

Toward Better Institutional Setup in Spate Irrigation System: the Case Study of Yandafero-Konso Lowland Spate Irrigation System, Ethiopia

Tolossa Lemma Tola

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By

Tolossa Lemma Tola

Supervisor

Prof. Charlotte de Fraiture, PhD, MSc.(UNESCO-IHE)

Mentor

Abraham Mehari Haile, PhD, MSc (UNESCO-IHE)

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ABSTRACT

Spate irrigation is a resource system, whereby flood water is emitted through normally dry wadi and conveyed to irrigable fields in many arid and semi-arid areas to improve the farmers' livelihood. This flood based irrigation require more cohesive co-operation among farmers than the conventional irrigation, to divert and manage the distribution of flood flows. The better institutional arrangement that shows strong collaboration and co-operation between stakeholders and users are desirable for sustainable spate irrigation management and development. The Yandafero spate irrigation system is one of the community management for a long time in Southern, Nationality and Peoples of Ethiopia. However, the practice of this spate irrigation was not getting the capacity to evacuate the communities from external food aid over 25years. The study attempted to find out performance of the current institutional arrangements with regard to O&M, water sharing and conflict managements, provision of credit and loan facilities, to assess impacts of this performance on agricultural productivity and to recommend, as necessary that build upon the strengths and address limitations of the existing institutions for better spate flow management. For this research the integral part of primary data collection like household survey, focus group discussion, key informant interview and field visited was made on three schemes (Oneya, Potota and Tarakom). In addition, relevant literatures and documents mainly focused on the general description and historical developmental activities on Yandafero spate irrigation system performed by different organizations were reviewed. Based on the data collected and intensive literature reviewed, five principal aspects of spate irrigation management: recognition of right to organized for collective action, O and M of infrastructure, Water sharing dynamics, conflict resolution mechanism, facilities of credit and loan for self-financed in manage of scheme were selected to evaluate the existing performance of institution arrangement under three selected schemes. The findings of this study show that, the farmers are organized under formal and informal Irrigation Water Use Cooperative (IWUC) to managed Spate water with external support of YFSS IFS project (EECMY/SWS). The IWUC, under each scheme was varies with respect to those of selected principles for evaluation. Out of proposed IWUC (9), only three irrigation water users (IWUC) get recognition with clearly stated (written) responsibility at Oneya scheme. According to evaluation, there is varies in frequencies of participation of farmers in maintenance activates of infrastructures under three scheme. At Oneya and Potota schemes there was poor status of diversion weir at the intake of main canals due to destructive of head work, closed gate, malfunction of flood flash and high sediment accumulation on the diversion weir. The water right and distribution rule was similarly established among the three schemes. However, there is a difference on the implementation and enforcement of those rules. For instance, according to assessment made, in Oneya the enforcement of water distribution rules are better than (56.7%) that of the Tarakoma(43.3%) and Potota(0 %). The development of internal rule and regulation of IWUC and codification of water distribution rule was only performed at Oneya. The overall evaluation indicates that, there is good performance of IWUC in Oneya and Tarakoma schemes regarding to coordinatng for construction of tertiary and field canals, regard to ensuring equal distribution of flood water and conflict management. In the case of Potota scheme, the sampled farmers evaluate the informal IWUC as poor performance toward providing equity of flood water distribution and solving conflict. The Yandafero farmers were practising credit and loan facilities through formal cooperative mechanisms by organizing themselves into different cooperative groups. At Yandafero spate irrigation, it can be generalized that there is a remarkable improvement of HHS agricultural production after active involvement of EECMY-SWS organization on management of spate irrigation. However, it is understood that the poor performance of farmers' organization toward management of spate irrigation system impacts the agricultural productivity. For instance, more than 50 % of sampled Potota farmers replied that as the average annual production of HHS before and after the improvement of diversion weir was the same (below 1000kg) where as dramatic increment at Oneya and Tarakoma after the modernization of diversion weir (>4000kg).The establishment of similar structural organization among three scheme that link IWUC and key governmental sectors with clear role and responsibilities will improve the existing management of Yandafero spate irrigation system.

Key Words: *Irrigation Water Use Cooperation (IWUC), Yandafero, spate irrigation, institutional arrangement, O and M, water right and distribution rule, conflict resolution, Oneya, Potota, Tarakoma*

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ABBREVIATIONS

DA	Developmental Agent
E.C	Ethiopian Calendar
EECMY/DASSC	Ethiopian Evangelical Church Mekane Yesus/ Development and Social service Commission
EECMY-SWS	Ethiopian Evangelical Church Mekane Yesus-South west Synod
ETB	Ethiopian Birr
HHH	House Hold Head
IWUC	Irrigation Water User Cooperative
JPA	Jarso Peasant Association
KDA	Konso Developmental Association
KWAO	Konso Woreda Administration Office
KWARDO	Konso Woreda Agricultural and Rural Development Office
KWCPO	Konso Woreda Cooperative Promotion Office
KWFEDO	Konso Woreda Finance and Economic Development Office
KWWA &C	Konso Woreda Women Affairs & children Office
KWWRMEO	Konso Woreda Water Resource, Mine and Energy Office
LWF	Lutheran World Federation
ME	Mekena Eyesus
MOM	Management, Operation and Maintenance
NGO	Non-governmental Organization
O & M	Operation and Maintenance
SNNP	South Nation Nationality People
WUA	Water User Association
WUC	Water User Cooperative
WUO	Water User Organization
YSIS	Yandafero Spate Irrigation System

1 INTRODUCTION

1.1 General

Spate irrigation is an ancient form of water management, involving the diversion of flashy spate floods running off from mountainous catchments, using simple deflectors constructed from sand, stones and brushwood on the beds of normally dry wadi. Flood flows, usually flowing for only a few hours with appreciable discharges and with recession flows lasting for only one to a few days, are channelled through short steep canals to bunded basins, which are flooded to depths of 0.5 m or more. Crops often like sorghum are grown from one or more irrigations using residual moisture stored in the deep alluvial soils formed from the sediments deposited from previous irrigations (Meharie. et al., 2011).

This flood based irrigation is required more cohesive co-operation among farmers than the conventional irrigation, to divert and manage the distribution of flood flows. The uncertainty stems from the unpredictable numbers, timing and volumes of floods, the occasional very large floods that wash out diversion structures and the frequent changes to the wadi channels from which the water is diverted. Substantial local wisdom has developed in the sitting and constructing intakes, organizing water distribution, and managing flood waters and the heavy sediment loads. In some locations large irrigation systems have developed over centuries, with what at first site appear to be rudimentary diversions and canals providing high water diversion efficiency, and a fair measure of equity between upstream and downstream water users. Command areas may range from anything between a few hectares to over 30,000 hectares spate schemes rank amongst the largest farmer managed irrigation systems in the world (Lawrence and Steenbergen 2005)

At Yandafero spate irrigation, the spate flow is distributed through a well-laid network of primary, secondary and tertiary canals. The traditional techniques used include building stone and brushwood spurs to divert a proportion of the stream flow and then guide it along long narrow hand-dug canals and into the fields surrounded by soil bund. The shape of the primary canals is remarkable: rectangular, narrow and deep. According to the discussion held with farmers', they prefer for this shape of the canals relates to the objective of creating high velocities and hence reducing deposition of fine sediments.

The central idea of the research was to analyze the existing institutional arrangements for management of flood irrigation system and to propose the better institutional setup that improves the productivity of the agricultural in the Yandafero-Konso lowlands of Ethiopia, where spate irrigation is practiced for food security of the community.

1.2 Background of study area

Konso is a town on the Segen River in south western Ethiopia. The administrative centre of the Konso special woreda is found under the Southern Nations, Nationalities, and Peoples' (SNNP) region. This town has a latitude and longitude of 5°15'N and 37°29'E coordinates and an elevation of 1650 m.a.s.l. The Konso have developed a complex and highly sophisticated agricultural system, which has allowed them to subsist in a mountainous area, harsh conditions and irregular rainfall. Farming is based on an elaborate system of terracing, soil and water conservation practices, irrigation, multiple cropping systems with the integration of live-stock and forestry and crop biodiversity. The Konso people have lived in isolation for a very long time (Förch 2003).

Yandafero flood-based farming is situated within Konso special woreda, in the Great Rift Valley at 5020 N Latitude and 36007 E Longitude (Abraham et al, 2013). It is practiced in Yanda plain (East of the 'karat' town of Konso special woreda) that crossed and formed by two rivers; the yanda(which is seasonal) and Segen(semi-perennial), which drain to the Chew Bahir(salt lake) at the border to Kenya. According to the discussion held with Kebede Katusa, head of Konso Special Woreda Agricultural Office (2013), the plain

consist of the Jarso PA¹ where the centre of the Yandafero spate irrigation systems was practiced and covered more than 7000ha. This plain was characterized with average annual precipitation 400-700mm, which is low rainfall that results unsustainable agricultural practices (YFSS IFS proposal, 2005-2008). After heavy rains in the Gandayla Mountain and Gidole high lands (approximately 58 Km far), runoff crossed different mountains and reach the Yanda plain. Since the topography of the area along the river were mountains and steep slope, the volume of the flood inside the yanda increase at lower stream. According to the Befekadu (2004), most of land along the Yanda River is difficult for agricultural practice except the yanda plain where considered as lowlands of Konso characterized with general slopes of less than 1% and well developed soil.

There is no well documented history on when the Yandafero spate system came to existence. The commonly shared opinion is that three decades back the Yanda River was a shallow flood canal meandering over the alluvial plain, spreading water over a large area after the rains. The current deep river only developed over the last 30 years. The change was brought about by the degradation of the catchment. This caused floods to become flashy and silt-laden. As reported of Abraham M.et al, (2013) in Deribe and Wuletaw (2001), there were 29 flood intakes made of tree trunks (driven in the river bed), brush wood, mud and soil irrigating a land area close to 4,000 ha. Eleven of the flood intakes date back to more than thirty years. Most of the remaining ones were developed in the last few years under food for work programme.

¹ Jarso Peasant Association(JPA) is the same to Jarso Kebele

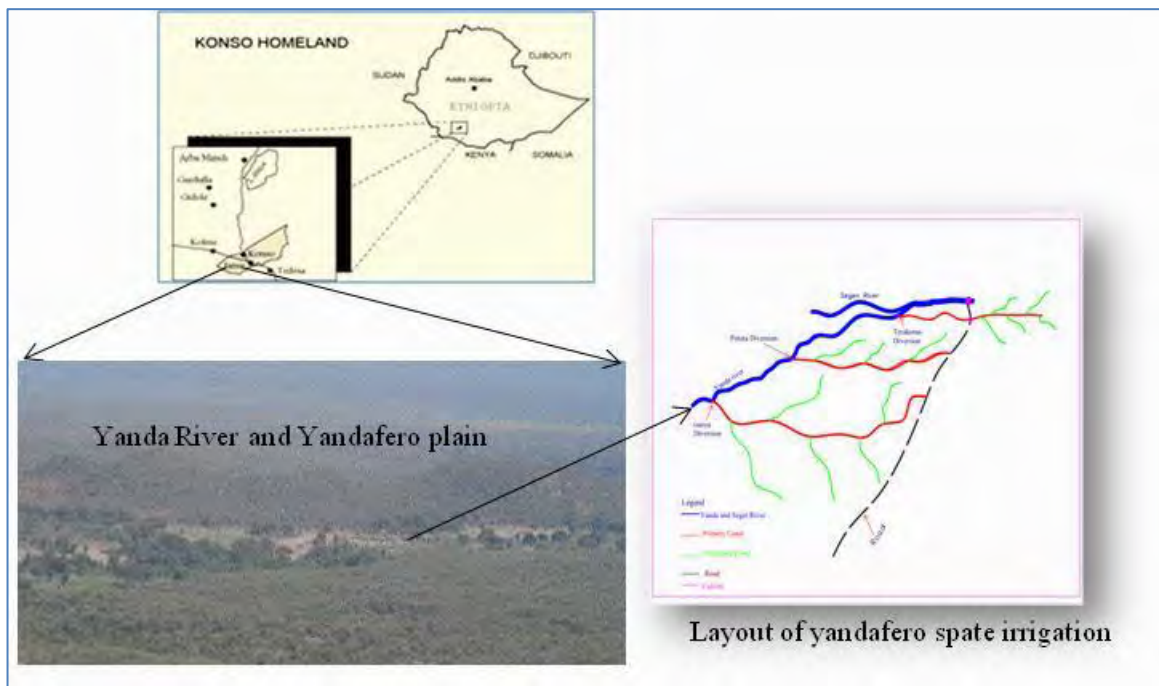


Figure 1-1Location of the study area

1.3 Problem statement

The farmer of Yandafero plain is prone to a flood which has been utilised spate irrigation for a long period of time. This is through diverting flash water from Yanda River into agricultural field by using their indigenous knowledge and traditional mechanism of diversion. The traditional techniques used includes building stone and brushwood spurs into the stream beds to divert a proportion of stream flow and channelling it along hand dug canals to the fields.

According to indicated in technical report of Farm-Africa (2000),² before 20 years Yandafero irrigation scheme was consist of a series of 27 small intakes and canals from Yanda River. However, the practice of this spate irrigation was not much productive and sustainable. Most of those intakes were severely damaged by high flood. Even though different local and international organization was developed varies proposal for the improvement and management of spate irrigation system, the productivity of the scheme was not changed and the communities continued waiting for food aid. The proposed management option was not implemented and remains as paper value due to varies reasons, like reflection of different opinions on the implementation among involved parties, shortage of fund, weak of institutional capacity building. Some of the proposed management was also follow similar arrangement to that of conventional irrigation systems which created doubt of its economical feasibility.

In 2005 the proposal was developed by EECMY-SWS³ under YFSS IF Project and started funding the construction of ten spate irrigation schemes in Konso woreda out of which three modernized diversion were on Yanda River (Yandafero Spate irrigation) and the rest on Segen River. Out of a potential 7000ha, only 1600ha have proposed to put into three modernized diversion⁴. Currently, out of 1600 ha proposed, only 1100 ha was utilized under two modern diversion structure (Oneya and Tarakoma). The left one

² Farm Africa Technical report on the review of spate irrigation system in Konso special Woreda,2000

³ EECMY-SWS is a faith based organization with development and social service (DASSC) wing in its organizational structure, commissioned for development work in the country, particularly in Jarso Kebele,Konso by developing YFSSIF project

⁴ EECMY-SWS Annual report 2005-2008

(Potota diversion) structure is not functioning. There is thus a need to establish the hindering factors to full utilisation of the potential and hence realization of more agricultural productivity.

Although, established farmers association is made responsible to timely operation and maintenance and assure equitable distribution of water within the canal network, the improved headwork of Oneya diversion was destructed and the farmers have used a traditional diversion mechanism which was washed away by high flood occurrence and results less amount of flood flow in the main canal.

Financial returns to spate-irrigated agriculture are relatively low and maintenances cost of spate irrigation systems is relatively high. Loans/credit facilities and encouraging traditional mechanisms of solidarity and mutual assistance are very weak. This may results the reduction of flood farming productivity in the study area.

The level of active interaction of farmer's, developmental organization and woreda sectors involvement in management, operation and maintenance (MOM) of spate irrigation system is very necessary for the sustainable productivity of the scheme. However, there is weak relationship between governmental organization and water users' committee that result water sharing problems and conflicts among upper and downstream of farmers. The institutional and policy for O&M for spate irrigation is important to sustain and improve the irrigation regime, and the absence of such arrangements, structures in a spate irrigation scheme are likely to collapse or become dysfunctional (Anderson, 2011). Because of this, it is important to understand what the current institutional arrangements and practices for O&M in Yandafero spate irrigation, and how these impact the agricultural output.

1.4 Research objective and Questions

1.4.1 Overarching objective:

Analyze the effectiveness of existing institutions in managing the Yandafero Spate irrigation system and enhancing agricultural productivity; and accordingly recommend improvement measures

Specific objectives:

- To make in depth assessment of the performance of the existing institutions with regard to O&M, water sharing and conflict management and provision of credit and loan facilities
- Analyze the impacts of the performance of the institutions on agricultural productivity
- Recommend, as necessary that build upon the strengths and address limitations of the existing institutions for better spate flow management and higher productivity

1.4.2 Research Question

Overall research questions:

How effective are the existing institutions in managing the Yandafero Spate irrigation system and enhancing agricultural productivity?

Specific research questions:

- What are the strength and weakness of the existing institutions with regard to O&M, water sharing and conflict management and provision of credit and loan facilities?
- What are the impacts of the performance of the institutions on agricultural productivity?
- What improvement measures, if any, can be recommended that build upon the strengths and address limitations of the existing institutions for better spate flow management and higher productivity?

1.5 Structure of the thesis

The paper has a range of preliminaries appeared before the structure of chapters. References and appendices are affixed at the end of the paper. The rest parts situated amid the aforementioned ones are organized into five chapters. Chapter one introduces the back ground and general description of study area; states the problems that initiate for study; the aim of the research and question. In chapter two, the methodology used to achieve research aims and to answer research question is described. In chapter three the historical review about spate irrigation development and institutional organization toward operation and maintenance of spate irrigation and agricultural production in different countries is assessed. In chapter four the research findings are discussed under three schemes (Oneya, Potota and Tarakom) of Yandafero spate irrigation. It is focussed on analyzing of the performance of the existing institutional arrangements toward spate irrigation managements based on the findings. Finally (chapter 5), the conclusions and practical recommendation are drawn based on the existing condition of O and M of three schemes of Yandafero spate irrigation systems.

2 RESEARCH METHODOLOGY AND APPROACH

Introduction

The methodology adopted in this paper for assessment of existing institutional arrangements toward management of spate irrigation was built on the three-step approach advocated by Herrera S, (2005). The first step consists of gaining and understanding of the existing institutional structure underlying Yandafero Spate Irrigation System (YSIS) management. This is achieved using the framework developed for this study that involves understating institutional environments (historical development aspects of YSIS, socio-economic aspects and existing infrastructure), existing organizational components and O and M strategies, and understanding spate water sharing principle. Secondly, the performance of existing institutional arrangements was tested under five principles selected for evaluation under this study (minimum recognition of right to organized, O and M of the spate infrastructure, conflict resolution mechanism, water sharing (rights and allocation) and credit and loan facilities). Finally, the linkage of this performance toward O and M of spate irrigation systems was analyzed. And necessary practical recommendation was made. The graphical representation of the framework is provided in Figure 2-2.

2.1 Data collection Method

To minimize the problem of lack and reliability of information, different methods (triangulation) of data collection were employed. Accordingly, questionnaires were designed and implemented to collect information related to the socio-economic and institutional aspects of the Yandafero Spate Irrigation Schemes such as participation of users, equity of spate water distribution, operation and maintenance of the schemes, conflict and its resolution, farm landholding size, crop yields before and after the intervention of project on spate irrigation development from selected households. Focus group discussions and interview at community level and woreda level were organized with prepared checklist. Observation was also an integral part of data collection particularly for three diversion headwork, and their primary canals how they are managed for their sustainable function. I also observed farm plots and demonstration/nursery stations.

Information obtained through grey documents of projects and organizations mainly focused on understanding the general description and historical developmental activities on Yandafero spate irrigation system takes place by different organization to solve the food insecurity in Konso woreda as the whole and particularly in Yandafero spate irrigation developments area (Jarso kebele). Different books and academic journals related to this research were reviewed.

2.2 Sampling Design and Analysis

This study used random sampling techniques. Farmers interviewed were selected randomly. But, before undertaking the random sampling, stratification is carried out. The spate irrigation beneficiaries in three schemes (ONeya, Potota and Tarakoma) were stratified into male and female headed households. The total HHs of spate irrigation beneficiaries from three blocks are 1800. The researcher determined the sample size of only 180 households with confidence level of 95 percent and confidence interval of 4.2⁵. Out of the three schemes, the samples were drawn from each block depending on the proportion of numbers of HHs. But due to small number of female household headed farmers in each block, 100% of female headed farmers taken as the sample in Oneya and Potota whereas 50% at Tarakoma (see table 2-1). However, efforts were made to include farmers from various social classes and those who are less connected to the formal organizations. The sampled was also tried to include the farmers found at the

⁵ In relation to the size of the sample (10%), the confidence interval adopted from sample size calculator is relatively small. <http://www.surveysystem.com/sscalc.htm> accessed November 24, 2013

upper, middle and lower of each main canal and secondary canals. Therefore 65, 55 and 60 HH beneficiaries from Oneya, Tarakoma and Potota spate irrigation development were selected respectively.

