Ethiopian Economics Association
(EEA)

PROCEEDINGS OF THE SIXTH INTERNATIONAL CONFERENCE ON THE ETHIOPIAN ECONOMY

Edited by:

Getnet Alemu

Volume II

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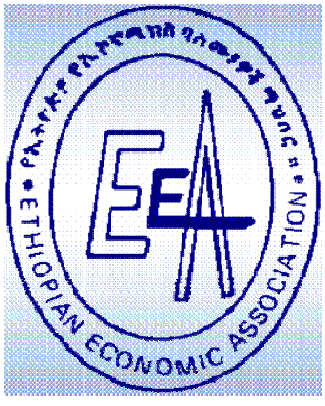

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❖ ALL ACTIVITIES OF EEA ARE SPONSORED BY THE EMBASSY OF UK (DFID), EMBASSY OF SWEDEN (SIDA), THE NORWEGIAN CHURCH AID, EMBASSY OF NETHERLANDS, EMBASSY OF IRELAND (DCI) AND FRIEDRICH EBERT STIFTUNG OF GERMANY (FES).

❖ THE 6th INTERNATIONAL CONFERENCE WAS SPONSORED BY THE UN ECONOMIC COMMISSION FOR AFRICA, AFRICAN DEVELOPMENT BANK, COMMERCIAL BANK OF ETHIOPIA, BANKERS ASSOCIATION, ETHIOPIAN AIRLINES, FUTURE AGRICULTURE AND ETHIOPIAN MANUFACTURING INDUSTRIES ASSOCIATION

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FOREWORD

The Ethiopian Economic Association (EEA) is happy to issue the proceedings of the 5th International Conference (the 16th Annual Conference) on the Ethiopian Economy that was held from June 7 – 9, 2007 at UN Conference Centre. EEA has been organizing annual conferences on the Ethiopian Economy every year as part of its overall objectives to contribute to the economic advancement of Ethiopia through dissemination of economic research findings; promotion of dialogue on 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.

In quest of its mission, EEA has been actively engaged in economic research, training, organization of International and National conferences and round table discussions on the Ethiopian economy and the dissemination of the results of these activities through its professional journals and various publications. It has also been engaged in providing professional opinion and reflections on many issues affecting the development of this country.

As a result of these and other efforts of the Association, EEA has established itself as a truly independent source of socio-economic policy options and data base in Ethiopia for the Ethiopian Government, the Ethiopian people and the International Community at large.

The 5th International Conference on the Ethiopian Economy was attended by about 450 participants. The conference was organized in five Plenary Sessions and four concurrent sessions. Panel discussion was also organized on the Current State of the Ethiopian Economy. The main speakers of the panel discussion were H.E. Ato Neway Gebreab, Director EDRI and chief Economic Advisor of the PM; Ishac Diwan, WB Country Representative to Ethiopia and the Sudan; Geni Kulgman, WB Lead Economist; Mulat Demeke, Economic Department of AAU; and Haile Kibret, EEA/EEPRI. In addition, keynote speech was delivered by Prof. Dr. Joachim Von Braun, Director General of IFPRI on Rural-Urban Linkages for Growth, Employment and Poverty Reduction.

Some of the sessions were co-organized with the World Bank, African Development Bank, Economic Commission for Africa (ECA), International Food Policy Research Institute (IFPRI), Ethiopian Development Research Institute (EDRI), Poverty Action Network (PANE) and Forum for Social Studies (FSS). The Plenary Sessions

discussed about 15 papers on Poverty, Future Agriculture, Urban-rural Linkages. Labour Market, African Development, Environment, Investment, Public Finance etc. Similarly, in the concurrent sessions about 68 papers were presented in the area of macro and sectoral issues, of which 49 papers were presented by individuals while the rest 19 papers were delivered by co-organizers.

Out of the total 49 papers presented by individuals on this 5th International Conference, the editorial committee received 39 papers from authors and reviewed them. Comments and suggestions including editorial comments were communicated to authors for improvement. Among the 39 papers, the editorial committee selected 23 papers to be included in this edition. In addition, 11 papers which were presented by co-organizing institutions were also reviewed and included in this edition. All these papers are organized into three volumes. Volume I contains ***Industry, Trade, Finance and Development;*** Volume II contains ***Social Sectors (Povery, Health, Education)*** and Volume III contains **Water, Natural Resource and Agricultural Practices.**

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 a resounding success. First and foremost, I thank the authors of the papers and the audience whose active participations made the conference meaningful and dynamic. The UN Economic Commission for Africa deserves huge thanks for granting us the free use of the UN Conference Centre. The African Development Bank, Commercial Bank of Ethiopia, Bankers Association, Ethiopian Airlines, Future Agriculture, and Ethiopian Manufacturing Industries Association are sincerely acknowledged for sponsoring the conference. The many professionals who dedicated their time to the conference and served as chairpersons deserve due thanks for their special contributions.

The staffs of the EEA/EEPRI deserve a special recognition for their enthusiasm and perseverance in managing the conference from inception to completion. I also want to extend my personal gratitude to the Organizing Committee and members of the Executive Committee of the Ethiopian Economic Association for the dedicated services and the leadership they provided to the Association.

I would like to seize this moment to express our gratitude to the Consortium of Donors who have funded the conference and all other activities of EEA/EEPRI and maintained continued interest in our Association. These are: Friedrich Ebert Stiftung of Germany (FES), Embassies of UK (DFID), Ireland (DCI), Sweden (SIDA), the Netherlands, Norwegian Church Aid and the African Capacity Building Foundation (ACBF).

Finally, I would like to extend my sincere gratitude to H.E, Ato Tadesse Haile, State Minister of the Ministry of Trade and Industry, for his an insightful keynote speech; ministers, parliament members, and other senior government officials who spared their busy schedule and participated in the conference.

Wolday Amha (Ph.D)
President of the Ethiopian Economic Association

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Agriculture and Natural Resources

ECONOMIC VALUATION OF PREFERRED TRAITS OF CATTLE IN CENTRAL ETHIOPIA[1]

Girma T. Kassie[2], Awudu Abdulai[3], and Clemens Wollny[3]

Abstract

This paper reports the relative economic values of and the willingness to pay for preferred attributes of cattle in crop-livestock mixed agricultural systems of Central Ethiopia. Choice experiment survey was employed to elicit preferences and random parameters logit model was estimated to quantify the relative economic weights of traits. The results show that fertility, disease resistance and calf vigor traits are equally or more important than milk in choosing a cow. The place where the cows were brought from is also an important attribute for buyers. Similarly, cattle buyers assign high values for good traction potential, disease resistance, calf vigor, and for places of origin when choosing bulls in the market. The smallholder community in this part of Ethiopia depends on semi subsistence agriculture and, therefore, livestock development interventions should focus on a multitude of reproductive and adaptive traits which stabilize the herd structure than focusing on traits which are only important to commercial purposes. In addition to producing breeds that are preferred by cattle buyers, incorporating these preferred attributes in breeding programs would contribute in reducing the erosion of the genetic diversity of the indigenous animal genetic resources.

[1] The authors are grateful for all who directly or indirectly contributed to the study. The study was funded by ILRI-BMZ project.
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1. Introduction

Cattle are by far the most important animals rendering different functions for the resource poor communities in the rural areas of Ethiopia. The functions of cattle include traction power, consumables (milk, beef, etc.), fuel and soil fertilization (dung), cash generation (selling milk, hides and/or live animals etc.), social prestige, and risk buffering. This importance has probably initiated the series of interventions to develop cattle production and productivity in the country.

Ethiopia's strategic interventions to enhance the productivity of the livestock sector over the last four decades focused on increasing milk production through provision of 'improved' in-calf crossbreeds, artificial insemination (AI), and exotic bull services (Desta, 2002). Thorough assessments made about the interventions revealed that in urban and peri-urban areas, the efforts have considerable success in terms of milk production. In the rural areas, however, these interventions not only fell short of their objectives but also resulted in unexpected effects such as unintended and unknown genotype calves (e.g., ESAP, 2004). Sustainable management of animal genetic resource diversity entails proper identification, valuation and maintenance of the different traits of the genetic resource to make it available for future use without compromising current consumption. The main challenge in this regard is that the economic implications of the erosion of the genetic diversity and consequently that of its conservation are not well understood. This is so essentially because the diversity of AnGR has a quasi-public[4] nature (Scarpa *et al.*, 2003a) and this makes the revealed preferences for genetic resources in ordinary markets less appropriate to value the diversity. Stated preference based analysis methods have instead become more common in the valuation of non-marketed resources.

The significance of stated choice based valuation of attributes has generated a considerable amount of interest and research in this area in recent times. After the pioneering work by Sy *et al.* (1997) in Canada, many authors have analysed economic values of cattle traits for some African countries. Tano *et al.* (2003) analysed the economic values of traits of indigenous breeds of cattle in West Africa focusing on trypanotolerance by employing conjoint ranking and ordered probit model. Using choice experiments (CE) and mixed logit model, Scarpa *et al.* (2003a) quantified the economic values of the traits of a creole – local – pig in Yacutan Mexico. Scarpa *et al.* (2003b), employing the same approach, estimated the values

[4] The quasi-publicness emanates from the fact that although cattle are privately owned, the genetic diversity embedded in them can be accessed with no or low cost by others, especially in a system where mating of cattle is uncontrolled. Similarly, the payment made while buying an animal is not for the invaluable genetic diversity due to the animal and yet the buyer can benefit from this diversity.

for the traits of indigenous cattle in Northern Kenya. Ouma *et al.* (2007) employed choice experiments and mixed logit and latent class models to analyze the relative values of traits and heterogeneities in trait preferences in the pastoral areas of Northern Kenya and Southern Ethiopia. Zander (2006) employed conjoint ranking and mixed and multinomial logit models to study the relative values of traits and preference heterogeneities of Borana cattle keeping pastoralists in Northern Kenya and Southern Ethiopia. Roessler *et al.* (2007) employed choice experiments and multinomial logit model to investigate the relative economic weights of pig traits in Vietnam, while, Ruto *et al.* (2008) examined the relative values cattle traits and preference heterogeneities in Northern Kenya using choice experiments and latent class modelling.

The present study contributes to the literature by employing choice experiments and random parameters logit model to identify and estimate the relative weight assigned to the preferred traits of indigenous cattle population in the most dominant crop-livestock mixed production system in Ethiopia. The mixed farming system covers almost all the highlands of Ethiopia and consists of 73% of the cattle population. The pastoral system covers the semi-arid and arid lowlands of Ethiopia consisting of 27% of the cattle, 66% of the goat, 26% of the sheep and 100% of the camel population. Commercial farms are quite marginal and concentrated in the pre-urban and urban area (EEA, 2006).

If countries like Ethiopia are to benefit from the livestock wealth they are endowed with, a well-informed livestock and conservation strategy has to be formulated based on comprehensive inventory of the genetic resources and proper valuation of their traits or characteristics which explain the reasons why they are kept for. Only two documented efforts by Zander (2006) and Ouma *et al*. (2007) were made to elicit preferences and estimate relative values of traits in the pastoral areas of southern Ethiopia. Yet, no attempt has been made to do same in the most dominant crop-livestock mixed production systems of the country. This research aims at filling this gap by focusing on the cattle population in Central Ethiopia.

The remaining part of the paper is organized as follows. In the second section, description of the study area, choice experiment, and the analytical framework of the research is presented. This is followed by results and discussion. The final section contains conclusions and implications of the results.

2. Materials and methods

2.1 The study area

Dano district of West Shoa Zone in Oromia region was selected as a pilot site for its remoteness and indigenous cattle population. Such criteria were used essentially to elicit the absolute preferences of livestock keepers for attributes of the indigenous cattle they raise. The district is located some 250 kilometers (km) west of Addis and has an area of about 659 square km with estimated human population of 83 thousand in 2005/6. Traditional classification of the agro-ecologies indicates that 5% of the district is highland (>2200 meters above sea level (m.a.s.l.)), 80% midland (1500 - 2200 m.a.s.l.), and 15% lowland (<1500 m.a.s.l.). The district receives on average 900-1400 millimeters of annual rainfall and has 15-30^{o}C average daily temperature. Livestock are crucially important component of the fully semi-subsistence livelihood system characterizing the district.

The study covered five markets. Four of the markets, namely, Sayo, Menz, Dano-Roge and Awadi-Gulfa, are situated within Dano district. Sayo, the administrative and economic capital of the district, has two different cattle market places that set on Wednesdays and Saturdays. Menz is a small market located at about 12 km north of Sayo and sets on Tuesdays. Dano-roge is located at the northern tip of the district some 28 km far from Sayo. Roge sets on Thursdays and, unlike in other markets, cows and calves are the cattle frequently exchanged. Awadi-Gulfa market is located 24 km northeast of Sayo and sets on Wednesdays. The fifth market, which is called Ijaji, is located in neighboring Cheliya district and sets on Saturdays. Ijaji market is the only fenced market of about 30 meters by 80 meters area and, comparatively, traders are more frequent in this market than in others. None of the markets has any shade for both human beings and animals or any trough for water and feed. Only Ijaji and Sayo are accessible by car throughout the year, while the others can be accessed only on foot in the rainy season. Animals are trekked to and from the markets throughout the year. All cattle markets are dominated with male buyers and sellers.

2.2 Choice experiment

Choice experiment (CE) is a popular stated preference method which is used to elicit preferences for attributes of differentiated goods based on statistically efficient designs of attributes and attribute levels. CE has theoretical underpinnings on random utility theory (McFadden, 1974) and characteristics theory of value (Lancaster, 1966; Rosen, 1974). CE is a significant improvement over the well known contingent valuation method (Bateman *et al*., 2003; Hensher *et al*., 2005) in that it goes beyond willingness to pay/accept for a non-specific change to determining the

relative weight of attributes of a good on its total economic value. CE also differs from conjoint rating and conjoint ranking in that it enables estimation of demand theory consistent marginal values of the attributes of a differentiated good which is practically less appealing in the rating and ranking approaches (Bateman *et al.*, 2003; Hensher *et al.*, 2005).

CE surveys have already become routine in the fields of, *inter alia*, environmental (e.g., Rolfe *et al.*, 2000; Campbell, 2007), food and beverage (e.g., Rigby and Burton, 2005; Mtimut and Albisu, 2006), and plant genetic resource (e.g., Windle and Rolfe, 2005; Birol *et al.*, 2006) economics. Application of CE for the valuation of attributes of livestock is very recent and only a few of the abovementioned studies (Scarpa *et al.,* 2003a,b; Ouma *et al.,* 2007; Roessler *et al*., 2007; and Ruto *et al*., 2008) employed it to elicit preferences.

The most important issues in designing a CE survey are attribute and attribute level determination, generation of statistically efficient and practically manageable experiment design, and management of the field interview. In this study, trait identification and trait level determination were done after a series of informal and focus group discussions both in the villages and in the markets where people of Dano district make a living and undertake cattle transactions. Respondents were asked to mention the attributes they consider to value the animals they keep or buy.

After further discussions with farmers, and based on additional information generated by pair wise ranking during subsequent surveys, seven traits were identified for cow traits CE and six traits for bull traits CE. Age was fixed to be 3 years for cows based on the average of the figures collected from farmers that is in line with fact that the average age of a cow at its first parturition is about 3.2 years in this part of the country (Workneh and Rowlands**,** 2004). For bulls, age was fixed at 4 years, as this is the age at which a bull would have ploughed for a year. The price levels used in the CE are averages of the minimum, average and maximums of the price distributions generated from respondents in the villages and markets for an 'average' cow and 'average' bull – average as perceived by respondents. Table 1 presents the traits and trait levels used in the choice experiments.

The traits and trait levels were statistically combined in an efficient way to generate profiles based on the attributes and attribute levels. Experimental designs commonly used in resource valuation studies are fractional factorial designs that focus on orthogonality (Rose and Bleimer, 2004). In orthogonal designs, ensuring statistical independence among the attributes is the primary objective. However, maintaining this orthogonality throughout the experiment to the data analysis stage is known to be highly unlikely (Bleimer and Rose, 2005). Hence, the more comprehensive approach

suggested by Kuhfeld (1997, 2005) to generate statistically efficient design with SAS algorithm was employed in this study. In addition to orthogonality, statistically efficient designs are characterized by balanced distribution of attribute levels, balanced utility across alternatives, and minimum overlap of levels in a choice set (Huber and Zwerina, 1996).

Table 1: Traits and Traits Levels Included in the Choice Experiments

Variable	Levels	Reference level
Origin	Dano Nearby districts Wellega Keffa	Dano
Body size	Small Medium Big	Small
Fertility (Cows only)	A calf/ 2 years A calf/ year	A calf/2 years
Milk yield (Cows only)	1 liter/day 2 liter/day 3 liter/day	1 liter/day
Plowing potential (Bulls only)	Poor Good	Poor
Calf vigor	Poor Good	Poor
Disease resistance	>2 times per year <2 times per year	>2 times per year
Price - Cows	Small price = 500.00 Birr[5] Medium price = 700.00 Birr High Price= 900.00 Birr	500.00 Birr
Price - bulls	Small price = 800.00 Birr Medium price = 1000.00 Birr High Price= 1200.00 Birr	800.00 Birr

The design generated 36 profiles classified into 18 choice sets (two profiles in each set) blocked into three so that each respondent could be presented with six choice sets. Similarly, the design for the bull traits CE generated 24 profiles categorized into 12 choice sets blocked into two so that each respondent receives six choice sets. In total, each respondent received 12 choice sets. Attributes and attribute levels were described with pictures and sketches which were carefully selected to clearly show the attributes and the differences in the levels of the attributes. The survey was

[5] Birr is the local currency in Ethiopia. One USD ≈ 8.8 Ethiopian Birr in 2007.

enumerated by three experienced researchers from the department of livestock improvement at Bako Agricultural research Center (BARC) and an agricultural economist for a consistent and clear explanation of all the attributes and attribute levels considered.

Valid numbers for experiments were 195 for cows and 198 for bulls. Accordingly, the total number of cow choice sets responded to were 1170 and that of bulls were 1188 with three alternatives in each set. The third alternative was an opt-out option included for the purposes of avoiding forced choice and generating theoretically sound taste parameter estimates. Except very few who declined for reasons of time shortage, all approached marketers were willing to participate in the CE survey. This is a relatively isolated community and the five markets are virtually the only markets where cattle in the district are traded. The sample is therefore believed to be representative of the cattle buyers in Dano district.

2.3 Analytical framework

Values of (quasi-) public goods are not typically exclusively derived from private use of resources and, therefore, the revealed preferences in the markets can hardly be used to generate the marginal effects of attributes of an animal, which can be considered as an attribute differentiated good (Drucker *et al*., 2001; Anderson, 2003; Roosen *et al*., 2005). In our case, market prices are aggregated payments for animals without any indication as regards the different attributes of the animal. The main advantage of CE over the revealed choice ones, like most stated choice-based methods, is the possibility of varying multiple attributes of the good in order to see the effect of a change in each attribute on the total economic value.

This study employed CE to elicit the preferences of cattle buyers. These choices were made in six choice situations (for cows and bulls each) and were about selecting the best option among three alternatives (including opting out) in each choice set. A choice of an alternative over the others implies that perceived utility of the chosen alternatives is higher than the rest. For an individual '*n*', presented with a choice situation '*t*', choice of an alternative '*j*' can be modeled as

$$Y_{njt} = \begin{cases} 1 \; if \quad U_{njt} \geq U_{nlt} \\ 0 \; otherwise \end{cases}$$, for all j = 1,2,..,*l*,.. m, $j \neq l$; n = 1... *N,* and *t=1,.., T.* **(1)**

where Y_{njt} is the choice variable which takes the value '1' if an alternative '*j*' is chosen and '0' if not in the choice set '*t*', and U_{njt} is individual *n*'s perceived utility of alternative '*j*' in the '*t*' choice set.

Based on utility formulation approaches of Lancaster (1966) and McFadden (1974), it can be shown that the chosen profiles are not preferred simply because they denote a cow or a bull, rather they are preferred because of the attributes characterizing the cattle profiles. The attributes included in characterizing the profiles were carefully identified and their levels determined and yet not all of the attributes could be included. In addition, not all the issues cattle buyers consider in choosing a given profile could be considered in analyzing the level of perceived utilities. As explained by McFadden (1980), the unobserved variations in preferences and in the attributes of alternatives and errors of perception and optimization by the respondents are the sources of randomness in the perceived utility.

Maximization of utility, therefore, needs to include both the deterministic and random components of the perceived utility. The random utility theory (McFadden, 1974) enables the formulation of utility (U) as additive function of these deterministic and random components. This can be formulated as

$$U_{njt} = X'_{njt}\,\beta_n + \varepsilon_{njt} \qquad \textbf{(2)}$$

where, X_{njt} is a vector of explanatory variables including attributes of alternatives, the socio-demographic characteristics of the respondents, and interactions of attributes and socioeconomic characteristics, and ε_{njt} is unexplained utility assumed to be independently and identically distributed (iid) across individuals, alternatives and choice sets with extreme value type I distribution. β_n is a conformable vector of the unknown weights the respondent assigns to the explanatory variables. Interaction variables of attributes and socioeconomic characteristics are introduced to account for sources of taste heterogeneity among the respondents. Significance of the coefficient of an interaction term indicates that there is heterogeneity of preferences around the mean of the attribute because of the respective socioeconomic variable (Hensher *et al*., 2005).

Given the stochastic component of utility is distributed iid extreme value type I, the probability conditional on β_n that the cattle buyer chooses alternative '*j*' out of '*m*' alternatives in a choice set '*t*' is a conditional logit (McFadden 1974) given by

$$\mathrm{CP}_{njt}(\beta_n) = \frac{\exp X'_{njt}\,\beta_n}{\sum_{l=1}^{m} \exp X'_{nlt}\beta_n} \qquad \textbf{(3)}$$

This specification, however, assumes homogeneous taste for traits across all respondents and the taste parameters of each individual (β_n) are known and completely explained by their means only**.**

Attribute taste heterogeneity is, however, shown to be a common phenomenon among cattle producers and consumers (e.g., Sy *et al*., 1997; Scarpa *et al.,* 2003a; Ouma *et al.,* 2007). A random parameters logit model which accounts for heterogeneity of attribute tastes is therefore employed in this study. In random parameters logit (RPL), the β_n's are specified to be random and to follow, most commonly, normal distribution[6] given as

$$\beta_n \sim \mathrm{N}[\beta, \Sigma_\beta] \qquad \textbf{(4)}$$

where β is the mean and Σ_β is the covariance of the distribution of β_n**.**

The random taste parameters (β_n) are unobserved and so the unconditional probability that a cattle buyer will choose alternative '*j*' is estimated by integrating the conditional probabilities over all values of each of the random taste coefficients weighted by its density function. That is

$$P_{njt} = \Pr[y_{nt} = j] = \int \frac{\exp(\mathrm{x'_{njt}}\,\beta_\mathrm{n})}{\sum_{l=1}^{\mathrm{m}} \exp(\mathrm{x'_{nlt}}\,\beta_\mathrm{n})} \phi(\beta_n \mid \beta, \Sigma_\beta) d\beta_n \qquad \textbf{(5)}$$

where the integral is multidimensional and $\phi(\beta_n \mid \beta, \Sigma_\beta)$ is the multivariate normal density for β_n with mean β and variance Σ_β.

The maximum likelihood estimation then maximizes

$$\ln L_N = \sum_{n=1}^{N} \sum_{j=1}^{m} y_{njt} \ln P_{njt} \qquad \textbf{(6)}$$

[6] Other possible distributions the random taste parameter can take include lognormal, uniform and triangular (Train, 2003; Hensher et al., 2005). We have tried different distributional assumptions for the random parameters before deciding to use the multivariate normal distribution.

with respect to β and variance Σ_β. This maximization can not be solved; because, the integral (equation 5) has no closed form solution. Simulated maximum likelihood estimation is, therefore, employed to estimate the unconditional choice probabilities (Train, 2003) According to Cameron and Trivedi (2005), using a direct simulator the integral (equation 5) is replaced by the average of R evaluations of the integrand at random draws of β_n from the N[$\boldsymbol{\beta}$, Σ_β] distribution. The maximum simulated likelihood estimator then maximizes

$$\ln \hat{L}_N(\beta, \Sigma_\beta) = \sum_{n=1}^{N} \sum_{j=1}^{m} y_{njt} \ln \left[\frac{1}{R} \sum_{r=1}^{R} \frac{e^{x'_{njt} \beta_n^{(r)}}}{\sum_{l=1}^{m} e^{x'_{njt} \beta_n^{(r)}}} \right] \quad \textbf{(7)}$$

where y_{njt} is 1 if alternative j is chosen and 0 otherwise, and $\beta_n^{(r)}$, r = 1,2,…, R, are random draws from the density $\phi(\beta_n \mid \beta, \Sigma_\beta)$. This study employed a range of numbers of draws (100 – 1000) and the results were found to be consistent. The results of the estimations with 1000 Shuffled Halton draws are, therefore, reported.

3. Results and discussion

3.1 Parameters of cow trait preferences

Choosing a profile in the choice sets, as opposed to opting out, was found to be highly preferred as indicated by the significant constant term (Table 2). Fertility, disease resistance, calf vigor and milk yield were found to be highly significant (P<<0.001) in influencing the choice of a cow. Body size, price and some locations were found to be statistically insignificant. The signs of all the taste parameters are as expected, except that of medium body size. The model in general is highly statistically significant (P<< 0.001) at 29 degrees of freedom (Table 2).

The magnitude of the parameter estimates show that fertility – or short calving interval – is much more important than all other attributes considered by cattle buyers. Disease resistance was also found to be more important than calf vigor, milk yield and the area the cow was brought from. Vigor of the calf was also identified to be very important in influencing cow choice. These findings conform to the basic objectives of rural life in this part of Ethiopia in general and with the specific purposes for which animals are kept.

The primary goal of majority of the households in this part of rural Ethiopia is producing sufficient food for the annual demand of the family. Secondly, households aim at supplying part of their produces to generate cash to pay for other costs of life including food, as food shortage is not uncommon. The main contribution of livestock in achieving these objectives is through traction power generated from bulls and through selling of live animals. Shorter calving interval implies more animals to sell and higher possibility of getting male calves to replace the aging bulls. Disease resistance is so important not only because it assures the herd stays productive but also saves the scarce cash resources of the rural people. A vigorous calf is described in the area as one that is fast growing, healthy and strong. The high value assigned to larger herd and the medication cost implications show the importance of calf vigor. The importance of these traits is comparable to the corresponding findings of the studies which analyzed preferences for cow traits (Tano *et al*., 2003; Ouma *et al.,* 2007; Zander, 2006) with apparent differences in the relative weights of the attributes.

Milk yield is also a highly significant attribute of cows. However, the relative weight assigned to milk potential of cows is lower than those for other traits. In Dano and the neighboring districts, milk is only produced for household consumption and selling milk is a social taboo that people would rather give it free. Some households milk their cows every other day as they do not have the storing facilities, or can not sell it. This result differs from the high importance attached to milk yield by the latent class of crop-livestock farmers in Kenya (Ouma *et al*., 2007). Given the fact that all the livestock development efforts have focused on dairy cows, the relative weight of milk trait shows the considerable disparity between the government's livestock development agenda and rural livelihood objectives.

The area the cows are brought from is another important attribute cattle buyers consider. The concept of breed does not have any recognition within the cattle keeping population in the area or among cattle buyers in the markets. People ask for the origin of the cow to judge its adaptability, in addition to examining some phenotypic characteristics which show considerable difference across locations. The regression results show that cows from the closely neighboring districts are preferred to that of the district. Although it does not seem that there is so much observable difference between the cattle populations within and around the district, farmers must have some reasons in the details of the characteristics of the cows. Taste coefficients of Wellega and Keffa zones were found to be negative and statistically insignificant. The negative sign implies that cows from these areas, which are very far, are less preferred.

Identification of traits (including price) and trait levels was completed four months before the CE survey. In the following four months, the inflation that has been

rampant in Ethiopia since May 2005 made the prices of the CE quite low. The respondents apparently considered the price levels to be small for most of the profiles presented. The three price levels were entered as categorical variables like all other traits with low price (500.00 Birr) taken as a reference level. The coefficients of the two price levels are statistically insignificant showing that the price levels used in the CE did not significantly influence the choices of alternatives.

3.2 Cow trait preference heterogeneity

The sources of taste heterogeneity were investigated by introducing interaction of the attributes and socioeconomic characteristics (Table 2). As education level increases, the sensitivity towards body size increases. The relatively educated group of respondents is composed of non-farmers who intend to consume the animals than keeping them either for production or reproduction. Higher sensitivity for diseases resistance of cows was also observed among small restaurant and inn owners as compared to farmers. This is essentially because these respondents can not afford to keep sick animals or take them to clinics after purchase as the animals are to be slaughtered for immediate use. For buyers, other than this group, purchasing sick animals might not be that risky as there is always a one month guarantee with which they can return the cows for the seller in case they are seriously ill. These restaurant and inn owners are also quite sensitive to the high prices of cows as compared to farmers. This is clearly the result of the effective demand of these buyers that they have to purchase the animals to run their businesses and postponing their decisions in case of high prices is less likely.

The results also show that farmer traders are less interested in fertility of cows as compared to farmers. This is intuitive and implies that the marginal utility of fertility is lower for farmer-traders as they mainly intend to resell the animals. Similarly, as family size increases, interest in fertility of cows decreases. This shows that bigger family sizes are of well established households with possibly less interest in increasing their herd size as compared to smaller families of young households that are expected to intend to increase their herd size. Traders, as compared to farmers, were also found to be less interested in milk yield of cows. This is in line with the peculiar culture of the community that discourages milk selling. Farmer-traders are less interested in disease resistance of the cows. This group of people purchases the cows essentially for reselling and hence is not expected to be interested in diseases resistance as much as farmers do. Traders and farmer-traders were uniformly found to be less interested in high price levels of cows as compared to farmers. These respondents are interested in increasing their marketing margins and are supposed to

be keener on paying less than more. As farmers are less informed about the prices across markets, the sensitivity of traders and farmer traders is expected.

Table 2: Simulated Likelihood estimates for cow traits

Variable	Structural Parameters		SD of the parameter distributions	
	Coefficient	St. Error	Coefficient	St. Error
Random parameters				
Medium body size	-0.420	0.303	0.207	1.623
Big body size	0.281	0.468	0.066	3.344
Fertility	1.802***	0.607	1.062*	0.595
Milk yield	1.003***	0.334	0.596	0.371
Calf vigor	1.049***	0.294	0.107	1.883
Disease resistance	1.593***	0.508	1.450***	0.535
Medium price	-0.200	0.288	0.977	0.990
High price	-0.130	0.319	0.794	0.771
Non-random parameters				
Nearby districts	0.552*	0.303		
Wellega zone	-0.469	0.323		
Keffa Zone	-0.270	0.294		
Constant	-2.980***	0.653		
Heterogeneity in mean parameters				
Big body*education	0.166*	0.099		
Fertility* farmer trader	-0.290*	0.160		
Fertility*family size	-0.093**	0.043		
Milk*trader	-0.505**	0.237		
Disease res.*farmer trader	-0.809**	0.350		
Disease res.*other occupant.	1.002*	0.580		
High price*trader	-1.003*	0.557		
High pr.*farmer trader	-0.312	0.302		
High Pr.*other occupant.	1.249*	0.659		
N = 1170	LL = - 630.47		Pseudo R^2 = 0.51	
χ^2 (df=29)= 1309.80	LL* = -1285.4		Adj. R^2 = 0.50	

****, **, and * significant at alpha is equal to 0.01, 0.05, and 0.1. N is number of observations, LL is value of log-likelihood function, LL* is value of the restricted (no coefficient) log likelihood function and χ^2 is chi-squared.*

3.3 Bull trait preferences

Body size was found to be a not so important trait in influencing bull type choices in these rural markets (Table 3). Negative sign of the medium body size level was, however, unexpected and this might potentially be due to the lack of distinct level

description in the survey or the levels were too close to differentiate from respondents' perspective. The mixed crop-livestock production system depends very much on the traction power of bulls for all the activities from first plowing to threshing. Only bulls are used for plowing in this area, making traction power a crucial characteristic of a bull. That is essentially what the model results reflect (Table 3). Plowing suitability has the largest taste coefficient with the expected positive sign and high statistical significance, indicating that good plowing potential is a trait that respondents consider when purchasing bulls.

The rural community has multiple objectives in buying and keeping cattle in such a production system. The bulls are bought and kept at least for two purposes - traction and reproduction. The reproductive contribution of bulls is very important as there are no communal or village owned bulls selected for this purpose. In particular, farmers normally do not take within-the-herd mating for granted and focus on traction suitability only. They usually inquire about the reproductive characteristics of the bull, which is proxied here with the calf strength. The attribute's coefficient is highly significant. The more vigorous the offspring of a bull is, the higher the probability that it will be chosen and the higher the utility derived. Disease resistance was also found to be positive and statistically significant, indicating preferences for healthy or disease tolerant animals. With limited resources to employ on medication and hygienic costs for their animals, rural livestock keepers are expected to be very interested in healthy animals.

The RPL estimation resulted in negative and statistically significant coefficients for nearby districts and Keffa zone. The negative signs of the coefficients indicate that bulls from both origins are less preferred to those from Dano and will result in less probability of choice for a bull. The differences in absolute magnitudes of the structural parameters of the location variables show that the probability of not selecting an animal will be higher if the origin is Keffa than neighboring districts. This is an exact reflection of the preferences of farmers in Dano, as cattle from Keffa region are considered trypanosomosis infected and less adaptable within the Dano district. This again implies that most of the buyers give high value to the fact that they know the pedigree of the cattle they buy which could only be possible if the animals were raised in their proximity. Given the lack of information and the uncertainties under which farmers make decisions, it is obvious that cattle buyers in this semi-subsistent farming system would prefer cattle from their districts.

The results also show that both medium (Birr 1000.00) and high (Birr 1200.00) levels of price have no significantly different influence on choice as compared to small price. These results appear realistic, given that the price levels used during the choice experiment were already low (in four months time - due to the lingering inflation) and

the low and medium levels of prices were nearly indifferent for the respondents. Even the high level of price was considered quite acceptable for almost all the hypothetical profiles presented in the choice sets.

3.4 Bull trait preference heterogeneity

The heterogeneity of the taste for traits of bulls emanates from differences in age, occupation, and education (Table 3). As age increases, the interest in medium body size increases. This might be due to the interest of elder farmers in having smaller animals that can be nurtured to be good for plowing. The results also show that traders, as compared to farmers, are more interested in big body size apparently because of the higher price attached to bigger bulls.

Similarly, as education level increases, the sensitivity towards big body size increases. Alike the preference for big body sized cows; the relatively educated group of respondents constitutes mainly non-farmers who aim at immediate consumption of the purchased bull. Increase in education level is also associated with higher interest in plowing strength of the bull. This is because most of the young respondents are relatively better educated than their elder counterparts and prefer already matured bulls which can be used for plowing to sustain the livelihoods of the young households. The effective demand of small restaurant and inn was again evident here as they were found to be very sensitive to higher prices.

Compared to farmers, traders were found to be less interested in plowing strength. This is intuitive as the interest of a trader is in reselling than having a bull that plows well. Likewise, as age increases, the interest in the plowing strength of bulls decreases. Traders and farmer traders were also found to be less interested in calf-strength and disease resistance attributes, respectively, as compared to farmers. These results are interesting as they show the special interests of traders, farmer traders, and people in other occupations as well as farmers.

Table 3: Simulated Likelihood estimates of bull traits

Variables	Structural Parameters		SD of the parameter distributions	
	Coefficient	St. Error	Coefficient	St. Error
Random parameters				
Medium Size	-0.766**	0.309	0.008	17.209
Big Size	0.471	0.288	1.039***	0.368
Plowing	1.570***	0.471	1.127***	0.297
Calf vigor	0.723***	0.118	0.006	10.873
Disease resistance	0.872***	0.159	0.035	6.719
Price 1 (1000.00 birr)	0.239	0.200	0.008	11.321
Price 2 (1200.00 birr)	-0.191	0.169	0.020	6.653
Non-random parameters				
Constant	-2.613***	0.244		
Nearby districts	-0.482*	0.252		
Wellega zone	0.230	0.158		
Keffa zone	-0.685***	0.246		
Heterogeneity in mean parameters				
Medium body*age	0.015**	0.008		
Big body*trader	0.489***	0.168		
Big body*education	0.161**	0.069		
Plow*trader	-1.018***	0.187		
Plow*education	0.222***	0.076		
Plow*age	-0.016*	0.008		
Calf*trader	-0.302***	0.109		
Disres*farmer trader	-0.296***	0.097		
High price* other occup	0.345**	0.167		
N= 1188	LL = -748.2		Pseudo – R^2 = 0.427	
χ^2= 1113.9, df=27	LL base = -1305.15			

****, **, and * significant at alpha is equal to 0.01, 0.05, and 0.1. N is number of observations, LL is value of log-likelihood function, and χ^2 is chi-squared.*

4. Conclusion

This research employed choice experiments and random parameters logit to elicit and analyze cattle trait preferences of buyers in the semi-subsistence livelihood systems of rural central Ethiopia. The results of the cows CE revealed that in areas where livestock serve multitude of purposes and where the production and marketing system is semi-subsistence, cows have other functions more important than milk production. Fertility, disease resistance and strength of the calves they bear are as much or more important than milk. The breed concept which is very much associated in Ethiopia with the area where the animal is brought from (Workneh and Rowlands 2004), was found to be less important as such and it appears that farmers are

interested in obtaining animals from the district or locations in which they live in. This is essentially because cattle buyers, who are mostly farmers, are more concerned about adaptability and therefore give high value to the fact that they know the pedigree of the cattle they buy.

The results of the CE for bulls indicate that cattle buyers assign high values for good traction potential, disease resistance, calf vigor, and for places of origin when choosing bulls in the market. The preferences cattle buyers have for these attributes do vary essentially due to differences in occupation, education and age. The primary objective of the rural community to produce sufficient food for the family for each year was manifested through the value assigned to traction potential which is more than twice that of disease resistance. These results are consistent with the basic reasons why animals are kept in the area, but appear to be incoherent with the government funded interventions of livestock development. An observation which needs to be emphasized is the consistency of the preferences of the cattle buyers in such a system characterized by lack of information in every aspect. Given the importance of livestock, bulls in particular, for the livelihoods of the communities in rural Ethiopia, such consistent valuation of the traits show that the objectives of the agrarian life are quite clear among the community – farmers, farmer traders, traders, and others – that production and marketing decisions are made on broader considerations than just milk and meat production.

The government of Ethiopia needs to revise the structure of the livestock improvement programs still running and needs to make note of the important details that influence the production, marketing and utilization of livestock products. The smallholder community in this part of Ethiopia depends on semi subsistence agriculture and so livestock development interventions should focus on reproductive and adaptive traits that stabilize the herd structure, rather than focusing on traits that are only important for commercial purposes. It can also be observed that improving these traits of cows owned by small holder farmers in the area will facilitate adoption of the new innovations or improvements instead of bringing over cattle from unknown sources and obviously with low adaptability.

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ECONOMIC ANALYSIS OF FARMERS' PREFERENCES FOR CROP VARIETY TRAITS USING A CHOICE EXPERIMENT APPROACH: LESSONS FOR ON-FARM CONSERVATION AND TECHNOLOGY ADOPTION IN ETHIOPIA

Sinafikeh Asrat[1]

Abstract

Ethiopia has immense wealth of crop genetic resources, which is part of its rich biological diversity. The country's genetic resources are, however, subject to serious erosion and irreversible losses due to policy, institutional, and market failures. This study aims to contribute to a better understanding of the challenges with bearings on the sustainable management of crop genetic diversity through analyzing farmers' crop variety attribute preferences and through identifying the key socio-economic factors that condition their attribute preferences. The study applies the choice experiment (CE) method to elicit preferences and estimate the relative importance of the attributes in defining the perceived utility to be derived from four traits of sorghum and teff varieties (the two major crops in the country). The attributes include selling price, productivity, environmental adaptability (resistance to drought and frost occurrences), and yield stability of the variety despite occurrences of disease and pest problems. The analysis of farmers' preferences is based on primary data collected from 131 teff and sorghum growing farmers in the Northeastern part of Ethiopia. The findings revealed that farm households attach the highest private value to environmental adaptability trait of both sorghum and teff crops; followed by yield stability and productivity attributes of the same crops. It was also found that differences between farm households, in terms of household characteristics, their endowments and constraints, and the level of development integration (in the areas of basic infrastructure and agricultural extension) affect farmers' private valuation of crop variety attributes. Based on the empirical results, a number of policy implications have been drawn in the areas of on-farm conservation and improved variety adoption in Ethiopia.

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1. Introduction

Societies depend on agricultural innovation processes for food security on local, regional and global scales. Crop genetic resources, embodied in the seed planted by farmers, are important components of these processes. Farmers, plant breeders, gene bank managers and other crop scientists draw on diverse crop genetic resources to innovate, support, and benefit society at large (Smale, 2006).

Sustainable management of crop genetic resources means assuring their diversity, both in trust collections and on farms. In agricultural systems, crop biodiversity is essential to combat the risks farmers face from plant pests, diseases and climatic shocks. Crop biodiversity also underpins the range of dietary needs and services that consumers demand as economies change (Edilegnaw, 2004; Smale, 2006).

Crop genetic resources are natural assets that are renewable but vulnerable to losses from either natural or human-made interventions, including the disruptions caused by droughts, floods or wars, as well as the gradual process of social and economic change. Technological changes in agricultural production over the past century, spurred by crop genetic improvement combined with the use of other farm inputs, have transformed rural societies in many parts of the world (Smale, 2006). Not all of these changes have been positive. For example, there is a growing concern about potential loss of crop biodiversity associated with social and economic change. The common challenge now is to develop strategies that enable crop genetic resources to be managed in ways that satisfy the needs of farmers and consumers at present and in the future.

Some countries with a high amount of unique crop diversity belong to the group of poorest countries in the world (von Braun and Virchow, 1996). Ethiopia is among those countries that are economically poor but still rich in biological diversity. It is a center of origin as well as a center of diversity for many crops including sorghum, *teff* (Eragrostis abyssinica), coffee (arabica), and *ensete* (Ensete ventricosum). As a result, the country is mostly described as a land of crop diversity (Harlan, 1969 cited in Edilegnaw, 2004).

According to a study by Worede *et al*., (2000), Ethiopia's genetic resources are, however, subject to serious erosion and irreversible losses. Natural resources *i.e.* land, water, forests and other forms of biodiversity have now deteriorated in the country (FDRE, 1997; 1998). Despite the resource degradation that has been occurring over the course of time, the country has still a diverse wealth of plant genetic resources (FDRE, 1996).

The benefits that Ethiopia may derive from its crop diversity endowments depend on how this *'rich but poor'* nation is able to address the challenges of poverty without further degrading its natural resources. It is, thus, both a challenge and an opportunity for Ethiopia to design conservation policies that enable its agriculture-based economy to make the best use of its crop diversity (Edilegnaw, 2004).

The purpose of this study is to contribute to a better understanding of the challenges by providing an insight into Ethiopian farmers' preferences for crop variety attributes and to identify the key socio-economic characteristics that influence these preferences. Be it for undertaking on-farm conservation ventures[2] or for successful rural interventions like contextual crop variety development and diffusion, policy has to be informed about, inter alia, '*who prefers what kind of variety attributes most?'* and *'how much are farmers willing to trade-off one variety attribute for another?'* This study essentially deals with these questions by analyzing farmers' attribute preferences for the two major crops in the country: sorghum and *teff* crop varieties[3]. Informing policy-makers on these factors contextually will enable them to understand the mechanisms of influencing farmers' variety management behavior and harmonize on-farm conservation with modern technology adoption.

The subsequent part of this paper is structured as follows: the relationship between farmers' concerns and variety attribute preferences is drawn in the next section; section 3 outlines the theoretical underpinnings behind the choice experiment approach; section 4 explains the survey methodology followed by a description of the study sites and sampled farm households. The design and administration of the choice experiment is explained in Section 5. Section 6 discusses the findings from the analysis of the choice experiment data. Policy implications are drawn in the final section.

2. Farmers' concerns and preferences for variety attributes

Undertaking on-farm conservation ventures requires understanding farmers' variety choice and variety attribute preferences. Such an understanding will also help in the areas of research priority setting and targeted adoption of crop varieties. Variety

[2] On-farm conservation refers to the sustainable management of genetic diversity of locally developed indigenous crop varieties, with associated wild and weedy species or forms, by farmers within traditional agricultural systems (Maxted *et al*., 1997). The dynamic nature of the conservation, its participatory nature, and the chance it gives to link crop diversity conservation with its utilization are all the desirable features of on-farm conservation ventures (Emerton, 2000).

[3] As a source of staple food for many parts of the country, *teff* is primarily grown to prepare injera (Ethiopian bread), porridge and some native alcoholic drinks.

attribute preferences and the varieties that embed these attributes are, in turn, shaped by farmers' economic (resource constraints, markets and risk) and non-economic (religion, culture and norms) concerns. For example, when local variety attributes satisfy farmers' concerns, their *de facto* conservation is the outcome of the harmony of variety attributes and farmers' concerns. In essence, farm household characteristics translate to variety attribute preferences and land allocation decisions (Edilegnaw, 2004). Farmers' variety attribute preferences are, therefore, the reflections of their concerns and hence studying variety attribute preferences implies studying their concerns.

The probability of existence of a variety on farmers' fields is a function of the extent to which it embeds the important attributes playing a key role to the household. Thus, the question boils down to the fitness of the variety attributes with household concerns. Each farmer, however, derives different utility from consuming different variety attributes based on the concerns facing him/her (Edilegnaw, 2004). This is because resource endowments, constraints, and the socio-economic setup of a farm household are likely to be different for different households inducing farmers to place different values on the importance of variety attributes. The survival of a variety on-farm or the successful adoption of newly introduced improved variety is, therefore, dependent on its capacity to supply the variety attributes that provide the most benefits to the farm household.

3. The choice experiment and welfare measures

Since most of the attributes that characterize the varieties of crops are not directly tradable, non-market valuation methods must be used to determine their relative economic value. These benefits primarily accrue to farmers in non-market values, or utility. The preferences of farmers, who are both producers and consumers of crop variety outputs, determine the implicit values they attach to crop varieties and their attributes (Louviere *et al.*, 2000).

Of the range of environmental valuation approaches, the choice experiment (CE) method is appropriate for valuing crop varieties, considering their multiple benefits and functions. This method enables estimation not only of the value of the environmental asset as a whole, but also of the implicit values of its attributes[4] (Hanley *et al.,* 1998; Bateman *et al.,* 2003).

[4] With hedonic pricing, a method of revealed preference, the evaluation of single attributes is also possible. The choice between hedonic pricing and choice modeling depends mainly on the source of the data (Mitchell and Carson, 1989). In case of revealed preference methods, the data is derived from observations of individuals acting in real-world settings where they also bear the consequences of their choices, which is not the case for responses collected through choice modelling.

The approach, upon which the framework for choice modeling is based, has a theoretical ground in Lancaster's model of consumer choice (Lancaster 1966), and an econometric basis in models of random utility (Luce 1959; McFadden 1974). From random utility models, welfare measures can be obtained, expressed as farmers' willingness to pay (WTP) or accept (WTA) compensation for a change in crop varieties' attribute levels. The estimates for these welfare measurements are obtained from applying a conditional logit (CL) model, whose specification is detailed in many textbooks (see e.g. Greene, 2000; Freeman, 2003). With one attribute being price, the implicit price (IP) for a change in any attribute, *ceteris paribus*, can be calculated. The IP is calculated by the ratio of coefficients of the attributes in question $\beta_{\text{attribute}}$, as obtained from the CL model and the coefficient of the monetary variable $\beta_{\text{monetaryvariable}}$ (see e.g. Rolfe *et al.*, 2000; Zander and Holm-Mueller, 2007).

$$IP = -\frac{\beta_{\text{attribute}}}{\beta_{\text{monetaryvariable}}} \qquad \textbf{(1)}$$

The assumptions about the distributions of error terms implicit in the use of the conditional logit model impose the independence of irrelevant alternatives (IIA) property (Louviere *et al*., 2000). This property states that the probability of a particular alternative being chosen is independent of other alternatives. Whether or not IIA property holds can be tested by dropping an alternative from the choice set and comparing parameter vectors for significant differences (Louviere *et al.*, 2000). A common test to detect violation of the IIA property is the Hausman test (Hausman and Mc Fadden, 1984), as applied to our data.

In this study, a CE was conducted to estimate the private utility farmers derive from four attributes for sorghum and *teff* varieties namely producers' price (marketability of the variety), its productivity, environmental adaptability, and yield stability (defined in more detail in section 5).

In a CE, individuals are given a hypothetical setting and asked to choose their preferred alternative among several alternatives in a choice set, and they are usually asked to perform a sequence of such choices. Each alternative (a *teff* or sorghum variety in this case) is described by a number of attributes and their levels. Maintaining local crop varieties in Ethiopia provides a public good with the external effect of conserving a genetic pool that has global significance for breeding and biodiversity. However, the approach of this study only captures internal (private) values to farmers, which are mainly use-values. Assessing such use-values plays a key role in orienting conservation and breeding strategies as conventional economic

analyses often ignore the importance of indirect use values (e.g. socio-cultural/medical use, their ability to withstand biotic and abiotic stresses) associated with local varieties (see Zander and Drucker, 2008).

The choice experiment was designed with the assumption that the observable utility function would follow a strictly additive form (Louviere et al., 2000). The model was specified so that the probability of selecting a particular crop variety was a function of attributes of that variety. That is, for the population represented by the sample, indirect utility from crop variety attributes takes the form:

$$V_{ij} = \beta_0 + \beta_1 Z_{pprice} + \beta_2 Z_{productivity} + \beta_3 Z_{adaptability} + \beta_4 Z_{yield-stability} \quad \textbf{(2)}$$

where β_{1-4} refer to the vector of coefficients associated with the vector of attributes describing crop variety attributes and β_0 is the alternative specific constant.

4. Survey methodology

Primary data were drawn from farmers residing in two Peasants' Associations (PAs)[5] in the Northeastern part of Ethiopia (North Wollo zone of Amhara Regional State). Two phases of data collection procedures were implemented for this study within the framework of IPGRI's (International Plant Genetic Resources Institute) Genetic Resources Policy Initiative (GRPI) - Ethiopia project, with an aim to support the development of policy options for sustainable conservation and utilization of crop genetic resources in Ethiopia. All the socio-economic characteristics employed in this study are collected in the first phase of data collection (from October 2006 till January 2007). Piloting of the first draft of the CE questionnaire and the actual CE survey were conducted in the second phase during June and July of 2007. In this study, the most important crop variety attributes and their levels were identified:

1. In consultation with experts in this area (crop breeders and researchers who have previous experience and knowledge on the subject),
2. reviewing previous studies and historical data from the national Central Statistical Agency (CSA), and
3. Through seed selection criteria put forward by the surveyed households during the first leg of the data collection process.

Stratified multi-stage sampling was adopted to identify Zones, Districts, PAs, villages, and farm households. Overall, a total of 131 farmers were selected and interviewed from the two PAs found in Guba Lafto district of North Wollo zone.

[5] A PA is the smallest representation of social units in rural Ethiopia comprised of 400 to 500 peasants.

4.1 Study site description

Summary of the main characteristics of the two PAs surveyed is reported in Table 1. *Teff*, sorghum, and maize are among the most important food crops in both PAs. Agro-ecologically, however, the midland area (locally known as *Woina dega*) is the dominant agro-ecology in Woinye PA covering 83%; whereas, the lowland area (locally known as *Kola*) is the major agro-ecology in Ala Wuha PA covering 95%. This should, however, increase the representativeness of our surveyed farm households as our sample is from the three major agro-ecologies of the country and of those growing the two major crops (sorghum and *teff*) in the country.

Table 1: Summary of main study site characteristics

Study site characteristics	Woinye PA	Ala Weha PA
Agro-ecological coverage	Midland – 83%, Highland – 10%, and Lowland – 7%.	Midland – 5%, and Lowland – 95%
Most important food crops	*Teff*, sorghum, *dagusa*, maize, wheat, and barley	*Teff*, sorghum, maize, and cow beans.
Livestock assets owned by an average household in the PA	1 ox, 1 cow, 2 calves, 3 sheep, and 3 goats.	2 oxen, 2 cows, 2 calves, and 4 goats.

Source: Agricultural bureaus in Woinye and Ala Weha PAs.

4.2 Farm household characteristics

The characteristics of the surveyed households and farm decision makers are indicated in Table 2. The descriptive statistics for binary variables (e.g. Gender) is reported in percentage terms. Assuming that the variables reported in Table 2 have the same direction of influence on preferences of attributes of both crops, their hypothesized effects on the demand for attributes considered in this study are also included in Table 2. Definition of each farm household characteristic reported in Table 2 is given below.

1) gender of the household head (denoted as *Sex* in the model estimation*,* where 1 denotes male and 0 denotes female)
2) the number of household members who share the same food stock (denoted as *Household size*)
3) farming experience of the household head in years (denoted as *Experience*)
4) whether or not any member of the farm household works off-farm (denoted as *Off-farm work,* where 1 denotes at least one member working off-farm and 0 otherwise)

5) whether or not the farm household has been participating in the agricultural extension package program (denoted as *Agri. Ext. Participation,* where 1 denotes participating and 0 otherwise)

6) average of walking distance (in minutes) the household head takes to reach electricity, piped water, telephone, primary school, secondary school, all weather roads, and irrigation infrastructures (denoted as *Access services*)[6]

7) whether or not the household head considers land shortage as the most important problem facing the household (denoted as *Land shortage,* where 1 denotes land shortage considered as the most important problem and 0 otherwise).

8) total land size operated by the household in hectares (denoted as *Total land size*)

9) total value of livestock (including hives and poultry), in Birr[7], that is currently owned by the household (denoted as *Livestock value*)

10) whether or not the household considers itself to be at least self-sufficient in relation to other households in the area (denoted as *Poverty status*, where a value of 0 means the household considers itself poor or very poor), and

11) number of dependents with no labor or money contribution in the household (denoted as *No. dependents*).

The average characteristics suggest that a typical farm household in North Wollo zone is a male headed medium sized household with 6 members, 2 of which are economically dependent and the experience of the primary decision maker is 25 years. The household has no member working off-farm, resides 50 minutes walking distance away from basic infrastructures, and participates in the agricultural extension program. The total land size operated by the average household is 0.75 hectares and considers scarcity of land as the primary problem. This farm family has 5,000 birr worth of livestock (including hives and poultry).

Table 2: Descriptive statistics of farm household contextual characteristics and their hypothesized effects on the demand for attributes of crop varieties

[6] Respondents were asked to specify the walking distance (in minutes) for each type of infrastructure and then an average walking distance (in minutes) was calculated for each household.
[7] Birr is Ethiopia's currency where 1 USD is approximately 9.7 Birr in October, 2008.

Characteristics	Mean (SD) N= 131	Producers' Price	Productivity	Environmental adaptability	Yield stability
Household characteristics					
Gender (the household head is a male)	90.1%	+, -	+,-	+,-	+,-
Household size	5.38 (2.04)	+	+	+	+
Experience	25.38 (11.64)	+	+	+	+
Off-farm work	32.3%	+	+	_	_
No. dependents	1.15	+	+	+	+
Poverty status (the household considers itself at least self-sufficient)	(1.45) 85.5%	+	+	_	_
Farm and livestock characteristics					
Land Shortage (the household considers land shortage as primary problem)	64.8%	+	+	+	+
Total land size (ha)	0.75 (0.52)	+,-	+,-	+,-	+,-
Livestock value (including hives and poultry)	5016.5 (4745.5)	+	+	-	-
Development integration Characteristics					
Access Services (in minutes)	48.24 (27.07)	_	_	+	+
Agri. Ext participation	70.2%	+	+	-	-

Source: Genetic Resources Policy Initiative (GRPI) - Ethiopia project, 2006/2007.

