The Socio Economic and Institutional Factors That Affect Traditional Small Scale Irrigation Activity along Chemoga River, Gozamin *Woreda*, Amhara Region, Ethiopia

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Abstract: This study was conducted to quantify the socio economic and institutional factors that affect traditional small scale irrigation activity along chemoga river, gozamin woreda, ethiopia. The objective of the study was to appraise socio economic, agricultural extension service and institutional problems that affect small scale irrigation activity along the river. Data were gathered through household interview, group discussion, field observation, key informant and expert interview. In addition, different secondary data were also used for the study. Both qualitative and quantitative methods were used for data analysis. Qualitative data is analyzed by using comparative analytical methods. Quantitative data were analyzed by SPSS V 16. Through frequency, mean, standard deviation, Chi-Square and T-test. socio economically lack of farm land, lack of training , lack of access to irrigation water because of illegal diversion are some of the factors. Institutionally there are no formal water users' associations, lack of institutional support, are some of the constraints. In addition, less involvement of stakeholders in agricultural extension service, training and evaluation of irrigation works for irrigation beneficiary Kebeles has contributed for the low performance of irrigation farms.

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Chapter One

1. Introduction

Ethiopia is known to be the water tower of East Africa. It is endowed with substantial amount of water resources surface as well as sub surface (Daniel, 2007). Ethiopia's irrigation potential estimate is not yet accurately known and there have been various estimates. For example, WB (1973) estimates between 1 to 1.5 million hectares (ha), IFAD (1987) more than 3.5 million ha (about 3.5% of land that can be utilized for irrigation), WaPCS (1995), Paulos (2003) and Negash (2004) estimate about 3.7 million ha of which only 386,603 ha has been used.

Seleshi *et al*. (2005) state that, irrespective of Ethiopia's endowment with potentially huge irrigable land, the area of land under irrigation so far is very small. To alleviate the problems of water resource use on agricultural practices and other sustainable and reliable development efforts, the country develops its own water resource policy. The overall aim of the country's water resource policy focuses on enhancing and promoting all national efforts towards the equitable and optimum utilization of available water resources for significant socio-economic development on a sustainable base (MoWR, 2001).

Traditional small scale schemes are developed and managed by the community on their initiative with limited government technical and material support and usually characterized by non fixed structures and practiced traditionally (Makombe *et al*., 2009). The traditional small scale irrigation is simple water diversions. It is very old practice in Ethiopia and has been in use for decades in the highlands where small farmers could divert river, spring water seasonally for a limited dry season cropping (FAO, 1994). It includes water harvesting based irrigation for example; household based minute irrigation; ground water irrigation and in-situ agricultural water management (Seleshi *et al*., 2007b). In Amhara Region, most of the irrigation activities are traditional. These traditional irrigation schemes are designed, developed and operated by farmers themselves with limited assistance from the government or other NGOs (Haile, 2008).

The diversion structures are constructed from wood, stones and grass roots. These structures are often washed away by flood and have to be remade each year. This process highly affected the irrigation activity and water management in the region (Hanibal *et al*., 2010).

Likewise, traditional irrigation activity is practiced for a long period of time in Gozamin *Woreda*. Chemoga River, which is the study river, drains most parts of the *Woreda* and flows north to south part of the *Woreda*. Successive field visits show that a common problem in these irrigation beneficiary *Kebeles* are *water* shortage, the continuous cycle of irrigation canal

construction followed by deterioration of the canal because of in adequate maintenance, problem of water allocation and lack of institution that manages water allocation and conflict resolution mechanisms. In addition, the follow up of the irrigation activity of the communities, particularly with regard to operation and maintenance, water utilization, economic and financial successes have not been well studied and documented.

2. Materials and Methods

2.1. Description of the Study Area

Gozamin *Woreda* is found in East Gojjam Zone, Amahara National Regional State. This *Woreda* is characterized by diverse topographic conditions. The elevation ranges from 1000m to nearly 4000m. Mountainous and highly dissected terrain with steep slope characterizes the northern parts of the *Woreda* and an undulating topography and gentle slopes characterize the central and southern parts of the *Woreda*. The *Woreda* relief in percentage is given as: 45% plateau, 48% mountain and 7% valley (GWAO, 2010).

The mean annual rainfall distribution is 1342 mm and the general distribution gradually increases starting from June and September. The area receives monomodal rainfall which is called the *kiremt* raining season (June to September). Highest monthly total rainfall amounts are recorded in August (298.03mm) and July (284.67mm) and the lowest records are observed in January (14.52mm) and February (10.6mm). Similarly, the highest and lowest mean monthly temperature records are in February (25.98^{o}c) and December (8.85 ^{o}c). Soils that cover much of the total area of this *Woreda* can be classified into seven types. These are Acrisols, Cambisols, Lithosols, Luvisols, Nitosols, Rendzians and Vertisols.

