ADDIS ABABA UNIVERSITY

COLLEGE OF DEVELOPMENT STUDIES

INSTITUTE OF REGIONAL AND LOCAL DEVELOPMENT STUDIES (RLDS)

COMMUNITY SPATE IRRIGATION IN RAYA VALLEY: THE CASE OF THREE SPATE IRRIGATION SYSTEMS

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HAILE KIDANE
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A Thesis Submitted to Addis Ababa University in Partial Fulfilment for the Degree of Master of Arts in Regional and Local Development studies (RLDS)

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Table of content

Acknowledgment IV
List of Tables VI
List of Figures VII
List of Plates VII
List of Acronyms VIII
Glossary of Local Terms IX
ABSTRACT X
CHAPTER ONE: Background of the Study 1
1.1. Introduction 1
1.2. Statement of the Problem 3
1.3. Objective of the Study 5
1.4. Research Questions 5
1.5. Significance of the Study 6
CHAPTER TWO: Research Methodology 7
2.1. Data collection Method 7
2.2. Sampling Design 8
2.2.1. Sample Selection for Household interview 8
2.2.2. Focus Group discussion and Key Informants 10
2.3. Data Analysis 11
2.4. Limitation of the Study 11
2.5. Organization of the Paper 11
CHAPTER THREE: Literature Review 12
3.1. Conceptual and Theoretical Framework 12
3.2. Empirical Review 16
CHAPTER FOUR: The Study Area 29
4.1 The Raya Valley 29
4.2. Description of the Studied Spate Irrigation Systems 35
CHAPTER FIVE: Result and Discussion 41
5.1. Institutional Arrangements and Community Spate irrigation Management 41
5.1.1. The structure and Function of WUA 41
5.1.2. Distribution of Spate Water 47
5.1.3. Maintenance and Rehabilitation of Spate Irrigation structures 54
5.2 Water Right and Rules in the Spate irrigation Management 60
5.2.1. The Water Rights and rules 60
5.2.2. Enforcement of Water rights and Rules 63
5.2.3. Codification of the Water rights and Rules 65
5.2.4. Spate Water Conflict resolution 68
5.2.5. Women Participation in Spate irrigation 70
5.3. Challenges of Improving Community Spate Irrigation 72
5.3.1. Problems of the Traditional Spate Irrigation Systems 72
5.3.2. Problems of the Modernized Spate Irrigation Systems 74
5.3.3 Community Participation 82
6. Conclusion and Recommendation 87
6.1. Conclusion 87
6.2. Recommendation 94
Reference: I
Annex- I Questionnaires IV

List of Tables

Table 2.1: Number of sample households from each scheme 10
Table 5.1: Performance evaluation of *Abo-Gereb* and *Abo-Mai* by sample farmers 45
Table 5.2: Farmers' response to the Share of spate water among *Melwens*.....49
Table 5.3: Farmers' response to the equity of share of spate water among subgroups 52
Table 5.4: Frequency of O and M activities in a rainy season in the studied schemes.....55
Table 5.5: Trend of O and M frequency in Fokisa after scheme modernization.....58
Table 5.6: Spate benefited in the rainy season of 2007 by head, middle and tail irrigators 62
Table 5.7: Assessment of view whether the *Sirit* is implemented in a way it is formulated.....64
Table 5.8: Incidence of conflict occurrences over spate distribution among farmers.....69
Table 5.9: Plot and management by female household heads 70
Table 5.10: Assessment of farmers need for the modernization of their traditional scheme ..73
Table 5.11: Farmers level of satisfaction after modernization of the Fokisa SIS 80
Table 5.12: Level of community participation during planning and design of the schemes ...82
Table 5.13: Farmers response on 'who owns the irrigation infrastructures'.....85

List of Figures

Figure 4.1: Location of the Study sites **30**
Figure 5.1: Organizational structure of WUAs in the studied SIS **44**
Figure 5.2. Traditional *Sirit* for *Maegel* Fokisa **66**

List of Plates

Plate 5.1: Farmers removing silt from Fokisa primary canal **58**
Plate 5.2: Inundated field in Fokisa spate irrigation system **61**
Plate 5.3: Damaged primary canal at Boboteya spate irrigation system **72**
Plate 5.4: Takeoff and sluice gates at Fokisa modern diversion weir **77**
Plate 5.5: Traditional approach canal over modern diversion weir at Fokisa **79**
Plate 5.6: Traditional versus modern spate irrigation canals in Hara **84**

List of Acronyms

BOARD	Bureau of Agriculture and Rural Development
BOFED	Bureau of Finance and Economic Development
Co-SAERT	Commission for sustainable Agriculture and Environmental Rehabilitation
Ha	Hectare
HHH	House Hold Heads
M.a.s.l	Meter above sea level
NGO	Non-Governmental Organization
O and M	Operation and maintenance
REST	Relief Society of Tigray
SIS	Spate irrigation system
TWRDB	Tigray Water Resource Development Bureau
TWRMEB	Tigray Water Resource, Mines and Energy Bureau
WARDO	Woreda Agriculture and Rural Development
WC	Water Committee
WUA	Water User Association
WWRMEO	Woreda Water Resource, Mines and Energy Office

Glossary of Local Terms

Abo gereb	Father of the River/ WC member involved in water distribution among different groups in a spate irrigation system
Abo mai	Father of water/ WC member involved in water distribution with in a group
Belg	Minor rainy season running from February to April
Chererto	Small floods from local catchment such as residential areas, communal routes and grazing lands
Feleg	Canal
Gujile	Sub Group
Horeye	Small earthen reservoir used to collect water from small runoffs
Kiremt	The main rainy season running from June to early September
Maegel	River diversion weir for spate irrigation
Mahberawi fird bet	Traditional community court
Melwen	Farm land of group of farmers served by a specific secondary canal
Shelshal	Ploughing maize and sorghum plots at random after crops reached a knee height to help the field retain more spate water
Sirit	Local and traditional rules and regulations formulated to administer spate irrigation systems
Tabia	Sub district
Woreda	District

ABSTRACT

The purpose of this study has been to assess the traditional spate irrigation in Raya Valley with special reference to three spate irrigation systems in the southern zone of Tigray region. The study attempted to find out the spate irrigation management practice in the community, institutional arrangement in the spate irrigation systems and identify challenges with improving the traditional spate irrigation systems. For this research household survey, farmer group discussion and key informant were interviewed to collect primary data. In addition relevant literatures and documents were reviewed.

The findings of this study show that the farmers in the study sites are self organized under Water User Organization (WUA) to manage the community spate irrigation systems. The systems are managed by elected Abo-Gereb (Father of the river) and Abo-Mais (water masters).The spate water distribution in the study areas is using network of primary, secondary and tertiary canals or field canals. The spate water is diverted from the river to the primary canal then further divided in to secondary canals. Each secondary canal is allocated to serve a group of farmers locally known as Melwen. Groups are liable to get spate water based on a predetermined sequence by lottery draw performed at the beginning of each rainy season. Spate water distribution with in the Melwen starts from the subgroups (Gujile) situated at the head then to the middle and finally to the tail.

The amount of spate water a farmer is entitled to is the inundation of individual plot. Each spate irrigation system has rules and regulations (Sirit) by which the Abo-Gerebs and Abo-mais enforce the fair distribution of spate water and regulate any offence against the smooth running of the system. The Sirit is used to solve conflicts among farmers and penalize offenders of the rules and regulations.

The major problem with the traditional spate irrigation systems is the repeated damage cased to the traditional diversion weir and irrigation infrastructures by floods. As a result farmers are engaged in repeated maintenance of the weir and infrastructures. On the other hand the modernised spate irrigation systems have failed to divert the designed amount of spate water and affected by heavy siltation problem.

The result of this study shows that spate irrigation improvement intervention works should be accomplished through real participation of farmers and initiate them to practically influence the planning and designing process so that successful modernization projects could be accomplished.

CHAPTER ONE: Background of the Study

1.1. Introduction

There is positive relation between irrigation service and poverty alleviation. The availability of water for irrigation in communities helps boost food production. It increases the potential for producing more food consistently in drought-prone and food-insecure areas (FAO, 2003).

One of the challenges Ethiopia is facing in attaining food security and reducing poverty is high dependence on rain fed agriculture. The country's economy which has been highly dependent on agriculture is very much weakened by recurrent droughts. The major problem associated with the rainfall-dependent agriculture in the country is the high degree of variability and unreliability of the rainfall pattern. To overcome the problem, the country needs to utilize all its potential water resources so that it can feed the alarmingly growing population. As a result the current government has placed particular emphasis on the development and expansion of irrigated land (Mitiku, et al, 2001).

The Tigray Region is one of the drought prone areas of the country. Up to 85 percent of the population of the region lives in rural areas and depends on subsistence agriculture. Due to the unreliable and erratic nature of rainfall most of the region is food insecure and seriously threatened by droughts. In order to ensure food security, the regional government has repeatedly formulated ambitious goals of water resource development activities. To overcome the shortage of water for agricultural production, the regional government devised strategies to conserve water when it falls abundantly during the short rainy season

and then to store it and use it for irrigation in the dry season. To implement the strategies different governmental and nongovernmental institutions were set and have been implementing several water harvesting activities. One of the institutions established was the Commission for Sustainable Agriculture and Environmental Rehabilitation (CO-SAERT) in 1995 to carry out construction and maintenance of small scale irrigation dams and irrigation infrastructures (Woldeab, 2003, and Mitiku et al, 2001). Co-SAERT planned to construct 500 micro-dams over ten years. However, the Commission had constructed only 44 micro-dams in eight years, and has stopped further construction because of sedimentation of earth dams and seepage problems. As a result the CO-SAERT was reorganized to Tigray Water Resource Development Bureau (TWRDB) and the direction of the institution was shifted to the introduction of household level water harvesting technologies and construction of river diversions (Awulachew, et al, 2005). Though it later failed to attain its goals the TWRDB on its part set a plan to construct 500,000 household ponds in five years with the objective of providing supplementary irrigation to crops during short rainy seasons that often make harvest fail.

Another rain water harvesting intervention works carried out by the Regional Water Resource Development Bureau was improvement of traditional spate irrigation systems which is found in the Southern Zone of the Region, Raya Valley (Awulachew, et al, 2005). Spate irrigation is a unique form of irrigation, predominantly found in arid and semi arid regions where occasional heavy floods of short duration is diverted in to farm fields using earth, boulders and brushwood (Peter Stern 1997). Spate irrigation in the Raya Valley is practiced by self organized farmers usually on a small scale by constructing diversion structures made of locally available materials. This type of irrigation is playing a significant role in improving agricultural production in the low land areas of the Raya Valley by

traditionally diverting the flood water that comes from the neighbouring highlands. Therefore, harvesting and make use of the seasonal runoff in the low lands through proper planning and designing of appropriate water harvesting technologies is one option of boasting agricultural production and improving of the livelihood of the farmers in the Raya Valley.

1.2. Statement of the Problem

The livelihood of farmers in Ethiopia largely depends on rain fed agriculture. Except in Western, South West and Central parts of the country, rainfall is highly variable and unpredictable. The unpredictability increases towards arid and semi-arid parts of the country. In drought prone areas of the country to overcome the shortage of rainfall farmers have been devising different mechanisms of water harvesting methods. In this regard Woldeab (2003) and Mitiku et al (2001) identifies different traditional methods of surface water harvesting and irrigation methods in Tigray Region. Some of the traditional irrigation methods include: river diversion, spring developments, flood spreading (spate irrigation) and pond systems.

Spate irrigation in Ethiopia has been practiced for many generations in the Raya Valley, Afar, Eastern Harerghe, Nathreth and Konso (Wallingford, et al 2007; Catterson, et al., 1999). In the period 2001 to 2007 nine community based spate irrigation schemes were modernized in the Raya valley by the Regional Water Resource and Mines and Energy Bureau (TWRMEB). However, according to Lawrence et al, (2005) global experience shows that most spate irrigation improvement projects have been dominated by heavy engineering approaches. Traditional spate diversion structures have been replaced by permanent ones with out effective participation of the farmers. Valuable knowledge of

farmers in spate irrigation and their preference are often not properly considered during the design process. This simplistic approach which ignored the complex social, geographical and hydrological characteristics of the different communities is referred as a main source for the limited number of successful intervention.

Both the traditional and modern spate irrigation systems in many countries such as Yemen, Eritrea, Pakistan and North African countries are well studied and documented. Comparing to the studies carried out in different parts of the world the traditional spate irrigation in different parts of the Ethiopia is not well studied. The rich experience of traditional spate irrigation practices of the local communities at different parts of the country remains to be largely undisclosed. Therefore, the specific problems that initiated this study are the repeated failure of improvement intervention works and the desire to look in to the largely undisclosed traditional spate irrigation practices.

1.3. Objective of the Study

The study aims at examining the local experience in spate irrigation management in three community based spate irrigation schemes in Raya Valley.

The specific objectives of the study are:

- To assess the spate irrigation management practice at community level
- To assess the institutional arrangement in spate irrigation management
- Identify challenges associated with improving community spate irrigation.

1.4. Research Questions

The main research question is "How is irrigation managed in the three community based spate irrigation systems?"

The specific research questions are:

- How do farmers manage spate irrigation systems?
- What are the main activities involved in community spate irrigation systems?
- What are the main problems associated with improving community spate irrigations?

1.5. Significance of the Study

The main purpose of the study is to look at how spate irrigation is managed at community level in the study areas. Therefore the result of this study will serve as source of information about the traditional experience of community spate irrigation management in the specific areas. It can also serve as an input for planning of community spate irrigation improvement works.

CHAPTER TWO: Research Methodology

The study focuses on three community spate irrigation schemes in the Raya valley which are found in Raya Azebo and Alamata woredas of Southern Zone of Tigray region. The sites selected for the investigation are Fokisa, Hara and Boboteya spate irrigation systems. Fokisa and Hara spate irrigation systems are improved schemes by the Tigray Water Resource, Mines and Energy Bureau (TWRMEB). Fokisa is reported to be better performing improved spate irrigation system while Hara has totally failed. The third scheme Boboteya is totally under community management and with no improvement intervention works.

2.1. Data collection Method

The data collection method employed for this specific investigation was survey method. Both primary and secondary data were collected and used for this study.

Primary data collection

Primary data for the study were collected from selected sample households, focus group discussion and discussion with key informants. Structured questionnaire was prepared and used to collect information from selected households. Discussion checklists were used for focus group and key informant discussions.

Secondary data collection

Secondary data from formal sources such as Tigray Water Resource, Mines and Energy Bureau (TWRMEB), Bureau of Agriculture and Rural Development (BOARD), Bureau of

finance and Economic development (BOFED) were used as a source of information about the study area and issues under investigation.

2.2. Sampling Design

This study used both purposive sampling and random sampling techniques. The purposive sampling technique was used to select the schemes to be studied. Selection of schemes was made based on the objective of the study and has considered the distribution of the schemes along the study area, the Raya Valley. From the lists of spate irrigation beneficiaries at each scheme random sampling was used to select sample households for interview.

2.2.1. Sample selection for Household interview

Two of the three spate irrigation systems namely Fokisa and Boboteya have 163, 260 household head beneficiaries respectively while the third one, Hara, which has totally failed have a total of 280 household head farmers under its failed irrigation infrastructure (diversion weir, primary canal and field canals). The researcher took 10 percent sample households from each scheme for the investigation. Therefore 16 beneficiaries from Fokisa, 26 beneficiaries from Boboteya and 28 beneficiaries from Hara totally 70 farmers were selected and interviewed.

Before undertaking the random sampling two stage stratification were carried out. First the spate irrigation beneficiaries (sample frame) in each scheme were stratified in to male and female headed households. The number of female headed households included in the sample population was based on the proportion they have in each spate irrigation scheme. For instance 16 percent of the beneficiary farmers in Fokisa spate irrigation system are female house hold heads, therefore 16 percent of the sample farmers taken from the scheme

are made to be female house hold heads. Second based on the farm land position along the spate irrigation infrastructure, the beneficiaries in each scheme were further stratified into head, middle and tail beneficiaries. It was found that the primary canals that divert spate water from the river at Fokisa and Boboteya are divided in to three and four secondary canals respectively. Each secondary canal is allocated to serve a group of farmers locally known as *Melwen*. Therefore, the stratification of the groups in to head, middle and tail was found to be relevant with in each *Melwen* than among the *Melwens* (groups). In this case the farmers at each *Melwen* were stratified in to head, middle and tail irrigators and sample farmers were taken randomly from each position proportionally. On the other hand, the Hara modernized spate irrigation system is totally nonfunctional and there are no beneficiary farmers. The sample farmers taken from Hara are the land owners at the command of the failed scheme. These farmers are currently organized into three groups which are served by three independent deflector type traditional diversion structures along the river. These three traditional diversion structures are serving 280 farmers and the sample of farmers taken is base on the number of farmers at each group. The total number of irrigators and the number of sample farmers taken from each scheme are summarized in table 2.1.

Table 2.1: Number of sample households from each scheme

Name of SIS	No groups	Total No of Beneficiaries	House hold head		No of sample farmers		
			Male HHH	Female HHH	Male HHH	Female HHH	Total
Fokisa	3	163	137	26	13	3	16
Hara	3	280	208	72	21	7	28
Boboteya	4	260	208	52	21	5	26
Grand Total		703	553	150	55	15	70

2.2.2. Focus Group discussion and Key Informants

The primary data collected from the sample farmers were further enriched by the group discussions made with community members believed to be knowledgeable about the spate irrigation management in each scheme. Three separate group discussion were held in the three spate irrigation systems. Each discussion comprised seven community members (Five males and two females).