5. Choice experiment design and administration

5.1 Setting the scene: attributes and levels for the choice experiment

The crop variety attributes and levels used in this choice experiment study are reported in Tables 3 and 4. Apart from their importance to farmers, these attributes (Producers' Price, Productivity, Environmental Adaptability, and Yield stability) are also policy relevant for designing an incentive mechanism to undertake on-farm conservation ventures at least cost (for example, by identifying farmers who are demanding attributes embedded in local varieties) or for successful rural interventions like crop variety development and diffusion.

Inclusion of monetary attribute(s) is necessary for the welfare analysis. Producers' price and productivity attributes can be used as a direct monetary attribute or as a proxy for monetary attribute depending on the socio-economic setup of farmers participating in the choice experiment survey. For farmers actively participating in the

local markets by supplying their *teff* and/or sorghum output, it would be appropriate to use producers' prices as direct monetary attribute but for farmers whose output is less than or just enough to satisfy their household food consumption needs, productivity seems to be more appropriate as a proxy for monetary attribute. The levels for these attributes are set based on the Zone's minimum, average, and maximum values of producers' price and productivity attributes of the crops since the last decade.

With more than 92% of the surveyed households reporting that they have faced drought problems at least once during the last ten years, the choice of environmental adaptability trait of both crops for our choice modelling exercise is appropriate. The same can be said about the attribute yield stability of both crops: about 90% of the surveyed households stated that they have faced disease or pest problems (causes of yield instability in our attribute definition) at least once during the last ten years. These attributes have two levels representing the existence or absence of the attributes in each crop (see Tables 3 and 4).

Table 3: Sorghum Variety attributes and their levels used in the choice experiment

Variety Attributes	Definition	Attribute Levels
Producers' Price	The amount of money the farmer receives by selling a quintal of the sorghum variety	110 birr, 150 birr, 200 birr
Productivity	The amount of yield/hectare the farmer is able to harvest by planting the sorghum variety on his land.	14 quintals/hectare, 19 quintals/hectare, 25 quintals/hectare
Environmental Adaptability	Whether or not the sorghum variety is resistant/ tolerant to drought and frost occurrences.	The variety is adaptable (resistant) Vs the variety is not adaptable (non-resistant)
Yield Stability	Whether or not the sorghum variety gives stable yield year-after-year, despite occurrences of crop disease and pest problems.	The variety gives stable yield year-after-year Vs the variety gives variable yield year-after-year.

Table 4: *Teff* Variety attributes and their levels used in the choice experiment

Variety Attributes	Definition	Attribute Levels

Producers' Price	The amount of money the farmer receives by selling a quintal of the *teff* variety	210 birr, 270 birr, 330 birr
Productivity	The amount of yield/hectare the farmer is able to harvest by planting the *teff* variety on his land.	8 quintals/hectare, 15 quintals/hectare, 20 quintals/hectare
Environmental Adaptability	Whether or not the *teff* variety is resistant/ tolerant to drought and frost occurrences.	The variety is adaptable (resistant) Vs the variety is not adaptable (non-resistant)
Yield Stability	Whether or not the *teff* variety gives stable yield year-after-year, despite occurrences of crop disease and pest problems.	The variety gives stable yield year-after-year Vs the variety gives variable yield year-after-year.

5.2 Design and administration of the choice experiment

A large number of unique crop variety profiles can be constructed from this number of attributes and levels[8]. However, in this study, fractional factorial design[9] was used to capture only the main effects, yielding nine alternatives which were allocated to different choice sets. These nine alternatives were created using an orthogonal design[10]. The choice sets were then completed using a cyclical design principle (Bunch, Louviere, and Andersson, 1996). A cyclical design is a straightforward extension of the orthogonal approach. First, each of the alternatives from a fractional factorial design is allocated to different choice sets. Attributes of the additional alternatives are then constructed by cyclically adding alternatives into the choice set based on the attribute levels. That is, the attribute level in the new alternative is the next higher attribute level to the one applied in the previous alternative. If the highest level is attained, the attribute level is set to its lowest level (Carlsson *et al.,* 2007).
We then assigned the initially created nine alternatives from our fractional factorial design to nine choice sets and constructed two other alternatives per choice set

[8] The number of crop varieties that can be generated from 4 attributes, 2 with 3 levels and the remaining 2 with 2 levels is $3^2 \times 2^2 = 36$

[9] Fractional factorial designs or main effects involve the selection of a particular subset or sample (i.e., fraction) of complete factorials (possible combinations), so that particular effects of interest can be estimated as efficiently as possible (Louviere *et al*., 2000).

[10] This procedure makes the variations of the attributes of the crop descriptions (profiles) uncorrelated in all choice sets (Alpizar *et al.,* 2001).

(hence 18 others) following the procedure mentioned above. In total, we constructed 27 alternatives for sorghum and 27 alternatives for *teff* divided between 9 choice sets per crop. An example of a choice set is presented in Figure 1.

Figure 1: Example of a choice situation

Assuming that the following sorghum varieties were the ONLY choices you have, which one would you prefer to plant?

Sorghum Variety Characteristics	Sorghum Variety 1	Sorghum Variety 2	Sorghum Variety 3
Producers' price	150	200	110
Productivity	14	19	25
Environmentally Adaptable	Yes	No	Yes
Stable-in-yield	No	Yes	No

I prefer to plant ***Sorghum variety 1*** ….. ***Sorghum variety 2***…. ***Sorghum variety 3***
(Please check (√) one option)

During the field work, enumerators explained using the local language the context in which choices were to be made; that attributes of crop varieties had been selected as a result of prior research and were combined artificially; and defined each attribute and choice set using visual aids to ensure uniformity. Respondents were informed that completion of the exercise would help agricultural policy makers in the design of variety development and local variety conservation interventions. Out of the 131 households interviewed for the choice experiment survey, 66 of them were randomly chosen and presented with choice sets containing sorghum variety options while the remaining 65 answered *teff* variety options. All of the surveyed households answered all of the nine choice sets (either sorghum or *teff* version) presented to them and hence a total of 1179 choices were elicited from our survey.

Bateman et al., (2003) suggest restricting the number of attributes chosen for the design to a relatively small number (such as 4, 5 or 6). This is because the minimum required sample size increases exponentially in the number of attributes. Given our

constraint to a relatively small sample size of about 130, we hence decided to include four attributes in the profiles.

6. Results

Equation (2) was estimated first by fitting two conditional logit models each for either *teff* or sorghum variety options. Then the result was tested for the Independence of Irrelevant Alternative (IIA) property, which is implicit in the error structure of the conditional logit (CL) model, using the Hausman and McFadden (1984) test contained within LIMDEP 8.0 NLOGIT 3.0. The tests, however, provided inconclusive results for both crops by failing to find a positive definite difference matrix for any two alternatives; and this was the case for all three tests conducted by dropping a different alternative each time indicating that the models do not fully conform to the underlying IIA property. In such cases, models that relax the IIA property such as Random Parameter Logit model (RPL, also referred to as Mixed Logit) have to be estimated (Hensher *et al.,* 2005). Accordingly, RPL model was estimated. The RPL model was estimated for each crop, all of the attributes except for the monetary attribute (producers' price) and the proxy for monetary attribute (productivity) are normally distributed. The models are estimated with simulated maximum likelihood with Halton draws using 500 replications. The models are estimated using Nlogit 4.0. Although the experiment was generic we include two alternative specific constants, since we want to test if there are any other factors other than the attributes themselves that affect their choices. The results are presented in Table 5.

The results in Table 5 show that all of the sorghum and *teff* variety attributes are highly statistically significant factors in the choice of both crops' varieties, and have the expected signs in that any single attribute increases the probability that a sorghum (or *teff*) variety is selected, other attributes remaining equal. The overall fit of the model for each crop as measured by McFadden's ρ^2 is very high. The estimated standard deviations of the random parameters are also significant, and in relation to the mean estimates they are sizeable, but they are not so high so that the likelihood of a reverse is high. The only problematic finding is that the two alternative specific constants are also significant. This indicates that all else equal, the respondents are more likely to choose alternative 1 or 2, compared with alternative 3 perhaps due to the design of the choice experiment questions.

Table 5: Random parameter logit estimates for choice of variety, standard errors in parentheses

	Sorghum	Teff

Variable	Coeff.	Coeff. Stdv.	Coeff.	Coeff. Stdv.
Alternative 1	0.364**	-	0.613***	-
	(0.1634)		(0.150)	
Alternative 2	1.293***	-	0.887***	-
	(0.2710)		(0.2632)	
Producers' price	1.841***	-	0.862***	-
	(0.2251)		(0.1492)	
Productivity	0.272***	-	0.217***	-
	(0.0235)		(0.0179)	
Environmental adaptability	4.703***	2.920***	4.446***	3.290***
	(0.7195)	(0.6060)	(0.7177)	(0.7014)
Yield stability	4.220***	2.6257***	3.1060***	2.654***
	(0.6597)	(0.5834)	(0.6165)	(0.5867)
Number of observations	594		585	
ρ^2	0.5659		0.5302	
Log likelihood	-283.2631		-301.9148	

Source: Own computation where *** is significant at 1% significance level, ** is significant at 5% significance level and * is significant at 10% significance level.

In Table 6 we report the estimated mean marginal Willingness to Pay (WTP) for each of the attributes. These are simply the ratio between the attribute coefficient and producers' price coefficient (expressed by MWTP1) or the ratio between the attribute coefficient and coefficient for productivity (expressed by MWTP2). It is worth noting that the attributes for environmental adaptability and yield stability are binary variables, and they can thus be directly compared. For productivity, it is the marginal WTP in Birr for an increase in productivity by one quintal per hectare.

Productivity attribute may also be used as a proxy for monetary attribute, and may even be more appropriate in cases where only a small portion, if any, of the production output of a farm family makes it to the market after satisfying the household food consumption needs of this farm family. The MWTP2 values reported in Table 6 are based on productivity attribute taken as proxy for monetary attribute.

Table 6: Mean marginal WTP for each variety attribute by crop and type of monetary attribute (standard errors reported in parentheses)

Attribute	MWTP1		MWTP2	
	Sorghum	Teff	Sorghum	Teff
Productivity	14.77 (1.7557)	25.16 (4.3994)	-	-
Environmental adaptability	255.50 (42.5005)	515.66 (111.8508)	17.29 (2.5569)	20.50 (3.3239)
Yield stability	229.27 (38.7734)	360.28 (88.9046)	15.52 (2.3204)	14.32 (2.8294)

Where **MWTP1**: Marginal willingness to pay values measured in terms of Birr per quintal of the respective crop (producers' price used as the monetary attribute); and **MWTP2**: Marginal willingness to pay values measured in terms of quintals of the respective crop per hectare (productivity attribute used as a proxy for the monetary attribute).

The results of both measures of marginal willingness to pay show that farm households in North Wollo zone seem to be very risk averse since they are willing to pay a rather substantial amount for more adaptable and/or stable varieties of both crops. This is perhaps reflected in their strong willingness to diversify the crops they plant between different kinds of traditional and improved varieties in order to buffer the impact of drought and/or disease problems.

The MWTP1 and MWTP2 values for environmental adaptability are higher than their counterparts for yield stability for both crops, and for *teff* the difference in WTP is significant using a t-test. The MWTP1 values for the productivity attribute show that they are willing to pay 15 birr and 25 birr for an increase in productivity by 1 quintal per hectare.

To account for observed heterogeneity of preferences across farm households, we also estimate models where a set of socio-economic characteristics are interacted with the attributes. However, in random utility models the effects of social and economic characteristics on choice cannot be examined in isolation but as interaction terms with choice attributes. Due to possible multicollinearity problems, it is not possible to include all the interactions between the explanatory variables collected in our survey and the four crop variety attributes when estimating the random logit models with interactions (Breffle and Morey, 2000). The results of the two models with socio-economic characteristics are presented in Table 7 and Table 8 below.

Table 7: Random Parameter Logit estimates for Sorghum variety traits interacted with socio-economic characteristics

Variable	Coefficient	St. Error	Coeff. Stdv	St. Error
Random parameters				
Yield	-0.0969	0.1259	0.1165***	0.0350
Environmental Adaptability	7.8472	354.4026	2.0653***	0.6060
Yield Stability	11.8976	354.4046	2.3695***	0.5898
Non-random parameters				
Alternative 1	0.1883	0.1957		
Producers' Price	0.0194***	0.0027		
Alternative 2	1.6914***	0.3318		
Heterogeneity in mean parameters				
Productivity* Sex	0.1460*	0.0819		
Productivity* Off-farm work	0.1126*	0.0675		
Productivity*Agri. Ext. Particip.	0.1106*	0.0649		
Env. Adaptability* Experience	0.1366**	0.0646		
Env. Adaptability* land size	-3.5191***	1.3252		
Number of Observations	513			
ρ^2	0.611			
Log likelihood	-219.2309			

Source: Own computation where *** is significant at 1% significance level, ** is significant at 5% significance level and * is significant at 10% significance level.

The results in Table 7 show that the interaction between the demand for higher levels of productivity in sorghum varieties and sex of the household head is positive. This shows that male headed households demand more productive sorghum varieties than female headed households. This may be because households with male heads have larger size (and hence demand more output from their land) than households with female heads and those females usually assume this position in a family when they are either widowed or separated from their husbands[11].

Farm households with at least one member working off-farm demand more productive sorghum varieties compared to those households with no member working off-farm. Production of sorghum by resource-poor farmers typically is at least partly for home consumption. The percent of sorghum grain produced that is marketed may, however, be greater for farm households with off-farm job opportunity since they are more likely to be better integrated into the local markets prompting them to demand higher productivity from their sorghum variety options. The results in Tables 7 and 8

[11] After running a Pearsonian bivariate correlation between household size and sex of the household head, we found that the two variables are positively and significantly correlated at 0.01 significance level.

also show that farm households with more experienced heads demand higher environmental adaptability trait from both sorghum and *teff* variety options. In the drought prone areas of North Wollo Zone such as the PAs covered in this survey, more experienced farmers are likely to go through greater number of recurrent drought encounters in the past inducing them to look for varieties that are better resistant to such environmental pressures.

The results in Table 7 may also shed light on why farmers choose to participate in the agricultural extension package program with the positive interaction term between productivity attribute and agricultural extension participation. Farmers may be motivated to participate in the extension because they demand high yielding sorghum varieties from these services.

The results in Table 7 also show that farmers operating a relatively large land size also demand less environmental adaptability trait in sorghum varieties compared to those operating smaller lands. Smaller land size can be translated into smaller total output and farmers are particularly risk averse towards non-adaptable varieties planted in these plots.

The results of the RPL model for *Teff* variety choices with socio-economic characteristics are presented in Table 8 below.

The RPL results for teff variety choices show that farmers with larger land size to operate also demand more productive teff varieties compared to those operating smaller lands. This is unexpected because with more than 63% of the surveyed households reporting land shortage as a primary problem, households with smaller land size are expected to compensate for this by demanding more productive *teff* varieties where *teff* is the most important crop for the majority of farmers. This is perhaps because *teff* is a highly commercial crop and the perceived utility from more productive *teff* varieties is higher for farm households operating larger land size and who are likely to produce greater proportion of their output for the market.

Table 8: Random Parameter Logit estimates for Teff variety traits interacted with socio-economic characteristics.

Variable	Coefficient	St. Error	Coeff. Stdv	St. Error
Random parameters				
Yield	0.1599	0.2074	0.1902***	0.0383

Environmental Adaptability	-10.2524*	5.4109	2.9503***	0.9803
Yield Stability	7.7871	6.1242	3.8258***	1.2642
Non-random parameters				
Alternative 1	0.5133***	0.1855		
Producers' Price	0.0121***	0.002		
Alternative 2	1.3787***	0.3442		
Heterogeneity in mean parameters				
Productivity* Land size	0.2758***	0.0951		
Productivity* drought frequency	0.088***	0.0304		
Env. Adaptability*livestock value	-0.553***	0.1775		
Env. Adaptability* Household size	1.4395**	0.6565		
Env. Adaptability* Experience	0.0961*	0.0523		
Yield Stability * Livestock value	-0.3958**	0.1629		
Number of Observations	531			
ρ^2	0.6002			
Log likelihood	-233.2257			

Source: Own computation where *** is significant at 1% significance level, ** is significant at 5% significance level and * is significant at 10% significance level.

The results also show that farmers who reported higher drought encounter frequency in the past also demand more productive *teff* varieties compared to those with less drought encounter. This perhaps shows their uncertainty about the future production prospect and the need to hoard maximum *teff* production output for household consumption for the coming season.

Households with larger livestock assets demand less environmentally adaptable and stable yielding *teff* varieties compared to those with smaller livestock assets. Crop production is the single most important source of livelihood for farmers who cannot rely on their livestock assets as an insurance against crop failure and, therefore, are very risk averse towards non-adaptable and/or non-stable *teff* varieties.

Results in Table 8 also show that the demand for environmental adaptability attribute of *teff* varieties increases with the household size. The shock to output associated with growing non-adaptable varieties has a much larger negative effect on larger households than smaller ones, inducing bigger households to be more risk averse towards such crops.

7. Policy implications

The study reveals the most important farm household and crop variety characteristics that are worth considering in designing on-farm conservation policies or for targeted adoption of improved varieties in Ethiopia.

The first policy implication is in the area of identifying the varieties conserved *de facto* and those that need external incentives. Once policy is informed on the types of varieties preferred by different farm household types, on-farm conservation costs can be optimized. For instance, *de facto* conservation of environmentally adaptable sorghum varieties by more experienced farmers with small land size to operate implies that there is no need to design external incentives for these varieties to deal with their maintainers. On the contrary, in an area where the demand for a certain variety attribute (say, environmental adaptability) is low, the variety (ies) embedding that attribute should be targeted for conservation.

The second policy implication is in the area of opportunity cost compensation. One of the issues to be dealt with in on-farm conservation is the opportunity cost that farmers are facing when the policy is in place (Edilegnaw, 2004). To this end, understanding farmers' preferences will enable policy makers to identify the variety attributes that have to be compensated. For instance, larger, more experienced and poorer farm households with few livestock assets are most affected when they have to abandon *teff* varieties (for the purpose of on-farm conservation) with better yield stability and environmental adaptability.

The Final policy implication is in the area of variety adoption. For the success of agricultural technologies, their attributes should address farmers' concerns. Thus, understanding farmers' preferences for variety attributes is an input to this end. For instance, according to our empirical results, to target and address variety demand for larger, more experienced and income shock vulnerable farm households, the priority variety attributes are environmental adaptability and yield stability of both *teff* and sorghum varieties.

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INSTITUTIONAL ANALYSIS OF WATER MANAGEMENT ON COMMUNAL IRRIGATION SYSTMS IN ETHIOPIA: THE CASE OF ATSBI WEMBERTA WOREDA, TIGRAY REGION AND ADA'A WOREDA, OROMIYA REGION

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Abstract

Improved access to agricultural water supply plays critical role in the sustainable livelihoods of rural people. This study examines nature, cropping pattern and impact of communal irrigation water use and identifies the determinants of collective action and its effectiveness in managing irrigation sites, based on a survey of 169 communities (groups) in Atsbi Wemberta woreda (Tigray region) and Ada'a woreda (Oromiya region), Ethiopia. Analyses of descriptive and econometric methods are used. Analysis of qualitative information supplemented the econometric results. Collective action in managing irrigation water generally functions well in both woredas, which supports the role of communities in sustainable management and utilization of common property resources. The econometric results show that collective action is more effective in irrigation water users of Atsbi than Ada'a. The study also implies that collective action for irrigation water management may be more beneficial and more effective in groups with intermediate number of beneficiaries that are close to markets and credit access, in groups that have longer years of experience in irrigation water use, in groups with larger family size and in schemes where there was participation of beneficiaries during construction of irrigation infrastructure. Collective action for community resource management is likely to be more effective if the participation of local organizations in the irrigation schemes is high and if involvement of external organizations is demand driven and complementary to local initiatives. Our evidence also shows that provision of training favors collective action. Thus, expansion of training for beneficiary farmers by governmental and non-governmental organizations will have positive and remarkable impact on efficient management of the common property resource. Groups that are distant from markets or with larger number of beneficiaries, private–oriented approaches to resource management may be more effective. In both study areas, local routes such as associations and conflict resolution committees are preferred by local communities. Hence, attention should be given to such informal institutions to strengthen their capacity and in creating strong linkage with the formal institution arrangements. Finally, it was also found that using communal managed irrigation schemes has a positive impact on beneficiary farmers' income as well as on the living standard of their families. Moreover, over time, beneficiaries depend more on the production from their irrigated fields. Thus, emphasis needs to be given in infrastructure and marketing.

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1. Introduction

1.1. Background of the study

Ethiopia is the second most populous country in sub-Saharan Africa, with an estimated population of over 77 million. In order to meet the food needs of its rapidly growing population, the country needs to double the production of its cereal production by 2025 (IWMI, 2007). Agriculture is the largest sector of the economy contributing about 50% of the country's GDP and employing over 85% of the population. Agriculture in Ethiopia is mostly based on rain-fed small-holder system (IWMI 2005).

Although the Ethiopian agriculture is basically rainfall–based, the country is endowed with vast water resources including 12 major river basins and 22 natural and artificial lakes. Considering both the available on surface water resources and the annual run-off amount, it was estimated that there would be about 1707 m^3 water /person/year available (Ibid).

Rainfall in Ethiopia is characterized by high spatial and temporal variability. Moreover, land degradation, mostly soil erosion, deforestation and overgrazing is high and is one major cause of declining crop and livestock productivity in the country. The challenge the country is facing is how to meet the increasing food demand with the existing but dwindling natural resource base under worsening climatic conditions. It is important to apply the right agricultural practices and management systems in order to increase agricultural productivity and production. This will require improved economic incentives, conducive organizational policy and institutional environment for the agriculture sector.

Irrigation is one means by which agricultural production can be increased to meet the growing food demands in Ethiopia. Irrigation can also stabilize agricultural production, facilitate diversification, and reduce vulnerability. Moreover, it creates employment opportunities. Ethiopia indeed has significant irrigation potential. Realizing the potential irrigation development can contribute towards food security and improved welfare, the Government of the Federal Democratic Republic of Ethiopia (FDRE), has embarked on wide range of water development efforts throughout the country. A separate Ministry of Water Resource Development has been established. However, irrigation development in Ethiopia has been focused on the agronomic, engineering and technical aspects of water projects, with little consideration to issues of management, beneficiary participation and availability of institutional support services. Moreover, in many developing countries the success of irrigation systems is

highly affected by policy, institutional and social factors much more than technical issues (Gebemedhin and Peden, 2002).

1.2 Statement of the problem

In rural Ethiopia, communities depend significantly on common property resources[3] for irrigation water, fuel wood, grazing land and construction materials. However, most of these resources are exploited on a first come, first-served basis which results in inefficient utilization of the resources and inequalities in the distribution of benefits to users (Gebremedhin et al 2002).

The solution to this problem in most developing countries depends not only on appropriate technologies and efficient market prices, but also on local level institutions of resource management and organizations that enforce them. This implies that devolving rights to local communities to help build institutions for common property management may not be a sufficient condition for sustainable use of such resources. Effectiveness in internal governance is needed for the effective application of community rules. Therefore, the need to identify factors that facilitate or hinder the development and effectiveness of local formal and informal institutions and organizations becomes important.

Since 1991, the role of local communities in resource management has been increasing in Ethiopia. Many communal small scale irrigation schemes have been constructed. In addition, the old ones have been cleaned up and rehabilitated and handed over to the community. Like in any other common pool resource, collective action[4] arrangement in irrigation water use faces two types of resource management problems: provision and appropriation. The problem of provision arises in arranging the construction and maintenance of canals, while appropriation arises in water distribution arrangement. To overcome those problems irrigation water users locally organize themselves and form different institutional arrangements for irrigation water management; examples include use of “water masters” and executives of water users’ associations. These institutional arrangements and monitoring and enforcement of laws and regulations have two implications; production (efficiency)[5]

[3] Common property resources are defined as those resources that are owned and managed by a given community. They are contrasted with open access resource, which have no defined owner (Gebremedhin et al, 2002).
[4] Collective action is action taken by a group, either directly or on behalf through an organization, in pursuit of members perceived shared interest (Marshall, 1998).
[5] Efficiency refers to application of irrigation water to plots based on the requirement of crops which takes into consideration soil type, crop type and stage of growth.

and distributional (equity)[6] dimensions. Water distribution to farmers can be explained based on timeliness and volume. Water available at the wrong time during the production process may be of little value, while water available in time but in lesser volume than needed may not have the desired effect on productivity. Hence, the design of appropriate water management institutions becomes critical.

However, little evidence exists regarding local level institutions and organizations for irrigated water management in Ethiopia. More generally, even if there is extensive literature on common property resource management (Ostrom, 1990; Bromley 1992), further empirical research is required to identify factors associated with collective action and its effectiveness in developing countries, since the effectiveness of collective resource management strategies is likely to be context specific (Runge, 1992). In addition, the outcome of this study may serve as a source of additional information for use by policy makers and planners during the design and implementation of irrigation development programs and prospects.

1.3 Objectives of the study

The paper has two interrelated objectives. First, it assesses the nature of collective action and examines cropping pattern and impact of using communal managed irrigation schemes of the two study woredas: Atsbi Wemberta and Ada'a woredas. Second, it uses econometric methods to investigate the determinants of collective action and its effectiveness in managing communal irrigation schemes.

The study has some limitations. The major ones relate to the unavailability of secondary data needed to supplement the primary data. Due to resource and time limitations, the study had to focus on only a few most important questions.

2. Conceptual framework

The conceptual framework for this study is based on the theory of collective action (Wade 1988; Ostrom 1990; Baland and Plateau 1986). Common property resources have two defined characteristics, i.e., exclusion is difficult albeit possible, but if use exceeds supply capacity it will become exhausted (Vanderlinden 1999). When community resource users are able to negotiate among themselves to set rules of access, when cost of monitoring compliances or violation is not very high, and when non-cooperation would lead to non provision, rational individuals will tend to

[6] Equity refers to equal distribution of irrigation water to all beneficiary farmers, based on the required timeliness and volume.

voluntarily comply with rules of restrained access, thus paving the way to the development of collective action. Analysis of individual incentives to contribute to collective action for common property resources management has been the most dominant economic approach to the study of the determinants and effectiveness of collective action (Baland and Platteau 1999; Agrawal 2001, Varaghese and Ostrom 2001). Underlying these incentives is the perceived distribution of benefits and costs, which may in turn be influenced by factors related to the nature of the resource, the characteristics of the community, the interrelationships between the community and the resource, the external environment such as the role of external programs and organizations and, access to markets (Agrawal 2001).

Both institutional analysis (North 1990) and transaction cost economics (Williamson 1986) hold that individuals weigh costs and benefits of their decisions in specific action situations. Perceived obstacles and inducements in a given environment condition individual choices (Oakerson 1992). Hence, in this study, factors related to the number and characteristics of group members of irrigation water beneficiary farmers (by facilitating or hindering trust and cooperation), importance of the resource for livelihood, farm characteristics and types of choices available (by raising or decreasing opportunity cost of cooperation), the external environment (through the effect of the involvement of external organizations and programs or access to markets on costs and benefits of collective action), community experience in participating in construction of the irrigation infrastructure, and in establishing and managing local organizations are considered important determinants of collective action and its effectiveness for irrigation water management.

3. Research methods and hypothesis

3.1 Source of data

The data for the analysis is obtained from a community-level survey in Atsbi Wemberta woreda in Tigray Region and Ada'a woreda in Oromiya Region. Atsbi Wemberta woreda is located about 860 km north of Addis Ababa; 65 km northeast of the capital of Tigray Region, Mekelle. There are 16 *Tabias*[7] and 2 town dwellers associations in the woreda. Agro ecologically, the woreda is classified as Dega. Altitude and rainfall increases from south to north and east to west. Shortage of rainfall is a major constraint of agricultural production. Rainfall is usually intense and short in duration (IPMS 2005). Ada'a is one of the woredas in East Shoa Oromiya region which is located about 47 km southeast of the capital Addia Ababa. There are

[7] Tabia, Peasant Association and Kebele have the same meaning. In this study, the three of them represent the lowest administrative units in Tigray and Oromiya regions, which comprise usually four to five villages.

27 Peasant Associations and 9 Town Dwellers associations. The population in Addis Ababa, Adama and Bishoftu creates a large market for most agricultural commodities. Agro-ecologically, the woreda is best suited for diverse agricultural production (IPMS 2005, Ada'a Woreda 2007).

This study relies on primary cross-sectional data collected in 2006/07 cropping season that was obtained from semi-structured community level questionnaire. All *tabias* which had irrigation projects operated during the study period, 2006/07 cropping season are included in the study. The questionnaires were administered at group of farmers' level which is at *Gugele* and *Gere* level. *Gujele*[8] and *Gere*[9] refer to the smallest administrative unit of Water Users Association (irrigation scheme). There were 94 and 75 groups of beneficiary farmers (*Gujele* (in Atsbi) and *Gere*(in Ada'a), respectively in year 2006/07. The size of a group (number of beneficiaries) differs group to group. The size of a group is decided by the community and ranged from 4-280 number of beneficiaries in Atsbi and 8-297 beneficiary farmers in Ada'a. All *Gugeles* and *Geres* which were found in communal managed irrigation schemes of the two woredas (in 2006/07) were included in the study. Each interview involved ten respondent chosen to represent different age, gender, position in the irrigation scheme, level of education (literate and illiterate), income (low, middle and high).

Table 1. Tabias and PAs included in the study

S. No.	Name of Tabias in Atsbi included in the study	No. of groups (Gojeles)	S. No.	Name of PAs in Ada'a included in the study	No. of groups (Gere's)
1	Golgol Naele	**37**	1	Godino	**31**
2	Feleg Woini	**6**	2	Kataba	**17**
3	Ruba Feleg	**4**	3	Ganda Gorba	**3**
4	Zarema	**2**	4	Koftu	**9**
5	Adi Mesaenu	**4**	5	Hidi	**15**
6	Haressaw	**25**			
7	Hadnet	**9**			
8	Hayelom	**7**			
Total		***94***			***75***

Moreover, Effort was also exerted to conduct an in depth focus group discussion with irrigation water beneficiaries at each scheme level that ranged from 10 to15 farmers. In addition, interview has been done with experts working in the OoARD (office of Agricultural and Rural Development).

[8] Gugele means a group of farmers who are organized for provision and appropriation of irrigation water use in Atsbi.
[9] Gere means a group of farmers who are organized for provision and appropriation of irrigation water use in Ada'a.

Why did we use community level survey for analysis?

Analysis of common property resource management can be done at any one of several levels, including those of the individual farm household and community level. In this survey the data which was used in econometric analysis was administered at community (*Gujele* and *Gere)* level. There are at least two reasons why a community (group) level survey is appropriate in communal irrigation management, as compared with household level. The first reason is *Gujele* and *Gere* is the smallest social unit that has the capacity to govern the administration and utilization of the common pool resource- irrigation water. Programs need to be managed by a larger collection of individuals. The second reason is since communal managed irrigation water has the attribute of a common pool resource in that the exclusion of farmers within the command area is difficult, but if use exceeds supply capacity it will become exhausted. Thus, in arranging collective action, it faces two types of common pool resource management problems: provision and appropriation problems (Ostrom, 1994). The problem of provision arises in arranging the construction and maintenance of canals and appropriation problem arises in water distribution arrangement. As a result, the whole structure of communal managed irrigation water may most closely reflect the combined practices of farmers in a group rather than that of any single household irrigated farm.

3.2 Methods

Both qualitative and quantitative approaches were used in this study. Analysis of descriptive and qualitative information from the survey was used to identify the nature of communal irrigation water management, actual uses of the schemes, the legal framework, conflict resolution mechanisms, problems encountered, cropping pattern and impact of irrigation water use in the two study woredas. Econometric analysis was used to investigate the determinants of collective action and its effectiveness in managing the irrigation schemes.

Dependent variables

The indicators of collective action and its effectiveness used in the econometric analysis include two categories.

Indicators of collective action:-

- ✓ Annual average value of a group members contribution for the resource management[10];
- ✓ Whether there is a guard for protection of the irrigation site;
- ✓ If group members pay for a guard to protect the scheme;
- ✓ Whether there is water distributor in the scheme;
- ✓ If group members pay for a water distributor.

And indicator of collective action effectiveness/enforcement includes
- ✓ Number of times penalty system applied per group in 2006/07.

Explanatory variables

The factors used to explain variations in collective action and its effectiveness in communal managed irrigation water use include 4 vectors of explanatory variables:-

Regional characteristic**-** whether the woreda is Atsbi or Ada'a

Group characteristics include:- Total number of households in a group, Total number of households in a group squared, Proportion of female household heads in a group, Proportion of literate headed households in a group, Average family size in a group, Proportion of households who used formal credit in a group during 2006/07 cropping season, Proportion of households who have access to extension program in a group, Proportion of households whom irrigated agriculture is the main source of income in a group, Total irrigated area in a group, Total agricultural land in a group, TLU of a group, Proportion of beneficiaries at the tail-end in a group, For how many years beneficiaries have used the irrigation water in a group, Numbers of times beneficiaries have received training on how to use irrigation water efficiently and related issues in year 2006/07 in a group.

Farm Characteristic includes:- Proportion of soil considered good by a group.

Village Characteristics include:- Whether rainfall adequacy in a village was considered good by a group

Access to Market and services (in hrs.):-Walking time from a specific groups' irrigated land to the nearest-town market, to village market, to *tabia* development post.

Scheme Characteristics include:- If the irrigation scheme was promoted by external organization, Number of external organization(s) which is (are) operating in that irrigation site now, Number of local organization(s) which is (are) operating in that irrigation site currently, Whether there is farmers' participation during construction of the scheme, Type of irrigation system (micro-dam, river diversion, spring water, shallow well and communal lake and pond. Communal lake is identified as a base variable.

3.3 Model specification and estimation

[10] Annual average value of group members contribution constitutes contribution in labor form, cash and in kind form (all types of contributions are converted into monetary value)

The type of regression model to use depends on the nature of the dependent variable. Least squares regression was used for annual average value of household contribution for the resource management, since the variable is continuous.

Selection models (Probit) are used to examine the determinants of:- whether there is a guard for protection of the site, whether group members pay for a guard to protect the scheme, whether there is water distributor in the site, whether group members pay for water distributor. Dependent variables - whether group members pay for a guard to protect the scheme is conditional on having guard. This implies that members pay if only if in cases where there is guard (which only in 103 number of observations in our case). Similarly, whether group members pay for a water distributor is conditional on the presence of water distributor. This shows that members pay if only if there is water distributor (which is only in 109 number of observations in this study). As a result we used Selection model in order to test and control sample selection bias, which was created by selecting only cases that have guard/water distributor. We selected the explanatory variable-proportion of beneficiary households who had access and used formal credit in a group in 2006/07 as the offset variable, because it was one of the most statistically significant variable for both the dependent variables (whether there is guard for protection of a site and whether there is water distributor in a site), but it has less effect on whether to pay or not.

In this study, we also used Tobit and Tobit decomposition model for analyzing the determinants of penalty system application in community managed irrigation schemes for the year 2006/07, since the dependent variable for which a large proportion of cases have zero as the lowest possible value. Among 169 number of observation, 35 number of them had zero as the lowest value of number of penalty system exercised. Unfortunately, clear procedures for interpreting of Tobit coefficients are not available. Therefore, it was important to decompose the Tobit coefficients, which reveal important additional findings that could not be discerned from the ordinary Tobit coefficients (Roncek, 1992).

Diagnostic tests - We run 6 different models (1 OLS, (4) Sample selection- Probit and 1 Tobit and decomposing its coefficients) using STATA software. For each of the models we applied different diagnostics, as noted by Darnell and Evans (1990), before proceeding to test a hypothesis, one should apply several diagnostic tests to make sure that the chosen model is reasonably robust. The first one was to find whether there was potentially[11] a problem of multicollinearity, but found potential problems only between total number of households in a group and total number of

[11] As notes by Gujarati (1995), if the pair –wise or zero-order correlation coefficient between two regressors is high, say, in excess of 0.8, then multicollinearity is a serious problem

households in a group squared; total area irrigated land in a group and total number of households in a group; the regional dummies and rainfall adequacy. The correlation between these variables was leading to high variance inflation factors (34.1- 57.9 VIF) (Gujarati, 1995 and Chatterjee and Price, 1991). However, we included all the variables in the models since they have statistically significant coefficients. Moreover, omitting one of the variables would result in omitted variables bias. The other variables had a variance inflation factor less than 7.10, indicating that multicollinearity was not a major concern for these variables [12](Gujarati, 1995 and Chatterjee and Price, 1991). Robust regression was undertaken to avoid the hetroskedasticity problem. We also tested if there was a problem of incorrect functional form. The result indicated that there was no evidence of functional form misspecification. We also tested normality and singled out the outliers. In addition, all regression results were corrected for sampling weights.

IV. 3.4 Research hypothesis

The vectors used to explain variations in indicators of collective action and its effectiveness include: Regional Characteristics**,** Group Characteristics**,** Farm Characteristics, Village Characteristics and Scheme Characteristics**.** Our hypothesis about how these factors may influence collective action draw from the literature on induced institutional innovation and collective action in managing common property resources (North, 1990; Baland and Platteau, 1996; Pender and Scherr, 1999; Gebremedhin, Pender and Tsefaye, 2002).

Group Characteristics **(X_G);-** When the total number of households in irrigated area is small, collective action may be low due to high fixed cost. While when the number of households is very high, collective action may also be low due to increasing variable transaction costs of attaining and enforcing collective action or higher competition for the resource. Hence, we hypothesize an inverted U-shaped relationship between number of households in a group and collective action for communal irrigation water management. Intermediate number of beneficiary farmers favors collective action, while low and very high household number hinders collective action (Pender et al, 1999).

The effect of proportion of female headed households on collective action is unknown because it is highly influenced by socio-cultural background of a community. Higher family size in a group expected to increase the benefit of collective management, since irrigated agriculture demands higher labor use individually as well as collectively. Higher literacy rate have two possible excepted effects; the first one is, it

[12] As a rule of thumb , if the VIF of a variable exceeds 10 (this will happen if R_j^2exceeds 0.90), that variable is said to be highly collinear, Gujarati (1995) Chatterjee and Price(1991)

may increase collective action since that beneficiaries may have better understanding and awareness about the management of the resource. The other effect, it may undermine collective action, since it allows high 'exit' options.

Higher proportion of households who use formal credit favors collective action, since most of a time farmers get credit to buy inputs such as fertilizer, improved seed, pesticides, herbicides, which are complementary inputs for irrigation water use. Similarly, access to extension program appreciates collective action as does higher proportion of households whom agriculture is the main source of income. Groups that have better physical assets (higher TLU and larger size of rain-fed agriculture plots) are the ones who are more likely to cover operation and maintenance costs and have better irrigation structure than groups that have few physical assets. Hence, physical capital is expected to have positive relationship with collective action. Economies of scale are important in favoring collective action. We expect that collective action should be greater and more effective in groups which have larger irrigated lands.

Higher proportion of beneficiaries at tail-end lead to greater scarcity of the resource, as a result collective action may increase. However, at high levels of scarcity and ecological stress institutional arrangements often break down as people scramble for survival and discount rates increase, which leads to lower collective action. Longer years of experience of irrigation water use and provision of training may increase awareness towards how to use the water efficiently and how to co-ordinate themselves, hence, leads to more collective action.

Farm Characteristics **(X_F);-** The effect of soil quality on collective action may have two different effects. While better soil quality may increase the value of the return from managing the irrigated water effectively, thus favoring collective action. The other one is soil quality may also decrease the incentive of members to abide by the rules, increasing the opportunity cost of labor or by providing more 'exit options', making enforcement of rules more difficult.

Village Characteristics **(X_V);-** The effect of group members' access to markets on collective action is mixed. Better access to markets may increase the value of the return from managing the irrigated water effectively, thus increase collective action. Better markets may also undermine individual's incentives to co-operate by increasing the opportunity cost of labour or by providing more 'exit options', making it more difficult to punish those who fail to co-operate. Rainfall adequacy in the village may also have mixed impacts on collection action for similar reasons. Access to development post appreciates collective action, since farmers have close contact with DAs and agriculture experts.

Scheme Characteristics **(X_S)**:-External organizations can have two different effects. On the one hand, they can favor collective action by providing interventions that are complementary to local collective action and if they are demand-driven. On the other hand, external organizations may retard collective action if their role substitutes local collective action such as by replacing local efforts or dictating management decisions or otherwise undermining collective action (such as by increasing 'exit options' of local community members).

It is expected that the effect of experience with local organizations on collective action will have a positive relationship due to possible learning effects and the effect of social capital on the costs or ability to enforce collection action. Farmers' participation during construction of the irrigation infrastructure may increase collective action, since it increases sense of ownership and belongingness.

4. Results and discussions

V. 4.1 Descriptive and qualitative analysis

Actual uses and administration of communal managed small-scale irrigation schemes in the two woredas

In Atsbi, on 221.1 ha of land, there are 14 communal managed irrigation schemes which constitute 1,855 beneficiary households (see Annex 1). On the other hand, in Ada'a there are a total of 2,059 irrigation water beneficiaries in 8 communal managed schemes, which cover 960.5 ha of land (see Annex 2). The main sources of irrigation water for those schemes are micro-dams, river diversions, spring water uses and shallow wells. Each irrigation scheme is owned and managed by the community. Each scheme has its own water users association (WUA), which is administered by water users committee (WUC). WUA is a local institution and has a basic character of authority and by-laws. It has rules, methods and sanctions for selecting executive committee, raising finances, setting disputes among irrigation water beneficiaries and supervising provision of the irrigation water service. Each water users committee has been selected among irrigation water users and constitutes 3-7 members and a chair, which varies from scheme to scheme. It also embraces a water distributor who is responsible for everyday operation of a scheme. Under these water users associations and executive committee, new structure was created by water users with water course representatives at outlet (block or group) level (*Gujele* and *Gere* level).There are 94 *Gujele* and 75 *Gere* leaders in Atsbi and Ada'a, respectively. In this study *Gujele* and *Gere* leaders means group (block) leaders. These leaders are

in charge of any issue concerned with monitoring and controlling of water distribution in their group. The water distributor controls block leaders at scheme level. Usually, the water distributor is one person per scheme.

Most of the current irrigation sites in Atsbi were promoted by external organizations, such as Co-SAERT, World Vision and Tigray regional bureau of water resource, with full community participation. In Ada'a Wedecha-Belebela dam was constructed by the then socialist government in collaboration to Cuban government in 1978. In both areas, all the modern schemes were constructed or began to operate after the fall of the military government.

Nature of collective action in the irrigation sites- as a common pool resource
As previously mentioned above, to overcome the problem of appropriation and provision of irrigation water management, beneficiaries has formed WUA (water users association) and WUC (water users committee) at each scheme and block (*Gujele* and *Gere*) leaders at each outlet level.

Before the start of the irrigation season, water users in general assemble to negotiate when to clean the canals and decide the water distribution program. Especially, water distributors have a big role in organizing the water distribution program and the mechanism to achieve the goals. The irrigation group leaders are in charge of control at turnout gates of lateral and sub-laterals. They also inspect at farm–level water distributions that are to be carried out by each block.

Participation of members in meetings- Many of the problems related to irrigation are solved directly by farmers themselves. According to the current status of the rules of the WUA in both districts, members should meet once a month and WUC once at fortnight to discuss problems, make decisions and once a year to elect new executive committee and water distributor. However, in practice, it is hardly the case. It seems that the only occasion that brings farmers and WUC to meetings is when they negotiate on the issues like when to clean the canals, when the irrigation system ceases to function or when an urgent action is needed.

Water distribution system:- In both selected areas, rotational irrigation is practiced. Rotational irrigation is the application of irrigation water in a given amount at a given time and in proper order, so that all farmers may get enough water to irrigate their fields. The irrigation distribution is designed according to the existing system layout and actual topographic conditions, so that irrigation water can be simultaneously delivered into each rotation block or group. This is why each irrigation site is divided into different *Gugeles and Geres* (blocks). Actually, water distribution shifts are established based on counting dates or complaints, instead of water needs by plants.

Indicators of collective action in the small-scale irrigation schemes

There are three kinds of contributions among irrigation water beneficiaries: in cash, kind and in labor form. Farmers in the two districts have comparable annual total average value of contribution per household for the resource management that is nearly 190 *Birr* in Atsbi and 206 *Birr* in Ada'a. The most common members' contribution is in form of labor, that members clean and maintain canals collectively in a number of times in a year. This form of contribution accounts for 95% in Atsbi and 86% in Ada'a as compared to the total amount of contribution.

All beneficiary farmers have an obligation to participate in cleaning, maintaining and minor construction of canals. Months like September and February are the most favorable times to clean the canals. The farmers form groups and team leaders and agreed on how much meter of canal to clean. If a group can't finish in an agreed time, it shall be punished by a cash fine set by WUA.

In these two districts, the canal water charge is zero. They have only collected money to cover some operation and maintenance costs and payment for guards and water distributor (in some cases). In Atsbi, the mean annual cash contribution is 2.81 *Birr* per household. Whereas, in Ada'a an average annual household cash contribution is 19.82 *Birr* for the resource management.

The third type of contribution is in kind. In some irrigation schemes of Atsbi, guards who protect irrigation farms and the infrastructure are paid in kind (cereals like wheat and sorghum). During minor construction, beneficiaries also contribute in kind, for instance raw materials such as stone and soil. The average annual contribution in kind is 5.6 *Birr* per household and 10.1 *Birr* per household in Atsbi and in Ada'a, respectively.

Legal framework

Concerning the existence of formal written rules, in year 2006/07, 89% of *Gujeles* in Atsbi have formal written rules. The figure is even higher in Ada'a, i.e., 97% of *Geres* have written rules. These rules and regulations for operation and water management were formulated by the irrigation water beneficiaries in collaboration with the woreda agricultural offices. For irrigation water management the beneficiaries collectively prepare and agree on a set of rules of restricted access to water and make arrangements of water distribution for their plots. It is the executive committee, water distributor and group leaders who are in charge of enforcing the use of restricted rules and regulations. The restricted rules constitute beneficiary farmers rights, obligations and penalty system applied. The most frequent violation of use restrictions of irrigation water is stealing of water (using water without turn), inappropriate usage

of water (over irrigating own plot and the nearby irrigated fields), not attending and being late in meetings. The mean variation in number of times for violation of rules among beneficiaries in these schemes is very high. It occurred nearly an average of 13 number of times per group (*Gujele*) in Atsbi and 26 number of times per group (*Gere)* in Ada'a in year 2006/07. Similarly, the mean number of times conflict occurred in 2006/07 cropping season due to irrigation water related issues was 19 times in Ada'a per group and 10 times per group in Atsbi. Moreover, in response of those violations of rules, on average six and three number of times in a group penalty was exercised in Atsbi and Ada'a, respectively in year 2006/07.

About three-fourth irrigation schemes in Ada'a are protected by guards, 96% of whom are paid their salary in cash. The WUCs collect money annually and pay an average of 207 *Birr* for a guard per month. These guards in average give services for 8 months. Forty one percent of the schemes in Ada'a have water distributors in which only 5 months[13] of a year he monitors the water distribution system in a scheme. However, in Atsbi, there are guards to protect the schemes in only 19% of the cases. It is the beneficiaries themselves who protect the irrigation sites turn by turn. In Atsbi, water distributors give services for an average of 8 months a year, with a payment of 52 *Birr* per month.

Conflict resolution mechanisms

Formal and informal institutions interact appreciably in conflict resolution at the local level in both study areas. Most disputes on the water use are resolved informally at the lower levels before they erupt into serious conflicts. There are 4 identified ways of conflict resolution mechanisms as mentioned below (considering both informal–formal mechanisms):- 1) One to one level between the victims: Both parties speak out and agree on resolving the conflict. 2) At block (group) level:- Normally a group leader is well respected person for both parties and can give more trustful and appreciable judgment. 3) Scheme level:- Water distributors and executive committees will involve in conflict resolution mechanism when the above solutions have failed and. 4)Community (*tabia*) court: the water users committees refer conflict management cases beyond its capacity to the community court. However, according to, scheme level focus group discussion results, irrigation water beneficiaries and the executive committees complain that the community (*tabia*) court is so busy and slow in deliberating and delivering solutions immediately because it manages almost every type of conflict in the community.

[13] The water distributor monitors the water distribution during the irrigation scheme is under operation (only 5 months a year).

Generally, water users prefer informal routes over formal ones (*tabia* level court system), because most people feel a stronger sense of identity and belongingness for those arrangements. Such parallel forums provide an effective conflict resolution institution for managing water conflicts at a lesser cost.

According to results from focus group discussions, in these two woredas the number of conflict occurrence increases from year to year because of two possible reasons. The first one is eventually, the volume of irrigation water decreases due to decreasing trend of rainfall in the areas. The second one is, through time farmers have begun to realize the benefits of using irrigation water. Therefore, every year the command area becomes wider.

Cropping pattern and impact of irrigation agriculture in the two Woredas

The introduction of irrigation has offered households the possibility of increasing the annual agricultural output. However, it has not replaced traditional rain-fed agriculture; rather, farm households use irrigated production to supplement the rain-fed production. Having access to irrigated plots helps households to meet families' consumption requirements. According to the result of focus group discussion with irrigation water beneficiary farmers, over the last years, households have depended more on the production from their irrigated fields, which enabled them to harvest twice in a year.

Crop types in the irrigation sites are classified into five categories: vegetables, fruits, pulses, spices and cereals. In both areas, the major types of crops sawn were vegetables and pulses. From vegetable category the larger share were tomato, onion and cabbage. With respect to pulses, peas and faba beans covered the largest area of land in Atsbi. However, in Ada'a chick pea, lentil and *'guaya'* took the largest share.

An interesting result that was obtained from focus group discussions with beneficiary farmers in the two study areas is that farmers have started to grow crops which were not previously grown in the areas. Besides, the result of discussions indicated that initially, most farm households had concentrated on specific crops; however, eventually the types of crops also have increased in number and in area coverage.
In addition, as per focus group discussion with beneficiary farmers, through time there is a shift in farm households' crop choice decision towards highly priced and marketable agricultural products. The farmers themselves witnessed, it has a positive impact on their income as well as on the living standard of their families. However, one thing to note in this case is, level and magnitude of benefit accrued to the beneficiary farmers significantly depends on market accessibility, since most of the crops grown in the irrigation sites of the two districts are perishable. Therefore, unless these products are able to reach to consumers immediately after harvested, either

their market value will decrease with time or it might be a complete loss to the farmers.

4.2 Econometric analysis

The econometric results for the determinants of collective action and its effectiveness for communal managed irrigation water use are presented in Annex 3-4.

Regional characteristics

Our findings revealed that, collective action is more prevalent and more effective in irrigation water users of Atsbi than Ada'a. Irrigation water users in Atsbi have enforced the penalty system in more number of times than beneficiaries who live in Ada'a, even if the number of violation of restricted rules occurred less frequently in Atsbi than in Ada'a. Moreover, groups which are found in Atsbi are strongly associated with having water distributor without payment. Instead voluntary labor compensation from beneficiary farmers during harvesting is common (an activity which demands higher labor force). This implies that how social capital reduce the cost of enforcing rules of collective action in communal managed natural resources.

Group characteristics

Our evidence also supports the hypothesis of an inverse U-shaped relationship between collective action and number of beneficiaries in a group. Groups are more likely to have and pay for guard and water distributor at intermediate number of household level than at low or high number of household level. We also found that average value of a group member contribution is negatively associated with total number of households in a group. But it is positively associated with total number of households squared. This is because of economies of scale and a U-shaped relationship between annual average value of a group member contribution and number of households in a group. Groups which have smaller number of beneficiaries contribute more in order to cover the operation and maintenance cost. But as the number of beneficiaries increases the average contribution per group decreases. However, after some point (as the number of households increases), management costs increases rapidly, requiring higher per group contribution. The turning point in this relationship (where minimum expected number of beneficiaries occurs) was at 154 households/group, well within the range of total number of households per group in the two study areas.

Higher proportion of female headed households in a group is associated with less average value of household contribution. This suggests that both financial and labor constraint appears to be a greater concern for female headed households. In addition to this, higher proportion of women farm decision makers in a group increases the

likelihood of having and paying for guards. This is an indication of female household heads' attempt to compensate labor constraints by hiring guards.

Our result also shows that better education status and collective action have strong negative association, in both statistically and qualitatively. This finding is consistent with the hypothesis that better education status tend to undermine individuals incentives to co-operate by increasing the opportunity cost of labor or by offering more 'exit options'. Expectedly, we found that larger family size favors collective action. It is positively correlated with household contribution, since groups with larger family sizes can provide labor as much as the irrigation agriculture demands.

Previously, we hypothesized that agriculture extension and formal credit program would encourage collective action. However the evidence presented that, it is access and using of formal credit that has positive and strong association with collective actions. Probably because of credit is primarily used to purchase inputs such as variety of seeds, fertilizer, pesticides, herbicides, which are complementary inputs for irrigation water.

Of the various group level factors, total irrigated area is one of the variables, which were hypothesized to affect collective action. It has strong positive association with hiring a guard. This indicates that as the irrigated land size increases the importance of hiring guard to protect the sites will be more crucial.

We also find that groups which have larger size of land for agriculture (rain-fed) and with higher TLU have positive association with having and paying for both guard and water distributor. This suggests that contributing for guard and water distributor relates to affordability issue. Thus, groups with a better physical resource are more likely to employ guard and water distributor than those with few physical resources. Years of experience of irrigation water use increases the likelihood of having water distributor. This implies that through time beneficiaries have realized the importance of having water distributor.
The regression result also shows that provision of training is positively associated with employing both guard and water distributor. In addition, it correlates positively with penalty system exercised. These findings are consistent with the argument that more frequent provision of trainings favors collective action. It helps beneficiaries to understand easily the whole purpose of imposing and enforcing rules and regulations. It also enables them to be aware of how to use the water more efficiently which has a positive effect on sustainable utilization of the resource. One more time provision of training implies 3.7% higher probability of exercising a penalty system, in groups with no penalty have been exercised. Thus, more frequent provision of trainings (on how to use the irrigation water more efficiently) by governmental and non-governmental

organizations for beneficiary farmers will have a remarkable and positive impact on the benefit of collective action.

Farm characteristics
Higher proportion of land in good soil also increases the likelihood of employing water distributor, implying higher agricultural potential favors collective action.

Village characteristics
In areas where there is adequate amount of rainfall, less use of penalty system is observed, probably because of divergence of interests, hence higher costs of collective action. This finding supports the hypothesis that higher agricultural potential may also lead to higher labor opportunities.

With respect to market access, groups which are closer to town market are more likely to have guard and water distributor. In addition, being closer to village market and *tabia* development post have positive correlation with contributing for payment of guard and water distributor. Besides, groups closer to town market, village market and *tabia* development post have higher tendency of applying the penalty system. Probably, beneficiaries may have more access to information and also understand the benefit of imposing rules and regulations on irrigation water use to produce more market oriented crops which they can sell it in those markets.

Scheme level characteristics
The study shows that initial involvement of external organization in promotion of irrigation schemes has negative association with number of penalty system exercised. Perhaps initially the external organizations in the irrigation sites might displace local collective action. Communities with greater number of external organizations make higher annual contribution per group. Average value of annual group contribution increases by 25 *Birr* per additional number of external organization. It also increases the likelihood of having water distributor. It suggests that the presence of external organizations increase the benefit of collective action by increasing awareness on profit opportunities and new technologies in irrigation schemes. Communities with greater presence of local organizations are more likely to have and contribute for both guard and water distributor. This finding supports the hypothesis that local organizations may favor collective action due to possible learning effects of how to enhance benefit from collective action.