There are a number of rivers in the *Woreda* such as Shegeza, Chemoga, Kullech, Degelle, Atemena, Gedeb,Wuseta and Wutren. The length of Chemoga River from its stream to its mouse is approximately 45 km. It is characterized by diverse topographic conditions. The elevations range from 1000 m.a.s.l. to nearly 4000 m.a.s.l. (ANRS, 2008).

Historical Development of Irrigation Activity

There is no clear data about the historical back ground of irrigation activity along Chemoga River. But according to the data which is obtained from DAs and key informants, initially, irrigation activity along Chemoga River started during the Imperial Regime in the late 1960s in Qebie *Kebele* in special place called *Yederet* village. Following Qebie *Kebeles*, other *Kebeles* also start irrigation activity along the different courses of the river. Farmers constructed traditional canal to divert the river. However, during that time there was no association which controls the scheme operation and maintenance activities in different *Kebeles*. The management aspects were performed by individual farmers.

2.3. Research Design

For this study mixed research methodology, specifically sequential exploratory research design was used. Sequential exploratory strategy primarily gives emphasis for qualitative data and use quantitative data as supplementary for the qualitative data.

Data Type and Sources

Primary Sources of Data

Primary data for this study were collected from agricultural experts of Gozamin *Woreda*, DAs and sample households. The instruments used for data collection are described and designed in terms of importance in providing the necessary data. These are household interview**,** group discussion, field observation, key informant interview and expert interview.

Household Interview

Interview question was prepared for selected sample households. The interview question contains both open and closed ended questions. It helps to gather the demographic characteristics of sample households; such as the level of education, sex ratio of the household and socio economic activities of the sample households, agricultural extension service provision towards irrigation activity, conflict resolution mechanisms in irrigation beneficiary *Kebeles* etc. This was performed through the supporter of one local guider.

Group Discussion

The members included in group discussion were the *tabia* leaders, DAs, irrigators, non irrigators and WUAs committee members. Participants were selected based on their irrigation use and level of education in the selected sample *Kebeles*. Group discussion was conducted to generate detailed understanding of the irrigation systems. For one *Kebele*, there was one day group discussion. From each *Kebele*, 6 participants were selected and a total of five groups were formed.

Field Observation

Field observation for this study was made in the selected sample *Kebeles* of the study in different parts of the river. Field observation was primarily designed to observe the ways of water use by the irrigators, the fairness of water diversion among *Kebeles*, the factors that affect water allocations in different *Kebeles* and more beneficiary *Kebeles* from irrigation. In addition, field observation was conducted to fill the information gaps and to cross check the responses of key informants and expert interview, household interview and group discussion. The field visit was carried out with the supporter of one local guider.

Key Informants Interview

Key informant interview was conducted to generate general understanding of the irrigation

agriculture, historical background of the irrigation activity, the major technical, institutional and management problems in the irrigation systems and crops grown in the irrigation schemes. Informants were selected based on their knowledge about irrigation activity and year of stay in the study *Kebeles*. Key informants include elderly and knowledgeable irrigators and WUAs committee members. A total of 13 key informants were participated.

Expert Interview

Expert interview was held with *Woreda* irrigation desk officials and professionals and DAs. It was designed to generate data for analyzing the governance structure of the irrigation departments, the operation of the irrigation systems, institutional service provision issues and stakeholders and inter institutional linkages. A total of 5 DAs and 3 *Woreda* irrigation desk officials and professionals were participated.

Secondary Sources of Data

Data collected from the secondary sources include topography, drainage patterns, agro-ecology, climatic condition, demographic information and economic activities, area and soil type of the Woreda and other necessary documents and studies were used.

2.3. Sampling Technique and Sample Size

Multistage sampling design was used to select the respondents. There are 26 *Kebeles* in Gozamin *Woreda* and from these there are nine irrigation beneficiary *Kebeles* from Chemoga River and located at different parts of the river. In the first step from nine *Kebeles*, five of them were purposively selected. In the second stage, household lists of the selected *Kebeles* were obtained from *Kebele* administration office and DAs Office. Household were grouped into two groups in which the first group includes households having access to irrigation farm and using their irrigation farm and the other group includes households who have access irrigation farm but they didn't use irrigation farm. There are 941 households who have access to irrigation water along the river. From these 418 of them use their irrigation farm and the rest 523 households don't irrigate. In the third stage samples were taken proportionally from the two groups and a total of 150 sample households were selected from the total populations. Therefore, sample households participated in this study were 67 irrigators and 83 non irrigators respectively. In the fourth stage after getting the total sample size of the study, the sample frame of each *Kebele* administrations was determined. In the fifth stage sample households were selected from each *Kebele* administrations. To select sample households systematic sampling method was applied by taking the n^{th} element of the sample frame.

