7) provide estimates for v and u after replacing ϕ , σ , and λ by their estimates and using equation (2).

As the motivation in here is also to determine factors contributing to inefficiency besides understanding farmer-level technical efficiency, we need to take explicit account of these factors in our model. Now let's assume that $z = (z_1, \dots, z_Q)$ represent the vector of exogenous factors affecting technical inefficiency, which might include extension contact, involvement in off-farm employment, age, and gender in the case of peasant farmers we are interested in.

Generally, the two-step approach⁴ and the 'direct' or 'single step' approaches appear to be the two major approaches that could be pursued to determining or identifying the factors affecting technical inefficiency in agricultural production. We followed the second approach, that is, the 'direct' or 'single step' approach. In the 'direct' or 'single step' approach the exogenous factors affecting technical inefficiency are included directly in the production function, and specified as

$$\ln y_{it} = \ln f(x_{it}, z_q; \beta) + v_i - u_i \quad (8)$$

If we assume that the z_q variable is measured in log, the marginal effect of a z variable on output could be determined as:

$$\frac{\partial \ln y}{\partial \ln z_q} = \gamma_q, \quad (8a)$$

which, in turn, also implies that:

$$\frac{\partial y}{\partial z_q} = \gamma_q \frac{y}{z_q} \quad (8b)$$

In this approach z will, presumably, have two effects: one, it shifts the production technology, upward or downward, depending on the sign of γ ; two, it increases or decreases output through reducing or increasing technical inefficiency.

⁴ The two-stage approach often involves a two step procedure. In the first step, the model like Equation (6) is estimated under the assumptions that hold with no Z variables included and, then, Jondrow et al (1982) estimators used to obtain farmer-specific estimates, $\hat{u}$. In the second step, $\hat{u}$ is regressed on the vector of Z variables. That is, run OLS $\hat{u}$ on an intercept and some Z variables to obtain estimates of γ . Unfortunately, this approach has serious drawbacks: Firstly, it is assumed that the elements of z_q are uncorrelated with the elements of x_i . ML estimates of $(\beta, \sigma_v^2, \sigma_u^2)$ from Equation (6) under such assumption are biased and inconsistent, unless the X and Z variables are true orthogonal. Secondly, in the first step, (as in assumption (8a) below), the mean of u is assumed to be zero and there appears no Z variable. But in step two, the attempt is to explain u using a set of Z variables which is a contradiction. (Kumbhakar and Lovell, 2000)

4. Empirical Model and Data

4.1 Empirical model, variables and hypothesis

A Cobb-Douglas functional form which includes both the conventional inputs and exogenous factors affecting inefficiency was the one considered in our analysis. Despite its restrictive assumptions, we found the Cobb-Douglas functional form to better fit the data. The specific model estimated was:

$$\ln y_{it} = \beta_0 + \beta_1 \ln L_{it} + \beta_2 \ln R_{it} + \beta_3 \ln X_{it} + \beta_4 M_{it} + \beta_5 Oxen_{it} + \gamma_1 Age_2 + \gamma_2 Age_3 + \gamma_3 Age_4 + \gamma_4 Edu_1 + \gamma_5 Edu_2 + \gamma_6 Edu_3 + \gamma_7 Edu_4 + \gamma_8 Accirrig + \gamma_9 Gen + \gamma_{10} Off + \phi \quad (9)$$

As it could be clear from Equation (9), three categories of variables have been considered in the model; output variable, x-variables or the conventional inputs and z-variables or exogenous factors assumed to affect inefficiency. The details of the variables considered and their measurement has been provided in Table 1, below.

Farm labour input (L), area of land cultivated (R), modern inputs (X), value of owned farm implements (M), and number of oxen (Ox) were the variables considered as regards to the conventional inputs. Considerable resources are being committed through the extension program, to increase modern inputs (fertilizer, seed, pesticides, etc) utilization of peasant farmers, with more emphasis given to improving production through increasing fertilizer consumption rate of farmers and credit provision. Hence, it would be worthwhile to assess whether these efforts would bring about the desired outcome. Following the arguments behind the variable modern inputs was hypothesized to be positively related to output, although the issue is debatable (Taylor and Shonkwiler, 1986). Extension contact was assumed to be implicit in the variable X (modern inputs), in the use of modern inputs such as fertilizer and, hence, excluded from consideration to avoid co-linearity. Number of oxen was hypothesized to have positive effect on efficiency. Considerable number of peasant farmers in the area do not own ox. Most often, farmers who have one ox plow their fields by joining hands with others / peer. It could be envisaged that lack of adequate draught power leads to delay and poor land preparation, inefficient farm operations and late planting with a major depressing effect on yield.