As hypothesized previously, community participation during construction of irrigation scheme has a positive impact on collective action. It increases the likelihood of hiring and contributing for guard than communities who did not participate at all. That is an indication of the existence of stronger sense of ownership and belongingness. This

suggests that it may serve as one type of policy instrument to enhance the effectiveness of community managed resources.

In terms of types of irrigation system dummies, groups that are located in river diversions contribute more than groups that are found in communal lakes. Perhaps structures of river diversions demand high contribution of labor during clearance and maintenance than communal lakes do. In addition, statistically significant positive correlation is depicted between groups which use micro-dam irrigation water and having guard and negative correlation with having water distributor. The expectation is that the structures of modern micro-dams need higher protection of external as well as internal damage caused by individual and cattle, but less water distribution related problems exist because of the presence of modern structures that can be easily handled by group leaders.

4. Conclusions and implications

Improved access to agricultural water supply plays critical role in the sustainable livelihoods of rural people. Recognizing the potential irrigation development can contribute towards food security and improved welfare the current Government of Ethiopia has embarked on wide range of water development efforts throughout the country. Since 1991, many communal managed small-scale irrigation schemes have been constructed. In addition, the old ones have been cleaned up and rehabilitated and handed over to the community. However, in Ethiopia the history of irrigation development has been characterized by emphasis on technical and engineering aspects with inadequate attention accorded to policy, institutional and socio-economic factors (Gebremedhin et al, 2002). This study analyzes the nature, cropping pattern and impact of communal managed irrigation water use and identifies the determinants of collective action and its effectiveness in managing irrigation sites, based on a survey of 169 communities (groups) in Atsbi woreda (Tigray region) and Ada'a woreda (Oromiya region), Ethiopia. Analyses of descriptive and econometric methods were used. Analysis of qualitative information supplemented the econometric results.

In 2006/07 cropping season, in Atsbi, on 221.1 ha of land, there were 14 irrigation schemes which constituted 1855 beneficiary households. On the other hand, in Ada'a there were a total of 2059 irrigation water beneficiaries in 8 communal managed schemes, which covered on 960.5 ha of land. Each irrigation scheme is a common property resource that is owned and managed by the community. Each scheme has its own water users association (WUA), which is administered by water users committee (WUC). In addition, there are water course representatives at outlet (block)

level, which are called group (*Gujele* and *Gera*) leaders. They were 94 in Atsbi and 75 in Ada'a. Each water users association has its by-law and each beneficiary contribute for irrigation water management through cash, in kind, or through uncompensated labor contribution.

Collective action in managing irrigation water generally functions well in both study areas. Our evidence revealed that farmers have started to grow crops which were not previously grown in the areas. It was also found that it has also a positive impact on their income as well as on the living standard of their families. In addition, through time beneficiary farm households depend more on the production from their irrigated fields, which enabled them to harvest more than once a year round.

Our evidence was consistent with the hypothesis of an inverted U-shaped relationship between number of households in a group and collective action, for dependent variables-having and paying for guard and water distributor. Moreover, we also found U-shaped correlation between household number in a group and annual average group contribution, suggesting collective action is high and more effective at intermediate number of beneficiaries.

Our findings revealed that, collective action was more effective in irrigation water users of Atsbi than Ada'a. The study also implies that collective action for irrigation water management may be more beneficial and more effective in groups with intermediate number of beneficiaries that are close to markets and credit access, in groups that have longer years of experience in irrigation water use, in groups with larger family size and in schemes where there was participation of beneficiaries during construction of the irrigation infrastructure. Collective action for community resource management is likely to be more effective if the participation of local organizations in the irrigation sites is high and if involvement of external organizations is demand driven and complementary to local initiatives. Access to formal credit has positive and significant impact on collective action. Therefore, emphasis should be given on availability of institutional support services.

In both study areas local routes such as associations and conflict resolution committees are preferred by local communities (than formal ones). This is because of the existence of a stronger sense of identity and belongingness than in the formal set-ups. Therefore, attention should be given to such informal institutions to strengthen their capacity and in creating strong linkage with the formal institutional arrangements. Through time the demand for irrigation water increases among beneficiary farmers. Therefore, assigning of water rights and strengthening organization and operation of WUAs will be very essential for further efficient use of the common pool resource.

Our evidence shows that number of provision of trainings favors collective action. Thus, more effort should be exerted by both governmental and non-governmental organizations to provide trainings more frequently to enhance the understanding of beneficiary farmers on how to use the irrigation water efficiently and to raise awareness towards the purpose of enforcing rules and regulations. Our findings also suggest that, in communities that are remote from markets or high group size, private –oriented approaches to resource management may be more effective.

We found that producing crops using communal irrigation water has positive impact on the welfare of beneficiary households. Therefore, to mitigate the erratic nature of rainfall and to cope up with the ever-increasing food demand of the population of the country, development and implementation of small-scale communal irrigation schemes will be helpful to promote productivity and production of farm households. The benefit found from the marketable crop started to be grown, depends on the availability of support services such as credit extension, input supply and marketing. Thus, efforts should be made in improvement of support services, infrastructure and as well as to create a market linkage.

Overall, the findings of the study show that collective action in managing irrigation water generally functions well in both areas which supports the role of community resource management as effective mechanism for sustainable utilization of the resource. This indicates that it can be one option to combat the risk of “tragedy of commons” in managing the common pool resource- irrigation water. Therefore, effort should be done to increase effectiveness of collective action in both areas to use the resource in more sustainable way.

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Annex-1: List of Communal Managed Irrigation Schemes in Atsbi Wemberta

Micro- Dams in Atsbi Womberta Woreda

Tabia	Kushet	Year of construction	No.of *Gugeles*	Actual years of irrigation water use experience (mean)	Actual total land irrigated	Total beneficiaries	Distance from the woreda town (Endaselassie) in K
Golgol Naele	Tegahane	1997	37	8	51.6728	542	2
Harressaw	Feliga	1994	25	12	42.3008	305	20
Kelisha Emni	Adi Shehu	1997	0	0	0	0	44
Ruba Felg	Debre Selam	1993	0	2.5	0	0	11.5
Era	Era	1996	0	0	0	0	28
Total			**62**		**83.9736**	**847**	

Communal Modern River Diversions in Atsbi

Name of River Diversion	Type of Technology	Year of construction	No. of *Gugeles*	Actual years of irrigation water use experience (mean)	Actual total land irrigated	Total beneficiaries	Distance from the woreda town (Endaselassie) in K
Enda Minu	Main-diversion	1996	6	28	64.375	410	26.5
Barka Adi Sebha	Cut-off drain	1996	0	0	0	0	7
Hadnet	Cut-off drain	1997	9	5	25.14	62	36
Habes	Cut-off drain	1997	0	0	0	0	12
Adi Mesanu	Cut-off drain	1996	1	1	6.25	9	6.5
Kuret	Cut-off drain	1997	3	8	8.535	130	5
Total			**19**		**104.3**	**611**	

Communal Traditional River Diversions in Atsbi

Name of River Diversion	Tabia	No. of *Gugeles*	Actual years of irrigation water use experience (mean)	Actual total land irrigated	Total beneficiaries	Distance from the woreda town (Endaselassie) in Km
Gera Rebue	Hayelom	1	40	9.875	62	25
Tsiquaf	Ruba Felg	1	24	1.5	20	10
Samera	Ruba Felg	2	25	5	58	10
Kimber (Tsigaba)	Zarema	1	3	1.25	13	16
Mebrahtom	Felg Woini	3	2	2.4782	32	4.5
Era Erere	Era	0	0	0	0	28
Total		**8**		**20.1032**	**185**	

Communal Spring Water Use

Name of spring water	Tabia	No. of *Gugeles*	Actual years of irrigation water use experience (mean)	Actual total land irrigated	Total beneficiaries	Distance from the woreda town (Endaselassie) in Km.
Afenjow	Ruba Felg	2	23	4.5	42	11
Tsigaba	Zarema	1	6	3	24	17
Total		**3**		**7.5**	**66**	

Communal Shallow Wells and Pond Irrigation Water Use

Place of the irrigation water source	Tabia	Type of Irrigation Water	No. of *Gugeles*	Actual years of irrigation water use experience	Total land irrigated (ha)	Total number of beneficiaries	Distance from the woreda town (Endaselassie) in K

found				(mean)		
Gereb Gesa	Adi Mesanu	Shallow wells	1	2	2	5
Gereb Gesa	Adi Mesanu	Large communal pond	2	2	3.25	9
Total			**3**		**5.25**	**14**

Annex-2. List of Communal Managed Irrigation Schemes in Ada'a Woreda
Communal Micro-Dam Irrigation Schemes in Ada'a Woreda

S. No.	Name of micro-dam	Tabia	Actual years of irrigation water use experience (mean)	Actual total land irrigated	Total beneficiaries	Distance from the woreda town (Debre Zeit) in Km.
1	Godino	Godino	14	241.25	405	12
2	Goha Worko	Godino	40	108	207	13
3	Harawa	Godino	20	50	68	18
4	Belbela-Fultino	Koftu	10	76	197	7.5
5	Dhanama	Ganda Gorba	7	20.625	54	10
6	Katab-Gimbi	Kataba	9	178.375	327	21.75
Total				**674.25**	**1258**	

River Diversion and Natural Lake Irrigation Use in Ada'a

S. No.	Name of the scheme	Type of irrigation system	Tabia	Actual years of irrigation use experience (mean)	Actual total land irrigated	Total beneficiaries	Distance fro the woreda town (Debre Zeit) in Km.
1	Mojo river	River diversion	Hidi	10.11	263.5	676	
2	Hora Kilole lake	Lake use	Hidi	3	22.75	125	
Total					**286.25**	**801**	

Annex- 3. Determinants of indicators of collective action in Atsbi and Ada'a, 2006/07 ***Coefficient (standard errors in parenthesis)***

Explanatory variables	**Average value of a group member contribution for the resource management**	**If there is a guard for protection of the irrigation site (dF/dx)‡**	**Whether group members pay for guard (dF/dx)‡**	**If there is a water distributor in the irrigation scheme (dF/dx)‡**	**Whether group members pay for water distributor (dF/dx)‡**
Regional Characteristics					
Woreda, cf.,Ada'a	-97.50147	-.1004423	.0251459	.8205165***	-.7869334***
	(91.39847)	(.144125)	(.0515297)	(.2488298)	(.1790068)
Group Characteristics					
Total number of households in the group	-2.44839***	.0125639***	.0034242***	.0011754***	-2.19e-17*** (4.63e-
	(.9388741)	(.0145803)	(.0017931)	(.0017479)	16)
Total number of households in the group squared	.0079435**	-.0000372***	-.0000915***	-7.17e-06 (6.43e-	
	(.0032323)	(.0000452)	(.0000525)	06)	
Proportion of female headed households in the group	-54.14266	.1279945**	.2524605***	.1827336	-3.81e-16 (8.12e-
	(52.90396)	(.1843523)	(.1916403)	(.1663727)	15)
Proportion of literate headed households in the group	-191.6583**	-.0273196	-.1053229	-.1377547	8.78e-17 (1.81e-
	(74.02852)	(.0643707)	(.1032882)	(.1023142)	15)
Average family size in the group	24.3402***	.0048154	-.0008083	.0109844	1.02e-16 (2.16e-
	(7.832015)	(.0093878)	(.008546)	(.0168198)	15)
Proportion of households who have used formal credit in the group	1.095235***	.0623452***		.2919586***	
Proportion of households who have included in the agricultural extension	(.2177543)	(.0947366)		(.1416184)	
programme	221.1597	-.0355268	.5541125	-.509087	-5.14e-16 (1.09e-
Proportion of households whom the primary source of livelihood is irrigated	(210.5841)	(.2431854)	(.3821659)	(.5904329)	14)
agriculture	2.963661	.0072542	.0792391*	.1676395***	3.63e-16** (7.69e-
Total irrigated area in the group	(52.05627)	(.0230683)	(.0825772)	(.0837026)	15)
	-1.260037	.0095655**	.0029209 **	.0030024	2.15e-16 (4.53e-
Total agricultural land in the group(non-irrigated land)	(2.395867)	(.0134072)	(.0037978)	(.0043583)	15)
Tropical livestock unit for the group	-2.853806*	.0071554 ***	.0030176 *	-.0016165	-1.91e-17 (4.05e-
	(1.465202)	(.009483)	(.0023954)	(.0028884)	16)
Proportion of beneficiaries at the tail-end	.4433728*	.0003973*	.0002909 *	-.0007405	3.68e-18** (7.78e-
	(.2589661)	(.0005813)	(.0004376)	(.0004243)	17)
Year of experience of irrigation water use, no.	26.69484	-.0744927	.1123086	-.4724717	8.61e-16 (1.81e-
	(75.93723)	(.1113372)	(.1185141)	(.2524078)	14)
Provision of training, no.	-1.329808	.0008542	.0012329	.0108338**	3.36e-17 (7.14e-
	(1.338798)	(.0046769)	(.0013417)	(.004208)	16)
Farm Characteristics	-.180455	.0172791***	-.015713 **	.0234287**	-6.35e-17 (1.33e-
Proportion of soil coverage considered good by the group in the catchment area	(5.302972)	(.0242046)	(.0164089)	(.0160673)	15)

Village Characteristics					
Whether rainfall adequacy in the village is considered good by the group	-18.93334	.012894	.1925832	.2886481***	9.23e-18*** (1.90e-
	(14.81855)	(.0400998)	(.1339614)	(.0844612)	16)
	109.7401	.0190732	-.1510933*	.4405119**	-.9999088
	(79.33109)	(.0925456)	(.1498897)	(.2471971)	(.000575)
Walking time from that group's specific irrigated land to(in hours)					
Town market					
Village market					
Development post					
	-.1544492	-.0004761**	.0000305 (.00014)	.0005327*	-3.07e-20 (6.38e-
Scheme Characteristics	(.1448537)	(.0006672)	-.0032064***	(.0003076)	19)
Whether the irrigation scheme was promoted by the external organization	.235727	-.0004279	(.0023282)	.0010231	-1.02e-18***
Number of external organization(s) which is (are)operating currently in that	(.6915918)	(.0014563)	-.0035514***	(.0015798)	(2.10e-17)
specific irrigation site	.5151172	-.000692	(.0024127)	-.0027727	-3.93e-19***
Number of local organization(s) which is (are) operating currently in that specific	(.6777663)	(.0019121)		(.0018438)	(8.07e-18)
irrigation site			-.0045196		
Whether there was farmers' participation during construction of the whole	10.09033	.0425002	(.0325335)	-.0808885	-8.18e-12 (9.69e-
structure	(27.50153)	(.0740186)	.0007954	(.0614335)	11)
Type of irrigation system dummy, cf., communal ponds	25.0423**	-.0207725	(.0190842)	.099223***	-2.07e-17 (4.28e-
Micro-dams	(11.38271)	(.0300775)		(.0327524)	16)
			-.0190024		
River diversion	18.9421	.0736847***	(.0249432)	.14125038**	1.26e-17 (2.61e-
	(13.59268)	(.0919245)	.0000461**	(.0535214)	16)
Spring water use	-40.34981	.9049967 **	(-.0317386)	-.1288109	.0000594
	(52.6411)	(.2456271)		(.1035174)	(.0003212)
Shallow well			.0493252		
	-78.77681	.0249966**	(-.022026)	-.0839703**	.1838809
_Cons	(92.72828)	(.0964438)		(.0470526)	(.3470024)
	165.3306**				
mills	(82.8344)				
	-14.36502				
Type of regression	(89.38776)				
Number of observation	-181.9143*				
F(28, 140)	(95.21018)				
Prob > F	-112.0618				

R-squared	(318.0857) **OLS** 169 29.77 0.0000 0.6036	 **Selection Model-Probit** 169 212.65 0.0000 0.8650	**-.1931062** (.1783197)** **Selection Model-Probit** 103 123.67 0.0000 0.6668	 **Selection Model-Probit** 169 100.77 0.0000 0.6169	**4.44e-17** (9.18e-16)** **Selection Model-Probit** 109 179.47 0.0000 0.7583

		Marginal Effects	
	[1]Latent Variables	[3]Conditional on being Uncensored	[4]Probabi Uncenso
Regional Characteristics			
Woreda, cf.,Ada'a	11.89077*** (3.129638)	6.556517*** (1.65821)	.773718 (.14347)
Group Characteristics			

.**Annex 4.Tobit/Tobit Decomposition Results – Determinants Collective Action Effectiveness on Community Irrigation Water Management, 2006/07.**
Number of penalty system exercised per group in 2006/07 cropping season

	Marginal Effects		
	[1]Latent Variables	[3]Conditional on being Uncensored	[4]Probabi Uncenso
Total number of households in the group	.0105169 (.0214443)	.0062018 (.01266)	.0007203 (.00147)
Proportion of female headed households in the group	.9746128 (2.724429)	.5747295 (1.60746)	.0667499 (.18661)
Proportion of literate headed households in the group	.1497064 (1.950338)	.0882819 (1.15007)	.0102533 (.13358)
Average family size in the group	.0264495 (.3127141)	.0155973 (.18441)	.0018115 (.02142)
Scheme Characteristics			
Whether the irrigation scheme was promoted by the external organization	-1.512739* (.8855637)	-.8770504* (.50704)	-.106490 (.06417)
Proportion of households who have used formal credit in the group	.0402548 (.0338929)	.0237383 (.02001)	.002757 (.00233)
Number of external organization(s) which are(is) operating currently in that specific irrigation site	1.657044*** (.4960262)	.9771596*** (.29505)	.113238 (.03513)
Proportion of households who have included in the agricultural extension program	4.595077 (9.652505)	2.709719 (5.68971)	.3147108 (.66205)
Number of local organization(s) which are(is) operating currently in that specific irrigation site	-.4523449 .5786978	-.266748 (.34164)	-.030980 (.03972)
Proportion of households whom the primary source of livelihood is irrigated agriculture	.9326368 (1.222324)	.5499762 (.72051)	.0638751 (.08394)
Whether there was farmers' participation during construction of the whole structure	1.690883 (1.773824)	.9466532 (.94064)	.1255824 (.10451)
Total irrigated area in the group	.0586374 (.0780284)	.0345785 (.04603)	.004016 (.00535)
Total agricultural land in the group(non-irrigated land)	-.0625308 (.0529208)	-.0368744 (.03129)	-.004282 (.00364)
Type of irrigation system dummy, cf.: communal ponds			
Micro-dams	8.376642* (4.383649)	3.981087**	.66605
Tropical livestock unit for the group	.0051532 (.0081646)	.0030389 (.00482)	.0003529 (.00056)
Proportion of beneficiaries at the tail-end	5.009939 (3.058099)	2.954363 (1.80447)	.3431241 (.21126)
Year of experience of irrigation water use, no.	-.0006786 (.0420731)	-.0004002 (.02481)	-.000046 (.00288)
Provision of training, no.	.5419897** (.2430756)	.3196115** (.14359)	.0371202 (.01694)
Farm Characteristics			
Proportion of soil coverage considered good by the group in the catchment area	.0474522 (.9905721)	.0279826 (.58415)	.0032499 (.06784)
Village Characteristics			
Whether rainfall adequacy in the village is considered good by the group	16.9014*** (3.268852)	10.53624*** (2.03316)	.8593785 (.08878)
Walking time from that group's specific irrigated land to (in hours)			
Town market	-.0079778* (.004421)	-.0047045* (.0026)	-.000546 (.00031)
Village market	-.0549612* (.0290206)	-.03241078* (.01707)	-.003764 (.00202)
Development post	-.1059926*** (.0320375)	-.0625039*** (.01885)	-00725 (.00229)

***statistical significant at 1%; ** statistical significant at 5%; * statistical significant at 10%
[1]Latent variables give ordinary Tobit results, [3]Conditional on being uncensored value shows the effect of the independent variable for cases with a non-limit values on the dependent variable and [4]Probability on uncensored indicates the effect on the probability of having a non-limit value for cases with the limit value of the dependent variable.

			(1.70444)		(.30028)
River diversion	11.78554***		9.058153**		.42532
	(4.297464)		(3.67628)		(.10626)
Spring water use	3.141721	(5.30952)	2.188808		.14801
			(4.24391)		(.14802)
Shallow well	-8.654913	(4.444963)			
			-2.984805	(.79237)	-.711035 (.20176)
_Cons	-28.80875**				
	(13.09756)				
/sigma	4.008876	(.25278)			
Type of regression	Tobit				
Left-censored observations at nconf<=0	35				
Uncensored observations	134				
Right-censored observations	0				
Number of observation	169				
LR chi2(28)	89.23				
Prob > chi2	0				
Pseudo R2	0.0996				
Fraction of sample above the limit and adjustment factor for unconditional expected value: **(Φ(z))**	0.792899				
Fraction of mean total response above limit and adjustment factor for cases above limit**:(1-zφ(z)/ Φ(z)- φ2(z)/ Φ2(z)**	0.5731				
Adjustment factor for cases at the limit**(φ(z)/σ)**	0.07696299				

Annex 4. Cont'd

***statistical significant at 1%; ** statistical significant at 5%; * statistical significant at 10%

[1]Latent variables give ordinary Tobit results, [3]Conditional on being uncensored value shows the effect of the independent variable for cases with a non-limit values on the dependent variable and [4]Probability on uncensored indicates the effect on the probability of having a non-limit value for cases with the limit value of the dependent variable.

SINGLE VERSUS MULTIPLE OBJECTIVE(S) DECISION MAKING: AN APPLICATION TO SUBSISTENCE FARMS IN NORTHERN ETHIOPIA

Zenebe GEBREEGZIABHER[♣†]

Abstract

Single objective approach is most widely used whereas consideration of multiple objectives is the rule rather than an exception in many real life decision-making circumstances. Under such situations, the key questions include: could the single objective approach be a reasonable approximation or does the multiple objectives approach has anything to add? How does the pattern of resource allocation change when priorities attached to the different objectives/ goals change? If indeed the multiple objectives approach has something to add, then understanding the behavior of economic agents in decision making involving multiple criteria would help to sharpen our prediction. This paper, therefore, tries to investigate whether or not single and multiple criteria/objective approaches necessarily lead to differing conclusions. The study used linear and goal programming techniques on a dataset from a stratified sample of 200 farm households drawn from Tigrai regional state, Northern Ethiopia, for 2001 and 2002 production years. Findings reveal that the two approaches might not necessarily lead to differing conclusions.

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

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1. Introduction

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

In the traditional 'single' objective approach, such as in the classic linear programming framework, one must assume that there is exactly one objective that is to be optimized subject to the absolute satisfaction of a number of 'constraints' (Ignizio, 1976). Often one of the objectives is optimized while the others are specified as constraints. Maximization of profit (or gross margin) or minimization of costs is the single most objective often assumed. Proponents of multiple objective approach argue that although logically sound, the single objective approach fails to faithfully reflect the real life decision situation for two reasons. Firstly, it assumes that the constraints that define the feasible set are so rigid that they cannot be violated. Secondly, decision-makers are usually not interested in ordering the feasible set according to just a single criterion but would rather find an optimal compromise involving several objectives. Moreover, a decision maker or a farmer, for instance, might be involved in diversity of occupations or activities such as farm and non-farm activities. Therefore, does the maximization of profit for the decision maker or a farmer refer to the farm, the non-farm or the two in conjunction also poses another dilemma. Particularly in the case of subsistence or family farms, the fact that the farm is a complete economic unit which(exhibits) the interdependence between income and consumption casts doubts upon the assumption of profit maximization as the ultimate goal, which family farms strive to achieve. Indeed some of the motives might not be purely economic, although some are relevant than others for economic behavior (Gasson, 1973).

Regardless of all these divergence of opinions, studies that applied multiple objective/criteria decision analysis to subsistence farm settings are scanty. Barnett *et al*., (1982) applied goal programming with multidimensional scaling to Senegalese subsistence farms. Bazaraa and Bouzaher (1981) applied linear goal programming

model to Egypt's agricultural sector particularly at the regional level. Moreover, whereas subsistence farm settings tend to be well suited for multiple objective/criteria analysis, previous studies in Ethiopia and elsewhere in Africa have employed linear programming, implying addressing single objective only. For example, Belete *et al*. (1993) tried to explore the possibilities for improving production and income of small farmers through better allocation of resources under alternative cultivation (work oxen acquisition) practices using linear programming model. Heyer (1971) applied linear programming to maximize market value of output as the single objective given constraints on peasant farms in the case of Kenya. Kassie *et al*. (1999) also used linear programming to analyze the benefits of integration of cereals and forage legumes with and without crossbred cows in mixed farms for highland Ethiopia.

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

The remaining part of the paper is organized as follows. In section two and three we briefly describe the literature review and the problem setting respectively. Section four presents the model, the study area and the data. Section 5 deals with discussion of results, followed by concluding remarks in section 6.

2. Literature review

Studies that used multiple objectives approach include Barnett *et al*., (1982), Bazaraa and Bouzaher (1981), Lee *et al*. (1995), Okoruwa et al. (1996), Hayashi (2000), and Romero (2004). Barnett *et al*., (1982) applied goal programming with multidimensional scaling to Senegalese subsistence farms. They found out that the multi-objective model did not exhibit superiority over a similarly structured profit maximizing model. Bazaraa and Bouzaher (1981) applied linear goal programming model to Egypt's agricultural sector particularly at the regional level, in relation to income distribution and regional employment goals. They concluded that a relatively higher degree of specialization and a relatively lower cotton production could be achieved through using improved farming techniques and labour-intensive means. Lee *et al*. (1995) applied multiple objectives programming to subsistence farming

cropping decisions in Western Samoa. Their findings showed that the imputed non-market value of an important exportable crop is three to five times greater than the market price. Okoruwa et al. (1996) also used a multi-objective programming model to analyze crop-livestock competition in west African derived savannah. Their results indicated that farm and herd sizes will become smaller and the degree of crop-livestock integration will increase significantly, as population pressure and cropping intensity severely limit access to grazing land. Hayashi (2000) provides detailed review of multi-criteria analysis as applied to agricultural resource management. By way of assessing the criteria (i.e., attributes, objectives) used for modeling agricultural systems, it summarizes pros and cons involved applying the methodology. Romero (2004) also provides a general structure, i.e., three alternative formulations of achievement function for a goal programming model, one of which is weighted goal programming.

Among the works that used single objective approach are Belete *et al*. (1993), Heyer (1971), and Kassie *et al*. (1999). Belete *et al*. (1993) tried to explore the possibilities for improving production and income of small farmers through better allocation of resources under alternative cultivation (work oxen acquisition) practices using linear programming model. Their findings suggested a substantial potential for increased net farm cash incomes through efficient allocation of existing resources, given current level technology. Heyer (1971) applied linear programming to maximize market value of output as the single objective given constraints on peasant farms in the Masii semi-arid area of Kenya. She compared three alternative production systems, namely, the traditional system, a system with quick-maturing maize, and a system with cotton. She found out that cotton and drought resistant maize alone might not necessarily provide substantial increase in income. Her results also implied that the optimism attached to new crop developments such as these could indeed be ill-founded. Kassie *et al*. (1999) also used linear programming to analyze the benefits of integration of cereals and forage legumes with and without crossbred cows in mixed farms for highland Ethiopia. They found out that introduction of cereal-forage legume intercropping significantly increases gross margin and cash income. They also found that the introduction of crossbred cows further enhances these returns.

The following conclusions can be drawn from the foregoing review. Firstly, particularly in the case of subsistence or family farms, the fact that the farm is a complete economic unit which (exhibits) the interdependence between income and consumption casts doubts upon the assumption of profit maximization as the ultimate goal, which family farms strive to achieve. Indeed some of the motives might not be purely economic, although some are relevant than others for economic behavior (Gasson, 1973; Lee *et al*., 1995). Secondly, whereas subsistence farm settings tend to be well suited for multiple objective/criteria analysis, previous studies particularly in

the case of Ethiopia have employed linear programming, implying addressing single objective only.

3. Subsistence farm household: Definition of problem setting

The most defining feature of subsistence farmers is mainly the subsistence nature of their livelihoods. They are simultaneously engaged in both production and consumption and a larger proportion of the produce is directly consumed by the household (Ellis, 1993). They are distinguished from the landless laborers in that they have access to (own) certain amount of land, which by combining with other family resources such as labor and perhaps hiring in of land and/or labor produce farm output mainly for own (family) consumption.

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

3.1 Activities

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

Crop or production activities: Crop choice or crop production can be subdivided into numerous activities. For simplicity we limit ourselves to four most important crops in order of their importance in production: barley, wheat, teff, and legumes. The decision problem facing the farm household is how much of land to allocate to the production of each of these crops given his objectives, resources and other constraints. Farmers in the area also maintain livestock for draft power and other purposes. The draft power aspect of livestock activities has been considered in this study. Looking after cattle is mainly the activity of children (Woldehanna, 2000). This implies that livestock

doesn't compete for labor with other activities given that participation of children in other major activities is minimal.

Consumption activities: Subsistence farmers put emphasis on security of family subsistence or food supplies through own production. Consumption activities considered in this study include consumption of teff, wheat, barley and legumes.

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

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

3.2 Resource supplies and other constraints

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

Labour (hours): Total labour supply is approximated based on demographic characteristics of representative farm household and local circumstances such as number of nonworking or holidays. The representative farm household is assumed to have a family of 6 persons with 3 working persons (head, spouse and one other male member) and 3 dependants. The total labour supply is derived by aggregating total working time of each of the three working persons. Only one-third of the total working time for the spouse and the other male member of family have been considered in the

total labour supply. Thus, the total labour supply is constrained to be less or equal to 2764 hours.

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

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

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

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

Crop balances: As it could be shown from Table 1 below, four commodity balances namely teff, wheat, barley and legumes are specified assuming that production of each of these crops less consumption and sales should be greater or equal to 0.

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

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

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

4. Model formulation, study area and data

VI. 4.1 Classic linear programming framework

Table 1 below presents a linear programming (LP) problem representation of the above problem. In this formulation, columns stand for activities or decision variables and rows stand for resource limits or supplies and other constraints. The first row in the table represents the objective function to be optimized. In such a classic LP model, a single most objective or goal, such as maximizing gross return or discounted value of net returns is often assumed. More technically speaking, in such an LP framework, the decision maker maximizes the objective function such as total gross margin subject to constraints (1)-(12). Only one objective is optimized while the rest has to be treated as constraints. The coefficients of variables (x_i), for i=1,2,3, and 4, entering the objective function stand for gross margin (in Birr) per unit area (*tsmdi)* per annum of teff, wheat, barley, and legumes respectively. The coefficient of x_5 is the rental price/cost (in Birr) per unit area (*tsmdi)* of rent in land whereas the coefficient of x_{15} is return from a unit of off-farm labor.

In this setting, other objectives, for example, achieving food security or meeting fuel needs are considered as constraints and they are not by themselves taken as objective functions. However, such way of handling decision problems involving multiple objectives may not be satisfactory for various reasons. Firstly, representing goals by standard linear programming constraints is very rigid, whereas the decision-maker may have some flexibility say, for example, in the amount of cash income she wants to achieve. The amount need not necessarily be exactly constant. Imposing strict constancy is not only unrealistic but also easily leads to infeasibility of problems.

Moreover, locating the constraint that might have caused the infeasibility could also be difficult in the case of large problems with many constraints. Secondly, since the objective function is optimized within the feasible region defined by the constraints, which could have been goals by themselves implies that priority of one over the other goal.

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

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

Production activities				Consumption activities						Sales activities								
Teff (*tsmdi*)[31]	Wheat (*tsmdi*)	Barley (*tsmdi*)	Legumes (*tsmdi*)	Rent in Land (*tsmdi*)	*Teff* (kg)	Wheat (kg)	Barley (kg)	Legume (kg)	Fuel wood (kg)	Sales of *Teff* (kg)	Sales of Wheat (kg)	Sales of Barley (kg)	Sales of Legumes (kg)	Off-farm work (hour)			
(x_1)	(x_2)	(x_3)	(x_4)	(x_5)	(x_6)	(x_7)	(x_8)	(x_9)	(x_{10})	(x_{11})	(x_{12})	(x_{13})	(x_{14})	(x_{15})			
241.33	298.05	279.34	104.92	-115.45										1.18	=	Z max (Birr)	
167.94	76.42	71.05	70.64						0.11					-1	≤	2764 Labor (hours)	(1)
34.70	87.46	77.13	48.24												≤	529 Working capital (Birr)[32]	(2)
4	3	3	2						0					0	≤	90 Ox-power (pair day)	(3)
1.0	1.0	1.0	1.0	-1.0					0					0	≤	6 Land (*tsmdi*)	(4)
									1						≥	771 Fuel need (kg)	(5)
113.31					-1					-1					≥	0 *Teff*[33] balance	(6)
	146.73					-1					-1				≥	0 Wheat balance	(7)
		199.72					-1					-1			≥	0 Barley balance	(8)
			195.77					-1					-1		≥	0 Legumes balance	(9)
					1	1	1								≥	1000 MSR[34] cereals (kg)	(10)
								1							≥	250 MSR Legumes (kg)	(11)
				-115.45						2.13	2.03	1.40	0.54	1.18	≥	1256 Cash need (Birr)	(12)

[31] *Tsmdi* is local unit for land area -1 *tsmdi*=0.25 hectare
[32] Birr is Ethiopian currency currently 1USD = 9.6717 Birr
[33] *Teff* is a staple crop it belongs to the grass family *Eragrostis tef*
[34] MSR is an abbreviation for minimum subsistence requirement

VII. 4.2 Multiobjective or Goal Programming Model

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

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

Minimize

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

subject to

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

for all i,

$$\sum_j a_{kj} X_j \leq b_k \quad \textbf{(3)}$$

for all k, and

$$X_j, p_i, n_i \geq 0 \quad \textbf{(4)}$$

for all j and i,

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

To set up the GP model of our representative subsistence farm household, the set of inequalities (5) and (10)-(12) in Table 1 are treated as goals, g_i, instead of constraints. This is done by introducing two associated variables, *n* and *p*, called the deviational variables, for each goal that convert inequalities to equalities (Romero and Rehman, 2003). Before we specify the WGP model for the subsistence farm household in

question as in below, we present the formulation of the golas. Note that the four equations, i.e., equations (6)-(9) below represent the goal constraints, g_i, for i=1,…,4.

VIII.

IX. Goal g_1

The first constraint or goal (equation (6)) stands for household's consumption of cereals. The deviational variable n_1 measures the under-achievement of goal g_1 whilst p_1 captures the amount by which goal g_1 has surpassed its target. Because consumption of cereals should not be smaller than 1000 kilo grams, the deviational variable n_1 must be minimized.

X.

XI. Goals g_2 , g_3 and g_4

XII. Goals g_2 (equations (7)) stands for consumption of legumes. Goals g_1 and g_2 in combination represent the food security objective of our representative subsistence farm household. Goal g_3 (equation (8)) stands for the goal of the representative farm household for fuel or energy needs. Consumption of legumes and fuel or energy needs should not be lower than 250 and 771 kilo grams respectively. Goal g_4 (equation (9)) represents the total cash income goal in Birr of the representative farm household. To achieve the desired level of g_2, g_3 and g_4 the respective values for n_2 n_3 *and* n_4 must be minimized.

It does not make sense minimizing absolute deviations especially when each goal is measured in different units. Hence, the variables of the objective function must represent percentage deviations from the targets. Therefore, the elements of the objective function have been standardized for the WGP model to give the objective function as in (equation (5)) below. Weights (W_i, for i=1,…,4,) now express the relative importance of deviating by one percentage point from the respective goals. For example, if we assume that the farm household feels that it is indifferent from any of the four goals, then, this is equivalent to setting all weights equal to 1.

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

$$\text{Minimize } 0.1W_1n_1+W_2n_2+W_3n_3+0.08W_4n_4 \quad \textbf{(5)}$$

subject to

$$1.0x_6+1.0x_7+1.0x_8+n_1-p_1=1000 \quad \text{(cereals)} \quad \textbf{(6)}$$

$$1x_9+n_2-p_2=250 \quad \text{(legumes)} \quad \textbf{(7)}$$

$$1x_{10}+n_3-p_3=771 \quad \text{(fuelwood)} \quad \textbf{(8)}$$

$$2.13x_{11}+2.03x_{12}+1.4x_{13}+0.54x_{14}+1.18x_{15}+n_4-p_4=1256 \quad \text{(cash income)} \quad \textbf{(9)}$$

and

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

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

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

XIII. 4.3 Description of study area and data

The farm dataset used in this paper was obtained from a stratified sample of 200 cross-sections of peasant farmers drawn from *Enderta* and *Hintalo-Wajerat* districts in Tigrai region, Northern Ethiopia for 2001 and 2002 production years. In addition, some findings of an earlier study by Woldehanna (2000) on same farm households were also used in the analysis. For instance, selection of most important crops was based on this earlier work. Description of the data and summary statistics of the characteristics defining the representative subsistence farm household are provided in Tables A.2, A.3 and A.4 in the Appendices.

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

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

Farm, off-farm and home activities might be distinguished as regards to labor allocation in the study area. Ploughing, sowing, weeding, harvesting as well as cattle keeping appear to be the major farm activities. Most of these major farm activities are carried out by the male members of the household, while female household members participate, mainly, in weeding and harvesting. Off-farm labor income accounts up to 35 percent of total farm household income and about 81 percent of the farm households are involved in off-farm activities (Woldehanna, 2000). Wage employment and self employment are the two types of off-farm activities in the area. Off-farm self employment constitute own-businesses such as petty trading, transporting by pack

animals, fuel wood selling, charcoal making, selling fruits, pottery/ handicrafts, and stone-mining or quarrying. Home time activities include food preparation, child caring, and water and fuel wood fetching, which are generally undertaken by the wife or female members of the household.

5. Results and discussion

XIV. 5.1 Linear programming model

First we has been solved for linear programming (single objective) model, with maximization of gross margin (Z) as the single most objective. The solutions of the model obtained are:

x_1 = 2.677 *tsmdi*	x_6 = 30.280 kg	x_{11} = 0
x_2 = 0	x_7 = 0	x_{12} = 0
x_3 = 4.855 *tsmdi*	x_8 = 969.720 kg	x_{13} = 0
x_4 = 1.277 *tsmdi*	x_9 = 250.000 kg	x_{14} = 0
x_5 = 2.810 *tsmdi*	x_{10} = 771.000 kg	x_{15} = 1339.3 hours

and the value of the objective function is Z=3397.7431 Birr.

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

XV. 5.2 Multiobjective or goal programming model

Different solutions can be obtained by attaching different values to the weight (W) parameter. For example, the first run (or initial algorithm) in GAMS for $W_1=W_2=W_3=W_4=1$, generated optimal solutions (see first row, Table 3):

x_1 = 2.667 *tsmdi*	x_6 = 30.280 kg	x_{11} = 0
x_2 = 0	x_7 = 0	x_{12} = 0
x_3 = 4.855 *tsmdi*	x_8 = 969.720 kg	x_{13} = 0
x_4 = 1.277 *tsmdi*	x_9 = 250.000 kg	x_{14} = 0
x_5 = 2.810 *tsmdi*	x_{10} = 771.000 kg	x_{15} = 1339.3 hours

And the optimum values for the deviational variables were:

n_1 = 0	p_1 = 0
n_2 = 0	p_2 = 0

$n_3 = 0$ $p_3 = 0$

$n_4 = 0$ $p_4 = 0$

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

Run	W_1 (Cereals)	W_2 (Legumes)	W_3 (Fuel wood)	W_4 (Cash income)
1	1	1	1	1
2	2	2	1	1
3	1	1	1	2
4	3	3	1	1
5	1	1	1	3
6	4	4	1	1
7	1	1	1	4
8	5	5	1	1
9	1	1	1	5
10	10	10	1	1
11	1	1	1	10
12	100	100	1	1
13	1	1	1	100
14	1000	1000	1	1
15	1	1	1	1000

Table 3 Results of sensitivity analysis of WGP solution

Run	Production activities					Consumption activities				Fuel wood (x_{10})	Sales activities					Goals			
	(x_1)	(x_2)	(x_3)	(x_4)	(x_5)	(x_6)	(x_7)	(x_8)	(x_9)		(x_{11})	(x_{12})	(x_{13})	(x_{14})	(x_{15})	Cereals (kg)	Legumes (kg)	Feulwood (kg)	Cash income (Birr)
1	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
2	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
3	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
4	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
5	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
6	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
7	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
8	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
9	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
10	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
11	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
12	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
13	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
14	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256
15	2.677	0	4.855	1.277	2.810	30.280	0	969.720	250.0	771.0	0	0	0	0	1339.3	1000.0	250.0	771.0	1256

As could be clear from above, we found the initial solution permits full or complete achievement of all the farm household's goals. Solution suggests that the farm household will achieve family subsistence food supplies of 1000 kilo grams of cereals mainly from production of barley with *teff* contributing about 30 kilograms (4.4 percent). The household achieves the minimum subsistence requirement of legumes or pulses. The household also meets all of its fuel or energy needs. Besides, the household achieves the target level cash income Birr 1256. More importantly, the cash income was found to come solely from hiring out or supply of labour for off-farm activities. Moreover, the solution also suggest the farm household has to rent in land in order to be food secure.

Sensitivity analysis was carried out to draw meaningful insights about the farm household's problem. Fifteen sets or iterations of weights (see Table 2 above), were considered to test the sensitivity of the WGP solution to reordering of priority levels or weights. Table 3 presents results of sensitivity analysis of the WGP solution. In doing so, the intention was to obtain or generate proximate measure of the tradeoffs between goals. Specifically, the tradeoffs between two goals; achieving family food security and maximizing cash income of household were considered. This was done by altering the relative weights of these two goals while holding the relative weight or priority level for fuel or energy needs goal of household unchanged. Nonetheless, very surprisingly, all the iterations of reordering of priority levels or weights yielded exactly identical results.

The fact that the multi-objective or goal programming model was insensitive to objective weighting reveals that it has little, if not nothing, to add and might not be superior to the traditional paradigm of choice involving single-objective. It suggests that the problem at hand is a classic case of decision-making environment that could be approximated, fairly reasonably, by a similarly structured model but with profit or gross margin maximization as the single most objective. The overall result was consistent with findings of Barnett *et al.* (1982) for Senegalese subsistence farms. Besides, the fact that the multi-objective or goal programming model result was insensitive to objective weighting cannot and shouldn't be attributed model assumption, given the premise that assumption that simplify calculations do not alter the qualitative conclusions Milgrom (1994).

6. Conclusions

Using linear and goal programming techniques, this paper tried to investigate whether single and multiple criteria/objective approaches necessarily lead to differing conclusions based on farm dataset from a stratified sample of 200 farm households

from Tigrai regional state, Northern Ethiopia. The key questions considered were: could the single objective approach be a reasonable approximation or does the multiple objectives approach has anything to add? How does the pattern of resource allocation change when priorities attached to the different objectives/ goals change? The multiple criteria or goal programming technique, in particular, was applied to investigate the tradeoffs between two objectives; (i) achieving family food security, and (ii) maximizing cash income or cash needs of subsistence farms in the allocation of scarce resources. The following concluding remarks could be drawn.

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

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

The fact that the multiobjective or goal programming model was insensitive to objective weighting reveals that it has little, if not nothing, to add and not superior to the traditional paradigm of choice involving single-criterion. It suggests that the problem at hand is a classic case of decision-making environment that could be approximated, fairly reasonably, by a similarly structured model but with profit or gross margin maximization as the single most objective. Our finding was consistent with earlier work for Senegalese subsistence farms Barnett *et al.* (1982).

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Appendices

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

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

Source: Woldehanna (2000)

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

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

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

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

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

Source: Woldehanna (2000)

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

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

Source: Own Calculation (Dataset of 2001 and 2002)

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

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

RAINFALL VARIABILITY AND OFF-FARM LABOR SUPPLY[1]

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Abstract

Rural households in semi-arid areas have to cope with extreme income variability. Household survival depends on the ability to anticipate and to cope with this income variability. This study examines the extent to which rainfall and rainfall variability affect off-farm labor supply in Northern Ethiopia, Tigray. A four year household level data (1996, 1997, 2001 and 2002) on 199 households and 10 years district level rainfall data for two districts was used for analysis.

Results confirm that rainfall and rainfall variability increases the probability of off-farm work participation and off-farm labor supply. This result further suggests that interventions in the labor market through public works programs may significantly improve the economic well-being and livelihood of rural households.

Key words: labor supply, rainfall, rainfall variability, Ethiopia, Tigray

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1 Introduction

Rural households in semi-arid areas have to cope with extreme income variability. Household survival depends on the ability to anticipate and to cope with this income variability. Through time, households have developed a range of mechanisms for this. These include use of credit, accumulation of assets, and informal insurance arrangements. For example, Udry (1994) shows to what extent households use credit markets to smooth income shocks in Northern Nigeria. Udry (1995) assessed the use of savings. Fafchamps et al. (1998) analyzed the role of livestock holdings, an asset, in a West African context. Dercon and Krishnan (2000a) provide evidence on informal risk-sharing arrangements in rural Ethiopia and Hoogeveen (2002) in rural Zimbabwe.

In a resource poor area like Tigray, Northern Ethiopia, the most important risk smoothing mechanism is probably households' effort to diversify activities or to supply labor off-farm. Here the existence and well-functioning of a labor market is relevant given that labor is the principal asset owned by the poor. For example, using Indian data Kochar (1999) examined household labor supply behavior in response to idiosyncratic crop income shocks. She concludes that in well-functioning rural labor markets households increase their off-farm labor supply in response to crop shocks instead of dissaving or borrowing. Similarly, Rose (2001) found that in India households are more likely to participate in off-farm employment in response to large rainfall variability. Empirical evidence is still lacking on how participation in labor markets is affected by rainfall shocks in a non-dynamic and subsistence agricultural environment in contrast to the more dynamic rural setting in India. Moreover, examining off-farm labor supply in areas where drought is a common phenomenon helps to identify the opportunities and constraints faced by rural households in the process of stabilizing income and smoothing consumption. Specifically, this chapter addresses the following questions 1) To what extent do rainfall and rainfall variability affect off-farm labor supply? 2) To what extent do other socio-economic factors affect off-farm labor supply decisions? Answering these questions is important in order to gain better insights into the process of how households deal with income variability, and thereby improving policies and interventions.

To answer the research questions we derive an off-farm labor supply function from a household model that incorporates rainfall and rainfall variability. The function will be estimated using panel data collected in Tigray, Northern Ethiopia, a non-dynamic and subsistence agricultural environment. A Hausman-Taylor panel data estimator is used for estimation (Hausman and Taylor, 1981; Gardebroek and Oude Lansink, 2003). Estimating the off-farm labor supply function introduces the possibility of selection bias because not all farms supply off-farm labor. In this paper we test for this.

The theoretical model is discussed in section 2. Section 3 presents a description of the dataset. The empirical model and estimation procedure are discussed in section 4. Section 5 provides a discussion and conclusions.

2. Theoretical model

This section develops a household model that combines the production, consumption and labor supply decisions of farm households. The model is partly based on Rose (2001)[4]. A farm household is assumed to allocate time to farm work, off-farm work, and leisure such that the value marginal products of time devoted to these activities are equalized.

It is assumed that household preferences can be expressed by a single utility function (Equation 1). The household is assumed to maximize utility (*U*) from consumption (C) and leisure (L) under a budget constraint (Equation 2), a technology constraint (Equation 3) and time availability constraint (Equation 4). The budget constraint (Equation 2) states that net household income equals farm income plus off-farm labor income, and other non-labor income (Y), such as remittances. Farm income equals revenue from selling agricultural outputs minus variable costs. Off-farm labor income equals off-farm wage (*w*) times the amount of labor supplied off-farm (H^0). Production (*Q*) (Equation 3) is a function of farm household's labor supply (H^F), variable input use (vector X) and use of fixed inputs (vector A). Moreover, output is assumed to be a function of expected rainfall $(E(\theta))$ and actual rainfall (ϑ). Expected rainfall is included because some production decisions (e.g. crop choice) depend on the expected rainfall. Of course, total output also depends directly on actual rainfall. Total time available (T) is devoted to on-farm work, off-farm work, and leisure (Equation 4).

Mathematically the household's utility optimization problem is given by:

$$MaxU = U(C, L) \quad \textbf{(1)}$$

Subject to:

$$P_C C = (P_q Q - P_x X) + wH^O + Y \quad \textbf{(2)}$$

$$Q = f(H^F, X, A, E(\theta), \vartheta) \quad \textbf{(3)}$$

[4] For details on agricultural household models, see Singh et al. (1986), Sadoulet and de Janvry (1995), and Taylor and Adelman (2003). To simplify presentation we omit indices indicating households.

$$T = L + H^F + H^O \quad \textbf{(4)}$$

$$E(\theta) = \overline{\theta} \quad \textbf{(5)}$$

$$\vartheta = \overline{\vartheta} \quad \textbf{(6)}$$

$$A = \overline{A} \quad \textbf{(7)}$$

$$w = w(K, Z) \quad \textbf{(8)}$$

$$L \geq 0, H^F \geq 0, H^O \geq 0, C \geq 0, Q \geq 0, X \geq 0, A \geq 0, E(\theta) \geq 0, \vartheta \geq 0, w \geq 0 \quad \textbf{(9)}$$

where P_C, P_q, P_x are vector of prices of consumption goods, farm output, and variable farm inputs respectively. *E* is expectations operator.

Constraints (5), (6), and (7) state that the expected amount of rainfall, actual rainfall, and amount of fixed inputs are exogenously given at fixed amounts $\overline{\theta}$, $\overline{\vartheta}$, and $\overline{A}$ respectively. The off-farm wage households face (Equation 8) is assumed to depend on household characteristics (vector K) and local labor market characteristics (vector Z). Equation (9) gives the non-negativity constraints. Rewriting (4) and substituting (3) and (4) into (2) the budget constraint can be written as:

$$P_C C = P_q f(H^F, X, A, E(\theta), \vartheta) - P_x X + w(T - L - H^F) + Y \quad \textbf{(10)}$$

The household utility and production function are assumed to be concave, continuous, and twice differentiable, ensuring a utility maximizing solution.

The Lagrangian (*G*) for the above constrained maximization problem is given by:

$$\begin{aligned} G(C,L) = U(C,L) + \lambda\Big[P_C C - \big(P_q f(H^F, X, A, E(\theta), \vartheta) - P_x X + w(T - L - H^F) + Y\big)\Big] + \\ + \gamma\big(E(\theta) - \overline{\theta}\big) + \psi(\vartheta - \overline{\vartheta}) + \delta\big(A - \overline{A}\big) \end{aligned} \quad \textbf{(11)}$$

where λ is the Lagrange multiplier associated with the budget constraint, γ, ψ, and δ are the Lagrange multipliers associated with the equality constraints of expected rainfall, actual rainfall and fixed inputs respectively.

Maximization of this Lagrange with respect to $E(\theta), H^F, X, A, Y$ yields the following first-order conditions:

$$\frac{\partial G}{\partial E(\theta)} = -P_q \frac{\partial Q}{\partial E(\theta)} \lambda + \gamma = 0 \quad \textbf{(12)}$$

$$\frac{\partial G}{\partial \vartheta} = -P_q \frac{\partial Q}{\partial \vartheta} \lambda + \psi = 0 \quad \textbf{(13)}$$

$$\frac{\partial G}{\partial H^F} = -P_q \frac{\partial Q}{\partial H^F} \lambda + \lambda w = 0 \quad \textbf{(14)}$$

$$\frac{\partial G}{\partial X} = -P_q \frac{\partial Q}{\partial X} \lambda + \lambda P_x = 0 \quad \textbf{(15)}$$

$$\frac{\partial G}{\partial A} = -P_q \frac{\partial Q}{\partial A} + \delta = 0 \quad \textbf{(16)}$$

$$\frac{\partial G}{\partial Y} = -\lambda \quad \textbf{(17)}$$

$$\frac{\partial Q}{\partial H^F} / \frac{\partial Q}{\partial E(\theta)} = \frac{\lambda w}{\gamma} \quad \textbf{(18a)} \quad \text{and} \quad \frac{\partial Q}{\partial H^F} / \frac{\partial Q}{\partial \vartheta} = \frac{\lambda w}{\psi} \quad \textbf{(18b)}$$

$$\frac{\partial Q}{\partial X} / \frac{\partial Q}{\partial E(\theta)} = \frac{\lambda P_x}{\gamma} \quad \textbf{(19a)} \quad \text{and} \quad \frac{\partial Q}{\partial X} / \frac{\partial Q}{\partial \vartheta} = \frac{\lambda P_x}{\psi} \quad \textbf{(19b)}$$

$$\frac{\partial Q}{\partial A} / \frac{\partial Q}{\partial E(\theta)} = \frac{\delta}{\gamma} \quad \textbf{(20a)} \quad \text{and} \quad \frac{\partial Q}{\partial A} / \frac{\partial Q}{\partial \vartheta} = \frac{\delta}{\psi} \quad \textbf{(20b)}$$

Conditions (12 and 13) give the value marginal products (VMP) or shadow prices of expected and actual rainfall respectively. Any change in the exogenous variables will lead to new shadow prices of the expected and actual rainfall. Condition (14) states that on-farm labor is utilized up to the point where the VMP of on-farm labor equals the off-farm wage. That is the household allocates its time to farm production up to the point where the marginal return from work on the farm is exactly equal to the off-farm wage. Equation (8) shows that this off-farm wage is farm-specific because it depends on household characteristics (e.g. education). Condition (15) shows that the VMP of a variable input equals its price. Condition (16) implies that the VMP of a fixed input is equal to its shadow price. It is expected that the VMPs of fixed inputs

decrease as their quantity increases. Condition (17) implies that the VMP of non-labor income is equal to its shadow price. A marginal increase in the amount of non-labor income received by the household relaxes the budget constraint (see Equation 2). If a farm household receives non-labor income, then household members will prefer to work less and enjoy more leisure. In contrast, if there is no non-labor income received, hours worked are likely to increase.

Condition (18a) states that the marginal rate of substitution between household on-farm labor and expected rainfall equals the ratio of the shadow price of on-farm labor supply (equal to the off-farm wage) and expected rainfall. Condition (18b) states this for actual rainfall. Expected and actual rainfall in a particular crop year can have three effects on the labor allocation decision. First, marginal increases (decreases) in the amount of expected or actual rainfall lead to a marginal increase (decrease) in time allocated to on-farm labor. This implies that farmers allocate more time for land preparation, and planting and also for collecting and harvesting rainwater. Here rainfall and on-farm labor are complements. Second, a marginal increase (decrease) in the expected and actual rainfall lead to a marginal decrease (increase) in on-farm hours work. On-farm labor and rainfall are in that case substitutes. Third, lower expected and actual rainfall would translate into an immediate reduction in the marginal productivity of on-farm labor. This leads to a reduction in farm income that can lead to an increase in off-farm labor supply. In case of a lower expected rainfall this could be interpreted as a precautionary effect.

Condition (19a) states that the marginal rate of substitution between a variable input and expected rainfall equals the ratio of the price of the variable input and the shadow price of expected rainfall. Condition (19b) does this for actual rainfall. There are two possible situations. First, a marginal increase (decrease) in expected or actual rainfall leads to a marginal increase (decrease) in the use of variable inputs (e.g. fertilizer). In that case rainfall and variable inputs are complements. Second, a marginal increase (decrease) in expected or actual rainfall decreases (increases) the use of variable inputs. In that case rainfall and variable inputs are substitutes.