Table 2: Sample size of the study *Kebeles*

Kebele	Total population access to small scale irrigation		Sample Size		Total Sample size per *Kebele* Administration
	Irrigator	Non irrigator	Irrigator	Non irrigator	
Yegagna	20	88	3	14	17
Qebie	288	139	46	22	68
Libanoes	58	103	9	16	25
Demba	35	117	6	19	25
Chimit	17	76	3	12	15
Total	418	523	67	83	150

Source: Kebele administrations offices of the respective Kebeles (2011)

2.4. Methods of Data Analysis

Qualitative and quantitative techniques were employed for analyzing the data. Qualitative techniques were used to analysis data collected from key informants, field observation, expert interview and group discussion. It is used to analyze the whole picture of institutional and organizational arrangements in water administration, mechanisms used to distribute water for irrigators and conflict resolution mechanisms. Qualitative data is analyzed by using comparative analytical methods.

The quantitative data generated through household interview were analyzed by employing the computer software known as Statistical Package for Social Science (SPSS version 16). Frequency, mean, standard deviation, Chi-Square test and T-test were employed.

3. Results And Discussion

3.1. Socio Economic Characteristics of Sample Households

3.1.1. Demographic Characteristics

In rural Ethiopia, family size, age and sex of the family head are the most important demographic features that affect the livelihood security of a household (Haile, 2008). The average family size at the national level in Ethiopia was 4.7 in 2007 (CSA, 2007). The data which was obtained from the sample households indicated that the average household size of the study areas was 5 persons. Chimit *Kebele* had the

largest family size which is 7 persons per household. Yegagna and Demba *Kebele* had the smallest family size 4 persons per household.

When comparing the family size of the sample households in relation to the irrigation used, the study showed that there is no wide variation in the family size and labor availability between irrigator and non-irrigator households. This implies that shortage of labor is not a serious problem at a household level. The results of Chi-Square test also show that there was no significant difference in family size and labor availability among the study groups (Table 4). With respect to the age of household heads approximately 93% of irrigators and 88.5% non irrigators were below 60 years and 7% of irrigators and 11.5% of the non irrigators were found to be 60 years and above. The Chi-Square test results also revealed that there was no significant age difference among the study group (Table 4). This indicates that household age difference is not a problem that affects the irrigation activity of the community.

Education/training plays a key role for household decision in technology adoption. The study revealed that 41.2% of irrigators and 50.2 % of the non irrigators are illiterate. While 32.5% of irrigators and 31.4% non irrigators can read and write without a formal education, 12.5% of irrigators and 7% of non irrigators had primary school education and 13.8% of irrigators and 11.4% non irrigators had also access to secondary school education (Table 4). In general, the performance of primary education in all the study areas was not satisfactory. The education level of household heads is higher for irrigators than non-irrigators (Table 4).

From group discussion with participants and key informants it is understood that irrigators easily contribute to the generation of new technologies and more readily utilize those technologies and they cultivate higher products from irrigating farm than non irrigators. Analysis of the survey data also indicated that the literacy level of the household heads significantly differs among the sample household groups of the *Kebeles* ($\chi 2$= 45.1, p=.000). From this, it is evident that there is correlation between the decision to participate in irrigation and a household's literacy level.

Table 4: Demographic characteristics of Sample Households

Characteristics		Irrigator (N=67)	Non irrigator (N=83)	Total	$\chi 2$
		%	%	%	
Household size	Male	56.6	52.8	54.73	
	Female	43.4	47.2	45.27	
	Total	100	100	100	62.3NS
Age of household head	20-40 years	49	40.4	44.7	
	41-60 years	44	48.1	46.05	
	61-80 years	7	11.5	9.25	
	Total	100	100	100	18.76 NS
Level of education	Illiterate	41.2	50.2	45.7	
	Read and write	32.5	31.4	31.95	
	1-8 grade	12.5	7	9.75	
	9-12 grade	13.8	11.4	12.6	
	Total	100	100	100	45.1*

Source: Field survey (2011)

* Significant at 95% level of confidence, NS=Not Significant

The results of Andrew (2010) about the impacts of irrigation on poverty and production using the case of irrigation in Mali, Bamidele *et al.* (2010) about factors affecting farmers' ability to pay for irrigation facilities in Nigeria and Kinfe *et al.* (2011) studies about the effect of small-scale irrigation in Central Tigray, also found that household education level affect the irrigation activity of the community.

3.1.2. Constraints in relation to irrigation water use

Accessibility of irrigation water and market proximity

As noted by the key informants, there are reasons for these variations. First, there is good accessibility of irrigation water in Qebie than Chimit. Second, farmers in Qebie have better experience in irrigation activity than farmers in Chimit. Because Qebie is near to the market center i.e. Debre Markos as compared to other *Kebeles* and because of market accessibility irrigators cultivate vegetables (onion, potato, tomato and cabbage, etc.). Key informants and group discussion participants also describes the reason for the low farm land under irrigation for Chimit farmers is that, there is shortage of water due to diversion of water by irrigators in the middle stream areas of the river, poor scheduling of water distribution and inadequate coordination of WUAs regarding water distribution.