The key informants contacted include water committee members, woreda irrigation experts, development agents and regional irrigation officials and experts. In each of the three spate irrigation systems discussion was held with the water committee members (*Abo-Gerebs*) and *Abo-Mais*. Discussions were made with woreda irrigation experts from the Woreda Water Resource, Mines and Energy Office (WWRMEO) and Woreda Agricultural and Rural Developemt (WARDO) experts. Each Development Agent working in the respective *Tabias* were contacted. Discussions were also held with Officials and Experts working in the Regional Water Resource, Mines and Energy Bureau (TWRMEB).

2.3. Data Analysis

All the information collected from household interview, focus group discussion and key informant interview have been used to prepare the final out put of the study. The method of analysis carried out in this study comprises both qualitative and descriptive statistics. Quantifiable information collected from closed questions was analyzed and discussed in the form of tables. Information from open end questions has been discussed through qualitative descriptions.

2.4. Limitation of the Study

The data collected for this study is based on the aforementioned methodology. However, this study is subject to the following limitations.

- It was found difficult to get a reference on the spate irrigation practice in the study areas, as a result this study used spate irrigation references from other countries.
- The total irrigators in the three spate irrigation systems are 703 household heads but the sample households limited to 70 (10%) may affect the degree of representation.

2.5. Organization of the Paper

The paper is organized under six chapters. The first chapter includes introduction, statement of the problem, objective of the study, research question and significance of the study. Chapter two deal with the methodology of the study. Chapter three presents an overview of review of literatures on spate irrigation. Chapter four deal with the description of the study areas. Chapter five elaborates survey findings and discusses of the results. And finally chapter five concludes by presenting conclusion and forwarding recommendations.

CHAPTER THREE: Literature Review

3.1. Conceptual and Theoretical Framework

Irrigation practice mainly involves three management activities. The first is the construction and operation and maintenance of physical structures. The second is the application of water to agricultural field. And third is the activity of managing the system and resolving conflicting among the users (Uphoff 1986, in Woldeab 2003). New irrigation technologies are not usually consciously designed to incorporate the essential features of the pre-existing technologies (both technical and social). The social, political, cultural, and institutional setting of the existing irrigation system is not well understood in order to design an intervention that can deliver benefits to the target community (Woldeab, 2003).

There is increasing recognition of the validity and importance of farmers' knowledge. The contribution of modern scientific knowledge to facilitated rural and agricultural transformation is also immense. The underlying conceptual and theoretical framework of this study is, therefore, the mediation of traditional versus modern knowledge.

According to Scoones et al (2000) traditional agricultural knowledge is interwoven between the technical (skills and capacities) and the non technical (cultural, ecological and social) factors. The endeavour to modify and support the local knowledge towards agricultural transformation requires change in professional behaviour towards local people's capacity, practice and values. Understanding the complexities and dynamic nature of irrigated agriculture Perrier and Salkini (1991: 15-16) asserts that upgrading traditional water

harvesting techniques with modernized technologies requires multidisciplinary perspective of "the knower exchanging the known".

While irrigation technological change may contribute to increased food production, one needs to be careful with substituting local technologies and knowledge of agricultural production. Agricultural transformation does not automatically mean that one or the other is better. One should avoid both extremes of traditional and modern agricultural knowledge. In this regard Perrier and Salkini (1991: 15-16) notes:

> *Transformation from traditional to modern agriculture implies a weakening of and elimination of ingrained attitudes. Social stability needs to be maintained but change has to occur if agricultural production is to be optimized. A dilemma of modernization is the balancing of public efficiency and individual equity; i.e. gaining maximal economic returns..... Rigid adherence to either is not tenable.*

Irrigation project improvement works often assumes modern knowledge of irrigation. Cultural priorities of local people are rarely considered by the project decision-makers assuming that it has nothing to do with socio-cultural setting of the rural society (Chambers, et al 1989). According to Woldeab (2003) and Chambers et al (1989) community irrigation scheme improvement works are often consider as the exclusive domain of the engineers. But besides being an engineering venture irrigation scheme improvement should also be considered as socio-technical undertaking of the concerned community (Woldeab 2003).

Every community owes its existence to generations of ancestors who accumulated and transmitted knowledge about irrigated agriculture. Respecting and understanding traditional knowledge is a pre-requisite to introduce any new technology and improvement works (World Bank 2006). In such context the socio-technical approach to improving community irrigation systems can be beneficiary in two ways. First it can help outsiders take wider look at the local social and technical background of the population involved. Second it can be a means to implement successful intervention works through practice of participatory project implementation. As a result the socio-technical approach is found to be relevant to the study of community based irrigation activities.

According to Catterson et al (1999) irrigation activities are characterized by group interactions associated with human behaviour and utilization of available local resources. In this case irrigation needs the right mix of social and technical knowledge possessed by the concerned community and development practitioners. Therefore, it is important to understand those interactions before introducing major change. Regarding the issues of incorporating rural people's social and technical knowledge Scoones et al (2000) presents three contrasting ways:

- Rural people's knowledge is considered as 'primitive' and 'unscientific' which needs to be 'transformed' through education in order to realize development.
- Rural people's knowledge is considered as 'valuable and underutilized resource' and need to be incorporated in order to ensure sustainable rural development.
- Both rural people's knowledge and western science represent different agro-ecological, socio-cultural and political settings which demand the development activities to address these differences.

However Mitiku et al (2002) asserts that rural peoples know-how on traditional irrigation management is considered as an opportunity for irrigation development activities through proper planning and community participation so that development intervention works become more successful and sustainable. The way towards successful irrigation development begins with a thorough investigation of local knowledge and interlink of irrigation with other local social activities. When new technologies are consciously designed to incorporate in to pre-existing technologies, the effect can be the strengthening of indigenous knowledge and institutions.

Considering the interaction of different actors in an irrigation system it is useful to focus on the actor linkages found in an irrigation system. According to Woldeab (2003) the actor oriented approach in an irrigation system encourages to look at the whole range of actors, with respect to their roles, involved in a system. Woldeab (2003: 4) identifies the main actors in two irrigation schemes in Hintalo Wajerat of Tigray Region to be 'land lords (during the imperial regime), farmers, local development administrators, development agents and *Abo-mai* (father of water)'. Though the relations among the actors are complex and with varying interests, they all have contribution in generating, revealing, and diffusion of technical and institutional knowledge. The involved actors are considered as complementary to each other in managing the water resource in the system.

In this case the need to focus on actor linkages is because of the increasing realization of importance and contribution of different actors in an irrigation system. The actors in irrigation systems are always under continuous interaction. The actor oriented approach is concerned with the relationships and flow of information among the different actors in the

system. If there is exchange of experience, flow of information and good partnership and coalition among the actors, socio-technical knowledge of all the actors can be effectively used.

3.2. Empirical Review

Irrigation

Irrigation is the supply of water to agricultural crops by artificial means where rain fall is not adequate to support agricultural production FAO (2003). In arid and semi-arid regions irrigated agriculture is widely practiced in order to offset the effect of drought (Peter Stern, 1979). According to the same author there are three major ways of supplying water to plants;

- Moisture conservation- the *in-situ* rain water harvesting method which is practiced in sloppy and shallow soils by constructing run-off interception and counter seepage furrows.
- Surface irrigation – is the supply of water to plants by techniques such as furrow irrigation, spate irrigation and drip irrigation.
- Overhead irrigation – water is supplied to plants using pressurized sprinklers.

With regard to the area irrigated there could be great differences between countries over what is meant by small, medium and large scale irrigation systems. According to Catterson et al (1999) in Ethiopia an irrigation system that severs a command area less than 200 hectare is considered to be small scale, where as irrigation system with command area between 200 and 3000 is a medium one. Large scale irrigation schemes are those having command area greater than 3000 hectare.

In some parts of the world irrigation has been practiced for thousands of years. In India and the Far East rice has been grown under irrigated agriculture for about 5000 years. Similarly irrigation has been in place along the Nile River, the Tigris and Euphrates for as long as 4000 years. Some of the ancient irrigation schemes in the East and Far East are still functioning without major change in their lay out and method of operation (Peter Stern, 1979).

Irrigation system construction works using modern engineering techniques began in India in the 19 century followed by large scale developments in the southern part of the United States. In the first half of the twentieth century, number of traditional irrigation schemes were modified and improved in many parts of the world. Most of these works included construction of river diversions, dams and field canals aiming at the efficient and effective utilization of irrigation water. Modification and improvement of large scale irrigation schemes were generally assumed to be beneficial in intensifying agricultural productivity. However, many problems related to social and management aspects became apparent in these schemes. As a result the importance of ensuring sustainable irrigation development works by focusing on small scale irrigation schemes got higher attention since the 1970s (Peter Stern 1979).

Community Based Irrigation Systems

According to FAO (2003) attention was turned in the 1980s to the informal sector of small scale irrigation schemes indicating a significant shift from engineering led irrigation solutions towards an interactive approach in which the financial, cultural and social circumstances of the small holder farmers was taken in to consideration. This is because

irrigation practised by individual farmers or smallholders using technology they could understand and manage easily is more efficient to address the need of the rural community. Over the last couple of years the 'bottom-up' or 'grass-roots' approach to development has been the main focus of attention. Ideas about how to increase food production have been adjusted to take into account some of the physical realities of land and water use and resource allocation. There has been an increased emphasis on poverty reduction and a renewed interest in alternatives to the more traditional ways of irrigating using available water resources.

Small scale irrigation schemes are usually community managed. The success of an irrigation system depends on the extent to which beneficiaries are able to make use of the facilities made available to them (FAO, 2003). Irrigation is characterized by group interactions associated with human behaviour. Accordingly, there are many versions of localized organizations that have developed in every country and society. Although their operations reflect the physical and social environment in which they exist, they all perform more or less the following functions: mobilizing local resources, distributing irrigation water as per an agreed schedule and resolving conflicts among users. As these traditional schemes are organized by the communities themselves, without external assistance, participation is self-mobilized and all irrigation issues are handled by the farmers themselves (Catterson, et al, 1999). Intended development intervention works in this respect may not be achieved without farmer's involvement in the process of irrigation management. After constructing the irrigation infrastructure government agencies cannot or do not want to manage the irrigation systems any more. Empirical studies show that farmers are able to sustainably manage irrigation systems at community level (Chandrasekaran, 2002). The water user association are usually established by the communities themselves in

order to controls and distribute water among the farmers. According to Woldeab (2003) the major responsibilities of Water Users Associations are:

- Distribution of irrigation Water
- Mobilization of farmers for canal cleaning and maintenance
- Resolving conflicts between farmers
- Supervising farm guards

According to Catterson et al (1999) based on the water source and distribution technology there are different of type of small scale irrigation systems. Some of the common types of small scale irrigation schemes in Ethiopia include;

- Diversion systems _ the most common type of irrigation. It utilises irrigation water from natural river flow. The infrastructures involved are diversion structure and water distribution canals. These schemes provide irrigation water during dry season and also provide supplementary irrigation during the rainy seasons.
- Spate systems _ occasional flood created during the rainy season is diverted from river beds. This form of irrigation is predominantly found in arid and semi arid regions.
- Spring systems _ water flow from small spring systems is exploited for the purpose of irrigation and domestic use. Usually water for irrigation is collected during the night time in night storage structures.
- Micro dams (Storage systems) _ these systems store water behind earth dams. Water from the earth dams is used to irrigate crop during the dry season based on the amount of water stored.

- Lift systems _ Pumps, manual or motorized are used to lift water from river beds where gravity irrigation is not possible.

It is obvious that irrigation increases the potential for producing more especially in the drought-prone and food-insecure areas. This remains the central hypothesis for investing on improvement of community managed small scale irrigation schemes. Many rural communities which have traditional small-scale irrigation infrastructure need technical and financial aid so that the regularly damaged diversion weirs and canal systems are improved (Catterson, et al, 1999). But rural communities need to have the opportunity to identify and decide the types of intervention works so that they make sure that it is in line with their expectations. Reviews made on why new or improved community irrigation schemes failed indicates that they were implemented without sufficient and effective beneficiary consultation and participation (Mitiku, et al, 2002).

Spate irrigation Overview

Spate irrigation is believed started in the present day Yemen and has been practice there for around five thousand years (Lawrence, et al, 2005). This type of traditional irrigation is common practice in arid and semi arid parts of the Middle East, Africa, South and central Asia and Latin America. Communities in these areas have developed this irrigation practice to cope with the unpredictable rain fall patter in the regions (Peter Stern, 1997, and Lawrence, et al, 2005).

Spate irrigation is characterised by a great variation in the size and frequency of floods from year to year and season to season, which directly influence the availability of water for agriculture in a season. But spate irrigation is important for the livelihoods of a

significant number of rural households, who often belong to the poorest section of the communities. According to Abraham (2007) spate irrigation is practiced in low land areas where there is surrounding mountainous with better rain fall pattern that can serve as source of flood and deep soils that are capable of storing ample water to support crops during period of low precipitation.

Spate irrigation systems differ from one community to the other community based on hydrogeological (catchment characteristics, rainfall pattern), geographical and sociological (land tenure, social structure) situations. It is also distinct from other irrigation systems such as river diversions that use water from perennial rivers. In spate irrigation systems there is high uncertainty. This uncertainty emanates from the unpredictability in timing, volume and sequence of floodwater (Lawrence, et al 2005).

According to Lawrence et al, (2005) most spate irrigation systems are farmer managed. The responsibility of managing the community spate irrigation is given to certain body in the community. For instance in Yemen local Sheikhs has been responsible while in Eritrea the community selects local elders believed to serve the community fairly. In both countries women are not allowed to involve in the spate irrigation committee. In all the farmer managed spate irrigation systems the main roles of the spate irrigation committee are:

- Distribution of spate water
- Management of silt in the flood canals
- Maintenance and rehabilitation of diversion structures

In countries where spate irrigation is practiced there are three methods of water distribution systems. The first is the water spreading system. Flood is diverted from the river and spread over fields with no guiding canals. This method of water distribution is practiced in Iran

and Pakistan to enhance the ground water recharge of an area and to supply water to communal grazing lands. The second is the field to field system. In this method of spate irrigation large volume of water passes from field to field by breaking field bunds after a bunded field is filled with water to predetermined depth. This system of spate irrigation is practiced in Yemen and Eritrea to retain much moisture in the soil where rainfall is very low to support the growth of crops. The third type is the controlled system. In this method of spate irrigation system control structures such as secondary canals, tertiary canals and field canals are used to convey water to the irrigated lands (ibid).

Lawrence et al, (2005) indicates that in arid and semi arid regions where farmers highly depend on spate irrigation, improving the existing irrigation systems and extending to new potential areas is an alternative development option. But the intervention in such irrigation systems has been insignificant for two main reasons. First there has been debate on the profitability of the investment in such subsistence farming. Second despite the simple looking spate irrigation system there has been little success in improvement works due to hydraulic and social complexities involved. The same author recommends the need for different approach so that such interventions become a success. These approaches include:

- Initiation of farmer driven planning – outsiders must work together with farmers to identify the most appropriate option to improve a particular scheme.
- Introduce farmer friendly technologies - the improvement works need to be low cost and easily maintainable using farmer owned knowledge and material.
- Maintain existing upstream and downstream water distribution – replacement of traditional diversions with permanent ones may result in unfair water distribution and become source of conflict.

- Adoption of integrated water resource management system- integration of spate irrigation system with suitable water use options.

As a international experience the spate irrigation practices of Pakistan, Yemen and Eritrea are presented below.

Review of International Experience on Spate Irrigation

Spate Irrigation in Pakistan

According to Abraham (2007) and Ahmed (2000) Pakistan is found in south Asia bordered by Arabian Sea, and India in the East, Iran and Afghanistan in the West and China in the North. The country has a total area of 80.4 million ha and has a mean annual rainfall that varies from less than 100 mm in the arid and semi-arid areas to more than 1500 mm in foothills and northern mountains.

In Pakistan, spate irrigation is practiced for a very long period. In the Province of Balochistan, there is evidence that spate irrigation was practiced as early as 3,000 BC and it was one of the most important agricultural systems in the country (Ahmed, 2000). According to FAO (2003), Pakistan has about 1.4 million ha areas under spate irrigation.

In community spate irrigation systems in Pakistan the rehabilitation and maintenance of spate irrigation infrastructures are organized by influential farmers in the community with large land holdings and have the resource and power to mobilize fellow farmers. The maintenance rehabilitation activities are done through campaigns with the mobilization of

joint community labour. Farmers with big land holding usually have tractors and are expected to take these along during the maintenance works, whereas other farmers with small land holding only provide labor. In this way fairness of labour contribution in O and M activities is restored. These influential farmers have also the capacity to arrange government subsidized bulldozer service in their respective schemes (Lawrence et al, 2005).

Water rights are enforced by the farmers of the system and spate water distribution is based on allocation rules which consider the unknown volume of each flood occurrences. The probability of getting spate is not equally distributed in the command areas of the spate irrigation systems. The probability of irrigate highly depends on the ability to control the flood. But since the traditional structures do not with stand heavy floods, free distribution exists along the river. In moderate flood occurrences the sequence of water distribution from head to tail is practiced. The strict rule in the spate water distribution is, however, there is no second flood benefit before every land in the command is served once (ibid).