Theoretically, for the household the decision whether or not to participate in off-farm work depends on a comparison of the off-farm wage with the reservation wage w^r, below the reservation wage the household will decide not to work off-farm. This can be expressed as follows:

$$I = \begin{cases} 1 & if \quad w^r < w \\ 0 & if \quad w^r \geq w \end{cases} \qquad \textbf{(21)}$$

where I is indicator dummy for off-farm work participation, w, is the off-farm wage. Due to non-separability between production and consumption decisions in the absence of complete markets the reservation wage is an endogenous variable, which will depend on the other exogenous variables in the model. Variables that increase the reservation wage relative to the off-farm wage reduce the probability of off-farm work participation, while variables that raise the off-farm wage increase the probability of off-farm work. An off-farm participation model will be estimated in section 6.4 in order to determine what factors determine the decision whether or not to work off-farm. This equation is also used to determine the Mills ratio that is used for testing whether or not there is sample selection bias in the off-farm labor supply function. Using the first order conditions one can derive the off-farm labor supply function. Off-farm labor supply can be expressed as:

$$H^O = f(P_q, P_x, A, Y, E(\theta), \vartheta, K, Z) \qquad \textbf{(22)}$$

The reduced form labor supply Equation (22) shows that off-farm work is expressed in terms of output prices, variable input prices, amount of fixed inputs, non-labor income, household's expectation of rainfall, amount of actual rainfall, household characteristics and local labor market characteristics (the latter two determining the off-farm wage).

3. Data

The theoretical model described in the previous section is applied to a four year household dataset for Tigray, Northern Ethiopia, covering the years 1996, 1997, 2001, and 2002. The dataset consists of 199 farm households in two districts of southern Tigray. It includes information on household time allocation, off-farm employment, total number of hours worked off farm, and local labor market and household characteristics.

Off-farm working hours and off-farm labor income were recorded by growing season. For estimation purposes off-farm working hours and off-farm labor income were aggregated into yearly data. Because we do not have information about the household specific off-farm wage, it is computed by dividing annual off-farm labor income by annual hours worked off-farm. In the off-farm participation model the dependent variable is a dummy indicating whether some members of the household participated in the labor market or not. About 73.3 percent of household's engage in off-farm employment[5]. The dependent variable for the off-farm labor supply model is

[5] The activities in which these 73.3% of the households were engaged include unskilled daily labour (67% of the households were involved in this at some point in the four year sample period), food for work (22% of households involved) and self-employment such as selling fire wood and charcoal, selling cactus etc. (38%

the total number of hours supplied off-farm. The average number of hours worked off-farm is 1530 for 412 observations.

As indicated in the theoretical framework, both expected and actual rainfall can have an effect on households' income and labor allocation decisions. The actual rainfall amount is critical for crop land preparation and crop planting, thus it has an effect on household labor allocation decisions. Therefore actual monthly average rainfall amounts for the short (March) and for the long (June) rain season are included.

Maximizing utility with a production constraint containing expected rainfall is equivalent to utility maximization subject to a production function dependent on the certainty equivalent of rainfall. The certainty equivalent depends on expected rainfall and the variance of rainfall[6]. The more variable rainfall is, the higher the risk involved and the lower the certainty equivalent. From the definition of the certainty equivalent it follows that in the empirical model there has to be an expression for expected rainfall and the variance of rainfall. For expected rainfall, we could use a (weighted) mean of rainfall in previous years. However, note that since we already included actual rainfall for different years, this weighted mean would be highly correlated with actual rainfall. Therefore, the certainty equivalent of rainfall is represented by rainfall variability[7]. Two variables of rainfall variability are constructed. First, rainfall variability within a year expressed by an index developed by Gurgand (2003)[8]. Second, rainfall variability between years expressed by the annual rainfall deviation from the 10 year period mean[9]. It is assumed that the larger the rainfall variability the lower the expected rainfall will be.

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of the households). Households were often engaged in more than one type of off-farm employment and therefore the percentages do not add up to 100%.

[6] The certainty equivalent is defined as: $CE(\theta) = E(\theta) - \frac{1}{2} \cdot \gamma \cdot \mathrm{var}(\theta)$, where γ is the Arrow-Pratt measure of absolute risk aversion.

[7] Note that this model set-up corresponds to Rose (2001) who tests the impact of rainfall expectations via the parameter for rainfall variability and the impact of actual rainfall on the difference between actual and expected rainfall.

[8] Rainfall variability is computed using the Gurgand (2003) index. That is, $\sigma_{dt}^2 = \sqrt{1/12 \sum_{m=1}^{12} (r_{dmt} - \overline{r}_{dm})^2}$ where *d*, *t*, and *m* denote district, a given year and a given month respectively. r_{dmt} measures monthly rainfall amount in district *d* during year *t* and in a specific month *m*, whereas $\overline{r}_{dm}$ measures the average monthly rainfall amount in district *d* and month *m* over the period 1993 to 2002. This index measures how typical rainfall has been in a given year. For every calendar month, the average precipitation over the period is taken as "normal" and deviation from this value for a given year is exceptional rainfall (Gurgand, 2003).

[9] To calculate rainfall variability we used rainfall data from the two districts for the years 1993 through 2002. We realize that not all these data where available when expectations where formed.

Farmers plant a mix of crops, of which the major ones are barley, wheat, teff, vetch, and lentil. Based on the amount of rain required the crops are aggregated into: most rain dependent crops (wheat and lentil); less rain dependent (barley and teff) and least rain dependent crop (vetch). Output prices of these outputs are determined by weighting the prices of the individual crops using the output quantities as weights[10]. Output prices and variable input prices are normalized by the price of the most rain dependent crop (wheat and lentil). Variable inputs are seeds, fertilizer and an aggregate of pesticides and herbicides. Output prices are determined by asking the head of the household what the level of output was and the value of each crop would have been if they had sold total harvest. Seeds of all individual crops are aggregated into one input. Seed price is a weighted average of the prices of individual seeds. The price of individual seeds is determined by asking what the price would have been if farmers would have bought the seeds. Prices of outputs and seed are therefore farm specific. So, they vary over farms and over years. Fertilizer, pesticides and herbicides prices are determined on district level and assumed equal between farms. Pesticides and herbicides are aggregated into one input using quantities as weights.

Fixed inputs are cultivated land, large livestock (which includes value of cattle, horses, mules, camels and donkeys) and small livestock (value of sheep and goats). Including large livestock enables to see if off-farm labor supply and assets are competing strategies to cope with income variability. Household characteristics are family size, which is measured by the number of persons living in the household for at least 9 out of 12 months, age, measured as completed years, and education of the household head. For education an education dummy is used indicating whether the household head is literate or illiterate. A district dummy is also included in the off-farm labor supply function. This dummy captures labor market characteristics of different regions.

Non-labor income (remittances from relatives, food aid from government, gifts or others) is also recorded. The descriptive statistics of the variables used in the analysis are reported in Appendix .I.

4 Empirical model and estimation

In this section an off-farm work participation model and off-farm labor supply function are estimated. Moreover, it is tested whether sample selection bias exists. Sample

[10] Alternatively cost and revenue shares could have been used.

selection bias might be a problem in estimating the off-farm labor supply function given that we have many zero observations.

4.1 The off-farm labor participation model

The participation model is binary and models the probability of each farm household engaging in off-farm employment. Equation (21) is used to derive the off-farm work participation model. The probability of off-farm work participation is specified as:

$$P(I = 1|x) = F(x'\beta) \tag{23}$$

where x is a vector of independent variables that are hypothesized to influence households' off-farm participation. F is the cumulative distribution function.

The distribution function is assumed to be normal, and is estimated using a pooled probit model. In this step the Mills ratio is calculated. The Mills ratio is included in the off-farm labor supply function. When the parameter of the Mills ratio is not significantly different from zero then we have selection bias. However if it is not significantly different from zero then the selection bias is not a problem and a panel data estimator can be used to estimate the off-farm labor supply function (Wooldridge, 220: 582).

Explanatory variables included in the participation equation are normalized output prices (prices of less and least rain dependent crop), normalized prices of variable inputs (seed, fertilizer, and an aggregate of pesticides and herbicides), fixed inputs (area of cultivated land, value of large livestock, and value of seep and goat), family size, household head age, education of the household head, rainfall variables (rainfall variability, mean annual rainfall deviation, mean rainfall amount in March and June), non-labor income and district dummy.

XVI. 4.2 The off-farm labor supply model

The labor supply function is specified as:

$$H_{it}^{*} = X_{it}'\beta + \varepsilon_{it} \tag{24}$$

Where H_{it}^{*} is a latent variable of off-farm hours worked and is observed for values greater than 0 and is censored for values less than or equal to 0; and ε_{it} is a random error. If the disturbance term in (24) is written as $\varepsilon_{it} = \eta_i + u_{it}$, where u_{it} an error term with mean zero and variance σ_u^2, and $E(u_{jt}u_{it}) = 0$ for all $j \neq i$ and $E(u_{it}u_{is}) = 0$ for all $s \neq t$ then the appropriate estimation technique depends on the nature of η_i. η_i is the household specific effect and measures household specific unobserved variables as management skills.

In the presence of a household specific effect (η_i), the fixed effects estimator yields consistent parameter estimates. However, since the fixed effects estimator requires transforming the data into deviations from individual means or first differences to get rid of the fixed effects, time-invariant variables also drop out of the model, even though they could be of interest. If explanatory variables are uncorrelated with the household specific error term a random effects estimation technique can be used. An advantage of the random effects estimator is that it allows estimation of parameters from the time-invariant variables in contrast to the fixed effects estimator. However, the assumption that all explanatory variables are uncorrelated with the household specific effects does not hold in many cases. Hausman and Taylor (1981) proposed a generalized estimation technique that combines the desirable properties from both the fixed effects and random effects estimators. Based on Hausman and Taylor Equation (24) is rewritten as:

$$H_{it}^{*} = X_{1it}'\beta_1 + X_{2it}'\beta_2 + Z_{1i}\alpha_1 + Z_{2i}\alpha_2 + \eta_i + \varepsilon_{it} \qquad \textbf{(25)}$$

Where X_{1it} are the variables that are time varying and uncorrelated with η_i (time varying exogenous variables); X_{2it} are time varying and correlated with η_i (time varying endogenous variables); Z_{1i} are time invariant and uncorrelated with η_i (time varying exogenous variables); Z_{2i} are time invariant and correlated with η_i (time invariant endogenous variables) and it is assumed that $E[\eta_i] = E[\eta_i | X_{1it}, Z_{1i}] = 0$, $E[\eta_i | X_{2it}, Z_{2i}] \neq 0$, $Var[\eta_i | X_{1it}, Z_{1i}, X_{2it}, Z_{2i}] = \sigma_\eta^2$ and $Var[\eta_i + \varepsilon_{it} | X_{1it}, Z_{1i}, X_{2it}, Z_{2i}] = \sigma_\eta^2 + \sigma_\varepsilon^2$.

The presence of X_{2it} and Z_{2i} would cause estimation bias in case the model would be estimated using a random effects approach. Hausman and Taylor showed how the available model variables can be used to instrument for these variables. The time invariant variables Z_{2i} are instrumented by the individual means $\overline{X}_{1it}$. The time varying variables X_{2it} are instrumented by their deviations from individual means $(X_{2it} - \overline{X}_{2i})$. By definition, Z_{1i} and X'_{1it} are uncorrelated with the household specific error term η_i so that Z_{1i} can serve as its own instrument and $(X_{1it} - \overline{X}_{1i})$ serves as instrument for X_{1it} (Greene, 2003).

In the short-run cultivated land and family size are assumed fixed, and therefore, they are treated as time varying exogenous variables.[11] Rainfall variables are considered exogenous. Prices of insecticides and herbicides and fertilizer are included as exogenous variables, because these prices vary across years but not across households. The Hausman-Taylor estimator is identified if the number of variables that are time varying and uncorrelated with the individual specific effect is greater than the number of variables that are time invariant and correlated with the specific effects. The district dummy, which is a measure of market characteristics, is considered to be a time invariant exogenous variable. Non-labor income received by the household, which is exogenous income that adds to the wealth of the household is treated as a time variant exogenous variable.

Prices of outputs and seed are treated as time-varying endogenous variables. These prices are determined on household level and vary over households and over years. Differences between farms can be interpreted as quality differences (Thijssen, 1992). Household head age and education are also assumed to be correlated with the household specific effects. The former as a time variant endogenous variable while the latter is a dummy and is considered as a time invariant endogenous variable.

5. Results

5.1 The off-farm work participation model

Estimation results for the off-farm employment participation model are reported in Table 1.[12] The likelihood ratio test outcome of 214.85 indicates that the null

[11] In Ethiopia there is no formal land market. Access to land is based on membership to village communities. Although there is an informal land market in the study area, it is not frequently used by many farmers and it is natural to think of cultivated land as a fixed input in the short run (average cultivated land size in 1996 and 2002 was about 1.78 ha and 1.63 ha respectively). Family size is also considered fixed in short run (the average family size in the year 1996 and 2002 was 5.57 and 5.91 members respectively).

[12] Marginal effects are calculated as the derivatives of the cumulative normal distribution at the mean of the explanatory variables; for dummies the marginal effect is expressed as the discrete change from 0 to 1.

hypothesis that all slope coefficients are zero is rejected at 5 percent significance level.

Rain variability is positively related to the off-farm work participation decision. As variability of rainfall increases by one unit, probability of off-farm work increases with 0.09. Mean annual rainfall deviation from the overall ten year mean also significantly and positively influences the probability of off-farm employment. The marginal effect indicates that a 1 mm increase in mean annual rainfall deviation increases the probability of off-farm work by 0.05. These findings indicate that rainfall variability, as indicator for expected low rainfall, encourages households to engage in off-farm work as an income and consumption smoothing strategy[13]. This result is consistent with Rose (2001); who concluded that the probability of household's participation in off-farm employment increases if it expects low and variable rainfall.

Mean rainfall amount in March and June are significantly and negatively related to the probability of off-farm employment. This indicates that as mean rainfall amount in March and June increases by 1 mm the probability of working off-farm decreases by 0.05 and 0.10 respectively. These are the critical periods in which on-farm labor is needed for land preparation and sowing. In these periods on-farm labor is likely to increase with good rainfall.

As expected the coefficient of value of large livestock is negatively and significantly related to the probability of off-farm work participation. This suggests that an increase in value of livestock reduces the probability of off-farm employment. As livestock value is a proxy for wealth, the negative relationship explains that relatively wealthy households are less likely to participate in off-farm work. This finding is consistent with the general belief that livestock is used as an income and consumption smoothing strategy in most developing countries[14]. Similarly, cultivated land negatively influences the probability of off-farm employment. The marginal effect suggests that a 1 hectare increase in the size of the farm reduces the probability of off-farm work by 0.02.

The coefficient for household head age indicates that households with older heads are less likely to participate in off-farm employment. The age of household head also proxies the stage in the family life cycle. Younger household heads have both the ability and the need (to take care of dependent family members in the household) to work off-farm. Contrary to expectations education of the household head had no

[13] Including the average rainfall over a longer period would imply perfect multicollinearity with the district dummy, and therefore is not included in estimation.
[14] Fafchamps et al. (1998) show for West Africa that during drought years livestock sales compensated for 15 to 30 percent of income fluctuations.

influence on the probability of off-farm work participation. This is possibly because of insufficient variability between households[15].

The probability of off-farm employment participation positively increases with family size. This suggests that larger households have a tighter budget constraint (insufficient farm income) thus a higher need for additional income. Another reason could be that a large family size results in a low on-farm marginal productivity of labor. An increase with 1 extra member increases the probability of off-farm employment with 0.06. This result is consistent with Woldehanna (2000) and Matshe and Young (2004).

Finally, normalized output and variable input prices do not have a statistically significant relation with the probability of off-farm work. The normalized price of the less rain dependent crop has the expected sign. As the price of the less rain dependent crop increases by 1 Birr probability of off-farm work decreases with 0.04, but not significantly. Contrary to expectations, the price of least rain dependent crop is positively related to probability of off-farm work. The price of seed is negatively related to the probability of off-farm employment. A high seed price is to be expected if farms have the idea growing crops is profitable. This reduces off-farm labor supply. This is consistent with the situation of the farmers in the study area where farmers usually save their own seed for sowing. Price of insecticides and herbicides is positively related to the probability of participation in off-farm employment. Herbicides and insecticides represent a labor saving technology and have a positive effect on the decisions to work off-farm. However the coefficient is not significantly different from zero.

In sum, the general picture that emerges is that off-farm employment is an important income stabilization strategy for rural farm households in Tigray that maintain traditional production systems primarily oriented toward self-consumption.

Table 1; Estimation results and marginal effects of the probability of household off-farm work participation[16]

Variable	Coefficient	z-value	Marginal effect
Intercept	-3.0894*	-5.41	
Price of less rain dependent crop	-0.1078	-0.55	-0.04
Price of least rain dependent crop	0.0436	0.33	0.02

[15] This is an unexpected result because most of the literature, for example Matshe and Young (2004), report a positive and significant relationship between the probability of off-farm employment and household head education.

[16] Since the left hand side variable is binary the farm-specific wage variable would be perfectly collinear, and is therefore excluded from estimation.

Seed price	-0.0680	-0.43	-0.03
Insecticide & herbicide price	0.0036	0.79	0.00
Fertilizer price	-0.1438	-1.71	-0.06
Rainfall variability	0.2160*	9.61	0.09
Mean annual rainfall deviation	0.1201*	9.21	0.05
Mean rainfall in March	-0.1281*	-8.53	-0.05
Mean rainfall in June	-0.2594*	-9.65	-0.10
Non-labor income	-0.0000	-0.36	-0.00
Value of large livestock	-0.0001*	-4.08	-0.00
Value of sheep & goat	0.0001	0.17	0.00
Cultivated land	-0.0458*	-2.56	-0.02
Family size	0.1412*	5.02	0.06
Head age	-0.0180*	-3.81	-0.01
Dummy head education	-0.2091	-1.85	-0.08
Log likelihood	-383.25		
LR chi2(17)	214.85*		
Pseudo R2	0.22		
Number of observations	708		

*significant at 0.05

XVII. 5.2 The labor supply model

From the off-farm labor participation model the inverse Mills ratio is derived. The ratio is included in the off-farm labor supply model to correct for sample selection bias. The labor supply model is estimated using the Hausman-Taylor instrumental variable method. The inverse Mills ratio appeared not to be statistically significant (t-value is -0.74) indicating sample selection is not a concern in the data. Estimation results are presented in Table 2[17].

Table 2: Estimation results and elasticities of household's off-farm labor supply [18]

Variable	Coefficient	z-value	Elasticity's at

[17] A standard Hausman (1978) test comparing random effects and fixed effects estimates was performed to determine whether the random-effects estimator would have been appropriate. The test statistic of 28.01 is larger than the critical value $\chi^2_{15;0.95} = 25.00$. So, it is concluded that there is correlation between at least one of the included variables and the household specific effect, so that the random-effects estimator would give biased estimates. An additional Hausman test is conducted to test the Hausman-Taylor model specification against a fixed-effects model. The test statistic of 7.20 is less than the critical value of 25.00, indicating that the chosen specification for the Hausman-Taylor model gives unbiased estimates.

[18] Flexible functional forms, such as quadratic, yielded inconclusive results. Specifically almost all of the coefficients of the interaction terms were not statistically significant and the signs obtained were also contrary to expectations. This is due to the small number of degrees of freedom and collinearity.

			mean value
Intercept	-1229.23	-1.05	
Time Variant exogenous variables			
Insecticide & herbicide price	6.17*	2.61	0.02
Fertilizer price	-248.01*	-3.38	-0.21
Rainfall variability	144.41*	2.73	9.32
Mean annual rainfall deviation	84.87*	2.83	0.98
Average rainfall in March	-98.11*	-3.09	-3.06
Average rainfall in June	-154.90*	-2.45	-6.55
Non-labor income	-0.11	-1.29	-0.02
Value of large livestock	-0.07*	-2.24	-0.38
Value of sheep & goat	-0.05	-0.15	-0.00
Cultivated land	-25.55	-1.33	-0.27
Family size	93.43	1.91	0.76
Mills ratio	386.11	0.88	0.44
Time Variant endogenous variables			
Price of less rain dependent crop	-227.95	-1.61	-0.21
Price of least rain dependent crop	25.71	0.25	0.01
Seed price	102.55	0.92	0.12
Head age	-32.51*	-3.64	-2.17
Time Invariant endogenous variable			
Dummy head education	765.33	1.51	0.41
Time Invariant exogenous variable			
Dummy district	8438.50*	2.76	5.43
Wald chi2(18)	168.50*		
Number of observation	708		

*significant at 0.05. The inverse Mills ratio is obtained from the equation on the probability of working off-farm and is used as an explanatory variable in the off-farm labor supply function (Equation 25).

As expected, rainfall and rainfall variability relate positively, and significantly, to the number of hours worked. Households increase off-farm labor supply in response to rainfall variability and mean annual rainfall deviation[19]. In response to a 1% increase in rain variability the number of hours worked off-farm increases by 9.32%. Similarly

[19] Kochar (1999) also finds that households increase their off-farm labor supply in response to an income shock.

the number of hours supplied off-farm increases by 0.98% if mean annual rainfall deviation increases by 1%. Mean rainfall amount in March and June are negatively correlated with off-farm labor supply. As expected, mean rainfall amount in March and June and on-farm labor are complements. During the growing season of the cropping year, on-farm labor productivity increases, and households are encouraged to supply more labor on-farm. A 1% increase in mean rainfall in June reduces off-farm employment by 6.55%. This is the month, where most of the planting takes place.

The coefficients of the values of large livestock and small livestock have a negative sign. The coefficient for large livestock is statistically significant, while for small livestock it is not significant. This shows that if the value of large livestock increases with 1% the number of hours worked reduces with 0.38%. The sign of the coefficient representing cultivated land is negative suggesting that as farm size increases the number of hours supplied to off-farm work declines. However, the coefficient is not statistically significant. Non-labor income has a negative effect on off-farm labor supply. However, the coefficient is not statistically significant. Off-farm hours supplied increase if family size increases (statistically significant). The elasticity suggests that as the number of family size increases by 1% off-farm hours supplied increase by 0.76%.

None of the normalized output prices have a significant effect on off-farm labor supply. The sign of the price of the less rain dependent crop has the expected negative sign. This implies that if the price of the less rain dependent increases off-farm labor supply decreases. Normalized prices of seed and insecticides and herbicides have the expected sign. The price of insecticides and herbicides has a significant and positive effect on off-farm labor supply. The coefficient for the price of seed is not significantly different from zero. Households reduce the number of hours supplied to off-farm work in response to a fertilizer price increase. This indicates fertilizer is a substitute for labor.

In the face of an ex-ante and ex-post rainfall risk household supply more hours to off-farm work. This is more likely to be the case when the household is very poor (no livestock) and the rainfall shock is very large. Off-farm labor supply is used as an income smoothing and mitigation mechanism.

6. Conclusions

Off-farm labor supply can be seen as an income and consumption smoothing strategy followed in response to rainfall variability. This chapter addresses the following questions: 1) To what extent do rainfall and rainfall variability affect off-farm labor supply? 2) To what extent do other socio-economic factors affect off-farm labor supply decisions? To answer these questions the discrete off-farm work decision and

labor supply function were analyzed for a sample of Tigray farm households observed in 1996-1997 and 2001-2002. A probit model was used to estimate the off-farm work participation model and a Hausman-Taylor instrumental estimator was applied for estimation of the labor supply model.

Results confirm that rainfall variability increases the probability of off-farm work participation and off-farm labor supply. If household's expectation of rainfall is low they are more likely to participate in off-farm work. Similarly, the probability of off-farm work participation and hours worked increases in response to a drop in actual rainfall. These finding are consistent with Rose (2001) who confirmed the existence of an ex-ante and ex-post labor supply responses to rainfall risk. Wealth, in the form of a large livestock, has a negative effect on off-farm work participation and hours worked. This confirms that a large livestock is an alternative strategy to cope with risk related to rainfall.

The analysis in this chapter is subject to some qualifications. First, this study has only addressed off-farm labor participation and labor supply responses in reaction to actual and expected rainfall. However, there are other sources of risk then risk related to rainfall, e.g. market price risk. Second, here we looked at off-farm labor isolated from other decisions taken on the farm. Finally, we ignored gender issues. Men and women tend to invest in different skills and thus face different labor market opportunities.

We conclude that off-farm labor supply is important in mitigating and coping with income variability related to rainfall variability. Therefore, improving the functioning of labor markets and creating them, e.g. through public works programs, may significantly improve the economic well being and livelihood of rural households.

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Appendix I: Descriptive Statistics

Definition	Number of Observations	Mean	Standard Deviation
Dependent Variables			
Off-farm participation (=1 if household members engage in off-farm work)	708	0.51	0.50
Off-farm number of hours supplied*	412	1530.23	1303.31
Farm Characteristics			
Cultivated land in hectares	708	2.01	1.13
Price of less rain dependent crop Eth Birr**	560	0.86	0.23
Price of least rain dependent crop Eth Birr	195	0.82	0.43
Seed price Eth Birr	573	1.04	0.37
Insecticide and herbicide price Eth Birr	26	53.35	69.83
Fertilizer Price Eth Birr	322	1.41	0.45
Value of large livestock Eth Birr	659	4162.80	3520.69
Value of sheep & goat Eth Birr	63	323.57	340.28
Rainfall			
Rain variability	708	48.29	17.09
Mean annual rainfall deviation (τ)	708	-8.60	17.10
Mean rainfall amount in March	708	23.37	14.92
Mean rainfall amount in June	708	31.65	11.463
Other household income			
Non-labor income Eth Birr	708	132.26	480.94
Household head characteristics			
Head age	708	49.93	11.75
Education household head (=1 if head is literate, 0 if illiterate)	708	0.40	0.49
Household characteristics			
Family size	708	6.08	2.03
Market characteristics			
District dummy variable (=1 if Enderta district)			

*Sample mean and standard deviation are computed for those who work off-farm that is 412 farm households.

** Eth Birr is a local currency, 1$=8.65 Eth Birr

DETERMINANTS OF ECONOMIC MIGRATION FROM PASTORAL AREAS: THE CASE OF SOMALI REGION OF ETHIOPIA

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Abstract

Even though Ethiopia is largely under-urbanized even by African standards, rural urban migration has fueled the burden on the already stagnant urban infrastructure existing in most urban areas in the country. This study analyzed the determinants of economic migration in the Somali Regional State of Ethiopia based on data collected from 178 migrant households were using descriptive statistics and logit econometric model. Among the migration forces considered, employment opportunities in place of origin and destination were the dominant factors causing economic migration accounting for about 40% of the cases. These are followed by better living conditions and educational facilities in place of destination which together accounted for 32% of the cases. Of the variables considered in the logit model; sex of the household head, household size, dependency ratio, relationship with communities in the place of origin, livestock composition, information and clan clashes were found to be important factors influencing economic migration decisions. The consideration of these factors would help policy makers in designing measures that would help reduce unnecessary rural out-migration.

Key words: *Ethiopia; economic migration and logit model*

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1. Introduction

Migration is one of the important social and economic phenomena that attracted the attention of policy makers and many social scientists. Many scholars tried to lay the theoretical foundations that would enable understand the causes of migration to help policy makers in making decisions. According to Ravensteins laws of migration, migrants move from areas of low to high opportunity, the choice of destination being regulated by distance, with migrants tending to move to nearby places. Lee (1966) further developed a general theory of migration where push and pull factors were considered to affect the tendency of people to move. On the other hand, Sjaatad (1962) advanced a theory of migration which treats the decision to migrate as an investment decision involving an individual's expected costs and returns over time. Todaro (1979) realized that rural-urban labor migration was no longer a beneficial or virtuous process solving simple inequalities in the spatial allocation of labor supply and demand but as a major contributing factor to the ubiquitous phenomenon of urban surplus labor and as a force which continuous to exacerbate already serious urban unemployment problems caused by growing economic and structural imbalances between urban and rural areas, particularly in less developed countries. Thus, proper policy formulation to overcome the social and economic problems associated with rural-urban migration requires the understanding of the causes of migration as well as the socioeconomic characteristics of the migrants themselves.

Many of the empirical studies conducted based their tenets of the analysis of determinants of rural urban migration on one or more of the above mentioned theories. Traditionally, most of the economic studies on migration have integrated the process into Todaro (1969) type economic models, and saw migration as the result of large differences in employment opportunity, income, and amenity levels between urban and rural areas (Lewis, 1954; Shaw, 1975; Brown and Gotez, 1987; Xu, Liu and Zeng, 1988).

With a population of 73 million in 2005, Ethiopia is the second populous country in Africa. Increases in internal migration associated with economic and political transitions have made migration a salient feature in Ethiopia. It is one of the countries with relatively high internal rate of migration and population redistribution in the world (Gurmu, 2000). Despite the low level of economic development, population movements in Ethiopia are substantial. The country has been undergoing major transformations from a centrally planned to a market oriented economy since the current government came to power in 1991. Under such transformations internal migration tend to play an increasing role both demographically and economically.

At the points of destination, like Jijiga, the deleterious consequences of rural-urban migration have been noted. With the demand for urban socio-economic amenities exceeding their supply, the urban areas, like Jijiga, became spectacles of multifarious social problems such as overcrowding, congestion, inadequate housing, high rates of unemployment and underemployment and other forms of delinquency. Despite its importance in policy making very few studies tried to explore the determinants of rural urban migration in Ethiopia. For instance, Marcos (2001) examined out-migration of rural communities in drought prone areas of Northern Ethiopia by using logit model. The results of the study showed that at individual level age and sex were found to be significant factors and females were found to be less likely to migrate for economic reasons. Among household level variables, means of ploughing, grain production level, ownership of modern items, and ownership of corrugated iron roof house all significantly differentiated between migration for economic and non-economic reasons. However, the study was based on data collected from place of origin, in the absence of migrants themselves. On the other hand, Markos and Gebre-egzabiher (2001) used a three level model to examine migration choice of 2000 households from 40 Peasant Associations (PA's) in Ethiopia. The reasons for migration were classified in to three, namely, economic, marriage and assistance to relatives. According to the findings of the study, while the likelihood of out-migration was significantly higher for females when the reasons for migration were marriage and assistance to relatives, it was found to be lower when migration is for economic reason.

The next section presents the description of the study area followed by the theoretical model in the third section. The fourth section presents empirical model used and the fifth section discusses results of the study. Finally, the sixth section concludes the paper.

2. Description of the study area

The Somali Region is one of nine regional states of the Federal Democratic Republic of Ethiopia and is located in the eastern Ethiopian lowlands bordering Djibouti, Somalia (including Somaliland) and Kenya. The region is almost entirely inhabited by people of Somali nation with estimated population of over 4.3 million in 2005.

Jijiga town is the capital of the region located about 630 km's east of Addis Ababa, and 105 km's east of Harar town. Based on estimates made by the Central Statistical Agency in 2005, Jijiga woreda had an estimated total population of 348,421 of whom 109,634 or 31.47 percent live in Jijiga town, which is greater than the zonal average

of 22.5 percent. On the other hand based on the survey conducted by the kebele's of the town in 2006, the total population of the town was reported to be 155,670.

As can be seen in table 2, Jijiga has a very high annual population growth rate, with its stagnant infrastructural facilities, compared to the other highly growing urban centers like Addis Ababa, Awassa and Mekele. This has created multifarious problems such as overcrowding, in adequate housing, high rates of unemployment and other forms of social problems in the town.

Table 1: Population change of selected urban areas of Ethiopia (1984-2005)

City/Town	Population			Average annual growth rate (%)	
	1984	1994	2005	1984-1994	1994-2005
Addis Ababa	1,423182	2,084,588	2,973,004	4.65	4.26
Jijiga	24,716	58,360	109,637	13.6	8.8
Awasa	36,367	69,169	125,135	9.02	8.1
Mekele	62,668	96,938	169,207	5.46	7.45

Source: CSA (2005)

Looking at the migration picture of Jijiga town, it was expected, from a prior projections of CSA, that Jijiga will have higher migration trend than other towns in the country. For instance, in 1970 the rate of migration was 2.2 percent and rate of natural increase of population was 2.4 percent, thus giving a population growth rate of 4.6. During this period there were 45 percent migrants and 55 percent non-migrants in the town. Out of the 45 percent migrants, nearly a quarter were from rural and urban areas of Hararge region and 20 percent were from other regions. The main direction of migration was from rural to urban than urban to urban migrants (CSA, 1991). Like most towns of Ethiopia, female migrants out-numbered male migrants in the town.

3. Theoretical model

Following Agesa and Kim (2001), the economy of Ethiopia can be considered as having rural/agricultural sector and an urban sector. The family in the rural sector is composed of a husband, wife, children and sometimes extended family. The rural household is assumed to maximize a utility function, with the following components: Goods that have to be purchased (G), the consumption of goods produced by the family (F) and subsistence cost (C) and emotional costs (E). The families are able to purchase goods with wage earned (W). R is used to represent real wage where R=W/P, P is the price level. The urban wage (Wu) is assumed to be higher than the

rural wage (Wr) in this model. The model also assumes that wages are the only sources of income, and that the urban wage and rural wage are fixed. The wages are also adjusted to account for the difference in cost of living between both sectors. The subsistence cost (C) component in the model is divided into subsistence cost when the family decides to stay in the rural areas (α>0) an additional subsistence cost when the family head decides to move to an urban area, which is μ>0. If the family has now to maintain two households, the total subsistence cost is α+μ and finally, when the entire household decides to move all at the same time, the total subsistence cost is β>0. On the other hand, emotional cost (E), describes the emotional toll on the migrant and his/her family when split migration occurs. In the absence of split migration E=0. Therefore, the utility function can be given as $U(G+F-C)-E$. If migration is chosen, the household moves to settle permanently in the urban area.

4. The empirical model

In this study, the logistic regression model was employed to establish relationship between migration decisions and individual, household and community level variables. The dependent variable used was migration decision which took a value of 1 if the household migrated for economic reasons and 0 otherwise. The classification of migrants as economic and non-economic was based on what the intention of the migrant family was at the time of departure. Those who expected a wage differential between their place of origin and the urban destination and intended to improve their earning were categorized as economic migrants. Those that didn't consider wage differential and had no intention of improving their earning during departure were considered as non-economic migrants.

The functional form of the logistic regression model used is specified as follows:

$$\rho_i = \frac{1}{1+e^{-z}}, \qquad Z = \beta_i X_i$$

Where, e is the base of natural logarithm

X_i represent the i[th] explanatory variable

P_i is the probability of migrating for economic/non-economic reason

β_i represent the regression parameters to be estimated

The description and measurement of the independent variables used in the study are presented in Table 2.

Table 2: Specification of the explanatory variables

Category	Variable	Measurement
Individual	Age	Age at time of migration in years
	Gender	1 if male and 0 if female
	Education	1 if literate and 0 otherwise
	Occupational skill	1 for those with transferable skills and 0 otherwise
	Martial status	1 if married, 0 otherwise
	Household size	Number of household members
	Family tie	1 if nuclear and 0 otherwise
	Dependency ratio	Active labor force and inactive labor force ratio
Household	Crop production	1 if involved in crop production, 0 otherwise
	Livestock holding	Number of livestock owned
	Livestock composition	1 if have no livestock at all, 2 if flock alone, 3 if cattle and 4 if camels
	Information	1 if information about place of origin was Secured, 0 otherwise
Community	Relationship	1 if the same clan with the community of origin, 0 otherwise
	Clan clash	1 if originated from area of clan clash

5. Results and discussion

5.1 Descriptive statistics results

Among the sample migrant households, 60.7 percent were economic migrants while the rest were non-economic migrants. From the sample migrant households, 64.7 percent of non-economic household migrants were female headed where as 35.3 percent were male headed households. The descriptive statistics results showed that there is statistically significant difference between the two groups with respect to sex (Table 3). Among the non-economic migrants those who had transferable occupational skills to an urban area accounted for 20.6 percent. For the economic migrant households the corresponding figure was 49.5 percent. A statistically significant difference was observed between economic and non-economic migrants with respect to transferable occupational skills.

It has been found empirically that family tie plays an important role in individual migration decisions. Mincer (1978) indicated that nuclear type family organization discourages migration of household members for non-economic reasons. In this study, 41.2 percent and 47.6 percent of the non economic and economic migrants, respectively had extended families during departure.

Table 3: Some demographic characteristics of the sample migrant households in Jijiga

Variable		Economic migrants		Non-economic migrants		Chi-square	Total	
		No	%	No	%		No	%
Sex	Female	48	5.7%	44	64.7%	5.97**	92	53.1
	Male	57	54.3%	24	35.3%		81	46.9
Occupational Skill	Non-holder	53	50.5%	54	79.4%	14.6***	107	61.8
	Holder	52	49.5%	14	20.6%		66	38.2
Family tie	Extended	50	47.6%	28	41.2%	0.692	78	45.1
	Nuclear	55	52.4%	40	58.8%		85	54.9

, * represent levels of significance at 5% and 1%, respectively

5.2 Results of the econometric model

The econometric model results showed that among the 15 variables included, seven were found to be statistically significant determinants of economic migration decisions (Table 4). Accordingly, being male household head is positively and significantly related to migration decision for economic reason and the odds ratio in favor of migrating for economic reason increases by a factor of 3.72 for families who are headed by males compared to female headed households. Men are more mobile in terms of visiting urban areas than women who are supposed to take care of home activities. This helps men to get more information about urban areas. On the other hand, household size was negatively and significantly related to the migrating decision of the households for economic reason. The odds ratio in favor of migration for economic reason decreases by a factor of 0.55 as the family size increases by one person. Similarly, dependency ratio was found to be negatively and significantly related to economic migration. The odds ratio in favor of economic migration decreases by a factor of 0.78 as dependency ratio increases by one unit. Thus, because of the economic burden in urban areas those households with high family size and more specifically high dependents had less likelihood of migrating for economic reasons. Furthermore, access to information was found to be positively and significantly related to the probability of migration for economic reasons. Information and know how about the opportunities in the place of destination is an important determinant of migration status as it decreases the cost of migration. The odds ratio in favor of migration for economic reason increases by a factor of 16.22 for those households who had information about their place of destination. Finally, clan clash had a positive and significant relationship with economic migration decision and the odds ratio, in favor of migration for economic reason increases by a factor of 0.33 for those families who are found in areas of clan clashes. Clan clashes sometimes might

destroy households' asset base and means of livelihood and might exacerbate economic migration.

Table 4: The Logit Model Results

Variable	Coefficient	Odds ratio
Constant	4.68	
Sex	1.31**	3.72
Age	0.03	1.03
Education	0.25	1.28
Occupational skill	0.53	1.70
Martial status	0.22	0.80
Household size	-0.68***	0.55
Family tie	-0.43	0.65
Dependency ratio	-0.25***	0.78
Relationship	1.47	4.36
Crop production	-1.28	0.28
Livestock composition	-0.02	0.98
Information	2.79***	16.22
Clan clash	-1.12**	0.33
Log likelihood function	56.61	
Percent correctly predicted	88.43	
Chi-square 118.16***	118.16***	
Number of observations	173	

*, ** and **** significant at 10%, 5% and 1%, respectively

5.3 Current situation of the migrants and willingness to return

The study also analyzed the current employment status of migrants. It was observed that most of the economic and non-economic migrants are self-employed accounting for 56.9 percent and 56 percent, respectively. And as shown in table 5 non-economic migrants have higher percentage of unemployment.

Table 5: Distribution of family migrants by current employment status

Employment status	Economic Migrants		Non Economic		Total	
	No.	%	No.	%	No.	%
Employed in Government sector	17	13.8	6	12	23	13.2
Self employed	70	56.9	28	56	98	56.7
Unemployed	36	29.3	16	32	52	30.1

On the other hand, sometimes the negative aspects of city life could lead many migrants to return to their villages; especially those who rush into the decision to migrate to an urban area find it difficult adapting to urban life styles. Accordingly, the majority of the economic migrants, 70.5 percent, have no intention of going back to their villages of origin (Table 6).

Table: 6: Distribution of family migrant by willingness to return

Return to village	Economic		Non Economic		Total	
	No.	%	No.	%	No.	%
Assistance	8	7.6	15	22.1	23	13.3
Improvement in place of origin	20	19.0	12	17.6	32	18.5
Non willing	74	70.5	35	51.5	109	63.0
Willing	3	2.9	6	8.8	9	5.2

6. Conclusion

The main objective of this study was to analyze determinants of economic migration, based on the reported reason of migration in Jijiga town that considered individual, household and community level variables. Our findings revealed that though most migrants are economic migrants there are also non-economic migrants. The empirical findings of the study showed that migrants responding to different migration forces have different characteristics. Male headed families are more likely to migrate for economic reason. It also showed that family size, dependency ratio and clan clash had adverse relationship with economic migration. Where as information about place of destination and relationship to the community of origin have direct effects on economic migration. Policies to contain migration should thus focus on rural development strategies that would enhance income generating activities in rural areas. In addition, expansion of family planning services in rural areas of the region would help reduce migration to urban areas. Expansion of basic infrastructural facilities in rural areas such as education, health, and others could also help reduce the tendencies to migrate.

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ENHANCING MARKET ORIENTATION OF SMALLHOLDERS: LESSONS FROM MARKET ORIENTATION OF HOUSEHOLDS IN SELECTED GRAINS IN ETHIOPIA

Berhanu Gebremedhin[1] and Dirk Hoekstra

Abstract

In spite of the policy decision of the GoE to commercialize subsistence agriculture, there is a dearth of information on the commercialization process and marketing behavior of small holders in Ethiopia. This paper attempts to contribute to redressing this gap of knowledge for the cereal crops of teff, wheat and rice; the pulse crops of haricot beans and chickpea and an oil crop (niger seed). Data for the study was collected from districts where these crops are important market oriented commodities. Analysis of the variation in market participation of households in these crops in areas where the crops are already important market oriented commodities offers a unique opportunity to gain insight into the determinants of the commercialization behavior of households. About 65 - 77% of households produce these market oriented commodities, on about 27 – 44% of the total cultivated area. About 47 – 60% of the produce of these market oriented commodities is sold. The important market places for producers of these commodities are the district town markets and markets located at the peasant associations (PA). Markets in other district towns or regional markets are rarely used by producers. Wholesalers and retailers are the most important buyers from producers. Econometric analyses show that market orientation of households is affected by factors related to household demographic characteristics, human and physical capital endowment, distance to markets, institutional support services, and village level factors of population density, agricultural labor wage and rainfall. Our results imply that market interventions to improve the gains to producers need to target district level markets. Special attention is required to female headed households in the process of commercial transformation of subsistence agriculture. The comparative advantage of female headed households may not be in grain production.

Population control measures may contribute to commercial transformation of subsistence agriculture through their effect of reducing household subsistence requirements. Improving the operations of factor markets of land, traction and farm labor could contribute to enhancing market orientation of farm households. Alternatively, institutional arrangements to improve household access to land and traction power could contribute to market orientation of households. Market access remains an important factor for market orientation of households, implying the need for interventions to develop market infrastructure. The extension and credit services that were designed to achieve food security objectives need to be re-examined to adopt them to the policy of commercial transformation of subsistence agriculture Ethiopia is following. In particular, the institutionalization and development of marketing extension services warrants emphasis.

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1. Introduction

Sustainable food security and welfare cannot be achieved through subsistence agriculture (Pingali, 1997). In line with this, the Government of Ethiopia (GoE) has adopted commercial transformation of subsistence agriculture as the basis of the Agricultural Development-led Industrialization (ADLI) development strategy of the country. As a result of the economic reform that took place in Ethiopia in 1991, grain markets have also been liberalized and restriction on grain trade lifted, and official pricing have been eliminated (Gabre-Madhin, 2001).

Commercial transformation of subsistence agriculture is a process and commercializing subsistence farmers may not instantly move on to high value crops. Often times, increased market orientation of staple crop production offers a more pertinent option to small holders, at least in the short and medium terms until infrastructural facilities are developed to accompany the production, processing, transportation and marketing of high value crops.

Commercial transformation of subsistence agriculture can not be expected to be a frictionless process, as it is likely to involve substantial equity issues (Pingali and Rosegrant, 1995). Small holders can be left out from benefiting from the commercialization process due to inadequate services and infrastructure, and new set of transactions costs that emerge from new market institutions and actors. Moreover, economic development, coupled with rising per capita incomes, technological change, and urbanization is causing significant changes in food markets in developing countries (Reardon and Timmer, 2007). Ethiopia is not an exception. Hence, governments and development agencies are confronted with the challenge of ensuring that small holders and the rural poor benefit from commercialization either by participation in the market or providing exit options for employment in other sectors.

An understanding of the marketing behavior, market channels used and the determinants of market participation of small holders is required to aid in designing appropriate technological, policy, organizational and institutional strategies to ensure small holders and the rural poor benefit from the process of commercialization. In spite of the policy decision of the GoE to commercialize subsistence agriculture, there is a dearth of information on the commercialization process and marketing behavior of small holders in Ethiopia. This paper attempts to contribute to redressing this gap of knowledge for the cereal crops of teff (a grass-like fine seeded staple food crop), wheat and rice; the pulse crops of haricot beans and chickpea, and an oil crop (niger seed). Data for the study was collected from districts where these crops are important

market oriented commodities. Analysis of the variation in market participation of households in these crops in areas where the crops are important market oriented commodities offers a unique opportunity to gain insight into the determinants of the commercialization behavior of households during the process of commercial transformation of subsistence agriculture.

2. Overview of grain production and marketing in Ethiopia

XVIII. 2.1 Grain production

In Ethiopia, cereals, pulses, and oil seeds covered about 78%, 14% and 8% of the total grain cultivated area of about 11 million ha in 2004/05 production season (CSA, 2006). In the same production season, cereals, pulses and oil seeds contributed about 85%, 11% and 4% of total grain production of 12.5 million metric tons, respectively.

Measured in terms of contributions to total cereal production, maize, wheat, teff, sorghum and barley are the most important cereal crops in that order. However, the relative importance of the crops changes slightly when compared in terms of their contribution to total cereal area covered, due to differences in productivity (Table 1). Maize has the highest yield.

Table 1: Contribution of cereal crops in total cereal area and total cereal production in 2004/05

Crop	Proportion of total cereal production (%)	Proportion of total cereal area (%)
Maize	27	20
Wheat	21	22
Teff	19	25
Sorghum	16	15
Barley	13	14
Other	5	4

Source: Computed from CSA (2006) data

Among pulses, faba beans, haricot beans, field peas, chickpea, grass pea and lentils are the most important crops grown in that order both in terms of area covered and contribution to total production (Table 2). Faba beans contributed about 40% of total pulse production and covered about 31% of pulse area in the 2004/05 production season.

Table 2: Contributions of pulses to total pulse area and total pulse production in 2004/05

Crop	Proportion of total pulse production (%)	Proportion of total pulse area (%)
Faba beans	40	31
Haricot beans	18	25
Field peas	17	17
Chickpea	12	12
Grass pea	Na	7
Lentils	Na	6
Other	Na	2

na: data not available
Source: Computed from CSA (2006) data

Among oil crops, niger seed, lin seed, and sesame are the most important crops which together accounted for about 87% of total oil crop production in 2004/05. Lin seed and sesame are important export crops. While sesame is grown mostly in the lowland parts of the country, niger seed and linseed are grown in higher altitudes. Among these oil crops, niger seed is most important, followed by linseed both in terms of contribution to total oil crop production and area coverage (Table 3).

Table 3: Contributions of oil crops to total oil crop production and oil crop area in 2004/05

Crop	Proportion of total oil crop production (%)	Proportion of total oil crop area (%)
Niger seed	36	43
Lin seed	29	31
Sesame	22	16
Other	13	10

Source: Computed from CSA (2006) data

Grain production in Ethiopia can be classified into two cropping seasons: the main rain season and the short rain season. The main rain production season takes place during June – December, while the small rain production season takes place during March – June. The small rain season accounts for about 10% of total annual grain production in the country. Wheat, maize, barley and teff are the cereal crops grown during the small rain season, while haricot beans, lentils and chickpea are the pulse crops grown during the season. The proportion of production accounted for by the small rain season is much lower than the proportion of area covered by the grain crops, perhaps because of the erratic and unreliable nature of the small rains that affects productivity.

2.2 Grain marketing

Cereals are the major sources of food intake in Ethiopia, accounting for about 70% of calorie intake, out of which two-third is accounted for by teff, wheat and maize alone (Lirenso, 1993). Among cereals, maize, wheat and teff are most traded commodities in Ethiopia (Jayne, Negassa and Myers, 1998). Based on a survey conducted in 1997, Negassa and Jayne reported that nationally the proportion of maize, wheat and teff sold by smallholders was about 30%, 31% and 28% of production, respectively, and the proportion of total cereal sales (maize, teff, wheat, barley, sorghum, and millet) from the 1995/96 main season was about 26% of total cereal production. The same data source indicated that about 78% of oil seeds was marketed, indicating that oil seeds are produced mostly for the market.

Grain marketing was heavily controlled by the socialist military government that ruled the country during 1974-1990. The socialist military government was directly involved in wholesale and retail grain trade, essentially suppressing private grain marketing. Farmers were forced to sell a certain quota of their grain produce (usually 10-50%) to the then government grain trade parastatal known as the Agricultural Marketing Corporation (AMC), at fixed prices which were 2-3 times below the prevailing market prices. Interregional private trade was also severely restricted. The heavy government involvement and restrictions in grain trade during 1974 - 1991 had adversely affected producer incentives, farm technology uptake and productivity.

In 1991 grain trade was liberalized, official pricing was abandoned, trade restrictions were lifted and private grain trade expanded. Upon grain trade liberalization, the reform resulted in reduced marketing margins, better market integration and entry by private traders (Negassa and Jayne, 1997; Gabre-Madhin et al, 2003). After liberalization, about 95% of cereal marketed by smallholders in Ethiopia was handled by private traders.

However, margins and transactions costs remained high, and weak private sector capacity, inadequate market institutions and poor infrastructure remained fundamental problems in the marketing system. As a result spatial and temporal arbitrage opportunities remained underutilized and many markets remained segmented (Gabre-Madhin, et al., 2003). Despite the increased entry of private traders in grain trade, limited access to finance and storage facilities, lack of processing linkages and limited market information remain fundamental problems confronted by traders. Cereal marketing costs accounted for about 40% to 60% of consumer prices of cereal commodities in 1995/96 (Negassa and Jayne, 1997). Imperfections in the grain marketing system result in several consequent outcomes.

Surplus grain producing areas in Ethiopia are localized, implying the critical role of transportation to different and distant deficit areas. The size and topography of the country, limited transportation possibilities (road transport is the only available means for grain transportation), and the radial configuration of transport networks with Addis Ababa at the center has hampered inter-regional grain flows. As a result, localized shortage of food supply exists due to poor marketing and distribution networks, high transport cost, and related infrastructural problems that isolate surplus production areas from outside sources of effective demand even during good harvest seasons. Sometimes, surplus production results in sharp drop in prices. For example, in 1999/2000 a 19% increase in production resulted in 40% drop in grain prices (Hailegabriel, 2003), due to lack of processing, limited storage capacity, poor post-harvest grain management, weak domestic demand, and poor international or regional market outlets. Similarly, the significant surplus of grain in 2002 resulted in 60-80% drop in producer grain prices (Gabre-Madhin et al., 2003)

Post-harvest losses in Ethiopia could be as much as 5-19% for maize, 6-26% for millet, 6-23% for wheat, and 5-20% for teff (Ashagari, 2000), forcing traders not to store grain for more than the minimum turnover period. The problem of post-harvest loss is particularly important due to the fact that about 80% of farmer sales occur during January – March, the first quarter after harvest, and that about 50% of trader purchases also take place during this period (Hailegabriel, 2003).

3. Conceptual framework, data and analytical approach

XIX. 3.1 Conceptual framework

In this study, market orientation of households is conceptualized as incorporating both production and marketing decisions, because commercial transformation of subsistence agriculture is basically a shift from “sell surplus of what you produce” to “produce what you intend to sell”. There is a fundamental difference in the two approaches. In the first approach the prime objective of subsistence producers is to fulfill subsistence requirements and production decisions are made based on agro-ecological feasibility and subsistence needs. In this case, producers attempt to sell what ever surplus they might have upon fulfillment of subsistence needs. In the second approach, the prime objective of producers is profit maximization and production decisions are made based on comparative advantages and market signals. Hence, in this study, proportion of households producing the market oriented commodity and the proportion of area under the commodity are used as indicators of market orientation at

the community level, while whether household produces the commodity and proportion of produce sold are used as indicators at the household level.

Several factors affect market orientation of households by affecting the conditions of commodity supply and demand, factor and output prices, and marketing costs and risks faced by producers, traders and other market actors (Pender, 2006). Hence, in this study, market orientation is modeled as a function of household demographic factors (age and sex of head, household size, child dependents), human capital (education and labor supply); physical capital (land, oxen ownership, ownership of other livestock), institutional support services (access to extension, credit, and market information), market access (distance to nearest market, distance to district town market) and village level factors (population density, rainfall and agricultural labor wage).

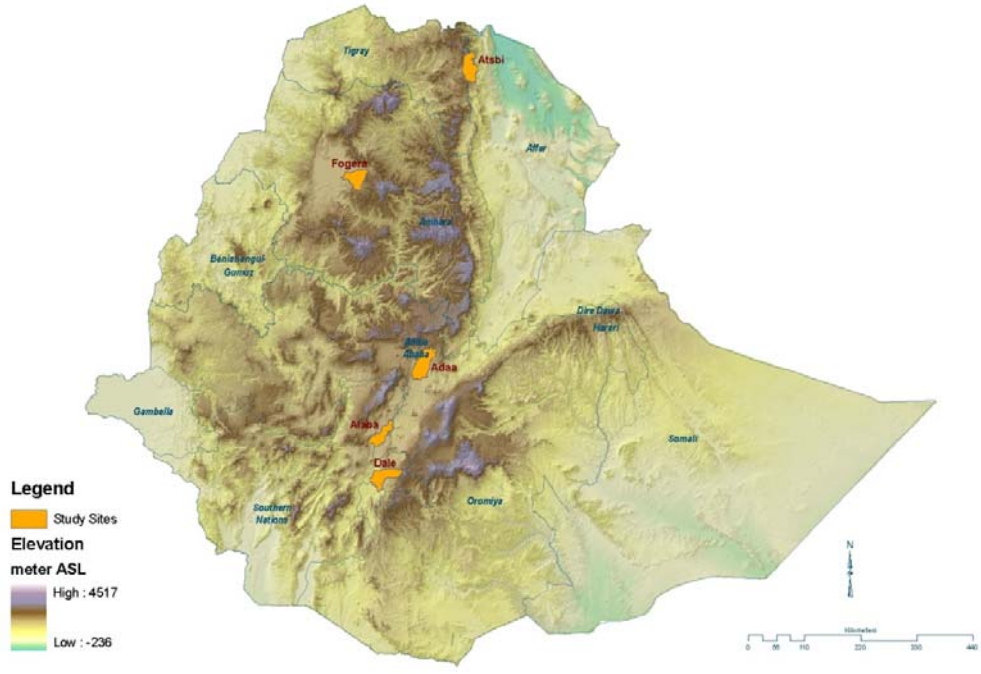
3.2 Data

Results are based on analysis of data collected from community and household surveys conducted in the five districts of Alaba (about 310 km south of Addis Ababa, in the Southern region), Dale (about 330 km south of Addis Ababa, in the southern region), Ada'a (about 45 km east of Addis Ababa, in the Oromia region), Fogera (about 610 km north west of Addis Ababa, in the Amhara region), and Atsbi (about 860 km North of Addis Ababa, in the Tigray region) in 2005 (Figure 1). The study districts are areas where these crops are important market oriented commodities for smallholders[58].

Since the focus of the study is on market oriented commodities that are important for smallholders, data were collected only from the farming systems in each district where the commodities are important marketable commodities. For this purpose, each district was classified into two farming systems based on cropping pattern. Analysis of the variation in the degree of market orientation of households in these market oriented commodities provides a good opportunity to explore the determinants of variations in market orientation of households that can inform policy making to facilitate commercial transformation of subsistence agriculture.

Figure 1: Study sites

[58] The districts are pilot learning woredas (PLWs) of the Improving Productivity and Market Success (IPMS) of Ethiopian Farmers project, implemented by the International Livestock Research Institute (ILRI) on behalf of the Ethiopian Ministry of Agriculture and Rural Development (IPMS, 2005). For more information on the IPMS project, visit www.imps-ethiopia.org.