The information collected through HH survey were coded and entered in to a computer for analysis using computer software SPSS and Microsoft Excel 2007 windows. Data obtained from secondary sources like crop yield analysed using simple statistical tools such as tables and charts

Table 2-1: Number of sampled households from three schemes of YSIS

Name of the Block	Total No, of Beneficiaries HHs	Household head		No. of sample farmers		Total
		Male HHH	Female HHH	Male HHH	Female HHH	
Oneya	650	648	2	63	2	65
Tarakoma	550	532	18	46	9	55
Potota	600	591	9	51	9	60
Total	1800	1771	29	71	20	180

Source: study survey and the Yandafero spate irrigation office (YSSIFS, 2013)

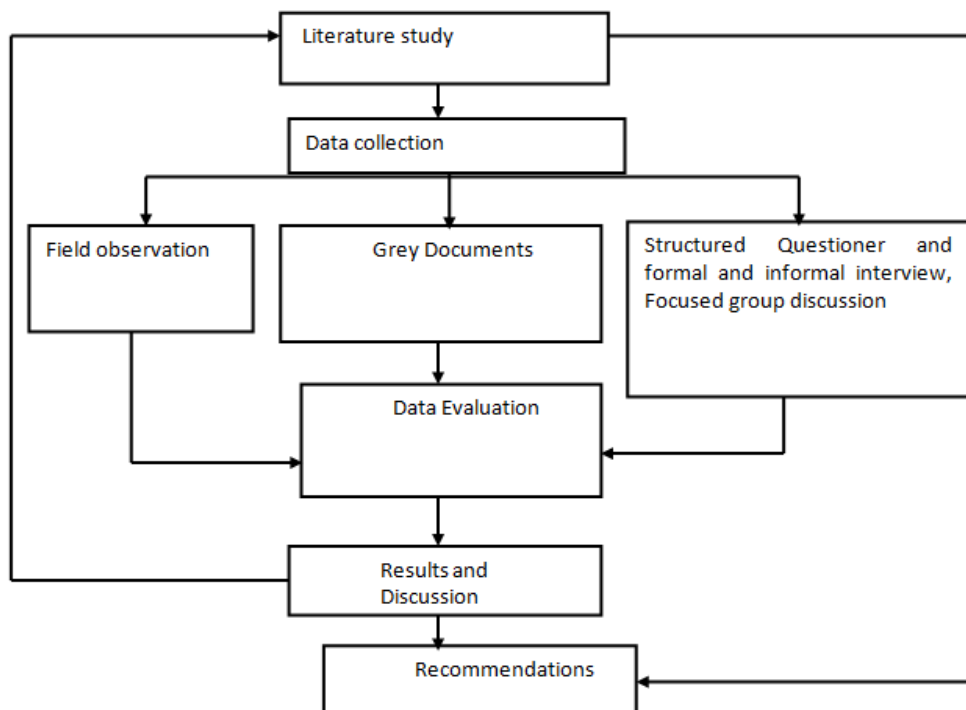


Figure 2-1: Research Approach

The detailed methodologies followed to answer the research question of the study are presented as follows:

- 1) **What are the strength and weakness of the existing institutions with regard to O&M, water sharing and conflict management and provision of credit and loan facilities?**

To answer this question, interview and focus group discussion were made with different governmental stakeholders sectors like KWARDO, KWFEDE, KWCPD, KWWRMEO, KWWA&CO and KWAO. EECMY/DASSC is one of the local non-governmental organization that interview was made to have in-depth information about the O and M of the spate irrigation infrastructure and clear indication of the responsibilities on Yandafero-spate irrigation. Intensive interview and questioner were also made with farmers of the scheme to get deep information about the local spate water sharing rules and right, conflict management, ways of election of water committees (whether it is fair and justice?), the presence and arrangements of WUAs and their responsibilities, the performance of committees with regards to leadership, resources mobilization, infrastructures maintenances, equity of water distribution and provision of credit and loan facilities.

Field observation was also made to visualize the reality of operation and management of spate water irrigation canals. Information was gathered from these interviews as well as from grey documents such as report documents, project documents, and documents related to organizational structure and mandates of different organizations on spate irrigation systems in different countries and typically at Yandafero-Konso lowland.



Figure 2-2 Discussion with Oneya's Farmers and with Konso Woreda Agricultural Office

2) What are the impacts of the performance of the institutions on agricultural productivity?

The questionnaires and interviews mainly targeted the farmers who are the key actors in this subject. The crop production data records were taken from rural development and agricultural office of the woreda for past 11 years and also checked and compared with farmer's accounts of target farmers (table2-1). However, due to burning of the office (electric problem) with the whole documents, insufficient crop yield data was available in the sector. To overcome this problem, the HH survey was taken place to get crop yield before modernization of diversion weir and after at three schemes (Oneya, Potota and Tarakoma). Additionally, assessment was made on performance activities by food aid organization on the development of spate water irrigation systems to insure food security at Konso wored, particularly at JPA⁶.

3) What improvement measures, if any, can be recommended that build upon the strengths and address limitations of the existing institutions for better spate flow management and higher productivity?

This objective was achieved after the strength and weakness of the existing operation and management of Yandafero- Konso lowland spate irrigation system were identified.

Conceptual Framework

⁶ JPA-Jarso Peasant Association is the same to Jarso kebele

After the intensive literatures review, the conceptual framework was developed. The conceptual framework focused on evaluation of existing institutional arrangements toward management of spate irrigation system and impacts on enhancing flood agricultural out-put (figure.2-2)

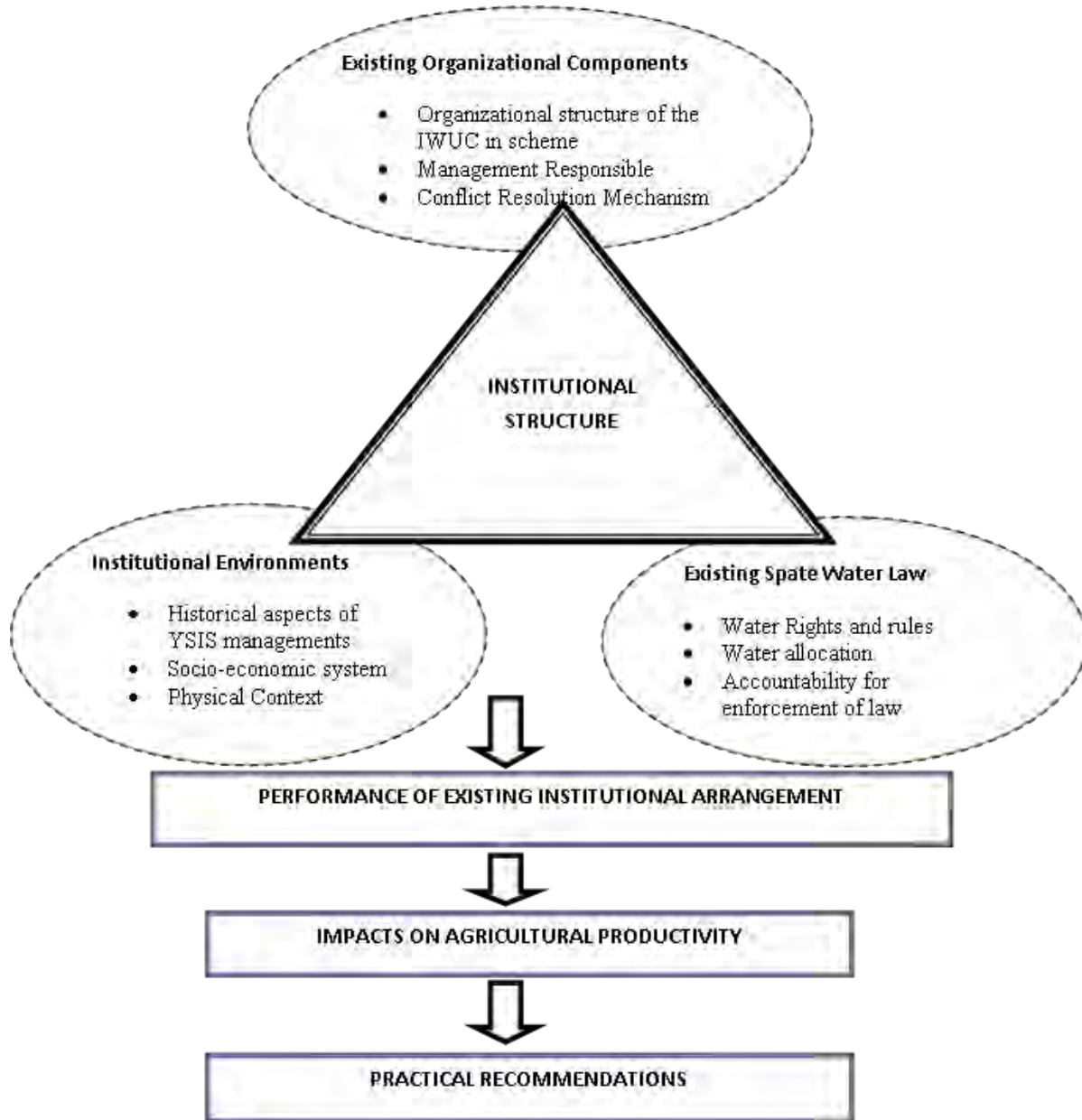


Figure 2-3: Conceptual framework

3 LITERATURE REVIEW

3.1 Spate Irrigation Development

Spate irrigation is an ancient practice by which floodwater is diverted from its river bed and channelled to basins where it is used to irrigate crops and feed drinking water ponds, serve forest and grazing land and recharge local aquifers. It has evolved over the centuries and provided rural populations in arid and semi-arid regions with an ingenious way to cope with the aridity of their climate. It is thought that spate irrigation started in present day Yemen, where it has been practiced for around five thousand years. Today, spate irrigation covers more than 3 million hectares across the world. Although its extent is relatively minor compared to other types of irrigation, it represents a unique option for the management of scarce water resource in support of agricultural production and rural livelihoods in many arid regions (Van Steenberg et al, 2010 in Shushay L, 2012).

3.1.1 Spate Irrigation development in Ethiopia

The development of spate irrigation in Ethiopia is driven by both public interest as well as farmer's initiative. Several regional states in particular Tigray and Oromiya have dedicated ample funds for new systems development. Almost all spate irrigation development in Ethiopia is very recent. This is unlike the history of spate irrigation in Yemen, Iran or Pakistan – which stretches over millennia. The area currently under spate irrigation is estimated at 140,000 ha, but the potential particularly in the lowland plains is much higher. Spate irrigation is increasing in the arid parts of the country: in East Tigray (Raja, Waja), Oromia (Bale, Arsi, West and East Haraghe), Dire Dawa Administrative Region, in SNNP (Konso), Afar and in Amhara (Kobe) (Steenbergen, Haile et al. 2011).

3.2 Organization and Management of Spate Irrigation

According to Bryan et al, in Haile in (2009) community water management can be developed by learning from and supporting local problem-solving to find pathways to sustainability, diversifying water user organization to fit local conditions, and weaving links with wider sub-basin, basin, and national water governance.

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 (Haile, 2007)

According to Abraham M, (2010) the organization has a number of outstanding features:

- Strong linkage with local government, creating a continuum between the formal government organization and the informal user organization;
- Articulation into smaller groups, that allow face-to-face contact and facilitate the organization of collective labour;
- Accepted manner of distributing the uncertainty in water supplies that is inherent to spate irrigation

According to Lawrence and Steenberg (2005), there are essentially three types of management arrangement: Those are, predominantly farmer-management, Combination of management by local government and farmer management and Combination of specialized agency management and farmer management.

3.2.1 Role of Farmers in Management of Spate Irrigation Systems

Most spate irrigation systems have a long history of farmer management. However, the levels at which farmers are involved in the management, operation and maintenance (MOM) of their spate irrigation

system varies considerably. It may range from the management of the entire traditional spate irrigation scheme to only the O&M of the "on-farm" canals in modern systems (Olaf Verheijen, 2013).

According to Lawrence et al, (2005) cited in Haile K (2009), in most spate irrigation systems are farmer managed. The responsibility of managing the 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 the entire 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. Actually, in different countries, the role of farmers is varies.

Eastern Lowlands in Eritrea

According to Olaf V. (2013) presentation on short course training about spate irrigation and water management under drought and water scarcity at UNESCO-IHE, for about 100 years, farmers in the spate-irrigated areas of the Eastern Lowlands in Eritrea have operated and maintained spate irrigation systems, which were developed by the farmers in response to their own needs, at their own cost and independently of any government support

Existing WUO and Rules and Regulations in Eritrea

In response to the need for collective labour and collective water management, the farmers along Wedi Laba, Wedi Mai Ule and Wedi Labka in the Eastern Lowlands Eritrea have their own traditional organizational structures with unwritten rules & regulations governing the distribution of irrigation water to their crop fields as well as the maintenance of the upstream major diversion works commanding the supply of water into the irrigation system (Olaf Verheijen, 2013). According to his presentation, for collective labour and collective water management, farmers formed own organisations: Farmers' sub-groups, Farmers' groups and Irrigation Committee

Traditionally, different rules & regulations were formulated and applied by the farmers for each farmers' group and sub-group to fine individual farmers, who did not contribute labour as required or who were breaching a main canal (*misqha*), field bunds (*kifaf* and *tewali*) or a field gate (*bajur*) without permission. Livestock owners could also be fined if their animals cause damage to standing crops in the fields. As many farmers' groups in the Eastern Lowlands had problems with the enforcement of these rules & regulations, they had to request the local administration to use its power to collect the fines (Olaf, 2013).

Wedi Tuban and Wedi Zabid in Yemen

According to the presentation of Olaf V. (2013) on the short course spate irrigation and water management under drought and water scarcity at UNESCO-IHE, the Ministry of Agriculture & Irrigation (MAI) responsible for O&M of headwork, main and secondary canals. As MAI is unable to carry out all necessary maintenance works, farmers decided to undertake and finance more and more maintenance works themselves. Informal farmers' groups formed to organise collective cleaning of canals and/or (re)construction of traditional diversion structure. MAI is encouraging formation of informal farmers' organisations to undertake routine maintenance works and to report any damage and maintenance works. Farmers' groups hire labour for execution of necessary maintenance and repair works. In some cases, small committees at village level have been established to organise O&M and to ensure that gates are not damaged or stolen

Similar to wedi tube in yemene, wedi Zabid is also initially the operation and maintenance (O&M) was responsible of Tihama Development Authority (TDA). According to Olaf V, (2013) presentation farmers' responsibility only started from field turnout. Enforcement of traditional water distribution rules weakened as TDA is not adequately supported by authorities to stop larger landowners to operate gates without permission of TDA. In response to limited O&M role of TDA, farmers increasingly organised O&M of spate irrigation systems themselves without waiting for assistance from outside. Farmers formed informal groups at village level to organise and coordinate the O&M.

Spate Irrigation Systems in Pakistan

In absence of pervasive role of government in management of spate irrigation systems, most schemes are farmer-managed, including one scheme along Nari River commanding 50,000 ha. Planning and execution of maintenance works are organised informally by number of influential farmers. During number of days, all farmers provide free labour for execution of maintenance works. In some of larger spate irrigation systems, water tax is collected through network of local leaders. In Kacchi Plains, 'engineers' are appointed for supervision of construction of large earthen bunds and checking safety of bunds during flood season (Olaf, 2013).

3.2.2 Field Water Management in Spate Irrigation

Field water management in spate irrigation systems is as important as effective water diversion. As much as possible the floodwater should be spread in a controlled, non-erosive manner. So far interventions in spate irrigation have mostly concentrated on improving the diversion of spate flows. Water management within the command area has often been treated as a 'black box' (Lawrence and Steenberg, 2005)

Effective floodwater diversion measures are necessary, but they must be supplemented with equally effective field water management and soil moisture conservation measures if sustainable improvement of land and water productivity is to be achieved. Modernization measures include: avoid overstretching the command area; limit the number of irrigation turns to two or an irrigation gift of 1000 mm; avoid field bund heights of more than 1 m; adopt a field-to-field water distribution system instead of an individual field water distribution system; for water rights and rules that entitle downstream fields to the more frequent small and medium floods thereby ensuring equity in both water quality and quantity; optimize soil water-holding capacity and infiltration rate through pre-and-post irrigation tillage, combined tillage as well as soil mulching (Abraham et al, 2010)

3.2.3 Strategies of field water distribution

In nature spate irrigation means that farmers cannot follow a predetermined irrigation Schedule where water quantities are applied to a crop when it is needed. This does not mean that water distribution within the command area is either haphazard or unplanned. Water distribution is regulated by prevailing water rights and rules and generally seems to follow a number of principles: (a) rapidly spreading the available flows, and preventing spate water rapidly disappearing in low-lying areas. (b) Dividing the floods in manageable quantities so as to avoid erosive flows and gully formation. (c) Ensuring that large enough water volumes to irrigate the downstream areas are conveyed in the short times that spate flows are available (Lawrence and Steenberg, 2005).

3.2.4 Equitable Distribution of Spate Water

Internal rules & regulations concerning the equitable distribution of spate water among individual water users are one of the most important ones that have to be developed by the water users' organization. Equitable water distribution refers to the sharing or allocation of available water resources among all water users in accordance with their legal or established right to that water (Olaf, 2013). According to the Olaf (2013), there are a lot of factors that bear directly on the attainment of equity include: Existence of system rules that are known clearly by both farmers and operators, adherence to those rules in actual water supply operation; and Confidence among farmers that the WUO will apply the rules fairly without undue favour or penalty to individuals.

3.3 Water Rights and Flood Water Distribution rules in Spate Irrigation

3.3.1 Water rights and Rules

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 (Woldeab in Haile, 2009). Water distribution rules and rights help to mitigate the unpredictability that is inherent in spate irrigation. Rules and rights impose a pattern and reduce the risk of conflict, by regulating relations between land users that have access to floodwaters. The

way rights are defined in spate irrigation systems is different from perennial systems. In essence water rights in spate irrigation systems are reactive. They deal with agreed claims in a changing and variable environment. They describe acceptable practices in a given situation, rather than quantifiable entitlements to a resource, as in perennial systems (Lawrence and Steenbergen, 2005).

Water rights in spate irrigation system are not static. They change under the influence of factors such as population increase and the pressure for new land development, changing cropping patterns and new marketing opportunities; the introduction of more robust diversion structures; shifts in power relations; and changing levels of enforcement. The link between enforcement and overall governance is very strong. Water rights are not something that precedes water management or can be used in isolation to change water management and water distribution (Mehair A, et al, 2007).

According Mehair A, et al, (2007) the most common and widely applied rights and rules relate to the following: demarcation of land that is entitled to irrigation; breaching of bunds, proportion of the flood water going to different canals and fields, sequence in which the different canals and fields are irrigated; depth of irrigation that each field is entitled to receive, access to second (and third) water turns.

3.3.2 Enforcement of Water Rights and Rules

The type of enforcement strategies and the degree to which the water rights and rules can be enforced varies mainly depending on the social structure of the communities and the level of the overall governance in the area (Abraham et al., 2005).

3.4 Agricultural Production and livelihood strategies in spate irrigation

Since the livelihoods based on spate-irrigated agriculture are precarious /uncertain due to (relatively) low crop returns and (relatively) high risk of crop failure, farming HHs have developed wide range of livelihood strategies to cope with large and unpredictable seasonal and inter-annual variations in water supply and crop production, including occasional crop failures. Some of their strategies, (P Lawrence and F.V. steenbergen, 2005):

- Cropping practices and patterns to cope with crop failure risk
- Diversification of household economy by depending on multiple sources of incomes, including:
- Livestock herding and wage labour and/or off-farm activities
- Labour migration and use of locally available natural resources
- Loans/credit and traditional mechanisms of solidarity and mutual assistance

4 RESULT AND DISCUSSION

4.1 Introduction

This chapter presents and discusses the main findings with regard to historical development aspects, flood water distribution systems, socio-economic and institutional set-up as well as operation and maintenance of Yandafero Konso lowland spate irrigation system focussing on the three major spate irrigation schemes (Oneya, Potota and Tarakoma). To start, however, the general description of the schemes and the flood water will be provided.

4.2 General description: - location, command areas and number of beneficiaries

There are few review documents that describes either conventional or other type of irrigation practice at Konso woreda. But, where and whenever possible, terraces are irrigated at Konso high lands. Runoff is redirected through care-fully constructed walls and channels. Stone canals and mud banks take water from rivers onto nearby fields. Though the exact beginning of the Yandafero spate system is unclear, the general opinion is that until recently the Yanda River was a shallow flood channel meandering over the alluvial plain, spreading water over a large area after the rains.

Since the alluvial soil was common at yanda plains and presence of enough moisture in the soil profile, the farmers' income from the agriculture was increased relative to the past (YFSS-IFS report, 2005-2008). This is the time of eye- opening for the farmers toward current present of development of Yandafero spate irrigation systems by different institution and migration of different farmers from high land of the Konso woreda where high number of population were settled to the fertile fields in the plains along the yanda river. For example, according to the YFSS IFS project report, in 1992 about 60 family heads, approximately 300 peoples settled in Yanda plains at once and started crop cultivation using traditional spate irrigation. The number increased constantly until recent time which is currently about 1800 HH⁷.

The Yandafero spate irrigation system layout contains three main parallel canals along the Yanda river body started from the West to the East: **Oneya, Potota and Tarakoma**, Figure 4-1. Each canal has its off take with its associated structures and irrigated lands. Each block has one main canal/primary canal with modernized diversion weir at head, secondary canals which are dichotomized from the main canals, then the tertiary canals which are known as *Korma Shaka* canals.