According to the respondents from group discussion availability of water is the most important factor that determines the farmer participation in irrigation activities. In all selected sample irrigation beneficiary *Kebeles*, DAs and WUAs committees do not clearly know the actual size of irrigable plot area managed by individual households. Hence, water committee could not adjust water allocation and resource mobilization to amount of water used and irrigable area controlled by individual households. Table 7 shows the constraints that discouraged them from participation in irrigated farming and led to underutilization their irrigation farm land. The surveyed households mentioned that lack of access to irrigation water, possession of large plot size and lack of clearly define water allocation schedule are the most important factors responsible for under use of the irrigable land respectively.

Table 7: Constraints in relation to irrigation water use

Constraint	No of respondent	Percentage
Lack of access to irrigation water	45	30
Possession of large plot size	50	33.3
Lack of clearly define irrigation water allocation schedule	55	36.7
Total	150	100

Source: Field survey (2011)

Especially, *Kebeles* in the middle stream area of the river (Libanoes) and downstream stream of the river (Demba and Chimit) are highly threatened. This was mainly due to shortage of water, inappropriate use of water by upper stream *Kebeles* (Yegagna) and middle stream of the river (Qebie) and poor water management in all *Kebeles*.

In addition, key informants and group discussion participants also expressed that the use of the river has become less feasible and farmers' don't use their irrigation farm properly because first, there is no equitable water allocation schedule in all *Kebeles* along the river. In the second place, there is problem of extension supports services about irrigation water management and use, input use and credit availability affect the cropping pattern and lead to under utilization of irrigation farm land. Thirdly, culturally, livestock freely graze in the command area of the irrigation farm during the dry season, leading to crop and canal damage and discouraged farmers participation in irrigated agriculture.

The results were consistent with other studies. Yahaya (2002) studies about development and challenges of Bakolori irrigation project in Sokoto state, Nigeria, Hussain *et al.* (2006) about impact of Small Scale Irrigation Schemes on Poverty Alleviation in Marginal areas of Punjab, Pakistan and Hiroyuki *et al*, (2010) supported the view that one prominent problem in irrigation project is insecure land tenure, which has discouraged peasants investment of labour and capital in irrigated agriculture. In addition, land in some parts is owned by multiple landlords in a fragmented manner and the rotation of water use, water allocation, construction of canals and enforcement of community level regulation depend on each landlord affect the irrigation activity of the community.

Many reasons were raised during household interview and group discussion about the factors which affect the irrigation activity of the community among which are; shortage of water and waiting for long days to get turn for water, lack of capital to purchase farm inputs and low commitment on the part of irrigators themselves. The respondents also ranked the main reasons that affect their irrigation activity.

According to them water shortage is the primary problem that affect the irrigation activity of the community. Poor scheduling of water allocation and illegal water diversion also affect the irrigation activity of the community respectively.

Table 9: Farmers ranking of the reasons for under use of their irrigated land

Reasons	Ranks			Total
	1 1	2	3	
Water shortage	36	17	11	64
Poor scheduling water allocation	25	21	13	59
Illegal water diversion	9	11	7	27
				150

Source: Field survey (2011)

Household Income

Sample households cultivated vegetables and fruits in their irrigation farm. Table 13 shows the average income of sample households from irrigation farm. On average Qebie farmers got 2683.9 birr from one ha irrigated farm. To the contrary, farmers in Libanoes and Chimit got 1658.9 and 940.3 birr from one ha irrigated farm respectively (Table 13).

According to key informants and group discussion participants, these income differences comes due to water shortage, the type of crops cultivated and market accessibility.

Table 13: Income from irrigated crop production in EtB by *Kebele*

Kebeles	Minimum	Maximum	Mean	Std. Deviation
Yegagna	315.00	3985.00	1896.3	1489.00
Qebie	300.00	9541.00	2683.9	2319.3
Libanoes	215.00	8412.00	1658.9	1839.00
Demba	651.00	6212.00	1738.5	1831.8
Chimit	456.00	1589.00	940.3	429.2

Source: Field survey (2011)

Market accessibility is an essential issue in irrigation crop production. Price of vegetables and fruits is highly fluctuating. In the study area, the market center where irrigation products are sold in Debre Markos and Robit found in Libanoes *Kebele*. The average distance from the market place i.e Debre Markos is different between *Kebeles*. Irrigators in Chimit, Demba and Libanoes have to walk longer hours than Yegagna and Qebie irrigators to access the nearest local market to sale their agricultural products (Table 1). In addition, there is no road connecting *Kebeles* to the market center. Farmers transport the products by using donkey and human holding.

In general, lack of market and market accessibility is one of the major factors that affect the irrigation activity of the community. For example, farmers in Yegagna and Qebie cultivated vegetables like onion, tomato, potato and the like which are highly perishable, so an efficient marketing channel is necessary. However, in the study area marketing system does not facilitate products desired by irrigators. One reason is the similarity of products and marketing patterns; for example, onion and tomato are the dominant vegetables, often harvested by farmers at the same time, which leads to a high availability and low prices during the main marketing period.