The commodities included in the study are teff, wheat, rice, haricot beans, chickpea and Niger seed. Data on wheat and teff were collected from the two farming systems in Ada'a and one farming system in Alaba, and data on Niger seed were collected from both farming systems in Fogera, while data on rice was collected from one farming system in Fogera. Data on haricot beans were collected from one farming system each in the districts of Dale and Alaba. Data on chickpea were collected from the two farming systems in Ada'a, and one farming system each in Fogera and Atsbi. The data pertain to the 2004/05 production season.

XX. 3.3 Analytical approach

Analysis of descriptive information is used to determine the level of market orientation, average household income from the sale of the commodities, and markets and market channels used by producers. Econometric analyses are used at both the community and household levels. At community level, econometric analyses are used to analyze the determinants of the proportion of households who produce the market oriented commodities and the proportion of area covered by these commodities. Interval regression (with robust standard errors) and OLS are used to

estimate the regression models as appropriate. Distance to markets, rainfall, agricultural labor wage, proportion of female headed households in community, population density, average cultivated land per household, average number of bullocks per household, average other livestock holding per household, average altitude, availability of credit and market information services in community are used as explanatory variables in the community level regression models.

At the household level, econometric analyses are also used to analyze the determinants of household decision to produce these market oriented commodities (Probit models) and the proportion of produce sold (interval regression), a measure of the extent of market orientation. Since the proportion of households who do not sell the produce was small, regressions for the determinants of household decision whether to sell or not were not estimable. At the household level, population density, access to markets, household characteristics (age and sex of head, literacy of head, household size, number of children dependents, and household labor supply), wealth factors (land ownership, and ownership of livestock), involvement in extension program and access to credit during the previous year, and rainfall are used as explanatory variables in the regression models.

A sample selection problem arises in the regression for the proportion sold by the household, since proportion sold is observed only for households who produce the crop. Hence, Heckman's two-step estimation procedure is used. The probability of growing the grain crop was predicted in the first stage, a predicted value of the inverse Mills ratio (IMR) is obtained and the ratio included as an explanatory variable in a second stage regression (Maddala, 1983). However, since the second stage regressions are censored regression (censored at both ends) the predicted IMR introduces hetroskedasticity because its errors depend on the values of the explanatory variables. Unlike in the linear model, hetroskedasticity results in inconsistent estimators (Maddala, 1983). Hence, in the second stage, interval regressions with robust to hetroskedasticity standard errors are used. Interval regression is a generalization of the Tobit model, and is estimable with robust standard errors **(**StataCorp.**,** 2001**).** The regressions for rice and haricot beans are not significant and not reported.

Identification of the second regression is an important issue. The problem of identification is resolved by finding variables that are correlated with the decision to grow a cereal crop, but not correlated with the decision of how much to sell. Altitude and walking time to nearest milling service are used as instruments in the Probit models. Intuitively, these variables explain the decision to grow a cereal but not to market it. Altitude determines the suitability of the agro-ecology for the crop, while

distance to milling service affects cost of consumption. Descriptive statistics of explanatory variables are given in Annexes 1 & 2.

4. Results and discussion

XXI. 4.1 Degree of market orientation

Indicators of the level of household market orientation in the commodities are given in Table 4. The indicators are calculated at the community and household levels.

Teff: Teff has become an important market oriented crop in Ethiopia. In the study area, about 77% of households produce the crop, on an average of about 31% of the total cultivated area (Table 4). On average, among the households that produce teff, a household produces teff on about 1.2 ha.

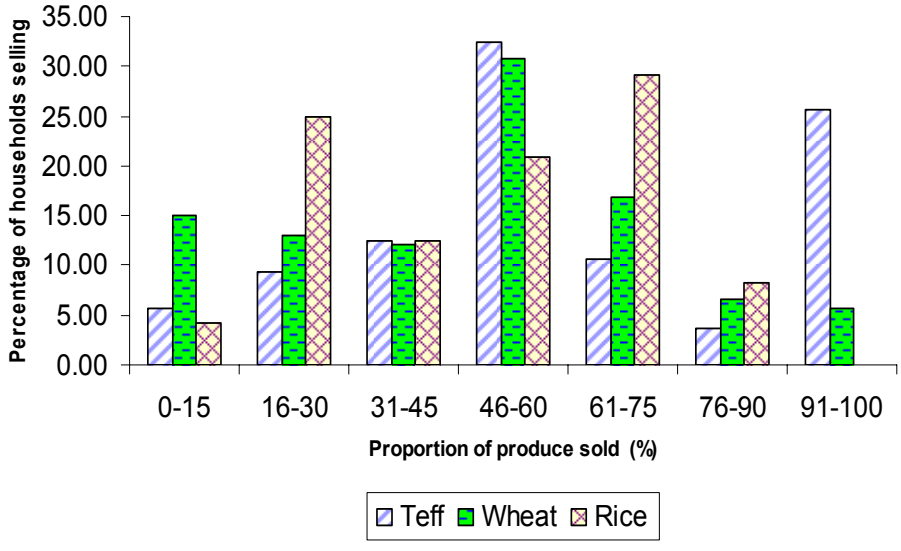
Table 4: Indicators of level of market orientation and average income

	Teff	Wheat	Rice	Haricot beans	Chick pea	Niger seed
Proportion of households producing crop (%)/PA[59] (STD)	77 (22.84)	64 (26.37)	72 (32.17)	62 (32.75)	20 (23.04)	28 (23.70)
Proportion of area covered by crop (%)/PA (STD)	31 (19.12)	27 (11.05)	44 (26.00)	13 (15.20)	3 (3.67)	9 (6.19)
Area allocated (ha/household) (STD)	1.2 (0.96)	1.4 (0.87)	0.62 (0.22)	0.29 (0.24)	0.53 (0.45)	0.42 (0.67)
Proportion of produce sold (%)/household (SE)	60 (2.38)	47 (2.81)	50 (4.35)	46 (4.91)	46 (4.84)	92 (1.46)
Amount sold (kg) (SE)	540 (50)	601 (96)	886 (149)	90 (20)	456 (68)	201 (29)
Average revenue/household (Birr) (SE)	1417 (126.36)	978 (145.92)	1567 (292.65)	108 (24.91)	801 (117.70)	565 (84.11)

About 60% of teff produce is sold, although there were significant variations across the study area. On average about 540 kg of teff per household was sold, with a monetary value of about Birr 1417 (USD 170.00). Analysis of the household market participation level shows that about 32% of households sold 46-60% of their teff produce, and about 25% of them sold more than 90% of their teff produce (Figure 2). It is interesting to note that the mode in the proportion of teff produce sold is 46-60%, followed by 91-100%. In general, the proportion of households selling teff increases with the increase in the proportion of teff sold from 0-15% to 46-60%, then drops when the proportion sold increases to 61-75% and 76-90%, after which it rises again.

[59] PA stands for peasant association which is the lowest administrative unit in Ethiopia comprising of about 4-5 villages.

Figure 2: Percentage of produce sold by percentage of households selling for teff, wheat, and rice



Wheat: Like teff, wheat is also an important market oriented commodity in the study area. On average, wheat is produced by about 64% of the households on about 27% of total cultivated area. On average about 1.4 ha of land is allocated for wheat by a household. About 47% of wheat produce is sold. A household sold about 600 kg of wheat for a sales value of about Birr 978. About 31% of households sold 46-60% of their wheat produce, while about 17% sold 61-75% (Figure 2). Like teff, the mode in the proportion of wheat produce sold is 46-60%, followed by 61-75%. The pattern of the variation in the proportion of wheat sold is similar to that of teff.

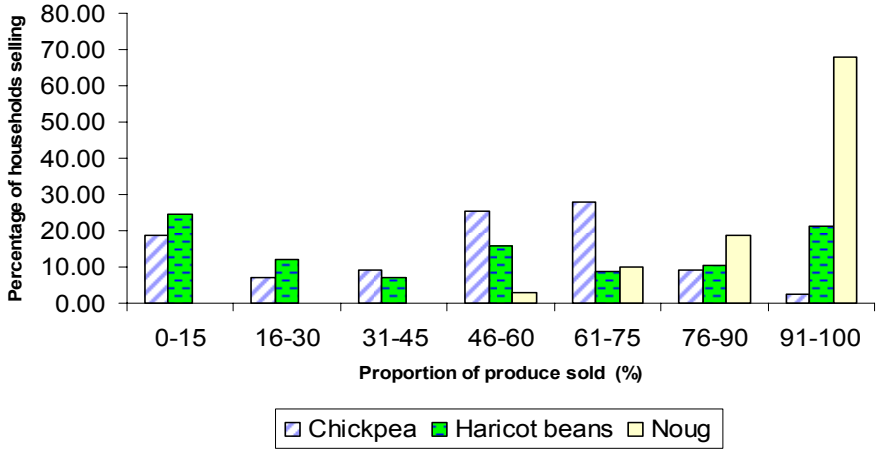
Rice: Rice, which has relatively recently been introduced to Ethiopia, is also fast becoming an important market oriented crop in one of the farming systems of the Fogera district[60]. About 72% of households produce rice in the farming system, on about 44% of the total cultivated area. Among the households who produce the crop in the district, an average household produces rice on about 0.62 ha of land. About 50% of rice produced was sold. A household sold an average of 880 kg of rice, with a sales value of about Birr 1566. About 28% of households sold 61-75% of their rice

[60] Upland rice is being introduced in the higher altitude farming system.

produce, while about 26% sold more than 90% of their rice produce, and 22% sold 46-60% (Figure 2).

Haricot bean: Haricot bean is an important market oriented commodity in the districts of Alaba ad Dale. About 62% of households produce haricot beans in the study area, on about 13% of total cultivated land. A household allocates about a third of a hectare of land for haricot bean production. About 46% of haricot bean production is sold, suggesting that haricot bean is also an important component of the household food basket. On average a household sold about 94 kg of haricot bean for a sales value of about Birr 108. The proportion of haricot been sold is more evenly distributed by the proportion of households selling. About 25% of households sell only 0-15 of their produce, while about 20% sold 91-100% of their produce (Figure 3).

Figure 3: Percentage of produce sold by percentage of household selling for chickpea, haricot beans and Niger seed



Chickpea: In the study area, chickpea is produced by about 20% of the households, on about 3% of the total cultivated area. On average a household allocates about 0.53 ha of land for chickpea. A household also sold about 456 kg of chickpea, about 46% of total chickpea produce, for a total revenue of Birr 800. The mode in the proportion of chickpea produce sold is 61-70% (about 28% of households selling), followed by 46-60%. About half of the households sold 46-75% of their chickpea produce (Figure 3).

Niger seed: Niger seed is an important market oriented oil crop in the two farming systems of the Fogera district. About 28% of households in the district produce niger seed on about 9% of the total cultivated land. A household allocates an average of 0.42 ha of land to niger seed production. During the study period, a household sold about 92% of its niger seed produce, or about 200 kg, for a revenue of Birr 565. No household sold less than 46% of its Niger seed produce, and about 65% of households sold 91-100% of their Niger seed produce (Figure 3).

XXII. 4.2 Market places[61]

Teff: The most important market places for teff producers are the nearest market outside the PA (where about 45% of households sold their teff produce) and the district town markets (where about 38% of producers sold teff) (Figure 2). Markets outside woreda and regional markets are not important for teff producers in the study area. The average distance to teff market in the study area is 2 walking hours.

Table 5: Producer market places (proportion of households selling) and average distance (SE)

	Teff	Wheat	Rice	Haricot beans	Chick pea	Niger seed
Market in PA	16 (0.03)	20 (0.04)	4 (0.04)	22 (0.07)	17 (0.06)	19 (0.05)
Nearest market outside PA	45 (0.04)	66 (0.05)	19 (0.09)	38 (0.08)	46 (0.09)	24 (0.05)
District town markets	38 (0.04)	13 (0.04)	74 (0.09)	38 (0.08)	37 (0.08)	51 (0.06)
Markets outside district	1 (0.01)	1 (0.01)	0	2 (0.03)	0	4 (0.03)
Average distance (walking hours)	2.1 (0.31)	1.5 (0.14)	1.9 (0.19)	1.4 (0.17)	1.5 (0.14)	2.5 (0.41)
Regional markets	0	0	0	0	0	0

Wheat: As in teff, the most important market place for wheat producers in the study area are the nearest market outside PA, where about 66% of producers sold their wheat. However, district town markets were not as important for wheat as they are for teff. Hence, the second most important market for producers is markets in PA (where about 20% of producers sold wheat), followed by district town markets (where about 11% of producers sold wheat) (Table 5). Markets outside district and regional markets

[61] Market places were classified into five: markets that exit in the PA where the household lives (Market in PA), markets in nearby PAs within the same district (Nearest market outside PA), markets located at district capital towns (district town markets), markets located at other districts (markets outside district), and markets located at regional capital towns (Regional markets).

are not important for wheat producers, as is the case with teff. The average distance to market for wheat is 1.5 walking hours.

Rice: Unlike in the case of teff and wheat, the most important market place for rice are the district town markets (where about 74% of the households sell the commodity), followed by the nearest market outside PA (where 19% of households sell rice) (Table 5). A small proportion of households use markets in PA to sell their rice. The average distance to market place for rice is about 2 walking hours.

Haricot bean: Nearest market outside PA and district town markets are equally important for haricot bean producers. About 38% of households sell in each of these markets. Markets in PA are the next important market places, where about 22% of haricot bean producers sell their haricot bean produce. As in teff, wheat, and rice, markets outside district and regional markets are not important for haricot bean producers. The average distance to the market place for haricot bean is about 1.5 walking hour.

Chickpea: The most important market place for chickpea producers are nearest market outside PA (where about 46% of producers sell their produce), followed by district town markets (where about 38% of producers sell their chickpea produce). Markets in PA are used by about 17% of households. The average distance to chickpea market place is 1.5 walking hour.

Niger seed: In the study area, district town markets are the most important market places used by niger seed producers (about 51% of producers use this market place). Nearest markets outside PA and markets in PA account for about 24% and 19% of producers, respectively. The average distance to Niger seed market is 2.5 walking hours.

XXIII. 4.3 Market outlets

Teff: On average across the farming systems, about 65% of producers of teff sold to wholesalers, followed by retailers (31%), and only about 2% of teff producers sold directly to consumers (Table 6). The role of rural assemblers and processors in the teff market chain is quite insignificant. Hence, the most important market channels for teff producers appear to be producer → wholesaler, and producer → retailer. All teff is sold in cash.

Table 6: Producer market channels (proportion of households selling (%) (SE))

	Teff	Wheat	Rice	Haricot	Chick	Niger

				beans	pea	seed
Rural assembler	2 (0.01)	0	13 (0.07)	11 (0.05)	4 (0.04)	4 (0.03)
Wholesaler	65 (0.04)	51 (0.06)	35 (0.10)	51 (0.08)	54 (0.10)	49 (0.06)
Retailer	31 (0.04)	43 (0.06)	22 (0.09)	22 (0.07)	42 (0.10)	32 (0.06)
Processor	0	0	22 (0.09)	0	0	15 (0.04)
Consumer	2 (0.01)	6 (0.03)	8 (0.06)	16 (0.06)	0	0

Wheat: Wholesalers and retailers are the most important buyers for wheat producers. On average, about 51% of producers sold to wholesalers, 43% sold to retailers, and 6% sold directly to consumers (Table 6). It is interesting to note that no producer sold to rural assemblers or processors. Hence, as in teff, the important market channels for wheat producers were producer → wholesaler, and producer → retailer. As with teff, wheat sale is effected only in cash.

Rice: The market channel for rice seems to be broader than other crops, except niger seed. About 35% of households sold to wholesalers, and 22% of households sold to retailers and processors each (Table 6). While about 13 % sold to rural assemblers, the remaining 8% sold directly to consumers. Hence, the important market channels for rice producers appear to be producer → wholesaler, producer → processor, producer →retailer, producer → rural assembler, and producer → consumer. As with teff and wheat, rice sale is effected only in cash.

Haricot bean: About 51% and 22% of haricot bean producers sell their haricot bean produce to wholesalers and retailers, respectively (Table 6). Direct sale to consumers is more important for haricot bean than for other crops. About 16% of haricot bean producers sell directly to consumers. About 11% sell to rural assemblers. No sales was made to processors. Hence, the important market channels for haricot bean producers are producer → wholesaler, producer → retailer, producer → consumer and producer → rural assembler. Almost all haricot bean sales are effected in cash.

Chickpea: As in wheat, there are only three buyers of chickpea from producers in the study area. Wholesalers are the most important buyers (accounting for about 51% of producers), followed by retailers (accounting for about 42% of sellers) (Table 6). Only about 4% of producers sell to rural assemblers, and no producer made sales to processors or consumers. Hence, the important market channels for chickpea

producers are producer →wholesaler, producer → retailer, and producer → rural assembler. All chickpea sales were effected in cash.

Niger seed: As with rice, the niger seed market channel is broader than the other crops. Although wholesalers and retailers remain to be the most important buyers of niger seed from producers, processors are also of some significance because of the processing requirements of the commodity (Table 6). About 49% and 32% of producers sell to wholesalers and retailers, respectively, while about 15% sell to processors. Only about 4% sell directly to rural assemblers. No sales is effected directly to consumers. Hence, the important market channels for Niger seed producers are producer→ wholesaler, producer → retailer, and producer →processor.

XXIV. 4.4 Determinants of market participation

Teff: At the community level, proportion of households who produce teff is explained positively by the size of cultivated land per household, but negatively by proportion of female headed households (Table 7). The explanation for the negative association between the proportion of female household heads and proportion of households producing teff can not be explained by resource endowment or household labor supply since we are controlling for these factors. Perhaps, women headed households do not have comparative advantage in commercializing in the laborious teff crop production Availability of cultivated land is associated with higher proportion of households producing the market oriented commodity, due to the land scarcity and also the land market imperfection that exist in the study areas.

The proportion of area covered by teff is explained positively by daily wage of agricultural labor, and availability of credit service, but negatively by the amount of rainfall. Higher opportunity cost of labor as reflected in higher wage rates appears to induce communities to shift to market oriented commodities, consistent with the findings reported in Pingali and Rosegrant (1995) and von Braun and Kennedy (1994). Availability of credit service, by easing liquidity constraints of households, also contributes to market orientation in teff. The negative association between rainfall and proportion of area covered with teff may be due to the water logging problem that results from high rainfall and heavy vertisols in the study area. Interestingly, non of the market access factors have significant impact on either the proportion of households who produce teff or the proportion of cultivated land covered by teff.

Table 7: Community level regression results for proportion of households producing Teff (interval regression) and proportion of area covered by Teff (OLS)

Variable	Proportion of households producing (interval regression)	Proportion of area covered by teff (OLS)
Nearest market place (km)	-0.00356 (0.00421)	-0.00118 (0.00217)
Nearest market town (km)	0.00342 (0.00249)	-0.00052 (0.00119)
Rainfall (mm)	-0.00059 (0.00043)	-0.00104 (0.00028)***
Average adult male daily local wage during peak season (birr)	0.00675 (0.00442)	0.00917 (0.00330)***
Proportion of female household head (%)	-1.05803 (0.30424)***	-0.22079 (0.18567)
Population density (persons/ha)	-0.01337 (0.03192)	0.00145 (0.02055)
Cultivated land per household	0.04366 (0.02330)*	0.00475 (0.01690)
Number of bullocks per household	-0.00922 (0.01556)	0.01382 (0.00869)
Number of other livestock per household	-0.00102 (0.00474)	-0.00169 (0.00292)
Average altitude (meter)	-0.00017 (0.00015)	0.00004 (0.00013)
Credit service availability in the PA	0.10398 (0.02921)	0.11408 (0.03138)***
Market info service available in the PA	-0.05831 (0.04952)	0.00250 (0.02395)
Constant	1.74229 (0.39852)***	1.09244 (0.28506)***
Chi^2/F	80.43	26.17
Prob > Chi^2/F	0.0000	0.0000
R^2	-	0.7087
Number of observation	85	84

Household level regression analysis also shows that household decision to produce teff, and the proportion of teff produce sold given the decision to produce, are explained by a host of community level factors, household characteristics, and access to services (Table 8). The Probit model shows that household decisions to produce teff is explained positively by the number of dependent children, household labor supply, number of bullocks owned, involvement in extension, and amount of rainfall. The decision is explained negatively by population density, household size, and cows owned. All significant variables in the Probit model have the expected signs.

Table 8: Household level regression results for decision to produce Teff (Probit) and proportion of produce sold (Interval regression)

	Household decision to produce teff (Probit marginal effects)	Proportion of teff produce sold (interval regression)
Population density (persons/ha)	-0.00016 (0.00044)***	0.06758 (0.02107)***
Nearest market place (km)	-0.00002 (0.00005)	0.00234 (0.00327)
Nearest market town (km)	0.00001 (0.00002)	0.00005 (0.00181)
Age of household head	-0.00005 (0.00013)*	-0.01499 (0.00570)***
Age squared	0.000006 (0.00000)**	0.00012 (0.00006)**
If household head is male	0.00330 (0.00694)	-0.01173 (0.04394)
If household head is literate	-0.00025 (0.00060)	0.02092 (0.03018)
Household size (no)	-0.00023 (0.00065)***	0.01139 (0.02663)
Children (<14 years old) (no)	0.00026 (0.00073)***	-0.01672 (0.02969)
Number of labor supply	0.00021 (0.00060)**	-0.01156 (0.02752)
Land owned (1/4 ha.)	0.00001 (0.00002)	0.00735 (0.00367)**
Bullocks owned (no)	0.00011 (0.00029)**	0.02696 (0.01296) **
Sheep & goats owned (no)	-0.00001 (0.00003)	-0.00727 (0.00425)*
Other cattle owned (no)	-0.00003 (0.00008)**	0.00161 (0.00585)
Equine owned (no)	0.00005 (0.00016)*	0.02374 (0.01741)
Chicken owned (no)	0.00000 (0.00001)	0.00088 (0.00365)
Involvement in extension (2003/04) (0/1)	0.00188 (0.00409)**	-0.07250 (0.03889)*
Access to credit (2003/04) (0/1)	-0.00006 (0.00019)	-0.25135 (0.04766)***
Rainfall (mm)	0.000003 (0.00001)***	0.00096 (0.00034)**
Average altitude (meter)	-0.000001 (0.00000)***	---
Nearest milling service (km)	0.00001 (0.00003)	---
Inverse mills ratio (IMR)	---	-0.00651 (0.05847)
Constant	4.86453 (8.26494)	0.05736 (0.37421)
F	1.58	16.36
Prob > F	0.0609	0.0000
Number of observation	164	156

Higher number of children dependents implies higher need for cash to cover household expenditures related with children such as school fees and other expenses, inducing households to grow market oriented commodities. Teff is a labor demanding crop and requires multiple rounds of land preparation. Hence, households with higher family labor supply and more traction power are more likely to grow it, given the labor and traction power market imperfection in the study area. Involvement in extensions increases likelihood of growing teff, since teff is one of the crops for

which a few improved varieties are available from the national research system and has received attention from the extension service. Higher amount of rainfall encourages households to grow teff for obvious reasons.

Population density is associated negatively with growing teff. Perhaps, more densely populated areas in the highlands of Ethiopia suffer from higher land degradation resulting in low soil fertility and thus reducing the probability of growing teff since it requires relatively good and fertile soils. Larger households have higher household consumption needs and perhaps are more likely to produce cheaper but more productive staple food crops relative to teff. Higher ownership of cows appears to detract from teff production, perhaps by offering an alternative income source to households.

We find U-shaped relationship between age and probability of growing teff. The turning point on this relationship is 38 years, well within the age range of household heads in the sample. The U-shaped relationship between age and probability of growing teff may indicate variations in consumption preferences of households. However, this is a tentative explanation for unexpected results and requires further testing.

Interval regression results show that the determinants of the proportion of teff produce sold are generally consistent with the determinants of household decision to grow the crop (Table 5). The proportion of teff produce sold is explained positively by ownership of land and traction power, population density, and amount of rainfall, while it is negatively explained by ownership of shoats, involvement in extension and availability of credit.

That population density is negatively associated with household decision to grow teff while it is positively associated with proportion of teff produce sold indicates that given the decision to grow teff, households in high population density areas offer higher amount of their teff produce to market, perhaps to cover for variable expenses such as fertilizer required to make up for the low soil fertility due to higher land degradation. Given the imperfections in the land market and land scarcity that prevails in the area, households with higher land ownership offer higher proportion of their teff produce for sale, as is also the case with traction power. In the presence of factor market imperfections, ownership of the resource increases efficiency. Households who live in areas of higher rainfall sell higher proportion of their teff produce, perhaps due to the effect of rainfall on teff productivity and thus production. None of the market access factors have significant impact on either the probability of household growing teff or the proportion of teff produce sold.

Contrary to expectation, we find an inverse relationship between involvement in extension and access to credit and proportion of teff sold, although involvement in extension is associated with higher probability of producing teff. Investigation of the nature of the extension and credit services are required to explain these unexpected results. Consistent with the result for the probability of growing teff, we also find U-shaped relationship between age and the proportion of teff produce sold. The turning point in this relationship is 65 years, within the age distribution of sample households. About 11% of household heads are 65 or more years old. The IMR is insignificant indicating little sample selection problem.

Wheat

At the community level, proportion of households producing teff is positively explained by agricultural labor wage rate, cultivated land per household, and availability of credit, while it is negatively explained by proportion of female headed households in community, and availability of market information service (Table 9). Similarly, proportion of area covered by wheat is explained positively by agricultural labor wage, ownership of traction power, and availability of credit, and negatively by the proportion of female headed households in community. All variables except availability of market information service have the expected signs. As in teff, none of the market access factors have significant effect.

Increased opportunity cost of labor induces households to be profit oriented and commercialize. Given the imperfections in the land and traction power markets in the study area, households with higher cultivated land and more traction power tend to be more market oriented in wheat. Availability of credit services appears to play role in enhancing market orientation by easing credit constraint of liquidity constrained households. Wheat is also laborious crop and female headed households may not have comparative advantage in producing it. A deeper analysis of the market information service provided at community level is required to explain the unexpected effect of the variable, including possibilities of measurement error.

Table 9: Community level regression results for proportion of households producing Wheat (interval regression) and proportion of area covered under Wheat (OLS)

	proportion of households producing (Interval regression)	**OLS (proportion of area covered)**
Distance to nearest market place (km)	0.0001 (0.0057)	0.0006 (0.0019)

Distance to nearest market town (km)	0.0027	-0.0003
	(0.0024)	(0.0009)
Rainfall (mm)	0.0007	-0.0003
	(0.0007)	(0.0003)
Average adult male daily local wage (Birr)	0.0115*	0.0053**
	(0.0059)	(0.0023)
Proportion of female headed households	-0.7242**	-0.1890*
	(0.3188)	(0.1083)
Population density (persons/ha)	-0.0255	-0.0057
	(0.0479)	(0.0123)
Cultivated land per household (0.25ha/household)	0.0851**	0.0071
	(0.0262)	(0.0101)
Number of bullocks per household	0.0099	0.0207**
	(0.0267)	(0.0102)
Number of other livestock per household	-0.0060	-0.0051
	(0.0100)	(0.0035)
Average altitude (meter)	-0.0001	0.0002**
	(0.0002)	(0.0001)
If credit service is availability in the PA	0.1427**	0.0883***
	(0.0644)	(0.0246)
If market information service is available in the PA	-0.1040**	0.0002
	(0.0474)	(0.0181)
Constant	-0.1271	0.0446
	(0.4695)	(0.1934)
Chi^2/F	99.56	9.95
Prob > Chi^2/F	0.0000	0.0000
R^2	----	0.61
Number of observation	73	73

Household level regressions of the determinants of probability household decision to produce wheat show that male headed households and households involved in extension program are more likely to produce wheat (Table 10). On the other hand, literacy of household heads detracts from household decision to produce wheat, perhaps because literate households have higher opportunity cost of their labor in other farm enterprises or off-farm employment.

Household level regression of the determinants of the proportion of wheat produce sold, given decision to produce, shows that the decision is positively explained by number of dependent children, labor supply, land ownership, ownership of equines, and rainfall, while it is negatively explained by household size and access to credit. All variables except credit access have the expected signs (Table 10).

Table 10: Household level regression results for decision to produce Wheat (Probit) and proportion of wheat produce sold (Interval regression)

	Household decision to produce wheat (Probit marginal effects)	Proportion of produce sold (interval regression)
Population density (persons/ha)	0.03931 (0.04825)	-0.01529 (0.02483)
Nearest market place (km)	0.01477 (0.00975)	-0.00874 (0.00534)
Nearest market town (km)	-0.00107 (0.00370)	-0.00249 (0.00246)
Age of household head	-0.00646 (0.01604)	-0.00971 (0.00806)
Age squared	0.00000 (0.00015)	0.00013 (0.00007)
If household head is male	0.27912 (0.16376)*	0.00430 (0.10003)
If household head is literate	-0.30222 (0.09930)***	0.04658 (0.06805)
Household size (no)	0.03637 (0.06429)	-0.09402 (0.03767)**
Children (<14 years old) (no)	0.00094 (0.06758)	0.07675 (0.03726)**
Number of labor supply	-0.01067 (0.06265)	0.07917 (0.03906)**
Land owned (1/4 ha.)	0.00969 (0.00928)	0.01161 (0.00465)**
Bullocks owned (no)	0.03570 (0.02620)	0.02382 (0.01818)
Sheep & goats owned (no)	-0.01650 (0.01129)	-0.00219 (0.00928)
Other cattle owned (no)	-0.00497 (0.01215)	-0.00244 (0.00692)
Equine owned (no)	0.00548 (0.03534)	0.06578 (0.03033)**
Chicken owned (no)	-0.00078 (0.00814)	0.00768 (0.00440)*
Involvement in extension (2003/04) (0/1)	0.31097 (0.14180)**	0.03165 (0.09419)
Access to credit (2003/04) (0/1)	-0.10719 (0.07912)	-0.45278 (0.08123)***
Rainfall (mm)	0.00098 (0.00123)	0.00102 (0.00044)**
Average altitude (meter)	0.00034 (0.00032)	---
Nearest milling service (km)	-0.01779 (0.00835)**	---
Inverse mills ratio (IMR)	---	0.07824 (0.15766)
Constant	-6.38198 (4.23557)	-0.09254 (0.59325)
F	2.14	9.22
Prob > F	0.0058	0.0000
Number of observation	138	106

Number of dependents increases the need for cash to cover expenses related to services associated with children. Availability of labor supply and cultivated land increase market orientation in wheat due to their effect on production efficiency as a result of imperfections in these factor markets. Equines are used for transportation of produce to market, thus reducing marketing costs to households who own them. Rainfall also increases proportion sold due to its effect on production. The negative association between household size and proportion of wheat produce sold is perhaps due to the higher domestic consumption needs of larger households. The negative association of credit service with proportion of wheat sold was not expected, especially since credit service is associated with higher proportion of households

producing the market oriented crop and the proportion of area covered by the commodity. A closer investigation of the credit service is required to explain this unexpected result. The IMR is insignificant indicating little sample selection problem.

Chickpea: Community level regression shows that the proportion of households producing chickpea is positively explained by amount of rainfall, adult labor wage, and cultivated land per capita (Table 11). There was no variable that explains proportion of households producing chickpea negatively. Similarly, the proportion of area covered by chickpea is explained positively by cultivated land per household, and negatively by distance to nearest market town.

Table 11: Community level regression results for proportion of households producing chickpea and proportion of area covered by chickpea (interval regressions)

Variable	Interval (proportion of households producing)	Interval (proportion of area covered)
Nearest market place (km)	-0.00185 (0.00687)	-0.00053 (0.00094)
Nearest market town (km)	-0.00409 (0.00299)	-0.00096 (0.00050)*
Rainfall (mm)	0.00051 (0.00023)**	0.00006 (0.00005)
Average adult male daily local wage during peak season (birr)	0.01320 (0.00711)*	0.00163 (0.00132)
Proportion of female household head (%)	-0.40688 (0.32012)	-0.03422 (0.05957)
Population density (persons/ha)	0.03053 (0.03878)	0.00768 (0.00829)
Cultivated land per household	0.11091 (0.01896)***	0.00901 (0.00365)**
Number of bullocks per household	-0.01067 (0.02784)	0.00236 (0.00320)
Number of other livestock per household	-0.00115 (0.00954)	-0.00162 (0.00113)
Average altitude (meter)	0.00026 (0.00013)**	-0.00001 (0.00003)
Credit service availability in the PA	0.01385 (0.06764)	0.00830 (0.01450)
Market info service available in the PA	0.05032 (0.06545)	0.00778 (0.01360)
Constant	-1.22348 (0.40575)***	-0.05609 (0.08821)
Chi^2/F	72.64	30.59
Prob > Chi^2/F	0.0000	0.0023
Number of observation	60	60

Similar to the effect on teff and wheat, higher opportunity cost of labor appears to induce market orientation in chickpea production. Availability of land is also clearly an important constraint in market oriented chickpea production. Distance to market appears to be important for market oriented chickpea production because of its impact on marketing costs.

Household level regression shows that household decision to produce chickpea is positively explained by ownership of traction power, ownership of equines, and involvement in extension, while it is negatively explained by land ownership, ownership of shoats and cows (Table 12). Ownership of traction power increases efficiency in chickpea production, as is also true with teff and wheat, while ownership of equines reduces marketing costs. The extension service appears to be effective in inducing market oriented chickpea production in the study area. The negative association between land ownership and household decision to produce chickpea was not expected. Further investigation is required to explain this unexpected result. Ownership of shoats and cows may be offering alternative sources of cash to the household.

Household regression also shows that the proportion of chickpea produce sold, given decision to produce, is positively explained by population density, dependent children, household labor supply, land ownership, and ownership of cows and poultry (Table 9). The proportion of chickpea produce sold is negatively explained by distance to market and household size, as expected, and ownership of traction power, contrary to expectation. Households in high population density areas sell higher proportion of their chickpea produce perhaps to cover variable costs associated with soil fertility amendment to make up for land degradation. The cash requirement associated with dependent children and the efficiency effect of household labor supply and land ownership induce market orientation in chickpea production. Distance to market reduces proportion of chickpea produce sold by raising marketing costs. Larger households sell less proportion of their chickpea produce due to their higher domestic consumption requirements. The negative association between ownership of traction power and proportion of chickpea produce sold was not expected. Perhaps, households with higher traction power tend to grow crops that require multiple preparation of land such as teff and wheat.

Table 12: Household level regression results of household decision to produce chickpea (Probit) and proportion of chickpea produce sold (interval regression)

	Household decision to produce chickpea (Probit marginal effects)	Proportion of chickpea produce sold (Interval regression)
Population density (persons/ha)	-0.05619 (0.03173)	0.27767 (0.12080)**
Nearest market place (km)	0.00543 (0.00452)	-0.04369 (0.01085)***
Nearest market town (km)	-0.00009 (0.00222)	-0.00080 (0.00835)
Age of household head	0.02140 (0.01162)*	-0.19035 (0.04576)***
Age squared	-0.00018 (0.00012)	0.00178 (0.00041)***
If household head is male	0.01920 (0.05937)	-0.06498 (0.15416)
If household head is literate	-0.01120 (0.04347)	-0.05980 (0.08915)
Household size (no)	0.00131 (0.03985)	-0.32354 (0.12355)**
Children (<14 years old) (no)	0.02268 (0.04192)	0.27353 (0.13847)*
Number of labor supply	0.01711 (0.04015)	0.25468 (0.13266)*
Land owned (1/4 ha.)	-0.02441 (0.00595)***	0.08743 (0.03406)**
Bullocks owned (no)	0.03339 (0.01541)**	-0.14313 (0.06436)**
Sheep & goats owned (no)	-0.01279 (0.00755)	0.00891 (0.02840)
Other cattle owned (no)	-0.01908 (0.00937)**	0.09071 (0.04127)**
Equine owned (no)	0.06675 (0.02128)***	-0.10438 (0.08621)
Chicken owned (no)	0.00023 (0.00390)	0.02029 (0.00755)***
Involvement in extension (2003/04) (0/1)	0.09315 (0.04705)**	-0.15818 (0.25928)
Rainfall (mm)	0.00027 (0.00018)	-0.00066 (0.00085)
Average altitude (meter)	-0.00019 (0.00009)**	---
Nearest milling service (km)	0.00001 (0.00457)	---
Inverse mills ratio (IMR)	---	-1.01738 (0.40308)**
Constant	-4.45431 (2.59574)*	7.05996 (2.20475)***
F	3.19	12.28
Prob > F	0.0000	0.0000
Number of observation	213	43

Niger seed: Community level regression shows that proportion of household producing niger seed and proportion of area covered by niger seed are explained positively by non-traction power livestock holding per household and altitude, while the proportion of household producing niger seed is explained negatively by distance to nearest market place (Table 13). No variable explained the proportion of area covered by niger seed negatively.

Table 13: Community level regression results of the proportion of household producing Niger seed and the proportion of area covered by Niger seed (OLS regressions).

Variable	OLS (proportion of households producing)	OLS (proportion of area covered)
Nearest market place (km)	-0.01793 (0.00772)**	-0.00392 (0.00242)
Nearest market town (km)	0.00127 (0.00809)	0.00208 (0.00146)
Rainfall (mm)	-0.00040 (0.00151)	-0.00018 (0.00026)
Average adult male daily local wage during peak season (birr)	-0.01256 (0.02080)	0.00150 (0.00538)
Proportion of female household head (%)	-0.27533 (0.64413)	-0.30239 (0.30152)
Population density (persons/ha)	-0.03560 (0.03955)	0.01327 (0.01642)
Cultivated land per household	0.11233 (0.13939)	0.07395 (0.04575)
Number of bullocks per household	-0.21314 (0.28063)	-0.18715 (0.07433)**
Number of other livestock per household	0.16343 (0.07273)**	0.05955 (0.01843)***
Average altitude (meter)	0.00115 (0.00046)**	0.00018 (0.00014)
Credit service availability in the PA	-0.11543 (0.09980)	-0.04972 (0.04647)
Market info service available in the PA	0.14962 (0.08935)	0.01603 (0.03143)
Constant	-1.40377 (1.75439)	-0.09570 (0.41733)
Chi^2/F	12.64	10.18
Prob > Chi^2/F	0.0001	0.0003
R^2	0.7587	0.6658
Number of observation	25	24

Household level Probit regression show that household decision to grow niger seed in the study area is explained positively by ownership of equines and involvement in extension service, but negatively by number of dependent children, ownership of land, and amount of rainfall (Table 14). The negative association between household decision to grow niger seed and number of dependent children and land ownership is unexpected.

Household level regression of the proportion of niger seed produce sold, given the decision to produce, is explained positively by population density, number of dependent children, household labor supply, all with expected signs (Table 14). The

high cash requirements associated with dependent children, the efficiency effect of household labor supply, and the factor scarcity due to population density increases market orientation of households in niger seed. The proportion of Niger seed produce sold is also negatively explained by distance to market and household size as expected, and by equine ownership contrary to expectation. Marketing costs associated with distance are clearly important for household decision on the proportion of niger seed produce sold, and household size reduces proportion sold due to the domestic consumption requirements.

Table 14: Household level regressions of household decision to produce Niger seed (Probit) and the proportion of Niger seed produce sold (interval regression)

	Household decision to produce Niger seed (Probit marginal effects)	Proportion of Niger seed produce sold (interval regression)
Population density (persons/ha)	0.02199 (0.06425)	0.03771 (0.01983)*
Nearest market place (km)	0.00043 (0.01030)	-0.00513 (0.00253)**
Nearest market town (km)	0.01660 (0.00930)	-0.00105 (0.00503)
Age of household head	0.00047 (0.03005)	0.01564 (0.01244)
Age squared	-0.00011 (0.00030)	-0.00018 (0.00012)
If household head is male	-0.01640 (0.16438)	0.02794 (0.06017)
If household head is literat	-0.08069 (0.11139	-0.03840 (0.04255
Household size (no)	0.12339 (0.08847)	-0.10083 (0.03235)***
Children (<14 years old) (no)	-0.20818 (0.09535)**	0.07858 (0.03556)**
Number of labor supply	-0.11504 (0.10159)	0.08007 (0.03926)**
Land owned (1/4 ha.)	-0.05926 (0.02902)**	-0.01287 (0.01578)
Bullocks owned (no)	-0.00495 (0.07681)	0.03435 (0.02572)
Sheep & goats owned (no)	0.04025 (0.02485)	0.01207 (0.00799)
Other cattle owned (no)	0.03440 (0.02659)	0.00956 (0.00804)
Equine owned (no)	0.21104 (0.09720)**	-0.05110 (0.02527)**
Chicken owned (no)	0.01354 (0.01010)	-0.00577 (0.00339)*
Involvement in extension (2003/04) (0/1)	0.31765 (0.12786)**	0.07017 (0.04357)
Access to credit (2003/04) (0/1)	-0.17035 (0.10609)	0.00259 (0.07279)
Rainfall (mm)	-0.00494 (0.00175)***	-0.00079 (0.00054)
Average altitude (meter)	0.00180 (0.00064)***	---
Nearest milling service (km)	-0.00670 (0.01482)	---
Inverse mills ratio (IMR)	---	0.07624 (0.08563)
Constant	8.43688 (6.46638)	1.62036 (0.70568)**
F	1.64	3.03
Prob > F	0.0580	0.0009
Number of observation	108	67

5. Conclusions and implications

Teff, wheat, rice, haricot beans, chickpea, and niger seed are important market oriented crops in the respective study areas. About 60%, 47%, 50%, 46%, 46%, and 92% of produce of teff, wheat, rice, haricot beans, chickpea and niger seed are sold by producers of the commodities, respectively. Except niger seed, these commodities are important both as sources of cash to the household and as food crops. Being an oil crop, niger seed is almost entirely produced for the market, with some amount consumed at home. About 77%, 64%, 72%, 62%, 20% and 28% of households in the respective study areas produce teff, wheat, rice, haricot beans, chickpea and niger seed, respectively.

Wholesalers are the most important buyers of these commodities from producers, followed by retailers, and rural assemblers. Wholesalers and retailers together account for 96%, 94%, 57%, 77%, 96% and 81% of producer sales of teff, wheat, rice, haricot beans, chickpea and niger seed, respectively. Processors are important buyers of rice and niger seed from producers, and consumers are important buyers of haricot beans.

The important market places for buyers to sell these commodities are either those located at the district towns or in the peasant associations (PAs) within the districts. District town markets are especially important for rice, haricot beans and niger seed. Markets outside of the districts and regional markets are rarely used by producers. The average distance to markets where producers sell their produce is about 2 walking hours. These results imply that market interventions to improve the gains to producers need to target district level markets. Almost all sales are effected in cash.

Community and household level econometric results show that market orientation of smallholders is affected by household demographic factors, human capital, physical capital, institutional support services, distance to market, and the village level factors of population density, agricultural labor wage and rainfall. Female headed households are less likely to grow the market oriented cereal crops of teff and wheat, perhaps due to low comparative advantage in such laborious crops. Moreover, female headed households have no positive association with any of the market orientation indicators used in this study. These results imply that special attention is required to female headed households in the process of commercial transformation of subsistence agriculture. The comparative advantage of female headed households may not be in grain production.

Household size is associated negatively with many of the market orientation indicators, with no positive association with any indicator. This suggests that larger households have higher household consumption needs, and so are more likely to grow cheaper but more productive subsistence crops, and sell less proportion of their produce. Hence, population control measures may contribute to commercial transformation of subsistence agriculture through its effect of reducing household subsistence requirements.

Number of child dependents, through its effect on cash need to cover expenses related with children, appears to induce market orientation. We find evidence of an U-shaped relationship between age of household head and market orientation of households in teff and chickpea, indicating the increasing preference for self sufficiency during the initial years and a shift to market orientation as the household gets older.

Given the scarcity of land and the imperfections in the factor markets of land, labor and traction power, endowment of these resources explained market orientation significantly positively. Hence, improving the operations of factor markets of land, traction and farm labor could contribute to enhancing market orientation of farm households. Alternatively, institutional arrangements to improve household access to land and traction power could contribute to market orientation of households.

Access to markets as measured by distance to market places does not effect market orientation of households in teff and wheat, but detract from market orientation in chickpea and niger seed. The study areas for teff and wheat are relatively plain lands and infrastructure is relatively better developed compared with the study areas for chickpea and Niger seed. Hence, market access remains an important factor for market orientation of households, implying the need for interventions to develop market infrastructure.

Among the village level factors, we find population growth to have mixed effects on market orientation. While population density detracts from the probability to produce teff and chickpea, it is associated positively with proportion of teff and chickpea produce sold. These results indicate that land degradation due to population pressure reduces the probability of producing teff and chickpea, but once decision to produce is made, proportion of produce sold is higher in order to cover variable costs associated with land preparation and soil fertility management. Wage of farm labor, by increasing the opportunity cost of labor, appears to induce market orientation.

The effect of extension and credit services in household market orientation is mixed. Involvement in extension service is positively associated with household probability of

growing the market oriented commodities, but has negative impact on the proportion of teff produce sold. While availability of credit at the community level is positively associated with proportion of households who produce the market oriented commodities and the proportion of area covered by the commodities, household use of the credit service has negative impact on the proportion of teff and wheat produce sold. Deeper investigation into the nature of the credit service is required to offer explanations. The extension and credit services that were designed to achieve food security objectives need to be re-examined to adopt them to the policy of commercial transformation of subsistence agriculture Ethiopia is following. In particular, the institutionalization and development of marketing extension services warrants emphasis.

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Annex 1: Descriptive statistics of explanatory variables used in community level regressions

1.1 Teff and wheat

Variables	Teff					
	N	Mean	Std. Dev.	Min	Max	N
Nearest market place (km)	86	6.52	5.15	0.00	25.00	74
Nearest market town (km)	86	11.86	7.92	0.50	37.00	74
Rainfall (mm)	87	980.79	72.13	858.00	1108.00	73
Average adult male daily local wage during peak season (birr)	87	11.88	4.34	5.50	23.00	74
Proportion of female household head	86	0.17	0.08	0.04	0.37	74
Population density	87	2.13	1.13	0.19	6.76	73
Cultivated land per household	87	2.67	1.54	0.68	6.81	74
Number of bullocks per household	87	1.26	1.57	0.00	12.90	74
Number of other livestock per household	87	4.38	4.82	0.00	35.54	74
Average altitude (meter)	87	1859.87	125.20	1603.00	2264.00	73
Credit service availability in the PA	87	0.66	0.48	0.00	1.00	74
Market info service available in the PA	87	0.60	0.49	0.00	1.00	74

1.2 Chickpea and haricot beans

Variables	Chick pea					
	N	Mean	Std. Dev.	Min	Max	N
Nearest market place (km)	60	6.52	5.19	0.00	21.00	73
Nearest market town (km)	60	13.13	8.72	0.50	37.00	73
Rainfall (mm)	60	886.20	180.88	493.00	1244.00	74
Average adult male daily local wage during peak season (birr)	60	13.13	4.34	6.50	23.00	74
Proportion of female household head (%)	60	0.18	0.11	0.04	0.48	71
Population density (persons/ha)	60	1.49	0.87	0.19	5.54	74
Cultivated land per household	60	2.73	1.79	0.00	6.81	74
Number of bullocks per household	60	1.53	1.78	0.00	12.90	74
Number of other livestock per household	60	4.74	5.52	0.00	35.34	74
Average altitude (meter)	60	1999.03	308.90	1603.00	2786.00	74
Credit service availability in the PA	60	0.83	0.38	0.00	1.00	74
Market info service available in the PA	60	0.67	0.48	0.00	1.00	74

Table: Descriptive statistics of explanatory variables used in community level regression

1.3 Niger seed

Variables	Noug				
	N	Mean	Std. Dev.	Min	Max
Nearest market place (km)	25	6.22	5.93	0.00	24.00
Nearest market town (km)	25	13.29	6.25	0.25	24.00
Rainfall (mm)	25	1,215.52	41.32	1,133.00	1,286.00
Average adult male daily local wage during peak season (birr)	25	10.20	1.98	6.50	13.00
Proportion of female household head (%)	25	0.16	0.06	0.02	0.33
Population density (persons/ha)	25	2.78	0.90	1.51	5.41
Cultivated land per household	25	1.16	0.44	0.00	2.08
Number of bullocks per household	25	0.78	0.31	0.09	1.81
Number of other livestock per household	25	2.21	0.96	0.59	5.60
Average altitude (meter)	25	1,900.08	100.57	1,789.00	2,139.00
Credit service availability in the PA	25	0.80	0.41	0.00	1.00
Market info service available in the PA	25	0.84	0.37	0.00	1.00

Annex 2: Descriptive statistics of explanatory variables used in household level regressions

2.1 Teff and wheat

Variables	Teff					
	N	Mean	Std. Dev.	Min	Max	
Population density	170	2.08	1.10	0.19	6.76	1
Nearest market place (km)	167	6.29	5.22	0.00	25.00	1
Nearest market town (km)	167	11.96	7.96	0.50	37.00	1
Age of household head	170	43.35	14.41	16.00	89.00	1
Age^2	170	2085.45	1403.84	256.00	7921.00	1
Sex of household head	170	0.84	0.37	0.00	1.00	1
Proportion of household heads literate	170	0.43	0.50	0.00	1.00	1
Number of household size	170	6.99	2.94	1.00	22.00	1
Number of dependents	170	3.15	1.97	0.00	9.00	1
Number of labor supply	170	3.56	2.08	0.00	16.00	1
Land owned (1/4 ha.)	170	7.75	4.20	0.00	25.00	1
Number of bullocks	170	2.04	1.82	0.00	10.00	1
Number of sheep & goats	170	2.18	3.34	0.00	23.00	1
Number of other cattle	170	3.19	3.05	0.00	21.00	1
Number of equine	170	1.34	1.23	0.00	6.00	1

Number of local poultry	170	4.17	4.67	0.00	24.00	1
Involvement in extension (2003/04)	169	0.61	0.49	0.00	1.00	1
Access to credit (2003/04)	170	0.75	0.43	0.00	1.00	1
Rainfall (mm)	170	972.82	73.54	858.00	1108.00	1
Average altitude (meter)	170	1864.87	124.42	1603.00	2264.00	1
Nearest milling service (km)	165	3.87	4.72	0.00	21.00	1

2.2: Chickpea and haricot beans

Variables	Chick pea				
	N	Mean	Std. Dev.	Min	Max
Population density (persons/ha)	43	1.52	0.57	0.40	3.02
Nearest market place (km)	43	6.37	4.76	0.00	20.00
Nearest market town (km)	43	12.41	5.79	0.50	28.00
Age of household head	43	47.05	11.47	30.00	80.00
Age squared	43	2341.88	1237.34	900.00	6400.00
If household head is male	43	0.88	0.32	0.00	1.00
If household head is literate	43	0.51	0.51	0.00	1.00
Household size (no)	43	8.14	2.21	4.00	14.00
Children (<14 years old)	43	3.70	1.71	0.00	8.00
Labor supply (no)	43	4.16	1.95	2.00	10.00
Land owned (1/4 ha.)	43	7.13	2.82	1.00	16.00
Bullocks owned (no)	43	3.09	2.04	0.00	10.00
Sheep & goats owned (no)	43	1.79	2.23	0.00	8.00
Other cattle owned (no)	43	3.26	2.50	0.00	10.00
Equine owned (no)	43	1.95	1.53	0.00	6.00
Chicken owned (no)	43	4.51	5.03	0.00	24.00
Involvement in extension (2003/04) (0/1)	43	0.93	0.26	0.00	1.00
Access to credit (2003/04) (0/1)	43	1.00	0.00	1.00	1.00
Rainfall (mm)	43	954.60	104.28	877.00	1234.00
Average altitude (meter)	43	1934.44	124.31	1713.00	2264.00
Nearest milling service (km)	43	4.54	5.21	0.00	20.00

2.3: Niger seed

Variables	Noug				
	N	Mean	Std. Dev.	Min	Max
Population density (persons/ha)	69	2.79	0.88	1.51	5.41
Nearest market place (km)	69	7.37	7.42	0.00	24.00
Nearest market town (km)	69	14.13	6.75	0.25	24.00
Age of household head	69	40.74	10.00	18.00	72.00
Age squared	69	1758.16	893.94	324.00	5184.00
If household head is male	69	0.90	0.30	0.00	1.00
If household head is literate	69	0.57	0.50	0.00	1.00
Household size (no)	69	6.58	2.22	1.00	13.00
Children (<14 years old)	69	2.75	1.46	0.00	6.00
Labor supply (no)	69	3.68	1.80	1.00	12.00
Land owned (1/4 ha.)	69	5.44	2.85	1.00	12.50
Bullocks owned (no)	69	1.81	1.15	0.00	5.00

Sheep & goats owned (no)	69	2.51	2.97	0.00	10.00
Other cattle owned (no)	69	4.64	3.82	0.00	23.00
Equine owned (no)	69	0.70	1.05	0.00	5.00
Chicken owned (no)	69	4.00	5.09	0.00	22.00
Involvement in extension (2003/04) (0/1)	67	0.73	0.45	0.00	1.00
Access to credit (2003/04) (0/1)	69	0.81	0.39	0.00	1.00
Rainfall (mm)	69	1215.38	43.28	1133.00	1286.00
Average altitude (meter)	69	1924.97	93.91	1789.00	2139.00
Nearest milling service (km)	69	5.01	5.28	0.00	15.00

THE TRANSFORMATION OF THE COMMONS: COERCIVE AND NON-COERCIVE WAYS

Abstract

The major economic activity for pastoralists is animal husbandry. The harsh environment in which herders raise their livestock requires constant mobility to regulate resource utilisation via a common property regime. In contrast to the mobile way of life characterizing pastoralism, agriculture as a sedentary activity is only marginally present in the lowlands of the Afar regional state in Ethiopia. Nevertheless, this study reveals a situation where the traditional land-use arrangements in Afar are being transformed due to the introduction of farming. In the past, the Imperial and the Socialist governments introduced large-scale agriculture in a coercive manner, thereby instigating massive resistance from the pastoralists. Currently, the recurrence of drought in the study areas has facilitated the subdivision of the communal land, on a voluntary basis, for the purpose of farming. Qualitative and quantitative means of analysis were used in order to highlight the coercive and non-coercive ways that have been used in the transformation of traditional property rights of Afar pastoralists.

1. Introduction

Change in natural environmental conditions has constantly influenced pastoral livelihoods in the Afar region of Ethiopia, though uncertainty in ecological conditions and insecurity of property rights have only relatively recently increased (Scoones 1995, McCarthy et al. 1999). As a result of these changes, the reliable flow of life-sustaining goods and services previously wrought from the area's erratic rangeland ecosystems is diminishing, putting pastoral livelihoods at great risk (Gadamu 1994). The adaptation of these pastoralists is not confined to a simple human-land relationship in an isolated setting, but is rather influenced by demographic change, agricultural expansion, attempts to incorporate them into the national economy, and insecurity arising from conflicts and border instability (Davies and Please indicate the estimated equation here.

Bennett 2007). Due to the widespread nature of droughts (Berkele 2003) and ethnic conflicts (Hagmann 2005) in several areas of Ethiopia, livestock mobility between alternative water and grazing areas has also been severely constrained (Padmanabhan forthcoming), weakening livestock and causing a significant increase in livestock mortality. The cumulative effect of these factors has led to the weakening of traditional authority, degradation of natural resources and growing vulnerability of different pastoral groups to ecological and economic stress, often resulting in poverty (Unruh 2005, Rettberg 2006).

