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Analysis of factors affecting proper utilization of water through Irrigation Cooperatives at Kolla Tembien Wereda, Central Tigray, Ethiopia

By

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Declaration

This is to certify that this thesis entitled ‘‘Analysis of factors affecting proper utilization of water through Irrigation Cooperative at Kolla Tembien woreda,Tigray Region’’ sub mitted in partial fulfillment of the requirements for the award of the degree of M.Sc., in Cooperative Marketing to the school of Graduate Studies, Mekelle university, through the department of Cooperative, done by Mr. Abraha Amare Id. No. FDA/PRO 011/99 is an authentic work carried out by him under my guidance. The matter embodied in this project work has not been submitted earlier for award of any degree of diploma to the best of my knowledge and belief.

Name of the student: Abraha Amare Signiture & date_____

Name of the advisor: Dr. Kelemwerke Tafere Signiture &date _____

Dedication

This thesis manuscript is dedicated to my mother, Tellech Tesfay and my father Amare Mesfine as well as to my lovely friends which I miss them Mr. Tadess Mesfine and Mrs. Berhe Gebreamelack may their kind and loving let soul rest them in peace?

Biographical Sketch

The author, Mr. Abraha Amare was born on January 23, 1958 in Tembien , district of Tigray Regional State to his mother Mrs. Tsellech Tesfay and his father Mr.Amare mesfine . He attended his elementary and secondary education at Abi-adi and Atse Yohannes Elementary and Comprehensive Secondary School, Mekele respectively. He joined Awassa agricultural College in 1983/84 academic year and graduated with Diploma. Soon after his graduation, he was employed by Bureau of Agriculture and Natural Resource Development of Gonder province and served as an expert of Animal husbandry for seven years in Esti district and then transferred to Tigray Regional State Bureau of Agricultural and Natural Resource development, working in Kolla Tembien district Bureau of Agricultural and natural resource office as wereda regulator team leader and a head respectively.

After twelve years service in, 1996 he joined Mekelle University as a summer in-service student and graduated in 2002 with BSc Degree in Animal husbandry . He has also served as a Team leader of Cooperative promotion office until he joined the School of Graduate Studies of the Mekelle University . He has joined then School of Graduates of Mekelle University on November, 2006 to pursue M.Sc. study in Cooperative Marketing .

ABSTRACT

Properly utilize of water is to be cited as one of the crucial problems that threaten to maintain the subsistence livelihood of the rural people in the study area. Tremendous efforts have been made by the government to cope up the utilize problem as to increase the status of the productivity per unit area by incorporating irrigation that could be utilize by individual HH.

When the issue of economic growth and development of the country is raised, one has to take into account the performance of the smallholder farmers. Reducing the challenges they are facing and utilizing their potentials can help to accelerate the agricultural sector and economic development of the country as a whole. Agricultural cooperatives are an ideal means for self-reliance, higher productivity level and promotion of agricultural development.

Therefore, the major concern of this study is empirically analyzing the factors affecting proper utilization of water through irrigation cooperatives found in the Kolla tembien district. Both primary and secondary data were taken for this study. All the irrigation cooperatives the study area select and a total of 120 sample respondents from kola tembien district. Primary data pertaining collected from selected respondents through structured questionnaire. The total respondents, of the cooperative are members for proper utilize of water. Secondary data of the cooperatives for recognizing irrigation cooperatives.

The descriptive statistics was to analyze the mean difference of continuous and frequency difference of dummy variables. The Nominal logistic regression model was employed to find functional relationships between the explanatory and dependent variables by utilization categories, which were found differently using the irrigation for different purposes. The result of descriptive statistical analysis showed that, out of the 18 hypothesized variables only seven variables (irrigation experience, off-farm income activity , water lifting devices , training ,

slope of the farm ,soil type of the farm and perception of the members) showed significance difference at 1% and 5% significant level.

Implications of this study are improving the irrigation cooperatives as well as utilize water of the irrigation cooperatives to face the challenges in the area especially in irrigation farmers' produces, increasing the participation of the farmers in the cooperative through provision of different services and benefits, appropriation of surplus in the form of patronage refund, increasing the productivity and specialization of the farmers, continuation of distribution of water to the farmers and above all continuous education and enlightenment of the farmers about cooperative and its benefits are the utmost priority areas of interventions to improve the proper utilization of water through Irrigation cooperatives in the area.

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Acronyms and Abbreviations

AC	Administration council
BOPED	Bureo of planning economy development
BoNARD	Bureo office natural agricultural resource & development
CDF	Cumulative distribution function
CSA	Central stastic agency
DAs	Development agents
EC	Executives council
FTC	Farmer training center
FCC	Federal cooperative commission
GA	General Assembly
GDP	Gross domestic product
HHH	Head of house hold
ICA	International cooperative alliance
KTWCPO	Kolla tembien woreda cooperative promotion office
KTARDO	Kolla tembien Agriculture Rural Development office
KM	Killo meter
LPM	Linear probability mode
Masl	Meter above see level
MOA	Ministry of Agriculture

MOARD	Ministry office Rural development
ML	Maximum likely hood
NGOs	Non Government Organizations
O&M	Operation and Maintenance
OLS	Ordinary Least Square
PA	Peasant association
TCPC	Tigray cooperative promotion commission
TU	Tertiary units
TVET	Technical Vocational Education Training
US	United States
WB	Water Bodies
WE	Water Enterprise
Woreda	District
WUA	Water user association

TABLE OF CONTENTS

List of Tables

List of figure

List of Tables in the Appendix

Chapter 1.Introduction

1.1 Background

Ethiopia is one of the largest countries in Africa covering a tremendous land and water resources (1.13 million Km^2), which had a mixed farming experiences with promoting small scale irrigation and other modern agricultural technologies. It has a population of 77.4 million of 43.8% population structured of 0-14 years and is characterized by extensive poverty, where 31.3 percent of the population lives on per capita income of US 108 dollar per year (World Bank, 2005,cited in Abadi,2006).

The Ethiopian economy is based on agriculture which accounts for about 46.5 percent of GDP, 80-90 % of export earnings, and 87 % of employment engaged in this agriculture sector farming activity.(CSA 2006) Despite of the highest share in the country's economy, the performance of the agricultural productivity is in somehow progressing. However, due to the over exploitation of natural resources manifesting itself to recurrent drought and use of poor farming implements and technologies as well as, the erratic rain-fed the gap to reduce the high level of food insecurity is still part of the daily life in many parts of the country, it cannot hope to meet its large food deficits through rain-fed production alone (MOA, 2002).

In most of the developing countries farmers depend on rain fed agriculture. Usually rainfall pattern varies from year to year and from place to place depending on weather conditions. Some time there is high rainfall while at other time there is shortage rainfall has its direct impact on rain-fed agricultural production. The development of small-scale irrigation scheme facilitates increased agriculture production in sustainable manner and assists in overcoming the problem of depending on rain.

Previously some attempts have been made to develop small-scale irrigation schemes through river diversion in some areas of Ethiopia. Most of the small-scale irrigation schemes developed was not successful due to different reasons, of which lack of institutionalizing water users association (WUA) and poor management system are significant.

Farmers who would be benefited from the small-scale irrigation scheme needed to be organized into association to make best use of the available water resource in their command. The members of association can exchange views and ideas and choose the best options to use the available irrigation scheme properly. Such association needs to be legally institutionalized to carry out the functions of water distributions, maintenance, repair and overall management. WUA could be organized and legalized on the basis of agriculture cooperative societies proclamation number 85/1994 and particularly on article 7 sub article 1and 2 organizing and institutionalizing the farmers in WUA will give more attention and more power than organizing them in other form.

In Ethiopia, the formation of cultural and traditional associations (e.g.`Edir`, `Ekub`, `Debbo`, etc) was dated many years ago. The peasants long realized the value of cooperation for improved productivity and for the task that require collective effort. For example, 'Debbo' is one of the traditional self-help organizations prevailing in agricultural communities of Ethiopia. People living in a given particular geographical boundary help each other in ploughing, weeding, harvesting, house construction etc.

It was after 1960 modern cooperatives societies came to birth (MoRD, 2002). These cooperatives were established during the feudal regime (1960 to 1975), Derg regime (1975 to 1990) and now after 1990. It was unfortunate that those cooperatives that were established during the previous two governments were not successful because they were used as political

tools and member's willingness was not given priority it deserves. It is even very difficult to get rid of those bad images of cooperatives printed in the minds of farmers for the establishment of similar voluntary associations such as cooperative societies in order to enhance bargaining power, raise sales and purchase, transaction volumes and so on.

Irrigation cooperatives enable farmers to own and democratically control their business. Farmers are organized to help themselves rather than rely on the government. And this allows them to determine services and operations that will maximize their profits. They increase the income of the farmers by raising the general effectively and properly utilize of water. They also increase the farm income of the farmers by equitable distribution of water made in cannels operations, by up grading the quality of maintenance duration of rivers.

The current government of Ethiopia has been taking bold decisions to create favorable conditions for the development of cooperatives such as monetary support, creating healthy and conducive environment for the cooperatives to grow and work smoothly and giving freedom and autonomy by replacing the existing cooperative laws on the pattern recommended by ICA. The government proclaimed the cooperative societies act by the Proclamation No. 147/1998 (Federal Negarit Gazeta, 1998). The proclamation states the necessity of establishing cooperative societies which are formed by individuals on voluntary basis and who have similar needs for creating savings and mutual assistance among themselves by pooling resources, knowledge and property. It also states the necessity of enabling the cooperative societies to actively participate in the free market economic system. In general, it becomes imperative to issue a comprehensive legislation by which cooperative societies are organized and managed in order to achieve their objectives.

Similarly, Tigray region, with a total population of 4.35 million, accounts agricultural economy of 55% of the regional GDP and providing an employment for more than 85% of the population (BoPED, 2000). The region belongs to semi arid areas of Ethiopia having an area of 5.34 million hectares depend on large on rain fed and, it's farming system bases.

The traditional practices, characterized by either too early or too late with variation in quantity, spatial, temporal distribution of the seasonal rain fall and wastage use of rainwater harvesting systems has made the socio-economic needs of the people unresolved and the expected optimum production worse was leading to poor livelihood of the family where they are not in a position to feed for the whole year which calls for the use of properly utilize of water .

Likewise, the study area requires sufficient amount of rain water as nearly 50% of the existing potential to produce enough food to feed the people and to fulfill the need on sustainable basis is still a long way and the use of means and know how harness available water resource into productive use remains a difficult and challenging task.

The need to exercise to irrigation cooperatives in the study area is mainly to meet the domestic needs, to provide effective use of supplementary irrigation to the long rainy season growing crops during the drier months of September and October and to supply availability of water short season growing crops, vegetables, tree and fruit saplings during any months of the year nearly nine months of the year after rain ceased. This could be as a result of personal, economic, institutional, psychological and technical factors.

This research focuses on the analysis of factors affecting proper utilization of water through irrigation cooperatives.

1.2 Statement of the Problem

The major constraint to irrigation cooperatives is lack of proper utilization of water particularly when in dry season. Hence, problems associated with dependence on rain fed agricultural systems are common in Tigray region especially in the study area with repeated famine and repeated crop failure are some to be mentioned.

The scarcity of this resource has become a key factor that affects agriculture and threatens a large number of people living in the study area, being highly challenged with uneven temporal and spatial distribution of rainfall. These extremities had undermined the productivity and reliability of their farming system. Even under normal rainfall conditions the HHHs were hardly producing sufficient food for their needs. Therefore, one alternative to improve agricultural production in the rain fed agriculture is to develop irrigation scheme and then by er proper use of water through irrigation cooperatives.

Research results and statistical data have revealed that Ethiopia is among the poorest countries in the world. Despite that agriculture is the main sector of the national economy and the development of the country is correlated with progress in it, the methods and techniques of production and water user association are traditional and, therefore, the level of its productivity is exceedingly low.

Irrigation cooperatives are the means to an economic development. They are indispensable for self-reliance, higher productivity level, Providing properly utilize of water raising the communities economic and social consciousness, and for launching an attack on a common enemy i.e. poverty. More control over water was expressed by members of cooperatives as a positive outcome of irrigation cooperatives. However, lack of control over water delivery was one of the problems mentioned.

Irrigation cooperatives are promoted by Ethiopian government as a means to increase use of water, increase efficiency of farm produces and supply of farm inputs and hence agricultural development in the rural sector of the country's economy. This is why the present study focuses on the utilization of irrigation water and identifying those factors influencing proper utilization of water through the irrigation cooperatives.

1.3. Objectives of the Study

As the aim of irrigation cooperatives to support crops suffering from moisture stress through supplementary irrigation and to provide water to domestic use, some farmers who own irrigation land in the study area are differently using it and are not meeting the advantage of irrigation cooperatives as it was expected.

The general objective of the study tried to assess the factors affecting proper utilization of water through irrigation cooperatives.

Thus, the specific objectives of the study are:

1. To analyze the socio-economic factors affecting proper utilization of water through irrigation cooperatives.
2. To identify the existing problems affecting the proper utilization of water through irrigation cooperatives.
3. To suggest possible strategies to improve the function of irrigation cooperatives.

1.4. Research Questions

Given the above objective of the research, the study was attempted to explain the following research question.

1. What are the socio-economic factors that affect the irrigation cooperatives to utilize water?

2. What are the problems of irrigation cooperatives to utilize water?

3. What are the possible strategies to improve utilization of water through irrigation cooperatives?

1.5. Hypothesis of the study

- There is no significance difference between factors affecting proper utilization of water through irrigation cooperatives and members' utilization of water.

1.6. Significance of the Study

When the issue of economic growth and development of the country is raised, one has to take in to account the performance of the smallholders. Reducing the challenges they are facing and utilizing their potentials can help to accelerate the agriculture sector and economic development of the country as a whole. Irrigation cooperatives are an ideal means for the improvement of the livelihood of smallholder farmers. The production and income of the farmers are dependent on the utilization of water through cooperatives in which they are members.

Utilization of irrigation water provides ways of improving cooperative's performance by pinpointing the weakness and strength of key activities i.e. identifying the factors affecting proper utilization of water through irrigation cooperatives. This analysis allows managers and other concerned bodies to reach conclusion about the recent status of the cooperatives.

1.7. Scope and Limitation of the Study

The main concern of the study was assessing and analyzing the factors which affect the irrigation cooperatives in the study area through collecting data and available information in five specific irrigation cooperatives.

The study could reflect a great importance if it was studied in all parts the Tigray region but due to limited financial and time resources, it focused in kolla Tembien woreda irrigation cooperatives only.

1.8. Organization of the Thesis

This thesis constitutes five major chapters. In the first and introductory chapters sub chapters that are discussed includes, background, statement of the problem, objectives of the study, Hypothesis study , significance of the study and scope and delimitations of the study. The second chapters elaborates a review of some theoretical and practical conceptualizations with respect to the agricultural cooperatives. A brief description of the study area and a thorough explanation of the methodologies used for the study are presented in chapter three. The findings of the study are presented in the result and discussions part in chapter four. Finally chapter five deals the conclusion & recommendation that are drawn from the study.

Chapter 2. Literature Review

These sections discusses the definition, classification of cooperatives and highlights the major benefit of cooperation, farmers' attitudes on the performance of cooperatives, elements for development of cooperatives in Ethiopia and also discuss definition and structure of water user associations. Reviews of theoretical and empirical studies on the management of cooperatives in Ethiopia and other parts of the world are also presented.

2.1. The Definition of Cooperative

A cooperative is defined as "an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly-owned and democratically-controlled enterprise" (ICA, 1995).

Center for Cooperative (2002) defined cooperative as a private business organization that is owned and controlled by the people who use its products, supplies or services. Although cooperatives vary in type and membership size, all were formed to meet the specific objectives of members, and are structured to adapt to members' changing needs. Chukwu (1990) considered cooperative as a democratically controlled business i.e. it is owned and controlled by the members. It also gives benefit to the members. It is often supplemented with the seven principles adopted by ICA.

2.2. Review of Basic Issues Concerning Cooperatives

2.2.1. Classification/ types of cooperatives

Chukwu (1990) presented different criteria of classifying cooperatives that have been adopted by different authors and some of the criteria for classification are summarized as follows. One of the classifying criteria is the area of operation of the cooperative. Urban cooperatives are those operating in the urban areas. There are housing, credit and saving etc. cooperatives operating in the urban area of our country. Rural cooperatives are those operating in the rural areas. Most of the cooperatives in our country fall in this category. There are grain, livestock, dairy, coffee marketing, Irrigation cooperatives in different rural areas of the country.