Investment in improvement of flood irrigation systems in the past in Pakistan has often been poorly conceived, expensive and inappropriate for the requirements of the farmers. Traditional diversion structures were replaced by permanent structures. The failure rate of the modernized structures has been however high. Since 1973 about 47 traditional spate irrigation systems were modernized in Pakistan out of which only 34 were functional while the rest have totally failed or have serious operational problems. The main cause of the failures were reported to be inappropriate engineering approach which focused on controlling of flood flow at a single point which resulted in either breaking of the diversion

structures or suffered from heavy siltation on their takeoffs (Lawrence et al, 2005, and Abraham, 2007).

Spate Irrigation in Yemen

The Republic of Yemen Middle bordered by Saudi Arabia in the north, Red Sea in the East, Arabian Sea and Gulf of Aden in the south and Oman in the west. Yemen has a predominantly semi-arid to arid climate. High temperatures prevail throughout the year in low-altitude areas of the western and southern coastal plains whereas greater variations in the temperatures can be experienced in high-altitude areas. Rainfall is highly erratic in time, quantity and location. There are two main rainy seasons in Yemen; the first from March to May, and the second from July to September. The total area of Yemen is approximately about 55 millions ha of which only about 2.5% (i.e. 1.7 million ha) is potentially cultivable. From the average annual total cultivated areas of 1,143,300 ha about 125700 (11%) is under spate irrigation system (ibid).

In Yemen, spate has been in practice for at least three millenniums and it may even date back to the third millennium BC. Currently about 90,000 ha, which accounts for 25% of the total irrigated area in Yemen, is covered by modernized spate irrigation system, while around 30,000 ha is commanded by traditional spate schemes (ibid).

According to Lawrence et al, (2005) water masters supervise flood water distribution, look after the maintenance of canals and dikes following heavy floods and resolve disputes. Water rights and rules govern the distribution of flood water among irrigated lands in the spate irrigation systems. The lands are irrigated in turn from upstream to downstream. Upstream lands are fully irrigated first before the downstream ones can take any spate

water. In addition the areas that first come under agriculture have the priorities to irrigate first. The right to irrigation is sometimes governed by the depth of application. Though it differs among schemes the maximum allowable depth of water a plot is entitled in the command is fixed. Generally, the water rights are well-established and respected in spate water distribution; however, it is also common that influential farmers try to and break those rules sometimes.

Since the 1980s a large number of spate systems were modernized. The main goal of these projects was to ensure the sustainable management and use of water resources and to increase agriculture productivity and hence improve the livelihood of the poor smallholders. The modernization consisted of the construction of permanent diversion weirs, the excavation and sometimes lining of canals and land levelling. The modernization of spate systems in Yemen has had a number of drawbacks. One is that the upstream irrigators got full control of the floods and led to destroy the built-in traditional spate flood division among the farmers along the river. Second the larger ability to control spate water flows in the upstream irrigators resulted in an accelerated sedimentation of the command areas and flood channels. Some modernized spate systems suffered from lack of operational sediment exclusion mechanism (Lawrence et al, 2005, and Abraham, 2007).

Spate Irrigation in Eritrea

Eritrea is located in north-eastern of Africa neighboured by Sudan in the North and West, Ethiopia and Djibouti in the South, and the Red Sea in the East. The country is composed of moist central highlands and arid lowlands. The low and erratic rainfall in the coastal zones of Eritrea makes agricultural production impossible without irrigation. But the abundant

runoff water from the adjacent highlands serves as a source of flood for spate irrigation (Abraham, 2007).

In Eritrea, spate irrigation started at the beginning of the 20th century by Yemeni migrants. About 50% to 55% of the total irrigated area was under spate irrigation. In the lowlands, the floods are diverted to adjacent irrigable lands by temporary diversion structures and, then conveyed by distribution canals to the series of fields that are surrounded by interior and exterior bunds (Lawrence et al, 2005, and Abraham, 2007).

The spate irrigation systems are led by elected water committee members elected by the beneficiary farmers. This committee is responsible to manage the spate water distribution among different groups in the system and resolve disputes that may arise in the system. To strengthen such a perception, the farmers drafted water sharing rules that significantly contributed to ensuring fair water distribution within and between the upstream and downstream fields. Any irrigator is obliged to participate in the operation and maintenance of spate irrigation structure, regardless of whether or not the damage of the structure affects the supply of water to his field (ibid).

Irrigation canals in a specific spate diversion structures are liable to get spate water based on sequence rule adjusted by the size of the flood received. In this case upstream fields and canals have the priority to small and medium floods and since the traditional spate structures do not withstand heavy floods the downstream canals and fields benefit from large floods. Every farmer in the SIS builds a bund around his plot and during spate irrigation distribution every plot is entitled to get a knee height (up to 50 cm) spate water.

The modernization intervention works has constructed permanent weirs and completely replacing the traditional diversion weirs. Some improvements were also introduced to the canal system by constructing permanent division structures at main canals. However, the performance of the modern structures was found to be far below expectations and less than what would have normally been irrigated under the traditional systems. The main problems that led to the poor performance of the modernization interventions were first the designs were inappropriate with regard to the water requirement of the irrigated fields and (discrepancies between design operation assumptions and the operational realities) and second discrepancies were created between the modern lay out and the indigenous water sharing arrangements. These setbacks together with the siltation problem in the modernized schemes limited the success of the intervention works (ibid).

Spate Irrigation in Ethiopia

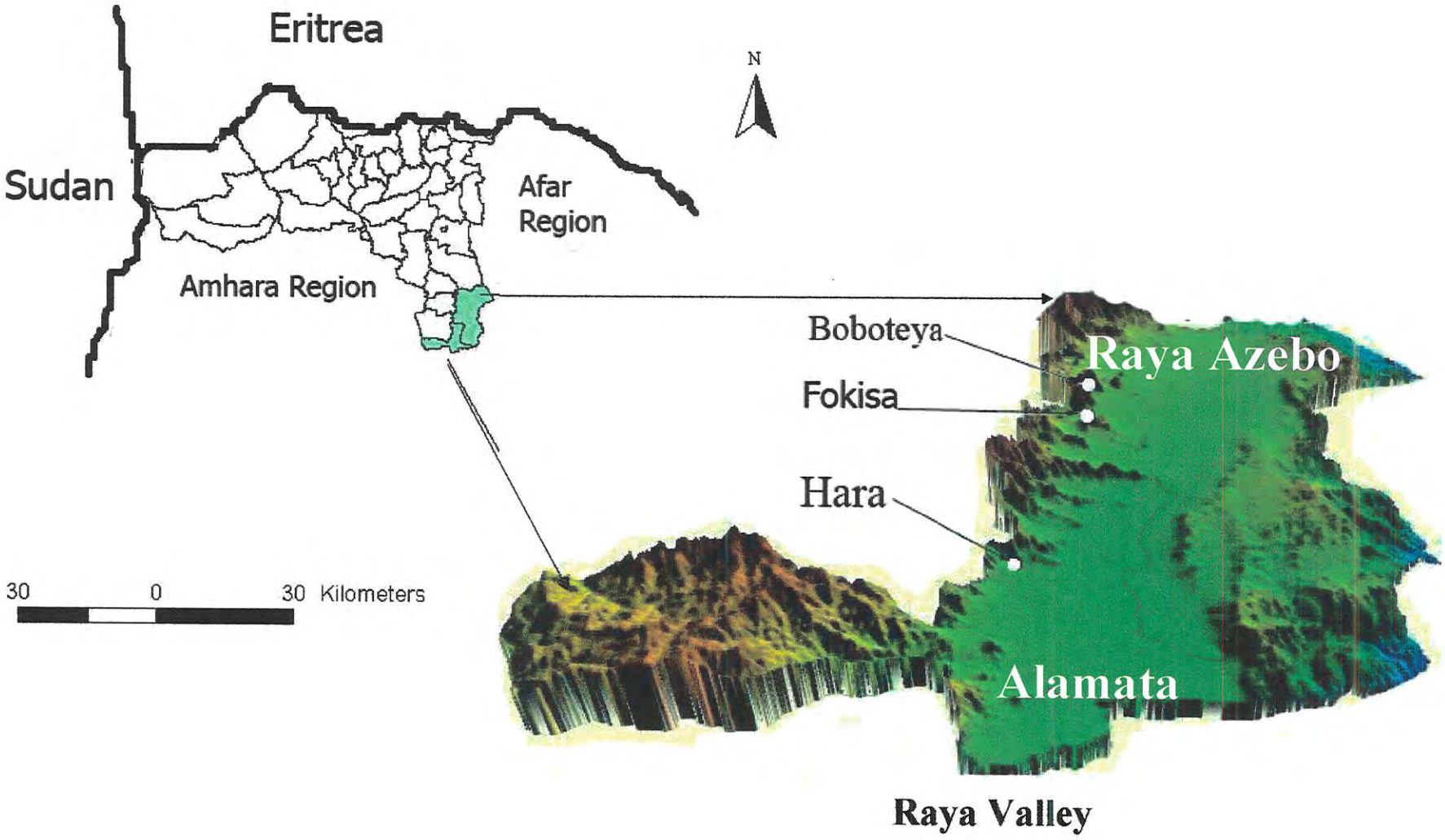
Wallingford et al, (2007) and Catterson et al, (1999) categorized spate irrigation in Ethiopia in to high land and low land systems. The high land spate system is usually referred as run-off system diverts flashy floods received from the same catchment to the relatively small irrigable land. The low land spate irrigation system is found in the foothills of mountainous water shades and has larger command area. The flood that comes from the neighbouring mountains becomes steady and lasts for longer time. Spate irrigation in Ethiopia differ form those in the Middle East and South East Asia where farming is more unpredictable and entirely dependent on one or two flood events and rainfall events. In contrast farming in Ethiopia relies more on rainfall and spate irrigation usually serves as supplementary to rainfall.

CHAPTER FOUR: The Study Area

4.1 The Raya Valley

The Raya Valley is located in the south-east part of the Tigray Regional State between $39^0$22' to $39^0$25' north latitude and $12^0$17' to $12^0$15' east longitude. It is bordered by Hintalo Wajerat Woreda to the north, Afar Region to the east, Endamekoni and Ofla woredas to the west and Amhara Region to the south. It comprises the total area of Raya Azebo and Alamata Woredas and some eastern high lands of Endamekoni and Ofla Woredas (REST 1996). The total of population of the Raya Valley Area is about 227,431(136039 for Raya Azebo and 85359 for Alamata woreda). From the total population in Raya Azebo 119984 (88%) and from the total population of Alamata 80796 (95%) live in rural areas (CSA, 2007).

Figure 4.1: Map of the Raya Valley and the Project areas with reference to the map of Tigray Region



Topographically the Raya Valley is divided in to two major zones: low land areas with an altitude less than 1500 m.a.s.l which mostly covers large part of the central part of the valley; and the high land areas having altitude above 1500 m.a.s.l which covers the western and eastern edges of the valley (ibid). According to the moisture index criteria provided by REST, the Raya Valley area is classified as dry climates of semi-arid and arid types (REST 1997: 4).

The Raya Valley has a bimodal rainfall pattern. Though diminishing from time to time, the area experiences a short rainy season locally known as *Belg* which runs from February to April followed by the main rain season called *Kiremt* which runs from June to early September (REST 1997).

Eastern and western highland of the valley experience better rainfall. For instance the Chercher highlands get average rainfall of 620 mm while the Maichew highlands get up to 775 mm of rainfall annually. The high fluctuation and unreliability becomes most common in the lowland valley of Mekoni and Alamata areas. The average annual rainfall collected from Mekoni and Alamata meteorological stations show that it is 486 and 693 mm annually respectively (ibid).

Agriculture and Land Use

Like the rest of the region, agriculture in the Raya Valley is dominated mainly by smallholders. Farming is done by the use of traditional bullock drawn plough pulled by draught animals and simple hand tools. Crop production is conducted mainly under rain-fed and traditional flood diversion to supplement water requirement of crops (REST 1996).

Most farmers in the Raya Valley pursue a strategy of mixed farming (crop and livestock production). Depending on the rainfall available in a specific season households produce sorghum, maize, barely, teff, and dekeko. In good rainy season, farmers are able to produce up to 30-40 quintal of sorghum per hectare. The area is also known for rearing livestock such as oxen, cows, camel, and donkey (ibid).

The Raya Valley is an agriculturally potential area for crop production, livestock grazing and browsing. Especially the low land areas of the valley are characterized with deep and fertile soil which is suitable for agricultural production. The size of land holding in the Raya Valley area varies from the mountainous part to the low land areas. The average land holding in the highlands of Mekoni and Ofla ranges from 0.51-1 ha while in the low land areas of Mekoni ranges from 1.01- 1.5 ha. This indicates that there is relatively better land holding size in the low land areas of the valley (COTWRD 2004).

Water Resource

The river systems in the Raya Valley drain to the Denakil (Afar) through the Hum Sheet (Sulula River). All the tributary rives in the valley flows to the Sulula River situated at the centre of the valley and drains south wards to join other rivers from Amhara region the Zoble highlands and drain together to the Denakil depression in the Afar region (REST 1997). The Raya Valley area is therefore part of the Denakil River basin which has a total catchment area of 74002 km^3 from Tigray, Amhara and Afar regional states. This river basin has a total mean annual flow of about 0.86 Bm^3 per year (Awulachew, et al, 2007).

The Raya Valley area has considerable surface water potential. In addition to the limited rainfall, the Raya Valley benefits from seasonal flow of more than 15 streams and rivers.

These streams and rivers come from the western and eastern highlands produce about 170Mm^3 water every year (REST 1996).

The lowland area of the Raya Valley has potential for exploitable ground water resource. According to the REST (1996: 16) study report the area has about 4233Mm^3 reserve ground water resource out of which 100Mm3 is exploitable annually. The ground water resource with good quality for irrigation can be obtained starting from depth of 60 m in the north to 20 m depth in the south of the valley. Both the surface and ground water resource of the Raya Valley are potential to utilize the relatively abundant and fertile agricultural land for irrigated agriculture.

Irrigation

According to COTWRD (2004) moisture stress is the major limiting factor for crop production in the Raya Valley. Rain fall is inadequate and erratic in distribution. In the low land areas of the valley it is difficult to produce crops such as the local long season cultivar of sorghum variety with the limited amount of rainfall. As a result farmers in the lowland areas of the Raya Valley are used to traditionally harvest flood water that comes from the neighbouring highland areas with relatively better rainfall to supplement their crops.

According to REST (1997) there are two types of traditional irrigation practices in the Raya Valley area. These are traditional small scale irrigation and spate irrigation. The traditional small scale irrigation is practiced in few rivers which has year round flow. In such kind of irrigation the major crop produced by farmers is *Chat* and some cash crops. On the other hand farmers in the foot hills of the valley attempt to overcome the moisture stress they face by traditionally diverting flood water that comes from the nearby hills and mountains

using temporary traditional diversion structures. This type of supplementary irrigation known as spate irrigation has been in practice in the area for generations. In this case using the traditional spate irrigation systems farmers in the Raya Valley supplement up to 21250 ha of land and thereby obtain relatively higher yield (REST 1997).

Since the last 10 years the regional WRMEB and other local NGOs like the REST are improving and modernizing the traditional irrigation structures and spate systems in the Raya Valley. As a result attempts have been made to replace the temporary traditional diversion structures with permanent diversion structures and field infrastructures. So far up to five traditional river diversions and nine traditional spate irrigation systems have been modernized.

4.2. Description of the Studied Spate Irrigation Systems

Fokisa SIS

Location

Fokisa spate irrigation scheme is found in Mekoni Woreda Genete Tabia, Southern Administrative Zone of Tigray Region. It is geographically located at 1404406 North of latitude and 569713 East of longitude. The scheme is found 5 kilometres south of Mekoni town on the high way to Alamata. It is found at an altitude of 1719 M.a.s.l (TWRMEB 2006).

Climate

Meteorological data obtained from the nearest Mekoni Meteorological station indicates that the mean annual rainfall is about 486 mm much of which is obtained during the *Kiremt* rainy season which runs from July to October. The months October to December are the coolest in which 12.9 ^{0}c is recorded in December and the highest mean maximum temperature 29.8 ^{0}c recorded in June (COTWRD).

Water Resource

The source of water for the Fokisa spate irrigation system is the Gereb Fokisa River. The total catchment area of the Fokisa river basin is about 75.4 km^3. The flood originates from the neighbouring highland areas of Mekoni Woreda. The elevation of these catchments is up to 2200 m.a.s.l. Though there are no recorded data of the annual runoff volume and peak flood of the river the estimation made by COTWRD (2005) based on empirical formula indicates that the peak discharge to be 220 m^3/s.

Development of Fokisa Spate irrigation system

For generations the farmers in the locality were using the flood water from the Gereb Fokisa River for spate irrigation using traditional diversion structures. In 1997 E.C the regional TWRMEB replaced the traditional diversion structures with modern and permanent one. According to the Engineering feasibility report of the scheme the main objectives of the modernization of the traditional structures were:

- To introduce reliable and safe diversion structure that is not liable to flood damage so that farmers would be relieved from reconstruction and maintenance of diversion structure after every season and heavy flood.
- To construct head work which insure a much more efficient and effective diversion of flood water able to provide supplemental irrigate for up to 500 hectare of land.