In this situation, livestock herders increasingly pursue non-pastoral income strategies to meet consumption needs and prepare against risky shocks such as drought (Little et al. 2001). Studies in diversification strategies (e.g. Holtzmann 1996, Kituyi 1990, Little 1992, Zaal and Dietz 1999) show that marked change and diversification is still discussed as a two-sided coin, which may either allow herders to better cope with high levels of risk or may exaggerate their problems. Cultivation is a major avenue of diversification and is seen by some as a viable risk management strategy (Campbell 1984, Smith 1998), while others view it as an unsustainable or even destructive option that accentuates the risks pastoralists face (Hogg 1988). Fratkin (1991) and Nathan et al (1996) show the potentially negative ecological and social effects of pastoral sedentarization and diversification. Yet, for Holtzmann (1996), diversification is seen as a cyclical rather than a linear process, whereby herders combine different income strategies at different points in their life-cycle. Equally, income diversification strategies such as farming among pastoralists do not necessarily lead to a diminished interest in livestock investments and production (Little et al. 2001). In this paper we will focus on crop production from a dual perspective: first looking at the historically coercive way of state intervention and, second, at the current means of responding to natural calamities. As we will

demonstrate, there is considerable difference within pastoral communities in motivations for diversification, predominantly along lines of wealth and gender.

Property right changes having to do with the evolving relationship between pastoralists and agriculture are at the center of this analysis, which looks into two cases related to agricultural production systems and Afar pastoralists. One case portrays the conflictive transformation of the traditional land use arrangements of Afar pastoralists, which came about due to the coercive intervention of the state in implementing projects associated with commercial farming, while the other shows the more or less collective adaptation to farming, as induced by recurrent droughts in the presence of small-scale and supportive state intervention. Indeed, the two cases show that pastoralism is under pressure arising from both policy-related and natural challenges.

Natural resource degradation and poverty in rural Ethiopia are fundamentally problems of institutional failures: both in terms of inadequately defined property rights and problems of governance (Mengisteab 2001). Institutional failure constrains the capabilities of rural households to effectively channel their assets – including natural, human, physical and economic, social and political capital – towards enhancing sustainable livelihoods, particularly in times of crisis, e.g. natural disasters, political crises and economic transitions (Bromley 1998).

Ethiopia's national poverty reduction program recognizes that there is a rising threat to pastoral livelihoods as a result of biased policies and environmental change. The changes in economic policy that came about following political changes in 1991 gave development priority to neglected regions and groups, like pastoral and agro-pastoral group in the lowlands. Consequently, the present constitution recognizes pastoral land as specified in Article 40 and shows the step-wise constitutional and legal recognition of a common property regime for rangeland resources. Nevertheless, the government is still facilitating the gradual conversion of pastoralists into more sedentary livelihoods, reflected in the majority of its strategies for change (UN OCHA-PCI 2007).

Historically, Ethiopian pastoralists have been the most marginalized groups in the policy arena (Helland 2002, Yemane 2003). During the Imperial regime (1930 to 1974), pastoralists were considered to be aimless wanderers who led a primitive way of life (Abdulahi 2004, Getachew 2001); moreover, they were considered to have been using natural resources wastefully (Gebre 2001). Hence, during this time the main ambition of government officials, who were entirely from peasant or urban backgrounds, was to convert these 'primitive' societies into sedentary farmers who would utilize resources more efficiently. Different government policies emphasized that efficient resource utilization was possible if the vast and 'inefficiently used' resources in pastoral areas came under the control of the state, legitimizing government intervention (ibid).

This modernist discourse, viewing pastoralism as a stage toward a gradual development towards agro-pastoralism and finally sedentary agriculture, had been the basis for most policy formulation under the socialist regime (1974 to 1991), until the nineties, and still causes great grievance and irritation in the public policy debates on pastoralists today. Catty (2007) stresses the simultaneity of pastoralists' cultural persistence and resistance to sedentarization and farming while also compromising and adjusting to modernization efforts and a globalizing world. In this paper, we discuss two cases of pastoralist involvement in agriculture and investigate the challenges and opportunities of this relationship. Modernist thinking, characterised by a linear development path, has influenced the pastoral situation in the past through forced diversification, while today we observe voluntary farming activities.

On the one hand, with its increasing involvement in land-use politics since the 1960s, the state as a powerful external force has inflicted severe changes upon the property right regimes that govern pastoralist life. The influence of the state-farms established in the Awash valley on dry-season pastures has forced the institutional arrangements of the commons into diversification. The role of state-induced farming presented challenges to the survival strategies of Afar pastoralists, differentiating them as 'winners' and 'losers'. On the other hand, the current endeavours of development intervention to promote farming are opening up other opportunities. The present study shows that the question of whether this recent option of small-scale farming is taken up by pastoralists depends on factors such as per capita livestock assets, suitability of the land for farming in general, access to wage employment as an alternative income source, and external support in regards to farming activities. The contradictory impact of these processes on property rights and collective action regarding poverty is also to be discussed.

The remainder of the paper is structured as follows: Section 2 briefly discusses the theory of transformation of property rights; the next section places the study at hand in the wider theoretical debate on property right changes; Section 3 describes the study sites and methods; Section 4 describes the current institutional arrangements of Afar pastoralists; Sections 5 and 6 discuss the transformation of the traditional land use arrangements of Afar due to coercive state intervention and natural challenges, respectively; and the final section summarizes the main findings and provides policy suggestions.

2. Theoretical perspectives on property right changes

The notion of property rights refers to a "bundle" of rights that individuals or groups have on a certain material or intellectual resource (Schlager and Ostrom 1992, Alchian and Demsetz 1973). Bromley (1991) defines these bundles of rights as including the right to derive benefits from the resource, the right to exclude others, the right to manage the resource and the right to transfer the resource to others through various arrangements, backed up and enforced by the collective. Rights may be time-

bounded or intermittent. Right holders are claimants over a resource − including individuals, communities, or legal entities − who may enjoy all rights in a bundle or be limited to only some of them. In most cases, conflicts take place among different individuals or communities regarding who should have command over a resource, how to use it, when to use it, and so on (Mwangi 2005). There are a great number of cases in which different people or communities bear overlapping claims over resources, such as in the case of the riverine pastures of Afar. In pastoral areas, grazing land is a common-pool resource to which a great number of herders have *de facto* rights (Kirk 1999, Swallow & Bromley 1995).

While rights imply the access of right holders to benefit streams, they do not *guarantee* the realization of benefits. All members of a clan in Afar hold rights to the common rangeland that belongs to their clan, but have different capabilities to utilize it. Households with little livestock have less means with which to actually access the resources. Ribot and Peluso (2003) sharpen this distinction by providing a broader framework for property right analysis. The basic idea underlying their framework is the distinction between *property* and *access*. Accordingly, 'access is about all possible means by which a person is able to benefit from things', while 'property generally evokes some kind of socially acknowledged and supported claims or rights' (p. 155). With this re-conceptualisation, they show how capability differences arising from access to different resources influence the quantity and quality of benefits that can be generated from them.

Collective action and cooperation may exist at various levels within an institutional framework (Schmid 2004, Ostrom 1990): for purposes such as defence and attack or peaceful exchanges (Hundie 2008). Institutions create stable expectations among people (Knight 1992) and, hence, well-functioning institutions facilitate cooperation (Schmid 2004). In some societies, the rules that govern human behaviour are more formalized than in others. In such cases, institutions are built intentionally to reduce the incentives for non-cooperation vis-à-vis cooperation (Olson 1965). In other societies, informal social relationships and the institutions embedded in those relationships shape behaviour and the decisions of actors to cooperate or not (Grant 2001).

3. Study sites and Methods

The Afar region extends from central to northeastern Ethiopia, following the East African Rift Valley. The study districts - namely Amibara, Awash-Fentale and Semu-Robi-Gele'alo - are found in the southern part of the Afar region (Figure 1). Amibara and Awash-Fentale are located in the middle Awash valley, within the Rift Valley, whereas Semu-Robi is found across the lowland-highland interface, towards the western border of the Rift Valley. All study areas are characterized by a semi-arid climate, with average annual temperatures ranging from 21 to 38 °C, the lowest temperatures being between December and February and the highest between April

and June. The average annual rainfall is about 697 mm, coming primarily in two rainy seasons, namely *karma* (July-September) and *gilel* (March-April).

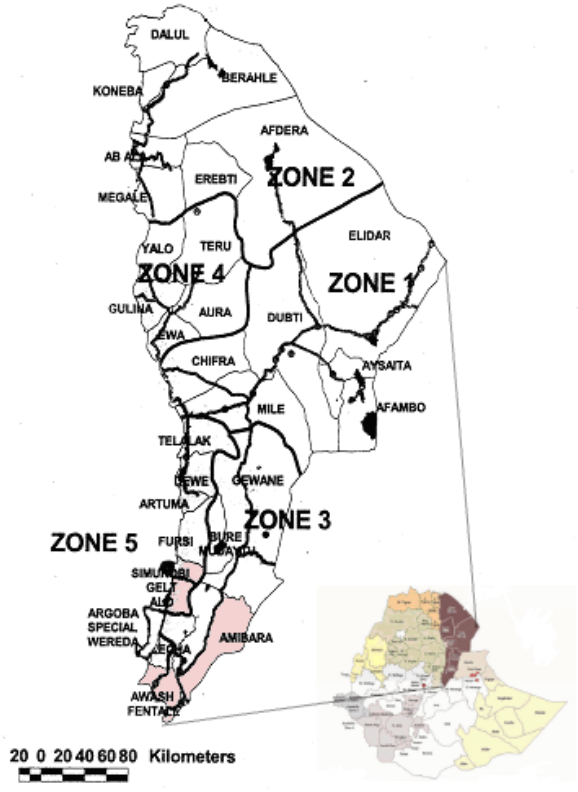

Figure 1: Location of Afar Region and Study Districts
Source: Afar Region Administration (2005)

The dominant source of livelihoods in the study areas is pastoralism, with limited levels of crop cultivation and other activities (Table 1). Afar pastoralists raise mixed species of primary livestock, including camels and cattle, and keep supplementary herds of goats and sheep, usually for commercial purposes. They manage their livestock under an extensive mobile system, with natural pasturage being the main source of livestock feed.

Table 1: Background of the three study sites

Location	Amibara	Awash Fentale	Semu Robi

Household economy	Pastoralism, farming	Pastoralism, farming (recently begun)	Pastoralism, fa (recently begun)
Ethnic and clan groups	Afar clans: Sidhabura, Rakbadermella Non-Afars: Amhara, Oromo and others	Afar clans: Rakbadermella, Mafay, Ayraso	Afar clan: Sidhabur
Kebeles studied	Ambash, Qurqura	Doho, Dudub	Harihamo, Daleti
No. of households interviewed	60	60	60
Location	Southern part of Afar region (in the middle Awash valley)	Southern part of Afar region (in the middle Awash valley)	Southwest part o region (across lowland-highland interface)

To investigate both historical and recent changes in the traditional property rights of Afar pastoralists, we pursued two different kinds of data sources, namely primary and secondary, and employed various procedures for data collection. Section five is mainly based on secondary data, including several unpublished documents accessed from the Middle Awash Agricultural Development Enterprise (MAADE), the Melka Werer Agricultural Research Center, and the Afar Region Administration. The information obtained from these and other documents was augmented with data generated through key informant interviews and discussions with groups of pastoralists.

Section 6 is mainly based on the data collected from 180 pastoral households, dwelling in six purposively selected sites namely: Ambash and Qurqura in Amibara district, Doho and Dudub in Awash-Fentale district, and Harihamo and Daleti in Semu-Robi district (Table 1). A two-stage procedure was used to select the sample households. First, using lists of household heads in each site (generated for the purposes of this study), with the help of the local elders pastoral households were stratified into three groups: poor, medium income, and better off. Thereafter, ten households were selected from each stratum using systematic random sampling technique. In most cases, household heads (usually male) were interviewed, though in a few cases responses were taken from an adult family member who was not the head. A group of trained enumerators conducted the interviews with individual sample households, guided by a structured questionnaire prepared for this purpose.

The overall data collection process encompassed two phases. The first phase (December 2004 – May 2005) involved several tasks, including implementation of the household survey, collection of secondary data, and collection of detailed qualitative data though group and key-informant interviews. The second phase (October 2006) was organized for a short period in order to strengthen the evidence

gathered from the first phase by reviewing secondary sources and conducting expert interviews.

4. Traditional institutional arrangements

The clan is the lowest and *de facto* unit of traditional administration in Afar, although there are also smaller social units, such as the *dahla* or sub-clan. As Getachew notes each clan comprises "a group of people related to each other by decent, living within shared territory and sharing common rituals and political leadership" (2001:54). Each clan has a well-established gerontocracy, whereby decision-making power regarding land and other natural resources resides within the clan council, consisting of the clan leader, elders, the *feima*[1] and local wise men.

Each clan manages its resources collectively, based on customary principles. Accordingly, herd management follows rotational grazing patterns. When rainfall is normal for successive seasons, clan members are instructed not to use reserved pasture areas. These areas are made accessible to the members only after other areas have been exhaustively used. Although each clan member has an inalienable use right over the resources, intra-clan customary laws (or operational rules) regulate these use rights.

The traditional institutions of the Afar allow two types of resource users. The first category includes clan members who use the rangeland permanently. They are primary right-holders (*waamo*) who have not only the right to use the resources on the rangeland but also to exclude others and to transfer to their heirs. The second type of resource users comprises groups of neighboring pastoralists whose demands for pastoral resources go beyond their own endowments, particularly during drought years. These groups are secondary right-holders. They can be termed "right-holders" because they have frequent access to clan resources that is generally recognized and accepted by clan members and traditional leaders. However, certain obligations are operational on secondary right-holders in order to obtain access to the resources. *Ex ante* negotiation is required with *waamo* right-holders, the success of which depends upon the relationship between the two groups and resource conditions. If they are allowed access, secondary right-holders are required to honor the customary rules of the host group. For instance, they should refrain from actions such as cutting trees, allowing other herders to use the resources and rushing their livestock into reserved areas.

5. Coercive ways of property rights change: The state subverting the commons

5.1. Triggers and Processes of Coercive Change

[1] *Feima* is a rule-enforcing authority in Afar traditional administration. It consists of a principal leader (*feima-abba*), a deputy leader (*erenna-abba*) and ordinary members.

The intervention of the state in Afar was very limited prior to the 1960s. Farming was limited to the lower Awash flood-fed plains, where some pastoralists in the Asahimarra section of Afar had been practicing mixed crop-livestock farming for generations (Getachew 2001). However, following the 1960s state interventions in these areas have increased, mainly for two reasons. First, the Afar plains - specifically areas in the middle Awash valley - were found to have great potential for wide-scale irrigated farming. The most attractive feature of these areas was their suitability for cotton production, which was critically important for expanding the country's textile industries: a primary focus of the first and the second five-year national development plans (IGE 1957; 1962). Second, pastoralism was not accepted as a livelihood strategy within the reigning national political mindset of the time. Rather, pastoralism was considered to be a primitive and nonviable way of life − to be avoided rather than preserved (Abdulahi 2004; Getachew 2001). Thus, the intention of the policy makers was to change this mobile mode of life towards sedentary farming. However, the pastoralists neither participated in the decision-making process nor were they convinced about the goal of change.

In 1962, the Awash Valley Authority (AVA) was established by decree as an agent of institutional change. AVA was responsible for undertaking several activities, such as the founding and management of state farms, coordination and financing of pastoral settlements and other schemes, and monitoring the overall transformation process, for which some 70,000 ha of dry-season rangeland was targeted (Getachew 2001). AVA had direct military and financial support from the government to implement the planned changes, using its military power, for example, to threaten the pastoralists. The Middle Awash Agricultural Development Enterprise (MAADE) began operations on the expropriated rangeland with the main objective of satisfying the demand of domestic textile industries for cotton. Initially, it had an operating area of 300 ha, which was increased to 13,116 ha in 1985. In addition to MAADE, several pastoral development schemes were implemented with directives coming from AVA. These included collective settlement farms and irrigated pastures[2]. The costs to cultivate the settlement farms were covered by the state while the pastoralists contributed nothing except their labor. The output of the settlement farms was distributed among registered households.

The implementation of the state-driven projects resulted in a mixture of property rights in the area. Firstly, by using its coercive power the state became a *de facto* owner of part of the land over which the pastoralists had had inalienable rights for generations. Secondly, the introduction of the collective settlement farms brought a

[2] The irrigated pasture scheme was envisaged to plant a variety of improved grass seeds through the participation of the settler pastoralists, so that the latter would appreciate the improved techniques and thereafter manage the irrigated pasture independently. However, this did not take place, and the irrigated pastureland served the dairy farm that had been established to fulfill the milk consumption of the staff of the state farms.

new variant of common property, apart from the traditional communal ownership of the rangeland. Indeed, the non-riverine parts of the area remained under the control of the pastoralists and were entirely allocated for livestock grazing, whereas traditional rights were nullified by order from the state in the riverine sites. This implies that the intervention of the state created a "legal dualism": Claims over the riverine sites were governed and protected by statutory laws, whereas the non-riverine sites remained outside of direct state protection and legitimacy.

Because the state, by the power vested in it, redefined the land use rules without consulting the pastoralists, the process of change was not smooth, with the pastoralists resisting every action of the state. Indeed, throughout the 1980s and 1990s Afar pastoralists put great pressure on the administration of the state farms[3]. The pastoralists expressed their dissatisfaction with and opposition to the implementation of the commercial farm schemes mainly by damaging mature crops in the field, a typical example being the recurrent damage caused by local people on banana plantations, which eventually forced the state farms to abandon banana production. Initially, the state farms allocated compensatory funds to be paid to clan leaders and elders in the form of employment benefits which would, it was hoped, ameliorate the dissatisfied pastoralists. This reward system did not put an end to the grievances, however, as the power of the pastoralists emanate from their great number, which was increasing over time.

In the course of time, the relative power of the two actors has changed in favor of the pastoralists. At the beginning, AVA had the power of mobilizing resources to constrain the choices of the pastoralists and was capable of controlling their actions. However, it couldn't maintain this power to continuously influence the choices and actions of its counterparts. This is partly attributable to the decline of attention paid by the government towards state farms after 1989. Especially after the economic reform of 1991, the stake of the state in business ventures dramatically declined. As a result, AVA did not receive enough financial, political and other supports from the government to maintain its power. In addition, the shift in the national political structure towards ethnic-based federalism and the concomitant establishment of the Afar National Regional State re-calibrated the power balance in favor of the pastoralists.

These changes had effects on the existing property rights and land use arrangements. With the efforts of the Afar regional government and the decision of the Transitional Government of Ethiopia, MAADE handed over a significant part of its land, including irrigation infrastructure and facilities, to the Afar[4] in 1993. This, in turn,

[3] The resistance was also supported by Afar Liberation Front (ALF), which declared armed straggle against the government on June 3, 1975, following the dramatic expansion of the commercial farms by the military government. (http://www.arhotabba.com/alf.html).

[4] The state farms handed over about 6547 ha, with the entire irrigation infrastructure intact (MAADE, unpublished document, 2005).

resulted in the existence of two distinct forms of property relations, consequently increasing the number of actors involved. First, the pastoralists subdivided part of the returned farmland and started private farming in collaboration with highlanders, implying the individualization of the traditional communal rangeland. Second, the pastoralists leased-out part of the returned land to local investors, whereby the latter annually transfer cash payments to the pastoralists[5], implying the introduction of a lease contract regime into the area.

In general, this sub-section shows that the state is the major source of property right changes in the middle Awash valley of Afar region. Empirical evidence from other areas in East Africa also confirms the significant role of the state with regard to property rights changes in pastoral areas. In some East African countries, such as Kenya and Uganda, the intervention of the state in forming modern ranches subverted traditional property rights arrangements and the existing ways of life (Fractin 1997; Mwangi 2005; Rutten 1992; Muhereza 2001; Helland 1977). Similarly, the pro-conservation policies of many East African governments resulted in the transfer of large areas of rangelands from pastoralists to the state (Fratkin 1997; Markakis 2004; Lane 1998; Kisamba-Mugerwa 2001), as did the pro-farming policies that facilitated the rapid expansion of large-scale commercial farms in pastoral areas of these countries (Rutten 1992; Lesorogol 2005; Shazali and Ahmed 1999; Fratkin 1997). None of these state-led transformations of traditional common property regimes were characterized by peaceful interaction between the state and the local people, and all took coercive lines.

5.2. Impacts of coercive change on the livelihoods of pastoralists

Direct intervention of the state has, step by step, changed the traditional property regime of the pastoralists and brought about new forms of land use arrangements that have direct implications for their livelihoods. Four distinct forms of land use arrangements have been realized since the initial interventions of the state, namely: state farms, settlement farms, individual small farms and private large-scale farms. These new variants of property rights have one main feature in common: they are all related to the production of crops. However, each of them is unique in terms of the types of actors interacting with pastoralists and the impacts on rights and capabilities of pastoralists to secure livelihoods that they entail. The existence of state farms implies *de facto* state ownership as well as the nullification of customary rights which pastoralists had had over land for generations. Indeed, the contemporary rights that pastoralists have over this portion of the former commons have been limited to use rights over crop residues, and only with the consent of officials from the state farms.

[5] As realized from group discussions, investors pay 30% of their annual profit to pastoralists in the form of rent. In addition to financial payments to the pastoralists, the investors have promised to improve local infrastructure, including schools, watering trenches and health stations. However, the pastoralists complain that none of the investors have honored their word regarding infrastructural development.

On the other hand, the expropriation of large tracts of dry season rangeland, without compensation, has resulted in the reduction of the capability of pastoralists to secure livelihoods through the traditional means of livestock production. In this respect, the present vulnerability of Afar pastoralists to recurrent droughts is at least partly associated with such expropriatory measures of the state (Sen 1981; Getachew 2001; Yemane 2003).

The settlement farms (established for compensatory reasons reflect a kind of interaction between the state and the pastoralists. In this case, the new resources necessary to produce crops were entirely supplied by the state. The existing irrigation infrastructure and the road networks were built by the state through a large outlay. Similarly, farm machinery and facilities were purchased by the state. The technical personnel and the management staff had also been installed through the efforts of the state. While these resources defined capabilities to exercise rights within the parameters of the new land use system, pastoralists already had well-recognized rights to the benefit streams from the land. In other words, they had the rights[6] as well as the capabilities to generate benefits from the settlement farms. However, the state was not "benevolent" forever, but rather stopped its support in the mid-1980s. The termination of state support and the concomitant transfer of all machinery and facilities to the state farms have debilitated the capability of the pastoralists to extract benefits from their land, although their rights to the land have remained intact. Lacking the knowledge and physical resources needed for farming, the pastoralists have not been able to continue crop production on the former settlement farms, despite their rights to do so. As a result, the entire settlement farm has been out of production and is covered, at present, by an inedible exotic weed (*Prosopis juliflora*). In fact, this part of the former rangeland is neither cultivated nor is it efficiently used for livestock production, which has direct implications for the livelihoods of the pastoralists.

The return of the confiscated land in 1993 was an important action that reduced the influence of the state on the traditional lands of the pastoralists. Actually, the pastoralists were free to decide on what to do with the returned land. Accordingly, the land was partly allocated to clan members and was partly leased out to local investors. In regard to individual parcels of land, the Afar have established partnerships with agriculturalists from the highlands. Individual landowners have the right to choose their partners, define and redefine the land use contracts, and terminate contracts if required. In the lease arrangements, the new partners of the pastoralists are local investors. Under this form of contract, the pastoralists collectively earn 30 percent of the investors' profits in return for the use of their land, which they distribute among themselves based on predefined criteria. They have

[6] In fact, pastoralists were restricted to using the land consistent with formal regulations for the area. For instance, they couldn't use it as rangeland.

formed a standing committee, including an accountant, to monitor all transactions of the investors. The committee has been entrusted to defend the rights of its principals and, hence, to take action when errors or other problems arise.

While the current situation shows the restoration of the rights of the pastoralists over their traditional land, capability limitations are apparent in terms of maximally exploiting the new venture. First, pastoralists have poor knowledge of farming techniques and lack resources (e.g. farm implements) necessary to cultivate crops. As a result, the highlanders are responsible for all farm operations in return of larger shares of the net farm proceeds (up to 70 per cent), whereas the contributions and earnings of the pastoralists are minimal. Actually, the share of the highlanders reflects the costs to be paid by the pastoralists due to their limited capabilities to produce crops on their own. Second, the capacity of the committee to actually carry out their responsibilities concerning the lease arrangements is questionable. The members have no accounting knowledge and some of them do not even know how to read and write. Hence, everything is done based on trust, implying the possibility that the pastoralists could be cheated if the investors desire to do so. Again, this implies the weak position of the pastoralists under such arrangements.

It is also worthwhile to pinpoint the distributional effects of the changes in property rights that have taken place. Traditional property rights allowed multitudes of users to share a resource system in accordance with certain predefined rules. Under the traditional arrangements, all clan members had equal rights to grazing resources and, hence, could extract benefits, provided that they had livestock. However, equality in rights to the communal heritage has not been ensured following the state-induced changes of property rights. During the initial period of the transformation, elites and their allies abandoned the customary rules and facilitated their own entitlement to the benefits from the settlement farms. Others used their physical fitness and connections with project leaders to secure their own benefits, while those households lacking such resources were denied access to them (Getachew 2001). The procedures following the subdivision of the newly returned land has also not been immune to discrimination. Contrary to the traditional land law, about 31 percent of the sample households were left out of consideration during the subdivision. A closer look at the assets of the sample pastoralists chosen for this study shows that those who have not been benefiting from the subdivided land are poorer (average 0.89 TLU of per capita livestock asset) as compared to those who have been benefiting (2.91TLU). This inequity and mistreatment is even more visible with regard to the women. ‘Women-headed’ households were neither considered when the returned land was distributed among clan members nor have they been beneficiaries

from the leased-out land because of tradition-based criteria: women are *de facto* minors in Afar customary laws[7].

6. Non-coercive ways of property rights changes: Triggers of voluntary adoption of farming

Afar pastoralists in the study areas have been highly threatened not only by the coercive actions of the state, but also by recurrent droughts. Two major droughts hit the areas since the mid-1990s, and short dry spells are common as well. The prevalence of drought has adversely affected the pastoral economy in two ways. First, it has reduced the total livestock assets and productive capacities of the area, thereby increasing mortality and morbidity rates. Sanford and Habtu (2000, cited in Mesfin 2003:44) have estimated that a 5 to 15% percent reduction in livestock assets occurred in Afar due to the drought of 1999/00. In fact, this estimation corresponds to the best-case scenario. Under the worst-case scenario, livestock loss has been estimated to range from 15 to 45 per cent. Emergency assessment reports of various development organizations and relief agencies indicate that the prolonged drought of 2002/03 had even more serious consequences for the Afar pastoralists (FEWS NET 2002; UN-EUE 2002a; UN-EUE 2002b).

Second, the successive droughts have re-calibrated the terms of trade against the pastoralists. Although no systematic records have been found yet, assessment reports of aid agencies indicate a sharp decline of livestock prices during the droughts. A UN assessment mission in the area indicated that pastoralists faced more than 50 % reduction in livestock prices following the drought of 1999/2000 (UN-EUE 2000). Similarly, livestock prices fell by 50 % to 60 % due to the drought of 2002, while maize prices simultaneously rose by about 235 percent (Davies and Bennett 2007). The adverse effects of the droughts on the terms of trade were compounded by other factors, such as export restrictions imposed by Saudi Arabia in September 2000, following a Rift Valley fever outbreak, and insecurity around the northern border of the Afar region in the aftermath of the war between Ethiopia and Eritrea in 1998.

These livestock losses coupled with the deteriorating terms of trade against pastoralists worsened food insecurity in the study areas, with the degree of food insecurity reaching its climax in 2002/03 because of the intensified drought. A serious famine hit the area, during which a large number of pastoralists lacked anything to eat. On 12 July 2002, the Disaster Prevention and Preparedness Commission issued a *Special Alert* that publicized the deterioration of food security in several parts of the

[7] Women have no ownership rights to land as well as other resources, including livestock. They hold conditional rights and, thus, are only entitled to benefit streams via their husbands. When a woman's husband dies, all jointly owned assets, including livestock, are transferred to her husband's family, and the widow loses control rights over 'her' former resources. As a small compensation, she can indeed maintain control over the livestock given to her as presents by her husband during their marriage.

country, particularly in the Afar region and the neighboring East Shewa zone of Oromia. According to the *Special Alert*, 448,500 people in the Afar region needed emergency aid, out of which 45.3 percent were located in Zone 3 (constituting Amibara and Awash-Fentale) and Zone 5 (constituting Semu-Robi).

The deterioration of food security in pastoral areas in general and Afar in particular necessitated an intensified intervention of external agents (governmental and non-governmental organizations) into pastoral livelihoods. While the most immediate external intervention was provision of food aid to save human lives, a number of programs and projects financed by the government and NGOs, such as FAO, Farm-Africa, CARE-Ethiopia, and Oxfam GB, were designed to improve the livelihoods of pastoralists. One intervention was focused on designing projects and programs to facilitate the expansion of crop cultivation in these areas.

Both traditional authorities and external agents were important facilitators of collective action to begin farming. In this respect, external agents (local government and NGOs) sponsored meetings at the *kebele* level. While there exist no formal records on the number of local meetings in the study sites, the average number of meetings reported by the sample households ranges between 7.2 (for Dudub site) and 18.6 (for Daleti site) for the year preceding the survey. During the meetings, the external agents explained their visions and commitment toward improving the livelihoods of pastoralists, mainly through programs targeted on farming. The interventions of the external actors were even more direct in three of the study sites, namely Harihamo, Daleti and Doho. In Harihamo and Daleti, the government directly supported collective activities in relation to farming through its food security program. Assistance included provision of farm tools, covering initial costs of farm operations (e.g. costs of tractor for tillage), provision of oxen, and other logistic and advisory support. At the Doho site, support was mainly provided by an FAO livestock recovery project office at Awash-Fentale which provided financial support for initial development of irrigation infrastructure and farm inputs, mainly seeds. Moreover, district level experts on agriculture were responsible for providing advisory support to the “agro-pastoralists”.

Similarly, the role of traditional authorities was substantial. Specifically, activities such as mobilizing clan members for meetings; organizing and supervising all activities, such as bush clearing and land levelling; and imposing sanctions on free riders required the active participation of the *feima* members. Traditional sanctions were to be applied, including asset penalties, like slaughtering the breeding cows of free riders, and corporal punishment, such as beating free riders in public to shame them[8].

[8] While all of the sample households were aware of the existence of these sanctioning mechanisms, none of them reported having faced any sort of punishment in relation to the collective preparations for farming.

The pastoralists were required to be involved in all activities to prepare the communal land for cultivation, following which it was allocated to the participants. The preparatory activities were done intermittently for about 4 months in Semu-Robi and for 2 months in Awash-Fentale. For Amibara, the exact duration is not clear, but according to sample respondents it ranged between 30 and 180 days. The overall participation rates across districts in these cooperative activities were 39.1 % (n=70) with 13.3 % (n=8) in Amibara, 23.3% (n=14) in Awash-Fentale and 81.4 % (n=48) in Semu-Robi.

7. Modelling the voluntary adoption of farming

In this case, farming is an enterprise that has been induced because of natural shock to the area. Understanding the movement of pastoralists towards farming entails comparison between the situation under farming and pastoralism.

Let U_{i1} and U_{i0} be the utilities of individual i associated with farming and pastoralism, respectively. We expected that community members would be heterogeneous in terms of the level of utilities generated from farming. We also expected that community members would vary in terms of the level of utilities they generate from pastoralism. Thus, U_{i1} and U_{i0} can be formulated as a function of other variables such that:

$$U_{i1} = \alpha + \beta_i X_{i1} + \varepsilon_{i1} \text{ and } U_{i0} = \alpha + \beta_i X_{i0} + \varepsilon_{i0}, \quad (1)$$

where α and β_i are parameter estimates and X_i is a vector of exogenous variables that cause heterogeneity among community members.

As a utility maximizer, individual i decides in favor of farming if $U_{i1} - U_{i0} > 0$ and otherwise if $U_{i1} - U_{i0} < 0$ [9].

Accordingly, participation in collective activities to start farming reveals that $\varepsilon_{i0} - \varepsilon_{i1} < \beta_i X_{i1} - \beta_i X_{i0}$. If we replace $\varepsilon_{i0} - \varepsilon_{i1}$ by ε_i and $\beta_i X_{i1} - \beta_i X_{i0}$ by $\beta_i X_i$ for brevity, then the probability that individual i will participate in collective action to start farming can be specified as:

$$P(C_i = 1) = P(\varepsilon_i < \beta_i X_1) \quad \textit{(2)}$$

[9] There could be indecision if $U_{i1} - U_{i0} = 0$, but this happens with zero probability if $U_{i1} - U_{i0}$ is a continuous random variable.

If a normal distribution function is assumed for ε_i, then the model turns out to be a probit model (Amemiya 1981). Alternatively, if a logistic distribution is assumed, the model becomes the logit one (ibid). The two alternative models produce similar outputs, except in rare cases when the data concentrates around the tails of the distributions (Amemya 1981; Greene 2000). Here the logit model is used, since it lends itself to easier interpretation.

Table 2 shows the description of the independent variables considered for logistic regression analysis and their hypothesized signs. The dependent variable takes on a value of 1 if a pastoralist participated in collective action to start farming and 0 otherwise. The explanatory variables had been tested for their importance by using descriptive statistics before they were subjected to regression analysis. The results show that participants are significantly different from non-participants with respect to all but one variable[10].

Table 2: Description of variables and working hypothesis

Variable code (X_j)	Description	Mean of X_j or Percent of X_j = 1	Hypo
AGEHH	Age of household head in years	40.1	-
EDUCATE	A dummy variable which takes on 1 if the household head is literate; and 0 otherwise	25.7	+/-
ACTIVLB	The number of household members within the age range between 10 and 60 years[11]	4.9	+
SUITAGR	A dummy variable which takes on 1 if the area is either suitable for rain-fed agriculture or can be irrigated given existing water resources and capacity to irrigate; and 0 otherwise.	66.5	+
PERCPLS	Per capita livestock holding of household (TLU)	3.1	-
EMPOPP	A dummy variable which takes on 1 if the household generates income from wage employment; and 0 otherwise.	10.6	-
SUPPORT	A dummy variable which takes on 1 if external agents provided direct support[12] before and during collective activities; and 0 otherwise.	49.7	+

Source: Own survey data

[10] The exception was EDUCATE.
[11] Classification was made based on local information.
[12] External support includes financial, material and advisory services. Moreover, the role of external agents in organizing local meetings has been taken into account to define the variable.

8. Regression results and discussion

The outputs of the regression are shown in Table 3. The signs of the coefficients in the regression are all in agreement with prior expectations. The chi-square statistic is significant, implying that the explanatory variables (taken together) are important in explaining the variability in the dependent variable (cooperation to start farming). The model was able to correctly predict 86 percent of the cases vis-à-vis participation in collective activities. Since the standard coefficients in the logistic regression equation are not directly interpretable, the marginal effects of explanatory variables were computed by using an additional algorithm in the LIMDEP statistical software version 7.

Table 3: Determinants of Cooperation among Pastoralists to Start Farming

	Coefficients	**SE**	**Marginal Effects**
Constant	-3.6695**	1.2439	-0.6348
AGE	-0.0143	0.01523	-0.0024
EDUCATE	0.5477	0.5483	0.0947
ACTIVLAB	0.0561	0.0776	0.0097
SUITAGR	3.8085**	1.1561	0.6588
PERCPLS	-0.1681**	0.0623	-0.0291
EMPOPP	-2.0585*	0.8831	-0.3561
SUPPORT	1.5636**	0.6195	0.2705
Chi-square	108.7822**		
Log likelihood function	-65.39940		
Percent of correct prediction	86		
Number of cases	179		

* and ** significant at 5% and 1% levels, respectively

Source: Own survey data

Four variables are important for explaining cooperation of pastoralists in collective activities geared towards starting farming: suitability of the area for agriculture, per capita livestock holding of a household, access to wage employment, and external support. Each of them will be discussed in some detail in the following.

The proxy variable for suitability for farming (SUITAGR) is positively related to the level of cooperation. This variable is supposed to capture the variability among the study sites with respect to their potential for crop cultivation. In this respect, the study areas were classified into two groups, based on the perceptions of the pastoralists. Ambash, Doho, Harihamo and Daleti were classified as potential sites for agriculture, either because of the presence of irrigation infrastructure (Ambash and Doho) or because of better rainfall distribution (Harihamo and Daleti). Contrariwise, Qurqura and Dudub were classified as non-potential areas. The heterogeneity of the

study sites with respect to their potential for agriculture implies the existence of spatial variation regarding the costs of running a new enterprise (i.e. crop production). In areas where shifting to farming is easier, either because of better rainfall or the possibility of irrigation, mobilizing people for collective action is easier, because people anticipate that they would incur relatively low costs in order to realize benefits that would be reasonably higher than the alternative engagements. The regression result indicates that the probability of cooperation in collectively organized action to start farming increases by about 66 % in areas where people perceive the possible benefits of farming. The perceptions of the pastoralists on the potential of their localities vis-à-vis farming influence their decisions, because expectations about the benefits of cooperation arise from individual perceptions.

The second influential factor is the level of wealth of pastoral households, as implied by per capita livestock ownership (PERCPLS). The expectation was that households with low livestock assets would have a relatively high incentive to go into cultivation as compared to better-off ones, for the simple reason that livestock are not dependable sources of livelihood for the former. This expectation holds true, as confirmed by the regression analysis results. More specifically, the probability that a household will cooperate in farm-preparing activities increases by about 2.9 % for each total livestock unit (TLU[13]) reduction in per capita livestock holding, implying that households with lower livestock assets are more likely to cooperate. In this regard, the variation among the pastoral households can be explained from a number of different perspectives.

First, the possible differences in labor demands between those with low livestock assets (≤ 4.5 TLU[14]) − hereafter considered as “poor households” − and those with larger livestock assets (> 4.5 TLU) − hereafter considered as “better-off households” − can be associated with differences in cooperative behavior between the two groups. Actually, better-off households own significantly larger quantities of livestock (67.3 TLU) than poor households (11.2 TLU), whereas, in terms of active labor force potential, the former is in a slightly lower position (4.4 persons) as compared to the latter (5.0 persons). Given the fact that those with larger livestock assets require more labor to properly manage their animals, the output reveals that labor is scarcer among households with better livestock assets. Thus, it can be deduced from the results that the introduction of crop production into the existing system would lead to greater pressure on better-off households in regards to labor allocation. When competition occurs between crop cultivation and livestock husbandry, it is less likely that better-off pastoralists would prefer to shift their labor to the “imported” enterprise (i.e. crop cultivation).

[13] TLU refers to Tropical Livestock Unit. 1 Camel = 1 TLU; 1 cattle = 0.7 TLU; 1 donkey = 0.5 TLU; 1 sheep = 0.1 TLU (ILCA 1992).
[14] In this region, 4.5 TLU per capita (or about 5 cows) is the minimum threshold level to sustain family members without requiring additional income from other sources (McPeak and Barrett 2001).

Second, the decisions of the pastoralists concerning farming activities reflect their ways of reacting to natural hazards, mainly drought. Pastoralists have exercised several traditional portfolio management techniques to mitigate risk. Livestock accumulation is one way to mitigate risk (Herren 1991; McPeak and Barrett 2001). McPeak (2005) shows that a larger herd size pre-crisis implies a larger herd post-crisis. Diversification of livestock ownership is another *ex ante* risk management strategy, in which pastoralists adjust the composition of their livestock in a direction that could minimize asset loss due to disaster. Pastoral households also spread their livestock spatially throughout their personal networks to reduce risk.

While these *ex ante* risk management strategies (although not exhaustive) may exist in many pastoral areas, the poor and better-off households do not have equal capability to exercise them. The poor appear to have lower capability to exercise any of the indicated options, simply because livestock are large investments to them. In this regard, the poor occupy lower positions, not only in terms of total amount of livestock, but also in terms of the diversity of these assets. A comparison made between the two groups vis-à-vis diversification (within pastoralism) shows that better-off households keep more livestock types (3.6 species) than poor ones do (3.3 species). Moreover, better-off households own more camels (about 30 head) than poor households (about 3 head), which shows that the former are in a better position to withstand recurrent droughts[15]. While keeping livestock at different locations across personal networks seems a rational way of mitigating risks, especially those arising from localized, not region-wide shocks. This strategy is also less likely to be feasible among poor households, because there is not enough livestock to distribute spatially.

Differences in *ex-ante* risk management strategies and capabilities between the poor and the better-off also affect their *ex-post* risk management strategies and capabilities to cope. In this respect, better-off households possess better resources to meet basic needs without resorting to other occupations, whereas poor households need to find opportunities outside of pastoralism to sustain their families. Therefore, the differences in cooperative behavior observed between poor and better-off pastoralists with regard to farming are also attributable to their differences with respect to *ex-post* risk management strategies.

Third, the difference observed between the two groups with regard to cooperative preparations to start farming can also be seen from the perspective of property rights. Common property regimes allow multitudes of users to share a resource system in accordance with certain predefined rules (Ostrom 1990; 1992). Nevertheless, this doesn't mean that all rights-holders derive equal benefits from the resource system. Rather, benefits are a function of rights and capabilities of individual

[15] Camels are best suited to arid areas like Afar. In times of water scarcity, they can endure without water for more than two weeks, while cattle need water at least once in three days. Moreover, camels feed on the foliage of trees and bushes, which are better in resisting drought than the grasses on which cattle are dependent.

actors to utilize a resource system (Rebot and Peluso 2003). A pastoralist who has limited financial ability to purchase additional stock obviously derives less benefit from the communal pasturage than his livestock-rich neighbour, given that the rate of livestock ownership is below the optimum. In other words, the former exploits only a small portion of his rights as compared to the latter although, in principle, he has the right to derive as much benefit as that of his neighbor. Indeed, not only rights but also capabilities determine the actual benefit structure among a group of people. This is particularly apparent in common-pool resources, particularly as with this case in rangelands, where there is *de facto* open access for all group members.

Capability differences among right holders to realize benefits from a communal resource system may result in differences in their reactions to new challenges or opportunities that may affect benefit streams. For the near-stockless Afar households, the incentive to cooperate in farming activities would be high, because in this way they can better exercise their rights over the resource system. The current literature indicates that traditionally pastoral communities do provide opportunities for poor members with a little or no livestock to make grazing contracts with better-off community members or outsiders, so that they can build their own herds (Ngaido 1999). However, our evidence shows that, with regard to contractual arrangements, there is no special institutional treatment for poor households, implying that their only feasible available option for exercising rights is to take up crop production, provided that entry is made possible for them.

Pastoral areas are generally marginal as far as intensive crop production goes. Consequently, livestock production appears to be the best and, in some areas the only, option under the existing technologies (Ahmed et al 2002). However, as a result of challenges (mainly drought) which have caused rapid deterioration of pastoral livelihoods, these days pastoralists usually seek out alternative means of survival, at least on transitory basis. Since opportunities are lacking in most pastoral areas, resorting to agriculture is the main option that pastoralists pursue. Indeed, a growing trend toward crop cultivation is now observable in many pastoral areas of Ethiopia in general and Afar in particular (Yemane 2003). In areas where alternatives are available, it is expected that pastoralists will make choices from the “bundle” of non-pastoral activities to sustain themselves, at least until the conditions for their main occupation improve. In such situations, alternative activities compete for pastoralists’ resources and, hence, the decision to cooperate in farming activities is a matter of evaluating the existing opportunities from the perspective of each pastoral household, differentiated as they are in terms of existing assets and capabilities. In this vein, our results indicate that wage employment opportunities (EMPOPP) tend to have a negative influence on the decision to cooperate in farming activities. The probability of opting for cooperation declines by about 36 % if a household earns income from wage employment.

State farms are the major sources of wage employment for pastoralists in the study areas, particularly in some locations of middle Awash valley. Although Afars are recruited only for lower level positions, those who get the chance do not hesitate to join state farms. All in all, about 11 percent of the sample pastoralists were employed in commercial farms. There are reasons why pastoralists prefer employment in state farms to farming by themselves. First, they can generate a more stable (and perhaps higher) income by being wage laborers, whereas farming is a risky business. Second, in most cases, pastoralists are employed as guards to protect crops (mainly cotton) from livestock[16], which is less tiresome than farm work and is preferable to pastoralists, who are quite used to tending animals.

Finally, support from external actors (SUPPORT) has been found to be positively and significantly related to participation in collective action to start farming. The probability that a household will participate in collective action increases at the mean level by 27.1 percent in the presence of external support. There are two possible explanations for this result. First, participation of external actors in organizing meetings facilitates discussions and information exchange among pastoralists. Some pastoralists may not participate because they are completely unaware of the intervention. Some others may be ambivalent because of incomplete information with regard to the intended activities. Thus, the existence of external support increases the likelihood of participation of those households that either unwittingly or due to ambivalence fail to cooperate, thereby improving their awareness regarding what has been intended for their locality, the costs and benefits of cooperation and non-cooperation, the commitment of external supporters, the reactions of other members of the community, and the "rules of the game"[17].

Second, financial and material support provided by external actors could increase the likelihood of participation. Such support, which augments the capacity of households to invest in the new venture, can particularly increase the participation of the poor, who may otherwise refrain from participation due to financial and material limitations. The positive effect of this variable is not, however, exclusively associated with poor households. Even the participation of better-off ones can be enhanced in the presence of financial and material support as a result of possible reductions in costs of participation vis-à-vis the anticipated benefits. Moreover, better off households may become persuaded to have their "share" from the resources externally injected into the system.

[16] Information obtained from MAADE indicates that there is great pressure coming from the surrounding areas to feed livestock on cotton stocks. While cotton harvesting normally comprises three rounds, pastoralists have been rushing their animals into the cotton fields immediately after first-round picking. In order to reduce this pressure from the local herders, guards are recruited from members of different clans. This is just to use social capital as a means of mitigating the problem. Quite large amount of money is allocated by MAADE to mitigate the problem. For instance, a total of 294,335 Birr (~USD 34,000) was allocated in 2004/5 for this purpose (personal communication with MAADE administrative officer).

9. Summary and policy implications

Traditional communal landholding has been prevalent in Afar, accommodating the interests of different user groups for many generations. Needless to say, this is attributable to the ecological conditions of Afar which entail the use of pastoral resources scattered over a wide area of land to produce livestock. However, this traditional land use system is changing because of pressures from both governmental policy and natural events. This study has examined both political and natural forces that have induced the transformation of the traditional land use arrangements in selected areas of Afar. State intervention, which has been imposed mainly since the early 1960s, brought about detrimental effects on the livelihoods of pastoralists. First, through employment of coercive ways, the state expropriated large areas of dry-season rangeland, resulting in the exacerbation of feed scarcity in the area. Second, the state had been enforcing the transformation of pastoralism into sedentary farming without taking into account pastoral households' capacities to produce crops. More specifically, the development schemes initiated and financed by the state couldn't enhance the capabilities of pastoral households in a way that would enable them to derive full benefits from their land. Being devoid of public participation, these schemes paradoxically fostered a dependency syndrome among pastoralists, which remained even after their termination. Third, state intervention created a window of opportunity for some pastoralists, while others such as women and the poor were deprived of obtaining benefits from the new arrangements.

When faced with challenges, pastoral households employ coping strategies which may involve different ways of using the available resources, even looking beyond pastoralism. The situation of recurrent drought, which was intensified in 2002 and 2003, has imposed difficulties on pastoral livelihoods in Afar. On the one hand, the emergence of this natural challenge triggered the intervention of external actors to facilitate cooperation among pastoralists, providing a catalyst for the motivation of the pastoralists to take up farming. On the other hand, this natural challenge has increased the expectations of people that they will be able generate greater levels of utility by participating in such collective efforts, given the existence of external assistance. The expectations, whether realized or not, have produced cooperative decisions towards engaging in organized activities. However, individual households are heterogeneous in their capability to withstand the natural challenge. In case studied, our results show that poor households are more interested in farming and, hence, promote the transformation process. Whether this demand on the part of the poor could lead to permanent individualization of the previously communal land remains to be seen.

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[17] There is also a possibility that external agents may romanticize the outcomes of forthcoming cooperative efforts to persuade those who have not yet decided to join them.

Overall, the study indicates that communal land ownership, which forms the basis for pastoralism, is under pressure as a result of state intervention and natural challenges, as also depicted by several other studies in pastoral areas (Blench 2001; Markakis 2004; Ensminger and Rutten 1991; Helland 2002). With regard to the present study, the following two points are worthy of policy attention:

1). Averting possible continuation of state coercion: The coercive expropriation of pastoral land has been slowed down since 1991, and Afar pastoralists have regained some of their lost rights over their traditional land. However, the current national policies are not immune from anti-pastoral ethos. For instance, the 2005 national land use proclamation declares the possibility that *communal rural land holdings will be converted to private holdings* if the government finds such transformation necessary (Article 5 No. 3). There is also a clear plan to expand the existing irrigated land in the Awash basin (about 66% in Afar region) from 68,800 hectares to 151,400 hectares (Flintan and Tamirat, 2002). The implementation of such a plan would be impossible without evicting pastoralists, and the costs of eviction are usually underestimated. Moreover, it is usually assumed that simply providing financial compensation would be sufficient for those who lose their land. However, for pastoralists who do not have enough skills to engage in other occupations, providing financial compensation without further assistance is akin to facilitating their movement towards destitution. The failure of past 'compensation' schemes in Afar (as discussed in this paper) indicates that investment expansion through compensation schemes may not lead to a situation in which all stakeholders benefit. Current experiences in non-pastoral areas of the country also show that undervaluation of land, large variance between what investors pay and what evictees receive in compensation, and ultimate failure of evictees to start new livelihoods are critical problems associated with the expansion of investments in rural areas of Ethiopia (Bekure, et al. 2006). These problems are attributable to a lack of effective institutions and appropriate governance structures, including (1) lack of clear guidelines on land valuation, (2) marginalization of landholders in the process of land transfers, and (3) a weak organizational setup to administer the transformation process. Indeed, such experiences provide good lessons that should be taken seriously in the national and regional policy arena before promoting investments in rural areas of Afar.

2). Harmonizing policy emphasis with the potentials of pastoral areas: The transformation of property rights due to natural challenges has had important implications for the livelihoods of pastoralists. In this regard, this paper has shown that poor households (in terms of livestock assets) are more interested in farming as compared to better-off ones. The decisions of pastoralists towards the commencement of farming activities could reflect their reactions towards recurring natural hazards: farming is considered as being a post-shock source of livelihood by

those households that cannot call upon their pastoral assets in seasons following a drought period.

Despite this fact, two points can be made about the potential of farming in the study areas in general. First, efforts to produce food crops under rain-fed conditions may not provide any substantial remedy to the decline of food security when drought occurs; during a prolonged spell it presumably will not. This is because crops are also biological products (like livestock) and, hence, can be negatively affected by drought. Livestock appear to be even somewhat more tolerant of drought conditions than crops, since they are mobile. The existence of mobile pastoralism in dry regions of the world also implies the relative viability of livestock production as compared to rain-fed agriculture in these regions. Second, although crops can be produced using irrigation in some ecological niches (e.g. nearby major rivers), an irrigation-based production system is less appealing in many parts of Afar, given the scarcity of water. Consequently, livestock production appears to be the best, and in some areas the only, option under the existing technologies. The relatively low participation level of better-off pastoralists in collective action to start farming also implies that crop production is not a substitute for, but rather is a subsidiary to, livestock production in such dry areas. Therefore, instead of overrating the sustainability and impact of farming on poverty reduction, it would be worthwhile to focus on livestock production (i.e. the core enterprise in pastoral areas). In this regard, improving key services, such as the livestock-market information system, veterinary and financial services; investing in infrastructure (roads and other facilities); and enhancing feed management are key to turning the silent transformation of the commons into a viable development path for the Afar. Moreover, farming and other alternative income sources should be promoted as a means of improving the capacity of (poor) pastoralists to overcome potential livelihood challenges.

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THE NEED FOR INTEGRATED NATURAL RESOURCE MANAGEMENT (INRM) IN REFUGEE SETTLEMENT AREAS: *THE CASE OF ERITREAN REFUGEES IN SHIMELBA CAMP OF ETHIOPIA*

Haileselassie Gebremariam

Abstract

In northern Ethiopia, the Tigray national regional state, due to its geographical proximity to Eritrea has been hosting more than 20,000 Eritrean refugees fleeing from their country of origin crossing the Ethiopian border starting from May 2000 because of the deteriorating political and socio-economic conditions in Eritrea especially after the Ethio-Eritrean war. As large groups of people settle in an area, they exert pressure on the natural environment especially in the case of refugees where the assistance from relief organizations is inadequate. The areas of refugee settlement have a direct bearing on the environment and the environment, in turn, has a direct bearing on the welfare and well being of people in the vicinity. It is not realistic to expect that the current carrying capacity of the refugee settlement area can withstand the increasing number of refugees. This has resulted in competition for scarce natural resources which have led to a growing tendency of conflict among the refugees and the local people. Therefore, it is crucial to examine the current level of natural resource degradation; examine the level of natural resource consumption of refugees and locals through socio-economic factors, assess the existence and causes of resource conflict and evaluate the current natural resource management practices to recommend possible alternative actions and to take the lesson to similar refugee settlement areas. In order to achieve the stated objectives, qualitative and quantitative data were used. Data were collected from primary and secondary sources. The qualitative aspect focused on major PRA[1] tools which were analyzed by Narration, while the quantitative aspect was based on formal survey of 150 sample households which was analyzed using descriptive analysis, t-test and chi-square test. The high population pressure has seriously affected and damaged the scarce natural resources and the agricultural productivity of the study area. There is a serious problem of fuel wood, grazing land and water resources. As a result frequent conflicts between refugees and the local population occur mainly from competition for these resources. However, natural resource management practices that have been adopted by the concerned bodies to date were found to be suboptimal (minimal) compared to the environmental impacts. The result suggests the need for user-oriented, integrated and participatory approach to ensure sustainable natural resource use by refugees

and local communities, which is in line with the basic principles o f Integrated Natural Resource Management (INRM).

1. Introduction

Refugees are people who left their homes escaping from persecution or imminent danger to their lives. Out of the global refugee population of around 11.4 million recognized by the UNHCR[2], 26.32% are found in Africa. Given continued insecurity, political violence, lack of human rights, and persecution, the number of refugees will likely increase. In Sub-Saharan countries, there is high refugee mobility mainly as a result of civil war, recurrent drought and unemployment (UNHCR, 2007).

Ethiopia is known for its long history of hosting refugees. The country has signed both the 1951 UN and the 1969 OAU conventions relating to the status of refugees. Currently in Ethiopia, there are more than 100,000 registered refugees and asylum seekers. There are also another 100,000 (estimated) self-assisted and unregistered Somali asylum seekers. Therefore, currently there are more than 200,000 refugees and asylum seekers in Ethiopia. The majority of them are from Somalia, Eritrea and the Sudan. The refugees have been hosted in eleven camps and in different cities of the country (UNHCR, 2008; ARRA[3], 2008; Blain, 2003).

As large groups of people settle in an area, they exert pressure on the natural environment. In refugee situations, at the initial stage of arrival, the focus of relief agencies is on saving lives through the provision of food, water, shelter, and medicinal services. However, refugees starting from their arrival in an area begin to make use of the natural resources of the area to meet their need for fuel wood, construction and rarely for cultivation (UNHCR, 2005; Blain, 2003). The areas of refugee settlement have a direct bearing on the environment and the state of the environment in turn has a direct bearing on the welfare and well being of people living in the vicinity (UNHCR and IUCN[4], 2005).

The Shimelba refugee camp is one of the eleven refugee camps in Ethiopia. It hosted 18,532 refugees (as of June 31, 2008) from Eritrea mainly Tigrigna, Kunama and Afar ethnic groups. The prolonged presence of a large number of refugees and the insufficient assistance has been leading to deterioration of natural resource base (ARRA, 2008).

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[1] PRA-Participatory Rural Appraisal
[2] UNHCR-United Nations High Commissioner for Refugees
[3] ARRA-Administration for Refugee and Returnee Affairs
[4] IUCN-The World Conservation Union

XXV. 1.1 Statement of the problem

In Ethiopia, the major environmental problems are land and soil degradation, deforestation and overgrazing (Blain, 2003). Many refugee crises create adverse environmental degradation (Sebba, 2006). The refugee camps in different parts of Ethiopia, especially in degraded areas, are under pressure from refugees and there is lack of intensive interventions from Governmental and Non-governmental Organizations. The extent of degradation has not been studied in the study area. The environmental problems resulting from high population pressure cause the welfare and well being of people living in the vicinity to deteriorate.