Cooperatives can also be classified based on their organizational level. The smallest individuals set up in the cooperative organizational level are primary cooperatives. They usually cover a limited area of operation. They have individual person as member. Their working capital is obtained from paid up shares of each member of the cooperatives. The other organizationally higher cooperatives work in the interest of these cooperatives. In our country there are 14,423 primary cooperatives operating in different sectors of the economy (FCC, 2005a). Cooperatives in the second layer of the organizational set up are secondary cooperatives. They usually formed by the number of primary cooperatives. Their working capital is obtained from paid up shares of the constituent primary cooperatives. Their area of operation covers the total area of the given constituent primary cooperatives. There were 104 secondary cooperatives operating in the different sectors of the economy (FCC, 2005a). The third layers in the organizational set up are the tertiary cooperatives. They usually formed by the secondary cooperatives and their

working capital is obtained from paid up shares of the constituent secondary cooperatives. So far these kinds of cooperatives are not formed in our country.

The other classification criterion of cooperatives is the sector in which the cooperative engaged. Cooperatives that engaged in the agriculture sector are classified as agricultural cooperatives. There are many agricultural cooperatives operating in the different sub sector of the economy. Industrial cooperatives (small scale industry) engaged industry sector. They are emerging in different areas of the country. There are 78 handicraft cooperatives in the country (FCC, 2004a). Service cooperatives are those engaged in the service sector of the economy. They usually engaged in the banking, insurance, transport, health, electricity etc. There are many saving and credit cooperatives and one newly established bank (Oromiya Cooperative Bank) representing this sector (FCC, 2005b).

The number of operation in which the cooperative engaged is another classification criteria of Cooperatives. There are single purpose cooperatives which have only one field of activity (one purpose e.g. marketing). There are also multi-purpose cooperatives which have more than one field of activity (two or more purpose e.g. credit and marketing).

2.3. Major Benefits of the Cooperation

The theory of cooperative organization provides several reasons why farmers join the cooperatives. According to Schroeder (1992) cooperatives provide quality supplies and services to the farmers at the reasonable cost. By purchasing supplies as a group, the farmers offset the market power advantage of other private firms providing those supplies. The farmer can gain access to volume discounts and negotiate from a position of greater strength for better delivery terms, credit terms, and other arrangements. Suppliers will also be more willing to

discuss customizing products and services to meet farmers' specifications if the cooperative provides them sufficient volume to justify the extra time and expense.

Increased farmers bargain power in the market places is the other advantage of the cooperative (Douglas and McConnen, 1999). Marketing on a cooperative basis permits farmers to combine their strength and gain more income. The farmers can lower distribution costs, conduct joint product promotion, and develop the ability to deliver their products in the amounts and types that will attract better offers from purchasers.

According to Parliament et al. (1990) a cooperative gives farmers a means to organize for effective political action. Farmers can meet to develop priorities and strategies. They can send representatives to meet with legislators and regulators. These persons will have more influence because they will be speaking for many, not just for themselves.

According to Folsom (2002) having a businesses owned and controlled on a cooperative basis helps farmers' entire community. Cooperatives generate jobs and business earnings for local residents. They pay taxes that help finance schools, hospitals, and other community services.

2.4. Farmers' Attitude on the Performance of the Cooperative

The cooperative is usually one alternative form of business organization that can offer good/ service to the farmers. If the other business organizations are regarded as dishonest, inefficient or exploitive, farmers will be predisposed to use the cooperative (Chukwu, 1990). On the other hand if the other business organizations are offering good/ service efficiently, honestly and at fair price, the farmers more likely to be less interested in the cooperative.

According to Klein et al. (1997) the performance of the cooperative will also affect the possibilities of having more farmers as member. If the cooperative is seen as inefficient, its

functionaries corrupt and not prepared to listen its members, the prospective members (farmers) will not have a good attitude towards the cooperative.

Cooperatives cannot be free of risks as they undertake speculative business activities (chukwu, 1990) , for example , in our country agricultural cooperatives purchase teff, coffee and other farm produces from the farmers in the harvesting season speculating that the price rises in the latter seasons. These risks are usually high for the average cooperative farmers who in most cases belong to the lower economic class of the society. Furthermore, decision making in the agricultural cooperative is known to be traditionally relatively low , whereas speculative business activities require flexible and speedy action. If there is repeated loss in the cooperative, farmers will be disappointed with performance and be less interested in the cooperative.

2.5. Elements for the Development of Cooperatives in Ethiopia

Wegenie (1989) and Abebe (2000) indicated that rural institution such as agricultural cooperatives should form the basis of future development endeavors in the country as they are best instrument for the mobilization of rural resources. However, Abebe (2000) emphasized that they should take into account local perceptions and realities, as well as built on the spirit of self and mutual help.

Subramani (2005) pointed out certain elements, which deserve attention in an integrated development of cooperatives in Ethiopia. The first element that he proposed was the choice of sectors where in cooperatives operate. Nowadays the agricultural sector of the country needs much attention as it is the backbone of the country and the majority of the population engaged in it. This is also true from the point of view of the policy (agricultural development led industrialization) the country adopted.

Defining the rights and responsibilities of the cooperative at a macro level is the second element in the development of cooperatives in Ethiopia. It has a key place as it constitutes a prime factor in determining the overall role to be played by the cooperative movement in the national planning and development programs. The existing government of Ethiopia has already legislated the cooperative society act by the proclamation No. 147/1998 (Federal Negarit Gazeta, 1998) and rules to define the rights and responsibilities of the cooperative. The third element that is proposed in the development of cooperatives is the choice of the organizational pattern. In Ethiopian case the development of primary cooperatives should deserve prior attention. After organizing and strengthening primary cooperatives, efforts should be made to link these vertically and horizontally. These linkages help to improve their competency and operational efficiency.

Education, capital, management skills and training facilities are the fourth element to be given attention in the development of cooperatives. These inputs are important to get effective output from the cooperatives. The government of Ethiopia has given emphasis for these inputs. It has been launching different training programs across the country. According to FCC (2004b) four universities already launched cooperative training program at the level of bachelor degree. Ardaita ATVET College, the former Yekatit 25 cooperative institute, is also giving middle level (diploma level) training program in the fields of cooperative. In order to avoid the capital shortage of the cooperatives, the government is establishing cooperative banks (e.g. the Oromiya Cooperative Bank) and other financial rural institution in the country.

He finally concluded that if the four elements of cooperative development properly handled, no doubt they would serve as four pillars to firmly hold the entire structure of the national cooperative movement for the better accomplishment of the desired national expectations.

2.6 Definition and Structure of WUAs

According Helen Shahriari (1997) Water User Association refers to the grouping of water users, usually farmers, who are taking water from one or more sources (such as reservoirs, irrigation canals, pumping stations) for the purpose of managing part of an irrigation and drainage system. A Water User Association is also defined as a non-profit organization, established by water users to ensure that farmers receive sufficient irrigation water when they needed. The boundary of the association can be based on a hydraulic unit, irrigation scheme or part of it, or a village administered area.

Village-based WUAs these are associations formed by inhabitants of the same village, regardless of the area and the off-takes to be irrigated. The O&M in such a case is limited to the canals serving the WUA members, which in most cases are tertiary and sometimes quaternary canals. In this case WUA boundaries are the same as village boundaries.

The Water User Associations are non-profit organizations, established to administer, operate, maintain and protect all works and structures, with full participation of their members. Farmers recognized the hydraulic-based WUA as an opportunity for better control of water delivery and distribution.

2.6.1. The Level of Farmer Participation in the WUAs

Under the revised Irrigation Code, WUAs are now steadily taking over operational responsibilities for irrigation and drainage systems. In addition, the Government administration has started to involve WUAs in the design and supervision of rehabilitation works. The current arrangements require that all rehabilitation design and civil works be reviewed and approved by WUAs, who technically should represent farmers. Moreover, farmers in principal,

are supposed to participate in the General Assembly for electing the members of the WUA Board. However, the actual level of the farmers' involvement in WUAs needs real scrutiny.

WUAs in principal are democratic organizations which are selected by the farmers and are in charge of approving the design work of the canals, delivering water in an equitable way, collecting fees, resolving conflicts, etc. But the question is whether WUAs are real democratic institutions as required by the law, or whether they are turning into special interest associations without the full involvement of farmers. Answering these questions is particularly important with WUAs taking over the secondary canals. Lack of trust among farmers towards WUAs which can stem from non-democratic selection of WUAs members; and local influence of the more powerful farmers during the process of the WUA establishment can hinder the full participation of farmers, prevent them from paying, and encourage them to take water in illegal ways. Farmers in some cases perceive WUAs as a government institution. This is partly because in some districts a number of the chairmen and secretariats of the WUA boards are former employees of Water Enterprises.

Gaining farmers' trust and encouraging their full participation in all stages of the formation of WUAs through training and education is vital for long-term sustainability of user associations. To reduce the risk of mistrust and promote democracy in selecting the head of WUAs, it is important to organize farmers at the tertiary units, where they can be trained in participatory management. In addition, it is important that women be included in the training in tertiary units, which will increase the overall participation of farmers. The involvement of women in tertiary systems and internal organization of WUAs increases overall farmers' empowerment in management systems and enhances the role of women in agriculture, where they are already doing a large share of work. Presently, all three projects studied in the paper intend to involve

women and increase their participation. In addition, organizing farmers in general at the tertiary unit to encourage their participation is also been pursued. For instance, Participate Management unit (PMU) of the WB project has been taken some action in this regard and has developed related modules.

Role of Water Enterprises still have a major role to play. Without them quality control and safety of water resources can be at risk. As a result, they should be restructured and their supervisory capacity strengthened with respect to quality control. Currently, the mandate of WEs is being limited to river protection, and operation and maintenance of large reservoirs and primary canals. These require higher technical expertise and carry larger liabilities. Therefore, WEs need to be trained in technical and environmental issues relating to irrigation and the upkeep of reservoirs and river protection. A strong, lean and efficient Water Enterprise can be a great support to the success of WUAs.

2.6.2 The Existence of Comprehensive Laws and Regulation

At present, as mentioned earlier, there is an Irrigation Code regulating WUAs, however, the law is recent and there is need for continued improvement on water strategy and regulations according to new needs and development. In short, there are some internal issues regarding WUAs such as membership, participation of farmers, the rate of fee collection, training, leadership roles and communication and some external issues such as laws, water strategy, regulation, and WE management, which need to be considered.

The ineffectiveness of many bureaucratic modes of irrigation management does not mean that the state is irrelevant and or that it should be excluded from involvement in governance. Effective irrigation management requires that people understand and develop locally

appropriate institutional arrangements and division of roles between the state, the community of water users and the private sector (Lam, 1999).The continuously changing environment in which irrigation systems operate constitutes another challenge to irrigation management. Rapid economic development, competitive uses of water and changes in the political and social setting pose many new challenges for irrigation management. As industrialization advances and economies develop, irrigation becomes more than simply delivering water to fields in an orderly manner (Lam, 1996; Ostrom, 2005; Shivakoti and Bastakoti, 2006).

2. 7 Empirical Studies on the irrigation Cooperatives

According Helen Shahriari (1997) Sustainability of the irrigation sector would be jeopardized if WUAs fail to properly manage transferred units, canals, and tertiary systems. Without the necessary skills, WUAs will not be able to manage irrigation and drainage systems efficiently, causing deterioration to set in again. WUAs sustainability could be threatened if revenues generated by small private farms are not sufficient due to lack of markets. Further, WUAs might fall apart if actions by members give reasons for distrust, for example, a lack of financial accountability or mishandling of WUA's funds. Continued support by technical assistance throughout the project, and even after its completion, will be critical to further strengthening the newly established WUAs.

According Gaesh P.shivakoti (2005) Irrigated agriculture has been a major factor of development during the past several centuries. Coordination of water supply on irrigation canals will be more challenging and more farmers will rely on ground water which can be made available when their crops are in need of water. Basic reform will be needed occasionally for restructuring and establishing new decision making processes and ground rules. Incremental

innovation will be needed more regularly, for the process of intra and inter-organizational learning about how to make irrigation system management and irrigated agriculture more productive, effective, equitable, efficient and sustainable in the face of constant change.

2.7.1 Conceptual framework

The two categories of variables associated with proper utilize of water through irrigation cooperatives are the independent and the dependent variables. Based on the factors as personal, economic, physical, institutional, technical and psychological factors, which assumed to be important across irrigation cooperatives and utilization of water would be considered in this study . Therefore this study deals with Analysis factors affecting proper utilize of water through irrigation cooperatives, by taking utilization of water undertaken in the study area and to analyze these processes. There is a need to frame the research into study areas where the researcher has to focus, and address the research questions.

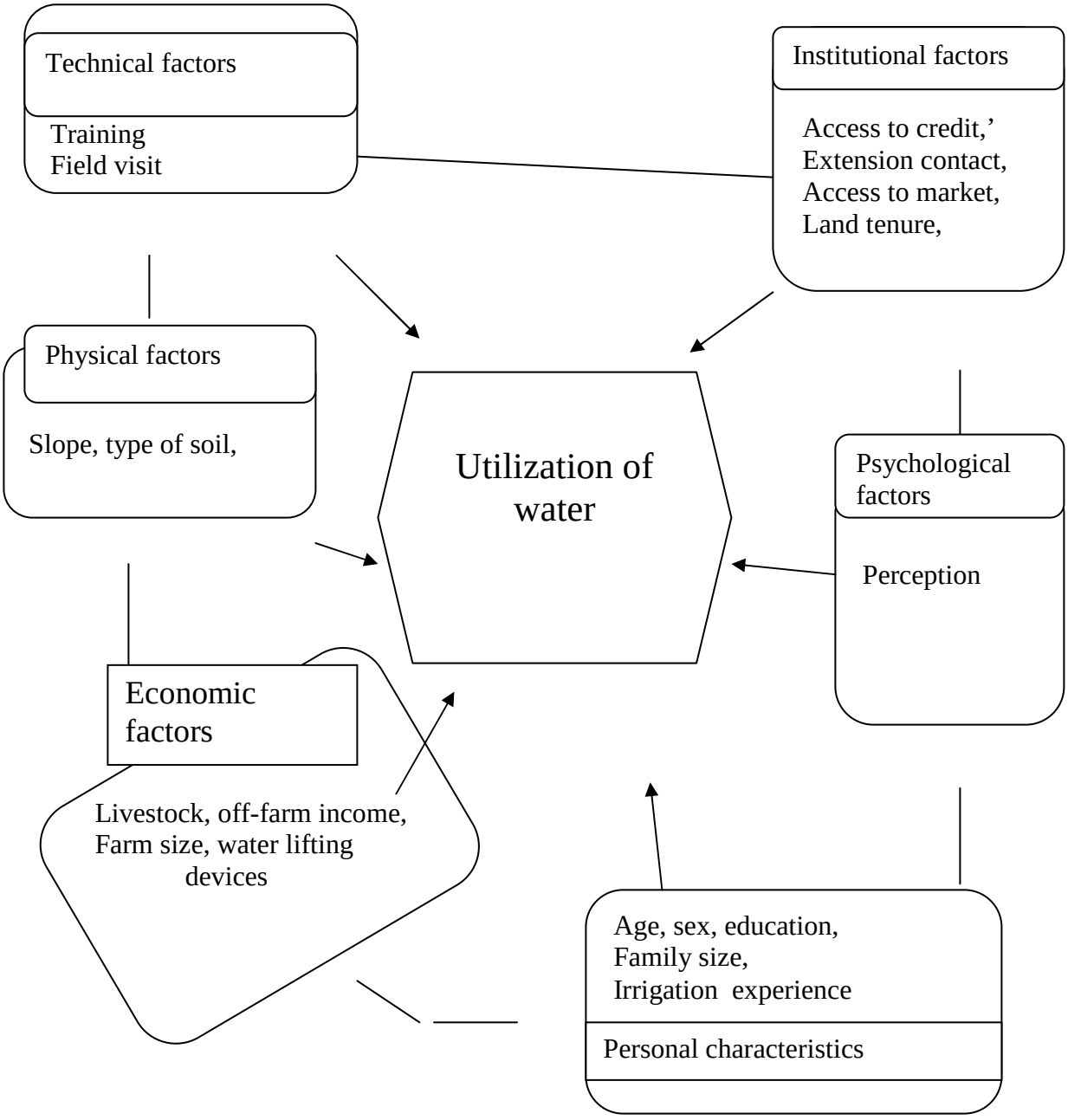

Figure 1 .Conceptual frameworks

Chapter 3. Materials and Methods

3.1. Descriptions of Kolla tembien Wereda

The study area was conducted on central zone of Tigray region, particularly in kola Tembien wereda at five Irrigation cooperative namely: Laelay Taelet, Tahetay Taelet, Maye Daero, Welegsa , and Begasheha.