By replacing the traditional diversion structure it was planned to supplement up to 500 ha of land with spate water. The modern head work was built to supply spate water for only the command areas to the left of the river. The diversion weir has a 35 m length and 1.5 m height. The un-gated takeoff deflects at 60^0 from the river and has three meter width and one meter height. The weir has three sluice gates with one metre height and 0.9 m width each located to the same side of the primary intake. The canal infrastructures in Fokisa were made based on the existing traditional irrigation infrastructures. The layout of the existing traditional spate water distribution structures (channel) were not disturbed or replaced rather the size of the canal were adjusted according to the expected volume of the primary canal discharge. After the project was modernized it has been able to supply spate water for about 200 ha of land (TWRMEB 2006).

Hara SIS

Location

Hara spate irrigation scheme is found in Tigray Regional state, Southern zone, Alamata Woreda Kulugizelemlem Tabia. It is geographically located at 1374272 North of latitude and 561855 East of longitude. It is situated three kilometres north east of Alamata town at an altitude of 1540 m.a.s.l. The scheme is at the foothills of the south eastern part of the Grakahsu Mountains which have elevation up to 2200 m.a.s.l (REST 1997).

Climate

The nearest meteorological station for Hara spate irrigation system is Alamata meteorological station which is at an average altitude of 1580 m.a.s.l. Accordingly the mean annual rainfall of the area is 693 mm. The area experiences bimodal rainfall, but since recent years the rainfall pattern has drastically changed. Reliability of rainfall is becoming so low year after year that crop production is affected significantly. The woreda is characterized by its unreliable and erratic rainfall pattern and is one of the drought prone woredas in the region (ibid).

Water Resource

The source of spate water for the Hara spate irrigation system is the Hara River. The total catchment area of the Hara River basin is about 36.41 km^3. The river used to have dry season flow before a diversion ware was built a kilometre or so above the Hara spate irrigation weir. To overcome the moisture stress they face at the end of every rainy season

farmers in the area harvest the flood water from the river that originates from the neighbouring highlands with slightly reliable rainfall (ibid).

Development of Hara spate irrigation system

The Hara spate irrigation system was constructed in 1995 E.C and handed over to the beneficiaries in 1996 E.C. The modernization work was carried out with the intension to supplement up to 400 ha of land using the flood coming from the river (TWRMEB 2006). Prior to its modernization farmers along both banks of the river were using spate water from the river using traditional diversion structures.

The Hara diversion weir is 35 m length concrete masonry. The modern headwork was build to supply spate water for commands at the right and left banks of the river. At both ends of the weir there are 32 inch diameter tube intakes constructed at right angle and under sluice gate facing parallel to the river. Both the intakes and the under sluice gates are gated with wheel manoeuvrings. The primary and secondary canals, which totally replaced the traditional ones, are made of combination of earth and cement masonry. The canals are earthen structures lined with selected material and the drop structures, crossing and de-sanders are made of cement masonry structures. The spate system started functioning in 1996 and totally stopped functioning in 1997 E.C for the reason that both the gated takeoffs of the weir was repeatedly silted with huge amount of sand and boulders which become difficult to clear and rehabilitate by the farmers after every spate flow (ibid).

Boboteya SIS

Location

The Boboteya traditional spate irrigation scheme is found in Mekoni Woreda Genete Tabia, Southern Administrative zone of Tigray Region. It is geographically located at1411963 North of latitude and 565724 East of longitude. The scheme is found four kilometres south west of Mekoni town on the high way to Maichew town. It is found at an altitude of 1842 M.a.s.l. Like the Fokisa spate irrigation system the nearest meteorological station to Boboteya is Mekoni Meteorological station. Therefore the rainfall, temperature and other climatic conditions are similar to that of the Fokisa SIS.

Water Resource

Boboteya traditional spate irrigation scheme is found along the Gereb Mai_Akeno River. The river gets its flood flow from neighbouring Maichew highlands which rise above 2000 m.a.s.l. Farmers along the sides of the river are used to utilize the flood water that comes from the river using traditional diversion structures. Using this method farmers are currently supplementing up to 300 hectare of land. The Boboteya traditional spate irrigation system is the most upper reach of the Gereb Mai-Akeno River. Though they are small in terms of the area they irrigate, down steam of this traditional spate irrigation system there are four traditional spate diversion structures.

Traditional Spate Irrigation Structures

The structures are mainly divided in to two. One is the diversion structure locally known as *Maegel* and the second is the canals known as *Feleg*. The farmers along the Mai-Akino River build two types of diversion structures. The first is weir type and the second is deflector type. The weir type *Maegel* is made perpendicular to the river and extends across

the river bed. The farmers at Boboteya traditional spate irrigation system used to construct the weir type spate diversion structure using boulder, stone, sand and brushwood. Recently organized farmers in Boboteya are getting gabion boxes from local government bodies and local NGOs.

The deflector type *Maegel* constructed downstream of Boboteya are built using brush woods, boulders, and sands along the riverbed. Farmers guide the flood water to the main intake or primary canal by constructing structures that extends parallel to the river. They construct deflector structure by placing a tree branch upside down and pressing it using boulder stones and silt.

The flood water is diverted from the river bed to the canals locally known as *feleg*. The primary canal (*feleg*) in Boboteya branched in to four secondary canals which are each allocated to serve four groups of farmers (*Melwen*). The canals are simple dugout structures which distribute spate water from the primary canal to the groups and then to the irrigated fields.

CHAPTER FIVE: Result and Discussion

5.1. Institutional Arrangements and Community Spate irrigation Management

The study sites namely Fokisa, Boboteya and Hara SIS are under community management. The farmers in the study sites are self organized under Water User Associations (WUA) to manage the spate irrigation systems. The WUA are established based on the initiation and will of the community members using spate water from the same river and diversion weir. To manage the spate irrigation systems the community elects *Abo-Gereb/ Mai committee* (father of the river/ Water committee) and *Abo-Mai/ Wedi feleg/ Goita* (water master/ lord). The *Abo-Gerebs* are the higher level administration body of the spate irrigation systems. Below the *Abo-Gereb* there are *Abo-Mais* who are responsible to manage group of farmers in the spate system.

5.1.1. The structure and Function of WUA

With the development of spate irrigation system, WUA were organized probably in response to the reoccurring water sharing problems (Yeshey et al 2006). The WUA in the studied schemes are established in a democratic way by organizing community meetings. The *Abo-Gereb* and *Abo-Mai* are also elected in a democratic way by voting system. The number of *Abo-Gerebs* can vary between three and five. For instance the number of *Abo-Gerebs* in Fokisa and Boboteya is five and three respectively while the three independent traditional intakes of Hara have three *Abo-Mais* each.

Appointment of Abogerebs and Abomais

Farmers elect the *Abo-Gerebs* (Water Committee) members and *Abo-Mais* with out any external intervention. The *Abo-Gereb* and *Abo-Mai* are elected for unlimited period of time. A members of Water Committee or *Abo-Mai* can be replaced by another mainly if he applied he wants to resign for his own reasonable personal problems or the members want him to be replaced. According to the discussion held with community members the criteria they consider to elect *Abo-Gereb* and *Abomai* are personal integrity, social acceptability and fairness in their administration. The members of *Abo-Gerb* or *Abo-Mai* do not receive any kind of payment for their service in the spate irrigation system. The main functions of the *Abo-Gereb* and *Abomai* are scheduling water distribution, coordinate the maintenance of infrastructures, resolving conflicts, enforcing regulatory procedures and punish offenders. The *Abo-Gereb* and *Abo-Mai* are also vested with the power of water allocation to each secondary channel, and prevent water theft.

Responsibility of the *Abo-Gereb* (Water Committee)

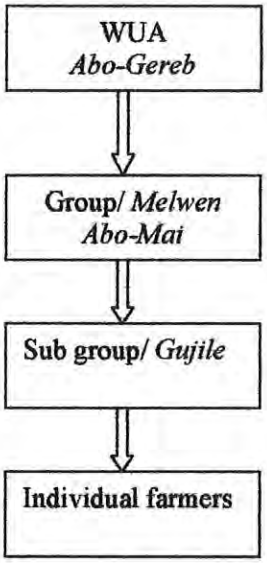
- Access and identify problem of the irrigation infrastructure and organize O and M works before the arrival of the rainy season
- Organize meeting and perform lottery draw of irrigation sequence of the secondary cannels for the coming rainy season
- During spate occurrence decide how many secondary canals can be supplied with spate water at hand
- Supervise the distribution of water to the secondary canals and verify and register the level of satisfaction with in each group

- Facilitate the opening and closing of canals according to the established sequence spate irrigation
- Monitor the diversion weir and the irrigation channel during irrigation and organize emergency O and M activities during the rainy season if necessary
- Implement the *Sirit* (rules and regulations of the spate system)

Responsibility of the *Abo-Mai*

- Deputies his group in the WUA
- Organize his group members for construction and maintenance of the spate irrigation infrastructures of the system
- Organize his group members and carry out O and M activities on infrastructures with in the group
- Supervise the distribution of spate water with in the group and settle any problem arising
- Implement the Sirit with in the group – impose fines on those who violated the Sirit and who do not participate in the operation and maintenance works
- Report out of hand problems that arises with in the group to the WC

Figure 5.1: Organizational structure of WUAs in the studied SIS



Source: survey result

The way the WUA organized in the studied spate irrigation systems look like the sketch in figure5.1. The Fokisa and Boboteya spate irrigation systems have *Abo-Gereb* on the top of the system. Just below the *Abo-Gereb* there are *Abo-Mais* who represent the *Melwens* (groups) who are liable to report and accept orders from the *Abo-Gerebs*. According to the discussion made with the water committee members during flood distribution one *Abo-mai* together with the respective *Abo-Gereb* supervises the distribution of spate water. They together supervise the secondary canal allocated for the group (*Melwen*) is open based on the established sequence and getting enough water to serve the members with in the group. The *Abo-Mais* ensure the farmers under their respective group are distributing water according to their turn and monitor the inundation of the fields and order the closing of field bunds if the fields under irrigation get enough water.

Table 5.1: Performance evaluation of *Abo-Gereb* and *Abo-Mai* by sample farmers

Performance	Evaluation criteria					
	Equity in spate distribution		Resolving conflicts		Infrastructure maintenance	
	No of response	%	No of response	%	No of response	%
Poor	3	4				
Average	12	17	2	3	4	6
Good	16	23	37	53	34	49
Very good	39	56	31	44	32	46
Total	70	100	70	100	70	100

Source: Survey results

As shown in table 5.1 farmers who evaluated the *Abo-Gerebs* and *Abo-mais* as good with regard to ensuring equal distribution of spate water, resolving conflict and organizing farmers for timely infrastructure maintenance is 23%, 53% and 49% respectively while those who evaluated very good is 56%, 44% and 46 respectively. In this case the level of trust of the community on the elected *Abo-Gerebs* and *Abo-Mais* in executing their duties and responsibilities levied on them is found to be high.

There is no defined schedule of activities in the WUA. The Water Committee periodically identifies activities and organizes the members for work. The Water Committee can organize meeting if there are issues to discuss with all members of the association. Before the beginning of the rainy season the Water Committee decides days for construction or maintenance of the diversion and irrigation infrastructure networks. After completing the construction and maintenance works the Water Committee evaluates if all structures are ready for flood diversion and carry out lottery draw in public to determine the turn of each secondary canal. Any maintenance requirement assessed by the Water Committee during the rainy is communicated to the *Abo-Mai* to mobilize his members for the emergency

maintenance work. The WUA has the right to use individual farmers land for flood rout with out any compensation claim from individual farmers.

Except the local material and labour contribution, there is no financial contribution made by the members. The only financial source available in the WUA is from fines that are collected from individual farmers who violated the *Sirit.* With this respect the finance available in the WUA is very limited. For instance the money available with the water committees in Fokisa and Boboteya is Birr 700 and 500 respectively. The money is claimed to be reserved with the water committee members. There are no receipts prepared by the WUA, no bank account and there is no financial auditing made by the farmers themselves or by any external auditor. It is found that there is no defined labour division among the water committee members. Asked about who chairs the water committee members and who keeps the money collected, the members responded that there is no such task division among the water committee members and claim they work as a group. The WARDO and WRMEO experts express that there is usually financial mismanagement in the WUA.

Though it is inappropriate to assume that SIS managed by community organization are with out problems local and customary system are the most effective even after intervention work take place by external agencies. A case in point is the Fokisa spate irrigation system in which after the modernization of the scheme it is still run by the beneficiary farmers using their traditional way of spate irrigation administration. Empirical studies also show that farmers are able to sustainably manage irrigation systems on a small scale level (Chandrasekaran et al, 2002, Yeshey et al 2006). This indicates that decentralized management of the SIS by WUA with financial autonomy and technical responsibility for maintenance and management is preferred and effective method of administration.

According to Woldeab (2003) WUA have no legal status in the region. The associations are not able to open bank accounts in the name of their respective WUAs. Similarly the organized farmers in the spate irrigation systems do not have legal status. According to the farmers and woreda agriculture office the water committees in the area are not allowed to be registered and gain legal status for the reason that the civil code legalize only multipurpose cooperative which includes the service of agricultural marketing and other services. A sole irrigation cooperative is not allowed to be legally registered.

5.1.2. Distribution of Spate Water

The spate water distribution in the study areas is using network of primary, secondary and tertiary canals or field canals. From the three methods of spate water distribution systems discussed in the literature namely the water spreading, field to field and control system (see page 21 and 22), the water distribution system in the study sites resembles to that of the controlled system.

Spate water distribution among the *Melwens* (secondary canals)

In Fokisa modern spate irrigation and Boboteya traditional spate irrigation systems the spate water diverted from the river bed to the primary canal is further divided in to secondary canals. The primary canal at Fokisa SIS is divided in to three secondary canals which are each allocated to supply spate water for three groups of farmers (*Melwens).* Similarly the primary canal at Boboteya SIS is divided in to four secondary canals which are each allocated to serve four *Melwens*.

Before the beginning of the rainy season the organized farmers in the studied spate irrigation schemes carry out rehabilitation and maintenance works of the diversion weir and primary and secondary canals in order to effectively use the spate water of the coming rainy season. Then they organize a meeting and perform lottery draw to decide which *Melwen* should get the first spate water, the second and so on.

The sequence rule is an important rule of water distribution in the studied spate irrigation systems. Groups are liable to get spate water based on a predetermined sequence by the lottery draw. Spate water diverted from the river to the primary canal is allocated to the secondary canals based on their sequence. Accordingly the distribution of spate water for that particular season is decided and groups irrigate their fields based on the established rotation.

The size of the flood determines the number of secondary canal getting spate water at a time. For this reason during the lottery draw a waiting list is reserved in case the flood is able to supply spate water to more than one secondary canal. In this case the number of secondary canals that can be supplied with flood water is decided by the water committee based on the flood size during flood occurrence. According to the discussion held with the water committee members and farmers the distribution of large floods to more than one secondary canal has two advantages. First it helps to irrigate more land and second it reduces the damage that would have been caused to the channels of the spate net work.

The *Melwens* are situated at different positions and distance with reference to the diversion weir and the primary canals of the spate irrigation system. Though each *Melwen* receives spate water based on the predetermined sequence, the distance of a *Melwen* from the

diversion weir and primary canal has certain level of effect on the amount and number of flood turns received by the secondary canal allocated to it. In table 5.2 the *Melwens* at Fokisa and Boboteya arranged based on their distance from the diversion weir and primary canal; the response of sample farmers is assessed with respect to the equity of flood received by each group of farmers (*Melwens*).

Table 5.2: Farmers' response to the Share of spate water among *Melwens*

Scheme name	Group/ *Melwen*	Total No of respondents	Share of spate water among *Melwens*					
			Equally shared		Not equally shared		No response	
			No	%	No	%	No	%
Fokisa	1	6	5	83	1	17		
	2	7	4	57	2	29	1	14
	3	3	2	67	1	33		
Total		16	11	69	4	25	1	6
Boboteya	1	6	4	67	1	17	1	17
	2	9	7	78	2	22		
	3	6	4	67	2	33		
	4	5	3	60	2	40		
Total		26	18	69	7	27	1	4
Total Number of respondents		42	29	69	11	26	2	5

Source: Survey results

The result from table 5.2 indicates that the farmers at the *Melwens* near to the diversion weir relatively feel that spate water is shared equally among the *Melwens*. As the *Melwens* become far from the diversion weir the number of respondents who feel that spate water is not equally distributed increases. Though there is a sequence rule arrangement in each spate irrigation system to ensure fair distribution of spate water among the *Melwens* there are situations where the groups near the diversion weir and primary canal benefit more

water than the other groups situated far. For instance small floods that occur at the beginning or at the end of the rainy seasons that are not able to flow far from the primary canals are allocated to serve the near by groups. In this case though it is not the turn of the group to receive the flood, groups near the primary canal benefit from intermittent floods that fail to reach the group that is waiting its turn. This is believed to make the farmers at relatively far position from the diversion weir to feel there is unequal sharing of spate water. For instance in table 5.2 the groups arranged based on their nearness to the diversion structures of Fokisa the percentage of farmers who responded it is not equally shared keeps increasing from 17% to 29% then to 33. Similarly in Boboteya it increases from 17% in the first group to 22% in the second to 40 in the third and finally to 40 in the fourth group.