Table 1: Definition and measurement of variables considered in equation (9)

Variable category	Variable name	Measurement method
Output ⁵	Aggregate crop output (Y)	Value of crop output in <i>Birr</i>
x-variables (conventional inputs)	(i) Labour (L)	Quantity of farm labour hours worked
	(ii) Land cultivated (R)	Area in ' <i>tsimdi</i> ' ⁶
	(iii) Modern inputs (X)	Value in <i>Birr</i> ⁷
	(iv) Farm implements (M)	Value of owned implements in <i>Birr</i>
	(v) Number of oxen (Ox)	Number of owned oxen
z-variables (exogenous factors)	(i) Age category of farmer	
	Age ≤ 40 (Age ₁)	As a dummy variable having a value of 1 if yes, 0 otherwise; contrast
	Age $>40 \leq 50$ (Age ₂)	Same as above
	Age $>50 \leq 60$ (Age ₃)	Same as above
	Age >60 (Age ₄)	Same as above
	(ii) Gender of farmer (Gen)	As a dummy variable having a value of 1 if female, 0 otherwise
	(iii) Off-farm activities (Off)	As a dummy variable having a value of 1 if the farmer is involved in off-farm activities including food for work, 0 otherwise
	(iv) Access to irrigation	As a dummy variable having a value of 1 if yes, 0 otherwise
	(v) Education of farmer	
	No education/illiterate	contrast
	Read and write1 (through informal learning) (Edu1)	As a dummy variable having a value of 1 if yes, 0 otherwise
	Read and write (through literacy campaign) (Edu2)	As a dummy variable having a value of 1 if yes, 0 otherwise
	Grade 1 to 4 level of formal education (Edu3)	As a dummy variable having a value of 1 if yes, 0 otherwise
	Grade 5 to 8 level of formal education (Edu4)	As a dummy variable having a value of 1 if yes, 0 otherwise

⁵ We considered/ concentrate only on crop output⁶ *tsimdi* is a local area unit 1*tsimdi*=0.25ha⁷ *Birr* is Ethiopian currency currently 1USD=17.20*Birr* and 1USD=7.00 *Birr* during the period the data was collected.

Access to credit, age of farmer, gender, and involvement in off-farm employment constitute z-variables considered in the model. The choice of such particular z-variables was largely based on economic arguments. Access to credit offers a characterization of the degree of market development or competitiveness. Consideration is also made only for age of farmer and education of farmer was excluded from consideration because of the absence of significant difference in level of education among the peasant farmers considered. The effect of age of farmer on efficiency was anticipated to be either positive or negative; as age increases there is an experience effect which is efficiency increasing (potentially). However, as the old age is approached the capacity to do work might decrease. Old aged farmers are also less receptive to new technologies, implying negative relationship. To capture these different effects, four categories of age of farmer were specified (Table 1). The effect of age is measured visa-vis those with less or equal to forty years. Gender of farmer as specified in the model is anticipated to be negatively related to efficiency. It might appear that nothing could be done to influence gender per se. However, differences in resource endowments along gender lines and discriminatory cultural traditions might be expected to induce differences in efficiency across gender, for which an appropriate intervention could be designed. The argument is that, firstly, women in the area do not carry on plowing by themselves. The practice is either they rent out their land for sharecropper or look for somebody/ relative who does the plowing operation, which affect timely operation and/ or size of harvest. Secondly, women might have constrained access to credit and modern inputs for various reasons which also confer the negative relationship.

The effect of involvement in non-farm activities on efficiency might possibly be mixed, that is, both positive and negative. By acting as a residual sector that absorbs the workers who cannot be readily absorbed in agriculture, the rural non-farm sector might contribute to improved farm productivity of peasant households, through its income effect, by relaxing their capital or liquidity constraint and allowing the purchase of inputs such as farm labor, seeds, fertilizer and pesticides (Woldehanna, 2000). That is, in situations of the existence of surplus or unused labor and wage income from off-farm employment being, at least partly, reinvested in agriculture, a positive effect on efficiency might be anticipated. On the other extreme, when there is no surplus or unused labor and involvement in off-farm activities competes with labor for agriculture, it could be the case that it has

negative effect on efficiency. On the balance, the net effect of involvement in non-farm activities is hypothesized to be either positive or negative, depending on the relative magnitude of the two effects.

