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# Institutions for irrigation water management in Ethiopia: Assessing diversity and service delivery

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# Acronyms

| | |
|---|---|
| DA | Development agent |
| ETB | Ethiopian birr |
| FDRE | Federal Democratic Republic of Ethiopia |
| FGD | Focus group discussion |
| HHS | Household survey |
| IC | Irrigation cooperative |
| ILRI | International Livestock Research Institute |
| IMT | Irrigation management transfer |
| IWUA | Irrigation water users association |
| KII | Key informant interviews |
| LIVES | Livestock and Irrigation Value chain for Ethiopian Smallholders |
| MoWR | Ministry of Water Resources |
| NGO | Non-governmental organization |
| O&M | Operation and maintenance |
| WC | Water committee |
| WLE | Water, Land and Ecosystems |
| WUA | Water Users Association |

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# Abstract

Irrigation systems cannot ensure the equitable distribution of water among users and sustainable operation and maintenance of the schemes without capable irrigation institutions. In Ethiopia, traditional institutions have emerged with the expansion of traditional irrigation schemes and most of them were established and operated on the initiative of the farmers. These often have very limited financial and technical capacities. Current trends show that developing infrastructure is the major concern in irrigation development efforts. However, managing the schemes is largely overlooked, particularly for externally initiated irrigation schemes. Operation and maintenance of the irrigation schemes, particularly those at tertiary levels, are commonly not well set and often neglected or left to farmers without building their capacities. The overarching objectives of the study were to: i) assess the nature and diversity of irrigation institutions in the study schemes; ii) evaluate existing institutions service delivery with respect to selected attributes and draw useful lessons; and iii) identify appropriate interventions. This study focused on 10 irrigation schemes located in four regional states of Ethiopia (Tigray, Amhara, Oromia and SNNP). Various approaches were used to generate data required for this study, such as household interview, transect walk and systematic observation, focus group discussion, key informant interviews and the review of existing literature. We clustered the study schemes as modern, semi-modern and traditional, using selected criteria (operation and maintenance service delivery, managing financial service delivery, level of inequity) to generate empirical evidence for evaluation of their performances. The results found two forms of irrigation institutions: irrigation water users associations (IWUA) and irrigation cooperatives or water committee. More than 30% of the irrigation schemes considered in the study, regardless of their typology, had no institution. Membership in the irrigation institution for traditional schemes was 100%, while the average membership both in modern and semi-modern schemes was about 70% of the respondents. This contrasts with the new proclamation in Ethiopia on IWUA which suggest mandatory membership for any water user in a scheme. Without exception bylaws were either not detailed enough to address scheme specific problems or not recorded at all. Ambiguity associated with these, and probably presence of non-member water users, deterred the decision-making processes and the enforcement of rules and regulations for water use, thus create opportunities for free riders. This also explains the reason for occasional conflict between irrigators and the inequity of water distribution within scheme. In many cases, irrigation institutions service delivery limited to operational management and other services, such as financial management, were not common even at those schemes where irrigation fee exists. Problems associated with a lack of empirical evidence as to what to pay for and how much to pay and the application of flat rate—regardless of the amount of irrigation water used, which is not measured—and crop types grown as currently practised will not act as an incentive for prudent water use. Establishing the amount and types of irrigation water fees will be an important step to finance irrigation schemes. Understanding this diversity and these gaps and tailoring actions to local conditions is vital efforts to improve the service delivery of irrigation institutions in Ethiopia. Secondly, the service required for the sustainable management of irrigation schemes and mechanisms to operate them needs to be standardized.

Key words: Organizations, water users associations, operation and maintenance services, sustainable irrigation development.

# 1 Introduction

Irrigation systems are not stand alone physical entities, and require the active involvement of the community for their sustainable operation. In Ethiopia, although organizations for irrigation management existed in different forms, they were neither generally well recognized nor endorsed by the public sector. Where they existed, they generally lacked appropriate regulation and the legal basis to function properly. In several irrigation schemes in Ethiopia, cooperatives and water committees are involved in serving some of the purposes of irrigation water users associations (IWUAs) (Yami 2013). However, there are major differences between these organizations and IWUA. The pre-existing legal framework in Ethiopia, i.e. cooperatives and associations proclamations (FDRE 1998) does not provide an appropriate legal basis for IWUA for different reasons (Lempériere et al. 2014).