⁷ The household target to the three schemes of Yandafero spate irrigation system

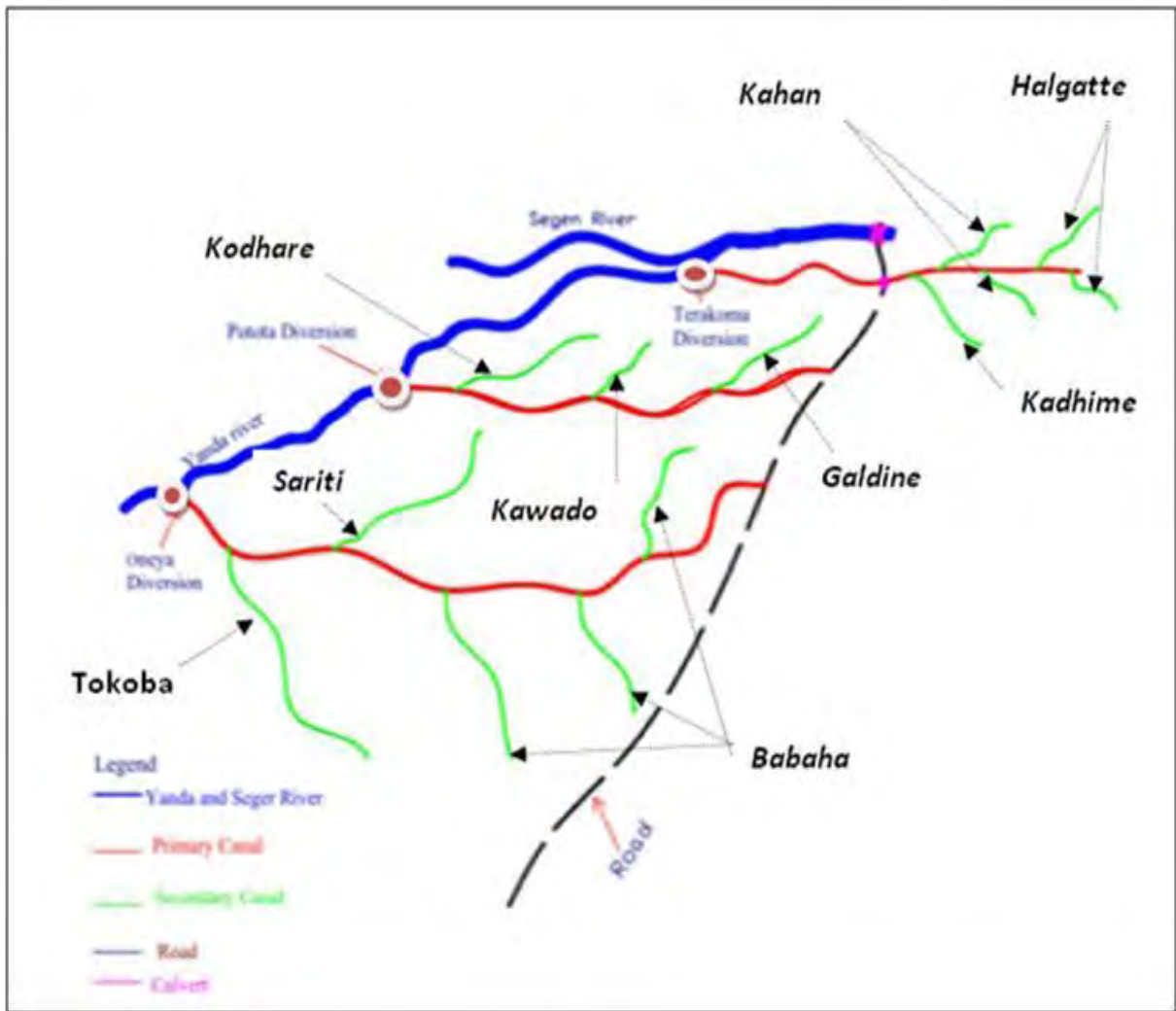


Figure 4-1 Layout of Yandafero spate irrigation system (own survey, 2013)

4.2.1 Location and dimension of diversion structures

Oneya scheme

The Oneya scheme is first in the Yandafero spate irrigation scheme and it is located in the west of the scheme, Figure 4-1. There is modernized diversion structure at the head work with different control structures, Figure 4-2. It is geographically located at 0343754 North of latitude and 0481874 UTM East of the longitude and altitude of 923-m a.l.s. The scheme is found approximately 25 km east of 'karat' the Konso town. It is found 3km toward north of the main road that passed to Guji zone of oromia region. It is constructed at up stream of Yanda Rivers with respective to other two diversion structure (figure 4-1).

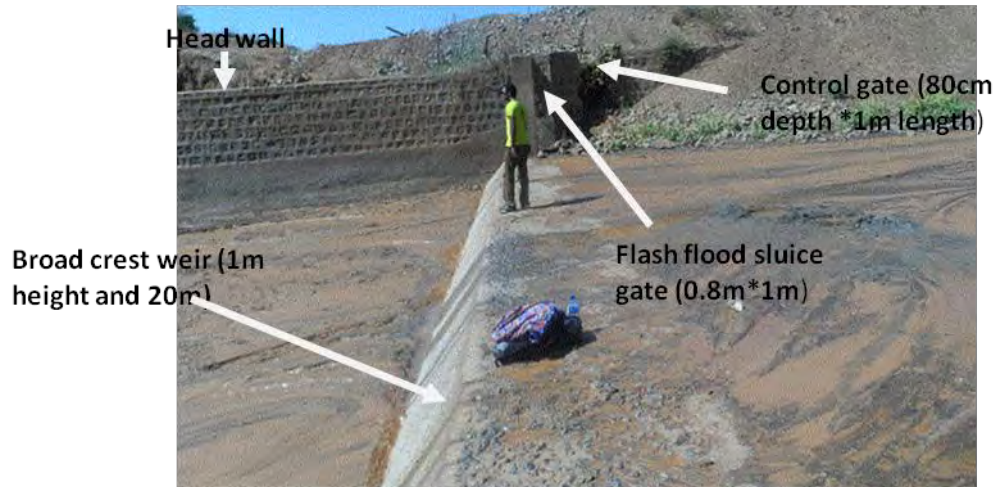


Figure 4-2 Oneya diversion structure of Yandafero spate irrigation, Konso, 2013

Like most spate irrigation systems in Ethiopia, there is no discharge data on Yanda River (where the Oneya diversion is built. However, according to Gizachow Toratio(irrigation expert and site engineer),the discharge was estimated by studying the historical background of the river and using floods marks at known locations. According to Gizachow, the designed capacity of the three intakes of primary canal is the same which is $1.25\text{m}^3/\text{s}$.

Potota scheme

Potota scheme is the second scheme at Yandafero spate irrigation system which possesses the Potota diversion structure constructed on Yanda River by projects of the EECMY-SWS in Konso wereda, particularly in Jarso kebel. The diversion is located at 0344373 E, 0591325 N UTM and 912 m a.s.l. The scheme is found approximately 30 km east of 'karat' the capital town of Konso and 4km of north of the main road that passed to Guji zone of Oromia region. It is constructed between the Oneya and Tarakoma diversion structure (Figure 4-1).However, according to the Gizachow Toraito (Site Engineer under YSSIFS project), it has been failed after only serving single flood season due to the dispute between the three dominant sub-villages (Kondhare, Kawado, Galdine) benefited from this scheme. The major causes are practicing of the new land development of upstream sub-villages (Kondhare and Kawdo) that result in the diversion of flood water to new lands. The illegal expansion of the boundaries of lands between kawdo and Galdine was also another cause for dispute.

But, during this study some discussions were started with communities and local government with facilitation of YFSS-IFS project to make functioning for the 2014 flood season.



Figure 4-3 Potota diversion structure (Gizachow T., 2013)

Tarakoma scheme

The Tarakoma scheme is the last block of Yandafero spate irrigation scheme (figure 4-1). It is located at downstream of the yanda river in Jarso Kebele. It is found approximately 35 km east of 'karat' the town of Konso woreda. It has the modernized diversion structure which is constructed at the head of its intake that located approximately 2.5 km of north of the main road that passed to Guji zone of oromia region. The geographically position of the head of diversion structure is 0343671 North of latitude and 0489365 East of the longitude at an altitude of 920m a.l.s on. The parts and dimension of diversion structure is shown in figure 4-4.

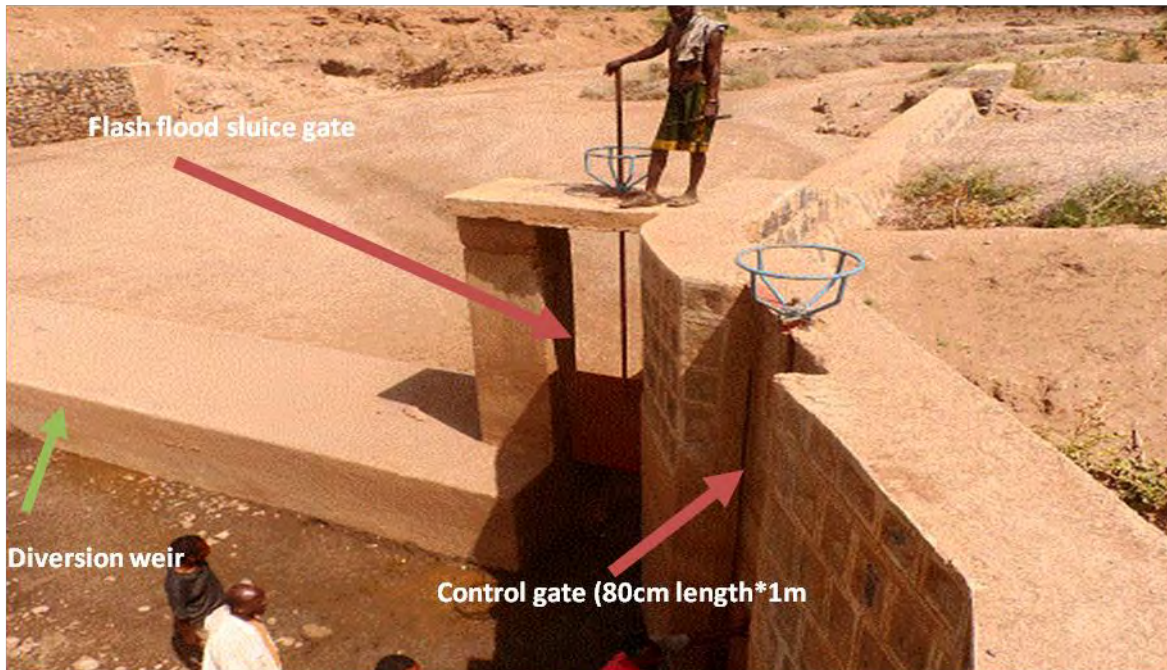


Figure 4-4 Tarakoma diversion structures

4.2.2 Irrigable area (command area) and number of beneficiaries in three blocks

It is indicated on layout (figure 4-1) as each block has the one main/primary canals with varies in length which branched into number of secondary canals, then tertiary/field canals. The Oneya scheme has 5 kilometre length of primary canals with 5 numbers of secondary canals. Similarly, in Potota, 7.3

kilometres of primary canals with 3 numbers of secondary canals and in Tarakoma, 1.3 kilometre length of primary canals with 5 numbers of secondary canals is found (Table 4-1).

Table 4-1: The Yandafero spate irrigation schemes, their canal network, command area and number of HHs beneficiaries

Name of scheme	Main and secondary Canals	Canal name	Length in Km	Total Command area(ha)	Total HHs beneficiary
Oneya	Main canal	Oneya	5	600	650
	Secondary Canals	Tokoba	2	158	
		Sariti	1.4	80	
		Babaha(3)	2.6	362	
Potota	Main canal	Potota	7.3	500	600
	Secondary canals	Kondhare	2	173	
		Kawado	2	159	
		Galdine	2	168	
Tarakoma	Main canal	Tarakoma	1.3	500	550
	Secondary canals	Kadhime	1.3	108	
		Kahanno(2)	2.4	187	
		Halgatte(2)	2.9	205	

Source: Data gathered during field survey and EECMY office, Konso, 2013

However, according to the discussion held with irrigation expert at Mekene Eyesus office and farmers, the number of secondary and tertiary canals would increased or decreased from flood season to season based on the amount of flood.

The proposed irrigable land from the three schemes was 1600 hectare and to benefits 1800 HHs (12,420 peoples⁸). However, currently only 1100 ha was irrigable land under Oneya and Tarakoma diversions and the left (500ha) is proposed to be irrigated from Potota diversion structure. The total command area and numbers of HH beneficiary in each scheme separately with secondary canals was indicated in table 4-1.

4.3 Historical profile and development phases of Yandafero spate irrigation system

A prerequisite for understanding the performance of current institutional arrangements toward management of Yandafero spate irrigation system is knowledge of the historical profile and developmental phases of spate irrigation in three schemes (Oneya, Potota and Tarakoma).

⁸ According to indicated by Nuri Kedir, (2006) in the Galunde Waketa Warotte MSc thesis(2009),the average family size of the study area was estimated 6.9

Though the exact starting time of the Yandafero spate irrigation systems is unclear, the general opinion shows that, for more than 30 years the farmers in the locality were using the flood water from the Yanda River for agricultural practice using traditional diversion structures (figure4-5). According to the hand sketched by Worku Karaffo(from Jarso kebele), there were 27 small intakes and canals from yanda river(appendix I)⁹. However, according to report of the consultant's visitors of Farm-africa (2000), the practice of this spate was not much productive and sustainable due to most of the intakes were demolished and the deepening of the bed of the Yanda River by about 3-4m. In the other side, the constraints of land in combination with rapid population growth forced the farmers to descend down to fertile Yanda plain.

These problems and related causes, like the occurrence of severe drought 1999/2000¹⁰ brought the mind of food aid governmental and non-governmental organization toward the developments of Yandafero spate irrigation system.

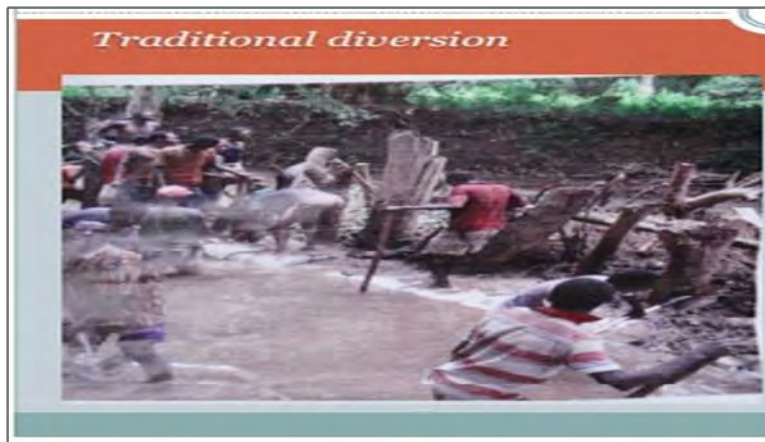


Figure 4-5: Traditional diversion structure at Yandafero Spate Irrigation (Galunde Waketa, 2009).

Through intensive literature reviewed and present conditions, two developmental phases were assessed to understand the general developmental activities toward Yandafero spate irrigation system. The first phase is the period when developmental organizations (farm-Africa, LWF and KDA) only identify the problems of Yandafero spate irrigation systems and proposed different mitigation and remains with supporting the spate communities through food aid (before 2005) while the second phase is active involvements of the current project called Yandafero Segen Sewet Integrated Food Security (YFSSIFS) under EECMY/SWS with construction of the current modern diversion structure of spate water in Konso woreda including in Jarso kebel (after 2005) till present.

4.3.1 Development and Management Activities in Yandafero-Spate Irrigation before 2005

According to Farm Africa (2000), the most pressing needs for assistance on Yandafero scheme includes redress the severe problems of erosion of the river bed to bring previously irrigated areas back to command, improvements to the existing spate irrigation intakes, possible improvement to primary diversion channels and providing improved river bank protection. Based on this, different option was developed by developmental organization like Farm-Africa, LWF and KDA together.

The construction of check dam in the river some distance downstream of Yanda River, building storage dams and construction of two spate diversion head work were the options proposed to protect the yanda river bed. Those all options was failed due lack of filled materials/borrowing from the upstream area of land adjacent to the site that did not check its suitability and scarcity of fund.

⁹ FARME-AFRICA Technical report,2000

¹⁰ FARME-AFRICA and KDA, 2000 review methodology of spate irrigation in Konso

To improve the spate irrigation intakes of Yandafero, the Farm-Africa proposed as the boulders would have to be imported to sites for gabion or rock-fill structures and masonry and concert structures would required with greater degree of technical assistance and supervision. This proposal was left without implemented due to its expensive in relation to the relatively small areas commanded by each intake and none would be easily sustainable by the farmers, without some outside assistance. The Farm-Africa, (2000) also proposed two ways in which the river bank erosion controlled. The first option was using boulders and gabions. This is through importing both the gabion and the boulders to the lower yanda river. The use of vegetation at the river bank was proposed as the second option.

However, the implementation of proposed option was failed due to different factors like, insufficient financial, weak organizational capacity, educated human resource, reflection of diversified interest from participant (Governmental organization, NGO communities) on system design and knowledge, attitude and skill about spate irrigation.

According to discussion held with KDA office Chairman (Kefle, 2013), since all proposed improvement were not implemented, the farmers continued using traditional spate irrigation with fixed crop species (mainly sorghum and cotton). Therefore, the target communities (Jarso kebele), continued supported by food aid. For example, according to reported by seft-net programme of zone office, October, 1999- May, 2000, the Jarso kebele was get 8671.05 Quintals from food aid.

4.3.2 Development and Management Activities in Yandafero Spate Irrigation System (2005-2013)

Even though different factors blocked the implementation of proposed improvement of Yandafero spate irrigation scheme, it was understood and believed among the different organization that, as the only best way of solving the food insecurity of the target communities (JPA) making the lowland productive through flood farming. Therefore, different organizations continued to support by learning varies lessons of the past operation and maintenance made on the Yandafero spate irrigation and other aspects.

Therefore, the Yandafero Segon Sawate Food Security Project (YFSSFS) project was developed in 2005 under the implementation of EECMY-DASSC/SWS¹¹ in Jarso kebele with identified major physical plans such as irrigation schemes construction, agricultural inputs supply (improved crop and vegetable seeds, and fruit seedlings), beneficiary capacity building trainings and preventive health (impregnated mosquito nets provision) etc. According to the discussion held with the YSSIFS project manager Mr Toriato Kustio (2013), then, the project started its first phase funding the construction of modern diversion structures at Segen River and simultinesly performing different rural development activities like agricultural extension, afforestation, health education and provision of portable water as preliminary work for the construction spate irrigation schemes in Jarso kebel(Yandafero). The detail description of the three schemes of Yandafero spate irrigation was described in table 4-1. In each scheme, the modernized diversion structure was constructed in different years by the YFSSIFS project. Table 4-2 describes the modernized diversion structures constructed under three schemes of yandefor spate irrigation system.

¹¹ EECMY-SWS- Ethiopian Evangelical Church Mekena Yesus: is a faith based organization with development and social service (DASSC) wing in its organizational structure, commissioned for development work in the country, particularly in Jarso Kebele, Konso by developing YFSSIF project

Table 4-2 Three modern diversion structures and their years of construction, design capacity and expended budget on Yanda River

S/no	Diversion name	Year of construction	Design capacity(m ³ /s)	Allocated budget(ET-birr)	Remark
1	ONEYA	2010	1.25	1884477.7	Completed and on service
2	POTOTA	2011	1.25	2430723.6	completed
3	TARAKOMA	2012	1.25	2624351.0	Completed and on service

Source: YFSS-IFS project of EECMY/SWS/ annual report 2013

According to 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 1600 hectare of land.

All head works are constructed from concrete with combination of gabion to minimize cost has been invested. However, it is problematic unless the stability of soil along the river bank and strengthens of the gabion to resist the high flood is insured. (Figure 4-6). Based on the placed structural facilities, the project engineer believes that the schemes will function for nearly twenty years. Nonetheless, it could be argued that the life span of the schemes will depend on two main things: first, the type of institutions established and the extent of their capacities built and second, the extent of irrigation scheme users' capacities built to manage the irrigation structures.



Figure 4-6 Destroyed gabion at Oneya diversion head work, 2013

4.3.3 Role and Responsibilities of Key Stakeholders on Managements of spate irrigation system after the modernization of the diversion weir

Even though the EECMY/DASSC is front line stakeholders in the development and management of current Yandafero spate irrigation system, there are also a lot of mandates given to the local governmental organization in favour of imperative for successful functioning of irrigation schemes and contribute for

sustainable management and operational performance of modernized spate scheme at Yandafero. The detail of key stakeholders and their responsibility indicated in table 4-3

Table 4-3 The role and responsibilities of Key stakeholders at Yandafero spate irrigation system

Governmental Sectors	Role and responsible
Woreda Administration office	<ul style="list-style-type: none"> -Coordinate Woreda level and other offices relevant to the work to insure full participation in providing infrastructure for spate irrigation communities - Closely controls Kebele council on fulfilment of their responsibility regarding the spate water managements. - Provides necessary administrative support in scheme managements
Woreda Office of Agriculture and Rural development	<ul style="list-style-type: none"> - Provide support in extension service and crop development - Capacity building and advice for irrigation communities - Solve dispute related with land distribution and Scheme Administration
Woreda Water Resources and Mining office	<ul style="list-style-type: none"> - Coordinate, develop and give technical assistance for proper O and M of the spate schemes - Advice on the engineering and proper headwork repair - Provide the portable water for spate communities
Woreda Cooperatives Promotion Office	<ul style="list-style-type: none"> - Formation of cooperative, - Provide the certificate of legality for Farmer organization/IWUC at spate irrigation with designed by laws, internal regulation - Prepared necessary training to build the capacity of IWUC on financial managements - Provide the market facilities and promote input/out marketing
Woreda Health Office	<ul style="list-style-type: none"> - malaria prevention at spate communities - Awareness creation on family planning and HIV/AIDS for spate communities
Woreda Women's and children's affairs	<ul style="list-style-type: none"> - Coordinate gender involvement/participation in spate irrigation scheme
Woreda credit and saving office	<ul style="list-style-type: none"> - provide credit service for the farmers - Develop the saving habit of the farmers through training. - Monitoring the farmers in order to pay back their loans on time

4.4 Flood water distribution systems

At Yandafero spate irrigation, the spate flow is distributed through a well-laid network canals (Figure 4-1 and Table 4-1)). As flood water come, the whole amount of water was diverted based on the design capacity of intake ($1.25\text{m}^3/\text{s}$) to main canal through gated intake. Then, the amount of flood water left from the first intake was passed to the next diversion intake and the process is repeated (firstly Oneya intake, then Potota followed by Tarakoma). After, spate water is diverted, then it flow along long narrow hand dung canals (primary canal) and divides in to the secondary canals, then field canals (Figure 4-8). There is only single improved (Sariti¹²) and many traditional division structures at secondary canals (Figure 4-7). The simple earthen bunds and locally available materials like brush wood used to divert water from a canal to groups of fields.