3.1.1 Physical characteristic of the study are

The study area, Kolla tembien Wereda is found in the central zone of Tigray region 95 km far from east of Mekelle. It is bordered with Naeder adet woreda to the North west , with Abergele wereda then by Tekeze river to the South, with mirabawi (western zone) to the West and with Misraqawi zone to the East, and it encompasses 22 PAs and 83 villages occupying an area of 1,389.70 Km^2 (WKTARDO, 2005).

It has a population of 153,722 persons out of which 49.4 % are female and 50.6 % are male. The numbers of household heads are 26,494 , where 83.97 % are male headed household, and the remaining 16.03 % are female household headed. The average family size is 5 persons per household head with average dependency ratio one to one of the economically active population over the children. The majority of the population in the study area belongs to the Tigrian ethnic group and the dominant religion is Orthodox Christian and very few Islamic followers are present (CSA, 2006).

The study area is also found within the altitude ranging from of 1400-2300 m.a.s.l, with different range of climate, topography, parent material, and land use resulting in varying soils.

The area exhibits unimodal type of inerratic and unreliability rainfall distributions (Appendix table 7) for which the nature of the rainfall is mostly late starting at July and ending at early August. It is also known for its drought prone where moisture stress in June (on set season) for germination and September (offset season) for the flowering and fruiting processes is crucial prerequisite for crop production as well as tree growth of which ten out of the twelve months of the year are within higher potential evapotranspiration than long term average rainfall.

3.1.2 Institutional services

The study area has institutional services like school education of 1-4 of grade schools are 27 , 1-8 junior high schools1 are 32 , 9-10 Secondary high school is 1 and preparatory high school is 1 Technique college is 1 education college is 1 . The type roads serving the community are of two types, namely the paved road passing across east to west (mekelle to adwa) of the wereda with 180 km long, and the weathered road type which connect the peasant association with Abi adi (the principal town of the wereda) of total length about 270 km and the density of the road is 5 km per village. It has also 12 clinics, 5 health posts and 6 animal veterinary clinic stations and other infrastructures like cooperatives and credit service providers .

The land tenure system is based on the constitution that all land is under the property of state and the farmer has the right to use and to transfer but not to sell or mortgaged. It comprises a total area of 147,000 ha, out of which the cultivated land is 21.10 %, grazing land 47.4 %, woodlots shrubs and trees 6.3 %, homestead 2.5 %, area closure and miscellaneous land is 22.7 % (WKARDO, 2005).

The total number of water supply units constructed in the study area 5063 water points out of which 334 of them are hand pumps, 78 are motorized, 31 spring development, 4 earth dams and 12 seasonal rivers. About 4588 of newly introduced Rain water harvesting ponds and 16 serious ponds have been built but some of them are not functioning because of seepage and other factors.

Table 1. Total constructed diversion of rivers in the study area.

Name	Type	Constructed / year
Laelay taelet & Tahetay taelet	Diversion	1990
Maydaero	Diversion	1996
Begasheka	Diversion	1998
Welegsa	Diversion	1998

Source: kola tembien wereda agricultural and rural development office, 2006

There are twenty two agricultural extensions and farmer training centers (FTC) with 66 development agents (3 workers in each development center) which provide extension service by mediating macro policies to local situations. They also facilitate training to encourage human resource development for a better self guidance and sustainability use of the technology by incorporating indigenous knowledge into the technical packages. Generating the demand to practice and to support the grass root levels enables to boost agricultural production through promotion of new technologies and improvement.

3.1.3 Farming system

The agriculture is based on rain-fed subsistence farming system of a mixed crop and livestock and traditional oxen driven implements type. The major cereal crops are maize teff, sorghume

,barely and millet . The types of animals raised are chicken comprising about 33.6 %, cows & 0xen 26.1 %, goat 28.2 % , sheep 7.4 %, donkey 2.3% , mule 0.1 %, 2.2 % bee colony& camel 0.1% etc (Appendix table 6). The vegetation cover of study area has been disturbed because of encroaching and illegal felling, either for domestic use like farm implements, fuel wood or invading of marginal farmlands. This destruction of vegetation has in turn created runoff by eroding topsoil creating soil loss that leads failure of soil fertility.

According to BoRAD (2005), the major livestock production constraints were shortage of animal feed and killing diseases like Pastoralists, Black leg, Anthrax, Foot and mouth diseases, Mastitis, reproductive diseases, internal and external parasite. Grazing and browsing are the major feeding method lying on natural pastures (grasses, leaves, leaf lets and branches), crop residues (straws, stalk, stoves sheaths and chaffer) and after-math grazing are alternative feeding type of which both of them tend to the main free resources, where the carrying capacity of the grazing land had remained only for about 2.3 ha per TLU (Zenebe, 2001).

3.1.4. Agricultural extension service

In order to realize the desired development in those countries where agriculture is the major means of survival, every effort towards growth should focus on the rural farming community. In this context extension services play a vital role in channeling the appropriate know-how to the farmers.

In the kola tembien districts there are 66 DAs that are responsible for providing the necessary technical supports required by the farmers. To upgrade the skill and learning capacity of the farmers the country revised the extension policy in the year 2001. The plan revised gives priority in establishing farmers training centers (FTC) and assigning three DAs who have a

diploma in specialized fields of agriculture in each kebele. This would enable farmers to get in touch and make use of new ideas and technologies on a variety of subjects to improve their livelihood. Taking this into consideration during the last three years a number of DA's have been recruited and enrolled in TVET (Technical Vocational Education and Training) to acquire the required skills.

3.1.5. Agricultural cooperatives

In kola tembien district there are 5 Irrigation cooperatives 22 multi-purpose agricultural cooperatives 1 union 5 saving and credit cooperatives (KTWCPO, 2005). And they have 12958 farmer members (10618 males and 2340 females) in 2006/7 . The total capital of the cooperatives was birr 2,682,812.86.The irrigation cooperatives provide fertilizer and other farm inputs and also managing irrigation systems and activities. The multi-purpose agriculture cooperatives provide primarily fertilizer and other farm inputs. One of the fascinating attributes of agricultural cooperatives is extending fertilizer in credit. They also market farm produces especially honey.

3.1.6. Cooperative organization and promotion service

The current government of Ethiopia is establishing, promoting and organizing cooperatives in the rural community, as they are a means to development. In the Kolla tembien districts there are cooperative organization and promotion office that are responsible for providing the necessary technical supports required by the cooperatives. As these offices are newly organized, the support they are giving is not satisfactory. The offices also face shortage of qualified personnel in the area of cooperative to meet their objectives.

The government of Ethiopia is working to mitigate the qualified manpower needs of the cooperatives. Four Universities launched training program in the first-degree level and diploma level training is taking place in the Ardaita agricultural TVET College. During the last three years a number of students enrolled in the departments of cooperatives. The cooperative offices as well as the cooperatives themselves in the district are expected to benefit from this in the coming few years. The other problem in the cooperative organization and promotion in the district is the shortage of capital. This makes the cooperatives unable to compete in the market especially in the purchasing of farmers' produces.

3.1.7. Agricultural credit services

Formal and informal institutions are the two main sources of credit in the study districts. Credit from informal sources such as friends, relatives and neighbors are used to cover family consumption requirements such as food purchases, medical expenses and sometimes to pay taxes. Interest charged on credit from friends, relatives and neighbors is nil in most cases. However, local moneylenders, who charge high interest rate, are found in the study areas.

There are also formal micro finance institutions that provide credits for the farmers. Farmers receive credit from these institutions for the prepayment to be paid for the cooperatives to obtain fertilizer in credit, fattening livestock, contracting land and ox and for other social obligation. The cooperatives also extend credit for the farmers i.e. they distribute fertilizer in credit for the farmers. Almost all farmers, who are the member of the cooperatives, take this credit.

Figure 2 . Map of Tigray Regional State and Study Area

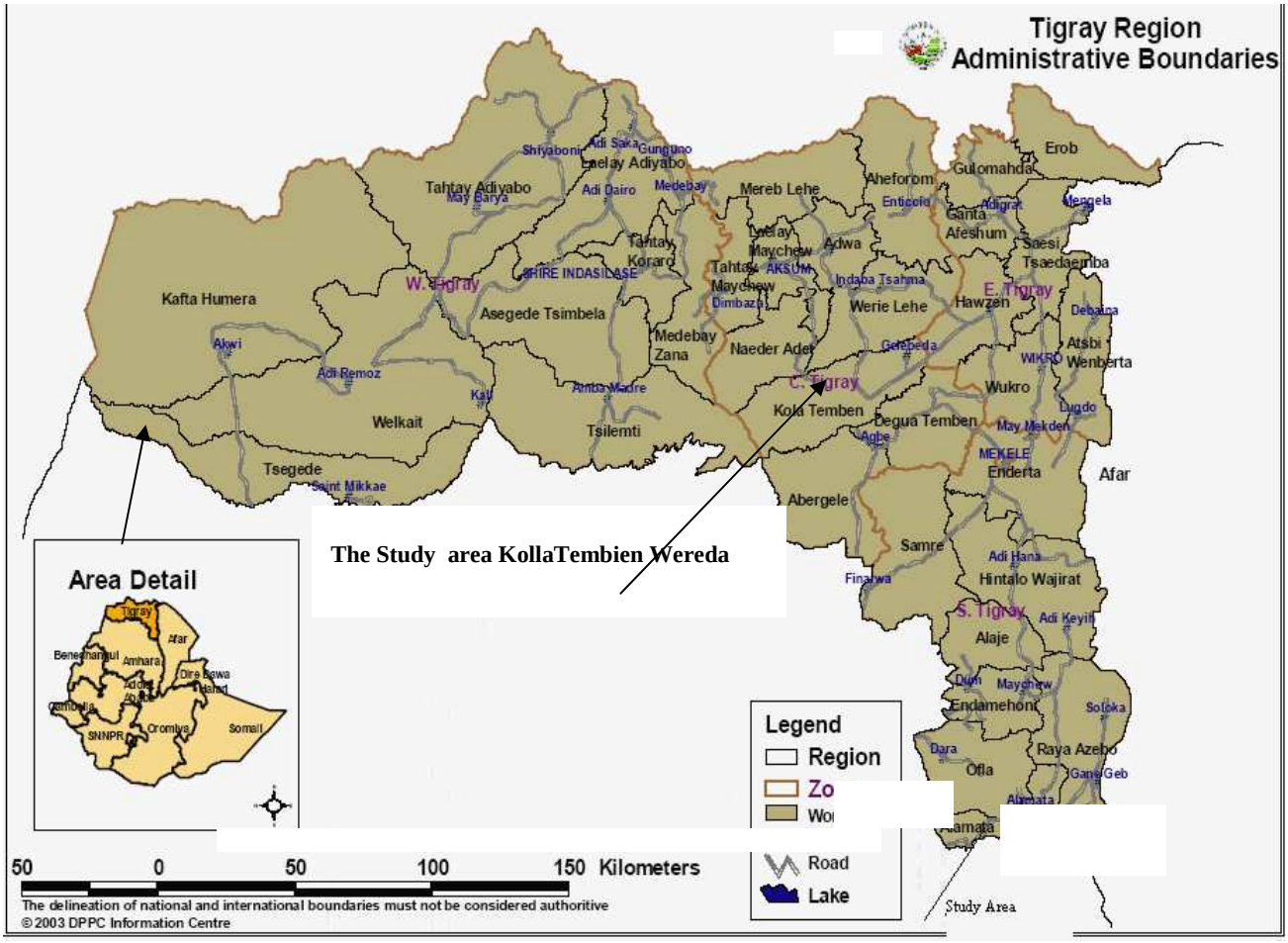

Figure 2.Tigray Region Administrative boundaries

3.2 Data Requirement

It is used to examine the resource use efficiently and appropriate methodology to draw a meaning full inferences of theory, since analysis of factors affecting proper utilization of water through irrigation cooperatives are influenced by a complex set of factors such as personal, ecoomic, institutional, technical, physical and psychological factors and some of the factors could infer as determinants of irrigation cooperatives (Feder *et al.*, 1985 and Maddalla, 1983).

3.2.1. Sampling design

In order to select the sample farmers and to draw important policy implications employing sound methodological principal is a prerequisite. Sampling procedure was used to select survey sites and the sampling unit farm household head for the study.

Kollatembien wereda, out of the nine Weredas (districts) of central zone Tigray, was purposively selected since no research was conducted in the study area. There are only five irrigation cooperatives in the wereda. All of five irrigation cooperatives were selected for the study. The farmers were selected randomly by using proportional probability to size from the list of the cooperatives members files (Table 2).

The number of farmers selected from each irrigation cooperatives were 120. For the sampling, the number of household head in the cooperative file was divided by nine and by the interval of the ratio the farmer will be selected starting from any number between 1and 9 randomly. If the respondents obtained was migrated to other areas leaving the cooperatives,the sample frame was updated before the selection.

Table 2. Distribution of sample size of household heads Members of Irrigation cooperative

Irrigation cooperative name	Actual		Sample proportion		Total sample respondent
	№	%	№	%	№
Laelay taelet	435	42.2	51	42.5	51
Tahetay taelet	327	31.7	38	31.6	38
Maye daero	196	19	23	19.2	23
Welegsa	40	3.9	4	3.7	4
Begasheka	32	3.1	4	3.3	4
Total	1030	100	120	100	120

Source: own survey 2006

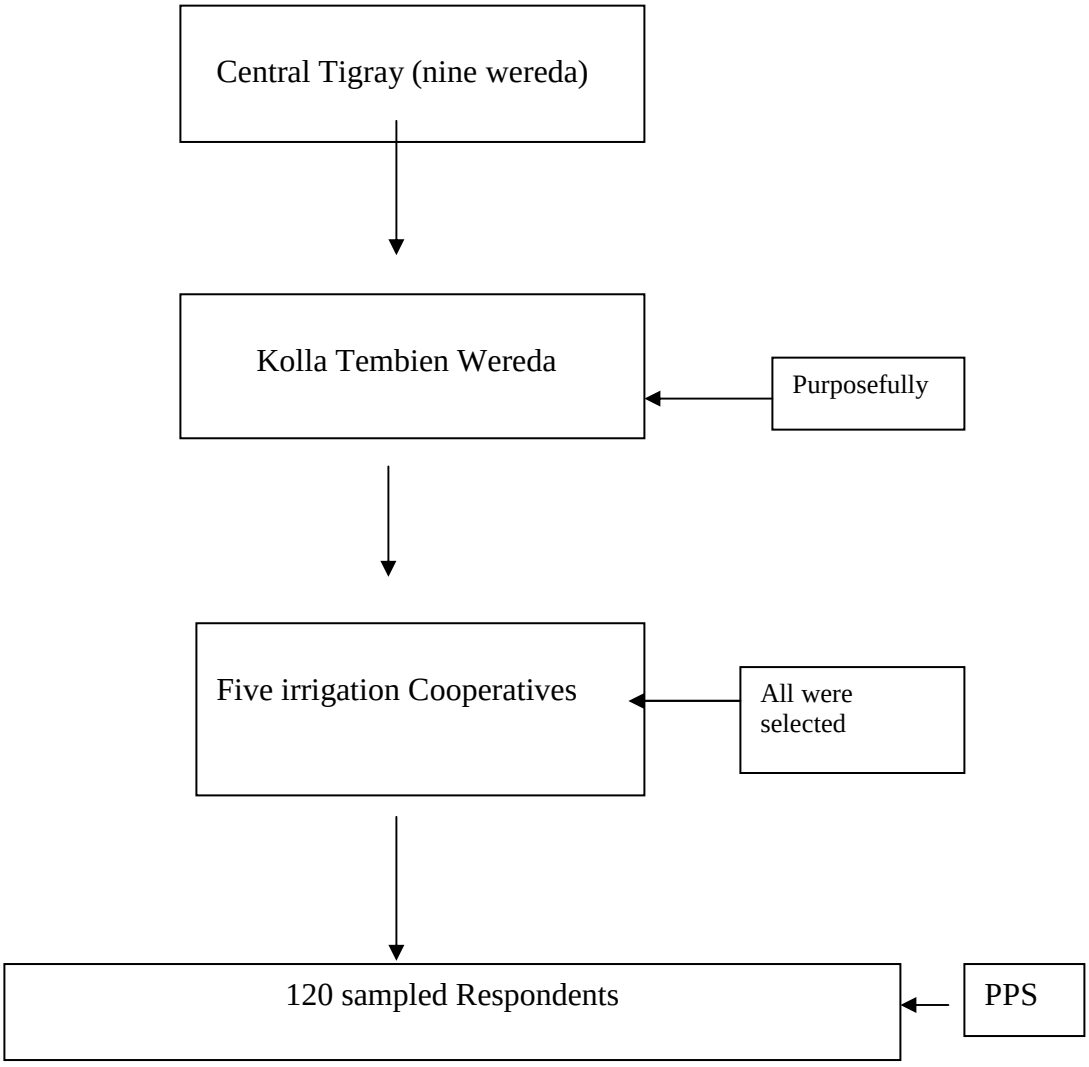

Figure 3. Sampling Design procedures

3.2.2. Methods of data collection and sources of data

The main tool used to collect the data was structured schedule which is administered in participatory designed to suit for discussion made with the sampled household heads of each Irrigation cooperative members , and before the actual data collection were carried out, three enumerators who can speak, write local language and able to communicate in English were recruited. Class room training were given about the objectives, content of the questionnaire, way of administering interview scheduling, utilizing properly of water irrigation cooperative and measuring the irrigated area .