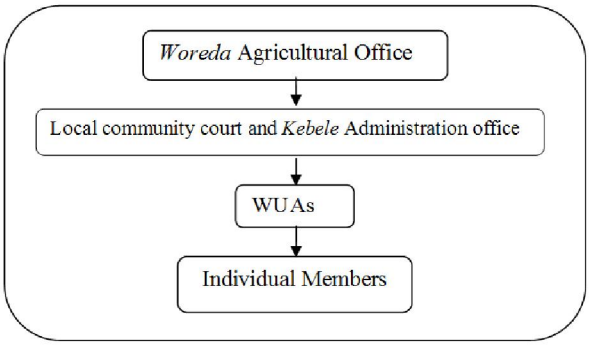
In addition to this, because there is no storage system in the study area, products quality deteriorates rapidly. During group discussions and household interview, when the farmers were asked about storage facilities, they replied the question itself by asking "storage for what? Why should we store?" This indicates that farmers are rightly producing for immediate sale after harvest. This means that farmers must sell within a very short time, often at what they consider low prices.

The result of Yahaya (2002) also supported the view that lack of market accessibility is found to be the result of both low crop price and lack of co-ordination in production among farmers. Their market information systems often resulted in over supply and under-supply of perishable vegetables and fruits during the harvesting and off-season farming respectively with corresponding price fluctuations. Lack of storage and transport facilities also exacerbates the problems.

Similarly Kinfe *et al.* (2011) states information on market prices and channels is one of the important aspects for livelihood improvement of rural farm households. Although, information on marketing of irrigation products and agricultural inputs is a determinant factor for irrigators, only some of the irrigators have access to information. This shows that, even in the age of information era, people in such areas are still using traditional way of information sources and means. Andrew (2010) and Hiroyuki *et al.* (2010) found that, village characteristics of irrigators and non irrigators, including distance to a road and distance to the market center affect the irrigation activity of the community.

3.2. Institutional arrangement of Irrigation Schemes

One of the social requirements for successful irrigation is organization and management structure that suit the irrigation infrastructure (Woldeab, 2003; Mollinga, 2005). The responsible irrigation institution in Ethiopia has been frequently changing in its governance structure. This frequently restructuring and institutional instability has adversely affected its existing human resource capacity at both *Woreda* and *Kebele* levels and the supports to be provided to user-communities.



Source: field survey (2011)

Figure 6: The institutional arrangement of irrigation management

The institutional arrangement of irrigation management in the studied irrigation beneficiary *Kebeles* look like the sketch in figure 6. WUA committee members are selected by irrigators at each *Kebele*. Each *Kebele* has one WUA committee and lead by Chairman. WUA committee members are responsible for everyday operation of the irrigation activity. According to key informants, the elections of WUA committee members vary from *Kebele* to *Kebele*. In Yegagna and Qebie *Kebele* irrigators elect

democratically based on ownership of land and active participation within the community are important considerations. But in Libanoes, Demba and Chimit they elect based on hereditary. Although, they are appointed by the irrigators democratically or hereditary, they don't have any formal office, payment or compensation for their services. These problems are the causes of water management problem in the study area.

3.2.1. Role of WUAs Committees

The WUAs committees have different responsibilities among which are**:-**

1. Water Allocation
2. Mobilize Communities Participation in Irrigation Management
3. Mobilize Canal Construction and Maintenance

1. Water Allocation

Water sharing is administered by WUAs. Water distribution shifts are established based on rotation. Rotational irrigation is the application of irrigation water by counting dates or complaints, instead of water needs by plants. Water is distributed simply for about 24 hrs for irrigators by rotation. But water allocation and rotational schedule, which was prepared and being implemented by WUAs has got limitations. Water allocation is made by guess and it does not clearly define the water rights of individual irrigators.

Time of water supply is not defined in accordance with the water requirements of the different crops grown and area of irrigable plots managed by individual irrigators. Irrigation water use depends only on spatial location of the farm plot; it does not consider the amount of water required for the type of cultivated crop, time interval of water application and the size of each irrigated land sizes. Water distribution is also not equitable. Inequity in irrigation water distribution is the most serious problem for the farmers and causes conflict.

For example, in Yegagna *Kebele* (Menqorquey village) vegetables particularly cabbage suffer from water shortage. Such problems also happened in Libanoes because around 0.025 ha sugarcane plants became dried (Plate 1).

Water distribution problem also causes many conflicts between upstream and downstream irrigators. The main cause of the problem is that the amount of water is very small in Chemoga River at the end of February; consequently, the upstream and middle stream irrigators always uses high amount of water through traditional river diversion. This creates conflict between with downstream irrigators, in the implementation of rotational distribution. In general, water distribution is the main issue in all *Kebeles* because there are no standardized programs and plans in water allocation to irrigate the cultivated crops.