Figure 4-7 Traditional (left) and improved (right) flood flow division structure at Oneya scheme, 2013



Figure 4-8 Field canal and flood water flow through secondary in Oneya scheme

From the interviews and personal observation during the field visited, field to field water distribution is common at field level of yanadefor spate irrigation system. The majority of portion of the command area was flat landscape (approximately 75%)¹³, which was good for field-to-field flood water distribution system. The way of irrigation is that, filling the first soil bund (65-70cm field bund height) with full of flood and close its itrance and then pass to the next bund. Repeating the same practice until the whole farm field irrigated.

¹² Sariti is one of name secondary canal located at Oneya scheme

¹³ It is according to Galunde Waketa, (2009) presented in his thesis work



Figure 4-9 Prepared Field bunds at Tarakoma scheme and irrigated fields

In field-to-field irrigation, there is no tertiary canal. When the upstream field of the group command by the canal bund is irrigated, water is released by breached in the downstream field bund to release water to the next field. This process is repeated until all the fields in command have been irrigated. If the spate continues after all fields have been irrigated, the canal bund is then broken and the process is repeated at a bund constructed further down the canal.

4.5 Socio-economic aspects at the study area

An understanding of the socio- economic circumstances of spate farmers and the coping strategies that they adopt is necessary if effective and sustainable improvements to spate irrigation systems. Generally, according to Olaf Verheijen, 2013, spate irrigation communities of different countries like Yemen, Pakistan, Eritrea and Ethiopia have developed a range of livelihood strategies to cope with the large and unpredictable seasonal and variation between annual in water supply and cropping production inherent. Livelihood and coping strategies adapted by farmers vary within and between schemes, regions, cultures and countries. More detail information about this is indicated by Verheijen, 2013.

At Yandafero- Konso lowlands of spate irrigation area, the farmers practicing different coping strategies of livelihood like cropping practices and pattern to cope with crop failure risk, diversification of household economics by depending on multiple source of incomes including livestock keeping, bee keeping, off-farm activities, use of locally available natural resource as food and traditional mechanic of solidarity and mutual assistance are the common. The detail of socio-economic behaviours' of the study area was described in the next section.

4.5.1 Land Tenure

At Yandafero-spate irrigation, spate water is either used by share cropper, tenants or land owners. Mostly, at each scheme of spate irrigation water is used by landowners. According HHs survey, approximately 100% of spate irrigated land was cultivated by land owners at Tarakoma and Potota scheme. In Oneya scheme 87 % of spate irrigated land was cultivated by land owners while 9 % and 4% cultivated by sharecropper and tenants respectively. The tenants or share cropper is practiced when landowners are incapable to cultivated due to old age, too ill, not offered seed crop to growth themselves, when they do not owned draft animals to repair and construct soil bunds or they are no resident locally.

In Ethiopia, the agricultural land is owned by government. However, the individuals land right are formally recognized and registered in government-administered cadastral records. But, this system not fully completed especially with regard to pastoralist and semi- pastoralist and arid areas of the country. The study area is also one of the areas that cadastral record not performed yet.

In Yandafero spate irrigation, the distribution of irrigable land within the schemes varies from relatively egalitarian to highly skewed. Historically, small number of HHs (less than 30 HHS) migrated from

highlands to low land of yanda plain where the agricultural land was free and started cultivation. Then gradually the number of HHs increase to 60 HHs in 1992¹⁴ and currently almost nearest to 1800HHs is benefited from Yandafero spate irrigation system under three schemes (Oneya, Potot and Tarakom). Therefore, the first arrived farmers (Jarso communities) occupied land in the favoured nearest to the Yanda River for easily access to water for their crop production by traditional system. As it is described in the section 4-3, since the traditional diversion of spate water was not sustained, the modernization of the diversion structures were takes place. Then, the farmers agreed to have fixed land size to be irrigated from modernized diversion of spate flow. Based on this, without taking and transferring the initial land to the other, they only decided the size of irrigable land under spate water. Table 4-4shows the land holding size and number of plot possessed by farmer under irrigation.

Table 4-4 Size of land holding under three schemes of Yandafero spate irrigation system

Scheme	Size of land holding	Average of number of plots farmer hold.	Total size of land holding under spate irrigation(ha)/farmer
Oneya	50m*50m	3	0.75
Potota	40m*40m	4	0.64
Tarakoma	35*35m	4	0.49

The size of land holding becomes decreasing from one scheme to other according to their time of construction. That means, the farmers under the first construct scheme (Oneya), get larger irrigable land than under the next constructed diversion Potota and then Tarakoma. This is expecting to accommodate the increased number of farmers with equal distribution of land. Therefore, the average land holding on Oneya, Tarakoma and Potota scheme are 0.75, 0.64 and 0.49 hectare respectively. However, to cope with different probabilities of receiving spate water, it is common in Yandafero spate irrigation systems for the framer possess plot of lands from 3-4 different place, with high and low probabilities of irrigation. This means at least, at low spate flow the farmers have the opportunity to irrigate his/her one of plot.

4.5.2 Net Annual Income at Yandafero- Konso Lowland Spate Irrigation System

There are several ways to identify income levels including surveys. However, experiences show that people are usually unwilling to give genuine information on the level of their income and this has been proved during the sample household survey when the annual productivity and land holding are not correlated.

The main, almost lonely incomes source of the people is mixed agriculture, crop and livestock production. According to the data from the Konso woreda finance and economic development (KWFED) and from the result of discussion held with farmers, the estimated net annual household's income at Yandafero-Konso lowland of spate irrigated area varies from year to year. Especially, before 20 years the households incomes of the farmers were very low, which is the average income per capita of the farmers was less than 15 Ethiopian Birr (ETB) per day.

According to the responses of the surveyed HHs, all have started producing twice in a year which was not the case before the intervention of project on spate irrigation management. About 54 percent of the sample HHs stated that use of spate irrigation is the main factor for twice harvesting whereas others reported the combination of factors like rainfall, malaria control and agricultural extension service in addition to spate irrigation in which still the use of spate irrigation is heavily underlined(Table 4-5)

¹⁴ It is according to indicated in the report of Yandafero Segen Sawat Integrated Food project 2005-2008

Table 4-5 Factors for twice harvesting

Factors enabling for twice growing/harvest	No. of HHs responded	Percent
Use of spate irrigation	97	53.9
Sufficient rain and use of spate irrigation	5	2.8
Use of spate irrigation and malaria control	13	7.2
Use of spate irrigation and agricultural extension services	65	36.1
Total	180	100

Source: Computed from HH survey in January, 2013

However, after the improvement of spate irrigation system through active implementation of Yandafero Segen Sawate Integrated Food Security Project (YFSS IFSP) by EECMY-SW, the income of farmers at Yandafero spate irrigation started to increase. The change of agricultural production before and after the active involvement of YFSS-IFSP is discussed in section 4-10. Besides to flood agricultural practice, livestock keeping and bee keeping have also great contribution to increase incomes of the farmers. Therefore, according to the information from developmental agent reports of Jarso kebele, the current HH average net annual revenue of Yandafero spate community is 39,256 Ethiopia Birr (2181USD\$¹⁵) in which 18042 Ethiopian Birr (ETB) in Oneya, 5719 in Potota and 15495 ETB in Tarakoma scheme. Tables 4-6 show the house hold net annual revenue of the of Yandafero spate irrigation relative to three other spate countries.

¹⁵ 1 USD \$ is taken as 18 Ethiopian Birr(ETB) in Decemebre,2013

Table 4-6: Net Annual Revenue from spate irrigation of different countries

Country	Scheme	Household annual revenue from irrigation area	net revenue spate US\$	Note
Eritrea	Sheeb	355		Further US\$165 from livestock products giving income of US\$520 in a “good” year.
Pakistan	Toiwar	300		Two thirds from crop production and one third from livestock
Yemen	Shabwah Governerate	412		Increases to between US\$765 to US\$1,000 for households with access to pump irrigation
Ethiopia	Yandafero spate irrigation	2181¹⁶		It is the total incomes under three schemes(Oneya, Potota and Tarakoma): about 47.8% from crop production, 26.2% from livestock herding and 26% from bee keeping

Source: Guidelines on spate irrigation (Abraham M. et al, 2010, page 13)

4.5.3 Coping Strategies in Yandafero-Spate-Irrigated Area

With low crop returns even in good years and the possibility of crop failures always in the background, spate-irrigated agriculture makes a precarious living. Even though the agriculture field was prepared very well for intercepting of flood, there was the condition of no spate water or insufficient to inundate the fields. For example, see figure 4-10 at the Potota scheme.



Figure 4-10 Crop failure due to insufficient water at Potota scheme, 2013

Intra-community based coping strategy:

Konso community in general and Jarso in particular have their own way of coping during drought induced hazards. Intra-community based strategy is an established tradition of Jarso community that has been

¹⁶ It is the current annual average household income at Yandafero spate irrigation system

coordinated and facilitated by nominated village leaders and elders. This tradition is considered as a first step to rescue the victims before external intervention starts. Very important point to make here is that food security is not only material but also societal. The deep rooted tradition of Jarso community is a power full societal asset that is used as an instrument to identify locally available food resources under individuals' disposal and distributes it to severely affected households. This could be termed as community social security and a local capability to offset risks over individuals in the community.

Individual strategies:

Farming households adopt a number of livelihood strategies to cope with these uncertainties. The most common is the diversification of the household economy; households in spate-irrigated areas generally depend on multiple sources of income. The co-existence of livestock herding and spate irrigation is almost universal. In the study area, livestock herding and bee keeping are common. See Figure 4-11,



Figure 4-11: Livestock herding at Yanadafero spate irrigation area, 2013

The other strategies include; saving surplus grains from one year to the next, investing in easily disposable property, such as livestock and draft animals in particular, in good years when there is crop surplus. Wage labour and off-farm activities provide additional household income. Locally available natural resources are widely exploited. The best example is intensively used as the food support aid Yandafero spate irrigation is traditional cabbage.



Figure 4-12: The traditional Cabbage tree grows within the villages.

A failed flood season often triggers substantial migration of able-bodied male family members, in search of labour. Following a poor season, money is borrowed from other family members and or kin/community transfers (gift), or local money lenders to purchase additional food items, or to obtain seeds for the next cropping season. Traditional mechanisms of solidarity and mutual assistance play an important role in the local communities.

Therefore, according to HHs survey at Yandafero spate irrigation community, overwhelming majority (97.2 percent) of respondents has reported that they adopted combination of different categories of coping strategies. Only 2.8 percent respondents reported for adopting a single coping strategy. (Appendix C)

4.6 Institutional setup and operation and maintenance strategies and practices in Yandafero spate irrigation system

Conceptual framework in figure 2-2 is used to analyze the existing institutional arrangements of management of the spate water in Yandafero-Konso lowland. The framework has enabled the research to depth describe the existing organizational components, the institutional environments and existing spate water law in the study area. It also enabled to identify the weakness and strengths of existing institutional structure through selecting five principles for performance evaluation. These principles includes: minimum recognition of right to organized, O and M of the spate infrastructure, conflict resolution mechanism, water sharing (rights and allocation) and credit and loan facilities were discussed in this chapter. In this chapter, the impact of institutional performance on agricultural productivity in Yandafero-Konso lowland spate irrigation system is also discussed. To formulate practical recommendation, the evaluation of institutional performance was made in three schemes of YSIS (Oneya, Potota and Tarakoma).

The Yandafero spate irrigation system was under community management with external support of EECMY-SWS NGO¹⁷. The majority of the operation and maintenance of the scheme was performed by community by organizing themselves at different level of scheme. Especially, the farmers are strongly responsible for the clearing of the sediment from the primary canals (locally called '*kaba*'¹⁸), secondary canals (called '*Korma Kuta*') and preparation of field bunds. The maintenance of the head work including the retaining wall at each diversion structure and improved division box was performed through supports of EECMY-SWS project. The project was also give continuous technically supportive for the communities during excavation of primary and secondary canals particularly on the adjustment of slope of the canals and direction of the canals.

The farmers on the study sites, especially Oneya and Tarakoma, were organized for the collective O & M of the irrigation systems. Then, Irrigation Water Users Cooperative (IWUC) was established with the consultation of Woreda Cooperative Promotion Agency (WCPA) and Developmental agents (DA). However; it is only formal and drafted written document on rule and regulation of the water user cooperative in Oneya scheme. Even though the informal IWUC was established in Tarakoma scheme, and not recognized as cooperative by the WCPO. This is due to the failed to draft the internal rule and regulation of the cooperative and make to be had to the WCPO for approval. But, currently they practiced the rule and regulation of O and M activities through oral/mouth. At present time, there are no organized farmers for O and M of spate irrigation system in Potota scheme. However, there were informal farmers organization called Potota Water User only exists for single flood season.

The numbers and way of IWUC established was varies among three scheme of Yandafero spate irrigation. Only three recognized IWUC established at Oneya and one informal IWUC at Tarakoma. In Oneya, the IWUC established at three different positions along the primary canal of Oneya diversion. These are: *Orshale IWUC (upper stream)*, *Kondo IWUC (middle)* and *Geldaha IWUC (downstream)*. However, in Tarakoma, the single IWUC is only established at diversion headwork.

4.6.1 Function and Structure of IWUC

In the Yandafero-Konso lowland of spate irrigation system, the farmers formed own organisations in response to need for collective labour and collective water management. The existing IWUC are established based on the initiation and will of the community members using spate water from the same diversion weir. The members of the committee are selected democratically by involving the beneficiaries' communities. Here below is the detail description of structures and function of farmers' organization.

¹⁷ EECMY-SWS is a faith based organization with development and social service (DASSC) wing in its organizational structure, commissioned for development work in the country, particularly in Jarso Kebele, Konso by developing YFSSIF project

¹⁸ The 'Kaba' and 'Korma kuta' are the local name for Primary canal and Secondary canal respectively

General Assemble (at Oneya)

Formed by all IWUC leaders at three levels of primary canal and additional three persons whose is the member of the executive body at respective levels (upper, middle and lower) of the main canal. The committee have six (6) executive members. Those are chairman, vice chairman, secretary, auditor, treasury and member. The chairman was elected by the general assemble in mediator of developmental agent in kebele.

The main responsibilities

- ✚ Decide when construction and clearing sediment of collective diversion structure in the riverbed will starts
- ✚ Maintain relations with local administration and non-governmental organization like EECMY-SWS
- ✚ Decide the start of planting season
- ✚ Supervises the layout and position of the traditional secondary canals
- ✚ Assign who operate the gate at diversion weir
- ✚ Keeps watch during the spate season and communicate with 3 IWUC at *Orshale, Kondo and Geldaha* and randomly contact individual field owners.

Irrigation Water Use Cooperative at Primary Canals (Kaba)

Similar organization of General Assemble at head, the WUC at primary canal was composed of six (6) executive members (chairman, vice chairman, secretary, auditor, treasury and member). This is formed by all leaders of farmers' group at respective primary canal levels. The chairman was selected democratically by vote of all the members in the mediator of person from executive members of IWUC established at the head/diversion.

Main responsibilities:

- ✚ Keeps contact with farmers' group
- ✚ Decides when the excavation and clearing of main canals will start jointly with the other WUC on the same main canal
- ✚ Solve the conflict related to spate water using, if it is beyond the capacity of the farmers' group leaders
- ✚ Approved the letters of farmers to be the members of spate water use after get acceptance by farmers' group
- ✚ Helps as the bridge between the farmers' group and executive body organized at the diversion level.

Farmers' Group

Formed per secondary canals (*korma kuta*) and consists about 4 farmers' sub-group. The executives' body was elected from the farmers' sub-groups.

Main responsibilities:

- ✚ Mobilising and supervising labour for maintenance works at secondary level
- ✚ Checking if all fields receives irrigation water
- ✚ Decide which particular plot of land has the first right to receive water when the next flood comes
- ✚ Assessing amount of labour required to carry out maintenance work jointly with WUC at the main canal.

- ✚ Conveying information and directives from IWUC to farmers' sub-group leaders and individual farmers
- ✚ Preparing written or oral reports about works under taken to be submitted to IWUC of main canal
- ✚ Settles any dispute among farmers' sub-group and reports violations
- ✚ Enforce water distribution rules and supervised water distribution

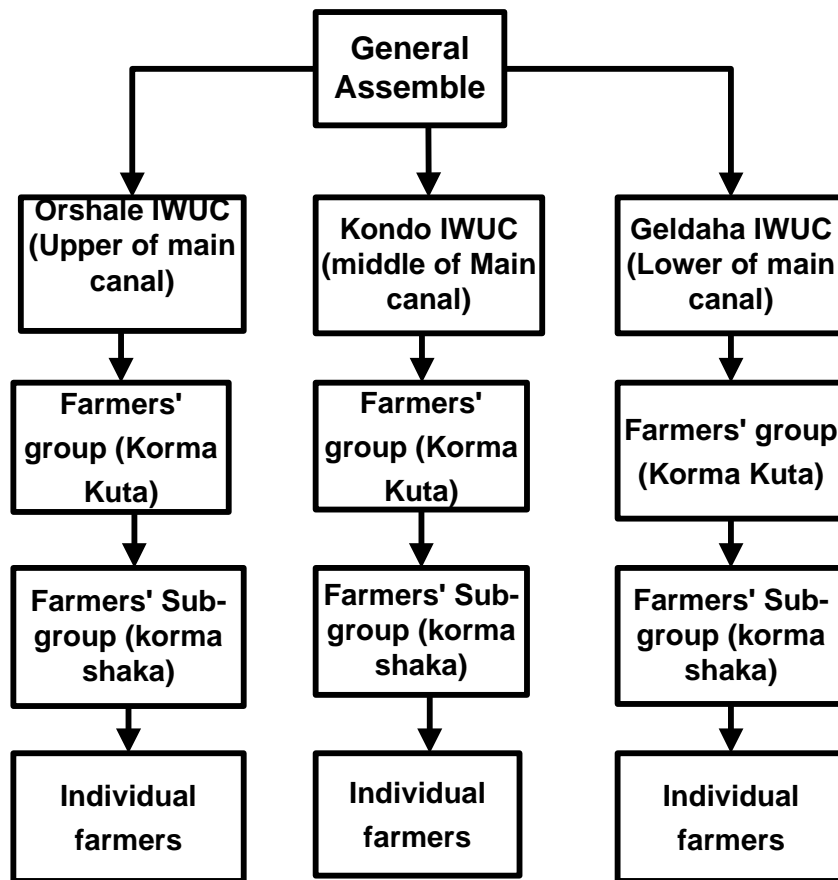
Farmers' Sub-group

It is formed based on the tertiary/field canals (*Korma Shaka*), according to their farm plots neighbours' to each other. The organization consist about 32-62 households. The leader was selected through all participation of the farmers who's involved in one sub-group.

Responsibilities

- ✚ Monitoring progress of field bunding
- ✚ Implementing rules for management of flood water
- ✚ Securing water delivery to branch canals where his sub-group is located
- ✚ Imposed fines on those who waste or steal water from adjacent fields
- ✚ Mobilizing the large teams of farmers to work on the cleaning sediment and excavation of main structure and branch canals

Figure 4-13 Farmer's Organizational structure in Oneya scheme, of YSIS



Source: survey result, 2013

Similar to the IWUC at oneya scheme, in Tarakoma possessed six executive members: chairman, Vice chairman, Secretary, Auditor, treasury and Member those elected in a democratic way by involving the whole farmers in meeting who's used the spate water under the diversion. The chairman was directly voted by the general assembly. According to the discussion held with community members and developmental agent, the criteria they used to select the chairman and other executive members are personal integrity, social acceptability and fairness in their administration. Currently, it consist 41 farmers' sub-groups. According to the written internal rule and regulation of the Oneya IWUC (which is drafted and codified in September 22,2012(figure 4-23) and the discussion held with key informant executive members of the Tarakoma IWUC, do not received any kind of the payments for their service.

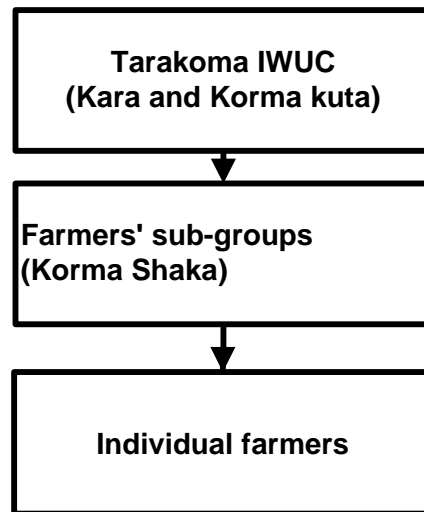
Responsibilities of the Tarakoma IWUC at head

The main responsibilities of the IWUC at Tarakoma spate irrigation systems were, sequencing of the flood water allocation and distributions, coordinate the operation and maintenance of irrigation infrastructures, resolving conflict between sub-groups of farmers, enforcing regulation procedures and punish offenders including coordinating in the construction of main canal and secondary canals/bunds.

As it shown on the figure.4-14 the farmers' sub-groups are established mainly to manage the spate flood water at tertiary/field level (*Korma Shaka*¹⁹). Their responsibilities were almost similar to the farmers' sub-group of the oneya spate irrigation system. It is composed of 12-18 households.

¹⁹ Korma Shaka is the local name for tertiary canal

Figure 4-14 Farmer's Organizational structural at Tarakoma scheme, YSIS



Source: survey results, 2013

4.7 Performance Evaluation of institutional arrangement in three schemes of Yandafero- spate irrigation Management

The practicality of spate water systems is mostly determined by the strength of the organizational structures involved in their operation and maintenance of spate irrigation systems. After intensive literature review, five principles were selected for evaluation performance of the existing institutional arrangements of Yandafero spate irrigation. These are minimum recognition of right to organized, O and M of the spate infrastructure, conflict resolution mechanism, water sharing (rights and allocation) and credit and loan facilities.