Following that practical field training on study related to the irrigation cooperative were employed. Simultaneously the interview scheduling was pre tested with ten randomly selected household heads interviewee and discussion was completed. Accordingly field observations physical study on the respondent's irrigation cooperative and the researcher made personal observations and informal discussions with farmers, cooperative officials and employees in the cooperatives on issues related to the cooperatives and their performance.

The actual collecting of quantitative data was conducted as face-to-face discussions and the qualitative data had been generated from (secondary sources) and interacted with different groups, actors of NGOs & government discussion to accomplish the objective of the study.

Regarding the sources, the primary sources were the sampled farmer household heads and the irrigated area. The secondary of data are collected from the following relevant sources, Tigray National Regional State, Finance and Economic Development Bureau, Agriculture and Rural Development Bureau, Kollatembien Wereda Agriculture and Rural Development Office, NGOs and others which took part in Irrigation practice. Other related data were also collected from reports, statistical documents as well as published and unpublished documents.

3.2.3. Methods of data analysis and interpretation

With respect to the expected output of the study, the qualitative and quantitative data obtained were analyzed using descriptive statistics and econometrics model for analysis.

3.2.3.1. Descriptive analysis

Statistics helps to answer the key questions in Irrigation cooperatives members whose resolution could lead to significant changes in the design of experiments to distinguish the impact improvements of the members that helps to extract a meaningful message. It is also a means for better analytical tools used to analyze data and plays in the analysis and interpretation ..

Therefore, descriptive statistics is a thought of describing the introduced randomization into optimal designed for model estimation, or it is an important tool used to analyze and to interpret the data which are collected to gain a meaningful message and conveying into the decision and reach to recommendation. In descriptive statistics the mean, percentage, and standard deviations were used to characterize the distribution of each variable under category respondent of the study area.

Whereas statistical inference is the study of relationship between the population and the sample drawn from the population, or it is the process of generating from the sample value to the population and a means of estimating and hypothesis testing with correlation and regression analysis, thus the hypothesis testing is a prior judgment or expectation about the value of a particular parameter.

The comparison of different characteristics of farm households were employed by running one way ANOVA using T test to see if there is statistically mean significant difference among continuous variables; and cross tabulation using chi-square for systematic association among the dummy variable characteristics.

3.2.3.2. Econometrics Model Analysis

The econometrics model is used to treat potential variables that are assumed to affect the decision of irrigation cooperative and the parameters of the model were estimated using maximum likelihood, where the significant variables do not have the same level of impact on farmers' decision to use the cooperatives. Once collection of data was completed, the coding and entering the data into SPSS version 13.0 for logistic regression analysis was the primary task.

3.2.3.3 Discrete regression models

Discrete regression models are models in which the dependent variable assumes dummy values. The simplest of these models is that in which the dependent variable Y is binary (it can assume only two values denoted by 0 and 1) (Amemiya 1981; Gujarati, 1988; Maddala, 1997). According to these authors, the three most commonly used approaches to estimating such models are the linear probability models (LPM), the logit Model and the probit models.

The linear probability model is the model, which expresses the dichotomous dependent variable (Y) as a linear function of the explanatory variable (X). Because of its computational simplicity, LPM has been used in econometrics applications especially during and before the 1960s. However as indicated by Amemiya (1981), Maddala (1997) and Gujarati (1988) the linear probability model has an obvious defect in that the estimated probability values can lie

outside the normal 0-1 range. The fundamental problem with the LPM is that it is not logically a very attractive model because it assumes that the marginal or incremental effect of explanatory variables remains constant, that is Pi= E (Y=1/X) increases linearly with X (Maddala, 1997; Gujarati, 1988).

The defects of the linear probability model suggest that there is a need to have an appropriate model in which the relationship between the probability that an event will occur and the explanatory variables is nonlinear (Amemiya, 1981; Gujarati, 1988 and Madalla, 1997).

These authors suggested that the sigmoid or S-shaped curve, which very much resembles the cumulative distribution functions (CDF) of random variable, is used to model regressions where the response variable is dichotomous taking 0-1 values. The cumulative distribution function (CDF's), which is commonly chosen to represent 0-1 response models, is the logit (logistic CDF) model and the probit (normal CDF) model.

Logit and probit Models are the convenient functional forms for models with binary endogenous variable (Johnston and Dinardo, 1997). These two models are commonly used in studies involving qualitative choices. To explain the behavior of dichotomous dependent variable we will have to use a suitably chosen cumulative distribution function (CDF).

The logit model uses the cumulative logistic function. But this is not the only CDF that one that emerges from normal CDF is popularly known as the probit model (Gujarati, 1995). The logistic and probit formulations are quite comparable; the chief difference being that the logistic has slightly flatter tails that is the normal curve approaches the axis more quickly than the logistic curve. Therefore, the choice between the two is one of mathematical convenience and ready availability of computer programs (Gujarati, 1988).

3.2.3.4. The Logistic regression Model Specification

Logistic regression is used when the response variable is a dichotomous or binary variable and the explanatory variables are continuous , categorical, or both . A dichotomous variable of the response variable takes only two values, which usually represent the occurrence or non – occurrence of some outcome events that are coded as 1or 0 respectively.

The response variable takes a value of 1 which a probability of proper P, or a value of 0 with a probability of poor 1 -P . This type of variable is called a Bemolli (or Binary) variable as its behavior is related to the Bemolli distribution.

A regression model with this type of response can be interpreted as a model that estimates the effect of the explanatory variable on the probability of the events occurring. Rather than directly predicting the response, logistic regression model, estimates the probabilities of group membership.

The Logistic Regression Model -the goal of logistic regression is to find the best fitting model to describe the relationship b/n the dichotomous characteristic of interest (response variable) and a set of explanatory (= predictor) variables. Logistic regression generates the coefficients of a formula to predict a logistic transformation of interest:

Thus if we are to get from a straight line (as in least squares regression) to the s-curve (as in logistic regression), we use the formula below:

For multiple logistic regression

$$\text{Logit}(p) = \ln\left[\frac{P}{1-p}\right] = \log\left(\frac{P}{1-p}\right) = \ß_0 + \ß_1 X1 + \ß_2 X_2 + \text{---} + \ß_k X_k$$

Where p is the probability , that Y=1 (proper) and X1, X 2 --- Xk are the explanatory variables.

Probability of proper = prob(proper) = p; Probability of poor = prob(poor) = 1-p.

$P = Prob\ (Y_i = 1/X)$

The above fomula shows the relationship b/n the regression equation ($ß_0 + ß_1 X$), which is a straight line formula, and the logistic regression equation (the one on the left).

The logit transformation is defined as the logged odds:

$$Odds = \frac{P}{1-p} \quad \text{and}$$

P can be computed with the following formula:

$$P = \frac{\exp(\text{log it})}{1+\exp(\text{log it})} = \frac{\exp(ß_0 + ß_1 X)}{1+(ß_0 + ß_1 X)}$$

$$1 - P = \frac{1}{1+\text{Exp(log it)}} = \frac{1}{1+(ß_0 + ß_1 X)}$$

3.2.4. Dependent variable

Analyze factors affecting proper utilization of water through utilization irrigation cooperatives was estimated in relation with the explanatory variables where as their measurement can be either dummy or continuous. Thus the dependent variable value starts from zero for those members of irrigation cooperative above zero, which bases on factors affecting proper utilization of water through irrigation cooperatives.

The dependent variable in this case is the utilization of water which has dummy value, expressed in terms of proper and poor utilization of water on the purpose of the irrigation cooperatives. In this study proper utilization of water has considered as the equitable distribution of water, conflict resolution, implementing fee collection for operation & maintenance canals on time.

3.2.5. Selected and hypothesized explanatory variables

Farmers' decision to use the irrigation in a given period of time is hypothesized to be influenced by a combined effect of various variables such as personal characteristics; economic; psychological; institutional, physical environments and technical factors in which he operates, Feder *et al.,* (1985), has also reviewed some of the above factors affecting performance of agricultural technologies in low income countries. Therefore the following variables were hypothesized to influence the factors affecting proper utilization of water through irrigation cooperatives in the study area as follows.

3.2.5.1. Personal characteristics

1. Sex of the household head is a dummy independent variable indicating the sex of the household head. A value of 1 represents if the household head is male, and 0 for female. Sex differences are found to be one of the factors influencing utilization of water through irrigation cooperatives. Many evidences show that the male headed household are more participating in using improved technology and do have larger access to extension service, credit and a better information than female headed household. Yenealem (2006) also indicated that cultural taboos, beliefs has prohibited female from involving in some labor demanding works such as threshing, plowing and digging. Therefore female's status is negatively influenced in utilization of water through irrigation cooperatives .

2. Age of the household head is a continuous independent variable, such that the age of the farmer can contribute either to generate or to erode confidence towards irrigation . With an increased age farmer can be more or less risk averse to irrigation cooperative , because of the experience he had and it is hypothesized that farmers with increasing age, there is probability of water user association than younger.

3. Family sizes is measured as continuous and it is expected that a household head with a large family size have sufficient labor and positively related with irrigation cooperative . The proper or poor utilization to maintain and efficient use of irrigation cooperatives are determined by the involvement of the family members. For those who have larger family sizes are positively influencing the irrigation cooperative as they can provide sufficient labor.

4. Irrigation experience is a started practice measured in number of years for which a respondent was involved to practice a given irrigation to improve one's livelihood through the application of skill or knowledge by getting full information and able to reach to evaluate the

advantage of the association . Therefore farmers with longer farming and experience of using any type of in situ water conservation and flood irrigation are able to assess potentially the benefits of new irrigation cooperatives than with short farming and irrigation experience. Therefore having such type of experience has a positive influence to improve irrigation cooperative than the one with no experience.

5. Education level of the household head is measured from the farmer's ability to obtain and process information from the involvement of schooling or grades attended. Education increases farmer's ability to operate or get use of information, so enables to adopt and prefer his choices easily. It is measured as 0 for a respondent that does not read and write called as illiterate; and those whose trying to read and write were considered as read and write; fore those who attend grade 1 up to higher level education are literate formal education . Sambrook and Akhter (2001) have supported the hypothesis in their finding that education was important for farmers to understand and interpret the information they got. Education has, influenced positively possibility of using irrigation cooperatives practices for securing food self sufficiency.

3.2.5.2. Economic variables

1-Farm size is measured in local unit and converted to hectare. Farmers owning larger farm plots are more likely to construct irrigation canals to collect runoff to storage to use them as a supplementary irrigation during dry spell; thus farm size is positively influenced in favor of using irrigation (Wegayehu, 2006).

2-Livestock owned is measured in tropical livestock units (TLU) (in Appendix table 5). The labor, land and animal are the basic sources to operate farming activities. A farmer who is benefited from selling animal power, animal and animal products can have an extra income that could in turn help to finance and purchase necessary inputs to irrigation. These farmers can

positively influence and can utilize of water through irrigation cooperatives earlier than who does not have any type livestock (Rockstrom, 2001).

3-Off farm income represents the amount of income where farmers earn in particular time can generate additional income to the household, like petty trading, daily labor, handicrafts, etc. Especially petty trading was the most important off farm activity which is undertaken by majority of the sampled households.

The households engaged in off-farm activities are better endowed with additional income to purchase inputs and is expected that the availability of off-farm income is positively related with irrigation cooperatives.

4 Availability of water lifting devices are assets or devices that multiplies power and minimizes loss of time during pumping or lifting water to irrigate an area from the storage and is measured based on the type of water lifting devices they own (dummy). thus a farmer owns nothing = 0 , pump=1, treadle=2 Farmers with improved water lifting positively influence irrigation cooperative than those who lift with manually.

3.2.5.3. Institutional variables

1.Security of land tenure rights is an institutional constraint that plays a major role in explaining economic behavior of farmers. Farmer who feels more secured of his land use right is able to invest for long term to under take on his/her land improvements. Securing land tenure is often considered as a prerequisite for long-term investments. Uncertain property rights and user rights are negatively determinant factors to investment particularly in agriculture and irrigation cooperatives .

2-Access to credit is an important to resource poor farmers who cannot finance agricultural inputs or to purchase from their own at early performance irrigation, so taking credit to purchase fertilizer has a positive influence (Techane, 2002).The lack of formal credit opportunities is highlighted as a serious constraints to invest on new technology; like treadle and motor pump particularly for the resource poor farmers. It is measured as dummy, farmer who have an access to any sort of credit over the given period of time to over come his financial constraints and thereby can buy an input and has a value of 1, otherwise values zero.

3-Distance to markets is measured in kilometer. Without good infrastructure and access to market, the growth in economic incentives may not parallel. These farmers who are far from the market respond negatively to irrigation cooperatives. Because it is hard to purchase inputs and sell farm products (perishable products, like tomato, onion, and banana. etc). Thus sites closer to market have higher interaction with society, therefore closer distance of market positively influences irrigation cooperatives.

4-Extension contact: Agricultural extension is the major source of information and technology dissemination center that aims at empowering farmers by putting them at the center of all decision-making processes and should be guided by the principle of self reliance. Meanwhile the agricultural extension service is a critical input like credit, seed and water in any development economically rewarding the more agricultural advice and visits. Incentive Agricultural extension is a source of commodity and information that influences positively the irrigation cooperatives .

3.2.5.4. Technical variables

1.Training is relatively a means of capacity building where most people tend to participate but few institutions have acquired knowledge for proper implementation and properly utilization of water . Farmers who don't have knowledge on the cooperative about its role of basement well performance. Need of training or practical support for construction is a means to decrease the complexity of the technology. So that the components of the training like tour, field visit and demonstration trials positively have influenced human behavior (Ehui *et al.*, 1986).

2.Field visit is a component of training that helps farmers get more information and make understand about the available irrigation cooperative at field level and in turn leads to a change in their knowledge, attitude and behavior. Legesse (1992) and Ngigi (2003) have stated that farmers who are hosted on field visit are significantly and positively influenced by the performance of introduced irrigation in relation to the benefit gained. Particularly they can understand easily the relation between the fertilizer application and role of irrigation from the point of production.

3.2.5.5. Physical characteristics

1-Slope suitability is a dummy independent variable categorized as steep, medium and gentle slope. Irrigation is not recommended for areas with higher slope of a given farm plot since they are exposed to soil erosion and it leads for unnecessary earth works. So unsuitability of the plot to hold water is exposed to leakage, sedimentation and the higher cost to construct, thus sloppy area discourages irrigation.

2. Soil texture (soil type) is expected to affect farmers' decision to construct irrigation on their plot as some soil texture has the capacity to crack or rupture. For example clay soil needs more labor and cost to construct irrigation structure. However, clay soil is more resistance, sticky and harder than sandy soils and that it is more suitable to construct underground irrigation structure than sandy soil type. Hence, sandy and courser soil is expected to have negative effect on irrigation cooperatives (Molla, 2005).