Irrigation systems cannot meet their intended objectives without appropriate organizations to manage, maintain and operate the systems. There are arguments emphasizing that irrigation service delivery and thus irrigations systems performance can be improved by transferring the management of public irrigation systems to IWUA or farmers organizations (Lempériere et al. 2014). Transfer of irrigation management from government agencies to farmer organizations or IWUA can have the following positive implications:

i. it can serve as a mechanism to reduce the financial burden of operation and maintenance of irrigation schemes;

ii. it builds a sense of ownership of irrigation schemes by the farmers and hence ensures better asset management; and

iii. it can result in better irrigation water management and service delivery as there is better cooperation between the water users (Lempériere et al. 2014).

Several global experiences also show that irrigation management by government agencies exert heavy financial burden on governments and irrigation performance has been disappointing in some cases. Farmers, hence, have preferred managing their schemes themselves, organizing themselves into legal institutions mandated for the provision of irrigation services to their members and the collection of service fees. Irrigation management transfer (IMT) has been widely practised for more than two decades in several countries in Asia and Latin America (e.g. Dadaser-Celik et al. 2008). Many countries around the world are currently moving to devolve a range of irrigation water management tasks from state agencies to participatory, autonomous and financially self-supporting water user associations (JICA and OIDA 2014). A very good example for the success of irrigation management transfer from the government to water user associations is the case of Turkey.

Turkey undertook large changes to irrigation management institutions and policies since the early 1990s. The State Hydraulic Works of Turkey was responsible for planning, implementing, operating and maintaining irrigation systems prior to the start of irrigation management transfer to farmers. Turkey started an accelerated program of transferring the responsibilities of operation and management of irrigation to farmers (Dadaser-Celik et al. 2008). As a result, Svendsen and Murray-Rust (2001) stated that by 1996, 61% of the irrigated area (about 1 million ha) and by 2001, more than 80% of irrigated area was transferred to irrigation associations. Kuscu et al. (2009) stated that the major reason for IMT Turkey is to decrease the budget and other assets required for the management of irrigation systems, which the farmers often perform it more economically.

Samad and Vermillion (1999) stated that government expenditure on irrigation management significantly decreased after IMT in Sri Lanka and other countries. Several researchers that conducted comparative performance evaluations on irrigation schemes before and after IMT generally confirm that they perform better in terms of cost effectiveness, irrigation efficiency, water fee collection efficiency, water productivity, satisfaction on service delivery etc.

To date the role played by irrigation organizations in irrigation management in Ethiopia is not significant (Yami 2013). Different organizations have existed at several irrigation schemes, particularly over the past decade, with the expansion of traditional irrigation schemes. Many of the local institutions (e.g. traditional irrigation schemes) often have very limited external support and most were established and operated on the initiative of the farmers (Yami 2013). However, several of these organizations have very limited financial and technical capacities and their performance has been poor (Yami 2013).

Awulachew et al. (2010) stated that in many irrigation schemes in Ethiopia issues like water fees, water rights, water conflict resolution, incentives for collaboration between the local, regional, and federal levels of government and incentives for accurate reporting of current projects etc. lack a regulatory framework. Public investment in irrigation in Ethiopia has largely focused on infrastructural development, with very little attention given to operation and maintenance and long-term sustainability issues (Brown 2011; Tilahun et al. 2011; Yami 2013). Even in several modern irrigation schemes in Ethiopia, formal, legitimate and public law of irrigation water users' organizations are generally given less attention and often neglected. Hence, schemes often failed to meet their expectations in terms of sustainability and outputs due to inadequate user involvements and poor institutional setup for proper operation, maintenance and irrigation service provision (Yami and Snyder 2012).

There are a few irrigation schemes where the irrigation organizations perform well. However, institutionalizing, setting up the underlying legal framework and building the capacity of irrigation associations is highly relevant for better irrigation management in Ethiopia (Yami and Snyder 2012; Yami 2013). Establishing water users associations (WUAs) would enhance the operation, maintenance and water management of irrigation schemes, particularly of the water distribution, water allocation, and scheduling and maintenance aspects of irrigation schemes in Ethiopia. It is with this intent that a proclamation was recently passed by the Federal Democratic Republic of Ethiopia for establishment of WUAs (FDRE 2014). The proclamation creates a legal basis for the establishment of WUAs as a particular type of legal entity for the operation and management (O&M) of irrigation systems.

The significance of irrigation development is well reflected in the policy documents of the Ministry of Water, Irrigation and Energy and the Ministry of Agriculture (MoWR 1999). One of the important aspects of the water resources policy of Ethiopia (MoWR 1999) is that it envisages for sustainability, equity and efficiency in use of the water resources of the country. There are large gaps in terms of capacity and finance particularly at lower levels. Operation and maintenance planning and cost implications, particularly those at tertiary canal levels are commonly not well developed and often neglected or left to the farmers without the provision of the proper capacity development support. As a result, issues like poor maintenance, poor asset management, poor irrigation service, and inequitable water allocation continue to be key concerns that need to be addressed by irrigation organizations (Yami 2013).