The recognition of right to organized for collective action is the major aspect for efficient performance of spate irrigation system. The main advantages of getting recognition of the farmers to organized on spate water use is make them sense of ownership on the scheme and they get acceptance on any support they asked in group. However, at Yandafero spate irrigation system only three IWUC get recognition at Oneya scheme (see Table 4-7).

Table 4-7 The proposed and established IWUC at Yandafero Spate Irrigation

Name of the Scheme	No. of proposed IWUC	No. of Established IWUC	Remark
Oneya	3	3	
Potota	3	0	
Tarakoma	3	0	There is one informal IWUC performing the activities of O and M
Total	9	3	

Source: Woreda Cooperative Promotion office (Shimelis A. and Wagayo Asres, 2013)

Table 4-7 shows that out of the 9 IWUC proposed only 3 was getting the recognition from the Woreda Cooperative Promotion Office (WCPO).

The other performance evaluation of the existing the institutional arrangements toward spate water managements was described below.

4.7.1 Operation and maintenance of Spate irrigation infrastructure

The operation and maintenance activities are fully responsibilities of the beneficiary farmers with the external support of EECMY-SWS organization. Seasonally, the spate irrigation systems are rehabilitated and all maintenance work is carried before the arrival of the rainy season. Generally at Oneya and Tarakoma schemes, the operation and maintenance work is organized through IWUC. During the operation and maintenance work the beneficiary communities rehabilitate all the commune structures. The rehabilitated structures include the diversion weir (head work), primary (*kara*) and the secondary canals (*korma Kuta*) by share labour (Figure 4-15). This is also true in the case of presence of tertiary canals.



Figure 4-15 Removal of the sediment from the primary canal at Tarakoma scheme, 2013

For the purpose of eased management, the Oneya IWUC organized the farmers' at main canal, at secondary canals and at tertiary/field canals (refer section 4.6 and 4.6.1). In Tarakoma, the informal IWUC have the responsibilities to organize the farmers sub-group for sharing of spate water and mobilize labour and materials for regular and emergency operation and maintenances activities under respective groups. However, in Potota scheme since there are no clearly organizational structures and responsibilities

of farmers; it creates the complexity of spate water management. However, managing field bund of each pilot is responsibility of the individual farmers (Figure 4-16).



Figure 4-16 Soil bund maintenance at Oneya scheme of Yandafero spate irrigation, 2013

Table 4-8 Frequency of farmers participation in Maintenance activities in a rainy season in three scheme of YSIS from sampled farmers

Scheme Name	Frequency of Farmers participation on Maintenance of activities	Frequency of response							
		Main canal(including head work)	Percent	Secondary canals(Korma Kuta)	Percent	Tertiary/field canals	Percent	Average	Percent
Oneya	1-3 times	33	50.8	2	3.1	0	0	11.7	18
	4-6times	12	18.5	16	24.6	24	36.9	17.3	27
	>7times	20	30.8	47	72.3	41	63.1	36.0	55
	never	0	0.0	0	0.0	0	0.0	0.0	0
	Total	65	100.0	65	100	65	100	65	100
Tarakoma	1-3 times	8	14.5	8	14.5	2	3.6	6	10.9
	4-6times	25	45.5	25	45.5	16	29.1	22.0	40.0
	>7times	22	40.0	22	40.0	37	67.3	27.0	49.1
	never	0	0.0	0	0.0	0	0.0	0	0.0
	Total	55	100.0	55	100	55	100	55	100
Potota	1-3 times	8	13.3	8	13.3	8	13.3	8.0	13.3
	4-6times	0	0.0	0	0.0	5	8.3	1.7	2.8
	>7times	0	0.0	0	0.0	0	0.0	0	0
	never	52	86.7	52	86.7	47	78.3	50.3	83.9
	Total	60	100	60	100	60	100	60	100

As shown on the Table 4-8, the frequency and type of O and M activities vary significantly among the three schemes. In Oneya scheme 55% of the sampled farmers were responded that as they are engaged with operation and maintenance of infrastructure greater than 7 times during the rainy season where as 18% and 27 % responds 1-3 times and 4-6 times respectively. These operation and maintenance activities at the main canals and diversion weir are mostly focused on the clearing of sedimentation from gate, weir, flood flash gate, and hand dug primary canal. The excavation of the secondary canals, construction of the field bund and keeping the slope at secondary and tertiary canals (locally called *Korma kuta and korma shaka levels*) are also performed. According to the farmers' respond of Oneya, they are more engaged with O and M activities at the secondary and tertiary canals than that of the primary canal.

From Table 4-8, we understood that, in Tarakoma scheme 49.1% and 40% of the respondent replied as the farmers engaged with operation and maintenance of the infrastructure greater than 7 times and 4-6 times respectively. The more frequency of O and M activities were takes place on the primary canal and at diversion weir as compared to that of Oneya and Potota scheme. The major activities performed in this scheme were removal of the sediments from the primary canal; branch canals, flood flash gate and diversion weir. They are also engaged with excavation of the newly branch canals and tertiary/field canals if extension is necessary. The Figure 4-17 is the extension of the canals visualized during the field visited.



Figure 4-17 The engagement of farmers with extension of primary canal at Tarakoma scheme, 2013

The other activity farmers involved at Tarakoma is preparing a small pond in the wadi at the some distance of upstream of diversion structure (Figure 4-18). These small ponds are prepared for two purposes. The first one is to harvest the water for livestock water drinking for further after the flood is passed. The other advantage is to trap the sediment cried my flood and reduces sediment entered to the intake of main canals.



Figure 4-18 The small pond in side of the wadi for harvesting water for livestock in Tarakoma diversion, 2013

It is indicated that in Table 4-8, only 13.3% of sampled farmers respond as they are engaged with O and M activities 1-3 times and 84% of the sampled farmers' replied as they are never participated in O and M activities. This is due to the absence of formal farmers' organization that mobilize them for O and M, and some of the farmers join at Oneya and Tarakoma scheme and also the dispute among sub-villages are the major reason for current poor participation toward O and M of the scheme. It is mentioned during the discussion as some upstream farmers diverted high amount of spate flow and irrigated the large land size beyond the allowable size (0.64ha) for spate irrigation which prohibited the downstream (Kawado and Galdine sub villages) farmers receiving appropriate flood water.

According to the discussion held with YFSS IFSP manager Torayto k. and irrigation engineer Gizachow T., the Potota scheme was failed after serving only single flood season due to disagreement between the upstream and downstream of the system.

Theoretically the arrangements and organization of the farmers and also frequency of participation of farmers in O and M of irrigation infrastructures seem to be good in Oneya and Tarakoma schemes. However, different problems were visualized during field visited on the flood flash gate, diversion weir and headwork at Oneya. Due to high accumulation of the sediment around the intake of primary canal and change of the bed level, the necessary amount flood water is unable to flow through it. There is also high accumulation of sedimentation above the flood flash gate. As the results of this, the flood flash closed and becomes functionless (See Figure 4-19).



Figure 4-19 The destructed gate and high accumulation of sediment on the diversion weir at Oneya diversion structure

The headwork of the diversion also destructed and back scouring of water is started (Figure 4-20).



Figure 4-20 Back scouring of the head wall at Oneya diversion structure, 2013

This all problems force the farmers to change the direction of the diversion site and divert the water to the primary canals by using local material like wood brush and soil mixed with stone.

After modernization of potota diversion, it stays without function at least for three years. High accumulation of sediments was occurred at the diversion weir and the gate was also closed (see figure 4-3). The primary canal was also become closed with grass and sediments (see Figure 4-21)



Figure 4-21: Closed of the primary canal in Potota scheme by grass and sediments, 2013

Generally, according to the discussion held with the IWUC committee of Yandafero- spate irrigation systems, the labour for operation and maintenance were contributed uniformly without considering either the size of landholding size or any other social status. Most of the materials used for construction and maintenance of the spate irrigation infrastructures are acquired from the local: stone, boulders, brushwood weed plants and sand. But some of the cementing materials, wire metals gabions and metal sheet used for opening and closing the gate was provided by EECMY-SWS; which is currently the only locally non-governmental organization helps the spate irrigation project on Yanda River. This project also support the communities regard to O and M of the spate irrigation system by giving guide how the level of the canals was maintained for gravity flow of flood and showing the appropriate sites for formation of branch canals(secondary or tertiary). The supports of this project were not limited by doing the above listed activities, but also give the training for the farmers on the way to increase their income additional to the agricultural productivity from flood farming. Since the farmers use simple hand tools during O and M works such as hoe, spade, 'Gejera' and axes, are provided through the project.

As it is described under section 4.6.1, the main functions of the IWUC is sequencing flood water allocation and distribution, coordinate the operation and maintenance of irrigation infrastructures, resolving conflicts, enforcing regulatory procedures and punish offenders including coordinating in construction field canal or bunds through their grouping structure under each blocks. However, practically not all of them were practiced uniformly and efficiently through the water distribution systems. For instance, in Oneya scheme spate irrigation system, the location of diversion structure was changed and replaced by traditional diversion materials due to poor performance of O and M. High accumulation of sediments were visited at broad crest weir and on flood flash gate (see figure.4-19).

The performance of IWUC to timely coordinating the construction and maintenance of spate irrigation infrastructure at different levels (primary, secondary and field) and O and M of spate irrigation as the whole was varies in the three block of Yandafero spate irrigation system. To evaluate the performance of IWUC, the sampled farmers from three position of secondary canals (upper, middle, lower) was selected. However since there is no farmer organization established for the management of spate irrigation system in Potota scheme, the evaluation was done based on the past performance of illegalized WUA established. Here down table 7 shows the performance evaluation of the three blocks IWUC at secondary and tertiary level and the whole O and M activities.

Table 4-9: Performance evaluation of IWUC by Sampled farmers

Scheme Name	Performance level	Evaluation Criteria					
		Coordinating the construction of <i>Korma Shaka/field canal network</i>		Timely organizing O and M of irrigation infrastructure		Average	%
		Frequency	%	Frequency	%		
Oneya	Very Good	10	15.4	18	27.7	14	22
	Good	43	66.2	35	53.8	39	60
	Average	8	12.3	8	12.3	8	12
	Poor	4	6.2	4	6.2	4	6
	Total	65	100	65	100	65	100
Tarakoma	Very Good		0.0		0.0	0	0
	Good	6	10.9	6	10.9	6	11
	Average	41	74.5	41	74.5	41	75
	Poor	8	14.5	8	14.5	8	15
	Total	55	100	55	100	55	100
Potota	Very Good					0	0
	Good					0	0
	Average					0	0
	Poor	60	100	60	100	60	100
	Total	60	100	60	100	60	100

As shown Table 4-9, in Oneya scheme, 60 % of the sampled farmers replied as the IWUC is good with regard to *coordinating the farmers for construction of tertiary and field canals* and *timely organizing for O and M of the irrigation infrastructure*. However, according to the farmers responded the performance level of IWUC to coordinating of the farmers for construction of field canals and timely organizing for the O and M of diversion headwork and primary and secondary canals is not the same. For instance in Oneya almost 66.2% and 35% of the sampled farmers respond as IWUC was good in coordinating the farmers at field level and timely organization for O and M of the infrastructure respectively. Therefore, the degree of trust of communities on the elected IWUC in charging their duties and responsibility on them is found to be good relating to coordinating construction activities field level while on timely organizing the O and M of the spate irrigation infrastructure was average.

In Tarakoma scheme, 75% the sampled farmers evaluated the IWUC as average with coordinating for construction of field canals and timely organizing operation and maintenance of irrigation infrastructure. In this case there is the medium trust of communities on the elected of IWUC committees relating to recharging their duties and responsibilities.

In Pototoa scheme, since there is no IWUC at current, the sampled farmers evaluated the informal IWUC that was established during the past served only for single flood season just after modernization of the diversion weir. Therefore, as shown in Table 4-9, farmers who evaluated the IWUC as poor with regard to coordinating for construction of tertiary canal and field canal network and organizing farmers for timely operation and maintenance of irrigation infrastructure is 100%. This means, the trust of the communities in water user committee were very low. Currently this scheme is not working properly. This poor performance of IWUC and other issues made the inefficient use spate irrigation system.

The common things in three schemes of YSIS were the absence of defined schedule of activities in the IWUC. The executive of water user cooperative at Oneya and Tarakoma periodically identify the activities and organizes the members for work. The IWUC can organize meeting if there are issues to be discussed with all members of the cooperative. Before the beginning of the rainy season the IWUC

leaders decides days for construction or maintenance of the diversion and irrigation infrastructure networks. After completing the construction and maintenance works, the executive IWUC forward the message for the farmers' group leaders to mobilize the farmers' sub-groups/individual farmers for the preparation of their respective of canals. Finally the IWUC committee evaluates if all structures are ready for flood diversion and discussing with respective leader if there is complain issue was raised.

However, according to the discussion held with the farmers and executive of water committee, this is not regularly takes place due to lack of allegiance among some executive members. But in the case of Oneya there is written "*internal rule*" that penalized the person failed to perform his duty (section 4.8.3). In the other block (Tarakoma and Potota), there is no written rule for this issue. But in Tarakoma, they perform orally with very weak enforcement of the rule.

The performance of Cooperation between IWUC and local governmental sectors at Yandafero spate irrigation system

As it is highlighted in the table 4-2, there are clear mandates stated under key stakeholder of local sectors in the development of spate irrigation. However, according to the response of sampled IWUC members at three schemes (Oneya, Tarakoma and Potota) replied as there is poor cooperation with Woreda ARD office, Woreda WRME office and Woreda WA&C office. The evaluation also shows that, only Woreda Cooperative promotion (WCP) office and developmental agent have average relationship. Especially, regarding overall management and coordination, as well as the extent of assistance in provision of required services like extension, technical advice, conflict resolution related land distribution, water distribution, financial and related supports required for scheme management are undermined. For instance, two major problems faced at the Yandafero spate communities still existed which is beyond the capacity of IWUC and need the support of the governmental efforts.

The first one is the disagreements among the farmers due to unfair use of the spate water at Potota scheme. Since the water sharing rule is upstream priority at Yandafero, the upstream farmers of potota use the spate water for extra land beyond the allowable for spate (i.e. only 0.64 ha). This is result less/no spate water received by downstream farmers. This is the area where the involvement of the government sector, especial Woreda Agriculture and Rural development office need to dispute the conflict. But this problem is not solved due to the week relationship of spate communities and governmental sector.

The second problem is at Tarakoma farmers due to the narrow size of culvert constructed by Ethiopian Road Authority. The majority of beneficiary of Tarakoma scheme was located down the road and used the flood water after it passed through the culvert and distributed proportional to the five secondary canals. But it is visualized that the size of this culvert becoming narrow from time to time and unable to allow the sufficient flood flow that inundated their lands in a given time. According to the response of beneficiary farmers, most of their land was left without cultivated due to the insufficient flood passed through culvert.

In addition to this, the intensive support of the operation and maintenance of the Yandafero spate irrigation system was given by non-governmental organization called Mekene Eyesus (ME). Actually, the all operation, maintenance and management of the system were performed by communities. This NGO only supports the systems, when the O and M activities are beyond the capacity of farmers and when it asked for support.

This organization also provide different material for the spate irrigation communities, like hand tools materials to the farmers who are interested to practice different in situ water harvesting techniques such as tie ridge, maize thrasher and preparation of nursery site. The Mekene Eyesus also intensively participated in livestock management of the woreda as the whole.

4.7.2 Water sharing and Conflict resolution at Yandafero-spate irrigation system

According to Mehar, et al, 2013, the basis for the water allocation and distribution rules and practices is ensuring equity among the farming community. The Yandafero-Konso lowland farmers strongly believed in social equity and each person has a societal obligation to work to goal. However, the cause for the unsuccessful of Potota spate irrigation system was the best indication of the unequal distribution of land hold and spate water.

Water sharing and Distribution at Yandafero spate irrigation

The water sharing at Yandafero spate irrigation system is upstream priority and in new flood season area that remained dry in the previous season gets the priority. However, at field level the water is shared in accordance with the rule that states: during small and medium floods that do not have the strength to reach the far downstream fields, the upstream farmers have absolute right to the water; where as in large controllable floods, the downstream fields have the first priority. At Oneya and Tarakoma scheme, as flood water come, the whole amount of water was diverted based on the design capacity of intake (1.25m³/s) to the main canal. Then, the amount of flood water left from the first intake was passed to the next diversion intake and the process is repeated. Therefore, in this case, the flood comes diverted to the Oneya primary canal firstly and then the left flood passed to the Potota and Tarakoma. From the main canals, the flood water is distributed to the secondary and tertiary canals through rectangular-shaped at the main canals and broad U-shaped earthen structures at branch canals. The farmers use locally available materials like brushwood and earthen bund to divert from main canal to branch canals.

The committee members through their years of experience, they can predict with greater certainty the onset of flood. Most of the farmers at yanda plain have permanent residence at the highland of the district which is 21-25 km far from their agricultural land due to malaria problem. Even though, they live at highland, they were spending the whole working day (Monday- night of Saturday) at their farm area. They only spent one day (Sunday) at their permanent residence to prepare of food for the whole week. Several days before the expected flood, all the committee members at each level gathered at the head work (diversion structure site) and make on site decision as how the structure should be ready to deliver the necessary of water according the water distribution agreement.

From the discussion held with the IWUC of Yandafero spate irrigation, the upstream farmers are familiar with violation of *the rule*: small floods- upstream field first and large floods- downstream first. Especially, in Potota scheme this rule is not enforced. This is the major reasons that create the conflict among the upstream and downstream of the potota scheme.

For this reason and other relating issues, in Oneya scheme, the committee developed the written "*Internal rule*" in 30/2/2012 year. This rules stated under "article 2, sub article 2.8 of in locally language (Amharic) called "*YE ONEYA MASNO WAHA TATAKAMEWOCH HEBRAT SIRA MAHABER YETEWESENE WESTA DAMBI*". This sub-article 2.8('Honebelow ye waha mawsaga masmar yabalashe ina yala tara wahun yetetekeme') consists eight rules under it and translated into English. The other

1. *The farmers who irrigate his/her land two times without reaching for other, will be penalized 1000ETB*
2. *The farmers who irrigate his/her land without his turn should pay 300ETB*
3. *The farmers who irrigate his/her land two times without his/her turn should pay 600ETB*
4. *If he/she repeat for three times, he/she should present in front of general committee for decision*
5. *Anyone who damage the water canal, will penalized 1000ETB*
6. *The person who cut-off very big trees which is not replaceable either from in his agricultural land or anywhere around the spate irrigation site will penalized 300ETB*
7. *The person who cut the forest around the canals should pay1500ETB*

8. *The person who drop any waste materials or plant residue or weeding into irrigation canals or carelessly left the weeding inside the canals will penalized 100ETB*

See Figure 4-24 for the other water distribution rule which is codified.

At the Tarakoma scheme, there are no written rules established on the water sharing and distribution. But they are widely used and practiced orally for water distribution.

Those rules include:

1. *In any new flood season, dry fields are first fully irrigated before any other field gets a single turn*
2. *Second turn only after all fields get one turn*
3. *At field level, small and medium floods, upstream field first; large floods, downstream first*
4. *Anyone who damage the water canal should pay 1000ETB*

Rule no. 3 is perceived among the Yandafero-spate irrigation farmers to be very important, as it creates an atmosphere of cooperation between the upstream and downstream farmers, which is a necessity for the sustainability of their irrigation scheme. This is mainly because the secondary and tertiary diversion which is built of stones and brush-woods is usually washed away by high to moderate floods. According to interviewed downstream farmers and farmer leaders explained of the Tarakoma diversion spate irrigation unlike Wadi labe of Eritrea spate irrigation system (Mehair et al 2011) that had it been for this rule, they would have contributed for the reconstruction of the diversion structure. But from time to time the downstream farmers understood that as this rule affect their right of water sharing. They reflected that as this rule should have to correct in the future. According to the discussion held with downstream farmers of the Tarakoma spate irrigation, due to the leaders of IWUC was selected from upper stream they kept this rule as incorrect.

Conflict Resolution Method on Yandafero-Spate Irrigation

Spate irrigation is natural characterized in risk associated type of water management at arid and semi-arid climate zone where mostly practiced. It is season type of irrigation systems which occurred only in a short period of time (even in 3-4 hours). This type of irrigation is different from conventional irrigation systems where the amount of water is fixed with defined rule and irrigation scheduling. Sometimes only the upstream farmers irrigated his land and the downstream kept as dry or the whole prepared land left without getting the flood. For this reason, there is no well structured scheduled established on the watering of his/her agricultural land (Mehair, 2011)

This characteristic of spate irrigation was also common at Yandafero-Konso lowland. At yandafore spate irrigation, since there is no legalized rule on the agriculture land distribution, lot of conflict raised among farmers. This is very common at the upstream and downstream conflict at Potota scheme. Additionally, most conflicts between the irrigation committees and the users originate from closing of the canal during herding livestock and lately releasing water to the next users. Even though a lot of conflict occurred among farmers on spate water sharing, the village forms a strong unit; each being traditionally autonomous and led by traditional leaders who play an important role in the community.