The spate irrigation in the study sites highly depends on the ability to control the flood and ability to divert it to the main canal. The traditional diversion structures usually do not withstand the heavy floods and the modern ones are heavily silted during heavy floods. According to the contacted water committee members in Fokisa and Boboteya small spate flows are diverted to one secondary canal while medium to two and large floods are distributed to all the secondary canals at a time. But in Boboteya SIS big flood can occur in the river but it rarely occur to the channels. This is because when the flood is big it usually breaks the side wall of the main canal adjacent to the rivers as a result the flood returns back to the main river. In the other case the problem in Fokisa SIS is there can be big flood on the river but because of sediment accumulation at the takeoff and along the primary canal the occurrence of big flood to the canals is minimum. If a big flood occurred and supplied spate water to all secondary canals and all farm lands in the spate irrigation system are served, the next spate will be allocated to the waiting group before the occurrence of the big flood.

Spate water distribution with in a *Melwen*

The farmers in each *Melwen* are divided in to sub groups known as *Gujile*. The number of *Gujiles* in each *Melwen* varies from 3-5. The purpose of dividing the *Melwen* (group) in to *Gujiles* (Subgroups) is for the eased division of spate water to farmers at different position of the group; head, middle and tail of the *Melwen*.

Spate water distribution with in the *Melwen* starts from the subgroups (*Gujile*) situated at the head then to the middle and finally to the tail. Two main reasons were forwarded as to why the irrigation starts from the head. First starting to irrigate from head of the group highly minimizes wastage of spate water. Spate water will not travel along extended dry canals which would aggravate the wastage of water through seepage before reaching the intended beneficiaries. Second farmers believe that if the spate water is first applied to the head of the group, it will have certain level of moisture effect to the rest of the plots in the group by raising the ground water level of the whole area and through underground seepage. An elderly man figuratively justifies this by saying "one starts creaming butter from the hair if he has excess then he can cream the rest of his body".

Table 5.3: Farmers' response to the equity of share of spate water among subgroups (*Gujiles*)

Scheme	Position of the plot	No of Respondents	Share of spate water among subgroups *(Gujiles)*					
			Equally shared		Not equally shared		No response	
			No	%	No	%	No	%
Fokisa	Head	5	5	100		0		
	Middle	6	4	67	2	33		
	Tail	5	3	60	2	40		
Boboteya	Head	9	7	78	2	22		
	Middle	8	7	88	1	13		
	Tail	9	5	56	4	44		
Hara	Head	9	5	56	4	44		
	Middle	10	5	50	3	30	2	20
	Tail	9	2	22	6	67	1	11
Total	Head	23	17	74	6	26		
	Middle	24	16	67	6	25	2	8
	Tail	23	10	43	12	52	1	4
Total No of Respondents		70	43	62	24	34	3	4

Source: Survey results

Table 5.3 shows that 62 % from the total respondents believe that spate water is fairly shared among the head, middle and tail farmers and 34 % believe that it is unfairly distributed. But considering their plot position 26 % of the head, 25 % of the middle and 52 % tail farmers responded that there is unfair distribution of spate water with in the *Melwens*. The trend shows that majority of the tail- end farmers feel there is unfair distribution of spate water with in the *Melwens*. In addition more than half (67 %) respondents of tail-end farmers at Hara SIS responded that there is unfair distribution while less than half of the respondents in Fokisa and Boboteya SIS (40% and 44% respectively) feel there is unfair distribution. The source of the difference among the schemes can be the

ability and capacity of the diversion and canal structures to convey sufficient spate water from the rivers and deliver to beneficiaries at different positions of the spate system.

According to Laurence et al (2005) communities in traditional spate irrigation systems design acceptable water distribution rules and rights that accommodate the need of water at the head, middle and tail of the system. But in spate irrigation distribution of water involves certain degree of unfairness among the plots at different positions of the irrigation system due to the unpredictability of the flood flow in terms of volume and time of occurrence.

Management of Spate Water by individual farmers

Before the beginning of the rainy season every farmer prepares his land for spate irrigation. Individual farmers prepare their respective plot to benefit from their turn of spate water as much as possible. Contour bunds are maintained and plot levels are adjusted to ensure uniform water distribution to every part of individual land holding. During ploughing farmers make number of big furrows using their oxen dragged farm implements at intervals along the contour locally known as *Tilmi/ Neghi.* These structures are reported to help the uniform distribution and ensure the maximum percolation of spate water. Farmers also plough maize and sorghum plots at random after crops reached a knee height. This practice locally known as *Shelshal* helps the retention of more spate water which will support the full growth of the plant during fruit bearing period especially at the end of the rainy season.

During flood occurrence every farmer makes sure that every part of his plot is well irrigated by facilitating the distribution of spate water and leading the water to different parts using spade and hoe. During their turn individual farmers organize their family members or

arrange borrowed labour in order to help distribute the spate water to all parts of individual plot and benefit from their turn with in the short period of flood occurrence.

The spate irrigation system in the study areas is combined with the in situ water conservation in which excess water from small external catchment such as road side drainages, adjacent residential areas and routs, and communal grazing lands is diverted to farm lands and communal ponds known as *Horeye*. In this case individual farmers divert small floods locally known as *Chererto* to their crop lands and *Horeye* using small canals. The *Horeyes* are used as a source of water for livestock and household consumption for some period during the dry season.

5.1.3. Maintenance and Rehabilitation of Spate Irrigation structures

The short and long term existence of the community spate irrigation depends on the contribution of members in operation and maintenance of the irrigation network. This requires the cohesion as well as the motivation of the users to assume the system is their own. This will contribute to the establishment of successful community based organizations that help the distribution of spate water, enforce rules and regulations, respect water turns and other social disciplines (Abraham, 2007).

In all the improved and traditional spate irrigation schemes the operation and maintenance (O and M) activities is full responsibility of the beneficiary farmers. Seasonally the spate irrigation systems are rehabilitated and all maintenance works are carried before the arrival of the rainy season. In all spate irrigation systems the O and M work is organized by the Water Users Association (WUA) of each respective scheme.

During O and M work the beneficiary community rehabilitate all the communal structures. The structures rehabilitated by shared labour include the diversion weir (*Maegel*) the secondary and the tertiary canal (*Feleg*). The maintenance and rehabilitation of field canals of each plot is the responsibility of individual farmer.

For the purpose of eased management of each group in the spate irrigation systems there are *Abo-Mai* (water master/ father of water) or alternatively called *Wodi_Feleg* who deputy their respective groups and have the responsibility to organize the farmers under their group for sharing of spate water and mobilize labour and material for regular and emergency operation and maintenance activities.

Table 5.4: Frequency of O and M activities in a rainy season in the studied schemes

Scheme	Frequency of O and M activities	Response	
		No	%
Fokisa			
	1-3 times	1	6
	4-6 times	8	50
	More than 7 times	7	44
	Total	16	100
Boboteya			
	1-3 times	2	8
	4-6 times	20	77
	More than 7 times	4	15
Hara	Total	26	100
	1-3 times	9	32
	4-6 times	19	68
	More than 7 times		
	Total	28	100
All schemes			
	1-3 times	12	17
	4-6 times	47	67
	More than 7 times	11	16
	Total	70	100

Source: Survey results

Table 5.4 shows that 67% of all the respondents replied that they are engaged in O and M activities 4-6 times in a rainy season. Though majority of the respondents in each scheme said they are involved 4-6 times in a season, the frequency and type of O and M activities vary significantly among the three schemes. In Fokisa modernized SIS 50% and 44% of the respondents said they are involved 4-6 times and more than 7 times respectively. Major O and M activities in this scheme are reported to be silt removing from the diversion weir and along the primary canal. In Boboteya traditional SIS 77% and 15% of the respondents said they are involved 4-6 times and more than 7 times respectively. The activities in this scheme are rehabilitation of the primary canal and diversion weir. On the other hand the respondents in Hara SIS 32% and 68% said they are involved 1-3 and 4-6 times respectively. In this scheme the major activities are rehabilitation of the deflector type diversion structures and maintenance of canal crossing with in each group.

The contribution of labour for O and M depends on being part of the command area of the spate irrigation system. In routine O and M works during and before the rainy season the contribution is uniform. As the result of this survey indicates the average landholding size per household in the three SIS range from 0.5 to 1 ha. As there is no major difference in the land holding size, the contribution of labour for construction and maintenance work do not depend on land holding size. A farmer has to contribute labour uniformly and additional labour if he is share cropping or hiring additional land than his own. But in case of emergency such as damage to the diversion weir and irrigation channels and urgent O and M is required before the arrival of another spate, every adult in the community regardless of family size is expected to mobilize to the maintenance work. The community can also apply to the local government (Woreda and Tabia Administration) to help mobilize additional

material and labour from other communities in case the damage to the spate irrigation system is huge and can not be urgently maintained by the beneficiary farmers before the arrival of the next spate. For instance in 2007 G.C rainy season the Boboteya traditional spate irrigation main canal was broken three times. The beneficiary farmers were unable to maintain the damage with in few days. As the same time the farmers were expecting flood in the next few days. As a result they applied to the Woreda and Tabia administration and were able to mobilize labour from nearby communities and gabions from the woreda Agriculture and Rural Development Office (WARDO).

Most of the materials used for construction and maintenance of the SIS are acquired from the localities. These materials include stone, boulders, brushwood weed plants and sand. The farmers use simple hand tools during O and M works such as hoe, spade, machete (*Gejera*), and axes. The only external material support gained specially in the Boboteya traditional spate irrigation is gabion. Farmers are provided with gabions boxes to seal the broken side of the primary canals. The farmers use weed plants to seal eroded canals (field canals) and they use tree branches (brushwood), stones and sand filled sacks to maintain communal crossings.

Farmers are usually occupied with maintenance works of the diversion weir and other infrastructures after every heavy flood. For instance the side of the primary canal adjacent to the main river in Boboteya is usually broken by heavy spate flows which cause farmers to lose water. They spend more time in maintaining this canal using gabions, sand filled sacks, brushwood and soil (mixture of the materials). Similarly in Fokisa modernized spate irrigation system farmers compare the frequency of O and M before and after the modernization of the scheme (Table 5.5).

Table 5.5: Trend of O and M frequency in Fokisa after scheme modernization

Trend	Response	
	No	%
Decreased	2	12.5
Increased	10	62.5
No change	4	25
Total	16	100

Source: Survey results

Regarding the trend of O and M frequency after modernization in Fokisa SIS 62.5% of the respondents said it has increased while 25% said there is no change when compared to the traditional SIS. According to the farmers before its modernization the major task of O and M on the traditional SIS was on the main diversion weir and primary canal. After the modernization most of the O and M activities are silt removing that accumulate over the modern diversion weir and the main canal after heavy flood.

Plate 5.1: Farmers removing silt from Fokisa primary canal

In all the spate irrigation schemes communal work of the SIS precedes individual farm activities. Farmers consider the operation and maintenance works of the SIS as part of their agricultural activities. Water distribution rules in spate irrigation serve as a measure to ensure the mobilization of labour for maintenance of the system. In the study sites the participation of every farmer benefiting from the system in the O and M activities is mandatory. According to Lawrence et al (2005) an individual farmer is entitled to getting spate water if he/ she is participating in the O and M of the headwork and flood channels. Therefore one's claim to spate water is directly linked to the contribution made in the irrigation system. The rule of water distribution based on the contribution made by individual farmer contributes to the smooth running of the system and helps to mobilize the minimum labour "critical mass" required for the O and M of the spate system. This is important as farmers are dependent on one another in major O and M activities.

5.2 Water Right and Rules in the Spate irrigation Management

5.2.1. The Water Rights and rules

According to Woldeab (2003) and Yeshey et al (2002) water right is the right to abstract or divert and use a specific amount of water from natural source such as river, lake or underground water. In the case of spate irrigation the right for water is dependent on the contribution made by individual member with regard to the construction of irrigation structures and the participation made in regular O and M activities (Abraham 2007, and Laurence et al 2005). Similarly the farmers entitled for spate water in the study sites are those who abide by the rules and regulation of the community and actively participate in the construction of spate irrigation structures and O and M activities.

The amount of spate water a farmer is entitled differ according to the method of irrigation. In countries where the field to field spate irrigation is practiced, such as Eritrea and Yemen, farmers build up to one meter high field bund around individual plots. The amount of water that individual farmer is entitled is a knee height of spate water (Abraham 2007, and Laurence et al 2005). The farmers at Fokisa, Boboteya and Hara where spate irrigation is applied trough controlled system structures namely primary, secondary and field canals the amount of water a farmer is entitled to is the inundation of individual plot.

Plate 5.2: Inundated field in Fokisa spate irrigation system

The spate water distribution arrangements in the study areas try to compromise between fair distribution among the farmers and prevention of wastage of spate water. According to the discussion held with the water committee members the distribution arrangement is made to be as fair as possible by insuring the sequential distribution of spate water among the different groups in the system. In this case who should get the first, the second and the third spate is determined by lottery draw performed in public. Regardless of its position in the spate irrigation system, a group gets spate water according to its turn which is determined by the lottery draw. This method of spate water distribution helps to create sense of ownership among the *Melwens* in the system.

Spate irrigation is full of unpredictability (Laurence et al 2005). Farmers at different positions in the system have different probability of getting spate water. The trend of spate

benefited in a season differs from group to group and with in a group from head to tail end sub groups (table 5.6).

Table 5.6: Number of spate benefited in the rainy season of 2007 by head, middle and tail irrigators

Number spate received	Position of the plot						Total	
	Head		Middle		Tail			
	No of response	%	No of response	%	No of response	%	No of response	%
0	0	0	0	0	2	3	2	3
1-2	16	23	19	27	21	30	56	80
3 and above	7	10	5	7		0	12	17
Total	23	33	24	34	23	33	70	100

Source: Survey result

The results from table 5.6 indicate that majority (80%) of the respondents claim to have received 1-2 spate flows in the specified rainy season. In addition 17% of the respondents have also said that they have received 3 and above spate flows. Those who received 3 and above spate flows are farmers from head and middle positions of the spate systems. Only 3% of the respondents said they received no spate in the season. Priority for spate water in the next season is claimed if a group is not served at least once. Those who receive at least one spate in the season do not claim for priority in the next rainy season, it will be another lottery draw. To prevent exaggerated difference in the number of spate irrigation benefited by each group or farmer there is strict follow up to make sure that no group or secondary canal get next spate before every group and plot is served once.

5.2.2. Enforcement of Water rights and Rules

The extent the spate water rights and rules are enforced depends on the strength of the social structure in the community. For instance spate systems in Eastern lowlands of Eritrea where farmers have similar access to land and have no major wealth variation spate water disputes are unusual. In Eritrea where there is homogeneity among the community the enforcement of the water rights and rules is the responsibility of elected irrigation committee. On the other hand spate irrigation in Yemen where there is great variation of land holding and wealth there is repeated conflict over the use of spate water. For centuries the enforcement of the spate water rights and rules in Yemen has been the responsibility of local religious leaders known as the 'Sheiks'. These powerful and rich religious leaders have the right to pass their leadership to their sons. The Sheiks are so respected and feared that their ruling is not challenged by the community or any institution. Despite the authoritarianism and failure to prevent conflicts the sheiks are prized for managing the division of spate water among different positions of the spate system (Laurence et al 2005).

The enforcement of spate water rights and rules in Fokisa, Boboteya and Hara has been the responsibility of selected *Abo-Gerebs* and *Abo-Mais* in each scheme. These *Abo-Gerebs* and *Abo-Mais* have rules and regulations locally known as the *Sirit* by which they enforce the fair distribution of spate water and regulate any offence against the smooth running of the syatem. According to the contacted Water committee members the *Sirit* is said to comprise a comprehensive set of rules covering all aspects of interest (figure 5.2). As a result though there is serious water scarcity one of the explanations given on the successful and healthy running of the SIS is that the majority of the farmers act according to the *Sirit* and offenders are penalized.

Table 5.7: Assessment of farmers' view whether the *Sirit* is implemented in a way it is formulated

Scheme name	*Sirit* enforced in a way it is formulated				Total	
	Yes		No			
	No	%	No	%	No	%
Fokisa	16	23		0	16	23
Boboteya	24	34	2	3	26	37
Hara	24	34	4	6	28	40
	64	91	6	9	70	100

Source: Survey results

From the sampled farmers 91% believe the *Sirit* has been implemented by the WUA in a way it is formulated in their respective scheme. This shows the farmers have considerable trust over the WUAs. A strong adhesion to the rules and regulations by the WUAs is observed. Farmers in the study sites express their solidarity to the *Sirit* for the fact that they need to stay with social norm in which they have a local proverb interpreted as "it is better to give up water than give up your village". The fact that only negligible individuals derogate temporarily from the norms, which consequently receive pertinent penalty, contributes to the effectiveness and sustainability of the institution itself. If the rules and regulations are violated and the violators are not negatively rewarded (penalised), it can result in local conditions of a free access to the resources.

Local management and social control are possible only in a context where the individual action have as strong probability of being detected by the WUA. One can suppose that there is finally cost from disobedience of the rules with in the framework of the division of water and this cost tends to increase with time. As it is the case with the *Sirit* of Boboteya and Fokisa WUAs, the social and economic cost of non-compliance with the *Sirit* is sufficiently high that the opportunist behaviour is not magnified.