Once the model is specified in such a way, as in Equation (9), then Coelli's Frontier package (Coelli, 1996) could be used to carry on the estimation and derive the parameter estimates β and γ as well as farmer-specific technical efficiency. Note that we include both the conventional inputs variables and the inefficiency factors into one estimation framework. The very reason that we followed this second approach is to come by the aforementioned drawbacks of the two-stage approach. We used STATA, frontier models for Maximum Likelihood estimation. To take care of the zero value for some of the right hand-side (RHS) variables, a value of one was added onto the observed values of the dependent and conventional inputs variables before loglinearizing.

4.2 Study area and data description

Tigray is the most northern region of Ethiopia. Agriculture and allied activities (crop, livestock and forestry) have an important contribution to regional economy, i.e., regional GDP (Gross Domestic Product). Its average share for the last five to six years, i.e., during fiscal years 2004/05 to 2009/10, has been 38.5% in real terms. Service sector constitute 39.6 percent. Within the agricultural value added, crop and livestock constitute the greatest share; with about 90 percent in the regional agricultural GDP and about 35 percent in the total regional GDP (BoFED, 2011). Within the overall regional GDP crop and livestock constitute about 70 and 24 percent, respectively. Crop production in the region is cereal dominated. Cereal crops account for 84 percent of the cultivated land, while oil crops and pulses constitute 9 percent and 7 percent, respectively. Perennial crops constitute less than 1 percent of the cultivated land. Regionally speaking, sorghum, barley and teff are the three most import cereal crops in terms of area coverage. However, the role may differ or be the other way around depending on area specific conditions.

The panel dataset used in this paper come from a random sample of 200 peasant farms in northern Ethiopia. The data set refers to 1996, 1997 and 2001 production

years and farmers in the sample are located particularly in *Enderta* and *Hintalo-Wajerat* districts of the Tigray region. The description of the dataset has been provided in Table 2. About 13 percent of the households considered are females.

Table 2: Summary statistics of variables considered in the analysis

<i>Variable</i>	<i>1996</i>	<i>1997</i>	<i>2001</i>	<i>Panel</i>
	<i>Mean, n=199</i>	<i>Mean, n=199</i>	<i>Mean, n=199</i>	<i>Mean, n=597</i>
<i>Output</i>	2371.568	1417.281	1909.709	1899.519
<i>Land</i>	7.104	7.101	7.889	7.365
<i>Labor</i>	640.618	548.186	94.921	427.814
<i>Oxen</i>	1.552	1.552	1.738	1.614
<i>Modern inputs</i>	441.873	500.798	551.359	488.010
<i>Farm equipments</i>	237.828	237.828	294.067	256.574
<i>Gender of farmer</i>	0.110	0.110	0.160	0.127
<i>Age 40 or less</i>	0.271	0.261	0.150	0.227
<i>Age 40to49 years</i>	0.261	0.276	0.261	0.266
<i>Age 50to59 years</i>	0.261	0.256	0.306	0.274
<i>Age 60 and above</i>	0.195	0.195	0.266	0.219
<i>Read and write1</i>	0.095	0.090	0.0	0.062
<i>Read and write2</i>	0.030	0.035	0.025	0.030
<i>Grade 1to4</i>	0.216	0.221	0.281	0.239
<i>Grade 5to8</i>	0.015	0.015	0.040	0.023
<i>Off-farm part.</i>	0.663	0.849	0.321	0.611
<i>Access to irrigation</i>	0.050	0.065	0.256	0.124

Peasant households in the area are involved in farm and off-farm activities. About 36 percent of the peasant households were found to be involved in off-farm activities. Mixed crop-livestock farming is the dominant system in the area. Crops grown by peasant farmers include lentils, vetch, linseed, and vegetables with barley, wheat, teff, and sorghum being the four most important crops in order of importance. Most of the peasant agriculture is practiced under rain-fed condition.

5. Results and Discussion

Note that the intention of this paper is to measure technical efficiency of peasant farmers in northern Ethiopia using stochastic frontier approach and to determine factors causing inefficiency. Therefore, maximum likelihood parameter estimates of the stochastic Cobb-Douglas production frontier (i.e., equation 9) with both the

conventional inputs variables and the factors of inefficiency included in one estimation framework was carried. Results are presented in Table 3. The ML estimates of β parameter show that from among x-variables (the conventional inputs) the variables land, modern inputs, and value of owned farm implements were found to be significant, all with positive signs whereas labor and number of oxen turned out to be insignificant. Given that coefficients could be interpreted as elasticities, due to Cobb-Douglas specification, our results imply that a 1 percent increase in land input/area by, ceteris paribus, increases output about 0.42 percent.