The interviewed farmers and religion leaders respond as the majority of Yandafero farmers are large well disciplined and always strive to ensure that water is distributed in accordance with the rules that are drafted and implemented with their consent. They have strong desire and they perceive it as their social and religious obligation that water is shared equally among the different economic and social classes of the farming community. Despite all these however, they understood that it would be difficult to completely avoid water conflicts and they decided to put in place conflict resolution mechanism (see figure.4-23)

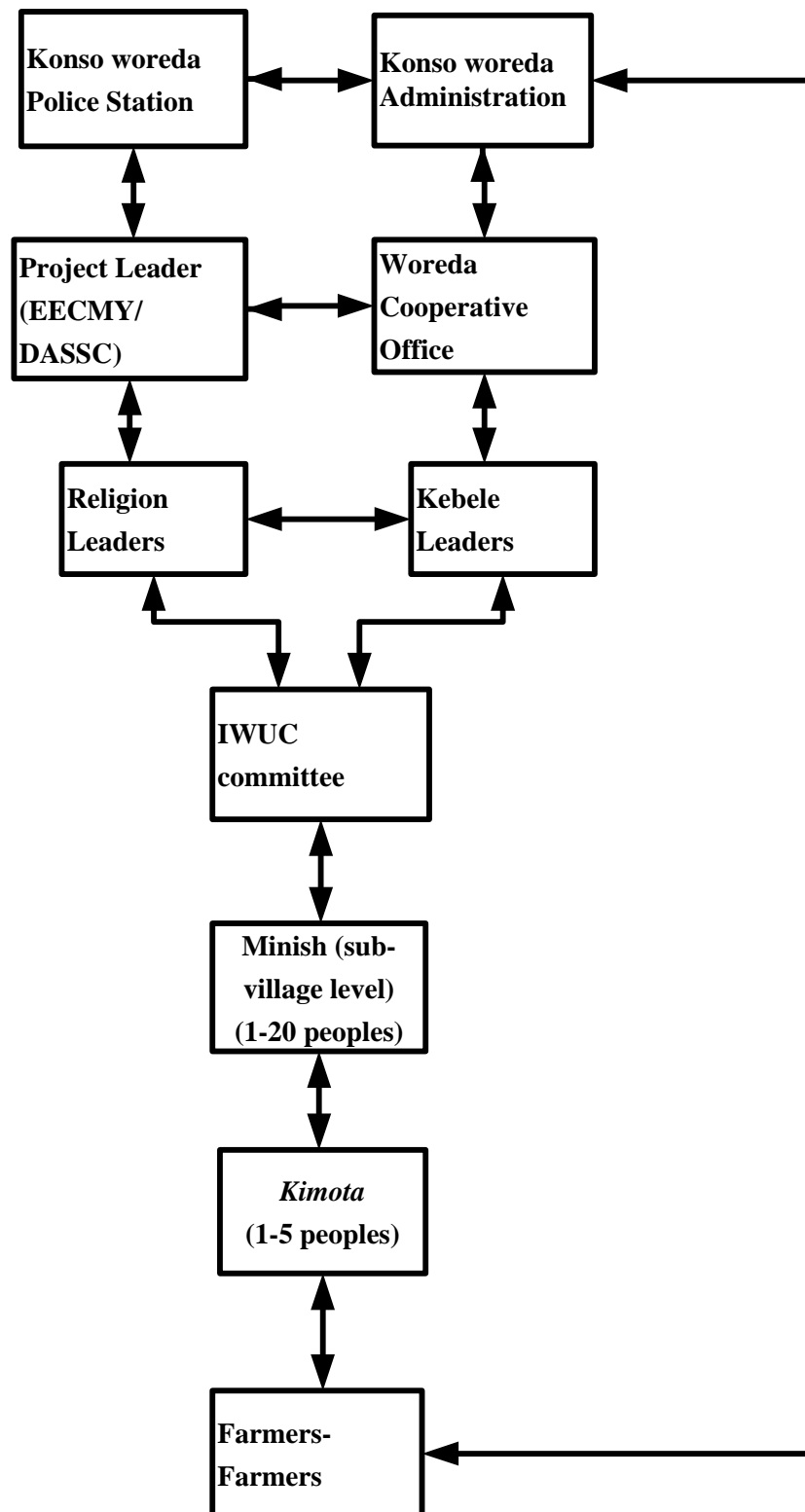


Figure 4-22 Organizational Structure for conflict resolution on Oneya scheme (source: own survey, 2013)

The conflict resolution mechanism at the Tarakoma scheme was also follow similar structure with the conflict resolution structure at Oneya except failed to have *Minish* level. There is no also religion leaders' involvement on conflict resolution.

In Yandafero spate irrigation system, most of the causes for the conflicts that arise at field level are: in the upstream tertiary units (during small to medium floods), the breaking of the field bunds by the downstream farmer before upstream farmers gets the required water depth. Actually, there is no fixed depth of irrigation water in the field bund. But it is understandable that, the upstream farmers have to get till the field bund is nearest to fill. Within the downstream tertiary units (during large floods), the blockage of flood by the upstream farmer, which result in a very serious conflict as it is the violation of rule number 3, the rule perceived to be the corner stone for ensuring the cooperation between upstream and downstream farmers. Conflicts resolutions at field level are preferred to be solved by mutual understanding between the worrying persons. If they fail to solve the problem, on the request of one or both, the *Kimota* was could interfere. If he fails to handle the situation, he can ask the assistance of the *minisha* in the case of Oneya scheme and, IWUC leaders in the case of Tarakoma. Also, on request basis it can reach the kebele leaders or even the woreda administration (see Figure. 4-23)

Table 4-10: Performance evaluation of IWUC on Equity of flood distribution and conflict resolution

Scheme Name	Performance level	Evaluation Criteria			
		Equity Flood Distribution		Resolving Conflicts	
		Frequency	%	Frequency	%
Oneya	Very good	8	12.3	65	100
	Good	53	81.5	-	-
	Average	4	6.2	-	-
	Poor	0	0.0	-	-
	Total	65	100	65	100
Tarakoma	Very good	2	3.6	-	-
	Good	33	60.0	55	100
	Average	16	29.1	-	-
	Poor	4	7.3	-	-
	Total	55	100	55	100
Potota	Very good	-	-	-	-
	Good	-	-	-	-
	Average	-	-	-	-
	Poor	60	100	60	100
	Total	60	100	60	100

Source: Survey result and discussion with farmers of Yandafero spate irrigation, 2013

As indicated in the above Table 4-10 the response of farmers toward the equity of flood water distribution and conflict resolution was varies from one scheme to other at Yandafero spate irrigation. From Table 4-10 farmers who evaluate the Oneya IWUC as very good with regard to ensuring equal distribution of flood water and resolving conflict was 12.3% and 100% respectively while as good with regard to ensuring equal distribution of flood water was 81.5%.

Therefore, it is realized that the confidence of spate irrigation communities on the WUC committee executing the responsibilities and duties imposed relating to solving the conflict on time was very good. For instance, the Oneya farmers raised the example during the discussion as the only two conflicts were occurred in one flood season. The conflict occurred between two farmers: on the timely release of the flood water to the next farmer's land and the disagreement between two farmers sub-group on the position of tertiary canals. Additional to the IWUC leaders and farmer's group leaders, the farmers sub-group

leaders should must travel through respective flood distribution level and check everything at the day of flood water comes. So, this both conflict get the immediate solution at *kimota* level.

From the above Table 4-10, the reply of Tarakoma sampled farmers to evaluate IWUC as good toward the ensuring equity of flood water distribution among the farmers and timely solving and protecting conflict between the different levels was 60% and 100% respectively. In this case, the feeling of the farmers toward the election of WUC executing their responsibility and duties imposed on them was found to be good.

In the case of Potota diversion, the sampled farmers evaluate the IWUC as poor toward providing equity of flood water distribution among the spate water communities and solving conflict was 100%. According to the discussion held with the potota farmers and development agent, this poor performance was occur due to disagreement between the communities of spate water. During the discussion held with the downstream farmers, it is realized that, the question of the downstream farmers have strong relationship with (re)distribution of upstream lands or developing internal rules who strongly protect the upstream farmers from breaking the rule of allowable land holding size under spate irrigation water . In Ethiopia, most of the time the redistribution of irrigable land was the sensitive issue and need the intervention of legal body like WARD office.

4.8 Water Right and Rules in Managing Flood Water in Yandafero-Spate Irrigation Systems

4.8.1 Water Right and Rules

To manage the predictable nature of flood water and reduce the risk of conflicts, several categories of water rights and rules are in place in different spate irrigation systems (Abraham M, et al, 2003). As the analysis shows under water allocation and distribution of Yandafero-spate irrigation sytsmes, spate irrigation was applied through controlled systems structures at the intakes of primary canals. At secondary, tertiary and filed canals, the water was diverted proportional through traditional mechanism. But at Oneya scheme there was one division box at "*sariti*"(the second branch canal on Oneya), which is arranged manually by farmers and divert proportional amount of water to the secondary canal. At Yandafero-spate irrigation, the amount of water a farmers was entitled to be the inundation of individual plot.

According to the discussion held with district Water Resource Mine and Energy (WRME) and chair man of each IWUC, the water right and water distribution rule were not formally prepared at Yandafero-spate irrigation system. Since the yanda plain (Jarso Peasant Association) was considered as pastoralist area and the local governmental organization believed that as they are not governed by formally recognized water rule and water rights due to no regular water flow and no permanent residence were practiced. Even though the Yandafero-spate irrigation was located at dry agro-climate zone, the current life styles of farmers were similar to that of the highland community. This is obviously happened due to intensive use of flood water (seasonal) of the Yandafero farmers. They also gradually developed different traditional and informal water right and water distribution rule including the rule of O and M of spate irrigation system.

As it is familiarized during different meeting and discussion with individual farmers, leader of farmers, kebele administration and staff of EECMY/SWS, the water right and water distribution rules are more or less similar to that of Lawrence and Steenbergen, (2005) developed. But not all are established and practiced similar at all three blocks (see Table 4-11).

According to the Shushay Legesse, (2012), the actual implementation of the water rights and rules was analysed.

Three different implementation modalities were considered (Lawrence, 2005):

- ✚ Fully implemented: if the water right and regulation rule was fully implemented on the scheme.

- ✚ Partially implemented: if the water right and rule was partial implemented through negotiation by the elders without keeping the rule of WUA.
- ✚ Semi- partially implemented: if the water right and rule was implemented by default which was in rare case during the flooding time.

Table 4-11: Water right and water distribution rules at three schemes of YSIS

No.	Water Right and water distribution rule according to Lawrence and Steenbergen, (2005).	The Scheme name					
		ONEYA		TARAKOMA		POTOTA	
		Established	Practiced	Established	Practiced	Established	Practiced
1	Demarcation of land entitled to irrigation	✓	✓	✓	✓	✓	X
2	Rules on breaking diversion bunds	X	X	X	X	X	X
3	Sequence in which the different fields along a flood	✓	✓	✓	partial	✓	partial
4	Practices regarding second and third water turns	✓	partial	✓	partial	✓	X
5	Rules on small and big floods	✓	X	✓	X	✓	X
6	Proportion of the flow going to different flood channels and fields	✓	✓	✓	partial	✓	partial
7	The depth of irrigation that each field is to receive	✓	✓	✓	✓	✓	X

Source: results of survey data and discussion with each executive committee of IWUC, 2013

As shown in Table 4-11, the water right and distribution rule of YSIS was understood as the similar with the international spate irrigation water right and distribution rule. However, those water right and water distribution rules were practiced orally/not a written form and without legal recognition. But all of the listed rule and rights were intensively practiced except the rule on breaking diversion bunds. According to Abraham M et al, (2010), state in spate irrigation guide line, the rules on breaking bunds are usually in place in areas where the entire wadi bed is blocked by earthen bunds, as in the lowland systems in Pakistan. But in the case of YSIS, each diversion was constructed with broad crest and full barrage weir. So, the rule on breaking the bund was not familiar with scheme.

At the Yandafero spate irrigation system, the water right and distribution rule was similarly established among the three spate blocks (i.e Oneya, Tarakoma and Potota). However, not all were similarly implemented among each block. As shown in Table 4-11, under the Oneya and Tarakoma schemes, the rule of demarcation of land entitled irrigation and the rule of depth of irrigation that each field is to receive was fully implemented where as the rule of second and third water turns was partially implemented. The rule on small and high flood was to not implement in three cases of scheme.

In Potota, almost all of the established rules were not fully implemented. As indicated in section 4.7.1 this is the major reason for the current poor O and M of the scheme as the whole. Under Potota and Tarakoma schemes, the rule of sequence in which the different fields along a flood channel are watered, and practices regarding second and third water turns in were partial implemented. These two rules which were partial implemented in individual farmers and family's member and discussion during flooding time rather in organized manner through the IWUC.

The gate keepers would be assigned by IWUC committee and have the responsibility of opening and closing the gate for the distribution and division of flood water, to meet the demands of the farmers. The gate keepers were selected from each level of farmers' organization. For instance at Oneya, the gate keepers were selected from farmers' Sub-group (one person), from Farmers' group (one person) and from executive IWUC at main canals. At a time three gate keepers were assigned on this diversion. For the next flood season the other gate keepers would assign. The same procedure was followed for the other diversion. Then, in this sense they distribute and control the flows of flood water to the main canal at each diversion. For other levels (secondary, tertiary), it is managed according to the distribution of responsibility by farmers' organization at each level (refer section 4.6.1). But, according to the farmers' reflection, practically sometimes they open and close the gate as they want and nobody control them. This makes challenges to distribute the flood water fairly through the scheme.

4.8.2 Enforcement of Water Rights and Rules

In Yandafero-Konso lowland spate irrigation system, the farmers' organization at different level was responsible for the enforcement of spate water right and rules. According to this, the farmers' group and sub-group leaders in Oneya scheme were responsible for enforcement of water distribution rules and right. In Tarakoma scheme, keeping the sequence of the flood water allocation and distribution and enforcing regulation procedures were performed by IWUC leader which is placed at the main canal and secondary canals.

Unlike Oneya and Tarakoma schemes, the Potota scheme was not familiarized with enforcement of any water right and distribution rules. This is one of the reasons for the unsuccessful of the Potota diversion spate irrigation. Especially, lack of the demarcation rules: area entitled to irrigation. They often protect the prior rights of downstream landowners, by expanding new land at upstream, which could result in the diversion of floodwater to new lands.

According to the reflection of IWUC members in Oneya scheme, the "*internal rule*" established said to comprise a comprehensive set of rules covering all aspects of interest. But the IWUC was too poor on the enforcement of established internal rules.

Table 4-12 Assessment of farmers' response on the implementation of water rule and regulation the way it formulated

Name of the scheme	Water rule and Regulation enforcement in a way its formulated				Total	
	Implemented		Not Implemented		Frequency	%
	Frequency	%	Frequency	%		
Oneya	42	23.3	23	12.8	65	36.1
Tarakoma	32	17.8	23	12.8	55	30.6
Potota		0.0	60	33.3	60	33.3
Total	74	41.1	106	58.9	180	100

Source: survey result, 2013

We can understand that from the Table 4-12, at Yandafero spate irrigation system, out of the sampled farmers(180 farmers) approximately 59 % replied as does not believe the rule and regulation has been implemented by responsible farmers under different levels in a way it was formulated where as 41% believed the rule and regulation has been implemented. This show the farmers have less trust over the IWUCs. It is also understood .as the enforcement of water rule and regulation has been performed differently in three schemes. For instance, according to assessment made by sampled farmers Table 4-12, in Oneya the enforcement of water rule and regulation was better than(23.3%) that of the Tarakoma(17.8%) and Potota(zero percent). The farmers in Oneya scheme have considerable trust over the IWUCs that show strong adhesion to the rules and regulations by the farmers group and sub-group leaders is observed. In Potota scheme, there is very weak performance of the formulated water rule and regulation.

The interviewed farmers and farmer leaders explained that as a lot of problems happened on the enforcement of those rules. The major reason experienced for failed to implement the water rule as it proposed was the weakness of the farmers to expose the body who violate one of those rules. The responsible body also did not implement the rule according to stated. He/ she may be implementing the rule in partial way. For example if the rule number 7(see page 43) was violated, the responsible body only penalized 500 ETB instead of 1500ETB. This is because of to keep good relationship among farmer who violate the rule and the committee leader who responsible for enforcement of this rule. This is mostly practiced at the farmers' sub group level. The community considered such type of action or half punishment for violation "Corruption

4.8.3 Codification of the Water Rights and Rules

Codifying water distribution rules clarifies and completes local water management arrangements and introduces a neutral factor in resolving disputes (Mehair et al, 2010, PP 168). But not in all spate systems, the water rights and water distribution rules are codified. In most communities the rules and rights are communicated via the word of mouth (Abraham, 2007). Rules can be enforced based on codification together with the establishment of the WUA, in this way the operation and maintenance at different level was initially safeguarded.

In the Yandafero spate irrigation scheme the water right and distribution was only codified in Oneya scheme. According to the discussion held with the farmers and water committee members in Oneya, the community used to have a written codified water right and rules starting from Sept, 22, 2012. It is developed by selected farmers through democratic way in which the whole farmers participated in the election. Their duties are to draft the water right and rules and codify it. Then, they present for the whole farmers for their opinion. After they gathered additional idea from the farmers, they bring to the Woreda Cooperative Promotion office for approval. According to this, the "*Internal Rule*" of Oneya IWUC was approved since September 22, 2012. It is prepared by local Language (Amharic) and presented here by translating to "English". See some the codified rules Figure 4-24.

Figure 4-23 The traditional codified water distribution rule at Oneya Scheme of Yandafero spate irrigation

Written internal Rules that codified at Oneya Scheme of YSIS

Date: September 22, 2012

1. A member who absent in the meeting for the first time warned orally and if he/she repeated for the second and third time shall pay 30 and 60 Ethiopian Birr (ETB) respectively. For more than 3 times, he/she should avail in front of general assemble and get decision.
2. IWUC leader or sub-committee leader who did not punctual during the committees meeting warned for the first time and panelized to pay 5 and 10 ETB for the second and third times respectively. For more than 3 times, he/she will come to in front of general assemble for decision.
3. IWUC leader or sub-committee leader who did not punctual on the time of O and M activities of spate irrigation system warned for the first time and shall pay 15 and 30 Ethiopian Birr(ETB) for the second and third times respectively. If he/she repeat for more than three times shall get the final decision from general assemble.
4. A members who get out-off the meeting before the end for the first time without official permission from concerned body get oral warning from the leaders and shall pay 500 and 1000 ETB for the second and third respectively.
5. A member who does not participated in clearing of the canals shall pay 30 ETB/day till only 4 days. For more than 4 days, he/she shall get the decision from the general assembly.
6. A farmer who does not involved during the excavation of canals and but possessed the irrigable land nearest to the canals, shall pay 1000 ETB to involved into the spate water users members and use the water according to the internal rule and regulation
7. A member who does not take care of the properties that given by the project for the individual farmers or in group may be either in the form of borrowing or incentive shall punished 500 ETB.
8. A person(member or not) who does released the livestock in the irrigation infrastructure shall pay 60 ETB/livestock
9. A member who assigned to keep the gate and did not keep shall pay 300 ETB/day and pay additional 200 ETB if he failed to report on time.
10. Regarding to water sale: 20 ETB/ha for the member and 400 ETB/ha for who is not the member.
11. The farmers who irrigate his /her land two times without reaching for other, shall pay 1000ETB
12. The farmers who irrigate his/her land without his turn shall pay 300ETB
13. The farmers who irrigate his/her land two times without his/her turn will be penalized 600ETB
14. If he/she repeat for three times, he/she should present in front of general committee for decision
15. Anyone who damage the water canal, shall pay 1000ETB
16. The person who cut-off very big trees which is not replaceable either from in his agricultural land or anywhere around the spate irrigation site shall pay 300ETB/tree
17. The person who cut the forest around the canals shall pay 1500ETB
18. The person who drop any waste materials or plant residue or weeding into irrigation canals or carelessly left the weeding inside the canals shall pay 100ETB

Source: IWUC of the Oneya Scheme, 2013

However in the case of Tarakoma, the water right and rules are communicated via the word of mouth and during the discussion held with IWUC leaders in Tarakoma informed as they are almost complete the

selection of farmers who responsible for preparation the first drafts of "*Internal Rule.*" However in Potota, this internal rule development and codification was not familiar.

4.8.4 Provision of Credit Facilities at Yandafero Spate Irrigation System

Indebtedness is common in spate-irrigated areas as many farmers encounter serious cash deficits during the year, or have to take on debts to survive an adverse year. According to Mehair, et al, 2010 stated in spate irrigation guidelines, friends and relatives are usually the first source of credit. Shopkeepers and traders are another important source as many small scale farmers obtain seeds on credit at the start of the cropping season. Farmers in spate irrigation systems rarely have access to formal credit facilities of banks and financial institutions owing to the inherent risks of spate-irrigated agriculture and the low value of the crops that are produced. However, the communities of spate irrigation developed different mechanism of credit and loan facilities in different countries. For example, according to Mehair, Tihama region of Yemen follows the traditional system of delayed payment practised by most merchants, traders and shopkeepers. In this case, the interest is not officially charged but different price levels may be negotiated depending on the time delay in payment. It is also described as the Pakistan farmers' takes loans for seeds from shopkeepers at a monthly interest rate of 5-10 %. They also purchase seed on credit and pay on 80 % mark up.

In Yandafero-Konso spate irrigation, the farmers practised credit and loan through cooperative mechanisms. According to the discussion held with the leaders of the cooperative and the Woreda Cooperative promotion office, the farmers organized themselves into different cooperative groups. They may organize themselves either according to neighbouring of the pilot, following the same religion or per sub-village. After they are organized and select their executive committee, the list of the members submitted to the Woreda's Cooperative Promotion office with their informal rule and regulation for approval. According to the Kumeda Kurucha, 2013(woreda cooperative expert), 18 cooperatives (9 under irrigation water cooperative and nine (9) under Women's saving and credit cooperative) were get approval in May 18, 2012 based on the rule of Woreda Cooperative Promotion office (>10 members to form cooperative) see appendix C. Then, the office opened the legal bank account in the name of each cooperative and prepared the book account for individual members. This individual book account has been used for three purposes: for regularly saving, borrowing wisely and repay promptly (see fig.4-24).