5.2.3. Codification of the Water rights and Rules

Documented spate water distribution rules and rights are only available in schemes that have long history in countries such as Yemen and Pakistan (Laurence et al 2005). In other spate irrigation systems there are no complete records of water right and rules. In most communities the rules and rights are communicated via the word of mouth (Abraham 2007). According to the discussion held with the community members and water committee members in Fokisa the community used to have a written *Sirit* (water right and rules) since the Imperial Regime prepared by a local land lord with the name Hajji Yasin who owned most of the land under the spate irrigation system. The *Sirit* was last reviewed and improved in 1987 E. C to adjust to the new land developments, land redistribution and population increase. This *Sirit* is still used by the community even after the modernization of the spate irrigation system. Similarly the Boboteya SIS has a *Sirit* which was issued in 1990 E.C and serving as bottom-line for the spate water distribution in the community. The community in Hara on the other hand have the spate water distribution rights and rules communicated through the word of mouth.

Though the documented *Sirit* in Fokisa and Boboteya are not finely detail, it was said to have pin pointed the issues that can create ambiguity in spate water distribution. The written *Sirit* clearly defines each farmer's right and duties which contribute towards involving every user enthusiastically. The *Sirit* in the two sites are basically similar and the *Sirit* of Fokisa spate irrigation system translated and presented in Figure 5.2.

Figure 5.2. Traditional *Sirit* for *Maegel* Fokisa

Sirit for *Maegel* Fokisa (Hajji Yasin)

Date 30/06/1987 E.C

1. A member who does not participate in silt removing shall pay 10 birr per day
2. A member who does not participate in gabion box filling shall pay 20 birr per day
3. A member who provokes a quarrel during spate water distribution shall be fined 18 birr
4. A member who insults *Abo- Gerebs* or *Abo-Mais* shall be fined 50 birr
5. A person proved to have stolen water by breaking canal out of his turn and deprived other entitled persons of their share shall pay 200 birr
6. After irrigating his land if a farmer does not close his field canals and let other people close the canals for him he will be fine 50 birr
7. A member who reveals a secret spoken in the WUA shall be fined 18 birr
8. A member who failed to pay his fines and relieve the person who bailed him shall be excluded from the association
9. A member who repeatedly failed to participate in construction and maintenance of irrigation infrastructures and provoked quarrel shall be excluded from the association
10. A member penalized for violating the *Sirit* and complain his case to local Sheik or Priest shall be excluded from the association
11. If a member dies leaving behind underage children, his plot will get spate water with out request for participation in any activities in the scheme until the children get matured
12. Members who did not get a single spate water the previous rainy season gets priority in the next season
13. A member has the right to make one married son/ daughter member of the SIS by paying three birr membership fee, the rest will be members by paying 300 birr each.
14. Money collected in the WUA will be used to procure materials relevant for the SIS.

Source: WUA of Fokisa and Boboteya

The *Sirit* from Fokisa spate irrigation system (figure 5.2) focuses on three main issues. The first is the level of penalties imposed on offenders of the *Sirit* in the spate irrigation system. According to the level of offence it varies from levying monetary penalty up to total dismissal from the association membership. All this penalties contribute to minimize conflicts over the use of spate water. Second the *Sirit* accommodates social security that every member has in the SIS. Those who are not able to participate in the operation and maintenance works in the scheme due to age or illness are guarantied the supply of spate water with out precondition. In addition member farmers who do not get spate water in the previous spate season are guarantied to receive spate water first in the next rainy season. Third the *Sirit* substantiate the development of discipline that contributes to the sound running of the scheme. During spate irrigation distribution farmers are recommended to carry hand tools that are pertinent to the work. For instance in Boboteya during spate water distribution if a farmer is found carrying a Machete (*Gejera*) he will be fined 100 birr. The Sirit advocates members to comply with the resolutions by the WUA, respect the *Abo-Gereb* and *Abo-Mai*, refrain from conflict instigating activities and show their respect to their community members by paying what they are penalized and freeing the person who bailed them.

The *Sirit* is observed as legitimate and the authority of the elected *Abo-Gereb* and *Abo-Mai* is also respected. Cultural settings of the community codify and confirm the individual farmer's right and access to water as well as duties and responsibilities. Local management and social control are consequently possible in a context where misconducts are timely detected and corrected. As it is the case with the *Sirit* of Fokisa and Boboteya WUAs, the social and economic costs of non-compliance with the Sirit are sufficiently high that the opportunist behaviour among members is negligible.

5.2.4. Spate Water Conflict resolution

Conflicts over the use of spate water emanate among different water user associations along a river and with in a water user association served by a common diversion. Along river Fokisa there are three spate irrigation schemes. These are Fokisa (*Maegel Hajji Yasin*), *Maegel Bun laelay* and *Maegel Bun Tahtay*. Fokisa is the upper most reach and modernized SIS. Along river Mae-Akino there are four traditional spate irrigation schemes. These are *Maegel Boboteya, Maegel Mengesha, Maegel Haftu Hadush* and *Maegel Gendadey*. All the spate irrigation systems along river Mai-Akino are traditional diversion structures. According to water committee and community members in both spate irrigation systems there has been no conflict over water use among different WUA along the river for two main reasons. First the lower WUAs believe that the upper WUA has the right to divert the flood water because it is the first to be constructed before the down stream *Maegels*. Second the upper WUA do not have the capacity to fully control and divert the river flood. As a result down stream traditional spate structures are not fully denied of spate water. Some of the moderate floods and most of the big floods that occur in the two rivers are not fully controlled by the upper most diversion structures. Therefore the flood partly goes to down stream farmers so that minimizes farmers' conflict over spate water use.

Conflicts among farmers with in an association are managed by the *Abo-Gereb* and *Abo-Mai* based on their *Sirit*. According to the discussion held with the water committee members and community members there has been no major disobediences that dismantle the integrity of the WUAs. Most cases are resolved with in the WUA. If individuals disobey to respect the verdicts of the water committee they will be sued and the case will be forwarded to the community court (*Mahberawi fird bet*) in which much sever penalty is

levied on the offender. For instance in Fokisa if a farmer is penalized 200 Birr by the water committee for diverting flood out of his turn and disobeys to pay, it is known that the *mahiberawi ird bet* will penalize the offender a minimum of 500 Birr instantly. In this case most members do not extend their case that far. This is a discouragement to disobey the resolution (verdict) by water committee.

Table 5.8: Incidence of conflict occurrences over spate distribution among farmers

Scheme name	Incidence of Conflict				Total	
	Yes		No			
	No	%	No	%	No	%
Fokisa	1	1	15	21.	16	23
Boboteya	1	1	25	36	26	37
Hara	3	4	25	36	28	40
Total	5	7	65	93	70	100

Source: Survey results

The data collected from the study sites indicates that only 7% of respondents recognize the existence of conflict incidents over spate distribution among farmers with their neighbours. The farmers who responded they had conflict with their neighbouring plot owners mentioned two main causes of the incidents. First after irrigating their land some farmers ignore to close their field intakes on time properly. Second there are some farmers who intestinally try to divert spate water out of their turn which is reported to trigger conflicts. Despite the existence of certain level offences the results from table 5.8 indicates that there is a significant level of discipline reigning in individual farmers in respecting the communal interest in managing the spate irrigation system.

5.2.5. Women Participation in Spate irrigation

Although the Ethiopian constitution legalize women's equal right on ownership to land, there seem to be a general consensus that women who head their households are disproportionately poor and disadvantaged in their access to labor and other factors of production (Woldeab 2003). Indeed although all of the female household heads in the study sites are land owners, they generally seem to have less ability to manage their land (table 5.9).

Table 5.9: Plot and management by female household heads

Plot management	Number of respondents	
	No	%
Sharecrop	11	73
Use family labour	3	20
Relative/ community support	1	7
Hire labour		0
Total	15	100

Source: Survey results

The data from table 5.9 indicates that 73 % of the female respondents entered in to sharecropping arrangement while 20% said they use labour from their own household. However, 7 % of the respondents said their relatives and neighbours take care of the farm activities. The results indicate that women are regularly linked to other households in carrying out their farm activities.

Farmlands owned by female household heads are irrigated based on the plot management they follow. Those women who shared out their plot participation in the spate irrigation

system is through the sharecropper. If they use labour from their family any adult men member of the family are supposed to participate. Farmlands of old women, men and children of deceased members cultivated with support of relatives and neighbours are liable to get spate water with out any demand for contribution in O and M or other related activities in the spate irrigation system.

Women's participation in the study sites with regard to spate irrigation management seems to be low. They do not involve in the spate irrigation administration nor participate in meetings concerning the irrigation systems. According to the community members there has been no woman water committee member in the history of the spate irrigation systems. Women's participation in the spate irrigated agriculture is in activities such as weeding and harvesting. Though contacted farmers and water committee members in Fokisa and Hara claimed that women have no contribution in construction, O and M of spate irrigation structures and distribution of spate water in Boboteya women are reported to be active participants in silt removing and gabion box filling activities.

5.3. Challenges of Improving Community Spate Irrigation

5.3.1. Problems of the Traditional Spate Irrigation Systems

In the study areas the traditional spate irrigation infrastructure mainly comprises the diversion weir and the irrigation channels. According to the information collected from the sample farmers and the water committees the most sever problem with regard to the traditional spate irrigation in Boboteya is the damage caused to the primary canal. The side of the primary canal adjacent to the main river usually breaks down by heavy floods. As a result the diverted flood spills back to the river through the broken side of the main canal. The area supplied with spate water is therefore reduced due to the loss of spate water.

Plate 5.3: Damaged primary canal at Boboteya spate irrigation system

Other problem mentioned by the farmers is erosion caused by flood on the secondary and field canals especially where there are gully crossings. Farmers use sand filled sacks to build crossings but loss significant amount of water. Farmers also identify the use of tree branches to clog broken canals as having impact on the reduction of the scarce forest in the vicinity. They said that they are using big amount of tree branches to rebuild broken primary and secondary canals.

Table 5.10: Assessment of farmers need for the modernization of their traditional scheme

Scheme name	Do you support the modernization of the traditional SIS				Total	
	Yes	%	No	%	No	%
Boboteya	18	64	10	36	28	100

Source: Survey results

Accordingly to the assessment in Boboteya 64 % of the farmers support the modernization of the traditional irrigation scheme. The main reasons they want the modernization includes they want to be relieved from the repeated maintenance of the diversion structure and the primary canal adjacent to the river. They also indicated that if it is improved they hope that they will get sufficient spate water to irrigate their crop. In addition they said there will be no cutting of trees to seal broken canals. However 36% of the respondents opposed the modernization of the traditional scheme. Their scepticism emanates from their experience they have witnessed in other improved irrigation schemes. The main fears raised by the respondents were first the new structures may fail to divert spate water and second it can be regularly silted up which will engage them in silt removing activities.

Recently the water committee members and Abo-Mais were approached by regional experts from TWRMEB to discuss on issues of improving the Boboteya traditional SIS. According to the regional experts the farmers are posing preconditions on the improvement of the scheme. There include:

- They want the new diversion weir to be on the site where the traditional weir is located
- They want the traditional primary, secondary and field canal layouts remain intact
- They want the construction of retaining wall on the primary canal adjacent to the main river

Farmers say they support the modernization of the traditional structures based on the stated preconditions otherwise they want their scheme to run as it used to be.

5.3.2. Problems of the Modernized Spate Irrigation Systems

According to Laurence (2005) improvement of community spate irrigation systems supported by external agencies are base on three major categories:

- Investment in major civil engineering to provide new spate irrigation infrastructures
- Lower level support to traditional systems
- Provision of earth moving equipment at subsidized rates

Since the second half of the 20th century traditional spate irrigation systems were modernized by extensive engineering investments in Yemen, Pakistan, Eritrea and Tunisia.

The success history of the modernized spate irrigation systems has been inconsistent. For example out of 47 modernized spate irrigation systems between 1960 and 1990 in Pakistan Balochistan province only 16 were reported to be operational. The main reason behind the failure was reported to be inappropriate engineering designs which resemble to the river diversions that have perennial flows (ibid).

Traditional spate irrigation systems also get external support from local governments and NGOs. In Ethiopia for instance food for work programmes were used to extend flood canals and build new traditional spate structures in Konso. In countries like Eritrea NGOs provide gabion boxes to communities so that they can build or maintain spate diversion structures. On the other hand in Pakistan farmers are provided with low cost rental bulldozers to remove silt accumulated over the spate irrigation infrastructures and construct earth bunds (ibid).

The modernization of the traditional spate irrigation systems in Fokisa and Hara was based on the replacement of traditional spate irrigation structures by modern ones. The traditional spate diversion structures were replaced with modern concrete weirs and irrigation channels. Especially in Hara the diversion structure and irrigation infrastructures were replaced with modern canals which have crossings, drop, and de-sanders. Regarding the replacement of the traditional structures by modern structures there is certain disagreement between the community and the experts. Though there is no complain from the farmers on which the spate diversion weirs are situated, they don't agree on the angle on which the takeoffs are constructed, the size of the takeoffs, provision of sluice gates on the diversion weirs and the slop of the primary canals.

Angle and size of takeoffs

The fact about at what angle the main intake from the river should be built is the main issue raised by the farmers and regional experts. The nature of spate irrigation by itself is diverting torrent flood with big amount of water that comes with immense energy and speed which lasts for specific period of time. The main intakes at Hara which are at both wings of the river were built at right angle to the river. The intakes are also 32 inch (0.81 meter) diameter tubes with hand wheel operated control gates. For this reason the forceful flood that comes from the river were unable to get in to the narrow piped takeoffs at right angle of the riverbed. Rather the pipes were completely silted up with boulders and silt by few floods. Taking the problems encountered at Hara and other spate improvement projects the construction of Fokisa spate irrigation took some recommendations of farmers about the size and the angle at which the takeoffs should be. As a result the takeoff at Fokisa was built to divert flood at 60^0 angle and the size of the takeoffs was 3m wide and 1m high with no control gates.

However, the beneficiary farmers are not yet satisfied with the angle at which the Fokisa takeoff is constructed. They said the low flood conveyance and siltation problem in the modernized scheme is due to the wide divertive angle and the size of the takeoff. According to the farmers the takeoff and the primary canal in the modernized structure should have gone almost parallel to the river for certain length before it is totally diverted. Due to the mentioned problems farmers said flood from the river collides with side wall of the river bank above the head regulator and flows back to the river before it gets to the takeoff. In this case much silt and boulders are thrown to the main takeoff but little flood water.

Plate 5.4: Takeoff and sluice gates at Fokisa modern diversion weir

Sluice gates

The purpose of constructing the under sluice gates is to prevent/ reduce the entrance of silt to the primary canal and helps to remove silt that deposits above the diversion weir specially near the head regulator or flood takeoff section of the primary canal. According to the discussion held with the regional experts the problem of siltation on the diversion weir as well as the main canal in Fokisa SIS is because the farmers are not opening (operating) the sluice gates regularly. The farmers are required to open the sluice gates when siltation occur above the diversion weir and main takeoff so that the silt is removed by a flood. In this case once the weir is freed from silt it is supposed to serve as a de-sander for the next flood which is expected to deliver relatively silt free spate water to the main takeoff. Farmers in the other side do not support the construction of the sluice gates. They said due to the critical water scarcity they want every flood that occurs to be diverted to their land.

They said they do not have a flood to spare to help scouring of silt accumulated over the weir and on the head regulator. According to the farmers the problem of the silt is because of the angle of the takeoff and the gentle slop of the primary canal. Farmers said siltation is part of spate irrigation when it is distributed along the canals and irrigated lands. The problem is when it hinders the flow of spate water by sleeping over the takeoff and main canal.

Despite their protest farmers at Fokisa were forced to open the sluice gates one rainy season by the WWRMEO. They found it difficult and labour demanding to open the gates. The next season they totally ignored the opening of the gates. Since then the gates were not opened and there is huge accumulation of sand above the diversion weir, on the main takeoff and primary canal. Due to the huge silt accumulation farmers currently has opted to build traditional approach canal above the modernized diversion weir to help divert flood water to the main takeoff.

Plate 5.5: Traditional approach canal over modern diversion weir at Fokisa

Slop of canals

Other problem that the farmers expressed was about the slop of the takeoff and primary canal in Fokisa modern spate irrigation structures. They said the slop of the takeoff and the primary canal is gentle which reduces the speed and force of the diverted flood. As a result the flood loses its force of silt scouring and aggravates the accumulation of much silt over the primary canal. The farmers in this case want the slop of the canals to be like the slop in the main river bed so that the speed and silt carrying capacity of the flood is maintained.

According to Laurence (2005) traditional canals have low sedimentation problems and canal scouring problems as compared to the modern canals. This is mainly because traditional spate canal slops are similar to the river bed slop from which water is diverted.

The slop of the traditional spate irrigation structures is generally steeper than that of the modern spate irrigation canals.

The major problems observed in the construction and design of the modernized spate irrigation systems are the aforementioned. The modern spate irrigation structures cost much more than the traditional structures and relied very much on expert with modern knowledge. According to the monitoring and evaluation report by the TWRMEB carried out in 2006 (TWRMEB, 2006) despite the siltation problem the Fokisa SIS was reported to be best performing among all the modernized spate irrigation systems by supplementing up to 162 ha of land. The assessment made by this study to evaluate the level of satisfaction by the sample farmers after the modernization of the Fokisa spate irrigation system is presented in table 5.11.