2. Mobilize Communities Participation for Irrigation Management

According to the unwritten rules and regulations of WUAs in all sample *Kebeles*, members should meet once a month to discuss problems and make decisions, once a year to elect new WUAs. However, in practice, it is hardly the case. It seems that the only occasion that brings farmers and WUAs to meetings is when they negotiate on issues like when to clean the canals, when the irrigation system ceases to function or when an urgent action is needed.

Farmers are passive about participation of meetings concerning with irrigation activity in their locality. About 81% of the respondents also support this idea and said that "there is no arranged meeting program in our locality, but we discuss about water allocation, canal maintenance, conflict resolution and other problems in our *edir* some times". About 19% of respondents also never participated on irrigation meetings in their locality. Group discussion participants also said that members meet only once or twice a year for canal maintenance and water allocation according to the instruction given by WUAs committees. Most of the time, they meet around September and February. Key informants also described that there is no coordination between upstream irrigators and middle stream irrigators (Yegagna, Qebie and Libanoes,) and downstream irrigators (Demba and Chimit). Due to this reason, there is a great communication gap between them. This problem affects their water use and management and led for the problem of water shortage especially downstream users are highly susceptible.

The combination of these problems brings conflict between irrigators in one *Kebele* or between *Kebeles*.

3. Moblize Canal Construction and Maintenance

Traditional river diversion is the dominant method used by farmers in all *Kebeles*. This type of diversion system is simple for irrigators to divert water from the river. The canals are constructed from grass roots, mud and stones and there is crack in different parts of the canal. Consequently, these problems reduce the amount of water that reaches to the cultivated land. It is also venerable for destruction due to various factors.

The construction and maintenance of canals is done by the community finance and labor contribution without outside support. The WUAs committee is responsible for the mobilization of the farmers and resources required for maintenance activities and for the scheduling of maintenance of the canals. Farmers undertake canal cleaning and system maintenance activities twice a year under the leadership and coordination of the WUAs committee members. In accordance with the existing bylaws, the first round is

under taken in *Kuagme* every year. But most of the time they conduct canal-cleaning activities in September, when the rainfall is low. The second round is undertaken between February-March.

Concerning the maintenance and cleaning of canal, locally known as *feses,* the community has unwritten, very simple and traditional bylaws. The following are the traditional bylaws of WUAs:-

(1). Those farmers who are absent in canal cleaning should pay 5 birr/person / day,

(2). He/she will not get any water until he pays his penalty and

(3). Users who do not respect the decision of WUAs will be excluded from any social affairs in the community.

However, key informants and group discussion participants suggested the above bylaws of WUAs lack enforcement to practice on the ground. In all *Kebeles*, the canal structures (conveyance and distribution canal networks) have deteriorated due to a number of reasons. The first reason is poor coordination of the irrigators' to maintain or protect the water ways.

Canals are not protected against livestock and are frequently damaged because culturally, livestock graze freely over the command area of the irrigation farm and fragmentation of irrigable plots was also a cause of maintenance problem. Survey results of the farmers' opinions regarding maintenance problem showed that poor coordination of maintenance is the major problem followed by, weak enforcement of bylaws for system maintenance, breaching of canals and extraction of water by illegal means and damage from animals. The maintenance problems have threatened the safety and sustainability of the irrigation activity (Table 15).

Table 15: Farmers opinions regarding poor canal maintenance

Causes	No of respondent	Percentage
poor coordination of maintenance	22	32.8
weak enforcement of bylaws for system maintenance	18	26.7
breaching of canals	17	25.6
extraction of water by illegal means and damage from animals	10	14.9

Source: field survey (2011)

The maintenance activities of the canals also vary from *Kebele* to *Kebele*. The study of Cai *et al*.(2001) also support this result and states that maintenance of important infrastructure such as irrigation and drainage systems and roadways has been deferred; and farm equipment and irrigation pumps are not being adequately serviced and replaced in a timely manner. Gashaye and Tena (2008) suggested that proper maintenance enables the keeping of water control infrastructure in good working condition so that the design water level is maintained. The head loss across structures (water level difference between upstream and downstream of structure) in irrigation canals is the single most important factor disrupting the intended delivery of irrigation water. There are a number of illegal water abstraction and canal breaching. Majority of installed tertiary canals were not operational.

3.3. Causes of Conflict in Irrigation Water Use and Conflict Resolution Mechanism

Water dispute is a common phenomenon for all *Kebeles* irrigation activities. Due to shortage and inequitable allocation of water, conflicts are arising among irrigators. Conflicts over irrigation water persistently occur between irrigators within the same *Kebele* and between upstream, middle stream and downstream irrigators. Key informants and group discussion participants explained that conflicts arising from water allocation are rampant among irrigators.