In the beginning, each individual members of cooperative contribute fixed amount of money to open the Cooperative account book. This first payment is called "registration fee" and its amount is decided after discussion of all farmers participant. According to the discussion held with the cooperative leaders, the amount of money contributed for registration is varies among the cooperatives. For instance, the registration fee in *Etigle, Orshale, Oneya and Geldahe* cooperatives are 5,10,20,and 50 ETB respectively. Additional to the registration fee, the cooperative prepared share with different amount and sold it to either the existing or to the new members. The money gather from water rent and other income was also deposited into the cooperative account (see appendix C)



Figure 4-24: Individuals farmers Book Account for credit at YSIS

According to the discussion held with Cooperative promotion Office and each cooperative leader , if the individual farmers want to deposit money in to his/her account, simple present his/her book account with money to the cooperative leader (chairman). The chairman received and records the amount of money on the farmer's book account and sign on it. Then, the chairman brought the money he collected to Woreda Cooperative Promotion Office and deposit into the Cooperative Bank Account under which the farmers was involved. Also, if the farmer wants to borrowed the money for either O and M of spate irrigation infrastructure or to buy the agricultural inputs like seed, fertilizer, etc, he/she directly went to the Woreda Cooperative Promotion Office and took the money by bringing his/her book account. Similar procedure was repeated for repayment of the money.

The finance available in the IWUC of Yandafero spate irrigation as a whole is better than other spate irrigation systems in Ethiopia like Fokis and Boboteay in Raya spate irrigation, Tigray. For instance the money available with the water committees in Fokisa and Boboteya is 700 and 500 ETB respectively (Haile Kidane, 2006). In, Oneya and Tarakoma cooperatives, there was 26660 and 13870 ETB in their account respectively which is more than 10 times greater than Boboteya of Raya, Ethiopia (see appendix c). Actually the source of this finance not only from fines and also from registration fee who each individual farmers paid to be the members of IWUC, water renting and other incomes. It is found that there is unwritten job division among the water committee members at each level. According to the cooperative leaders, the Woreda Cooperative Promotion Office and kebele's development agent improved the performance of cooperative through providing training on cooperative management and book keeping with the finance support of YFSS IFS project.

4.9 The Female HHs Participation in Yandafero Spate irrigation System

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 in Haile Kidane,2009). Indeed although the entire female household heads in the study sites are land owners, they generally seem to have less ability to manage their land (table 4-13).

Table 4-13 The Plot management of Female households at Yandaefro spate irrigation

Ways of Plot management	Responded Female HHS	
	Frequency	percentage
Sharecrop	1	5
Use family labour	16	80
Relative/ community support	3	15
Hire labour	0	0
Total	20	100

As it is indicated in Table 4-13, 80% of the sampled female HHs replied that, the labour need for management of their plot was used from their own household while 5% and 15% replied as they are used through sharecropping and supported from relatives/communities respectively. In the study area, the sharecropper is entitled to 50 percent of the harvested crop by providing the bullocks for land preparation and labour for planting, weeding and harvesting. Seeds are provided either by the land owner or by sharecropper. But after the harvest that seeds shall back to for who contributed. Even though the majority of the female HHs study area was carrying out their farm activities by the labour of their families, they have the culture of cooperation with the other households in the form of *dabo*²⁰.

The female household heads are participated in the O and M of spate irrigation to get the spate water based on the plot management they follow. Those women who shared out their plot of land participation in the spate irrigation system are through the sharecropper. Even though sharecroppers are entitled to 50 percent of the harvested crop, the sharecropper is responsible for maintenance of field bunds. The cleaning of the primary and secondary canals according to the rule and regulation of irrigation use cooperative of the scheme are also his responsible. However, the landowner has the obligation to participate in the meeting of the cooperative and pay the necessary payment related with O and M decided by the committee.

If they use labour from their family to farm activities, any adult men member of the family are supposed to participate in O and M of the spate infrastructure. The females are also participated through preparing food and *Caka*²¹ for the farmers who participated in cleaning and construction of water canals (See Figure4-25). Farmlands of old women, men and children of deceased members cultivated with support of relatives and neighbours are liable to get spate water without any demand for contribution in O and M spate irrigation system.

²⁰ Dabo is the local way in which the farmers come together and support each other on activities like cleaning of weeds, construction field bunds, plough of the lands and crashing of the crop.

²¹ Caka is the traditional drinking material that is prepared from the mixture of maize and added 'Gesho'-for fermentation. It is very common traditional drinking alcohol in the Konso farmers.



Figure 4-25 Role of the women's in Tarakoma scheme of Yandafero spate irrigation

Generally, the women's involvement into the water committee members in the study sites seems to be low. According to survey, only one female household was included in the water committee members at the study area. This is only at Oneya scheme. There have been no woman water committee members at Tarakoma and Potota schemes. According to the response of the executive committee, this is due to lack of interest from the women's side to be the members of the committee. The female households were also reflected that as they have no willingness to be the members of the committee due to the house work burden. Since they are mostly spent their time on doing house work, they believe that as no time to participate in the committee meeting that takes place far from the residence area.

4.10 The outcome on Agricultural productivity after active institutional arrangement on spate management

The activities performed on O and M of spate irrigation has influenced the agricultural outputs. In this study, the impacts of performance of institutional arrangement toward the O and M of spate irrigation on agricultural productivity were visualized in two ways. One is the performance of farmers' organization (internal) toward O and M of spate irrigation systems under three schemes (Oneya, Potota and Tarakoma). Actually, this performance was discussed in the above section 4-7 and 4-8 and here the impacts of this performance on agricultural production is assessed. The second way is the contribution of external (Non-governmental) organizations for the development and management of yandefor spate irrigation system and the agricultural output.

The conventional approach to agricultural practise in the study area for several years has failed to bring adequate improvement in crop production (supply side) and this result the food insecurity at the study area. Therefore, as it described under the above section 4.3.1, one of the best approach identified by different food aid organization for insuring the sustainable food security was efficiency utilization of flood water at lowland area (Yanda plain). As the result the local, national and international organization were participated on the improvement of spate irrigation systems.

Even though a lot of activities were performed with different organization before 2005 in the improvement of Yandafero spate irrigation, the aim of insure to food security was not achieved. During this period there were no clearly identified arrangements either farmers organization or governmental/institutional organization for management, operation and maintenance of spate irrigation systems. According to the reflection of Kefelawu L. (2013), the Head of KDA, the only dominant crops cultivated during this time was only sorghum and cotton on small lands with small farmers. But sometimes maize was practiced. According to his reflection, during this time the food was supplied from Arba Minch to Konso special woreda to feed the local community.

However, after the active contribution of the known local NGO called EECMY/SWS (after 2005) on the improvement of spate irrigation structure through capacity building ,providing different inputs for

agricultural purpose and technical support the farmers household incomes were increased. According to Kefelawu, currently the farmers started exporting the production directly from Konso to the centre of the country. The harvesting time was also increased from one to three or four per year and currently the food security of the target kebel was insured.

Before construction of modern diversion weir, the project did preliminary survey on way of increasing agricultural production and performed preliminary activities in the area. Therefore, the project find out as irrigation development is one method of reducing vulnerable risk to rain fed production and supplement the rain fed season with spate irrigation. Then, the potential area for irrigation in Yandafero plain identified as at least 1500-2000 hectares. The existing agricultural extension, livestock management and natural resource management and conservation were also the other component for crop production that identified by the project

Since historical transition from highlands farming to yanda plain along Yanda River was directed by the community itself, the project has provided its support following the footsteps of community's action. At this stage all the stakeholders were encouraged and the back donors and project implementer were much interested and committed to extend their support at larger scale in to next phases. The project has planned and implemented improved varieties of cash crops, vegetable and fruits gardening, modern beekeeping and goat credit as important source of HH income and nutritional value.

As realised from reports and discussions, tremendous effort has been exerted by the project staff and project expatriate consultant to demonstrate and introduce improved varieties of cash crops, vegetables and fruit (Figure 4-27). The five nursery and demonstration sites were also established for seedling production, trial and demonstration. To diversify crop production, different types of crops like ground nut, cow/black eye pea, short cycle maize and sorghum varieties, sesame and cotton were planted on demonstration plots and on model farmer's field. Vegetables and fruit package of intervention was also aimed at diversifying household income base and food habit. Accordingly, vegetables production has been introduced at demonstration sites and beneficiary farms. The main improved vegetable varieties distributed in this regard were Onion, Green Pepper, Chilli, Tomato and Pumpkin. Thousands of fruit trees such as Mango, Papaya, Banana and Orange root stocks were distributed during the last 3-4 years. Training was given for selected farmers on fruit development and grafting.



Figure 4-26: Kaladisha nursery site at YSIS, 2013

Table 4-14: Average crop yield for the successive past 11 years at Jarso Peasant Association (JPA)

year	Crop yield			
	Sorghum (Q/ha)	Maize Q/ha	millet Q/ha	Beans Q/ha
1989	5	3	2	2
1990	5	4	2	3
1991	3	*	*	*
1992	1	2	1	2
1993	2	7	2	2.7
1994	6	5	4	3
1995	4.5	*	3	2.5
1996	5.7	*	1	-
1997	6.5	6	3	-
1998	6.2	2	4	-
1999	3.4	1.5	1	-

Source: YF-HDPPP, 2001-2003(year 1989-1995), Development agent- Konso, 2013 and Galunde Waketa, 2009

Table 4-15: % HHs responded to average annual production before and after the intervention of YFSS IFSP in three blocks of YSIS

Average amount of harvested(Kg/ha)	% of HHs respond at three schemes of Yandafero spate irrigation before and after modernization of diversion weir					
	ONEYA		POTOTOA		TARAKOMA	
	Before	After	Before	After	Before	After
Below 1000kg	91.5	1.1	65.2	51.2	84.3	1.0
1000-2000kg	6.4	3.5	28.8	32.0	12.0	1.8
2000-3000kg	2.1	4.9	4.0	11.8	2.7	3.0
3000-4000kg	0.0	10.0	2.0	5.0	1.0	16.0
>4000kg	0.0	80.5	0.0	0.0	0.0	78.2
Total	100	100	100	100	100	100

Source: survey HHs data, 2013 and Development agent office of Jarso PA

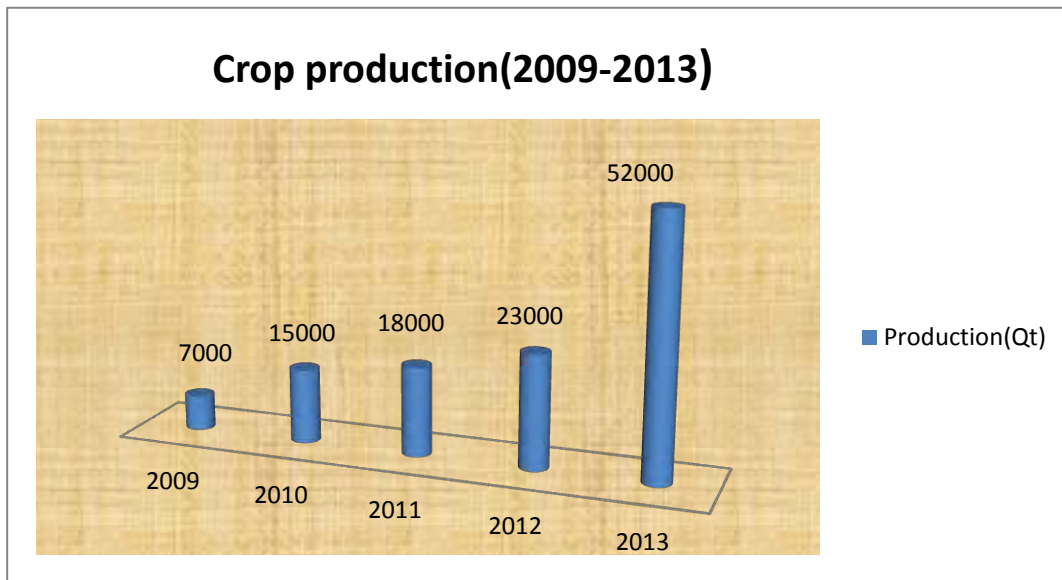
Table 4-15 presents differences in HH production before and after project intervention production between each irrigation block (Oneya, Potota and Tarakoma). Accordingly, 91.5%(Oneya),

65.2%(Potota), and 84.3%(Tarakoma)of HHs reported as the average harvested were below 1000kgs per year before the construction of modern diversion weir, while 1.1 %(Oneya), 51.2 %(Potota) and 1.0 %(Tarakoma)of HHs responded as harvested below 1000kg after the project intervention.

Based on the facts portrayed by the table and discussions made so far, it would be likely to generalize that there is a remarkable improvement of HH food production after the intervention the project. However, according to the HH responded at Potota scheme on the table 4-15, the average annual production after and before the construction of modern diversion weir is almost the same (>50% HHs responses as the amount of harvest is <1000kg). These show that, the only intervention of project in a way of construction modern diversion weir is not enhancing agricultural production. There should be strong internal organization of communities' for management of spate irrigation infrastructure. Therefore, the poor performance of farmer's organization toward management of spate irrigation system at the block result insignificant variation of crop production before and after the project.

According to EECMY/SWS/DASSC summary annual performance project reports (20012/13), the cultivated area has revealed dramatic increase from less than 350 hectares in 2005 to 1650 hectares in 2013 at Yanda plain. Likewise the community level production (maize and sorghum) has substantially increased from 7000 quintals in 2009 to 52,000 quintals in 2013(fig.4-28)

Figure 4-27: Performance of crop production at Yandafero spate irrigation (2009-2013)



Source: EECMY/SWS summary annual report, 2012/13

5 CONCLUSION AND RECOMMENDATION

5.1 Conclusions

The study has focused on the better institutional arrangement toward management of Yandafero spate irrigation system. It attempted to evaluate the performance of existing institutional structure with respect to minimum recognition of right to organized and set up of IWUC, O and M of spate irrigation infrastructures, flood water sharing(water right and distribution rules), conflict resolution mechanism and provision of credit and loan facilities and it's impacts on agricultural productivity. Moreover, general institutional environments like historical aspect and socio-economic situation and management activities of Yandafero spate irrigation before 2005 were reviewed and analyze to answer the research questions.

It was found that, before 2005 the food aid organizations developed different proposal to improve the productivities of Yandafero spate irrigation systems aimed to increase the HHs of Jarso peasant association (study area). Some of the improvement includes: protecting yanda river bed by building check dam at some distance downstream, improve intakes by using masonry and concrete structure, improving of design of primary canals and protecting bank erosion by using boulders and gabions structures. However, the implementation of proposed activities was not implemented due to weak organizational capacity, available financial, human resource and diversified interest from involved parties. Even though the communities have been continued farming by diverting flood water through traditional methods, they were not to be secure of food. Therefore, the target communities (Jarso kebele), have been continued supported by food aid. According to the report by Seft-Net Programme (SNP) of zonal office, October, 1999- May, 2000, the Jarso kebele get 8671.05 quintals from food aid. The design and arrangement of O and M of the spate scheme were not well known and that is why several traditional spate diversion intakes (27) can no longer command the initial area and Yanda river bed eroded up to 3-4m.

Existing Institutional Set-up and Performance toward O and M

- The existing institutional arrangement with regard to O and M, water sharing and conflict management and provision of credit and loan facilities at Yandafero spate irrigation system was described under three schemes (ONEYA, POTOTA and TARAKOMA) with respect of three modernized diversion structures.
- Generally, Yandafero SIS was managed under community through IWUC and with support of YFSS IFS (EECMY/SWS) project with poor involvement of governmental sector. The construction and maintenance of the head work, division box, and drop structure including retaining wall was performed by YFSS IFS in combination of farmers. However, the majority of the O and M of the scheme was performed by communities themselves through establishing farmers' organization for the collective work at different levels.
- In Yandafero spate irrigation scheme, only three formal irrigation water user cooperative IWUC at Oneya and one informal IWUC at Tarakoma were established which was below the proposed (9). Out of 1800 household farmers, only 1008 households of beneficiaries have organized themselves into IWUC.
- The farmers' organization for collective action (IWUC), under each scheme of Yandafero spate irrigation system was not the same with respect to those of selected principles of institutional evaluation.
 - ✓ In Oneya scheme, the farmers' organizational structure were divided into three groups with clear statemente of their responsibilities i.e. '*Korma Shaka*' who responsible for the tertiary/field canal maintenance, '*Korma Kura*' who are correspondence at secondary canals and IWUC at head(*Kaba*) corresponding at primary canal(including head work) respectively. The leader under each group was selected democratically by vote of the members.

- ✓ In Tarakoma scheme, the farmers' organized as *Farmers' sub-groups (Korma Shaka) and IWUC (Kaba)* correspondence at tertiary and (primary canal and secondary canals) respectively with clear responsibilities. However, unlike Oneya, their responsibilities were not in a written form.
- ✓ Currently, there is no identified farmers' organization with clear responsibilities in Potota scheme of Yandafero spate irrigation.
- ✓ Generally, there is lack of defined schedule for activities in IWUC/WUA and absence of fixed period how long leader can stay on power, which results lack of proper annual evaluation of the performance of the IWUC/WUA leadership.

The performance evaluation of farmers' organization in three schemes with regard to management of spate flow varies:

- According to the evaluation made, there is good performance of IWUC toward coordinating the construction of field bund and tertiary canals in Oneya scheme. The timely operation and maintenance performance of IWUC of the spate irrigation as the whole was average. The farmers were engaged with high frequency of O and M activities (> 7 times) of secondary and tertiary/field canals (refer Table 4-8) at rainy season. However, since there was less frequency of O and M at intake of primary canal and diversion weir, it is visited that high accumulation of sediments on the diversion weir, closed of intake gate and flash flood, destruction of headwork (gabion part) and back scouring of headwork. Then, the traditional diversion structure was constructed which have less resistant from washing away during high flood. This creates complain from downstream framers' as the results of structure diverts less amount of water for them as compared to the improved one.
- At Tarakoma scheme, the performance of farmers' organization with regard to timely operation and maintenance of spate irrigation is average. Most of the farmers are engaged 4-7 times with activities of O and M of primary, secondary and tertiary/field canals during the rainy season.
- Currently, the Potota diversion not functioning due to poor performance of management.
- There is poor relationship of farmers' organization with local governmental organization like WARD office, WRME office and WA&C office at Yandafero spate irrigation.
- In Oneya scheme, there is well written '*internal rules*' developed on water sharing and distribution, O and M, whereas no in the case of Tarakoma and Potota. But some of those rules practiced in oral/through mouth in Tarakoma (See section 4.8.3). Therefore, 81.6 % and 60%, sample farmers respond as there is good equity of flood water distribution in Oneya and Tarakoma respectively. In the case of Potota scheme, the sampled farmers evaluated as poor toward providing equity of flood water distribution among spate water communities and solving conflict was 100%.
- There is well developed conflict resolution mechanism at Oneya and Tarakoma schemes of Yandafero spate irrigation system, but not in the case of Potota.
- At the Yandafero spate irrigation system, the water right and distribution rule was similarly established among the three spate schemes (i.e Oneya, Tarakoma and Potota). But not all are similar implemented among each schemes and some of the rule was not familiar with the scheme.
- There is traditionally codified of water right and rules (written by farmers' organization leaders) which is only under Oneya scheme. However some of the codified water right and rules were practiced orally in Tarakoma. Out of sampled farmers 59% responds as they are not believed as the rule and rights has been implemented by responsible body according to its formulated and codified whereas 41% believed as was implemented. However, there is the variation among the three schemes.

- There is a formal credit facility of bank and financial system in Yandafero-Konso spate irrigation. The farmers practised credit and loan through cooperative mechanisms. Currently, the Woreda Cooperative promotion office gives for 18 cooperatives (9 irrigation water cooperative and 9 Women's saving and Credit Cooperative) legality including Oneya and Tarakoma.
- Two conditions are required for farmers to be supplied with water: they must be the member of spate water user and pay the requested fee for registration and must participate in network maintenance before join the member of IWUC.

Agricultural productivity

It is conclude that, the institutional performance toward management of spate water affect agricultural productivities of the area. The conventional approach to agricultural practise in the study area for several years has failed to bring adequate improvements in crop production. According to the data assessed on crop yields the average crop yield for the past 11 successive years (1989-1999) was not exceeds 4.4 Q/hectare. Since there were no clearly identified arrangements neither farmers organization nor governmental/institutional organization for management, operation and maintenance of Yandafero spate irrigation before 2005, flood farming was not apart the community waiting for food aid. However, in recent times food security was insured at the study area (Jarso peasant association) after different food aid organization have been changed their support from food supply to intensively investing on development of spate irrigation systems with ensured community participation to the maximum level and by having '*community first, project second*' intervention approach.

It is analyzed that, the improvement made on the existing spate irrigation systems and developing new diversion structures was the major inputs for efficiency use of spate water to increase crop production. Additionally, improving the existing agricultural extension, livestock management and natural resource management and conservation were also inputs for increasing agricultural outputs. So, these all activities were performed at the study area by EECM/SWS for the last nine years. Currently, five nursery and demonstration sites were established at Yandafero spate irrigation system for seedling production, trial and demonstration. Vegetables and fruits package intervention was also practiced to diversify HH income. The average crop yield per hectare was increased (58.6 Q/hectare in 2013).