Table 3: Stochastic frontier model estimates of Cobb-Douglas production function

<i>Variable</i>	<i>Individual year cross-section estimates</i>			<i>Random Effect Est. (Panel)</i>
	<i>1996</i>	<i>1997</i>	<i>2001</i>	
<i>Land</i>	0.626***	0.537***	0.604***	0.272***
<i>Labor</i>	0.146**	0.351***	0.307***	0.338***
<i>Oxen</i>	0.093	-0.066	0.164**	-0.130*
<i>Modern inputs</i>	0.129*	-0.012	-0.071	0.506***
<i>Farm equipments</i>	-0.034	0.063	0.126***	0.406***
<i>Gender of farmer</i>	0.149	-0.118	-0.215**	-0.023
<i>Age 40to49 years</i>	0.023	-0.024	0.067	0.086
<i>Age 50to59 years</i>	0.197***	0.024	0.115	0.113
<i>Age 60 and above</i>	0.116	-0.068	0.033	0.020
<i>Read and write1</i>	-0.039	-0.186**		-0.216**
<i>Read and write2</i>	-0.324**	-0.038	-0.086	0.028
<i>Grade 1to4</i>	0.041	-0.027	-0.072	-0.091
<i>Grade 5to8</i>	-0.027	0.004	-0.102	-0.032
<i>Off-farm part.</i>	-0.214***	-0.206***	-0.093	-0.248***
<i>Access to irrigation</i>	0.508***	0.420***	0.318***	0.404***
<i>Constant</i>	4.928***	4.226***	4.642***	
σ_v	0.333***	0.230***	0.265***	0.265***
σ_u	0.007	0.410***	0.363***	0.589
σ^2	0.111***	0.221***	0.202***	0.853
λ	0.002	1.712***	1.373***	
<i>n</i>	164	164	158	486
<i>Log likelihood</i>	-52.462	-52.443	-54.381	-405.72
<i>Wald chi2(15)</i>	435.71	396.61	478.74	7936.81
<i>Prob > chi2</i>	0.000	0.000	0.000	0.000

The analysis was performed for the aggregate value of annual crop output. The coefficient estimates of the β parameters showed that the parameters for the variables land, modern inputs, and value of owned farm implements are significant

among the conventional inputs, all with positive signs whereas labor and number of oxen turned out to be insignificant. Given that coefficients could be interpreted as elasticity, due to Cobb-Douglas specification, our results imply that a 1 percent increase in land input/area, for example, *ceteris paribus*, increases output by about 0.42 percent. Increasing modern inputs use by 1 percent would also, *ceteris paribus*, improve output by 0.012 percent.

The individual year estimate values of λ , i.e., the ratio of the variances of u_i and v_i for peasant farmers in the study area, reported as 1.712 and 1.373 for the years 1997 and 2001 respectively (which is >1) shows that the one sided error term dominates the symmetric error term, which implies that the discrepancy between the observed level of output and the maximum attainable level of output is dominated by technical inefficiency rather than random factors outside the control of the farmer.

ML estimates of the γ parameters also showed that among all the variables considered the variables age, education, irrigation access and involvement in off-farm activities were significant. However the interpretation may not be as straight forward as in the variables specified in logs. However, the variables gender of farmer is found to have no significant impact on inefficiency in most cases except for one year, 2001. That is, technically speaking gender of farmer was found to have no significant effect on inefficiency particularly in the case of panel estimates. This could probably be because share cropping arrangements in the study area are reasonably efficient. Involvement in off-farm activities is found to have significant negative effect on farm production. May be because, on the balance the labor competing effect of involvement in off-farm activities outweighs the liquidity relaxing (income) effect.

In general, individual year estimates imply that the discrepancy between the observed level of output and the maximum attainable level of output is dominated by factors of technical inefficiency rather than random factors outside the control of the seemingly suggesting for the scope (opportunities) for increased productivity through more efficient use of farmers' resources and inputs with current technology. However, panel estimates imply that the discrepancy is dominated by random factors outside the control of the farmer suggesting that increase in productivity

(i.e., enhancing food security) largely requires investment new inputs and technology to shift the production possibility frontier upwards.

6. Conclusions and Implications

In Ethiopia agriculture still plays a major role in the economy of the country and considerable resources are invested on modern inputs and technology packages delivery under the agricultural extension program especially during the last two decades. Nevertheless, empirical evidence on farmer-level efficiency and productivity are very scanty and little work has been done in that respect in Ethiopia. In addition, some of these studies have considered a deterministic setting. But, such a specification ignores the fact that output can be affected by random shocks outside the control of the farmer. The problem with this approach is also that the entire shortfall of observed output from maximum feasible output is attributed to technical inefficiency.