Table 5.11: Farmers level of satisfaction after modernization of the Fokisa SIS

No	Level of satisfaction	Response	
		No	%
1	Highly Satisfied	2	8
2	Moderately satisfied	13	50
3	No change with the traditional	10	38
4	Dissatisfied	1	4
	Total	26	100

Source: Survey results

The data collected from the sampled beneficiaries at Fokisa indicates that 50% of the respondents are moderately satisfied while 38% responded there is no change from the amount of flood they used to get from the traditional spate irrigation system. The rest 8% and 4% of the farmers responded highly satisfied and dissatisfied respectively. The results indicate the satisfaction of the farmers after modernization is found to be concentrated

between those who responded they are moderately satisfied and those who found no change with the traditional system. Because of the aforementioned problems the objectives of modernizing the Fokisa traditional SIS (Page 36) which aimed at ensuring the 'efficient and effective diversion of flood water that would be able to provide supplementary irrigation water for up to 500 hectare of land' seems to have failed to fully attain its goal after construction because it is now able to irrigate only 162 ha.

Lack of relevant data about the rivers

The unpredictability in timing and volume makes flood water management a challenging task in spate irrigation systems (Abraham 2007, and Laurence et al 2005). According to the discussions held with the TWRMEB design engineers lack of relevant flood flow data about the rivers serving as source for water for the spate irrigation systems is also a major problem. The lacking data include:

1. Run off amount of each river
2. Time and duration of runoff and
3. Frequency of flood occurrence are not well known

As a result establishing the amount of water that can be diverted from each river and the area that can be irrigated by each spate irrigation scheme has been difficult during designing works. This was indicated as major setback to the success of the modernized spate irrigation systems while the traditional spate irrigation remains to be relatively efficient.

5.3.3 Community Participation

Today the approach to investment in any rural development has fundamentally changed with the promotion of participatory policies (Scoones et al 2000). Similarly spate irrigation modernization projects demand the participation of beneficiaries in project planning, designing and implementation. The aim is to ensure that the modernization works are farmers' need and farmers are willing to run the scheme afterwards.

Involving beneficiary farmers in the planning and design of irrigation intervention works contribute to identify intended works are the need of the farmers and design will better adapt to the farmers needs. The farmers should be the ones who define the need and priorities for the modernization. Experts need to identify the problem in the traditional spate irrigation systems in the view of the farmers. Embarking to construction before agreeing the proposed solution with the farmers and get their approval results in making things worse for the farmers. To what level the farmers at Hara and Fokisa SIS participated in the planning and design preparation of the modernized schemes? According to the experts in TWRMEB before the planning and design work a meeting with the whole beneficiaries is conducted to know if the community needs the scheme to be modernized. The result of this study on the level of participation of the communities in the modernized spate irrigation systems (Hara and Fokisa) is presented in table 5.12.

Table 5.12: Level of community participation during planning and design

Level of Participation	Number of Responses	
	Number	%
Attend Organized meetings	4	9
Attend as well as recommend	27	61
Did not participate	13	30
	44	100

Source: Survey results

The result from table 5.12 indicates that 9% of the respondents said that they only participate in the organized meetings while 61% responded they participated as well as recommended on how the modernization should be carried out. The rest 30% (most of them women) responded they did not participate in any of the organized meetings.

The next question is 'was the recommendations posed by the farmers seriously taken by the planners and designers?' The respondents from Hara SIS remember they only participated in a meeting which was organized to ask the beneficiaries if they want the construction of permanent diversion weir and irrigation infrastructure. Expecting they would get full control of the flood and hopping to get enough spate water they supported the modernization of the traditional SIS. There was no further farmers' involvement in further project planning and scheme design. During the construction of the scheme most of the beneficiary farmers involved as hired labourers in which 3 kg of grain was paid per day per person. During construction farmers were raising questions and commenting on the size as well as the angle at which the takeoff is founded and were questioning the importance of replacing the traditional irrigation channel by new cement lined channels.

Project designers of the Hara SIS seem to have neglected the knowledge and experience of spate irrigation management of the community. The traditional water distribution system was altered by the construction of the new takeoffs primary and secondary canals which totally replaced the traditional spate water distribution canals. As a result the secondary canals remain idle for years while traditional channels go by their side and usually crossing them at many points.

Plate 5.6: Traditional versus modern spate irrigation canals in Hara

Taking lesson from the failure at Hara and similar unsuccessful modernization intervention works project planners and designers in Fokisa SIS tried to involve farmers in the planning and design activities. After the discussion held with all the beneficiary community to assess their support to the modernization of the traditional scheme they were allowed to get involved and forward their view on what components should the modernization work incorporate. In this case community members, the *tabia* administration and water committee members were involved at different levels and shared their view and experience and expectation from the modernization of the scheme. For instance the site where the diversion weir was constructed is exactly where the traditional diversion was situated. One major demand of the farmers during the planning process was they wanted the new diversion structure to divert as much water as possible by contracting large takeoff and

primary canal at an acute angle with reference to the main river. As a result relatively large and ungated takeoff at 60^0 deflection angle was constructed. In addition the irrigation channels in Fokisa were modernized based on the existing traditional canals. The traditional channels were only upgraded and improved never changed by new ones like the case at Hara.

Just like the case at Hara during the construction of the scheme the community members participated as daily labours under food for work payment arrangement. During construction the farmers reported to have been recommending how and where the main takeoff and primary canal should be constructed. Asked about if their recommendations were considered by the experts the farmers said 'experts are good at hearing but they do not put in practice what they are told'. According to the water committee members the WUA in the traditional scheme were not involved as institution. The participation level was therefore a loose discussion and consultation with the community members.

Table 5.13: Farmers response on 'who owns the irrigation infrastructures'

ownership of the irrigation infrastructures		Scheme name			Total
		Fokisa	Boboteya	Hara	
Community	No	11	26	0	37
	%	69	100	0	53
Government	No	5		28	33
	%	31	0	100	47
Total	No	16	26	28	70
	%	100	100	100	100

Source: Survey results

With respect to the ownership of the irrigation infrastructures 69% of the sample farmers at Fokisa responded that the scheme belong to the community while the rest 31% responded it belongs to the government. All the respondents in Boboteya said the spate irrigation system belongs to the community while all the farmers at Hara refer the failed modern spate irrigation infrastructures to belong to the government. The results from table 5.13 indicate that the more the beneficiaries are involved in planning and design of the spate irrigation modernization works the more the objectives of the improvement works are attained and farmers' feeling of ownership of the modernized scheme increases. A case in point here is the construction of failed Hara SIS which was carried out without effective partnership of the beneficiary communities. But the result from Fokisa SIS indicates that as the level of farmers' involvement in the planning and designing of the intervention works increase the success of the project and farmers sense of ownership increases.

6. Conclusion and Recommendation

6.1. Conclusion

Spate irrigation in the Raya Valley results from the rainfall on the Maichew and Ofla highlands west of the Mehoni and north of Alamata. Even if sufficient rainfall is not received in the valley, rainfall from the surrounding mountains become the main source of supplementary irrigation which enable farmers harvest a reasonable good crop production. The farmers in the Fokisa, Boboteya and Hara spate irrigation systems manage the spate water that comes from the neighbouring highlands in organized way to irrigate their plots. The main management activities involved in the spate irrigation systems are diversion and allocation of spate water to canals, distribution of spate water to farmers' plots, operation and maintenance of spate irrigation structures and conflict management.

As briefly discussed in the main body of this study the spate water diverted from the river to the primary canal is allocated to secondary canals which serve group of farmers (*Melwens*). Each secondary canal is liable to get spate water based on the sequential arrangement decided at the start of each rainy season by lottery draw. The water distribution with in each group of farmers (*Melwens*) starts from head then to the middle and lastly to the tail end subgroups (*Gujiles*). Though it is said that this method of water allocation and distribution ensures the fair allocation of spate water among group of farmers at different positions and minimizes the lose of water while distributing among sub groups, it is found that the farmers at distance position from the diversion weir and those farmers at tail end of each group to have received less amount of water and have more tendency to feel there is unfair spate water distribution.

Despite the relatively unfair distribution and uncertainty of spate irrigation which emanates from the unpredictability of spate occurrences in terms of number, time and volume of flood, all the farmers in the studied SIS participate in all O and M and other activities organized by their respective WUA. The WUA are the pillars of the traditional spate irrigation management. These traditional organizations are led by *Abo-Grebs* (Water Committee) at WUA level and the *Abo-Mais* at group level. The WUAs in the studied schemes have rules and regulations (*Sirit*) to manage the activities with in the spate irrigation systems. Majority of the farmers believe that the *Sirit* is observed according to the objectives it was formulated for. As a result there has been no conflict among the beneficiary farmers which goes out of the control of the respective WUA.

Generally the observed success of traditional spate irrigation management by the WUAs in the study areas can be summarized as:

- Presence of social values which backs the development of discipline among the community members that contributes to the sound running of the scheme
- Formulation of rules and regulations (*Sirit*) defining each farmer's right and obligation that contribute positive step towards involving every user
- Homogeneity of users in the SIS in which all subsistent farmers with almost similar land holding and living style and also relatively manageable number of farmers.
- Democratic election of traditional water administrators such as *Abo-Gerebs* and *Abo-Mais* and the level of confidence (trust) levied on the administrators.

- Well established and frequent communication net work between and among members with their respective water committee and *Abo-Mai* which results from the simple and traditional way of communication in which each *Abo-Mai* is liable to organize his group to the communal diversion construction works, operation and maintenance or converge for *Maegel* (WUA) meeting.

- Full autonomy of the WUA with respect to SIS administration and spate water distribution

However, the need for capacity building of the traditional spate irrigation management through provision of training on financial management and introduction of labor division among the water committee members can improve the financial management system in the in the spate irrigation systems.

On the other hand, the intervention works in the study sites replaced the traditional structures with modern structures. In Hara the traditional diversion weir (*maegel*) and irrigation canals (*feleg*) were replaced with cement masonry structures. But in Fokisa only the diversion weir was replaced by cement masonry while the traditional irrigation canals network was not replaced but upgraded to accommodate the expected volume spate water.

The main objectives of the modernization intervention works were:

- Construct head work which insure a much more efficient and effective diversion of flood water to provide supplemental irrigate for up to 500 ha of land in Fokisa and 400 ha in Hara

- Introduce reliable and safe diversion structure which is not liable to flood damage so that farmers would receive reliable spate water and would be relieved from operation and maintenance of irrigation structures after every season and heavy floods
- Reducing deforestation by limiting the use of brushwood for construction of diversion structures

Given the above objectives though there are erosion problems at the canals and crossings the diversion weir and canal networks at Hara are at good condition. Similarly the diversion weir and the irrigation canals in Fokisa spate irrigation infrastructures are at good condition. The Hara spate irrigation failed to function in the first rainy season due to huge siltation problem which buried the gated takeoffs at both wings of the weir. With regard to the planned and attained irrigated land, Hara has totally failed and unable to supplement any of the farm lands under its command. On other hand the Fokisa spate irrigation system out of the planned 500 ha the scheme is currently able to supplement 162 ha of land. In this case to minimize the siltation problem in the SIS there is a need to carry out coordinated work of soil and water conservation in the surrounding highland.

Before the construction of the modern structures in Fokisa spate irrigation system farmers used to construct the traditional diversion structures which is repeatedly swept after every heavy floods. After the modernization the O and M activities in Fokisa spate irrigation system become silt removing from diversion weir near the head regulator, take off and mainly from the cement lined primary canal. As the result from table 5.5 indicates the modern spate irrigation system has led farmers to be engaged in increased O and M activities as compared to the traditional one. So the objective of reliving the farmers from

repeated O and M activities by constructing permanent diversion irrigation structures has not met its objective.

In Hara spate irrigation system since the modernized scheme has totally failed the farmers have opted to build three traditional deflector type diversion structures using combination of brushwood, boulders and silt. On the other hand in Fokisa spate irrigation system the silt accumulated over the diversion weir and on the primary canal is becoming unmanageable to farmers. As an option farmers are building approach canal over the modernized diversion weir using brushwood, boulders and silt. Therefore at both sites the projects has no/ limited contribution on minimizing the deforestation problem in the areas.

The main problems associated with the modern spate irrigation structures mentioned by the farmers are the angle at which the takeoff and the primary canal deflect from the main river, the size and slop of the primary canals and the debate over the importance of the sluice gates. Witnessing the failure of modernized schemes like Hara there is improvement incorporating farmers' idea over the size of the primary canal and the angle of deflection. But there is still disagreement over the importance of sluice gates which designers said are important for clearing the silt that accumulates over the diversion weir. But farmers do not open the sluice gates because they do not want to lose the scarce floods that occur rarely.

The presence of successful traditional spate irrigation systems like the Boboteya SIS indicates that farmers are capable of carrying out substantial civil works and are able to mange properly the water allocation, distribution and O and M activities. But the planning and design of the rehabilitation and improvement works have mostly been carried out without effective partnership and participation of farmers. Farmers' valuable knowledge of

spate irrigation and their preferences regarding the type of works and changes to be made in the layout of their irrigation system were often not properly considered during the design process.

The importance of community participation in the planning and designing of spate irrigation projects can be seen from the Hara and Fokisa spate irrigation systems. During the construction of the Hara spate irrigation there was no farmers' participation. But farmers in Fokisa were allowed to express if they want the scheme to be modernized and consulted how they wanted it to be modernized. Though the farmers' participation was not more than consultation the result attained in the scheme can indicate the importance of farmers' participation for successful improvement intervention works. The relative success in the scheme is achieved due to the experience gained from failed schemes such as Hara and incorporating farmers' needs and suggestions in the planning and design of the modern structures.

Therefore, vigorously involving the WUA as an institution can result in implementation of successful modernization projects, develop sense of ownership by the community and construction cost can also be reduced by mobilizing free labour and local material contribution.

Generally, the result of this study indicates that there is robust traditional spate irrigation management experience in the study area. Experts have also scientific knowledge which can contribute to facilitate rural and agricultural transformation in the irrigation development sector in the region. There is also considerable room for improving the traditional spate irrigation systems to improve the water conveyance efficiency of the irrigation structures and as a result improve crop production in the Raya Valley. But whose

Knowledge is more valuable? According to Perrier and Salkini (1991) the principle is about "the knower exchanging the known". Farmers because of their proximity would be most capable to identify as well as recommend solutions to their problem in their respective spate irrigation system. In this case if the indigenous farmers' knowledge and the scientific knowledge of planners and engineers are properly integrated through participatory planning and design, the objectives of modernizing traditional spate irrigation systems can be attained.

6.2. Recommendation

Based on the findings of this study the following general recommendations are given:

- The farmers' livelihood in the study areas largely depends on the ability to control and divert spate water. For this reason Farmers have organized strong WUA in order to collectively divert the spate waters and are successfully managing irrigation activities in the traditional spate irrigation systems. Hence it is recommended to strengthen the existing community based WUA by providing technical and material assistance with out imposing new rules and regulations of managing irrigation schemes.

- The spate water distribution rules and rights are formulated based on generations of spate irrigation experience and social structure of the concerned community. As a result the water rules and rights are observed by majority of the farmers. Therefore, care should be taken not to disintegrate the long standing local institution together with improvement works.

- The farmers in the study areas have been designing and constructing traditional spate irrigation structures that have sustained the systems for years. The planning stage of the improvement works should, therefore, pave the way for real participation of farmers and initiate them to practically influence the planning and designing process. Hence through farmers' participation and partnership better improvement designs and successful modernization projects could be accomplished.

- Proper attention should also be given to properly study the traditional spate irrigation management practices, institutional arrangements, water rights and distribution rules so that improvement intervention works could take in to consideration the local farmers need and expectations.

- The major problem observed in the modernized spate irrigation schemes is silt accumulation problem on the diversion weir, in the takeoffs and primary canals. Therefore, there is a need to ensure more reliable spate water supply by reducing risk of failure in the conveyance network and by increasing deliveries to various commands by design operational sediment exclusion mechanisms that reduce silt accumulation over the irrigation structures so that the spate water conveyance efficiency of the modern spate structures are enhance.

- In addition to designing appropriate sediment exclusion mechanism soil and water conservation works in the highlands which are serving as source of flood should be considered to minimize siltation problem in the spate irrigation systems.

- The designing and construction of improved irrigation structures should be done so that they can reduce the labour, time demand for operation and maintenances and reduce the loss of spate water. The structures (such as the sluice gates and primary canals) also need to be easily operable and maintainable by the farmers.

- The spate irrigation intervention design works were done where there was lack of hydrological data on the spate irrigation systems such as runoff amount, time and duration of runoff and frequency of flood occurrence. Therefore collection of

appropriate data from the rivers should be given priority and installation of measurements, data base management and information system should be established to ensure better design in the future.

- Besides learning from the failure of spate irrigation modernization works there should be initiation from the TWRMEB to rehabilitate or reconstruct failed spate irrigation systems such as Hara SIS so that farmers can re-establish their traditional water rights from the systems.

- Finally further research is recommended to systematically assess, identify and document the traditional spate irrigation practices in the Raya Valley so that appropriate improvement designs can be produced and successful improvement intervention works can be implemented.