In all three schemes(Oneya,Potota and Tarakoma) of irrigation, more than 65% of HHs reported that on the average below 1000kgs per year harvested before the construction of modern diversion weir ,whereas 1.1 %(Oneya), 51.2% (Potota) and 1.0 %(Tarakoma) of HHs responded harvested below 1000kg after the improvement of the diversion weir. From these results it could be generalized that there is a remarkable improvement of HH food production after the intervention of project and active performances of internal farmers' organization toward the management of Yandafero spate irrigation system. However, this is not the case in Potota scheme- the same production before and after the project due to poor performance of internal farmers' organization in managing spate irrigation infrastructure.

Generally, there are dedicated hard working farmers in Yandafero-Konso lowland farmers. With some technical and financial support from nongovernment organizations, the farmers have the potential to produce surplus.

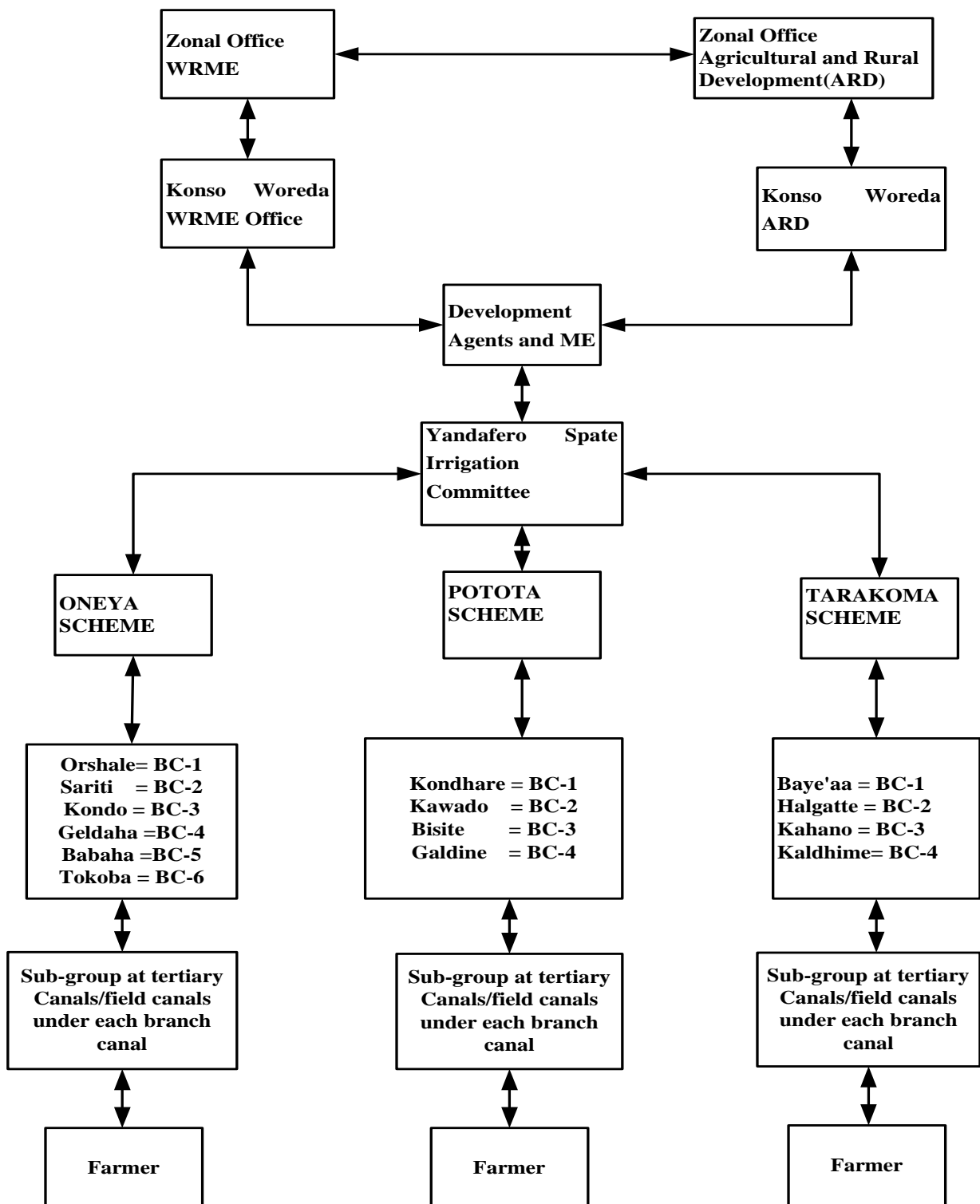
5.2 Recommendation

Based on the conclusion the following points are recommended and proposed.

- As it was described in the main body of the study, there is poor relationship between the farmers' organization and local government in Yandafero-spate irrigation system. However, to optimize the flood water management and to make it sustainable, the active participation of governmental sectors in supporting spate communities is necessary. Therefore, active involvement of the local governmental sectors according to the its mandate (especially the Woreda Agriculture and Rural Development) is necessary for solving the following problems at Yandafero-Konso lowland spate irrigation systems:

- Unfair spate water uses which result the disagreement among the farmers and between upstream and downstream farmers at Potota scheme.
- Lack of formal recognition of farmers' organization that makes less trust of farmers on the O and M of spate infrastructures.
- Shortage of capacity building through training of spate communities on the use of agricultural inputs to increase house hold incomes
- Poor market facilities for the spate communities due to lack of infrastructure like road
- Poor managements on the bank of yanda river(3-4m depth and expanding of the river bank due to erosion) due to beyond the capacity of the farmers
- The yanda farmers' make their permanent residence at highlands which is 25-35km far from their irrigable land due to fear of Mosquito and lack of portable water.
- The complain of farmers' at Tarakoma scheme on receiving the reduced amount of flood due to construction of small size culvert on the main road from *Karat to Guji Zone* by Ethiopian Road Authority and closed due to high accumulation of sediments.
- The government should encourage, the practice of field based experiments involving farmers and awareness creation works started by YFSSISF project to change farmers' perception on the new crop varieties.
- Even though the overall assessment shows that 81% is good in equity of flood water distribution in Oneya scheme, unfair water distribution is occur after destruction of the diversion head. Therefore, for timely maintaining and making functioning of the destructed headwork and intake and flash flood, the intervention of YFSSISF project is necessary with continuous technical and financial support.
- Like at Oneya scheme, the written internal rule and regulation of farmers organization at Tarakoma and Potota schemes should be prepared and formalized for its strong enforcements of implementation according to stated.
- For better water distribution and to insure the equity of water distribution among the farmers, lottery draw for water sharing (which is strongly practiced at Raya spate irrigation in Tigray) is recommended at secondary levels and there should be clear rules on the closing and opening of intake gate at the headwork under three schemes.
- The farmers at Yandafero spate irrigation scheme are by far performing better in constructing field bunds and managing the flood at field level. However, the high labour requirement for bund maintenance and removing of sediments from main canals is tedious. Hence, to ensure more timely maintenance activity and reduce labour for field preparation, the governmental sectors should strength the established cooperative association for introducing small farm machinery deserves a worthy consideration.
- For better understanding the overall performance of Yandafero-spate irrigation system, it is high-quality recommendation if other study would takes place relating to analyze the technical aspect of the scheme.
- The three schemes were diverting the water to their respective main canal from the same river (Yanda River). So, one can affect the others. Therefore the existing farmers' organizational structure does not show such linkage. The organizational structures also did not show the linkage of governmental and farmers. Therefore, to show those all linkages, the following farmers organization structure was proposed. For ease management, the 14 IWUC is proposed, which is established based on branch canal (BC)-Secondary canals (Figure 5-1).

Figure 5-1 Proposed organizational structure of IWUC at Yandafero-spate irrigation system



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APPENDICES

Appendix A: Checklist and Questionnaires designed to collect Primary data

This questionnaire and checklist is designed to collect data for academic research of entitled: Toward better Institutional set up in spate irrigation System: The Case of Yandafero-Konso Lowland Spate Irrigation System, Ethiopia. The data generated through this questionnaire and checklists will be used for academic purposes only.

Part I: Questionnaires and semi-structure interview for Sampled Farmers

General information

Enumerators: 1. _____ 2. _____ 3. _____

Name of the irrigation scheme: 1. ONEYA 2. POTOTA 3. TARAKOMA

Date of interview _____ Started time _____ Completion time _____

Sex: 1. Male 2. female

Age: (1) 0-14 (2) 15-64 (3) 64+

Religion (1) Christen (2) Islam (3) Waqa (4) Non-religion

A. Socio-economic issues

1. Have you had landholding since you started spate farming? Yes ___ No ___
2. If yes, what is the total size of your landholding under spate irrigation _____ (in ha or timed
3. How your spate irrigated land was farmed? 1. Tenancy 2. Sharecropping 3. By himself 4. Others _____
4. What is/are the major crops grown during main season? 1. Sorghum 2. Maize 3. Papaya 4. Mango 5. Others _____
5. How many times did you grow/harvest within a year? 1. Once 2. Twice 3. Others _____
6. If you used to grow twice, what factors promoted you to do so? 1. Sufficient rain 2. Use of spate irrigation 3. Provision of agricultural extension services 4. Other(s), specify _____
7. What is the amount of average annual production before and after the intervention of YFSSIFSP on spate irrigation managements

Before

After

1. below 1000kg

2. 1000-2000kg

3. 2000-3000kg

4. 3000-4000kg

5. Greater than 4000kg

8. During crop failure years/seasons how did you cope? (Coping strategies against food insecurity)

1. Sale of livestock _____

2. Reducing quantity of foods and number of meals _____

3. Eating wild food _____

4. Household members seeking work within and vicinal Pas _____

5. Sale of fire wood/ charcoal/grass, honey _____

6. Inter households/relatives transfers and borrowing of food and cash _____

7. Temporary migration _____

8. Governmental transfer (relief Aid) _____

9. Others _____

B. Operation and Maintenances and Institutional arrangements of spate irrigation

9. Who do you think is the owner of the irrigation infrastructures? (1) Community (2) government (3) No response

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

1. Yes 2. No 3. I don't know

11. 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 _____
12. What do you think are the main functions of the IWUC?
 1. _____
 2. _____
 3. _____
 4. _____
 5. _____
13. How do you evaluate the performance of the spate irrigation committee with regard to the following functions?
 1. Leadership Poor (1) Average (2) Good (3) V. Good (4)
 2. Resource Mobilization Poor (1) Average (2) Good (3) V. Good (4)
 3. Infrastructure Maintenance Poor (1) Average (2) Good (3) V. Good (4)
 4. Equity in Water Distribution Poor (1) Average (2) Good (3) V. Good (4)
 5. Resolving conflicts poor (1) Average (2) Good (3) V. Good (4)
14. 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
15. Have you ever had a conflict related to spate irrigation water utilization with your individual neighbouring farmers? 1. Yes 2. No
16. If yes to question 13 please mention all cases and their causes you remember.
 1. _____
 2. _____
 3. _____
 4. _____
 5. _____
17. How do you resolve the conflict you face with your neighboring farmers? (Please specify the resolving procedure from simple to serious conflicts that may require the involvement of other bodies)
 1. _____
 2. _____
 3. _____
 4. _____
 5. _____
18. Does the WUA in your spate irrigation system have rules and regulation on how to use spate water? 1. Yes 2. No

19. 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. _____ |

20. Do you use spate water for other purpose than crop production? 1. Yes 2. No

21. If the answer for question 18 is yes for what other purposes?

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

22. Are you involved in maintenance and rehabilitation of spate irrigation infrastructures? 1. Yes 2. No

23. How many times do you participate in maintenance of the spate irrigation scheme in rain season?

1. 1 – 3 times
2. 4 - 6 times
3. More than 7 times
4. Never

24. How do you contribute labor in maintenance and rehabilitation of spate structures?

1. According to family labor size
2. According to irrigated farm size
3. There is equal labor contribution
4. Others specify _____

25. 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 _____

C. Distribution of Spate Water

26. Is there water distribution equality? Yes/ No

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

1. The farmers who is near to the main intake
2. The farmers who is participate in maintenance rehabilitation activities
3. The farmers who is violate the rules and regulations
4. Others specify _____

28. 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 _____

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

1 _____

2 _____

3 _____

4 _____

30. Do you believe the rule and regulations are enforced in the way they are formulated? 1. Yes 2. No

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

1 _____

2 _____

3 _____

4 _____

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

1 _____

2 _____

3 _____

4 _____

33. 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 _____

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

1= Yes 2= No

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

1 _____

2 _____

3 _____

4 _____

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

1= Yes 2= No

37. Do you pay any water use fees?

1= Yes 2= No

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

1 _____

2 _____

3 _____

4 _____

FOR FEMALE HHs ONLY

39. Are you involved in the decision making of spate water management in your community? 1. Yes

2. No

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

1. Sharecrop

2. Hire labour

3. Use their family labor

4. Mention if any _____

41. Do you attending any WUA meetings?

1= regularly

2= occasionally

3= never

Part II: Checklists for Interview and discussion

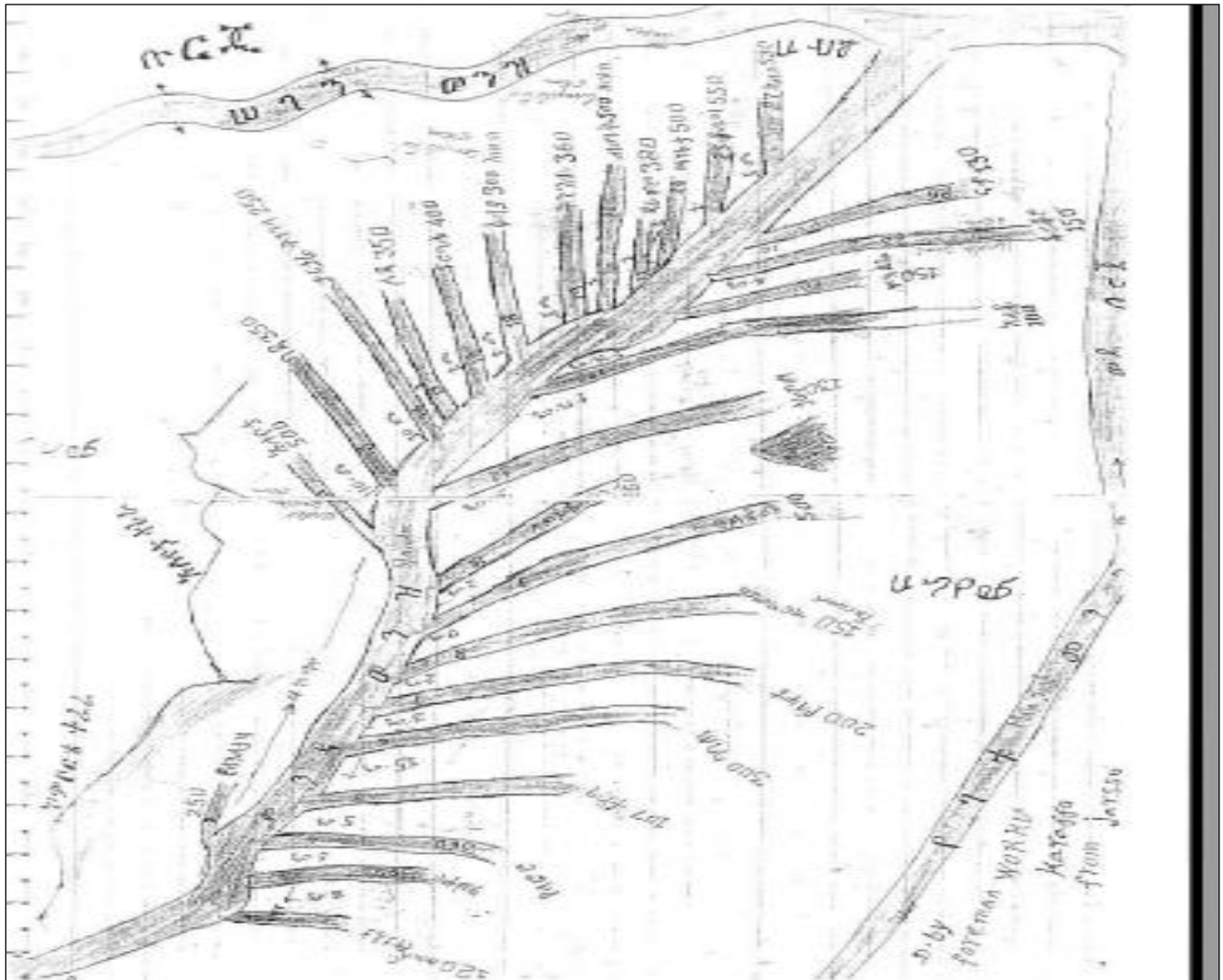
I. Checklists for Interview and discussion to the Water Committee leaders

1. How is the IWUC/ Water committee in your community formed?
2. What are the major objectives on which the IWUC/ Water committee is formed?
3. How frequently do the IWUC/ 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 downstream/ 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?

II. Checklists for Interview and discussion with woreda experts

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 are the organizations involved in the ladders of spate management
5. Is your office involved in the management ladders as a member/in any way? Identify in which ladders your office is involved.
6. What impediments do: Traditional spate irrigation systems have? Modernized spate irrigation systems have??
7. What specific interventions do you think the scheme need so that they can generate maximum benefit to the community?

Appendix B: Free hand sketch layout of 27 small traditional intakes developed on Yanda River (Farm-Africa, May 2000)



Appendix C: HH responses towards coping mechanisms during crop failure

Type of coping Mechanism	Frequency	percent
Sale of livestock	3	1.7
Sales of livestock, Honey, wood/grass, eat wild fruits and kin and/or community directed transfer (gift/borrowing)	96	53.3
Sales wood/grass/charcoal, wild fruit, food for work and reduce quantity of food and number of meals	26	14.4
Saving surplus grains for next year, Off-farming activities, Using locally available natural resource(traditional Cabbage)	24	13.3
Kin and/or community transfers (borrow, gifts), Traditional mechanisms of solidarities('Kanta' or 'Idir' etc)	29	16.2
Governmental transfer(relief aid)	2	1.1
Total	180	100.0

Appendix D: Modern diversion structures constructed by EECMY /SWS/ DASSC: YFSS IFP

s/no	Name of site	Year of construction	Type of structure	Canal length (km)		Design command area(ha)	Main canal capacity (m ³ /s)	Beneficiaries	Allocated budget(ET- birr)
				Main Canal	² ndary Canals				
1	GELDEHA	2005	Broad crested weir	2.6	3.324	600	1.5	500	638941.25
2	ORSHALE	2006	Full barrage	2.6	2.04	400	1.2	250	428625.0
3	ITIKLE	2006/7	Weir + barrage	2.9	4.6	300	0.9	300	512507.0
4	KONDO	2007/8	Weir + barrage	3.4	2	650	1.95	650	796928.0
5	METTE	2007/8	River bed protection	3.0	5.344	900	3.0	650	1451185.0
6	MACHA	2009	Full barrage	6.0	9.615	1000	2.5	1000	1715102.1
7	SARANGA	2010	Weir + barrage	3.8	5.2	500	1.25	500	2383680.0
8	YANDA ONEYA	2010	Broad crested weir	5.0	6.0	600	1.25	650	1884477.7
9	YANDA POTOTA	2011	Broad crested weir	7.3	6.0	500	1.25	500	2430723.6
10	YANDA TARAKOME	2012	Full barrage	1.3	6.6	500	1.25	500	2624351.0
11	YANDA PAPAHA	2012	Broad crested weir	7.8	15.257	500	1.25	500	2529335.7

Source: Ethiopian Evangelical Church Mekane Yesus South Syndos Office, Konso, 2013

Appendix E: Irrigation water user's cooperatives and women's saving & credit cooperative capital status Year 2013

Irrigation water users cooperatives and women's saving & credit cooperative capital status Year 2013											
No	Name of the cooperative	Type of cooperative	Current status								
			Member			Capital					
			M	F	T	Registration fee	Paid up share	Saving	water rent	Other income	Total
1	Etigle	Irrigation water	130	3	133	665	6650	63400	508	15029	86252
2	Geldaha	Irrigation water	90	7	113	5650	8400	2565	4939	11136	32690
3	Orshale	Irrigation water	95	8	103	1030	4120	8420	0	0	13570
4	Kondo	Irrigation water	127	1	128	2560	3840	3612	1595	20	11627
5	Sharanga	Irrigation water	334	5	339	3390	16950	43890	3934	16570	84734
6	Mecha	Irrigation water	208	14	222	2180	5450	17160	240	11110	36140
7	Oneya	Irrigation water	93	5	98	1960	4900	19800	0	0	26660
8	Laka Kayla	Irrigation water	226	3	229	2290	6870	0	0	4000	13160
9	Tara koma	Irrigation water	91	0	91	1820	4550	7500	0	0	13870
	sub total		1394	46	1456	21545	61730	146547	11216	57865	318703
10	Etigle women's	Saving & credit	0	86	86	285	1730	24150	0	9750	35915
11	Keldime womens'	Saving & credit	0	45	45	135	1330	10520	0	10449	22434
12	Kube women's	Saving & credit	0	45	45	135	890	12304	0	9661.5	22991
13	Nalaya women's	Saving & credit	0	128	128	384	2580	30517	0	13162	46643
14	Sharanaga women's	Saving & credit	0	146	146	441	2940	36125	0	12461	51967
15	Mecha women's	Saving & credit	0	126	126	378	2500	28940	0	12297	44115
16	Geldaha women's	Saving & credit	0	28	28	84	560	6315	0	10140	17099
17	Birbisa women's	Saving & credit	0	56	56	168	1100	6670	0	10877	18815
18	Jarso women's	weaver	0	30	30	150	1200	12802	0	13300	27452
	sub total		0	690	690	2160	14830	168343	0	102098	287431

Source: Konso special woreda Cooperative Promotion office, 2013