Refugees and host population, though in varying proportion, cause environmental degradation especially if the influx of refugee is high; it seriously threatens the local ecosystem and the economic activities dependent upon them. In Shimelba, the refugee number has been constantly increasing overtime. According to the camp officials, currently on average 600 refugees (new comers) enter the camp monthly. From sustainable resource use point of view, it is unrealistic to expect the current carrying capacity of the land to withstand the ever increasing number of refugees. Therefore, host population is affected by the inappropriate or excessive dependency on the natural resources by both groups.

In addition, competition for scarce resources is almost always at the heart of every conflict. Failure to manage natural resources efficiently and equitably contributes to conflict (Sebba, 2006). There is a growing sign of conflict between host population and refugees which seeks a systematic way of tackling it.

It is clear that the decades of long civil conflict as well as the recent war with Eritrea have contributed to the current status of degradation. Another reason for the degradation is also related to the unwise management of resources. Even though attempts have been made in the direction of rehabilitation and prevention, it has been limited to few activities with minimal success considering the extent of the problem.

XXVI. 1.2 Objectives of the study

The General objective of the study is to examine the extent of natural resource degradation and investigate the natural resource consumption of refugees and local population.

The specific objectives are:

1. To examine the current status of natural resource degradation.
2. To examine the level of natural resource consumption of refugees and host population.
3. To assess the existence and causes of natural resource conflict.
4. To evaluate the existing natural resource management practices.
5. To draw development, research and policy implications.

1.3 Research questions

XXVII.

The basic research questions are the following:-

1. What is the status of natural resource degradation in the study area?
2. What is the level of natural resource consumption by refugees and locals?
3. What are the major existing resource conflicts with their causes in the area?
4. What are the existing natural resource management practices and approaches in the area?
5. What are the alternative development, research and policy interventions?

XXVIII. 1.4 Significance of the study

Understanding the relationship between refugees and local population with the environment will enable to design effective and efficient measures to stabilize and arrest the environmental degradation in refugee settlement areas.

XXIX. 1.5 Scope and limitation of the study

The study is limited to one kebele (sub-county) specifically where the refugees and the locals share same natural resources. The study uses cross sectional data, but decisions on natural resource management depend not only on current environmental situations but also on the function of previous environmental setting. However, these data were unavailable.

2. Literature review

It has been recognized that refugee migrations bring both costs and benefits to host countries. Refugees generally impose a variety of security, economic, infrastructure and environmental burdens on host countries. At the same time, however, refugees can also benefit hosts by expanding consumer markets for local goods, bringing in new skills and indirectly opening up job opportunities for locals. The significant flow of resources in the form of international humanitarian assistance, economic assets and human capital represent an important state building contribution to the host state, but security problems and other hindrances usually inhibit the state's ability to access and control them. Some argue that the potential benefit for the state and its citizens goes beyond the burdens imposed by a mass influx. Refugee resources and security threats potentially provide long-term gains, and, by compelling the state to strengthen its grip on border areas, enable the state to 'harden' its presence there. However, for host states to realize the potential of refugee resources and continue hosting refugees, they must be assisted by appropriate humanitarian programmes (Jacobsen, 2002; Smith, 2005; Amstislavski, 2001).

International refugee instruments were adopted well before environment emerged high on the global agenda. Since environmental impacts resulting from involuntary movements were not anticipated, no remedial measures are contained in these international instruments (Kamaru, 2000).

However, focusing solely on saving lives in the very short-term is not enough, since an essential condition to achieve humanitarian protection is to analyze the relationship between the governments of host countries and the refugees settled in camps. These relations are deeply influenced by the refugee policies implemented by the host countries whose role is crucial in promoting or preventing livelihood security among the camp dwellers (Smith, 2005; Betts, 2005; Rutinwa, 2003).

Political conflicts in various parts of the world become frequent with extended duration. The processes that have been carried out to return refugees to their home country have been increasingly delayed. At the same time, global terrorism and concerns about security have slowed down the processes of resettlement in traditional resettlement countries and, in some cases, the number of refugees who can be resettled has fallen and their countries of origin have been restricted. The increasing size of refugee population influxes to countries of first asylum has meant that host governments have been reluctant to facilitate local integration; indeed, local

integration carries with it a connotation of permanence as well as security problems and resource burdens. Failure to find acceptable durable solutions among these three options have combined to result in increasing numbers of refugee situations worldwide that can be described as 'protracted' (Amstislavski, 2001; Jacobson, 1997).

With regard to the relationship between refugees and the environment, it is well acknowledged that their impact on the host environment can be severe, as the primary concern of the refugees is safety and welfare and not the protection of the environment and natural resources. In a matter of weeks tens of thousands of people are grouped in crowded refugee camps situated often in barren and treeless areas, where firewood is scarce and expensive. As a result, among the many issues characterizing refugee camps the most important is fuel shortages that can affect not only refugee food security, but also their physical security, especially when they are women, because they must travel miles to collect firewood which makes them vulnerable to rape and robbery by gangs of bandits (Rutinwa, 2003; Jacobsen, 1997, Betts, 2004).

Some who favor keeping refugees in camps argue that since environmental damage is inevitably associated with a mass influx, it is better to concentrate and segregate refugees in camps where environmental damage can be contained rather than spread throughout the receiving region. In camps, it is argued, refugees can be provided with food, firewood or fuel alternatives and water, and in so doing decrease their need to damage resources from the local environment. In addition, segregating refugees will reduce their economic and cultural impact on the local community (Whitaker, 1999).

But camps are associated with a unique set of environmental problems and risks (Gorman, 1993). An initial problem concerns start-up costs. After land has been allocated, at least partial deforestation occurs in order first to clear land for the camp and then to provide construction materials and fuelwood. A second problem derives from the concentration of large numbers of people in camps. Although relief agencies and host governments claim that by restricting refugees to camps they can be isolated from the surrounding community and environment, in practice refugees cannot be confined to camps unless very strict and effective controls are imposed. Refugees' needs for fuelwood can be only partially met by relief inputs. Relief deliveries are often insufficient to meet everyone's needs, or they can be delayed by months and a large number of refugees must then try to meet their needs outside the camp (Wilson et al, 1989; GTZ[5], 1994). When camps are situated in semi-arid or

[5] GTZ-Gesellschaft fur Technische Zusammenarbeit (German Agency for Technological Cooperation)

otherwise ecologically fragile regions this concentrated and localized increase in demand can lead to rapid degradation. The situation is aggravated when refugees have herd animals (although it is often the case that herd animals are not permitted in camps, or that refugees sell them because cash is needed). The problem compounds itself as the supply of firewood, pasture or water declines and these resources become treated as commodities. In Malawi, where there was a significant deforestation associated with the Mozambican refugees, Wilson et al. (1989) showed that increased fuelwood collection by refugee wood vendors (whose opportunity costs for collecting wood are relatively low) led to a fall in the effective price of wood, and a consequent increase in local fuelwood use. People also sell fuelwood or exchange it for food rations during times of food insecurity such as during the hungry season before the harvest when food stocks are depleted.

The conventional reasoning is straightforward: by creating a sudden, sharp increase in population density, refugees and their herd animals impose a population shock on asylum communities which cannot withstand the strain on resources. Deforestation occurs as refugees seek out firewood and shelter materials; grazing land becomes denuded as refugees' herd animals strain the carrying capacity of the range; water sources cannot support greatly increased utilization and become polluted and depleted; and there is garbage and other waste accumulation around refugee camps (Black, 1994a; Jacobsen 1994). In addition, refugees are seen as 'exceptional resource degraders' as a consequence of their poverty, short time horizons, lack of local environmental knowledge and traumatized psychological status (Myers, 1993).

In this paper the term 'environmental degradation' refers simply to the process of change that occurs with respect to forests, soil and water. This process is often negative, because the environmental pressures imposed by an influx may lead to loss of woodland and rangeland, increased soil erosion and a breakdown of soil ecology, and reduction in groundwater recharge and deterioration of water sources (Black, 1994b; Hoerz, 1995). However, environmental degradation is partly in the eye of the beholder: what local people and refugees perceive as necessary and even sustainable use of natural resources may be seen by national governments and international agencies as threats to the conservation of particular ecosystems (Jacobsen, 1997).

According to the UNHCR, the major environmental problems related to refugee areas are deforestation, soil erosion and depletion and pollution of water resources (UNHCR, 2005). Although deforestation is a problem in many countries, in the case of refugees it involves an additional socio-economic dimension as they use-and to some extent may depend upon-other people's commodities. In the early stages of

refugee crisis, significant impacts can be imposed on forests and biodiversity, by the harvesting of timber for cooking and shelter, and the hunting of wildlife for food.

According to UNHCR (2005) among the main factors which influence the type and scale of the impact are the number of refugees involved; duration of stay; housing arrangements; fragility of local ecosystems; carrying capacity of allocated site; areas of land allocated to refugees; general availability of forest resources; kind of cooking stoves and practices used; types of building materials; food people consume; and planning, coordination and control of forest related activities undertaken for and/or by the refugees.
Little literature exists on the relationship between socio-economic status of refugees and environmental action in Ethiopia. Environmental concerns related to refugee influences are increasingly becoming an important agenda in Ethiopia. Particularly, regional governments are becoming increasingly concerned about refugees' impacts on the natural resource base. The depleted vegetation cover and the scarcity of natural water sources are noticeable in the surroundings of the camps. A study made by UNHCR/ Ethiopian Mapping Authority (EMA) in 2001/02 in Bonga refugee camp revealed a serious level of environmental degradation (ARRA and GRS[6], 2005). The scale of mitigation efforts thus far has apparently not measured up to the level of degradation in refugee settlement regions of Ethiopia. The environmental impact assessment study revealed a serious level of environmental degradation, which environmental intervention is being viewed at a very micro scale. A clear need of scale up and build the capacity of intervention programs on areas of community based natural resource management is critically important (UNHCR, 2006).

Environmental scarcity is caused by the degradation and depletion of renewable resources, the increased demand for these resources, and/or their unequal distribution. Population growth and increased per capita resource consumption can cause depletion and degradation, which can in turn produce a decrease in total resource supply or, in other words, a decrease in the size of the total "resource pie". But population growth and changes in consumption behavior can also cause greater scarcity by boosting the demand for a resource. So, if a rapidly growing population depends on a fixed amount of cropland, the amount of cropland per person, the size of each person's slice of the resource pie, falls inexorably. In many countries, resource availability is being squeezed by both supply and demand pressures. Scarcity is also often caused by a severe imbalance in the distribution of wealth and power that results in some groups in a society getting disproportionately large slices of the resource pie, while others get slices that are too small to sustain their livelihoods. Such unequal distribution or structural scarcity is a key factor in virtually

[6] GRS-Gambella Regional State

every case where scarcity contributes to conflict. The three sources of scarcity are degradation and depletion of renewable resources, the increased consumption of these resources, and/or their inequitable distribution which often interact and reinforce one another (Ohlsson, 1999).

Competition between locals and refugees for insufficient resources (firewood, fodder and water) can create conflicts and damage traditional and sustainable local system of resource management. According to Ohlsson (1999) the refugee presence in Eastern Chad negatively affected local access to environmental resources such as firewood and water. Many refugee camps are located in areas where environmental degradation and desertification were a problem even before the arrival of the refugees. In an area where trees are the primary source of fuel, deforestation constitutes a problem for both locals and refugees. Most of the conflicts opposing refugees and host communities reported have their source in competition over natural resources. Local women living in villages close to the camps have to walk double the usual distance to collect firewood. Confronted to such situation, the local population makes use of purported traditional rights over land and natural resources (Women's Commission, 2005).

Refugees in Chad from the humanitarian disaster in Darfur, the Sudan, have been increasingly involved in conflicts and open skirmishes with the local population over environmental resources such as grazing, wood and not least water. With the international humanitarian intervention, however, inequalities have increased, since the refugees at least get handouts of food, while the local population is very vulnerable after an unusually dry growing season. Added to this fact the refugees go out and tend for themselves, encroaching (sometimes against national and local laws) on scarce environmental resources; open conflicts have been observed (Ohlsson, 2004) as a result.

Generally, conflicts over land can be perceived as 'livelihood clashes' between refugees and nationals, since land is a critical resource for supporting livelihoods (Mugerwa, 1992; Verma, 2001). Hence it is important to understand the interplay between various factors that influence access to and utilization of land by both host communities and refugees. Quite often, animals stray into locals' agricultural plots leading to a conflict between refugees and local populations. Usually, conflicts arise when livelihoods are threatened and this threat can be internal (within the households or communities) or external-from outside the households or communities (Mugerwa, 1992; Verma, 2001). In all, conflicts over land between refugees and host populations have had negative impact on the way both refugees and locals access livelihood goals (Sebba, 2006).

There is an increasing realization among all involved in refugee works that refugee situations often have negative impacts on the surrounding natural environment (UNHCR, 1996; UNHCR, 2002). Until the early 1990s, UNHCR focused all its efforts towards meeting the immediate needs of the refugees, putting aside considerations about the impacts that a large number of refugees would have on the natural environment of the hosting area (UNHCR, 2002). However, with the onset of the last decade of the century, the idea of incorporating environmental concerns into all sectors of refugee assistance schemes emerged and was strengthened by the design and issue of an all embracing Environmental Guideline by the UNHCR, in 1996. The main objective of this guideline is to include environmental concerns and measures at all stages of refugee assistance with a main focus on undertaking preventive measures to avert serious environmental damage in refugee hosting areas.

Refugee related environmental problems require the involvement of a number of parties both at the local and international level. The main actors at the local level include the national government at the national and local level, the local host community and the refugees themselves. At the international level, the main parties are the UNHCR, international NGOs and donors. Since environmental issues touch upon different actors, the effectiveness of any intervention in the area is highly dependent on the coordination and cooperation among these actors (Blain, 2003).

Although environmental problems confronting UNHCR, refugees and local populations vary a great deal due to specificity of an area's climate, the physical setting and socio-economic conditions, there are several key principles which are applied in UNHCR's environmental work. Four major principles summarized in the UNHCR Environmental Guidelines (1996) are: integrated approach, local participation, cost effectiveness and prevention before cure.

Awareness creation on environmental issues in refugee operations is an important part of most projects supported by Engineering and Environmental Services Section of UNHCR, both at local and government levels. To increase awareness and enable managers and others better deal with managing environmental concerns in such situations, UNHCR has, since 1998, hosted regional training programs for selected staff, implementing partners and government agencies. Mainstreaming these actions into programmes and transforming policies, such as those outlined in the Environmental Guidelines, into action is an increasing area of growth and collaboration with partners.

Due to the lack of better tools, relief groups rely almost entirely on field experience in addressing environmental issues. At this point the overwhelming priority of relief efforts is saving lives and there is little time to address longer-term issues such as

future impact on environment and sustainability. Use of locally available renewable energy sources and environmentally sound design approaches in the construction and operation of camps seldom influence the criteria that inform the design of camp environments (Amstislavski, 2001).

Another additional element is considering of utilizing opportunities presented due to increased participation of refugees. Appropriate incentives of transferring skills; provision of wood, food, money in exchange for labor and skills inputs of refugees are important. Environmental budget requests need to be integral part of special funding appeals. This ensures efficiency and effectiveness in environmental protection. The required budget allocation and efforts of securing funds should consider possible detailed activities starting from emergency operations (UNHCR, 2002).

Establishing natural resource management system is a long-term activity that calls for the involvement of local communities and range of stakeholders. Among the stakeholders, an environmental implementing agency with experience of both relief and development is an ideal candidate. The challenge for stakeholders involved and acting institution is to work within existing structures, creating new structures only when existing facilities are incapable of addressing environmental concerns (Blain, 2003).

There is a need for clear policy direction and coordination on environmental issues within the refugee context. Given that no clear regulations may exist governing the refugee populations' use of natural resources, special guideline should be developed in line with national environmental policies and the prevailing legal framework.

Participation of local people begins with taking the leading role in planning and implementing environmental protection and rehabilitation. Experiences have shown that sustainable environmental management practices are best achieved with the full and meaningful participation of the affected communities. Possible mitigation measure heavily relies on considerable input from the affected people (UNHCR, 2002).

Local institutions and village natural resource committees need to be gradually strengthened to insure better sustainability of activities. Strengthening efforts go beyond legalizing and delineating responsibilities. The adverse environmental impacts of hosting refugees often run far deeper than visible degradation. A significant threat that emerges is that the local institutions face a difficulty or total disruption of traditional natural resource management practices and institutions built

over long durations. Gender related issues and concerns should be integrated at the project design and implementation phase (UNHCR and SAFIRE[7], 2005).

It is important to note that, refugees can't be expected to put environmental considerations ahead of their own safety and welfare. This is where UNHCR and other organizations lend a hand in helping confine the impact of refugees to a low level as much as possible and assisting host countries with rehabilitation and cleans up operations (UNEP[8], 2000).

3. Research methodology

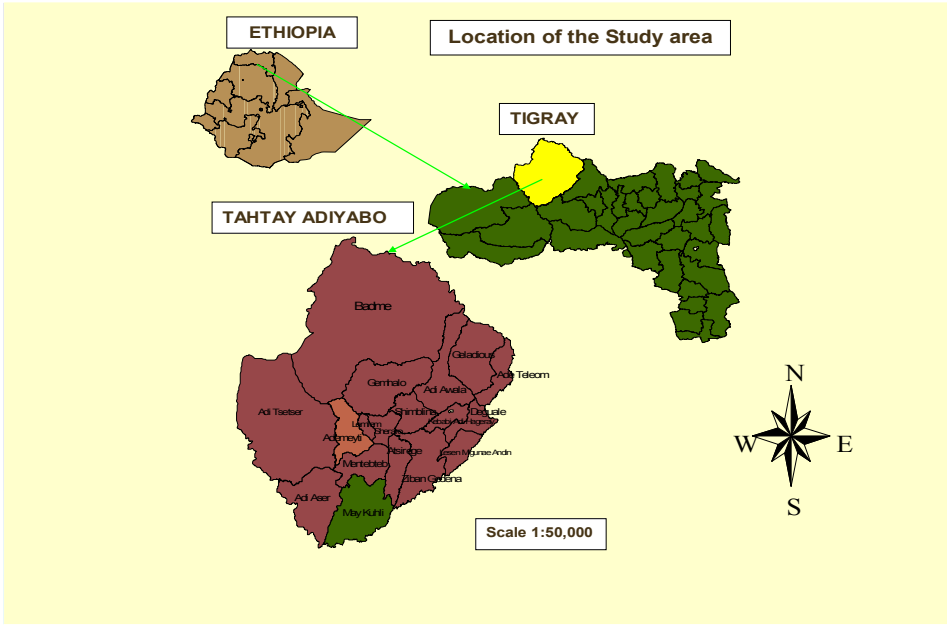
XXX. 3.1 General description of the study area

Tahtay Adyabo woreda (Sheraro town), where Shimelba refugee camp is located, is found in the North Western Zone of Tigray National Regional State (TNRS). Sheraro town is found 1,185 kms away from Addis Ababa in the north, 50kms from the Eritrean border in the North and 175 kms from Humera town (the Sudan border) in the West. In the woreda, 16,300 households are estimated to live. The study area comprises mainly Mai-kuhli kebele (sub-county) which has 1,093 households. The major livelihood of the rural population depends on agriculture.

Shimelba refugee camp is located 30 kms away from Sheraro town southwards, 80kms away from the Eritrean border in the north and 169 kms away from Humera (the Sudan border) in the west. The total area allocated for the camp is approximately 200 hectares. The refugees in the camp are allowed to use different natural resources i.e. 7kms from the center of the camp northwards, 5kms towards east, and 10kms towards west and 4kms towards south. A grazing land of 400 square kms (17kms westwards away from the camp) is allocated for the refugees' livestock currently estimated around 4,500 livestock (ARRA, 2007).

Figure1: Location of the study area

[7] SAFIRE-Southern Alliance For Indigenous Resources
[8] UNEP-United Nations Environment Programme.



The camp is situated at an altitude of 1,140 meters a.s.l in a semi-arid zone, 14º10′28.76″ N and 37º43′23.45″ E. The dominant soil type is vertisol with a dark-grayish brown color. The mean annual rainfall of the camp ranges between 581.2mm and 1,102.5mm while the mean annual temperature of the camp is 29.2ºC.

3.2 Source and method of data collection

Qualitative and quantitative data was collected from primary and secondary sources. The primary data was collected using two sets of procedures: formal survey procedure and informal survey procedure. Quantitative data was collected using structured interview schedule translated into households' vernacular language (Tigrigna and Kunama). Pre-testing was undertaken and necessary modification was done before conducting the formal survey. Ten eligible enumerators were selected and given theoretical and practical training/orientation. The major PRA tools and techniques that were used to collect qualitative data are direct observation, semi-structured interview, focus group discussion and key informant interview.

3.3 Sampling techniques and procedures

First the sampling frame was identified by delineating the common area (7kms from the center of the camp to the north, 10kms west, 5kms east and 4kms south) in which

both the refugees and the locals commonly use the natural resource base. A total of 11,062 households (1,093 local households and 9,969 refugee households) were found in this sampling frame compiled from a list of UNHCR and ARRA ration card list and a list from Mai-kuhli kebele. From this sample frame 150 sample households were randomly selected using simple random sampling. The survey was conducted on February 2007. At that time the total population of the study area was 13,756 refugees & 5,465 locals.

XXXI. 3.4 Analytical procedures

Following the completion of data collection, data was coded and entered into SPSS[9] version 12.00. Analytical techniques applied for quantitative data analysis include descriptive statistics, t-test and chi-square test. The study also employed narration and triangulation for the analysis of qualitative data.

4. Result and discussion

XXXII. 4.1 General characteristics of sampled households

Of the total 150 sampled households, 110(73.3%) households were refugees while 40 (26.7%) households were locals. The ethnic groups found in the sample are Tigrigna, Kunama, Tigray (locals), Saho and Tigre in the proportion of 39, 30, 26.7, 2.7 and 1.3 percent respectively (Table1).

The age of the sampled households ranges from 18 to 86 years. The age group ranging 18-40years comprised 70.7% of the sampled households (Table1). These are the potential work force for development activities including natural resource management activities. The average age of the refugees was 35.9 years, while that of locals was 39.9 years.

The average household size of the refugee households and local households was 4.4 and 6.1 respectively. This indicates that the locals have a relatively higher household size than the refugees due to the fact that most refugees have left some of their family members in Eritrea. Of the total sample household heads 67.3% were males

[9] SPSS-Statistical Package for Social Scientists

and 32.7% were females. Of non-refugees household heads 35% were female while from refugees 31.8% were females (Table1).

As indicated in Table 1, about 64.7% of the total sampled households were literate (can read and write). Among the refugees 68.2% were literate while 55% of locals were literate which implies the relatively higher proportion of literate households opens a good opportunity for enhanced efforts in natural resource management particularly in awareness creation about environmental degradation and protection. This is because trainings and regulations can be easily accepted with constructive feedback.

Out of the total interviewed households 83.3% reported that none of their family members were involved in off-farm work. Relatively larger proportion of non-refugee households (20%) engaged their family members in off-farm activities than the refugees (16.4%) (Table1). This lower level of off-farm work by households indicates the higher dependency on natural resources for livelihood. Therefore, creating off-farm employment is one viable option to reduce this higher dependency.

The major economic activity of the sampled households involved in trade and livestock raising comprised 21.3% each. The other activities are mixed farming (20.7%), no activity (14.7%), employed in different organizations (10.7%), crop production (9.3%) and as daily laborer (2%). As indicated in Table 1, almost all employed respondents (14.5%) in government and international organizations in the camp are refugees; priority is given to them deliberately in order to enable them secure an alternative income source.

Table 2: General characteristics of the sampled households

General characteristics	Refugees		Locals		Total	
	n	%	n	%	n	%
Age group of sampled household heads						
18-24	23	20.9	1	2.5	24	16
25-40	56	50.9	26	65	82	54.7
41-64	26	23.6	13	32.5	39	26
Above 64	5	4.5	0	0	5	3.3
Sex of the sampled household heads						
Male	75	68.2	26	65	101	67.3
Female	35	31.8	14	35	49	32.7
Total	**110**	**100**	**40**	**100**	**150**	**100**

Educational level of the sampled household heads						
Illiterate	35	31.8	18	45	53	22.8
Only read and write	5	4.5	6	15	11	25.7
Primary	31	28.2	16	40	47	39.7
Secondary	31	28.2	0	0	31	11.8
Tertiary	8	7.2	0	0	8	7.2
Total	**110**	**100**	**40**	**100**	**150**	**100**
Involvement in off farm income by family members of sampled household heads						
Yes	18	16.4	8	20.0	26	17.3
No	92	83.6	32	80.0	124	82.7
Total	**110**	**100**	**40**	**100**	**150**	**100**
Major economic activity of the sampled household heads						
Crop production only	7	6.4	7	17.5	14	9.3
Livestock rearing	30	27.3	2	5.0	32	21.3
Mixed farming	1	0.9	30	75.0	31	20.7
Employed	16	14.5	0	0.0	16	10.7
Petty trade	31	28.2	1	2.5	32	21.3
Daily laborer	3	2.7	0	0.0	3	2.0
None	22	20	0	0.0	22	14.7
Total	**110**	**100**	**40**	**100**	**150**	**100**

Source: Own computation

Another livelihood activity is trading, constituting different types of trade forms varying from petty trade to shop keeping and running restaurants. It is reported that 28.5% and 2.5% of refugees and members of the local community respectively are engaged in trading, where a huge variation among the two groups is observed. Access to other income source through remittance, employment, former experience in trading and ample time creates good opportunity for refugees to involve themselves dominantly in these activities; this is particularly so regarding the urban based Tigrigna refugees. Major trade activities are restaurants and bars, cafes, different kinds of shops such as boutiques, mini-supermarkets, and music shops. Such employments are held on contractual basis in activities such as; ration distribution, nursery site development, data collection for different studies, etc.

Above all they are also hired as formal employees in occupations like teaching and assistant office clerks. In addition the refugees are better educated than the locals, which creates better opportunity for their employment.

XXXIII. 4.2 Analysis on the status of natural resource degradation

Based on the result of the study degradation is prioritized as follows; deforestation, overgrazing and depletion of water sources. These problems cannot be seen in isolation; rather, one is a cause of as well as an effect to the other.

4.2.1 Decline and scarcity in forest products

Almost all respondents are highly dependent on biomass for source of energy, house construction and animal feed. Their sources of fuel wood and fodder are from the natural forest. They use the forest for different purposes including house construction (48.3 %), maintaining houses (33%) and medicinal value (11.2%) (Table 2).

Firewood is the primary source of energy for cooking; 60.3 % of the households were using it and 35 % of households use charcoal for fuel and the remaining 4.6% use dry leaves as their primary fuel energy source (Table 2).

Pressure of large numbers of refugees leads to shortages and scarcity of fuel wood. Refugees and local communities are forced to travel longer distances to fetch fuel wood. The search for wood rapidly changes from the environmentally benign collection of dead wood to cutting of live trees. From the total respondents, (86.6%), replied that there is a decreasing trend in forest use (Table 2). This is due to excessive use of forest resources. For instance, the level of degradation can be seen when analyzing the amount of wood used for construction of the houses, the average distance change traveled to access the fuel wood at the camp establishment time as compared with the present time and the price change in the fuel wood sources.

Table 3: Use and trend of forest products

Use of forest products	Refugees		Locals		Total
	n	%	n	%	%
House construction	95	35.6	34	12.7	48.3
House maintenance	66	24.7	22	8.2	33
Incense collection	1	0.4	4	1.5	1.9
Fruit collection	11	4.1	4	1.5	5.6
Medicinal value	28	10.5	2	0.7	11.2
Total	**201***	**75.3**	**66**	**24.7**	**100**
The trend of forest products is					

Increasing	26	9.4	11	4	13.4
Decreasing	182	65.9	57	20.7	86.6
Total	**208**	**75.4**	**68**	**24.6**	**100**
Major source for fuel energy					
Firewood	103	43.5	40	16.9	60.3
Dried leaf	10	4.2	1	0.4	4.6
Charcoal	74	31.2	9	3.8	35
Total	**187**	**78.9**	**50**	**21.1**	**100**

Source: Own computation

Table 4: Reasons for firewood shortage

Reason for firewood shortage	n	(%)
Population pressure	83	46.6
Scarcity of forest	49	27.5
Absence of alternative source	46	25.9
Total response	**178**	**100.0**

Source: Own computation

When the camp was established in May 2004, there were around 7,955 refugees and on average three logs were allowed for constructing one house which results (2,600houses * 3 logs) = 7, 800 logs were used for construction. In addition 200ha of forestland was cleared for constructing the camp.

As the survey result showed average firewood consumption of refugee respondents and locals was 1.36kg/person/day and 0.91 kg/person/day respectively. According to the estimate of WBISPP, 2002, the annual increment of yield per hectare for northwestern Tigray was 0.22 tons air dry woody biomass/hectare. Taking this sustainable level of harvesting (0.22tons/ha) and assuming that the per capita rates of consumption and the supply pattern remains the same, the total area needed for harvesting dead wood is calculated as follows: The total firewood consumption based on the current refugee population is 6,828.5 tons i.e. 1.36 kg/person/day * 365 days * 13,756 population = 6,828.5 tons. The sustainable yield for northwestern Tigray as proxy to Shimelba: 0.22 tons/ha. Therefore, the total area that should be accessed to refugees 38km^2 i.e. 6,828.5 tons / 0.22 tons/ha = 31,038 hectares.

With the assumption of constant supply and consumption pattern and taking the refugee camp as a center, the distance that the refugees travel to collect dry fire wood can be calculated as using the formula below: Area = $\prod r^2 \rightarrow 310.38km^2 = 3.14 r^2 \rightarrow r^2 = 310.38/3.14 \rightarrow r = 9.94$ km. Thus they will travel a radius (r) of about 9.94 km

from the camp to collect dry wood to meet their energy requirements with a slight decrease in total woody biomass stocks or without much loss of the forest cover of the area. However, currently the distance refugees' travel has reached almost up to17 km in the direction of Tekeze River (to the west of the camp).

Although there is no significant mean difference in the amount and frequency of fire wood and charcoal collected between refugees and locals as shown in Table 4, there is a substantial demand for fuel wood energy among both groups.

Table 5: Amount and frequency of fuelwood and charcoal for sampled households

Amount & frequency	Refugees			Locals			t-statistics
	n	mean	SD	n	mean	SD	
Fire wood	98	4.22	3.70	40	3.92	3.54	-.436NS
Charcoal	34	49.10	25.94	8	38.75	16.20	-1.075NS
Fq firewood	90	2.07	1.15	34	49.10	25.94	0.144NS
Fq charcoal	29	1.90	1.61	8	1.25	0.463	-1.112NS

Source: Own computation

According to the focus group discussion held with partners, stakeholders and locals there has been a tremendous decline in the population of indigenous mother trees species like Acacia bussei, "*sebea*" and "*akuma*" (vernacular names).

As the key informants explained, in 2004 the price of one bundle of firewood was around 5 birr but currently it is approximately 10 birr which increased almost by two fold. Even though price change does not implicitly imply scarcity, scarcity is one of the major factors for this change.
The possible causes of deforestation are the high influx of refugees in the camp which lead to a stage where consumption pattern is above supply/regeneration pattern. The natural resource management practices concerning afforestation are very low to replace the consumption. The alternative energy sources are not well studied.

4.2.2 Decline in livestock feed and overgrazing of pasture land

Livestock production is one of the main economic activities in the study area. Different types of livestock are reared in the study area in order to produce animal products for food as well as to generate income. Types of livestock reared in the study area include cattle, goat, sheep, horse, mule, donkey and chicken.

According to the survey result on Table 6, average livestock owned by the total sample households was 8.5 TLU[10]. Proportionally, refugees owned almost twice greater livestock than locals. The mean livestock number of the refugees was 10.5TLU, whereas locals possessed (6.5TLU). The majority of the locals possess below average livestock units, whereas high proportion of refugees owned above average livestock unit. About 33.3% of the locals and 13.9% of refugees owned 5.01 to 7.84 TLU. On the other hand, about 30.6% of the locals and 38.9% of the refugees possessed greater than or equal to 7.49 TLU. However, there was no significant mean difference in total TLU. But there is a significant mean difference in some of the livestock units such as ox, bull, sheep, goat, donkey and camel at 10 % and 5 % which implies the Kunama refugees take the higher proportion of livestock population. The higher ox and donkey TLU owned by locals shows dependency in the mixed farming system while the higher TLU in cow and sheep by refugees shows use of livestock products as income generating and supplement their ration.

Table 6: Total Livestock of sampled households in TLU

Livestock ownership	Refugees		Locals		Total	
	n	%	n	%	n	%
<1.00	5	13.9	2	5.6	7	9.7
1.00-3.47	9	25.0	7	19.4	16	22.2
3.48-5.00	3	8.3	4	11.1	7	9.7
5.01-7.48	5	13.9	12	33.3	17	23.6
>7.49	14	38.9	11	30.6	25	34.7
Total	**36**	**100.0**	**36**	**100.0**	**72**	**100**

Source: Own computation

As it was mentioned earlier the major occupation of the Kunama refugees is livestock rearing. The role of livestock in supporting livelihood of the local community as a whole is almost equivalent to that of crop production.

Table 7 Average livestock owned (TLU) by sampled households

Type of livestock	Refugees Mean	Locals Mean	t-statistic
Ox	0.52	0.8	2.430**
Bull	0.38	0.7	.906**
Cow	4.5	1.75	-1.6491NS

[10] TLU-Tropical Livestock Unit

Calf	1.31	0.87	-1.248NS
Heifer	1.45	1.13	.523NS
Sheep	0.22	0.01	-2.409**
Goat	0.37	0.65	1.755*
Donkey	0.31	0.48	2.080**
Camel	0.93	0.13	-1.957**
Chicken	0.03	0.04	1.161NS
Total TLU	**6.5061**	**10.5086**	**-1.599NS**

**=significant at 5%,*=significant at 10%, NS=Not significant. Source: Own computation

However, there is a serious problem of feed shortage where out of total respondents involved in this occupation 67.6% answered that they face livestock feed shortage in the area (Table 7). Furthermore, elder informants pointed out that the area was able to generously support the livestock long time ago. It has now been reached to the point that the productive and perennial grasses are approaching to completely disappear. For instance the allotted area for refugees' livestock which is estimated to be for 4,500 different farm animals is only 400km^2 and the area is beyond its carrying capacity, which has resulted in an excessive overgrazing and bare soil. The only option taken by the refugees has been moving live stocks to other areas for search of feed in three different directions.

Table 8: Shortage of livestock feed

	Refugees		**Locals**		**Total**
Shortage of livestock feed	**n**	**%**	**n**	**%**	**%**
Yes	29	76.3	21	58.3	67.6
No	9	23.7	15	41.7	32.4
Total	**38**	**100**	**36**	**100**	**100**
			X^2 Statistics		0.099*

** Significant at 10%* Source: Own computation

The main cause for overgrazing is the combined effects of livestock population pressures of locals and refugees. Scattered bushes/shrubs and trees are left on most of the denuded grazing lands with periodic rejuvenation of leaves on the trees and annual grasses after getting rain showers. As a result livestock are required to cover long distance a day to graze or browse on the very sparse vegetation cover and yet hardly meet even their maintenance requirement all year round. The locals blamed the refugees' livestock for the overgrazing. As a major strategy to alleviate the feed shortage problem 33% of the respondents are giving collected feed for their livestock, moved their livestock for search of feed (25.3%), sold some of them (24.2%) and (17.6%) gave tree branches and leaves.

4.2.3 Depletion and scarcity of water sources

There were two rivers locally named ‘Mai-emni’ and ‘Mai-hadas’ and three springs which were flowing all year round. These water sources have already dried up. Besides, underground water scarcity is caused in the area due to erratic seasonal rainfall and subsequent runoff which minimize the underground water recharge. In addition, unwise and over-consumption of this water sources further aggravate the problem of water scarcity. The locals are very much concerned about the recurrence of bad seasonal rainfall pattern; in which most of the time causes total crop failure.

In bad season, moisture deficiency is not only causing total crop failure but also aggravates the animal feed problem as well as a decrease in river flows and groundwater recharge. Along the route of the rivers small scale irrigation was possible and some farmers were practicing. The unwise and over consumption of water resources due to the population pressure of both human and livestock intensify the problem.

4.2.4 Decline in soil fertility

Mixed farming (crop and livestock production) is also practiced by considerable proportion of the community in the area. This type of activity is very dominantly observed in the local community comprising 30.5% of the total respondents. Though, few refugees are able to access farm land through renting, it is not common.

Livelihood solely on crop production is practiced by some of the local population, 9.3 %, but is not very considerable as in the case of livestock keeping. In general, livestock raising, crop production and mixed farming constituted the major economic occupation of the local population and refugees: 17.5 %, 5%, and 75% for locals and 6.4%, 27.3%, 0.9% for the refugees respectively. The major crops grown in the area are sorghum, sesame, finger millet, maize, green pepper, noug and wheat.
The pattern of land use is different among refugees and locals. Refugees are not allowed to have their own land except through renting from the locals. From the total respondents only 8.1% of refugees answered that they access land through renting. On the other hand, locals have their own land; from the total respondents 64.5% answered they own their own land and 14.5% and 19.4% of them are able to rent in and rent out, and almost all use it only for crop production.

Table 9: Perception of sampled households in the trend of crop production

The trend of crop production is:	n	%
Increasing	14	19.4
Decreasing	50	69.4
No change	6	8.3
I do not know	2	2.8
Total	**72**	**100.0**
Major reason for the decline in crop production	**n**	**(%)**
Soil fertility decline	32	38.1
Lack of access to inputs	11	20.2
Pest	9	16.7
Erratic rainfall	21	25.0
Total	**72**	**100**

Source: Own computation

From the total crop producer respondents 69% answered that they have observed a decrease in crop production in the area since the last three years and only 19.4 % of the respondents answered that they have observed increment in crop production.

Table 10: Level of food sufficiency for the sampled households

Do you face food shortage?	n	%
Yes	25	35.7
No	45	64.3
Total	**70**	**100.0**
Compensation Mechanism	**n**	**%**
Aid	2	4.4
Help from relatives	1	2.2
Remittance	3	6.7
Selling of livestock	30	66.7
Petty trade	2	4.4
Daily laborer	7	15.6
Total	**45**	**100.0**

Source: Own computation

Although not scientifically confirmed, farmers reported the low fertility status of the soil as a major cause for the decline, where soil fertility decline (38.1%), erratic rainfall (25%), lack of access to inputs (20.2%) and pest (10.7%) are the prominent reasons for the decline in the productivity. The low soil fertility has resulted from erosion, deforestation and the unwise land management practices, etc. In addition 35.7% of the respondents answered that they faced food shortages during last year production season (see Table 25), and 66.7% respondents reported they sold their livestock as the major mechanism for compensating the food shortage.

XXXIV. 4.3 The nature of conflict and its consequences

4.3.1 Forms of the natural resource conflict

XXXV.

This paper recognizes the importance of the actors in conflict situations; but greater attention is given to the objects of conflicts: the natural resources of the study area.

Table 11: Level of occurrence of conflict by the sampled households

Faced any conflict for the last 3yrs?	Refugee		Locals		Total	X^2-statistics
	n	%	n	%	%	
Yes	67	45.3	16	10.8	56.0	4.055**
No	43	29.1	22	14.9	44.0	
Total	**110**	**74.4**	**38**	**25.7**	**100**	

***=significant at 5%* Source: Own computation

As can be observed both from the formal and informal survey, severe conflict has happened between refugees and locals due to competition in the wood and grazing sources. Out of the total respondents 56% reported they faced conflict while 44% reported they did not face any conflict. Shortages of natural resources lead to competition which in turn results in conflict. This resource scarcity and insecurity deter appropriate management of natural resources. Conversely, changes in the management of natural resources can definitely increase the supply which both locals and refugees seek and can reduce competition. Conflict in the case area is strongly felt and a prevalent phenomenon. It is obvious that there is a visible tension of conflict for the scarce resources-fuel wood and grazing land.

The increasing trend in occurrence of conflict shows conflict is increasing over time as a result of competition for scarce resources and increasing number of refugees. In the study area, three major potential forms of natural resource conflicts are identified.

Conflict over grazing land: Kunama refugees are forced to graze their livestock in and around the camp areas due to shortage of pasture which has caused conflict. The refugees are driven by the demand for more pasture land because grazing areas are overgrazed forcing herders to take their flock longer distances in search of favorable pasture land, which has been used by the local community for farming or pasture has caused a conflict.

Table 12: Summary of reported conflicts in the study area.

Year of conflict occurrences	Conflicts involving violent killings	Conflicts involving cattle raids	Total number of conflict occurrence other than violent killings	Total number of human casualties
2004	0	30	29	29
2005	3	150	84	87
2006	6	300	152	158
Total	**9**	**480**	**265**	**274**

Source: Mai-kuhli kebele police office, 2007.

Conflict over fuel energy source: As mentioned earlier, a large influx of refugee population concentrated in the camp inevitably alters the social dynamics in the area. The locals have slowly started rejecting the refugees accusing them of ingratitude for their excessive reliance and exploitation of the natural resource and such cumulative events have become a potential cause for dispute and conflict. This has been manifested in firewood collection by refugees for household consumption and for generating additional income. The firewood collection resulted in violence, especially, if the activity coincided with confrontations of resistance from locals by snatching the fuelwood from the refugees. This can be confirmed by the number of conflicts for fuelwood by the survey data collected on sample households; 37.3 % of the respondents from the refugee and local communities faced fuelwood conflict in the area. As it was mentioned previously, currently the demand for fuel energy has forced refugees to travel to longer distances (up to 17 kms) to the places even not permitted for them to pass.

Table 13: Reason of conflict over wood by sampled households

Reason of conflict over wood	Yes		No		Total	
	n	%	n	%	n	%
demand for construction	51	34.0	99	66.0	150	100.0
demand for fuel energy source	56	37.3	94	62.7	150	100.0
demand for sale	17	11.3	133	88.7	150	100.0

Source: Own computation

Conflict over soil: Another conflict has recently manifested since 2006 in the form of soil source conflict for mud bricks construction. Analysis of this conflict is crucial because the increasing influx of refugee entirely depends on mud brick for constructing their house.

4.3.2 Major causes of conflict

The major identified causes of conflict in the area are rapid population pressure, ecological degradation, inadequate ration, and competition and alienation. The total number of refugees is tremendously increasing at the rate of arrival of 600 persons per month. Fuelwood demand for the newly arriving refugees and the existing and the local population totally depend on this scarce natural resource base.

Table 14: Trend of population growth in Tahtay-Adyabo woreda

Population increase at "Mai-kuhli Tabia" level	2004	2007
Locals	3,775	5,465
Refugees	8,345	13,756

Source: ARRA, 2007.

The gradual destruction of tree and bush coverage in the area is one of the observed problems. Causes associated with these are the demands for more fuel wood and increased reliance on animal biomass consumption which resulted in a gradual decline of the supply of natural fertilizer to soil. Rises in temperature and soil erosion are also phenomena increasingly being observed as a result. The area has increasingly become devoid of natural vegetation. Encroachment of weed herbs and pests has also increased from time to time.

The sample survey also revealed that both population pressure and competition (55.3% of the respondents) are mentioned as major cause of the conflict. However respondents identified resource competition (20%), political reason (14%) and population pressure (10.7%) as causes of the conflict.

Table 15: Causes of conflict

What is the primary cause of conflict?	n	%
Population pressure	16	10.7
Resource competition	30	20
Both population & competition	83	55.3
Political reason	21	14
Total	**150**	**100**

Source: Own computation

The amount of ration distributed to the refugees is 15kgs of wheat per person per month and refugees sell some of their ration for grinding and other purposes. And in practice, this amount is not enough. Thus the refugees used the available forest resource for income generating and compensating the gap in the ration.

Competition as a result of scarcity in both sides has been aggravated. Refugees persistently have attempted to exploit every opportunity of expanding the grazing areas near the marginal lands and allotted area. Unlike scattered grazing, concentrated grazing has by itself resulted on rapid range degradation and has lead to competition and confrontations over access to grazing land.

Alienation is a consequential feeling of competition. The competing parties through the process and the actual measures taken in the competition will develop a collective felling that they are losing out to their counterparts. The locals replied affirmatively for the question “Do you feel your community is disadvantaged due to overtake of resources?” which shows the prevalence of strong sentiment of resource alienation. On the contrary to this the refugees feel that they are increasingly being denied access to fuelwood and grazing land sources by locals in the surrounding area. Refugees explain it by saying “the locals hate us.”

4.3.3 Conflict resolution mechanisms

As part of the effort of the administration to assess the situation of conflict in the area, ARRA, through its protection department has been trying to organize a joint committee from both communities to solve problems at grass root level. But it is way behind to be called effective and comprehensive enough.

One major gap of the management of conflict was that the rule as to how forest land and grazing land was to be acquired, titled, utilized and alienated to others is not clearly put. Detailed regulations are not also outlined as to what forms of use is allowed. The solutions to natural resource conflicts are not to be found in any single action at any one level of society. Rather, interventions are needed at a range of levels which address the various ways in which the problems have been caused. While a range of actions is needed, there must be an overall process which will direct attention to these conflicts, analyze their causes and identify solutions

Hence, towards conflict resolution in the area there are different activities which are mostly targeted at resolving conflicts through negotiating between the two parties; this is mostly held by the camp administration conflict resolution committee which consists of five members (ARRA protection, refugee representative, representative from the locals, local administration and police).

However, alienation and competition are further aggravated by the failure of authorities to take effective measures towards resolving disputes over access to resources and by the perceptions of being disadvantaged when authorities take some measures of regulating access to resources.

XXXVI. 4.4 Natural resource management practices and approaches

4.4.1 The current practices in natural resource management

Typical approaches of implementing natural resource management practices in the study area are through Food for Work (FFW) for locals and cash for work in case of refugees. Food for work program was undertaken among the locals whereas some voluntary participation was undertaken in the case of refugees. In this regard UNHCR, ARRA, Natural Resource Development programme (NRDP), International Rescue Committee (IRC) and Zoud Oust Asia (in Dutch Language South East Asia ZOA) refugee care are involved in the natural resource protection and conservations program in and around Shimelba refugee camp. The interventions include mud brick construction, stone/soil bunds, eye brow basins, terracing, building check-dams, hillside plantations, water development, awareness creation, forest guarding, nursery development, beehive distribution, afforestation, and biomass saving stoves distribution.

The extent of the damage on natural resources has reached to a critical level and efforts in natural resource management are far below the expected. For instance according to the survey result 40 % of the respondents indicated that they were involved in soil and water conservation activities, but the rest 60 % of the respondents answered that they have never been involved in any of the soil and water conservation activities.

Among the respondents that involved in the conservation activities it is indicated that such initiatives particularly in the soil and water conservation, 33% reported they were initiated by themselves and hence 67.1% were in group mobilized. About 22% of the respondents answered that they were invited and involved in the planning of the soil and water conservation activities. On the other hand 78% of the respondents answered that they were not involved.

In addition, according to the survey result 31.8 % of them maintained the structures after construction, whereas 68.2 % reported they did not maintain the works. Even if there are some efforts undertaken in providing training in soil and water conservation

activity in the area, only 20 % of the respondents answered that they took trainings on soil and water conservation techniques.

Table 16: Participation in Natural Resource Management activities by sampled households

Natural resource management activities	Response	Refugees		locals		Row Total (%)	χ2-Statistics
		n	%	N	%		
Participated in Soil & water Conservation activities (SWC)	Yes	23	20.9	37	92.5	40.0	62.642***
	No	87	79.1	3	7.5	60.0	
Participated in the planning of SWC	Yes	14	12.7	19	47.5	22.0	20.669***
	No	96	87.3	21	52.5	78.0	
Maintained SWC works	Yes	14	12.7	33	86.8	31.8	71.586***
	No	96	87.3	5	13.2	68.2	
Participated in SWC training	Yes	9	8.2	21	52.5	20.0	36.009***
	No	101	91.8	19	47.5	80.0	
Participation in tree planting	Yes	76	69.1	37	92.5	75.3	8.650***
	No	34	30.9	3	7.5	24.7	
Taken care of the planted trees	Yes	71	78.0	32	86.5	80.5	1.199NS
	No	20	22.0	5	13.5	19.5	
Areas of tree planted	own farm land	2	2.6	5	13.5	6.2	42.435***
	homestead yard	68	89.5	11	29.7	69.9	
	closed area	1	1.3	5	13.5	5.3	
	communal land	5	6.6	16	43.2	18.6	
Frequency of training	every year	4	40.0	12	66.7	57.1	4.480NS
	twice a year	4	40.0	6	33.3	35.7	
	once in a year	2	20.0	0	.0	7.1	
Type of training received for the natural resource management	Nursery Management	2	22.2	6	35.3	30.8	0.476NS
	SWC	5	55.6	8	47.1	50.0	
	Afforestation & terracing	2	22.2	3	17.6	19.2	

Source: Own computation ***=significant at 1%, * =NS=Not significant

According to the survey result, 75.3 % practiced tree panting and the rest had never been involved in such activity. As indicated in Table 6, own initiation, group mobilization and food for work were reported as the method of their participation in tree planting with 59.5 %, 24.4% and 5.3% respectively. Where about 69.9%, 18.6 %, 6.2 % and 5.3% of the respondents reported that they planted the trees in homestead yard, communal degraded land, own farmland and closed areas respectively. Hence, about 80.5 % of the respondents reported that they cared for the planted trees and

19.5 % didn't take care of the planted trees. As mentioned above, there are also some efforts in the area of natural resource management training with 50 % of the respondents answering that they were involved in training of soil and water conservation, and 30.8 % responded they were involved in nursery management and 19.2 % reported both.

Table 17: Method of participation in SWC & tree planting activities by sampled households

For SWC	Refugees		Locals		Total
	n	%	n	%	%
Own initiation	13	14.3	17	18.7	33
Group mobilization	9	9.9	25	27.5	37.4
Food for work	2	2.2	11	12.1	14.3
Cash for work	4	4.4	10	11.0	15.4
Total	**28**	**30.8**	**63**	**69.2**	**100**
For tree planting					
Own initiation	58	44.3	20	15.3	59.5
Group mobilization	15	11.5	17	13.0	24.4
Food for work	0	.0	7	5.3	5.3
Cash for work	7	5.3	7	5.3	10.7
Total	**80**	**61.1**	**51**	**38.9**	**100**

Source: Own computation

4.4.2 Major constraints and opportunities in natural resource management

Inadequate planning in site development activities:

The site development activities should have taken into account the potential impacts of excessive clearance of ground vegetation. Inclusion of environmental specialists in the emergency phase should have resulted in improved environmental planning. It was important to undertake appropriate environmental screening at the time of establishment. The site was not selected based on taking a variety of factors. Therefore, the site should have been appraised from an environmental perspective before it was confirmed. This could have been done easily by including natural resource mapping in site planning. It did not require specialist training and could have helped to screen possible settlement sites. In addition, involving relevant government environment departments in site selection would have resulted in decisions which would have been more acceptable and environmentally sound. This means camp siting and design could have dramatically reduced the severity of environmental damage.

At camp establishment phase, the refugees must have been informed of regulations regarding natural resource use. These may relate to tree cutting, charcoal making or management of wood harvesting areas. The absence of environmental contingency plan, resulted in a condition where addressing environmental concerns came after a lot of damage. The delay in incorporating environmental considerations has resulted ineffective and costly attempts to tackle negative environmental effects. Information on a small number of key environmental features was normally sufficient for contingency planning by using locally available information. On the other hand, clear definition and analysis of the environmental problems was essential for the design of a successful mitigation strategy. The nature of environmental problems should have been clearly defined and understood at the camp establishment stage. The collection of baseline environmental data in the emergency phase would have greatly facilitated subsequent impact assessment.

Low level of local participation in natural resource management practices:
Sustainable environmental management practices are best achieved with the full and meaningful participation of the affected communities. It is obvious that given assistance and direction, local communities can be effective managers of natural resources. Local people should have taken the leading role in planning and implementing environmental rehabilitation strategies within their own communities. It has been therefore critical to conduct participatory problem identification and needs assessment of the target area before launching any environment-related programme. Obviously enabling participation and empowerment requires commitment and patience from donors and implementing partners. Nevertheless, without it, the sustainability of any environmental rehabilitation initiatives is likely to be compromised as it has happened now.

Effective and sustainable environmental management and rehabilitation activities in the longer-term require a detailed understanding of the incentives and motivations for refugees or local communities to become involved in such activities. Environmental activities should seek, therefore, to maximize the benefits to the individual without compromising environmental sustainability. Non-monetary economic incentives can include a range of environmentally-friendly commodities such as fuel-saving stoves, firewood and various essential household items that would otherwise have to be purchased.

Institutional Constraints:
It is clear that institutional capacity-building is a common prerequisite for effective participation of local government and/or institutions in environmental management. Government department responsible for natural resource management, NRDP, is currently very ill-prepared and under-resourced to handle the demands of a refugee

influx. The level of government participation in environmental initiatives is far below the expected. The link between UNHCR and its partners and relevant government technical departments has been very weak. According to the focus group discussion, there is a problem of coordination in preparation of action plans.

Policy gaps:

Government policies determine the extent and success of refugee participation in environmental management activities. Even though government policy is often the key to success in natural resource management, it has been totally neglected. While the goal of local and refugee participation in environmental management strategies is a sound principle, its viability rests on the government's willingness.

In the Environmental Policy of Ethiopia, opportunities for refugee participation, decision-making and access to (with assumed control over) natural resources are not clear. Due to this the likelihood of achieving effective refugee participation has greatly diminished. Government must therefore develop a clear policy statement on refugee access and usage rights, and then follow this through the necessary enforcement measures that may be required. But for short term solution preparing basic guidelines as a supplement to create a supportive policy framework is very crucial.

Based on the results from the discussion, systematic and integrated approaches to environmental interventions in refugee assistance can have substantial gains (so far largely unrealized). What should have been done in early stages was to devote resources in a slow and transparent manner to build trust. Participatory approaches, including INRM, allow identification of roles, responsibilities, weaknesses and strengths in a community becoming involved in natural resource management. Participatory approaches allow refugee and local populations to identify problems and possible solutions, with limited input from external facilitators. This can develop into a process of planning and implementation of community-based management strategies. The use and application of participatory approaches require properly trained facilitators.

5. Conclusion

The refugee population has a considerable proportion of young people where the age group of 15-45 years constitutes 82% (majority of the total respondents). These are potential work force for development activities including natural resource management activities if aided with incentives, participatory approach, and coordinated effort by stakeholders and implementing partners. The occupational

background of the refugee population is mainly pastoral and trading activities particularly small business which is influenced by their background. On the other hand, current major occupations of the locals depend on crop-livestock production.

The high population pressure has seriously affected and damaged the scarce natural resources and the agricultural productivity of the study area. This is due to the relatively high refugee population allowed to settle in one camp; which has accounted for the massive impact on the environment. The study area as a whole is semi-arid which is characterized by low and erratic rainfall which affects the productivity of crop production. The sale of forest products (fire wood and charcoal) has become one of the means of income generation to a large number of both communities (groups) resulting in huge forest resources depletion and environmental degradation. The provision of forest resources for the large number of refugee and local population has been a very demanding task and there is a serious problem of fuel wood scarcity in the study area. The allotted grazing land for the refugees is beyond its carrying capacity compared to the livestock population. This and the competition for scarce fuel wood has resulted in a serious conflict with the local population. Ever increasing household energy demand in the area is found to be the major cause for the ongoing deforestation. So it calls for further research and development interventions for the provision of other alternative energy sources.