This study intends to assess the nature and diversity of irrigation institutions in the study schemes in 10 irrigation schemes located in four regional states of Ethiopia (Tigray, Amhara, Oromia and SNNPRS) and to evaluate the existing service delivery by these institutions.

# 2 Materials and methods

## 2.1 Location of the study schemes and key features of irrigation institutions

The 10 irrigation schemes studied here are located in four regional states of Ethiopia (Figure 1). The study sample schemes were selected using criteria such as representativeness for different scales (large, medium and small) and managed by smallholders, crop types and agro-ecology (e.g. altitude range 1500–2725 masl). Some salient features of the irrigation schemes as related to institutions are depicted in Table 1.

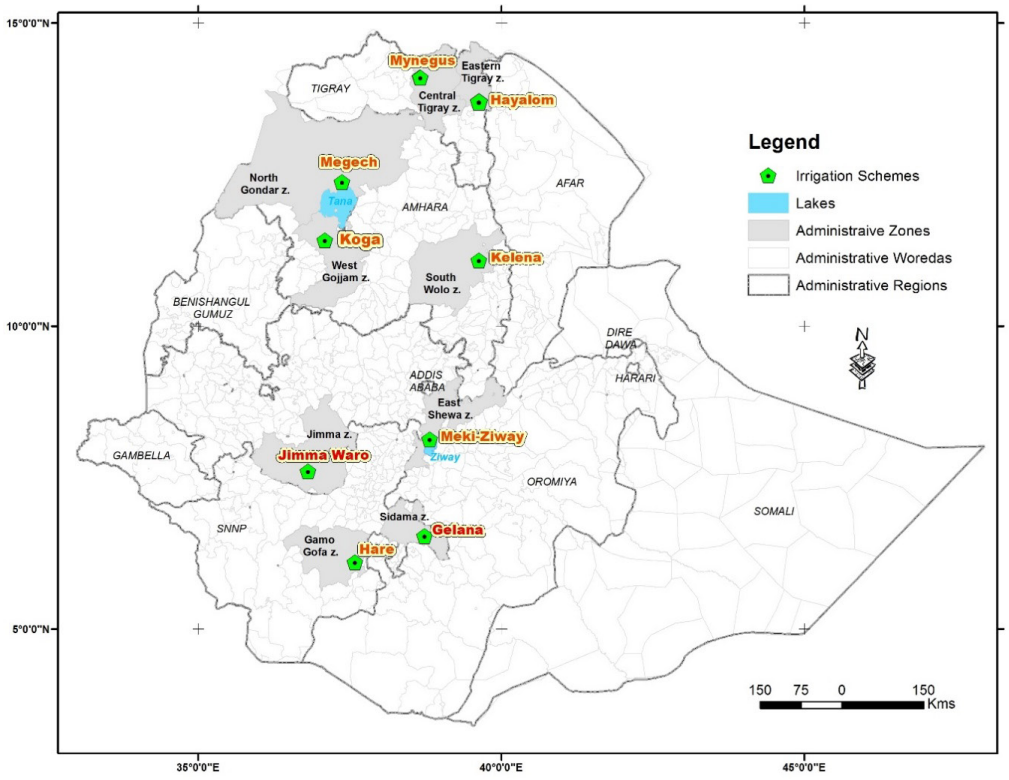

Table 1. Salient features of the schemes related to organizations for water management.

| Scheme | Koga | Megech | Kelena | May Nigus | Wukro/ Hayelom | Meki | Waro | Hare* weir/Hare diversion | Gelana |
|---|---|---|---|---|---|---|---|---|---|
| Location, zone | West Gojam | North Gondar | South Wollo | Central Tigray | Eastern Tigray | East Shoa | Jimma | Gamo Gofa | Sidama |
| Typology | Modern | Traditional | Traditional | Semi-modern | Semi-modern | Semi-modern | Traditional | Semi-modern/ traditional | Semi-modern |
| Major crops | Wheat, potato, onion | Onion, garlic, tomato | Tomato, onion, potato | Onion, maize, cabbage | Onion, tomato, maize | Onion, tomato | Potato, onion, tomato | Banana, maize, onion, tomato | Coffee, maize ensete, tomato |
| Presence of irrigation organization | Yes | No | No | Yes | Yes | Yes | Yes | Yes | No |
| | IWUA | | | WC | WC | IWUA | WC | WC | |
| Function of organization | Water allocation and maintenance at quaternary levels | – | – | Water diversion, allocation and overall maintenance | Water diversion, allocation and overall maintenance | Permission to new users, water fee collection and pump maintenance | Water diversion, allocation and maintenance | Water allocation, maintenance | – |
| Condition of membership | Compulsory | – | – | Optional | Optional | Optional | Optional | Optional | – |
| Internal regulations | No | – | – | Yes | Yes | Yes | Yes | No | No |
| Irrigation service fee | No | No | – | Yes | No | Yes | No | No | No |
| Contribution to maintenance | Labour | None | – | Labour | Labour | Labour/fee | Labour | Labour | Labour |

* Hare has both traditional and modern schemes.