3.2.5.6 Psychological factors

1-Perception is any criteria, method or stimuli by which farmers use to differentiate or decide to adopt one aspect of practice in terms of its quality and characteristics. It is a variable that is influenced by individual's values, beliefs, attitudes, and objective assessments of relative advantage, compatibility, observably, risk and uncertainty (Tesfaye, 2003). Therefore it is a dummy variable that takes the value 1, if the HHH perceives that the irrigation exceeds than other irrigation systems, and 0, other wise. This variable measures farmers 'recognition of properly utilize and poor utilize of water influences irrigation cooperatives.

Table 3.Summary definition of Explanatory Dependent variables and unit of measurement

Variables		Description and measurement of opertionalization
Personal	AGEHHH	Age of the HHH, measured in continuous, +
	SEXHHH	Sex of the HHH, dummy variable, 0=if male and, 1= otherwise +
	EDUCLEVE	Education level of the HHH, measured ,1=illiterate,2=read&write,3=formal education +
	IRREXP	Experience of using irrigation in years, continuous +
	FAMSIZ	Family size of the HHH measured in number (A.E); continuous +
Economical	WATLIFT	Access of pumping devices owned by HHH (1, if =yes, 0=no) +
	TLU	Total livestock owned by the HHH, measured in TLU, continuous +
	FARMSIZ	Farm size of the HHH, measured in hectare; continuous +
	OFFARMIN	Amount of money earned from off farm activity per month in birr, continuous+
Institutional	DISMARK	location of the market from home in (Km) continuous +
	FREXCON	The number of times visited by extension agent per month, measured 1=nothing; 2= 0nce, 2=twice, 3= thrice etc; continuous +
	ACCRED	Access of farmer to take credit in birr or in kind (1, if yes, 0= 0thewise) +
	LANDTEN	Right of the household head to own land useit.1=If secured. 0=otherwise+
Techni	TRAIN	Participation of the HHH in training concerning irrigation coops. 1=yes, 0=no+
	FIELDVIS	Involvement of the HHH in field tour for practical .1=yes, 2=no+
Psyc	PERCIRR.C.	Belief of the HHH for preference of the technology. Dummy+
Physical	SLOPFARM	refers to the slope of the plots measured,1=if steep, 2= medium, 3=gentle+
	SOILTYP	Soil texture of farm ,1=clay soil, 2=sand, 3=loam +
	Dependent Va	Utilization of water. 1= properly , 2 = poor

Chapter 4. Result and Discussion

The overall results of the survey are presented and discussed based on the objective of the thesis using descriptive analysis and econometrics results of personal , economic, institutional, physical, psychological and technical variables. Thus descriptive statistical tools such as mean, percentage, standard deviation, mean differences by the help one way ANOVA (for continuous variables) and χ^2-test (for dummy variables). Moreover, econometric procedures using logistic regression model were employed using JMP software computer program. The descriptive result comprises different sections, expressed in terms of the distribution of categories by level of utilization of water through irrigation cooperatives as follows.

4.1. Distribution of Respondents by Level of utilization of water through irrigation cooperatives

Irrigation cooperatives status were assessed based on the extent of use of each practices with reference to the optimum or recommended level, for which management quotient was developed to evaluate the utilization of water through irrigation cooperatives by the help of the given recommendation and capacity of the irrigation to irrigate for cereal crops, vegetables, fruits, trees at their frequency of irrigation incorporated with distribution equitable of water ,fee collection for operation and maintenance of canal, resolution conflicts of members, the tendency of using water lifting technologies (Treadle or motor pump) and other management practices. Using all these incorporated practices help to categorize the status of each respondents in relation to the irrigation cooperatives.

Distribution of the respondents (Table 4) relies on the results of the, utilization of water through irrigation cooperatives. The result showed that the total respondents were having 86 members with 71.3 % accounts proper utilization of water and 34 members with 28.3 % accounts poor utilization of water through irrigation cooperatives

Table 4. Distribution of respondents by the level of utilization of water through irrigation cooperatives

Dependent variables Category	No	Percent
Proper utilization of water	86	71.7
Poor utilization of water	34	28.3
Total	120	100

Source : own survey(2008)

4.2. Descriptive Statistics and Influence of explanatory Variables

4.2.1. Characteristics of the sample household head

Attempts were made to collect information on different characteristics of the sampled HHHs to provide information on some of the key variables of the study area. The variables examined the cooperatives and members attitudes in irrigation cooperatives management of water descriptive analysis in this section were as follows.

4.2.1.1. Personal characteristics

1- Age of the household head: Theoretically can generate or erode confidence, in line to this with increasing age, utilization of water through irrigation cooperatives is negatively affected due to that the older are risk averters and more conservatism to use irrigation cooperative than the younger but there are cases where irrigation practice could be positively influenced by older people due to they have longer farming and irrigation experience and accumulation of wealth than the younger.

The result of this study revealed that the age of the sample respondents ranges from 15 to 86 years with mean age of 45.78 years. The average age of respondents said cooperatives have proper and poor utilization of water were 45.41, 46.71 years respectively which have a standard deviation of 14.41. Therefore, those respondents who have responded

irrigation cooperatives have proper utilization are less aged than those respondents who have responded irrigation cooperatives poor utilization of water. But, statistically there is no significant difference between the age and utilization of water. The ANOVA one way sample test showed that there was no significance difference and negative relationship between the age and utilization of water through irrigation cooperatives practice (T = - 0.44 and P = 0.66) (Table 5).

The result was supported by the finding of Lapar and Pandey (1999) showing that there is a positive relationship to adopt soil and water conservation practices and age, even though Bekele and Holden (1998) findings reported a negative relationship between age and decision

of farmers to adopt soil and water conservation practices and adoption of fertilizer in the highlands of Ethiopia.

2. Family size of the sampled household head is defined as the number of individuals who resides in the respondent's household, including family members who are temporarily away from home. The family members are converted in terms of adult equivalent to know economic active labor (Appendix table 4). Thus, the study result showed that the average family size of the total sampled household head was 3.47 people per household head which is less than the regional average of 5.17 persons (CSA, 1994). The minimum and maximum family size of the HHH was one and ten persons respectively.

Accordingly the result shows that average family size of respondent who have said irrigation cooperative proper and poor utilization of water were 3.35 and 3.76 person per family head respectively which responded irrigation cooperative have poor utilization are high family size than those proper utilization water . The findings shows that there was no significant difference and negative relationship between family size and utilization of water through irrigation cooperatives (T= - 0 . 988 ; P=0.325)table 5

The result is supported by the findings of Oweis *et al.*, (1999), described that family with average size family members has the probability of improving irrigation cooperatives.

3. Irrigation experience is one of the most important values given to the members of irrigation such that they had acquired and share their knowledge of traditional irrigation through their life time by under taking their experience of using different water utilization systems to their farm in order to utilize properly water. The experience of water use properly from rivers to grow vegetable in their back yard in Cypress had make the farmers weigh the utilization of water through irrigation cooperatives as a function of external environment

Even though the respondents have an experience of practicing irrigation experience ranging from 1 up to 27 years, but the experience of using this irrigation cooperatives ranges between one up to ten years.

The result of this study revealed that the irrigation experience of the sample respondents ranges from 1 to 10 years with mean experience of 9.1 years. The average irrigation experience of respondents said cooperatives have proper and poor utilization of water were 9.91 , 7.12 years respectively which have a standard deviation of 7.119. Therefore, those respondents who have responded irrigation cooperatives have proper utilization are more experience than those respondents who have responded irrigation cooperatives poor utilization of water. But, statistically there is significant difference between the irrigation experience and utilization of water. The ANOVA one way sample test showed that there was significance difference between the irrigation experience and utilization of water through irrigation cooperatives practice at 5 % significant level (T = 2.322 and P =0.023) (Table 5). This indicates that they had acquired and share their knowledge of traditional irrigation using different water utilization.

The result of Ngigi (2003) have supported that farmers of Kenya who were exercising flood irrigation, trench and stone bund were the early irrigation for watering of fruits and tree saplings, and digging community ponds for watering livestock and farmer with experience of irrigate his back yard was positively influenced in irrigation cooperative.

Table5 . Distribution of respondents by Age , family size and Irrigation experience by utilization of water through irrigation cooperatives.

Variables	Irrigation cooperatives category			T	P
	Properly utilization	Poor utilization	Min-Max		
Age	45.41	46.71	15-86	- 0.44	0.658
Family size	3.35	3.76	1-10	- 0.988	0.325
IRR experience	9.91	7.12	1- 27	2.322**	0.023

** refers significant at 5% significant level

Source: own survey result (2008)

4. Sex of household head Gender is discrimination on the basis of sex that we fail for the most part to understand its original function while sex is biological classification. Even if gender-neutral policies of the extension systems provide equal chance of participation in the economy and equal access to productive resources, those who are marginalized are receiving less benefit and are further excluded due to less access to productive resources (Lubwama, 1999; cited in Yenealem, 2006). Inline to these women HHH are limited access to information, inputs, new technology, education and, health care. They have differential roles in small-scale farming as well as decision making (Legesse, 1992).

In similar way the irrigation cooperatives and irrigation are influenced by those who owns productive resources (small size of farm land) and who decides what to produce, and how much to produce, therefore this proposition is observed mostly in females.

The result shows that among the 120 sample HHHs 71.7% and 28.3 % of them were male HHH and female HHHs respectively. Accordingly out of the respondents said irrigation cooperatives have proper utilization of water 53.4%, 18.3% male and female HHHs respectively and poor utilization 23.3 % , 5 % male and female HHHs respectively. Therefore, those respondents who have responded irrigation cooperatives proper utilization are high in number than those respondent who have responded irrigation cooperatives poor utilization of water. This figure shows that there was no significant difference among the utilization of water and sex by irrigation cooperatives (χ^2 = 0.86, P= 0.354). This could be attributed to various reasons, due to traditional thinking that irrigation is to men's job or the technology is gender neutral or blind, hindering of women participation (Table 6).

Table 6. Distribution of sample HHH by sex and utilization of water through irrigation cooperatives practice

Sex	Category of Respondents of irrigation cooperatives				χ^2-value	P
		Properly utilization	Poor Utilization	Total		
Male	%	53.4	23.3	56.7		
Female	%	18.3	5	23.3		
Total		71.7	28.3	100.00	0.86	0.354

Source : own survey (2008)

5 . Education level helps farmer's ability to acquire a process and use of information relevant to the irrigation cooperatives.

The survey result revealed that the respondents have different educational level comparing that those who are illiterate, can read and write, attend formal education 65.8% , 1.7 % , 32.5 %

frequency respectively .The illiterate education of respondents said irrigation cooperatives have proper utilization is 48.3 % greater than poor utilization

respondents said is that 17.5 % . The read and write , formal education of respondent said of irrigation cooperatives have 1.7 % and 21.7 % proper utilization respectively greater in number than the poor utilization respondents have said that read and write ,formal education are 0 %and 10.8 % respectively. The figure shows that there was no statistically significant difference among the categories and education of irrigation cooperatives (χ^2 =139 , P = 0.499) (table 7) and a positive relationship relation between education and the respondents by irrigation cooperatives practice.

This has been supported by the findings of Paulos (2002) that education was an important for farmers to understand and to interpret the information they got and had also conducted that farmers with higher education level are more likely to used improved technology and could affect a farmer to be either to be an early or late adopter of fertilizer. Ngigi (2003) has also reported that farmers with better education level in Kobo district were found as users of flood irrigation.

Table7 . Distribution of sample HHH by education and utilization of water through irrigation cooperatives practice

Education level	Category of Respondents of irrigation cooperatives				χ^2-value	P
		Proper utilization	Poor utilization	Total		
Illiterate	%	48.3	17.5	65.8		
Read and write	%	1.7	0	1.7		
Formal education	%	21.7	10.8	32.5		
Total		71.7	28.3	100.00	1.139	0.499

Source: own survey (2008)

4.2.1.2 Economic factors

1.Farm size is one of the economic assets considered as a wealth status of a household.

The survey result showed that the land holding of the sample farmers ranging from 0.06 to 0.50 hectare with an average of 0.2439 hectare. Mean holding of the respondents said irrigation cooperatives have proper and poor utilization of water through irrigation cooperative were about 0.2465 and 0.2371 ha respectively . Therefore, those respondents who have responded irrigation cooperatives proper utilizations are large land holding than those said poor utilization of water. The one way ANOVA sample test result indicated that statically there was no significant difference among management of water category and farm size through Irrigation cooperatives (T =0.553 and P=0.581)(Table 8).

Rolling (1988) also generalized that progressive farmers have relatively larger holdings and are early adopters. Similar results of Tesfaye (2003) showed that land size were one of the main productive assets that determine farmers' potential for properly utiliztion of water.

Table 8 . Distribution of sample household head farm size in hectare by utilization of water .

Irrigation cooperative category	Mean	St.Dev.	Min	MAX	T	P
Proper utilization	0.2465	0.08475				
Poor utilization	0.2371	0.08350				
Total	0.2439	0.08346	0.06	0.50	0.553	0.581

Source: Own survey result (2008)

2. Livestock holding is one of the main economic activities for various reasons taking as a secondary occupation, for which livestock are sources for generating income (by selling animal products like meat, milk, & egg), traction and draught power (provided by oxen), transport (by pack animals) and sources of organic fertilizer and fuel (animal dung). The other importance livestock serves as a measure of wealth and prestige. Therefore, farmers used to rear different types of livestock kept dominant on-farm (cattle, sheep, mule, horse, donkey, and chicken) so they have positive relationship with Irrigation cooperatives.

Accordingly keeping the standardization of analysis, the livestock number was converted to Tropical livestock unit (TLU) (Appendix table 5). Thus the study reveals that on average a household head had owned 2.52 TLU

The result of this study revealed that the livestock holding of the sample respondents ranges from 2 to 84 number of animals with mean 21.12 of number animals . The mean number of livestock holding respondents said cooperatives have proper and poor utilization of water were 20.60 , 22.41 respectively. Therefore, those respondents who have responded irrigation cooperatives have proper utilization are less livestock holding than those respondents who

have responded irrigation cooperatives poor utilization of water. But, statistically there is no significant difference between the livestock holding and utilization of water. The test of one way ANOVA sample test showed that there was insignificance difference and negative relationship in livestock holding with the utilization of water through irrigation cooperatives practice (T = - 0. 696 and P=0.488) (Table 9).

REST (2003) has reported that respondents with higher livestock holding had a positive relation to accept an innovation and have the capacity to bear risks of using available extension packages and encourages himself to use of Irrigation.

Table 9 . Distribution of sample HHHs livestock holdings by utilization of water through irrigation cooperatives

Irrigation cooperatives Catagories	Livestock holding				T	P
	Mean	St.Dev	Min	Max		
Properly utilization	20.60					
Poor utilization	22.41					
Total	22.12	12.787	2	84	- 0.696	0.488

Source: Own survey result (2008)

3-OFF-farm income is self employing activity where households are involved outside their own agriculture activities like working as casual laborer on other farmers land etc to support their family (Tsegay, 2003). Thus, the majorities of sample respondents do have several sources where they could generate income, for that they could support their household economy during critical shortage of food consumption and compensating other expenditures like school fee, replacing selling of agricultural products and are also source of solving lack of seasonal and cyclical employment.

The survey result showed that the average monthly off farm income of the total respondents were 204.55 Eth Birr with a minimum of 30.00 Birr and maximum of 1000.00 Birr. Accordingly the respondents of irrigation cooperatives responds that proper utilization and poor utilization of water through irrigation cooperatives earned about 138.18 and 337.27 Eth. Birr respectively . Therefore ,those respondents who have proper utilization are less off-farm income than those respondents who have responded poor utilization of irrigation cooperatives .The result had shown that there was significant difference and negative relationship among off-farm income and respondent categories at 5 % significant level (T = -2.362 and P-value=0.037) (Table 10).

The result indicates that support house hold head economy during critical shortage of food consumption and compensatory their hose hold. but negative relation ship with proper utilization of water

Table10 . Distribution of sample HHHs off-farm income per month by utilization of water through irrigation cooperatives

Irrigation cooperative category	Mean	St.Dev.	Min	MAX	T	P
Proper utilization	138.18					
Poor utilization	337.27					
Total	204.55	196.637	30	1000	-2.362	0.037

Source: own survey data (2008)

4. Availability of water lifting devices are the tools used to pump water. Farmers with different water lifting devices have different capacity of using of water productivity, that is a farmer capable of having better devices can irrigate larger area timely than who pumps manually.