Moreover, smallholder farmers in Ethiopia and elsewhere in the developing world are constrained by a host of factors including capital shortage, problem of draft power, as well as access to irrigation. Hence, it would be of interest and more appealing, however, when all these factors are incorporated into the model and let the model determine as to which of these host of factors are most important ones.

Therefore, in this paper we derive farmer-specific technical efficiency and simultaneously determine the socioeconomic factors affecting inefficiency for a sample of peasant farmers from northern Ethiopia using a random effect stochastic frontier model. The novelty in here is that, firstly, it broadens our knowledge about farmer-level technical efficiency by providing panel data insights from northern Ethiopia. The coefficient estimates of the β parameters (i.e., conventional inputs) showed that the all variables land, labor, modern inputs, and value of owned farm implements are significant all with positive signs except for number of oxen.

ML estimates of the γ parameters (factors of inefficiency) also showed that among all the variables considered the variables education (read and write1), involvement in off-farm activities and access to irrigation are most significant.

Individual year estimates imply that the discrepancy between the observed level of output and the maximum attainable level of output is dominated by factors of technical inefficiency rather than random factors outside the control of the seemingly suggesting for the scope (opportunities) for increased productivity through more efficient use of farmers' resources and inputs with current technology. However, panel estimates imply that the discrepancy is dominated by random factors outside the control of the farmer suggesting that increase in productivity (i.e., enhancing food security) largely requires investment new inputs and technology to shift the production possibility frontier upwards.

Results also suggest that conclusions drawn based on estimates from cross-section data might indeed be potentially misleading

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Appendices

Table A1: Domestic production and food aid in Ethiopia by year ('000 metric tons)

Year	Food aid	Food grain production	Share of food aid (%)
1985	1272	4855	26.2
1986	926	5404	17.1
1987	277	6684	4.1
1988	1096	6902	15.9
1989	461	6676	6.9
1990	657	6579	10.0
1991	925	7078	12.0
1992	840	7055	11.9
1993	519	7619	6.8
1994	980	6945	14.1
1995	683	7492	9.1
1996	150	10328	1.5
1997	205	10217	2.0
1998	417	8103	5.2
1999	1320	11745	11.2
2000	860	12779	6.7
2001	224	11964	1.9
2002	1506	8923	16.9
2003	0	13047	0.0
2004	965	11380	8.5
2005	387.5	12895	3.0
2006	339.0	14458	2.3
2007	60.6	15499	0.4
2008		17088	
2009	591		
Average 1985-2009	652.5	9654.8	6.8

Source: MEDaC (1999), FDRE (2002) and FAO/WFP (2008, 2009)

Table A2: Area under cultivation, yield and production of major crops for 2007/08-2009/10

Crop type	2007/08			2008/09			2009/10		
	Area (ha)	Yield (qt/ha)	Production (qt)	Area (ha)	Yield (qt/ha)	Production (qt)	Area (ha)	Yield (qt/ha)	Production (qt)
Cereals	8,730,001.31		137,169,906.60	8,770,188.00		144,964,059.00	9,233,025.14		155,342,279.88
Barley	984,942.72	13.8	13,548,070.55	977,756.70	15.5	15,194,042.00	1,129,112.36	15.5	17,504,436.37
Maize	1,767,388.91	21.2	37,479,490.62	1,768,122.00	22.2	39,325,217.00	1,772,253.11	21.99	38,971,630.66
Sorghum	1,533,537.26	17.3	26,591,292.20	1,615,297.00	17.4	28,043,510.00	1,618,677.24	18.36	29,712,655.25
Finger millet	399,267.90	13.5	5,379,914.64	408,098.50	13.7	5,603,044.70	368,999.15	14.21	5,241,910.54
Teff	2,565,155.22	11.7	29,929,234.99	2,481,333.00	12.2	30,280,181.00	2,588,661.14	12.28	31,793,742.81
Wheat	1,424,719.03	16.3	23,144,885.23	1,453,817.00	17.5	25,376,398.00	1,683,565.26	18.27	30,756,435.71
Oats	30,556.21	12.0	365,857.75	30,604.84	14.0	427,729.25	24,017.99	13.75	330,191.19
Rice	24,434.07	29.2	713,160.65	35,088.28	20.4	713,937.35	47,738.88	21.6	1,031,277.37
Oilseeds	707,059.29		6,169,279.99	855,147.50		6,557,044.20	780,915.89		6,436,143.98
Pulses	1,517,661.93		17,827,387.94	1,585,236.00		19,646,301.00	1,489,308.45		18,980,472.57
Other crops									
Sugar cane	21,482.25	363.9	7,817,336.53	15,601.73	358.6	5,594,040.80	18,908.42	355.63	6,724,393.51

Source: CSA (2011).