About 86.9% of respondents also described that there is serious conflict between irrigators because of water allocation problem and 35.7% described the reason for the causes of the conflict to be shortage of water and water theft (between irrigators) and the rest 27.4% and 36.9% describes the cause of the conflict to be lack of rule and regulations about irrigation water use and in appropriate use of water by some irrigators respectively (Table 16).. Irrigators in the middle stream of the river constituted the highest share of irrigation water use and created disputes over irrigation water between downstream irrigators. They also expressed that water shortage, increasing number of irrigators, illegal abstraction of water and lack of enforcement of bylaws for water allocation has also some of the most important constraints that led to unnecessary competition and water disputes.

According to key informants the cause of the conflict between irrigation beneficiary *Kebeles* is that, in one *Kebele* or between *Kebeles* irrigators completely divert the river without considering the downstream *Kebeles* and there is no arranged water allocation time table. Irrigators simply use 24 hours whatever they get. This brings water shortage for downstream *Kebeles*. Most of the time the conflict is more severe between *Kebeles* and sometimes there is bloodshed. Some irrigators in the middle area of the river extract and capture more water by abusing water distribution turns of WUAs. They do not release water for the downstream irrigators as per the established distribution schedule, leading to conflict between the upstream and downstream irrigators. The conflict has been sometimes more serious.

Conflict Resolution Mechanism

Although conflicts arise because of water use, there are different mechanisms to solve conflicts and to

use the water properly. Those are formal and informal institutions involved in conflict resolution mechanism in all the study *Kebeles*. Most disputes on water use are resolved informally at the lower levels by WUAs before going out into serious conflicts. There are four identified ways of conflict resolution mechanisms in study areas.

(1). Argument between the victims: both parties speak out and agree on resolving the conflict,

(2). At block or group level: group leaders are elected among irrigators. Normally group leader is well respected person for both parties and can give more trustful and appreciable judgment,

(3). At WUAs level: WUAs committee involve in the conflict resolution mechanism when the above solutions have failed and

(4). *Kebele* administration and the community court level: at this level chairman of WUAs committee refer the conflict cases to the *Kebele* administration and the community court.

The WUAs transfer cases of irrigators who were found guilty of illegal water abstraction to the *Kebele* administrations and the local community court. The community court, which is responsible for managing almost every type of conflict in the community is said to be supporting the WUAs committee with resolution of high level conflicts over water use.

However, irrigators complains that the community court is too busy and too slow in deliberating and delivering verdict that the rules and regulations of water use are not being enforced as they should be. Because most of the time cases do not make timely decisions, suspend even for a month or more and did not charge them at all. This has further intensified illegal practices to obtain water. Respondents also described that resistance by some irrigators was the major obstacle to enforcing rules and conflict management by WUAs committees. Key informants and participants of group discussion and household interview mentioned lack of incentive for WUAs committee members, resistance by some irrigators, lack of support from the *Woreda* agriculture office experts with related to conflict resolution mechanism and water allocation and lack of commitment of WUAs in water allocation and conflict management are the prime reasons for the problem of conflict management. This indicates that *Kebele* administration and community court have little attention on irrigation activity related to conflict resolution activities.

The result obtained by this study is consistent with other studies. Renault and Makin (1999) also supported the view that conflicts is occur between the irrigators. This is because of unauthorized operations of gates and harmful interventions. The lack of disciplinary measures may be a serious constraint to increased conflict between irrigators. Cai *et al*. (2001) also suggested that, an inequitable allocation of water among the irrigators could significantly affect the economic position of the other irrigators. This causes a major conflict with the downstream irrigators, which depend on irrigation in the summer growing season. Gashaye and Tena (2008) found in their study that there was no water sharing agreement between upstream and downstream users and there was no equity in water distribution. The WUC is not empowered to take action and enforce its bylaws. The majority of the water management problems revolve around the inability of the association to sanction offenders. The tortuous legal processes in the judicial system and the lack of recognition of the cooperatives bylaws were the most serious challenges that the cooperatives face currently.

Weakness of WUAs Committee

The responsibility of running operation and maintenance of the irrigation activity was delegated to WUAs in the hope of enhancing effectiveness, equity and responsiveness in irrigation management and to ensure sustainability. However, they are weak and unable to take responsibility for running operation and maintenance of the irrigation activities as expected because of the following organizational and institutional weaknesses and socioeconomic constraints.

Absence of formal WUA. According to group discussion participants, all existing farmer organization over seeing irrigation system management is customary or indigenous organizations set up based up on traditions. Although, organizations exist they are coincidental, not properly institutionalized. In formants also describe WUAs in the selected *Kebeles* are not registered by the government and have no legal entity.

Because of registration problem there is legal entity problem to get agricultural inputs and market facilities, credit service etc. from government and NGO's.