Thus sample respondents were asked the type of device they own . Out of the total sample respondents those who have motor pump, Tridle pump and who have not were 72 % and 28 % respectively. The water lifting device who have own said respondents proper utilization are less than the respondents poor utilization of water .So this indicates that the farm land is good for gravity pressure irrigation water. More over the statistical result shows there is significance difference at 1% significant level and appositive relation ship between water lifting device own and utilization of water (χ^2 = 9.932 and P=0.002) . (Table 11). The probable reason could be they are in need of the other traditional lifting mechanisms which are locally made and low cost.

Table 11. Distribution of sample HHHs availability of water lifting devices utilization of water through irrigation cooperatives

Water lifting device own	Irrigation Cooperatives category				X^2	P
		Properly utilization	Poor utilization	Total		
Yes	%	30.3	41.7	72		
No	%	3	25	28		
Total		33.3	66.7	100	9.932	0.002

Source: Own survey result (2008)

4.2.1.3. Institutional characteristics

The success or failures of particular technology in particular places at particular time are conditioned by many institutional factors; often interact during periods of crisis and risks (Reij et *al*., 1996; cited by Kebede, 2006). There are a number of important themes arising which include among others access to extension service with regard to information and technology,

Access to market and inputs, land security and tenure rights, investment and access to agricultural credit could also encourage to irrigation cooperatives.

1. Security Land tenure rights is among the institutional constraints that affect farmers' investment on various land holdings to carry out for a long or medium term measures on the context of agricultural activities. Thus, the bases of land tenure security for which farmers can confidentially carry out long-term investments require assuring of feeling of ownership.

Land tenure issues can have a variety of influences on irrigation projects. On one hand, it may be that lack of tenure security that people are reluctant to invest in irrigation structures on land, which they do not formally own. Where land ownership and rights of use is complex, it may be difficult to persuade the cultivation to improve land that someone else may use later. On the other hand, there are examples of situations where the opposite is the case. In some areas, farmers like to construct bunds and plant trees because it implies a more definite right of ownership (Zenebe, 2001).

The result shows 14.3 % of the total respondents were sure that they would cultivate their plot until 5 or limited years and 10.1%, 4.2% proper and poor utilization of water responded respectively, who were sure to use the same plot and even can inherit or transfer their plot to their children . In contrast to this about 85.7 % believe that they cannot inherit to their children. Even couldn't cultivate more than five years and pointed out their lands for nursery site, institutional construction & that rural people living nearby towns are displaced and their land is taken away for construction purposes. They believe the land tenure policy would assure them the property of ownership and the analysis result shows that there is no significant difference among the respondents by land tenure security and irrigation cooperatives (χ^2 =0.003 and p= 0.955). (Table 12).

Similar result has been reported by Fetein et al., (1998) indicating that there is relationship between tenure and adoption of agriculture technology. Instead, They find that peasants are more concerned with political and economic insecurity than insecurity of land tenure.

Table 12. Distribution of sample HHHs by security land tenure rights and irrigation cooperatives

Response	Category of the respondent irrigation cooperatives				Value	
	N	Properly utilization	Poor utilization	Total	χ^2	P
Yes	%	10.1	4.2	14.3		
No	%	61.3	24.4	85.7		
Total	%	71.4	28.6	100	0.007	0.934

Source: Own survey result (2008)

2. Access to credit is an economic incentive to resource poor farmers, who cannot finance agricultural input to purchase from their own savings especially during the early stage of irrigation. The same is true to that of investing some materials and to hire labor to construct and use of irrigation. It is important if there are opportunities to use any type of credit (formal & informal) for those of poor resource. The formal sources of credit in the study area are Dedebit Micro-finance Enterprise (DMFE) and local cooperatives, where as relatives, friends, traders, etc. are informal which farmers could get credit. However, some farmers have access to credit while others may not have (BoPED, 2005).

The survey result showed that, out of the total respondents 85 % of them had access to credit for livestock and improved seed and 15 % of them did not obtain credit due to lack Transaction cost . Accordingly about 61.7 % , 23.3 % of the respondents were said yes the properly and poor utilization of water respectively. and accordingly about 10 % and 5 % of the respondents

were said no the properly and poor utilization of water respectively refrained from credit because of lack of physical properties for which they are used as collateral lack of awareness fear of failure crop and other unspecified reasons.

The result shows that statistically there was no significant difference (χ^2 =0.261 and P=0.610) among the members category by credit access and irrigation cooperatives (table 13).

This could be due to the nature of the credit system and the result has been supported by the finding of Ebrahim (2006) verified that the preposition of access to credit decreases due to problems related to lack of transaction cost.

Table 13. Distribution of sample HHHs Access to credit by utilization of water through irrigation cooperatives

Response	Category of the respondent				Value	
	N	Proper utilization	Poor utilization	Total	χ^2	P
Yes	%	61.7	23.3	85		
No	%	10	5	15		
Total	%	71.7	28.3	100.00	0.261	0.610

Source: 0wn survey data (2008)

3. Distance of market . market is not the only place where farmers sell their agricultural products right after harvested to cover costs of farm inputs of social obligation and urgent family expenses but also a means to exchange information and discuss about the innovative improved agricultural technologies (Tesfaye, 2006).Thus closeness is what matters the interaction among it and the society.

The survey result indicated that the average distance of respondent's home from the nearest market place takes about a mean of 1.28 hr with a minimum of 1 hr and a maximum of 7.00 hrs

to reach to the nearest local market. Accordingly the respondents properly and poor utilization of water through irrigation cooperatives travel for about 1.27 and 1.29 hrs respectively to reach the market . Therefore the result shows that the respondents proper utilization of water responded average distance nearest than responded poor utilization of water through irrigation cooperatives. The result shows that statically there is no significance difference at significance level (T = - 1.18 and P=0.906). (table 14). Thus this could have motivated farmers to irrigation earlier than those who lived far from the market. The members can sell the fresh and perishable fruits and vegetables produced at the right time. This is another important issue that was shared by cooperatives. The success of irrigation cooperatives in the long-run very much depends on the access of the farmers under the command area to the market.

This has been supported by the survey result of Molla (2005) pointing out that farmers nearest to market can adopt irrigation earlier than who lived far from local market and where their farming system is based on rain fed.

Table 14. Distribution of sample HHHs distance of market by utilization of water through irrigation cooperatives

irrigation cooperatives category	mean hour	St.Dev	Min	Max	T	P
Properly utilization	1.27	1.078				
Poor utilization	1.29	1.194				
Total	1.28	1.107	1	7	- 1.18	0.906

Source: 0wn survey data (2008)

4-Agricultural extension contact enables to boost agricultural production through promotion of new technologies by providing the farmers with available information and advice. Therefore

it is one of the single variable predictors that emerged significantly in most of the research work on technology transfer and adoption. Extension contact is measured by frequency of participation in different extension events like training, demonstration, visit, and meetings Rolling, (1998).

The survey result indicated that the total respondents were visited by an extension agent with mean of 2.32 times. While the properly and poor utilization of water said had been visited by extension agent with mean of 2.31 and 2.32 times respectively. As per the hypothesis , the relation between extension participation and over all proper utilization of water was found to be in significant difference at significant level (T = - 0.40 and P=0.968) (Table15).

The findings of Endrias (2003), Chilot *et al*., (1996) and Edulu (2006) have reported that extension contact has played positively on adoption extension packages and soil conservation structures in Dedio and Ener districts respectively.

Table15 . Distribution of sample HHHs extension contact by utilization of water through irrigation cooperatives

Irrigation cooperative category	Mean	St.Dev	Min	MAX	T	P
Properly utilization	2.31	1.140				
Poor utilization	2.32	1.296				
Total	2.32	1.181	0	5	- 0.40	0.968

Source: own survey result(2008)

4.2.1.4 Technical factors

1. Training (TRAIN) is an important aspect of participation that equips farmers with new knowledge, skill and performance properly. Farmer's decision to adopt irrigation in preference to other alternative technologies depends on the degree of risk and complex to

operate the irrigation cooperative. The more complex technology is the greater resistance to adopt and difficult to understand and requires greater management, skill and knowledge supported by demonstrations and field visits.

Participation of training on agricultural activities is an important aspect which equips farmers with new knowledge and skill to perform new practice or certain technology properly and help to solve the problems existing during construction and maintaining of the canals of irrigation. Frequent training could help solve the complexity of the operation irrigation which arose during, management of water distribution and utilize, maintenance of canals and diversion rivers and water pump operation etc.

Thus the result shows that out of the total respondents 35.8 %, 64.2 % of them had participated and not participate in training respectively. Accordingly the respondents said that irrigation cooperatives have proper utilization of water and poor utilization of water 30 % , 5.8 % of the trained were respectively, and the rest were respondent irrigation cooperative are 41.7 % , 22.5 % non trained. Therefore, the respondent who have responded irrigation cooperatives proper utilization of water are large in number than poor utilize of water. The figure Indicating that the result show statistical significant mean difference at 5 % significant level (χ^2 = 4.795 and p=0.029) (Table 16) and positively influenced the training by the respondent of utilization cooperatives. The result indicates that training supports that practically on field visit and experience share for adopting irrigation utilization of water.

Fujitaet al., (1999) finding had supported that extension training supported practically on field visit and experience share has a higher probability of adopting irrigation techniques.

Table 16 . Distribution of sample HHHs participation in Training by utilization of water through irrigation cooperatives

Response	Category of the respondent				Value	
	N	Properly utilization	Poor utilization	Total	χ^2	P
Yes	%	30	5.8	35.8		
No	%	41.7	22.5	64.2		
Total	%	71.0	29.0	100.00	4.795	0.029

Source: Own survey result (2008)

2. Field visits is a form of equipping a trainee with practical and experience sharing activities to upgrade skill and develop the confidence of once attitude and to adopt and get use of the technology (Tsegay,2003). With regard to the maintenance, proper utilization of irrigation during the survey year (2006/7) of the respondents, those who had been exposed to field visits, and experience sharing are beneficial to operate the devices and to understand the nature of the technology. Thus the result shows that out of the total respondents 71.6 %, 28.4 % of them had participated and not participate in field visit respectively. Accordingly the respondents said that irrigation cooperatives have proper utilization of water and poor utilization of water 10.8 %, 60.8 % of the them were who involved in field visit respectively. In contrast about 4.2 %, 24.2 % were who don't involved in field visit proper and poor utilization cooperative respectively. Therefore, the respondent who have responded poor utilization of water conduct field visit in irrigation cooperatives are large in number than properly utilize of water.

The result with them or select the one who have a capability to accept nearby extension agents. Reveals that there was no significance difference (χ^2=0.003 and P=0.955)(Table 17) and positively influenced among the respondent of utilization cooperatives and field visit by irrigation cooperatives. The probable and observed reason for this non significant could be that DAs may select farmers who have more homophiles

Table 17 Distribution of sample HHHs participation in field visit by utilization of water through irrigation cooperatives

Response	Category of the respondent of irrigation cooperatives				Value	
	N	Properly utilization	Poor utilization	Total	χ^2	P
Yes	%	10.8	60.8	71.6		
No	%	4.2	24.2	28.4		
Total	%	15	85	100.0	0.003	0.955

Source: Own survey result (2008)

4.2.1.5 Physical characteristics

A farm plot with respect to its quality, topography suitability, texture of the soil to retain moisture and its fertility to support plant with nutrients, fitness of the plot to any agricultural activities and the amount of labor finance and time needed to operate are the critical farmers measurement how he can arrive to decision on his plot to gain a better production of irrigation cooperatives.

1: Slope of the Farm is the natural landscape of a particular area that helps to identify its physical factors which limit or speed up the promotion of agricultural activities (Tesfaye, 2006). The condition of the farm plot in terms of its capability to retain run off and the cohesiveness of the soil particle from detaching and eroding by rain drop depend on the soil

texture and gradient of the catchments (FAO, 1994). Therefore constructing irrigation without the consideration the texture of the soil and gradient of the plot, it could be damaged high runoff and destruction of canals and diversion may create and affects to irrigation cooperative to manage of water.

The survey result showed that out of the total respondents 83.4 %, 10.0 % and 5.9 % of their plots were found in gentle, medium and sloppy areas, respectively. In line with this about 61.7 %, 21.7 % properly and poor utilization of water for farm plot was found in gentle slope respectively. Whereas about 4.2 %and 5.8 % properly and poor utilization of water for farm was found in medium slope respectively .Therefore the respondents responds proper utilization of water said greater in number which have gentle slope farm land. The result showed that there was significant difference at 5 % significance level (χ^2 =6.575 and P=0.037) (Table 18).

The finding has been supported by FAO (2000) indicate that construction of irrigation systems in farm plots greater than 5% slope had aggravated high run off and soil erosion and accumulation of sedimentation which increases cost of maintenance. Hatibu and Mahoo (1999) had also described that the steepness of a plot affects the use of irrigation technologies and farmers lag to decide and to invest their labor and time.

Table 18. Distribution of sample HHHs slope of the farm plot by utilization of water through irrigation cooperatives

Response	Category of the respondent of irrigation cooperatives				Value	
	Unit	Properly utilization	Poor utilization	Total	χ^2	P
Gentle	%	61.7	21.7	83.4		
Medium	%	4.2	5.8	10.		
Sloppy	%	5.8	0.8	5.9		
Total	%	71.7	28.3	100.00	6.575	0.037

Source: Own survey result (2008)

2. Soil type of the farm plot to retain or to hold water depends on the texture of the soil, thus a farm plot with fine soil particle has the ability to hold water and the soil pore could hinder the water movement within, in contrast courser soil texture creates percolation of water with higher seepage.

The survey result has shown that out of the total respondents about 30 % ,20.8 %,49.2 % of their farm plot was textured largely with clay, loamy and sandy soil type respectively. In line with this About 16.7 %, 13.3 %, 41.7 % of the clay ,loamy and sandy soil type respectively of properly utilization of irrigation cooperatives . 13.3 %, 7.5 %, 7.5 % of the clay ,loamy and sandy soil type respectively of poor utilization of water through irrigation cooperatives.

Therefore the respondent of irrigation cooperatives proper utilization of water responded the texture of soil high in farm land than poor utilization of water responded through irrigation cooperatives. Thus the result showed that there was significant difference at 5 % significant level (χ^2 =10.296 and P=0.006).(Table 19).

Similar findings reported by Molla (2005) associated with the water holding capacity defined as rate of its infiltration due to soil textural characteristics.

Table 19 . Distribution of sample HHHs soil type by utilization of water through irrigation cooperatives

Response	Category of the respondent of irrigation cooperatives				Value	
	Unit	Properly	Poor utilization	Total	χ^2	P
Clay	%	16.7	13.3	30		
Loam	%	13.3	7.5	20.8		
Sandy	%	41.7	7.5	49.2		
Total	%	71.7	28.3	100.00	10.296	0.006

Source: Own survey result (2008)

4.2.1.6. Psychological factors

Perception towards irrigation Socio psychological factor that could arose against undoubted thinking like the probability of loosing domestic animals or drawing of children in the diversion rivers , seepage due to failure of technical design, costly to maintain and to operate etc all of these affect negatively the utilization of water through irrigation cooperatives. Roger and Shoemaker (1971) farmers' decisions to adopt a new technology irrigation in preference to other alternative technologies depend on complex factors, and the typical characteristics of technology are based on relative advantage, observably , complexity, compatibility, risk and uncertainty.

Farmers have subjective preference for irrigation characteristics and those could play major roles in technology adoption. Adoption (rejection) of technologies by farmers may reflect rational decision-making based up on farmers' perceptions of the appropriateness (inappropriateness) of the characteristics of the technology under investigation (Ebrahim, 2006).

The survey result showed that about 76.6 % , 20.9 %, 2.5 % ,of the sample respondents perceived that superior , less superior ,no difference respectively in the irrigation cooperatives . More specifically, who perceived that of the sample respondents perceived 57.5 % ,14.2 % superior and

less superior in proper utilization and 19.1 %,6.7 % , 2.5 %, who perceived that of the sample respondents poor utilization of water .

Following this, the chi-square test result revealed that there was significant difference in perception at 5 % significant level among the categories by(χ^2 value = 8.257, P= 0.016).(Table 23) The probable reason could be that the members of Irrigation cooperatives doubted thinking.

Table 20. Distribution of sample household heads their perception by utilization of water towards irrigation cooperatives.

Response	Category of the respondent of irrigation cooperatives			Value	
	Properly utilization	Poor utilization	Total	χ^2	P
Superior	57.5	19.1	76.6		
Less superior	14.2	6.7	20.9		
No difference	-	2.5	2.5		
Total	71.7	28.3	100.0	8.257	0.016

Source: Own survey result (2008).