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Annex- I Questionnaires

Questionnaire and discussion checklists for the project proposal 'Community Spate Irrigation in Raya Valley: The case of Three Spate Irrigation Systems'

By Haile Kidane

Part I

Questionnaires to sample farmers

A. General Information

Name of the irrigation scheme _____

Enumerator_____

Date _____

1. Sex _____

2. Age _____

3. Religion 1= Orthodox 2= Islam

B. Operational and management Arrangements

1. Location of the Farm

1=Head

2=Middle

3=Tail

2. Who do you think is the owner of the irrigation infrastructures?

1= community

2= government

3= No response

3. When do you think spate irrigation begin in your locality?

_____

4. Do you have Water User Association or spate irrigation committee in your irrigation scheme?

1= Yes 2= No

5. If yes to question 4 how do you elect the committee?

1= By organizing meeting and voting

2= Are selected by the elderly in the community

3= They appointed themselves because of their influence in the community

4= Other specify _____

6. What do you think are the main functions of the WUA and the spate irrigation committee?

WUA	Spate irrigation committee
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
4. _____	4. _____
5. _____	5. _____

7. How do you evaluate the performance of the spate irrigation committee with regard to the following functions?

1= Leadership Poor ( ) Average ( ) Good ( ) V. Good ( )

2= Resource Mobilisation Poor ( ) Average ( ) Good ( ) V. Good ( )

3= Infrastructure Maintenance Poor ( ) Average ( ) Good ( ) V. Good ( )

4= Equity in Water Distribution Poor ( ) Average ( ) Good ( ) V. Good ( )

5= Resolving conflicts poor ( ) Average ( ) Good ( ) V. Good ( )

8. Have you ever had a conflict related to spate irrigation water utilization with your individual neighbouring farmers?

1= Yes 2= No

9. If yes to question 8 please mention all cases and their causes you remember.

1. _____

2. _____

3. _____

4. _____

5. _____

10. How do you resolve the conflict you face with your neighbouring farmers? (Please specify the resolving procedure from simple to serious conflicts that may require the involvement of other bodies)

1. _____
2. _____
3. _____
4. _____
5. _____

11. What hostile activities do you think are there among the community members that can potentially result in conflict with down/ up steam users?

1. _____
2. _____
3. _____
4. _____
5. _____

12. Does the WUA in your spate irrigation system have rules and regulation on how to use spate water?

1= Yes 2= No

13. If yes to question 12 would you please mention some of your rights and duties as a user?

Rights	**Duties**
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
4. _____	4. _____
5. _____	5. _____

14. Who decides on how many times should a plot in the command area irrigated in a season?

1= Individual farmers

2= Water committee

3= Agreement made between/ among farmers

4= Specify _____

15. Do you have abandoned spate infrastructures near to your plot?

1= Yes 2= No

16. If yes to question 18 what are the main reasons

1= _____

2= _____

3= _____

4= _____

17. Does the river course in your spate system change direction?

1= Yes 2= No

18. If yes to question 17 what are the main reasons?

1= _____

2= _____

3= _____

4= _____

19. What are the main risks involved in spate irrigation agriculture?

1= No flood season (Dry year)

2= exceptionally high flood

3= High sedimentation that settle in the canals and fields

4= Any combination of the above in order of importance _____

5= Other risks specify _____

20. Do you use spate water for other purpose than crop production?

Yes = 1 No = 2

21. If the answer for question 20 is yes for what other purposes?

1. _____

2. _____

3. _____

4. _____

22. Have you had any training in the following aspects?

1= Spate water management (Yes / No)

2= Spate infrastructure management (Yes/ No)

3= Crop Management (Yes / No)

Specific questions to farmers in improved spate systems

23. How do you evaluate the spate water availability after the construction of the new spate infrastructure?

1= Highly Satisfied

2= Moderate Satisfaction

3= No Change from the traditional

4= Reduced spate water supply from the traditional

24. What problem do you think the improved spate schemes have

1= _____

2= _____

3= _____

4= _____

C. Maintenance and rehabilitation Issues

1. Are you involved in maintenance and rehabilitation of spate irrigation infrastructures?

1= Yes 2= No

2. How many times do you participate in maintenance of the spate irrigation scheme in a rainy season?

1= 1 – 3 times

2= 4 - 6 times

3= more than 7 times

3. What kind of local materials do you use to construct spate diversion structures?

1= _____

2= _____

3= _____

4= _____

4. What kind of local tools and labour do you use to construct and maintain spate diversions?

1= _____

2= _____

3= _____

4= _____

5. How frequently does the structure get damaged with in a season?

_____

6. What is/are the main cause/s of structure damage in your spate scheme? List down in order of importance.

Main intakes (canals)	secondary/ Field canal structures
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
4. _____	4. _____
5. _____	5. _____

7. How do you contribute labour in maintenance and rehabilitation of spate structures?

1= According to family labor size

2= According to irrigated farm size

3= There is equal labour contribution

4= others specify _____

8. Do you hire labour for operation and maintenance works during peak labour demand period?

1= yes 2= No

9. What is the size of your land?

1= 0.0 - 0.5 ha

2= 1 .0 - 2.0 ha

3= 0.5 - 1 .0 ha

4= > 2.0 ha

10. What part of your cultivated land is accessible for spate irrigation?

1= All

2= Half

3= Other specify _____

11. Do you irrigate all of your land accessible for spate irrigation?

1= Yes 2= No

12. If not, why?

1= Shortage of spate water

2= Getting sufficient produce from rain feed agriculture

3= Because of poor operation and maintenance works

4= others specify _____

Specific Questions for Farmers in improved Spate Systems

13. How do you evaluate the operation and maintenance work frequency and work load before and after construction of the new spate infrastructure?

1= Decreased

2= Increased

3= No difference

14. If the answer for question 13 is "increased" what kind of operation and maintenance works are taking you more time?

1= Maintenance of diversion wire

2= Silt moving from canals

3= Construction of farm bunds

4= others specify _____

D. Distribution of Spate Water

1. Are you receiving enough spate water up to your field end?

1= Good supply

2= Sufficient

3= Insufficient

2. Do you feel you share equal water with every user in the scheme?

Yes=1 No =2

3. If no to question 1 the reason is

1= Because of your plot's location

2= Because of the unfair distribution in the scheme

3= Become of reluctance to participate in maintenance rehabilitation activities

4= Other / specify _____

4. If there is inequality, which groups of people in the scheme get more?

1= The farmers near to the main in take

2= The farmers who participate in maintenance rehabilitation activities

3= The farmers who violate the rules and regulations

4= Others specify _____

5. How do farmers react when they feel that they are getting less spate water?

1= Apply to the spate water committee

2= Conspire with similarly affected farmers and try to get more spate water

3= Independently break the rules and regulations to get more spate water

4= Others specify _____

6. What punishment do spate water rules and regulation defaulters receive in your system?

1= _____

2= _____

3= _____

4= _____

5= _____

7. Do you believe the rule and regulations are enforced in the way they are formulated?

1= Yes 2= No

8. If no, what are the weaknesses? Please, list down in order of importance

1= _____

2= _____

3= _____

4= _____

5= _____

9. Who should enforce the rules and regulations in your spate system?

1= Water Users Association

2= Water Committee

3= Others specify _____

10. How many spate flows do you experience in one spate season?

	Main season	Second season
1= Good Season	_____	_____
2= Fair Season	_____	_____
3= Bad Season	_____	_____

11. How is spate water distributed in your scheme?

1= spreading water through guided canals in to the command area

2= field to field technique – by breaking upper bunds

3= controlled system - each field having its own intake

4= others Specify_____

12. Do you have an agreement or rule on how to break bunds to let spate water in to your plot?

1= Yes 2= No

13. If yes to question 12 what does that say?

_____

_____

_____

14. Are there special considerations of spate water distribution for crop-type and stage of growth during water allocation?

1= Yes 2= No

15. Do you pay any water use fees?

1= Yes 2= No

16. If yes to question 15 what purpose it is used for?

1= _____

2= _____

3= _____

17. How do you mobilize when the spate water comes during the night?

_____

_____

_____

E. Gender Issues

1. What is the contribution of women in spate irrigation activities?

_____

_____

_____

2. How do women farmers irrigate when spate water occurs during the night time?

_____

_____

_____

3. What major problems do female farmers face in the spate irrigated agriculture?

1= _____

2= _____

3= _____

4= _____

Specific questions to Women Farmers

4. Are you involved in the decision making of spate water management in your community?

1= Yes 2= No

5. If yes to question 4 in what activities?

1= Water distribution yes/ No

2= Spate Water Committee Establishment yes/ No

3= Spate infrastructure operation and maintenance activities yes/ No

6. How do you manage your plot in the spate irrigation system?

1= Sharecrop

2= Hire labour

3= Use their family labour

4= Mention if any

_____

_____

7. Do you attending any WUA meetings?

1= regularly

2= occasionally

3= never

8. What major problems are you facing in relation to spate irrigated agriculture?

1= _____

2= _____

3= _____

4= _____

9. What are the farm activities you are involved in the spate irrigated agriculture?

1= Land preparation

2= Weeding

3= Harvesting

4= Trashing

5= Animal husbandry

6= any combination of the above _____

F. Improvement intervention issues

Specific questions for farmers in improved spate schemes

1. Where you happy when you first herd that the spate irrigation system is going to be upgraded?

1= Yes 2 = No 3=Indifferent

2. If yes to question 1 why?

_____

_____

3. If no to question 1 why not?

_____

_____

4. Where you consulted/ participated during the planning stage of the improvement project?

1=Yes 2=No

5. If yes to question 4 in what aspect did you participate?

1= simply attended meetings about the project

2= attended meetings and actively expressing feelings, ideas, views, etc.

3= other _____

6. Did you/ other community members have recommendations that should be considered in the improvement of the spate irrigation system?

1= Yes 2= No

7. If yes to question 5 what were your recommendations and suggestions with regard to the improvement of this spate irrigation scheme?

1= _____

2= _____

3= _____

4= _____

8. Were your recommendation and suggestions taken in to consideration by the designers during planning and implementation?

1=Yes 2=No 3= partly

9. Which ones where taken in to consideration and which were not?

Considered	Not considered
1= _____	1= _____
2= _____	2= _____
3= _____	3= _____
4= _____	4= _____

10. What difficulties are the people facing with the modernized spate irrigation system?

1= _____

2= _____

3= _____

4= _____

5= _____

6= _____

11. What type of contribution did you make for the modernized project?

1= labor

2= material

3= land

4= 1&2

5= 1&2&3

12. Was there strong resistance from the community side opposing the improvement of the spate irrigation system?

1= Yes 2= No

13. If yes to question 12, how was the conflict resolved?

1= The community was consulted and persuaded with full consent and participation

2= It wasn't resolved as the project designers went on with the process

3= The community internally opposed; however eventually yielded in as it didn't have the power

4= others, specify _____

14. Have the improved spate irrigation scheme denied former beneficiaries or brought new users?

1= Denied formers beneficiaries

2= Have brought new beneficiaries

3= Both

15. What do you think were the main problems with regard to the infrastructure of the traditional spate irrigation system? (In order of importance)

1= _____

2= _____

3= _____

4= _____

5= _____

Specific questions for farmers from traditional spate schemes

16. Have your community ever requested to any institution to upgrade/ modernize the spate irrigation system you are currently using?

1= yes 2= No

16. Do you support if any institutions show the tendency to up grade your traditional spate irrigation infrastructure?

1= Yes 2= No

17. If yes or no to question16 what are your main reasons?

1= _____

2= _____

3= _____

4= _____

5= _____

18. What advantages do you think the traditional spate irrigation system has as compared to the modernized ones?

1= _____

2= _____

3= _____

4= _____

G. Agrarian Structure

1. Major Crops grown during main Season

1= _____

2= _____

3= _____

2. Major Crops during Second Season

1= _____

2= _____

3= _____

3. Have your production needs been met under this spate irrigation scheme?

1= Yes 2= No

4. In which way do you use spate water for crop production?

1= As supplementary to rainfall

2= As a only source of water for crop production

5. Do you use improved seeds?

1= yes 2= no

6. If yes to question 5 from where do you get it?

1= Agriculture office

2= Dealers

3= Other farmers

4= others specify

7. Do you have sedimentation problem in your crop field as a result of the spate irrigation?

1= Yes 2= No

8. If yes to question no 9 how do you manage it?

_____

_____

_____

9. Which crops are more affected by sedimentation problem?

_____

_____

10. Do you thing that sedimentation has any benefit anyway?

1= Yes 2= No

11. If yes to question 11 what benefits does it have?

1= _____

2= _____

3= _____

12. What season do you experience spate flow?

1= Kiremit (winter)

2= Bega (summer)

3= Meher

4= Tsedey

5= any combination of the above_____

13. Is the woreda Agricultural office helping you in spate irrigated agriculture?

1= Yes 2= No 3= Not significantly

14. If yes, in what ways is it helping you?

_____

_____

Part II
Interview Checklists
A. Interview checklists for discussion with Water Committee members
Interview checklists to the Water Committee Heads/ Abbo-Mais

Date _____

Name of Irrigation Scheme _____

1. How is the WUA/ Water committee in your community formed?
2. What are the major objectives on which the WUA/ Water committee is formed?
3. How frequently do the WUA/ Water committee conduct meetings?
4. What are the dominant issues that are discussed during the meetings?
5. How do you evaluate the kind of support you receive from government/ NGOs operating in your locality?
6. Do you have any major problems in relation to poor participation of members, water availability, conflicts, external interference, etc?
7. Have you ever had a conflict related to spate irrigation water utilization with down stream/ upstream users?
8. Does the WUA in your spate irrigation system have rules and regulation on how to use spate water?
9. Are the rules and regulations codified in to written documents or is that communicated via word of mouse?
10. Do you have operation and maintenance calendar of the spate irrigation system?
11. How is maintenance and rehabilitation of the spate irrigation infrastructures handled?
12. How is spate water allocated and distributed to users?
13. Do you collect spate water use fees?
14. Can women be selected as members of the water committee?

Interview checklists to the Water Committee Heads/ Abbo-Mais from improved schemes

15. Is the water committee in the scheme re-elected or let to operate after the scheme is modernized?
16. Does the scheme constructed with the consent and full participation of the target beneficiaries?
17. What type of help do you need so that you can maximum profit from your scheme?

B. Interview checklist for focus group discussion with beneficiary farmers

Name of Irrigation Scheme _____

Date _____

Group Members

Name	**Age**	**Sex**
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____

1. History of spate irrigation in the community
2. What are the major social organizations in the community that help the productive utilization of spate irrigation?
3. How is spate water distributes to different canals and individual farmers?
4. What are the procedures of establishing Water Users Association and water committees?
5. How are spate water related conflicts resolved?
6. How are the rules and regulations related to spate water utilization codified and applied in the community?
7. Resolving conflicts between/ among different water committees (upstream and down stream users)
8. What are the kinds of penalties applied to defaulters?
9. What are the strength and weaknesses of the traditional and improved/ modern spate irrigation systems?
10. What are the major environmental benefits and problems in spate irrigation (with special focus to soil and forest conservation)?

11. What are the days of the month on which you mustn't engage yourself in part or whole of spate irrigation work?

1. _____ 2. _____ 3. _____

4. _____ 5. _____ 6. _____

7. _____ 8. _____ 9. _____

10. _____ 11. _____ 12. _____

13. _____ 14. _____ 15. _____

12. Describe your activities per month (farming calendar) in a year?

1= Construction of diversion _____

2= Maintenance of spate irrigation infrastructure _____

3= Field levelling and band construction _____

4= Flooding _____

5= Ploughing / seeding _____

6= Harvesting _____

13. Do you know of loss of human or animal life while engaged in spate irrigation works?

14. Local sayings (proverbs) that are related to spate irrigation

C. Interview checklists for discussion with Woreda irrigation experts

Date _____

Woreda _____

Interviewee _____responsibility/ position_____

1. Under whose management is the spate irrigation system?
2. What is the contribution of your office in managing the spate irrigation system?
3. What technical support do you provide to the spate irrigation schemes in the woreda?
4. What identified ladders of spate management bodies exist in the irrigation system?
5. Is your office involved in the management ladders as a member? Identify in which ladders your office is involved.
6. What are the main advantages of-
   - Traditional spate irrigation systems?
   - Modernized spate irrigation systems?
7. What impediments do:
   - Traditional spate irrigation systems have?
   - Modernized spate irrigation systems have?
8. How do you evaluate the effectiveness of improving traditional spate irrigation schemes in your woreda?
9. What specific interventions do you think the scheme need so that they can generate maximum benefit to the community?

D. Interview checklists for discussion with Development Agents

Date_____

Interviewee _____

Name of the spate irrigation scheme _____

1. What is your contribution in spate water management in your assignment area?
2. Are you involved in resolving conflicts that arise in spate water utilization?
3. What are the administrative ladders of spate water management bodies in the community?
4. Are you involved in any of the administrative bodies?
5. Have you witnessed conflicts that failed to be resolved with in the community?
6. What major problems do the spate irrigation schemes in your assignment area have?

E. Interview checklist for discussion with regional irrigation Officials and Experts

Date _____

1. What do you think are the main objectives of the interventions in the traditional spate irrigation schemes?
2. Is the intervention works 'improvement' or 'modernizing' of the traditional spate irrigation schemes?
3. How far do the improvement/ modernizing processes use the local traditional knowledge and experience of spate irrigation management?
4. How far do you think the community were involved in the planning, designing and implementation of improving/ modernization of the traditional spate irrigation schemes?
5. How far the recommendation and suggestions of farmers forwarded during planning were taken in to consideration during the project design and implementation?
6. What are the advantages and disadvantages of improving/ modernizing traditional spate irrigation schemes?
7. How do you evaluate the success of the so far carried out interventions on the traditional spate irrigation schemes?