Lack of clearly defined water allocation schedules. In spite of the presence of management structures extending down to boundary or territory level, there have been lack clearly defined water allocation rights. According to key informants and group discussion participants, WUA committee allocates water by guess because of lack of technical capacity and lack technical support from the *Woreda* irrigation desk office. Hence, WUA are unable to undertake effective, reliable and equitable water distribution. Consequently, some powerful groups resist the committee during coordination of operation and maintenance activities. These discourage the possibility for proper allocation and distribution of irrigation water and conflict management by the committee in all *Kebeles*.

There is lack of transparency and accountability of the WUA committee members. The roles, responsibilities, authorities and accountability of the executive and sub-committee members are not clearly formulated in the bylaws. The members of the committee do not clearly know their power, authority and accountability. In addition, irrigators blame the committee members' abuse the irrigators and they allocated water for their relatives by using their power. Key informants and group discussion participants also describe in some cases WUAs committee members are selfishness, lack commitment and responsiveness.

Lack of adequate external support for water allocation, conflict management, technical assistance and capacity building programs from the *Woreda* irrigation desk and other concerned bodies. According to informants, there is lack of clear statement on institutional responsibilities and accountability for small scale irrigation management from the *Woreda* agriculture office as well as other concerned bodies and low level of participation and consultation at all levels. In general, these the above problems discourage the possibility for proper allocation of irrigation water and conflict management by WUAs committees in all irrigation beneficiary *Kebeles.*

Concerning the weakness of WUAs other studies also arrived to similar results. Machethe *et al*. (2004) found in their study that scope of WUAs is limited to irrigation related issues and does not go beyond provision of support services**.** Gashaye and Tena (2008) also investigated that Geray Irrigation Scheme has been administered by Water User Cooperatives (WUC). The cooperative adopted a generic bylaw. The bylaw indicated that the association is responsible for water distribution, system maintenance, collection of water fees, soliciting for input supplies, credit facilitation, planning and monitoring, etc. But none of these responsibilities have been executed as desired.

3.4. Provision of Agricultural Extension Service

The household interview (Table 17) indicate that, from total irrigators, 55.95% of households didn't get extension programme, 78.6% of the respondents did not get irrigation training and 53.57% of the respondents responded that there is lack of institution which evaluates their irrigation activity and maintenance of canals (*feses*). This shows that less involvement of stakeholders in agricultural extension service in training provision and evaluation of irrigation works for irrigation beneficiary *Kebeles* has contributed to the low performance of irrigation farms.

Group discussion and sample households also support this idea. Farmers in the study area have lack of training on irrigation crop production and practicing irrigation without much extension support. The provision of agricultural extension services in all *Kebeles* is very low. At the time of this study there had been no DA assigned with irrigation professional except DAs with natural resource management and crop production background. Farmers reported that they did not visit and give extension advice for the farmers. In addition, they have multiple responsibilities and are over stretched with many activities. Therefore, they are unable to undertake strict follow up of the irrigation activities of the communities and couldn't deliver adequate extension services to farmers.

Table 17: Irrigators response about the provision of Agricultural Extension Service

	Responses	No of respondent	Percent
Do you get extension service from institutions about irrigation activities?	Yes	30	44
	No	37	56
	Total	67	100.0
Have you participated in training and conference related to irrigation water use and management?	Yes	14	21
	No	53	79
	Total	67	100.0
Is there a seasonal/annual evaluation of the irrigation works (canals/structures) by the concerned institutions?	Yes	31	46
	No	36	54
	Total	67	100.0

Source: Field survey (2011)

Thus lack of specific roles from the office of agriculture, water and cooperative promotion agency has a great contribution for the poor performance of the irrigation activities of the communities specifically in relation to, extension service, training, water administration and allocation.

Accessibility of Agricultural Inputs and Their Utilization

Proper utilization of modern agricultural inputs such as improved seeds, fertilizers, pesticides and fungicides are basic and essential to any farm enterprise. The input supply, especially fertilizer and high yielding seed varieties from the government agencies is good during the rainy season but there is

lack of input supply during dry season when irrigation is practiced intensively. As a result, farmers in the area get inputs through farmers to farmers' seed exchange mechanisms (27.1%), *Woreda* agriculture office (fruit seeds like avocado, mango, banana, orange etc.) (18.6%), private shops and local open markets (34.3%) (Table 18).

Due to the high price of seeds in private shops as compared to, farmers to farmers' seed exchange, *Woreda* agriculture office and open markets, most farmers get seeds from local open markets, farmers to farmers' seed exchange and *Woreda* agriculture office. The quality of seeds from local open markets and farmers to farmers' seed exchange is often low which affects yield negatively, unknown purity and usually susceptible to disease and pests. Therefore, they did not suit the irrigation systems.

Table 18: Sources of agricultural input

Sources of input	No of respondent	Percentage
Woreda agriculture office	28	18.6
Private shops and local markets	51	34.3
Cooperatives	30	20
Farmers to farmers	41	27.1
Total	150	100

Source: Field survey (2011)

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