4.3. Econometric results and discussion

The independent variables influences properly utilization of water through irrigation cooperatives categories were compared by logistic regression model by removing the high insignificants

4.3.1. Econometric results and discussions on the significant variables

The results of this study confirm a priori expectation in the decision to irrigation cooperative was influenced by the interaction of several personal, economic, physical, technical, psychological and institutional factors. Based on nominal logistic regression model, the parameters of the variables that were expected to influence the irrigation cooperatives was used to estimate (table 21).

Independent variables until the whole model test is significant i.e. P value < 0.05 the parameter estimate table examined and tested individually the independent variables and computed out of them were found to differ significantly at P value < 0.05 significant level.

Therefore out of 18 explanatory (8 continuous and 10 dummy) variables that were hypothesized to affect farmers' decision of use of irrigation, 17 were employed in the statistical model, and the output of nominal logistic regression model has displayed three variables namely, availability of the water lifting device of the house hold head , training of the house hold head and soil texture of the house hold head were found significantly influencing the factors affecting properly utilization of water through irrigation cooperatives at significant level of P value < 0.05 .

Available of water lifting devices had influenced the utilization of water though irrigation cooperatives positively and significantly at less than 5% significant level P = 0.013 . Farmers who live in area where their controlling mechanism based on cultural and economic conditions face problems driven by crop failure due to combination of off seasonal essential rain fed areas. Assurance of crop irrigation is essential through diversion Rivers and locally adopted, manually operated, simple economic and easy to operate water lifting devices are required. Thus to have

effective irrigation water lifting devices like Treadle pump , water pump which are human operated pump of powered provided by other operators feet or hand to extract water from underground are also important practice required.

Training of the house hold head is relatively a means of capacity building where most people tend to participate but few institutions have acquired knowledge for proper implementation and properly utilization of water through irrigation cooperatives . Farmers who don't have knowledge on the irrigation cooperative about its role of basement need of training or practical support for construction canals and others is a means to decrease the complexity of the utilization is significantly at less than 5% is significant level p = 0.011. So that the components of the training like tour, field visit and demonstration trials positively have influenced human behavior.

Participation of training on agricultural activities is an important aspect which equips farmers with new knowledge and skill to perform new practice or certain technology properly and help to solve the problems existing during construction and maintaining of the canals of irrigation. Frequent training could help solve the complexity of the operation irrigation which arose during utilization , distribution of water, pump operation etc.

Soil texture of the farm plot to retain or to hold water depends on the texture of the soil, thus a farm plot with fine soil particle has the ability to hold water and the soil pore could hinder the water movement within, in contrast courser soil texture creates percolation of water with higher seepage.

It affects farmers' decision to construct irrigation on their plot as some soil texture has the capacity to crack or rupture had influenced the utilization of water though irrigation cooperatives positively and significantly at less than 5% significant level p = 0.03 . For

example clay soil needs more labor and cost to construct irrigation structure. However, clay soil is more resistance, sticky and harder than sandy soils and that it is more suitable to construct underground irrigation structure than sandy soil type. Hence, sandy and courser soil is expected to have negative effect on irrigation cooperatives.

Table 21. Summary of maximum likelihood parameter Estimates of logistic regression model significant

Characteristics	Term	Estimate	Std.eror	Chi square	Prob> chisquare
	Intercept	-0.0427623	51.815495	0.00	0.9993
Economical	Water lifting device	0.8707878	0.3537574	6.06	0.0138
Technical	Training	0.80489742	0.3228903	6.21	0.0127
Physical	Soil type	0.8489511	0.3832306	4.91	0.0267

Sources: Computed from the survey data

4.3.2. Effects of Changes in the Significant Explanatory Variables on the irrigation cooperatives

Explanatory variables positively or negatively influence the dependent variable at different significant levels and magnitude of these factors that vary spatially and temporally on the same line influences and effects to change are also different among members and the entire samples. Thus, the Logistic regression model has an important role in identifying these differences through marginal effects among members and the entire sample of the respondent by a specific

unit. Therefore, the different impacts of explanatory variables on irrigation cooperatives among members and the entire sample households are listed down as effects of changes (derivatives).

Availability of water lifting devices lack of water lifting devices negatively influenc**es** the irrigation cooperative. Accordingly the marginal effect result has indicated that, with an increase use of pumping practice for a particular purpose, irrigation cooperatives among members . This indicates farmers with longer experience and equipped with pumping devices had advantageous in having information and using the technology earlier by developing confidence. The result has been supported by Ngigi (2003) that a farmer who has experience on using gravitational canals to irrigate his field has a possibility to adopt water pumping where it is not possible to convoy water through gravity.

Training farmers and making them participate in the workshops and training of irrigation cooperatives during field days are expected what they saw or involved in the mobilization to participate and can influence their decision. However, in the utilization of water to distribute equally and maintenance of canals do not make involve farmers to be trained technically from the initial planning up to evaluation and as a result the irrigation cooperative of the farmer to utilize it, and to maintain the canals and utilization of water . The complexity nature of any new management of irrigation cooperative training determines farmers' utilization of water.

Training on construction and maintaining irrigation was positive and significantly influenced farmers' adoption behavior. Those farmers who have got training on irrigation practice were found to be efficient in utilizing water than farmers who were not provided with training. Many farmers in arid and semi-arid areas were not effectively utilizing water due to lack of interest in the properly utilize and inadequate training in irrigation cooperatives and small scale irrigation works.

Soil type of the irrigation farm land: The disadvantages in runoff irrigation in small-irrigation system are that the terrain should preferably be even and the success of this method of irrigation depends very much on soil type . Each irrigation cooperatives requires particular biophysical conditions. (E.g. soil type). Clay and black type of soil cannot be easily ruptured than sandy soil. Likewise sandy soil is not more preferable for constructing underground water harvesting structures due to seepage, even if it demands low labor and construction cost than loam and clay soils, sealing the walls and base of the storage with cement to reduce percolation is high investment.

As the aim off irrigation cooperative to support crops suffering from moisture stress through supplementary irrigation and to provide water to domestic use. However, some farmers who own irrigation land in the study area are differently using it and are not meeting the advantage of irrigation cooperative as it was expected.

The study tried to see the factors affecting proper utilization of water through irrigation cooperatives in the study area.

4.4 .Problems in utilization of water through irrigation Cooperatives

1. According to the respondents and key informants the major problems affecting the utilization of water through irrigation cooperatives are:Inadequate operation and maintenance of the canal: Due to unskilled labor contribution of the members, the canals were not giving the expected services for long period of time. 78 % of respondents have replied that inadequate operation and maintenance of the canal is the first major problem for irrigation cooperatives. This is the causes for water loses by percolation and seepage in the canals.

2. Poor involvement of the target users: Each individual member did not consider as he has a responsibility of involving in irrigation cooperatives activities. Most members were expected from the elected committees to perform every activities of the society. Therefore, 57% of the respondents have replied that poor involvement of the farmers is the second major problem.
3. Irrigable capacity of water and real demand of farmers did not match with change in cropping pattern: A reliable supply of irrigation water to the cultivated plots of the member farmers of the cooperatives in judicious manner in accordance with the quantity, timely required and agreed up on. But 62% of the respondents said that the quantity of water supplied were either overflowed or under flowed without achieving level of production requirement.
4. Inequitable delivery and distribution of irrigation water: Delivery and distribution of irrigation water which includes the discharge measurements at the source, major control points such as head parts of minor distributors and lateral as well as rainfall and evaporation causes for inadequate distribution of water which contributed to steal water each other. Hence, 61% the respondents have replied that inequitable distribution and delivery of water is another major problem for irrigation cooperatives.

All the above problems have created conflict among the users during the period of low water supply from the sources. It is a common and prolonged problem from the middle to the end of the dry season.

Chapter 5. Conclusion and Recommendation

5.1. Conclusion

Most of the small-scale irrigation schemes developed was not successful due to different reasons, of which lack of institutionalizing water users associations (WUA) and poor management system are significant.

Irrigation cooperatives enable farmers to own and democratically control their business. Farmers are organized to help themselves rather than rely on the government. And this allows them to determine services and operations that will maximize their profits. They increase the income of the farmers by raising the general effectively and properly utilize of water. They also increase the farm income of the farmers by equitable distribution of water made in cannels operations, by up grading the quality of maintenance duration of rivers.

The major constraint to successful Irrigation cooperative is lack of proper utilization of water particularly when in dry season. Hence, problems associated with dependence on rain fed agricultural systems are common in Tigray region especially in the study area with repeated famine and repeated crop failure are some to be mentioned.

The study area is located in semi arid region where rainfall is erratic, irregular, and moisture stress is characterized by low productivity. Population pressure is also the most pressing problems that affect increasing agricultural production. The strategy to meet increasing food demand is to increase crop production through supplementary irrigation, by establishing irrigation cooperatives to manage water distributions. Accordingly regional government has made efforts by promotional office; but, irrigation cooperatives had been influenced and this make the objective of the study to focus on analyse and assessing the factors that affect the irrigation

cooperatives in the study area and to give highlights proper utilization of water through irrigation cooperatives.

The study area, out of the nine Weredas (districts) of central zone Tigray, was purposively selected since no research was conducted about this problem in the study area. There are only five irrigation cooperatives in the wereda .All the five irrigation cooperatives were selected. Finally, the respondents were selected randomly using probability proportional to size. 120 sampled HHHs were selected and interviewed using structured interviewed schedule.

After the data has been collected ,it was coded and entered into Statistical Package for Social Science (SPSS) version 13.0 computer program for analytical analysis .Descriptive statistics (percentage, mean, standard deviation, range etc) and econometricsmodel was used. Mean comparison methods to test the mean difference potential power of the continuous (one way ANOVA using T test) and frequency differences for dummy variables (using χ^2-test), bivariate correlation analysis and regression were practiced.

The results of descriptive statistical analysis indicated that, out of the eighteen variables ,seven variables such as irrigation experience , Off farm income activity , availability of water lifting devices, training of the HHH , slope of the irrigation farm land ,soil type of the irrigation farm land and perception of the respondents of irrigation cooperatives were significant at 1%, 5% and 10% significant level.

The results of logistic regression indicated that three variables, lack of water lifting devices, training and soil type of the farm were significantly affected the utilization of through irrigation cooperatives.

The major problems affecting the utilization of water through irrigation cooperatives are inadequate operation and maintenance of the canal, poor involvement of the target users

farmers ,Irrigable capacity of water and real demand of farmers did not match with change in cropping pattern and inequitable delivery and distribution of irrigation water.

5.2 Recommendation

The recommendations are based on factors affecting the proper utilization of water through irrigation cooperatives

The promotion and the proper utilization of water through irrigation cooperative is a prerequisite for implementing other strategies and for addressing food security in the study area, so strengthening irrigation cooperative , immediate researchers and extension workers to promote use of this organizing, by enhancing collaboration, local and regional administrators as well as networking partnership for exchange of immediate information and experience sharing, must taken as own aspiration and designs of the main task.

1. Irrigation experience has shown practice measured in number of years for which a respondent was involved to practice a given irrigation to improve one's livelihood through the application of skill or knowledge by getting full information and able to reach to evaluate the advantage of the association. Farmers with longer farming and experience of using any type of water conservation and flood irrigation are able to assess potentially the benefits of new irrigation cooperatives than with short farming and privately. Therefore, such type of experience has a positive influence to improve irrigation cooperative than the one with no experience.

2. A special focus must be given for the provision of water lifting devices by irrigation cooperative in the form of credit particularly for those resource poor farmers than incorporating with other credit convention systems. Since without these devices they could not pump the stored water and irrigated timely their fields and for the time being to make aware of the

advantage of the device, government must subsidize the cost to lower the price of the device to develop and promote use of irrigation cooperative. To accomplish this NGO's, government should take responsibility of establish a loan to buy the water lifting devices which can repay on the long run irrigation cooperatives.

3-Off-farm income is self employing activity where households are involved outside their own agriculture activities like working as casual laborer on other farmers land etc to support their family. Thus, the majorities of sample respondents do have several sources where they could generate income, for that they could support their household economy during critical shortage of food consumption and compensating other expenditures like school fee, replacing selling of agricultural products and are also source of solving lack of seasonal and cyclical employment of irrigation cooperatives.

4. It is proved that those farmers who have the largest contact with extension agent and received intensive training had brought a behavioral change to capture the benefits of the technology faster than those who do not, therefore the managing organizing demonstration sites and training for capacity building must be the task. Thus the extension contact hour must increase to reach and to treat equally the farmer by extension services.

5: Slope of the farm **is** the natural landscape of a particular area that helps to identify its physical factors which limit or speed up the promotion of agricultural activities. The condition of the farm plot in terms of its capability to retain run off and the cohesiveness of the soil particle from detaching and eroding by rain drop depend on the soil texture and gradient of the catchments. Therefore, constructing irrigation without the consideration the texture of the soil and gradient of the plot, it could be damaged high runoff and destruction of canals and diversion may be created.

6. Soil type **of** the farm plot to retain or to hold water depends on the texture of the soil, thus a farm plot with fine soil particle has the ability to hold water and the soil pore could hinder the water movement within, in contrast courser soil texture creates percolation of water with higher seepage. Therefore, cultivation irrigation without the considering the texture of the soil and gradient of the plot, it could be less production due to peculation water and low fertility.

7.Perception towards psychological factors that could arose against undoubted thinking like the probability of loosing domestic animals or drawing of children in the diversion rivers , seepage due to failure of technical design, costly to maintain and to operate etc all of these affect negatively the management of irrigation cooperatives. The farmers' decision in using irrigation through irrigation cooperatives was associated with specific cases on understanding the benefit and simplicity of the technology, therefore modification of farmers' perception (awareness creation) to bring behavioral change in developing their skill and knowledge through extension works, training and field visit and must be taken as an issue.

5.3 Implications for future research

Further research should be taken in to account:

1. Cropping pattern of the irrigable land should be studied so as to reduce overutilization of water through cooperatives.

2. The characteristics and water holding capacity of the soil should be studied for efficient utilization of limited water resource.

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7. Appendices

7.1 Appendix 1. List of tables in Appendix

Appendix Table 1. Primary cooperatives of the country by region, number of members and capital

Region	Number	Members			Capital (In birr)
		female	Male	Total	
Amhara	2114	1290476	154656	1445132	85211401
Oromiya	2720	145302	1453018	1598320	135766940
Debub	1480	108332	935719	1044051	140637880
Bennishangul	63	589	6804	7393	1931940
Harari	71	779	2380	3159	838989
Gambela	38	2067	2527	4594	300000
Afar	113	154	922	1076	693520
Tigray	1215	85633	341167	426800	54903066
AddisAbeba	6035	122163	307876	430039	41734692
DireDawa	327	2748	9648	12396	6179304
Somale	247	2267	8525	10792	5811425
Total	14423	1760510	3223242	4983752	474009157

Source: Federal Cooperative Commission, Annual Report 2004/2005

(Unpublished Amharic Version)

Appendix table 2. Primary cooperatives of the Tigraye region by type of cooperative, number of members and capital

Ser. No.	Cooperative Type	Number	Members			Capital		
			Male	Female	Total	Current	Fixed	Total
1	Multi purpose	576	238131	77806	315937	15397761	23845851	39243612
2	Irrigation	176	9328	2816	12144	41072	735800	776872
3	Animal Products	46	752	32	784	46416	325935	372350
4	Fattening	14	272	48	320	17950	140900	158850
5	Poultry Production	7	106	4	110	4575	31200	35775
6	Indiginous seed producers	2	27	90	117	18	54	72
7	Bee-Keeping & honey	14	194	5	199	6455	41530	47985
8	Construction	162	2237	101	2338	401073	344465	745538
9	Artisans	10	79	11	90	12120	16062	28182
10	Saving and credit	135	5153	2331	7484	5958087	4602795	10560882
11	Consumers	9	-	-	144	1115500	11640	1127140
12	Mining	13	355	2	357	23730	12291	36021
13	Brick producers	1	11	1	12	6500	910	7410
14	Housing	43	-	-	547	1639880	25270	1665150
15	Laborers	1	105	-	105	1050	525	1575
16	Wood Distribution	8	98	1	99	49700	2440	52140

17	Recreation	1	5	5	10	5000	500	5500
18	Metal Work	10	145	8	153	77500	1570	78770
19	Bio-gas	1	-	98	98	490	490	980
20	Tailors	1	1	9	10	500	500	1000
21	Electric	1	153	85	235	4760	1190	5950
22	Grind-mills	1	153	85	235	4760	1190	5950
	Total primary Coop.	1215	256978	83498	341167	24808496	30094571	54903066
	Union Coopeatives	20	-	-	160 1^0 coops.	-	-	5110890

Source. Tigraye Cooperative Promotion Commission, Second

Quarter Report 2004/2005. (Unpublished English Version)

Appendix table 3 Status Of Irrigation Cooperatives in Tigray up to 1997 Eth.cal.