The formal administrative organs, stakeholders and implementing partners are well aware of the degradation in the study area. However, measures taken to date towards environmental rehabilitation were found to be negligible compared to the environmental impacts. Failure to consider environmental issues from the outset of a refugee operation has resulted in a condition to widespread effects and costly to restore.

The natural resource management activities suffer from insufficient number of trained staff, shortage of financial and logistical support for the field work. In addition, the natural resource management interventions are characterized to a large extent as having been undertaken in isolation (no proper link-up with other natural resource management activities) and as having little involvement and support by the refugees and local population. There are no indications that the natural resource management activities have been participatory in different phases (planning, implementation, monitoring & evaluation). As a result the majority of the households (both locals and refugees) have preferred not to engage in natural resource management activities. Therefore, the involvement of the principal stakeholders including refugees and local population is not significant.

Government policies often determine the extent and success of refugee participation in environmental management activities. Even though government policy is often the

key to success of refugee participation in natural resource management, it has been totally neglected. Therefore, important gains can be made by lobbying and advocating for filling the gaps in the existing policy through regional and federal governments levels through further research investigations.

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Institutions in Protected Areas (PAs)[1] Management in Ethiopia: Evolution, Outcomes and Drivers of Institutional Changes

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Abstract

Institutions as predictors' of human behaviors and actions play significant roles for sustainable utilization and development of protected area resources. Formal institutions in PAs management had been in place even in the 13th century to curb the unregulated extraction of resources. In the early 19th century, formal institutions begun replacing customary institutions to manage resources, and this was associated with the emergence of the notion of strong national state and territorial expansion. In response to internal and external factors/drivers, formal institutions in protected areas management evolved towards more formal and comprehensive involving different actors. By applying tools of the new institutional economics, the paper argues that institutions in PA management in Ethiopia failed to meet desired objectives, and efforts on PA management have been with limited success, and degradation of resources has continued even further. Several species of higher wild animals are extinct while several are endangered; their habitats and scenery are destructed, whereas the country is left with 2-5% of forest cover. The system has created fertile ground for pronounced illicit extraction and illegal trade of wildlife and natural resources. With the increasing human and livestock population, natural hazards and conflicts, protected areas management continued to be in crisis. The recent failure of the private- government- community partnership initiative to manage PAs could also be cited as an example in this regard. The continued non-cooperative behaviors and actions of actors must be questioned. The institutional innovations in PAs management must take account of different actors' interests which often are contradictory in space and overtime. Within the sustainable development framework, incentive based policies and institutions that ensure local peoples' access rights to use and management of resources are vital.

[1] Protected areas means areas set aside for conservation of wild animals, birds, fish and their habitats.

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Introduction

Institutions[3] are relevant to make human behavior and actions predictable. Institutions are both barriers to and opportunities for ecologically sustainable human development (Dovers 2001). North (1990) posits that not all institutions are efficient and that inefficient institutions could persist for a long time thereby *hindering growth*. Institutions can be captured by powerful groups to serve their particular interests. Witness for example the institution of the Mafia that started in the early 20th century. Similarly, politicians, bureaucrats and other vested interest groups could retain inefficient institutions and satisfy their individual interest at the expense of others.

The utilization of resources during the different regimes in Ethiopia has been unregulated, and natural resources conservation and development were less emphasized, and hence the stock of resources kept deteriorating[4] and some have extinct, while some others are endangered. Successive governments in Ethiopia have made little efforts in developing these. The price system or market mechanism could not sufficiently address the problems of management of PAs. Characteristically, natural resources have multiple and intergenerational values and their management should be inline with the multiple purposes. Institutions are, therefore, crucial for ensuring sustainability of PAs resources. Historically, conflicts and droughts have been common phenomena in Ethiopia to have downward spiral on resources. Equally important are weak institutions, inappropriate policies, programs and strategies.

This manuscript is aimed at studying evolution of institutions/ policies and organizations in PAs management in Ethiopia in order to capitalize on the opportunities, and mitigate the daunting challenges facing in terms of institutional innovations and policies. This institutional approach to analysis of PA managements across the different governance regimes helps to get better understanding of historical account of institutions in the PA system, and this in turn helps in designing future policy, and institutions for resources conservation and development. The document is organized as follows. Following the introduction, section 2 presents how formal institutions for management of wildlife PAs resources evolved (since the turn of the 20th century). Section three presents programs/projects conceived and implemented during the different regimes while section four highlights management of

[3]Institutions are a set of formal (laws, contracts, political systems, organizations, markets) and informal rules of conduct (norms, traditions, customs, value systems, religions, sociological trends) that facilitate coordination or govern relationships between individuals or groups. North equates institutions with institutional environment, the set of political, social and legal ground rules.

[4] The forest cover of 35-40% at the beginning of the 19th century has declined to 2-5%, whereas loss of wildlife species and habitats is alarmingly increasing (ENA 2007), Rhino is extinct and elephant is approaching extinction (Leykun 1999), while 12 of 29 endemic birds of Ethiopia are on IUCN red list

selected national parks. Sections five and six present the outcomes and drivers of institutional changes in PA management. The last section presents summary and implications for researchers, policy makers and development practitioners.

(Murrelle Foundation 2007). Threatened are 32 species of mammals and 12 species of higher plants (Earth Trends 2003).

2. Institutions and policies in PA management: Evolution

Customary[5] institutions for management of resources existed in most parts of Ethiopia prior to the emergence of formal institutions (the focus of this paper). Although this study focuses to the time from the 20th century onwards (particularly since the reign of Emperor Minilik), formal institutions for natural resources management in Ethiopia have existed since time of King David, 1273-1304 (Demel 2003). Menagesha forest, the first and the oldest in the continent, was established in the 1450s by Emperor Zara Yacob (EFAP 1994; FDRE/UNDP-GEF 2006). Emperor Minilik issued regulation 1893 (Articles 8 and 14) and established Ministry of Agriculture (MoA) to deal with forest and land related resources, with the understanding that the failure of which causes drought. He also issued a legal notice to governors on hunting in 1901/2 (1908 European Calendar) and has prohibited hunting without a license.

Formal wildlife conservation institution/rule emerged due to both internal (local) and external factors. Firstly, despite the existence of traditional conservation institutions, the pressure on forest and wildlife resources has continued[6], whereas uses of resources have not been regulated. For instance, hunting wildlife had a social value (marriage obligation and sign of courage) for some communities in Southern Ethiopia, and among the Oromo youth it was a hobby, whereas among the governors, it had social value (prestige and adventure). The Emperor assigned governors and their subordinates to regulate hunting. (See also Abraha 1991). The hunters were required to reveal the animal products (such as ivory, skin), and also sell these to the Emperor, in which case he indirectly was monitoring and regulating the types of wild animal (elephant) hunted. Secondly, Kings in Europe established an association of wildlife, birds and fishery in 1901, and called up on states to follow their initiative. Concomitantly, Ethiopia acceded to the association in 1901/2, enacted rules and assigned personnel to protecting wildlife.

When formal institutions were designed and gained support, customary Natural Resources Management institutions continued weakening and losing their roles overtime[7]. But, where resources were more localized and there was collective action, customary institutions were sustained (e.g., Guassa-Menz), whereas for Borena and

[5] These are customarily established rules, norms, and traditions that shape human behavior in terms of use, and management of resources. The *Gada* System in Oromia, *Kedo Aba* in Afar and the Guassa-Menz in Shewa (since the 17th century) are only a few customary institutions to mention. Abraha (1991) reported that there had been customary institutions conserving wildlife resources for common purposes among different ethnic groups.

[6] Emperor Minilk had been shifting his palaces due to shortage of wood supply for his crew, and military. This was from Ankober to Debegojo, Jihur, Addis Ababa (Entoto), Addis Alem and then to Addis Ababa.

[7] Art. 3347 (1) of the Ethiopian Civil Code did away with all customary and religious laws prevailing in the country. This is when the expansionist state tried to nullify the customary institutions of the communities in the arid-lands/ecologies.

Karrayu communities these were staggered or relapsed. These actions in the newly occupied areas of Southern Ethiopia triggered tensions and conflicts. Emperor Minilik enacted wildlife hunting legislation in Southern Ethiopia, but an annual group hunting practice called *Adamo* by Oromo youth has been practiced until recently (see Shibru 1995). The replacement of all internal institutions by totalitarian regimes in the 21st century resulted in high costs and overburdened administration (Kasper and Streit 1998: p.115). The successors to Emperor Minilik gave less attention to management of wildlife and forest resources, and in improving the Emperor's initiatives[8]. This was partly due to the struggle for political power among key individuals and their supporters. The evolution of NRM institutions was not coherent with the theoretical literature that argues that there are pathways in institutional changes. Firstly, the design of formal institutions was not complementary to the customary NRM institutions. Secondly, government and its agents failed to adjust PA management institutions.

2.1. Emperial Haile Sellasie: 1930-1974[9]

During 1936-41, the Italian forces put forth policies that enable them govern the country including extraction of resources. In 1944, legislation was passed to regulate hunting of wildlife to ensure certain species were not over-hunted (Negarit Gazette 1944). This can be seen as an advent of wildlife conservation and an indication that the wildlife were showing signs of **'finiteness'** and thus, giving cause of concern. Forestry, game and fishery department under MoA was formed in 1945, but reorganization in the same year made forestry division at a sub-ordinate position. By mid 1940s, Ministry of Agriculture (MoA) took over duties over natural resources which were under the jurisdictions of Ministry of Interior. In 1957, to halt forest devastation, the forestry division under MoA was upgraded to ***department status***, and was responsible for forestry and game resources (Walia 1998). Other institutional provisions included Article 130 of the revised constitution of 1955[10] and concomitant proclamations. Articles 803 and 804 of the 1957 penal code contain provisions related to forest and wildlife conservation.

In 1963/64, a UNESCO mission, which was interested in conservation of endemic species, conducted studies and made its recommendations[11]in line with the two UNESCO resolutions, 1931 (XVII) and (12C/2.213). In 1965, the EWC department was established under the MoA, and at a latter stage, following the

[8] Emperor Minilik thought about the increasing demand for natural resources and shortage of supply. The introduction of suitable trees from abroad, research and plantations activities were to improve supply, while conservation policy was to restrict the increased demand and unregulated use.

[9] Ethiopia had been under Italian administration during 1936-1941 and evidences showed that natural resources were negatively affected due to over exploitation.

[10] The first Ethiopian constitution was adopted in 1931 (Girma Hailu 2000). This was succeeded by the 1955 revised constitution. This latter constitution had more provisions for conservation of resources.

[11] The recommendations were establishment of conservation bureau and conservation areas, staff training, wildlife research, fishery development, botanical and zoological gardens, financing of nature conservation and education.

recommendations, Awash and Simen National Parks received legal status by Orders No. 54 and 59/1969, respectively. As per Article 27 of the 1955 revised constitution and advice of council of ministers, EWCO was legally established in 1970 as an autonomous body, and this was headed by a manager and a board[12]. In addition to EWCO, Tourism, Travel and Tour, Airlines and Hotels were engaged with wildlife for business purposes, whereas Science and Technology and Addis Ababa University were conducting researches on wildlife. Abraha (1991) noted that the varied nature of the interests and activities of actors has been contributing to lack of coordination in resources utilization.

How the local people reacted to conservation policy, rules and actions of conservation managers could be explained as follows. Pastoralists' resistance started when the state failed to keep its promises (see Buli Ejeta 2001; Ayalew 2001; Bassi 2003). When ANP was delineated, the Emperor allowed Karrayu[13]to use pasture land held by one of the land owners, *Dejazmach Woldegebreal*, and this was only until this land was nationalized as state property in 1975 (see Ayalew 2001). Moreover, rotational grazing formerly permitted in ANP was prohibited with the tightening of the rule with out compensation to the pastoralists. For SMNP, local community resisted settlement in Arsi region and hence this was not implemented. For Bale Mountains, Nech Sar, Omo and Abjatta-Shala National Parks, communities continued resisting the rule and there have been recurrent conflicts[14]. The antagonistic relationship between EWCO and local communities was due to EWCO's restrictions on peoples' rights (Hillman 1991). Conservation rule enforcement cost (transactions cost) has been high, and this was partly attributable to top-down conservation planning and weak cooperation among actors.

The MoA issued legal notice No. 416/1972[15], and repealed all former regulations concerning wildlife resources. After two years, proc. No. 445/ 1974[16] amended proc. No. 416/1972. This amendment has specified species that needed the most care and those under controlled hunting. Overall, the government focused more on resources utilization as can be seen from increased foreign exchange earnings from wildlife during 1971-73 (NBE 1973; see Wondwosen 1984). The revenue from the sector during 1969-1979 was 4.17 million birr, which is greater than the budget (MoA 1980).

[12] The board was composed of representatives from MoA (chairman), and ministries of interior, finance, education and fine arts, commerce, industry and tourism and Haile Selassie I University and the General Manager.

[13] This is spelt differently by different individuals, but for this purpose the author uses "Karrayu" in the manuscript.

[14] The various regimes forcefully resettled local people, and in extreme cases people were killed when requesting their access rights and resisting the restrictive conservation policy. In SMNP, individuals were thrown down the cliff (Anemut 2007), while in some areas they were harassed and resources confiscated.

[15] This deals with prohibition of residence, hunting and human activities in National Parks, Game Reserves and Controlled Hunting Areas. It also deals with license, permits, duration, fees, types of licenses, methods of hunting, import and export of animals and trophies, handling and possession of these, and so on.

[16] This included the validity period of games licenses and also specified types of game animals and birds to be hunted and hunting limits, fees and checklists of permitted and prohibited animals and birds for hunting.

Despite the efforts stated above, the Imperial regime did not consider demands for more comprehensive reforms such as land tenure, decentralization and redistributive policies, and these necessitated mass appraisals. The 1974 had welcomed accelerated political and social movements, and hence the *Derg* overthrown the Emperial regime (Teklu 2006). The main constraints include little emphasis to the sector, lack of coordination among actors, corruption, heavy resource extraction to meet economic growth, the misconception that resources were abundant in the beginning, and civil unrest and insecurity.

2.2. The Derg/Committee, 1975-1991: Nationalism, total conservation

The state nationalized all lands and natural resources in 1975 (Proc. No 31/1975), and communities again lost access to the customarily held lands and resources. House clearing has been going until 1977 when the *Derg* gained full control. There were repeated reviews of policies, institutions and organizations, without fundamental changes. The *Derg* regime also forcefully removed local people out of PAs including state farms[17]as it upheld the 1969 conservation legislation. In late 1977, the government merged Wildlife and Forestry, and established Forestry and Wildlife Development Authority (FaWDA). In 1980, the authority gained its legal status (Proc. No 192/1980). This proclamation stated "…that the past forest cover has been depleted for the selfish interest of the aristocracy and the nobility resulting in degradation, whereas the wildlife resources were exposed to danger of extinction". Hence *total conservation of wildlife* (PAs) must be accomplished in their own rights, not for necessarily to meet tourist objectives

In 1985/86[18], the FaWDA was abolished under Proc. No. 78/1985, and again this brought forest and wildlife conservation and development under the jurisdiction of MoA. Under the National MoA within natural resources conservation and development main department (NRCDD), forest and wildlife conservation and development team was established. Subsequently, in the provinces and administrative regions, forest and wildlife team was again established under the natural resources conservation and development team. Articles 10 (1); 23 (2) and 55 (3) of the 1987 constitution adopted by the *Derg* provided legal support for wildlife conservation. A wildlife management policy was formulated in 1988[19] although not implemented (EWCO 1988 cited by Abraha 1991). In the mean time, participatory approach seems to have gained at least theoretical support. The initial trajectory of

[17] The socialist government (Derg) has established large state owned plantations strategically important areas, mostly lowlands areas where pastoral communities depend on.

[18] In 1985, following two years of no rain and subsequent drought and civil unrest, the Karrayu, Ittu and Afar continued demanding use of PA resources and hence were tolerated to settle in Western half of the park (Jacobs and Schloeder 1993; 2001).

[19] The then wildlife policy had several objectives such as conservation of wildlife and ecosystems, utilization, training, conservation education and research, cooperation with local people and government.

establishing and managing PAs was positive[20], but the success and sustainability was hindered by top-down, dictatorial policies, actions and external geopolitical events, *ceteris paribus*. The deepening civil wars in various fronts, economic crises and the changing world order such as reforms in former USSR (Ethiopia's ally) and termination of support contributed to the dawn fall of the *Derg* in 1991.

2.3. Post 1991 (Ethiopian Peoples' Revolutionary Democratic Front Regime)

When the civil war ended in 1991, most PAs in the country where over run and resources have been misutilized until a new order and administration was in place (Duckworth 2002; Jacobs and Schloeder 2001; Shibru 1995). A charter was adopted in 1992 with the establishment of Transitional Government of Ethiopia (TGE), and several policies were formulated and institutional provisions were made. In 1990/91, the MoA was restructured and the ministry of natural resources and environmental protection (MoNREP) was established at federal level, while regions established a bureau of the same (see Proc. No. 41/1993). Proclamation No. 94/1994 on forestry[21] was issued in 1994, while a draft document on wildlife management was submitted to the council of Ministers[22], and a draft wildlife policy and strategy was formulated. The MoNREP ceased to exist in 1995 with proc. No. 4/1995 which repealed the former, and transferred the Ministry's (MoNREP) rights and obligations to the MoA (i.e., wildlife and forestry aspects).

In 1995, newly adopted federal constitution established nine regional states whereby their borders demarcated along ethnic lines and physical features[23]. Moreover, the government formulated policies, programs, strategies, and proclamations at the different levels[24]. It also established focal organizations and provided legal backing in the environmental and natural resources management realms. Some of the organizations established include EPA (Procls. No 9/1995; 295/2002), IBCR (Procls. No 198/2000; 381/2002), whereas other proclamations in the environmental fields are the EIA (No. 299/2002), pollution control (No. 300/2002), and land use and administration (No. 456/2005). Polices and programs related to natural resources include Environmental Policy, and Conservation Strategy, 1997; the National Biodiversity Strategy and Action Plan, 2005; and National Important Bird Areas

[20] Until the late 1980s, Ethiopia had 9 National Parks (2 are gazetted), and 4 wildlife sanctuaries, 11 wildlife reserves and 18 controlled hunting areas (Leykun 1993, citing EWCO 1989). The nominal wildlife protected areas account for 3.2% of land surface of the country.

[21] This has repealed proc. No 192/1980 (but retained the wildlife component), and Proc. Nos 344, 345 and 347, 349, 350 and 351 of 1968.

[22] The Parliament approved draft legislation on wildlife in August 2007, and was legalized after the view by the standing committee. The policy and strategy on wildlife management was not signed until mid-2000s. The issues of forest wildlife resources have not been addressed for long time now.

[23] Initially, there were 14 regional states, and latter reduced to 9 regional states. With ethnic based decentralization, new forms of conflicts emerged in different localities. These include conflict for political autonomy, territory and accessing resources. This has affected the natural resources and human element.

[24] Policy formulation and development of programs in Ethiopia has been less participatory, mostly top-down, expert driven and behind doors. As a result, implementation of these was constrained.

Conservation Strategy, 2002. Subsequently, regional states were advised to develop their plans within the framework of the federal government plans.

During the late 1990s, most PAs were handed over to regions with the exceptions of two parks and two sanctuaries. As some scholars argue, the decision was so quick and no preparation was made, and hence this has created a gap in terms of handing over of duties, and management burden to new regional states (Leykun 2000; Berhanu 2006). EWCO was disbanded including its legal status, and all its responsibilities were handed over to Ministry of Agriculture and Rural Development (MoARD). This is in line with the North's (2005) argument that it easy to establish or dis-establish organization over night.

Procl. No 256/2001 re-organized the structure of federal organs, and under this proclamation, the Ministry of Rural Development was given a mandate administer Ministry of Agriculture and the latter was responsible for wildlife and forestry management. Proclamation No. 380/2004 has re-organized the federal executive organs, and this has defined the power and duties of MoARD[25]. Wildlife PAs under the central government are managed by WCD under MoARD. Those PAs handed over to the regional states are managed by the different regional bureaus. However, Amhara and SNNP Regional states have established an authority/agency responsible for wildlife PAs within the tourism and culture sector, while others are yet to do so.

In 2007, the HPR enacted new proclamations[26] (Proc. No 541/2007 on wild animals and Proc. No 542/2007 on forestry) and repealed Proc. No 94/1994 on forestry, and wildlife proclamation No. 192/1980. Demeke (2003) noted that Ethiopia's penal acts in use did not sufficiently deter wildlife offenders, and the revised legislation has ensured heavier sentences for wildlife offences. But, tightening the regulatory system in the absence of enforcement capacity does not ensure wildlife protection. Again as of 2006/7, government initiated business process re-engineering (BPR/I) to review performance of state agencies. This exercise instituted wildlife aspects in the tourism sector, and the Council of Ministers during its 52nd regular meeting approved an authority responsible for wildlife resources. It is another generation of dilemma or a step forward? In short, existing institutions and their arrangements could not ensure sustainable utilization and management of PAs. As a result, there remains a question as to what institutional innovations in PA management and institutional arrangements sustain the system of PAs in Ethiopia in view of the changing human and natural environments?

[25] This new Ministry is mandated to prepare land use and administration policy, draft laws on the conservation and sustainable use of forest and wildlife resources, and up on approval supervise their implementation.

[26] Despite the understanding the oldness of former wildlife proclamation (No 192/1980), the new wildlife proclamation has been delayed, and it is argued that the approval of the latter was also a requirement under phase 1 of the nationally executable PAs management project to be funded by Ethiopia and several Donors.

Some of the constraints since the 1990s include lack of commitment[27] and marginalization of the sector, whereas more focus is given to extractive sectors to ensure rapid economic growth. There has been lack of cooperation[28] among the different interest groups such as conservation managers, communities, investors, civil society and politico-administrative bodies. (see also Abraha 1991; Ayalew 2001). The executives and judiciary have been less effective, and less cooperative to enforce PAs management rules, partly due to the inherent problem with the conservation rule. Individuals and groups with vested interests also contributed to the slow performance of the efforts towards more participatory PA management. One might question why the government-private-community partnership effort to manage national parks in SNNPR region was deterred.

There has been an increasing trend in illegal use and trafficking of wildlife resources and its products (Simon and Mohammed 2005), and also over cutting of Doum palm tree and charcoal making[29] in ANP (Kahsay 2004). Moreover, increasing number of unlicensed fishermen and use of inappropriate fishing instruments have contributed to the low fishery resources in Lakes Chamo and Abaya, and cutting of wood resources in Nech Sar National Park. The conflicts between local people and PAs managers continued, which negatively affected the human and protected areas resources and infrastructures [30](Ayalew 2001; Hayatudin 2007; Jones 2005; CEIL 2007; Anemut 2006; BMNP GMP 2007). PAs located in two or more regional administrations seem to have affected seriously, primarily due to claims and counter claims by the different regional states, and local people under different administrations.

3. Programs/projects and organizational performance in PA management

In the last five decades, governments developed PA improvement programs/projects and established organization within the overall policy and legal frameworks presented in the previous section, but at a sub-optimal level. This section will present the programs and projects planned and implemented either in *toto* or partially to improve the system of PAs during the different regimes. This also tries to see the obstacles and opportunities in PA improvement program/project management.

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[27] The government has centered its development endeavors on agricultural development led industrialization strategy, whereas environmental management and sustainable development are rhetoric and theoretically motivated. Poverty and low economic growth are justified, and attention of actors is drawn towards these.

[28] The author noted the failed conservation and development projects, for instance, CARE Ethiopia (one ANP) in the early 2000 and several others, EU rehabilitation projects in Southern Ethiopia in the 1990s.

[29] Charcoal making in the rural areas is a growing livelihoods option, while at the same time the attempts by the government to protect illegal charcoal trade with Kella (check points) is a failure.

[30] The results indicated above apply to ANP, NSNP, SMNP and BMNP. Shibiru (1995) has reported the situations immediately after 1991 regime change.

3.1. Emperial Haile Sellasie Regime (1930 to 1974)[31]

3.1.1 Emperial regime (1941 to 1964): dormancy

In 1941, government initiated formalization of Simen Mountains protected area as a National Park (Hurni 2007). The 1944 Game legislation was a mere rhetoric[32] although conservation was deemed necessary. Several authors (Yonas 2001; Teklu 2006) reported the poor performance of natural resources conservation management during this period. For most of the duration, conservation activities concentrated mainly on controlled hunting (refer section 2.1). In early 1960s, conservation through PAs received better attention at national and international levels. In 1963/64-65, two UNESCO missions conducted surveys and made recommendations (**refer section 2.1)** to improve wildlife resources management.

3.1.2 Emperial regime (1965 to 1975): donor supports with limited actions

In 1965, the wildlife hunting license division was upgraded to EWCD, the board of which was chaired by MoA and Ministry of Interior (Brown 1970). The EWCD then evolved to Ethiopian Wildlife Conservation Organization (EWCO), a semi-autonomous organization with legal status under the Vice-Minister of Natural Resources within the MoA.

The government proposed Simen Mountains and Awash National Parks during first phase development plan[33]. Second phase developments planned a national park in Bale Mountains (but deferred) and a park/reserve in Baro river basin, and conservation areas in the rift valley lakes region. Despite deployment of a senior advisor and three expatriates as wardens in 1965-66 for the proposed three National Parks, results were not as anticipated. The wildlife sector was not given the necessary funds during the first two five years plan periods, 1957-67 (Abraha 1991). Teklu (2006) also noted that the government focused on forestry during these stated planning periods. But, some funds were allocated for conservation during the third five year plan period, 1968-72 (Abraha 1991; Teklu 2006).

Overtime, a number of conservation areas[34] have been proposed and some development activities were undertaken. Although inadequate, funds were allocated to develop the infrastructures of Omo, Mago, Abjatta-Shalla Lakes and Bale Mountains National Parks. Moreover, Ethiopia received technical, financial and material assistances from international organizations such as UNESCO, IUCN, WWF,

[31] The 1936-41 Italian occupation of Ethiopia was marked by more extraction of resources (widespread hunting) by neglecting existing national policies.

[32] Brown (1970) argued that the conservation law existed for 25 years, and this has been a dead letter.

[33] It is only in 1969 that the two national parks received legal status, and they remained to be the only national parks with legal status until recently. The reality is that these two National Parks are simply parts of Ethiopia.

[34] These were National Parks such as Omo, Mago, Abjatta-Shalla Lakes, Bale Mountains and Gambella, and Harar (Babile) Elephant Sanctuary (MoA 1980).

UNDP, FAO and foreign governments to strengthen wildlife conservation and development. The British and Japan assisted personnel and equipment, whereas Frankfurt Zoological Society (FZS) provided material assistance (Abraha 1991).
During the four years period (1965-1968), Ethiopian Wildlife Conservation Department (EWCD was administered by Major Gizaw, and a number of constraints[35] hindered the performance of conservation. Brown (1970) also reported the diversion of the 1967-68 budget for SMNP and budget limitation for ANP, and poor service for Omo Valley, but on the contrary, better facilities for the Head Quarter. The dependence on foreign technical and material supports, lack of these resources and failure to use resources properly hindered PAs management in Ethiopia.

3.2 Derg regime (1976 to 1990): central planning and total conservation
With change of the regime, a wildlife conservation authority was established in 1977 (see section 2.2). This marked a step to centralization of demonstration of conservation sector. Stephenson and Mizuno (1978) made recommendations for wildlife conservation of *Omo-Tama-Mago* rift valley of Ethiopia. A wildlife policy was formulated in the 1979 (PMGSE 1979), and in 1980, a development plan for wildlife conservation was prepared with the intention of total wildlife conservation to meet national objectives on their own rights, *not merely for tourist attraction* (MoA 1980). The development plan[36] had concentrated on physical development, wildlife management and integration with other concerned agencies. International financial and technical supports continued to improve this sector. The issues of concern were the law and its enforcement, poor integration of conservation with pastoralists, and lack of awareness about conservation.

Despite the centralized administration, natural resources received better attention in the beginning. It is argued that merging of wildlife and forestry under an authority in the late 1977 contributed to ensuring economics of scale in management, training and resource utilization. Some time in this period, hunting, illegal trade of wildlife and wildlife products, and the civet industry were somehow controlled (MoA 1980). A draft wildlife management policy was formulated in 1985 by MoA. In the 1980s, donors provided funding for training, technical and physical issues to improve PAs in Ethiopia (Hillman 1986; Hurni 1986; Jacobs and Schloeder 1993). Between 1983 and 1990, donors on the average contributed USD 750 thousands per annum (Hillman 1993a). In the late 1980s, with the continued instability and civil unrest, funds were not

[35] Corruption and biased staff deployment at the Head Quarter, limited budget (lower than neighboring countries) and lack of better legislation, and absence of agreed boundary for the first three parks. Additional constraints were poor staff quality, poor communications with expatriates and field operations, and poor planning (Brown 1970).
[36] This plan targeted 9 parks, 2 wildlife sanctuaries, 11 wildlife reserves, 14 controlled hunting areas, anti-poaching and crop depredation unit, research center, conservation education unit, and personnel training.

managed well, whereas many conservation opportunities were lost[37]. The forest and wildlife conservation and development program was at its highest when the Authority was in charge, and was at its lowest during the transition period in 1992-93 as PAs were overrun when lawlessness prevailed.

3.3 Post 1991 (EPRDF regime): new thinking and some practices

A number of key programs/projects have been conceived and planned to improve system of PAs in Ethiopia (See FDRE/UNDP_GEF 2006). Nearly all of these are largely financed by external donors[38] and partly by the Ethiopian government. From among the conceived program/project initiatives, some were not implemented at all, whereas a number of them were implemented to achieve desired objectives. The strategic programs/projects that were not implemented at all include National Conservation Strategy (1994) and Conservation Strategy of Ethiopia (1997). The National Forestry Action Program also initiated by the previous government has only produced a study document, while the wildlife policy and strategy including wildlife proclamation have been on stay list for long time.

The following are some of wildlife and forestry[39] PA improvement programs/projects that were implemented, but with limited outcomes. UNDP-Ethiopia supported program on emergency support to wildlife management sector of a trust fund during 1994–2003 provided emergency support to ten PAs[40]. The EU funded Southern Region National Parks rehabilitation project,1993-1998 also focused on local people participation in PA management including benefit sharing, whereas the WWF project focused on rehabilitation in Bale Mountains National Park. The Austrian IDP (phase 2 will continue) and Swiss governments' projects attempted to develop tourism for Simen Mountains National Park (see FDRE/UNDP_GEF 2006). The Ethiopian Wolf Conservation (EWCP) has contributed to the Ethiopia's overall conservation programs since 2000. A project financed by GEF and Ethiopia including several co-financers has been initiated and its outcomes are yet to be seen. The driving principles of these programs/projects are local people participation, benefit sharing, and sustainable PAs management. This hints an evolutionary institutional approach to PA management, but slow response.

4. Management of Selected National Parks

4.1 Awash National Park (ANP)

[37] The purchase of new aerial survey plane, funds for infrastructure in Awash National Park and other protected areas, and training of staff in Tanzania.

[38] Traditionally, Ethiopia is dependent on donor for its budget, and the government was expecting 30% of its annual budget from donors in 2007. Historically, this amount is claimed to be the lowest in its kind.

[39] Participatory or joint forestry management projects include Chilimo, Adaba- Dodola (WAJIB), Borerna and Belete-Gera. Some of these projects are claimed to have positive outcomes (several authors).

[40] The Wildlife resource intervention had a three-phased approach which included: 1) emergency support to selected protected areas; 2) restoration of wildlife sub-populations; and 3) the establishment of a trust fund for meeting recurrent costs of priority protected areas (FDRE/UNDP_GEF 2006).

This was an Imperial hunting area prior to the recommendation by UNESCO mission to be developed as a national park. It has been under development since then, and the first management plan was prepared in 1970 by Robertson (First Warden), and subsequent management plans were prepared in 1978, 1985, 1993 and early 2000s (Jacobs and Schloeder 2001; WCD 2004). Following the shift in conservation paradigm, the 1993 and early 2000s[41] management plans have proposed participatory PA management, but both were not properly implemented due to unreasonable demands and EWCO's unwillingness to work with the communities (Jacobs and Schloeder 2001; WCD 2004). Mekbeb (2003) reported that pilot ICD projects have been started for ANP, BMNP, and Simen MNP although the first phase failed to achieve any satisfactory results. This shows that Ethiopia has been far behind to adapt or adopt the evolving PA management approaches that have been tested by the rest of the world including neighboring African countries.

Since the late 1990s, the administrative boundaries of ANP fall within Oromia and Afar regions, and wildlife conservation department under federal government is mandated to manage this. Presently, a third of ANP's total area of 756 km^2 is encroached and it is on the peril. The author argues that cooperation seems to have weakened among the park management, the regions and local administrators, investors, NGOs and local communities. Property rights over resources continued to be sub divided among the varying interest groups and individuals. Historically, the Afar and Karrayu communities have claims over the park (see Bekele 2005; citing AVA; Ayalew 2001). A road alignment proposal by Metehara sugar state plantation connecting Sabure and Metehara via the park under Mt. Fentalle has been a point of debate between conservation and land developers, and hence decision has to come from higher officials.

4.2 Simen Mountains National Park[42] (SMNP)

Hurni et al (forthcoming) have reported the evolution of institutional approaches to management of SMNP. Different studies and development activities have been undertaken in and around the park since 1960s (for details see Hurni et al 2000; Hurni 2005). With the decentralization efforts, the SMNP has been handed over to Amhara National Regional State (ANRS) in the late 1990s, and the ANRS has established an authority responsible for management of PAs and has made different institutional provisions. The regional government has made concerted efforts on conservation activities and basic services such as roads, schools and health facilities.

[41] CARE Ethiopia has taken the initiative by inviting respective actors and it has made concerted efforts to pilot ICD project by adapting experience from other African countries. But, this was not successful.

[42] A world heritage site since 1978, and has been labeled as a endangered world heritage site since 1996 (Hurni et al forthcoming). A world heritage committee studied its status if its situation improved, but the

However, the alignment of a district road was a point of discord among different actors. At present, the attempts to delineate park boundary[43] has triggered conflict between the local people and government and park management (Anemut 2007). These all imply that institutional issues for sustainable management of PAs in Ethiopia have yet to be worked out, and more research is needed.

4.3 Nech SAR National Park (NSNP)

NSNP was proposed during the second phase development plan, and designated as protected area in 1974, whereas the actual development begun thereafter. The EU funded national parks rehabilitation project in the Southern Ethiopia including Nech Sar National Park could be cited as one of the latest efforts made to improve systems of PAs. Alison M Jones (2005) prepared a management plan for NSNP, which could be used as a reference. Moreover, the Ethiopian environmental protection authority developed a management plan for conservation and sustainable utilization Chamo and Abaya wetlands including NSNP (EPA 2005).

Following the initiative by Nelson Mandela[44], African Parks Foundation (APF) expressed interest to manage and rescue endangered national parks in Ethiopia. Since 2005, the APF project by involving relevant actors has made commendable efforts in improving the situation of NSNP (See APF 2005; APF 2006; APF Monthly 2008). However, the APF has withdrawn from managing two national parks in SNNPR as of early 2008 due to lack of an enabling environments and weak cooperation among actors. An informant who has been working for years in the conservation sector argues that behavior of some individuals[45] influence the success/failure of PA management projects in Ethiopia. The APF in Malawi registered remarkable results in rescuing a PA due to the presence of enabling institutions and policies. Presently, Oromia and SNNPR regional states, and relevant actors have started negotiations regarding the future of Nech Sar National Park, the communities and other actors.

5. Outcomes of past and current efforts in PA management

committee reported that there are some issues to be worked out before restoring the park as a heritage list (Debonnet et al 2006). The regional government is working towards the requirement.

[43] SMNP with former area of **136** (formal) has been increased to **234 km^2** (yet to be legalized) after leaving out areas encroached by local people and including core areas suitable for wildlife including Ras Dashen in the Beyeda district (Hurni et al forthcoming).

[44] He insisted, during the 2003 World Conference on Protected Areas, private and non-state actors to assist developing African countries plagued by poverty, HIV/AIDS, economic growth and servicing debt burdens.

[45] The informant stated that the EU funded national parks rehabilitation project failed to achieve its objectives partly due to lack of enabling environment and partly due to vested interest of a few individuals (with opportunistic behavior). Similar problematic situations faced the success of APF in managing two parks in SNNPR in Ethiopia. The claims and counter claims over PAs resources and territory between regions and communities is also a crucial factor.

Biodiversity and physical resources: The nominal numbers of National Parks increased to 15 by the 2007, there are 6 parks under development[46], 18 controlled hunting areas, 11-12 reserves and 4 wildlife sanctuaries in the early 1990s and 82 forest protected areas. The nominal area of wildlife and forest resources covers 14% of the land, while that of wildlife resources is only 3.2% (FDRE/UNDP_GEF 2006). The number of extinct, endangered and near-endangered species of mammals, birds and vegetation including habitats destructed and resources degraded. In early 1970s, 9,000 elephants were reported nationally but their number declined to 2,450 by the 1990s areal survey. In Omo and Mago parks, the number of elephants declined by 44% and 67% compared to 1978 estimate (Cherie 2002). The Ethiopian Wolf is the most endangered in the world (Zelalem 2002). Wild ass is near extinction and at present fewer than 1,000 has been reported in the desert (Murrelle Foundation 2007). Thirty-six of 860 bird species known to exist in Ethiopia are threatened. Of these, two species are red-listed as endangered, 30 are vulnerable to near threatened and 4 are data deficient (Anteneh and Yilma 2002). Ethiopia annually loses 150-200 thousands ha of forest cover (Demel 2003). re COMMEND (2006) indicated annual loss of 65, 450 ha of high forest, 91,400 ha of woodland and 76, 400 ha of bush land.

Manpower development and experience: although the number, quality and experience is by far below standard compared to developing neighboring countries such as Kenya and Tanzania, there have been efforts by the government and international organizations in developing the manpower capacity of the sector. EWCO had nearly 300 and above staff in the early 1990s. The capacity to develop policies, legislation and other provisions was so inadequate, whereby this gap was filled by expatriates in earlier period. The sector is still deficient in manpower as can be evidenced from the profile of existing personnel (Author's experience).

Organizational memories and staff morale: Until 1990s, Ethiopia had managed to develop a semi-autonomous organization for protection and management of PAs. The performance of EWCO has been better in the 1970s and 1980s. However, the capacity was so limited, and its performance was only visible with the support from external donors[47]. At the start and quite for sometime in the 1960s, and even in the 1970s, the sector was dependent on donors for technical and financial supports. The existing data base on PAs is weak including organizational memories. This is attributed to the frequent organizational restructurings, and repealing of institutional provisions, proclamations, regulations and orders.

[46] Some of the parks are Alatish (Amhara and Benshangul) and Denkoro Washa in Amhara; Chebera Churchura and Maze in SNNRP; _____ in Tigray and Gerale in Somali regional state. However, several protected areas have encountered management crisis.

[47] Historically, the country has been known for its dependence on foreign aid in response to recurrent drought, civil unrest and other structural factors. On the other hand the PA management sector was the most marginalized.

In general, the conservation sector received inadequate attention and support from the successive governments, and in effect, this has been negatively affecting staff morale and commitment. This has impaired organizational performance and memories.

National income: EWCO has made a steady contribution to national economy through its activities towards tourism, hunting, export and utilization of pest animals and civet musk export (Hillman 1993: Vol. 2). During 1969-1979, the revenue collected from the sector amounted to ETB 4.7 Million (MOA WFCDD 1980). Although very low as compared with neighboring African countries, gross revenue from park entry fee and sport hunting during 1999-2003 was ETB 3.25 Million [FDRE/UNDP_GEF 2006).

Local Communities Participation: members of the communities in and around PAs have negative attitude towards PA management and institutions. The regulatory policy and bylaws have no provisions for local people participation and benefit sharing. The transaction costs to enforce the rules have been increasing and individuals have been paying considerable money in the form of penalty. There is a need for conservation education that empowers local people in the amendment of the conservation policy/institution (**See box 1**).

Weak law enforcement: this has been a daunting challenge in the last four or five decades. Conservation and development efforts were top- down and non-participatory. In north central Ethiopia, conservation projects worked against the rural people, even though the rhetoric that accompanies the projects emphasizes local control and long term benefits (Campbell 1991). In the mean time, lack of cooperation, lawlessness and open access (*res nullius*) resource regime prevailed within the PAs management system. The state and peoples of Ethiopia are the ultimate owners of resources, but in reality property rights over PA resources are fragmented (**See box 1**).

At national level, the formal institutions for NRM have been weak and ineffective, and corruption was common. Moreover, with the rise of formal state institutions, customary institutions for NRM were weakened. Yonas (2001) stated lack of guidelines and poor enforcement of law are the main reasons why the provisions of the legislations were not enforced. The transactions costs of rule enforcement have been increasing in view of soaring relations between PA management and local people. Illegal market for wildlife products and charcoal making has increased. The governments failed to adjust the policy and legislation. North (1990) suggests that institutions should be adjusted in response to technologies, relative prices, demands and so on.

Illegal trafficking of wildlife and products: Ethiopia has been identified as one of the counties known for its expanded unregulated market for wildlife and products of these, and a trafficking zone of wildlife products for neighboring counters such as

Sudan, Kenya and Somalia. The demand for wildlife products in the global market drives the illegal hunting and trafficking. On top of this, poor economic performance and concomitant low per capita income implies high dependence of natural resources. The lack of synergy between different actors, local people, state and non-state actors creates opportune time for unregulated use of resources. The preservationist policy deprives local people access to PAs means increasing law enforcement costs, and unsustainable level of investment in policing activities.

Weak planning and implementation: In most cases, PAs management plans were less feasible both technically and financially, and their implementation was impaired. The wildlife PAs delineations were on maps, and no physical demarcation in consultation with local communities and actors. Only two parks were formally gazetted in the last four decades, while others PAs were developed at varied levels. EPA (2006) noted that this reality also applies to forestry protected areas. The weak institutions, policies and strategies contributed to hinder planning and management of PA resources, and local livelihoods.

Design of conservation organizations and institutions: Over the last forty years, environmental and natural resource management organizations had been restructured every two years (Teklu 2006; Yonas 2001). Conservation rules were often theoretical and ended as paper works. For instance legal notice 61/1944 did not materialize for several years (see section 2.2). EWCO has undergone 8-9 restructurings during its lifetime, until it was disbanded in the late 1990s. During Derg regime at least three changes have been made to PA management organizations (merging wildlife & forestry in 1977 to establish an authority, dismantled the same in 1985/86 and transferred the responsibility to MoA). For long period, the conservation rule overlooked wildlife in the different forest PAs, and the new proclamations treated forest and wildlife PAs separately.

Since 1991, several numbers of restructurings of PAs management organizations have been undertaken including decentralization as well as re-centralization (see section 3). Presently, “Business Process Re-engineering” is underway and government is reorienting the functioning of its agencies. Wildlife issues are organized under culture and tourism, and received a status of an authority. Often organizational restructurings do not merely target organizational improvement but also to meet political objectives and needs of vested interests. Societal (cultural, social and economic) problems were less emphasized.

Lack of sustainable finance: the country had not been providing sufficient finance for PA management, and the successive governments relied on external finance to manage PAs.

Box 1: Challenges facing PAs management following their establishment.

The problem at SMNP was reported to be lack of local administrative support and increased human pressure on the wildlife habitats. For ANP, the failed promise of opening up of alternative areas for grazing and water for the Afar (Danakil) and Karrayu tribes were also problematic. The first ever expulsion of the pastoralist from ANP was made in 1969 when the Queen and Price of the Netherlands visited Ethiopia. (Brown 1970).

In early 1990s, change in government brought about new governance, policies, and institutions. ANP falls in two regions, and federal government is mandated to it. Local people continued accessing protected area resources even when the old PA legislation is in force. District administration and the judiciary failed to create an enabling environment such as regulation and rule enforcement, and this can been explained by a statement noted by Ayalew (2001). "…The administrator noted that local people have no alternative means of livelihoods, and insisted that the ANP management should stick to the park area under discretion." Similar problem situation could be cited for the relationships among private, NGOs, administration and ANP management in the region. The private (plantations) claim over conservation areas for resources including road inside ANP. At higher level, there is weak linkages and cooperation in settling and resolving the existing problems. The communication up ward with regional and federal levels administrations failed to create enabling environment. An attempt to establish local level committee from among the local people and district administration and police failed to bring improvement.

6. Drivers[48] of institutional changes in PA management

The institutional changes are in one way or another are influenced by internal and external factors, which are either directly or indirectly associated with protected areas resources. North (1990) stated that contributing factors to institutional changes are changes in population, climatic factors, market conditions, and technologies. Today, globalization is a driving factor for institutional changes. In our context, the drivers of institutional changes in protected areas management are presented as follows.

Conservation organizations and conventions: Worldwide there are a number of organizations and conventions that have been directly or indirectly influencing PAs management policy, legislations and approaches on the planet and Ethiopia. These organizations include are IUCN, WCPA, UNEP- WCMC, UNESCO Man and Biosphere Program (MAB), WWF, WRI, The Nature Conservancy, and International community, Universities, and Conservation societies. These organizations provide

[48] These are variable (s) that contribute to the changes in the institutional environment.

technical, financial and other supports, and hence contribute to evolution, development and change of institutions in PA management. Emperor Minilik initiated wildlife conservation [licensing] in "modern" Ethiopia in view of natural resources degradation which hinted finiteness, and also the establishment of wildlife association in Europe (Girma 2000).

International conventions and agreements for nature conservation influence Ethiopia's PA institutions and policies (see Proc. No. 416/1972). Ethiopia became party to the Paris Convention[49], CITES convention[50], and CBD[51] in 1977, 1989 and 1993, respectively. Ramsar convention about wetlands of international importance was initiated in 1971 whereas that of migratory species and their habitats was in 1979. The then Organization of African Unity (OAU) established convention of conservation of nature and natural resources in 1976 and invited all member countries to conserve wildlife. The IUCN sets definitions and criteria of different types of protected areas, and member countries are expected to adopt this, and use the same for the management of PAs. Ethiopia gets technical assistance of the organization for establishment of PAs until the present.

International financial organizations (global order): These are for profit and also have political motivations. These are promoting decentralization, good governance and privatization of public enterprises as prerequisite for advancing money to developing countries. Ethiopia, as one beneficiary, is experimenting decentralization, good governance and privatization of public resources. Although politicians justify decentralization on the grounds of political questions (AGF-V 2002), still the policy of financial organizations (World Bank, IMF) influences decentralization policy in Ethiopia. Ethiopian decentralization efforts are labeled by several scholars as centralized-decentralization, the state centric sentiment is still persists in the government. The extent of participation of communities in decision making in the areas of natural resources utilization and management is limited. The conservation approach is still more regulatory and top-down leaving less option for participation.

Weak policies and institutions: Polices and programs of successive governments in Ethiopia did not merely extracted natural resources, rather have affected the pastoralist livelihoods, their institutions and environment. The issues of property rights have been a limiting factor to resource use and management in Ethiopia. The governance has been weak, and this contributed to the continued institutional

[49] The Paris convention aimed at the preservation of outstanding cultural and natural sites, and this is entered in to force since 1975, but initiated in 1972 in Paris.

[50] Convention for the control of the international trade in endangered species of flora and fauna (CITES). See Ethiopia's legal notice No. 14/1989.

[51] The Government of Ethiopia ratified the Convention on Biological Diversity (CBD) in May 1993.

instability [52] in the country for several decades. Weak policy implementation and weak conservation rule enforcement have been mentioned time and again.

Pastoralist and pastoral development: Pastoralism in the arid/semi-arid lands has been considered as non-viable, while the pastoralists were seen as resistant to change and modernity. Polices have been marginalizing them, and pastoral development interventions in the past had little or no success to improve their livelihoods (Several authors). At least in theory, there seems a change in outlook about local communities and their rights over PAs (ILO convention No. 169, Articles 5,7,16 &17). With the changing political environment, pastoralists in Ethiopia have representatives in the parliament, and pastoral development policy (PDP) in Ethiopia seems encouraging, but this has to be evaluated for its feasibility. Pastoralists' representation in the parliament, PDP, and establishment of pastoral agencies has implications on conservation areas and the future institutions.

Conservation and development approach: fortress conservation centered on the biological aspects, and totally neglected the human element. Today, it is accepted to incorporate socioeconomic and cultural aspects with the rise of social science. The world seems to have embraced normative concepts such as human rights, cultural rights, property rights, participation and sustainability. The perception of conservation has evolved in view of social and development agendas, and three aspects are worth noting. These include broadening the protected territory to include resources in the surrounding context, go beyond the equilibrium conditions for ecosystems and stakeholders participation in management, and benefit sharing.

Population pressure and scarcity induced conflicts: the human and livestock pressure on PAs resources kept increasing, and human fertility transition seems far from now. For instance, the upper Awash basin is overpopulated by the Karrayu and Afar, neighboring tribes such as Ittu and Issa, and other settlers since 1940s, when state opened up investments[53] and urbanization started. The population surrounding NSNP has reached 102 thousands (APF 2005). The population is highly dependent on the natural resources whereas the pull factors are limited. On the other hand, the low per capita investment on natural resources implies scarcity of resources. Multiple resource users[54] have emerged and property rights are fragmented, and conflicts[55] have been increasing. In reciprocity, conflicts have been causes for natural resources degradation.

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[52] Examples are the uprisings in the 1950s, student movement and the mass revolution in 1970s, and three decades of civil war, and Ethio-Eriteria war concomitant instability in the economic, social and political sectors.

[53] Metehara sugar state alone hosted 35,000 people as workers and companions. At present, state plantations and private investments are expanding in the areas where PAs are located. The human and livestock populations in Fentale wereda accounted for 50,608 and 357,000 in 2004 (GTF undated).

[54] Local people, urban population, business men, conservationists, academic community, government and international agencies have interest on protected areas.

[55] Conflict and insecurity in the arid lowlands have long standing history and the nature of both factors is shifting with scarcity of resources, decentralization and cyclic drought and inadequate policies.

Invasive alien species (IAS) and Termites: The introduction of invasive alien species (IAS) in the areas has been a daunting challenge to Ethiopia. The costs of IAS[56]outweigh the benefits, and failure to manage or control such species negatively affects the biodiversity and livelihoods. The IAS are disrupting the existing ecosystem, and putting pressure on the existing biodiversity, and this implies scarcity of resources, trees, vegetation and etc. Termite colonies increased in the Awash National Park and this will have implication on the tree resources in the park.

Natural factors: droughts and worsening livelihoods justified the continued settlement of communities in the protected areas. This has partly contributed to the shift in thinking on conservation, 'Park with People' type of institutional arrangement and future incentive based conservation and development policies. During the last three decades acute or chronic droughts in the Awash area have occurred in 1972-1974, 1978, 1980-1982, 1984-1986, 1989-1990, 1992, 1996-1997 and 2001-2003[57]. The drought in early 2000s solely affected up 40 to 50% of livestock death in the areas surrounding ANP.

Climate change and pollution: The last century witnessed a 1% increase global average temperature, and there is an expected 2-3% increase in global temperature in the 21st century. Ethiopia is no exception to face the global challenges. Hurni (2007; 2005) argues that the change in the upper tree line for Erica in the Simen Mountains is attributable to climate change. The problem of river pollution is a widespread national problem. Witness for instance the different reports and statistics regarding the pollution of different water bodies (tributary of Awash) in the country. There is a need for appropriate institutions to mitigate the unsustainable development indicators such as pressure of human beings exert on nature and vice versa.

[56] IAS such as Prosopis, Water Hyacinth and Parthenum were introduced in different parts of the country and also in the study area for different reasons. In Nech Sar, these include Dichrostachys cinerea, Acacia mellifera and Acacia oerfeta (APF 2006).

[57] Pastoralism under pressure–Anecdotal community sources (Ayalew 2001).

Summary and Implications

Institutions make human behaviors and actions predictable. Formal institutions in PA management in Ethiopia evolved in response to the unregulated extraction of natural resources, finiteness of these and external factors. During the last century, there has been systematic and unregulated extraction of resources which contributed to the low forest cover of 2-5%, and low wildlife population, and several endangered and/or extinct wildlife, birds, vegetation and their habitats. Degradation of PAs resources continued in lieu of the increased population and increased dependence on resources, and lack of enabling institutional environment, *ceteris paribus*.

Institutions in PA management evolved towards more formal and externally devised rules with legal provisions and organizational setting involving many actors. In early 1900s, Emperor Minilik took the initiative to design PAs management institutions through the issuance of notice that prohibits hunting wildlife without license. In the 1940s to1950s, conservation rules remained more of *a theoretical backing* and practically, little efforts were made to meet conservation objectives despite the concern about the 'finiteness of resources'. In the 1960s, the government has made some conservation efforts (institutional provisions, policies and organization, EWCO) in collaboration with international agents. The Imperial regime, however, continued to depend on natural resources to generate income, while suppressing local interests, and these actions were not able to achieve conservation objectives.

With change of Imperial regime in 1975, Ethiopia adopted socialist economic system whereby institutional design, planning, and programming were centralized and top-down. With the intention of total conservation, regulatory institutions were tightened further and established more centralized authority, and utilization by government such as hunting was banned in late 1980s. Although there was relatively appreciation of resources, the centralist conservation approach during the *Derg* regime failed to solve fundamental problems, institutional and policies. In post 1991, environmental and natural resources issues seems to have gained at least theoretical support. Witness for instance the constitution, draft polices and proclamations that advocate sustainable development. In practice, a number of programs to improve PA management system have been planned and executed in *toto* or partially with the support of international donors, but fundamental problems of PAs management still persist.

Although the PA management system failed to achieve desired objectives, mixed outcomes of PA management could be cited. One is the growing tensions and conflicts between the local people (communities) and conservation agents/managers. There have been frequent, unplanned and haphazard amendments and restructurings of PA management policies, institutions and organizations. In Kenya and Uganda, however, institutions have been more stable and adaptive, and have been developing over time. In Ethiopia, there has been inadequate law enforcement despite the issuance of the conservation laws, and at times, commitment and

capacity to enforce the conservation laws were lacking. This issue was observed as a common problem during the different governance regimes under study. Although Ethiopia has significant number of PAs and is known for its rich biodiversity and ecological processes, several species and wildlife are extinct while several are endangered; habitats and scenery have been destructed. Currently, the country is left with 2-5% of forest cover which was 35-40% at the turn of the 19th century.

The major drivers of institutional changes in PA management included natural, social/demographic, institutional, policy and political factors. These imply that there is a need to look into the driving forces to manage PAs in the foreseeable future. Despite the rhetoric and theoretical underpinning on the importance of conservation, decentralization and participation and access to resources, there is still remains immense gap regarding the institutional innovations in PA management taking into account of the various interest groups, and tenets of sustainable development.

In sum, the future of PAs management must take account of the past, the present and future. The creation of enabling institutional environment in PAs management is the key success factor towards solving the fundamental conservation and development problems. Therefore, in institutional innovations, PAs management must take account of different actors' interests which often are contradictory in space and overtime. Within the sustainable development framework, incentive based policies (for individuals or groups or both levels) and institutions that ensure local peoples' access rights to use and management of resources are vital.

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Acronyms

BMNP GMP- Bale Mountains National Park, General Management Plan
ANP- Awash National Park
EPA- Environmental Protection Authority
EWCD- Ethiopian Wildlife and Conservation Department
EWCO- Ethiopian Wildlife and Conservation Organization
FAO- Food and Agriculture Organization
HPR- House of Peoples Representatives
IUCN- International Union for Conservation of Nature
MoARD- Ministry of Agriculture and Rural Development
NSNP- Nech Sar National Park
PAs – Protected Areas
PMGSE- Provisional Military Government of Socialist Ethiopia
SNNPR – Southern Nations, Nationalities and Peoples' Region
UNESCO- United Nations Education and Scientific Conservation Organization
WWF- World Wildlife Fund
UNDP- United National Development Program
WCD- Wildlife Conservation and Development
WFCDD- Wildlife and Forestry Conservation and Development Department

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