S. N.	Year	No.	Membership			Capital			Size of land inhectares
			Male	Female	Total	Registr Ation	Share+fixed & recurent	Total	
1	Upto1996(Eth.C.)	86	7240	2472	9712	9766	244210	253976	1442.20
2	1997(Eth.C.)	90	2088	344	2432	31206	491590	522896	800.14
	Total	176	9328	2816	12144	41072	735800	776872	2242.34

Quarter Report 2004/2005. (Unpublished english Version)

Source. Tigraye Cooperative Promotion Commission, Second

Appendix Table 4 : Conversion Factors Used to Compute Adult-Equivalent (AE)

Age Group (years)	Male	Female
< 10	0.0	0.0
10 – 13	0.2	0.2
14 – 16	0.5	0.4
17 – 50	1.00	0.8
Greater than 50	0.7	0.5

Source: Abebe Haile Gebriel, 2000.

Appendix Table 5 : Conversion Factors to Estimate Tropical Livestock Unit equivalents

Animal Category	TLU	Animal Category	TLU
Calf	0.25	Donkey (young)	0.35
Weaned Calf	0.34	Camel	1.25
Heifer	0.75	Sheep and Goat (adult)	0.13
Cow and Ox	1.00	Sheep and Goat (young)	0.06
Horse	1.10	Chicken	0.013
Donkey adult	0.70		

Source: Storck, et al., (1991).

Appendix Table 6 : Number of livestock found in the study area

Type	Number	percent	Rank of importan
Oxen and cow	87644	26.14	3
Goat	94481	28.18	2
Sheep	24692	7.4	4
Donkey	7821	2.33	5
Mules	127	.037	8
Chickens	112645	33.6	1
Bee-colony	7504	2.24	6
Camel	334	0.099	7
Total	335248	100.00	

Source: kola tembien wereda agricultural and rural development office, 2006

Appendix Table 7 : Summarized rainfall data of kola tembien wereda (1992-1999) EC

	Cropping year Ethiopian colander							
Annual Rain fall in mm	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99
	721.48	689.93	850.1	511	697	642	1216	690

Source: kola tembien wereda agricultural and rural development office, 2006.

Serial No……..
Date…….

7.2 Appendix II . Interview Schedule (for members of Irrigation cooperatives)

Remark: The following Interview have been set to understand analysis factors affecting proper utilization of water through irrigation cooperatives at woreda Kolla Tembien ,Tigray Region, Ethiopia. The answers are confidential and will not have any consequence on you personally in any ways. Please give correct answers to the following Interview.

I. Area information and Interview scheduling

1. Region _____

2. Zone_____

3. Woreda _____

4. Name of Rural Peasant Administration_____

5. Names of Irrigation Cooperative _____

6.Name of the Interviewer _____

7. Education Level (fill grades completed, or certificate earned) _____

8. Affiliation of the Enumerator: _____

A. House hold and demographic variables

A1.1. Name of the respondent (he/she must be head of the household: HHH)_____

A1.2. Age of the HHH: _____ years

A1.3. Sex of the HHH:

1. Male 2. Female

A1.4. Religion of HHH

a. Muslim b. Orthodox Christian c .Protestant d. Catholic e. Other (specify) ---

A1.5. Education level of HHH

a. Illiterate b Read and write c._____ Years of formal education d. Religious school e. other (specify) _____

A1.6. Social status of the HHH

1 Tabia baito leader 2. Religious leader

3 Tabia baito member 4. other specify

A1.7. Marital status of the HHH

a. Married
b. Unmarried
c. Divorce
d. Widowed

A1.8 Age, sex & education level of family members

Name	Age	Sex M=male F=Female	Education level use code from Q 1.5)

Experience in irrigation cooperative

A1.9. Do you participate in irrigation cooperative?

1-Yes 2- No

A1.10. Do you have the knowledge about the importance of irrigation systems?

1- Yes 2- No

A1.11. If yes for how long have you been using any type of irrigation system? _____Years

A1.12. Specify the type of irrigation system, which you ever more used before_____

A1.13. Do you have other alternatives of water source other than rain fed?
1.Yes 2. No

A1.14. Which one do you think help to have more exposure to use the irrigation?
1-Better educated 2-poletical membership 3-Religious leader

4-Development cadre 5- Contact farmer 6-other specify

A1.15. In which category does your household fall in relation to the use of irrigation in your community?

1- Poor 2- medium 3-better rich

A1.16Have you ever faced crop or tree failure due to moisture stress?

1- Yes 2- no

A1.17. Experience and revenue from ------activities

Activity	Did you participate in activities 1=yes 2=No	Years of experience	Annual income (Birr)
Farming			
Non-farming			

A1.18. How long has you practiced production of horticultural products? _____ Years

A1.9. What is your major means of income generation?

a. Horticulture production b. Grain and pulses production
c. Grain trading d. Horticulture trading
e. Livestock production f. Livestock trading
f. Other income generation

B Institutional Variable

land tenure security

B1.1.Do you feel that the farmland, where you built irrigation belongs to you throughout your lifetime?

1. Yes, 2. No

B1.2..If Yes, why? -----

1-Expectation of land will be redistributed 2. Land belongs to the government
3-Expectation of farmland can be taken any time by the government,
4- Will no longer stay in farming (stop farming) 5. Others (specify).

B1.3..Do you agree if the government allows you to sale your land?

1- Agree 2- Disagree 3- Difficult to decide

B1.4..Does the land tenure policy encourage to utilize irrigation?

1-yes 2-No

B1.5.What do you expect in your landholding after five years from now?

1-Increases 2- Decreases 3. Remain the same

B1.6.Is there any opportunities to get land for you the newly household heads?

1-Yes 2-No

B1.7.If yes, what is the mechanism to the get land?

1-Sharing from relative,
2-The PA can provide them from the dead with no relatives
3-rented in 4- other specify

B1.8 Is there any problem using of the irrigation related with the existing land tenure system?

1-yes 2-No

B1.9. If yes what are the main problems?

1- Renting land don't allow to use irrigation the whole of your life time
2- the land can be distributed
3- sharecropping doesn't encourage to invest once labor or time

Extension contact

B1.10. Have you ever got the agricultural extension service about the irrigation?

1-Yes 2-No

B1.11. If yes how many days per month did you get the service till now? ----------

B1.12.If no, why?

1-Extension agent is not adequate 2-the extension office is far
3- Luck of time to get advice 4-Other specify.

B1.13 Who provides the extension service about irrigation?

1) DA 3) Woreda experts 2) Local leaders 4) others, specify

B1.14.When do you discuss about the use of irrigation?

1-daily 2- weekly 3- monthly 4- quarterly

B1.15.which of the following types of advices more focusing

1-Design 2-irrigate farming 3– use RWH storages according the water& crop requirement
4–constructing and maintaining of canals 5-othersspecify—

B1.16What is the most common place where you usually contact development agent?

1-at farm field 2-demonstration 3-training center
4-at farmer's home 5-at his office

B1.17-.Is there any possibility of getting an advice on how to use the irrigation other than extension agent?

1-Research center 2-University 3-NGO 4. other specify

B1.18 How far is the distance of the extension center from your home? ----------km

B1.19.Have you ever participated training programs that is organized for farmers about irrigation last year?

1-yes 2-No

B1.20.If yes, what is the frequency of training? ----------

B1.21.Do you think the training was helpful to utilization of irrigation?

1-yes 2-No

Market

B1.22 Do you have the access to market to sell agricultural products which you produce them using irrigation?

1-Yes 2- No

B1.23.Which of the following market problems are that affects utilization of the irrigation technologies?
1-Distance of the market from the dwelling 2.Low decreasing out put price
3-High/increasing input price 4 Price fluctuations for out puts
5-Price fluctuation for inputs 6-High transportation cost
7-selling time 8.other specify

If choose choice 1 select How far is the distance of the market place from your irrigation farm land in hr ?

B1.24.Do you get fair price for your product? 1-yes 2-No

B1.25. If No. How does the fluctuation of price influence the usage of irrigation?

1-highly 2-moderately 3-nothing

Agricultural credit issues

B1.26. Do you have credit access to irrigation for horticulture production?

1= Yes 2= No

B1.27.If yes, who is the source of the credit?

1- Government scheme 2-NGO

3- Local trader's 4-Local formal cooperatives 5 traditional associations

6 Micro-finance institute 7 Bank 8. Friend/relatives/neighbor

B1.28. In what form do you take the credit?

1- Cash 2- In kind 3. both

B1.29.For what purposes is adequate to use the credit during implementation of irrigation?

1-To construct channel 2-to buy water-lifting devices
3- To buy cement 4- to hire labor
5-Others, specify----------

B1.30.If no, for question NoB1.26 why?

1-Lack of awareness 2-deslikes debit
3- Fear of the failure crop 4- having once own enough money 5-other spesify

B1.31.If your answer dislikes the debit what is the reason?

1- Collateral 2- grouping System of repaying back 3- Transaction cost
4-high interest rate 5-lackof down payment 6-Duration of credit is shortage 7-others specify

B1.32.If your answer is no access how did you solves such a problem?

1-by borrowing money from friends 2-borrowing from Relatives
3-by borrowing money from money lender 4-others specify

B1.33. Do you have the habit of repaying back your loan on time?

1- Yes 2-no

B1.34 If no why did not you paid on time?

1- Due to insufficient return from production 2- Lenders do not collect on time
3-no saving 4-others, specify

B1.35. Did you receive credit for the purchasing of inputs for horticulture production?

1. Yes 2. No

B1.36. How much did you receive during the last one-year? _____ Birr

C Socio Economic Variables

Number of Live stock owned

C1.1Do you own any livestock?

1-Yes 2-No

C1.2. If yes, specify the type and number of livestock stock and
What is the major problem you face during raising livestock?

1-Grazing land 2-disease 3- lack of water to drink

4-Traveling long distance to make them drink

S/N	Type of Animals	Number of heads own (available)	Died during the past two year	Sold during this past two year (1998-99E.C)	
				number	birr
	Oxen and cow				
	Calves				
	Heifer				
	Sheep and goat				
	Chicken				
	Horse				
	Mule				
	Donkey				
	Hen				
	Beehive				
	Caml				
	Total				

Off-farm income

C1.3 .Did any one of the household members engaged in any source of income activities?

1-Yes _____ 2-No _____

C1.4. On which type do you involve more

1. Off-farm 2; On-farm .3-Both

C1.5. Do you think involving in any of the above activities affects the work of irrigation?

1-yes, 2-No

C1.6 .If the answer to question1.3 is 'Yes' fill the main source of income in order of importance and the amount Birr you gain per month on average

Type of activity involved	Average total number of days involved/month		Average total estimated Income per month In birr	
Non-farm income				

Farm size

C1.7. Total irrigable area: ____ timad _____ ha

C1.8 Total Land holding _____ timad

1 Cultivated area _____timad 2 Private pasture land ____timad
3 Fallow land _____ timad 4 Homestead_____ timad
5 Others (specify)__ timad

C1.9 What is the size of land used twice in a year? _____timad

Family size

C1.10. Family size: ___ Male ___ Female ____ Total

C1.11. Number of working persons: ___ Male ____ Female ____ Total
C1.12. No. Of children in school: ___ Male ____ Female ____ Total

D. Physical Characteristics

D1.1. How many plots and which land type do you allocate to horticulture crops (soil type, slope, fertility, etc.)?

Type of production	No. of plots	Slope 1	Fertility status 2	Soil type 3
Citrus				
Vegetables				

1. Slope*:* 1) Flat 2) Steep slope 3) Medium
2. Fertility status: 1) Highly fertile 2) Medium 3) Low in fertility
3. Soil texture 1.sandy 2.clay 3. Loam
4. Soil Color:1-black 2-red 3-brown
5. Farm Suitability to irrigate: 1-suitabile 2- Not suitable

D1.2.Which of the above characteristic of the plot affects more your farm activity? -------

E. Psychological factors

Perception about the advantage and compatibility of the irrigation cooperatives

E1.1. How do you see the advantage (superiority) of the irrigation cooperatives over the local practices of irrigation? 1- Superior 2-less superior 3-no difference

E1.2.Do you think that environmental and economic benefits are as result of intensive use of irrigation?

1-yes 2-no

E1.3.How do you perceive the situation for crop failure?

1- Decreasing 2- increasing 4 no difference

E1.4.If increasing what is the reason?1- shortage of rainfall 2- excess of rain fall

E1.5.if shortage of rainfall What is farmers' evaluation of using irrigation?

1- Very good 2. Good 3. Poor

E1.6. what motivates you to have irrigation cooperatives on your farm?

1-The benefit obtained from the technology by other farmers. 2-Persuaded by extension agents. 3-Persuaded by contact farmers. 4-Persuaded by the government

E1.7..In your opinion how do you evaluate the importance of irrigation in generating income secure food?

1-Necessary 2-Unnecessa

F. Technological factors

F1.1 .Do you face technical operation complexity of water lifting devices?

1-yes 2-No

F1.2.If yes on which device

1- Tridle pump 2- water pump 3-both

F1.3.Do you think this complexity of the technology reduces utilization of irrigation?

1- Yes 2- no

F1.4 Does the failure of technical design of canals reduces the amount of water to be harvested from the catchments to the irrigation area?

1-yes 2-no

F1.5.How do you solve the technical problem of the technology?

1-through training 2-experience sharing through field visit

3-Up grading once skill through demonstration

F1.6.Have you ever got training related to irrigation techniques?

1-yes 2-No

for how many days-----

F1.7. How about Field visit?

1- yes 2-no

for how many days-------

water lifting devices

F1.8.Do you have a device to lift the water?

1-yes 2-No

F1.9 If yes, what type of device do you apply to lift the water for utilization?

1-rope and bucket 2- Tridle pump 3- motor pump

F1.10 If no, for question number 1.8 what is the reason? ----------

1-lack of money, 2-lack of the skill about the device, 3-high interest rate
4- in efficiency of the device, 5-initialy cost

F1.11. Do you believe that it is worth to cover the irrigation costs by your self ?

1-Yes 2-No

F1.12-If yes how much of your time do you invest? ----------

F1.13. If you use irrigation, what is source, method, frequency of use, and costs of irrigation?

Crop type	Source: 1= pond 2=borehole 3=river/spring 4=lake	Method: 1= Furrow 2=sprinkler 3=basin 4=drip	How many Times Applied?	Cost of using Irrigation (Birr)	
				Own Pump*	Rented Pump
1. Vegetables					
2. Citrus					

** Annual use cost includes fuel cost, wage (if employed labor is used),*

F1.14. What type of farm implements do you use for horticulture production? Give year of Purchase and the price?

Type of farm Implement/equipment	Number	Year of purchase	Cost of purchase (Birr)
Plough			
Hoe			
Rake			
Harrow			
Pump			
Others (specify)			

G. Performance of Irrigation cooperative

G1.1 Is there proper utilization of water ?

1 Yes 2 No

G1.2 Is there properly giving service irrigation cooperatives in Utilization of Water ?

1 Yes 2 No

G1.3 Is It giving Satisfaction to members

1. Yes 2 No

G1.4 Farmer'sperception towards performance of irrigation

S.no	Performance irrigation	Fully agree (3)	Partially agree(2)	Not agree(1)
	Utilization of Water			
	Maintenance of Channel			
	Collective action			
	Efficient utilization of Water			

General recommendation for improving the functions of irrigation coops

G 1.5 How is it maintain access to Water and more pressure on farmers to demonstrate that they are using water effectively and efficiently

1. Very important 2 Important 3 Less important

G 1. 6 how is it Good design in corporate with good management of irrigation system is critical to achieving high irrigation efficiency

1. Very important 2 Important 3 Less important

G 1. 7 What are the other Major functions of irrigation cooperatives

S.no	Major function of irrigation	Adequate	Not adequate
1	Technical Skills Planning		
2	Implementing and Monitoring the system		
3	Man management		
4	Technical in the physical system		

Thank you!