## 2.2 Data collection

Data on irrigation organizations was collected from primary sources using various tools. The tools include focus group discussions (FGDs), household surveys (HHS), key informant interviews (KII), transect walks and systematic observations. The FGDs comprised 5–10 individuals from the schemes. The composition of the FGD unit was farmers, *kebele*[1] development agents (DAs), a *kebele* administrator, and the chairperson of water committees or the fourth canal water users team in cases where the existing institution is an IWUA. For schemes that have no irrigation institution the FGD unit was limited to the first three groups. For the household survey, 30 farm households were selected from each scheme using stratified random sampling method. An arbitrary strata (as head, tail and mid irrigators) was primarily defined through transect walk in the schemes. Hence 10 farmers were selected from each stratum: head, middle and tail reaches. The KII was undertaken with focal persons of the *woreda*[2] irrigation development office, *kebele* DA, *kebele* administrator and chairpersons of irrigation institutions wherever such organizations existed.

## 2.3 Irrigation schemes typology building

Accordingly, 3 out of 10 schemes are clustered under traditional, 1 as modern and 6 as semi-modern schemes. From the 10 studied schemes, 3 have no irrigation institution. In these schemes where institutions exist, membership is optional except in the case of the modern schemes. Traditionally, irrigation schemes are just clustered as traditional or modern depending on whether their headwork is from locally available material or concrete. Here, we adopt the irrigation

1 Kebele is the lowest administrative unit in Ethiopia, also called peasant association.

2 Woreda is the second lowest administrative unit in Ethiopia, also called districts.

typologies developed by Agide et al. (2015, in press). The authors classified the schemes into three typologies based on multiple criteria (Agide et al. 2015, in press). Seven criteria considered for building the typology of irrigation schemes were the water source, type of intakes (headworks), conveyance and distribution systems, flow control structures, on-farm water application methods, drainage conditions and irrigation organizations (Agide et al. 2015, in press). To each of these criteria, a weight was assigned by a team of experts so that the total weight sums up to 10. Then each scheme was graded against each criterion out of 10, and the grades were then added together to find the final grade which was then converted to 100. The schemes were hence categorized into modern, semi-modern and traditional typologies based on the total grades. The basis for categorization is arbitrary and is as follows: modern (grade >80%), semi-modern (grade >50 <80%) and traditional (grade <50%). The typology of the schemes is shown in Table 2.

Table 2. Irrigation scheme typology based on multi-criteria evaluation.

| Scheme | Grade (multi-criteria analysis) | Typology |
|---|---|---|
| Koga | 92.5 | Modern |
| May Nigus | 62.25 | |
| Meki | 59 | |
| Wukro/Hayelom | 58.5 | Semi-modern |
| Hare Weir | 58 | |
| Gelana | 50.25 | |
| Kelena | 46.5 | |
| Waro | 42.5 | Traditional |
| Megech | 42.25 | |
| Hare diversion | 36.5 | |

## 2.4 Performances evaluation of irrigation schemes' in irrigation service delivery

Evaluating the nature and performance of institutions for irrigation water management is not based on numerical values of certain indicators; but on qualitative descriptions, comparisons and responses from stakeholders, including farmers, development agents, *kebele* administrators (compare also Yami 2013). To characterize the nature of organizations for irrigation management and for evaluation of irrigation institutions service delivery, the indicators used involve (see also Lempériere et al. 2014):

- existence/absence of irrigation institutions;
- functions of institutions;
- institutional achievement to ensure water delivery equity;
- farmers' perception of the services rendered;
- willingness of the farmers to contribute to operation and maintenance;
- incidence of conflicts between farmers and organizations; and
- role of women irrigation organizations.

Data related to irrigation organizations at the irrigation schemes are mainly qualitative and the analysis is based on a qualitative comparison and descriptive statistics of pertinent information. As such, qualitative data obtained from the FGD, KII and HHS at each of the schemes were described more logically, and compared to each other to find out diversities and similarities among their organizational setups. This gives a better understanding of the types of irrigation organizations that have already existed in these schemes and their shortcomings in terms of accomplishing their tasks.

# 3 Results and discussion

## 3.1 Irrigation institutions and their autonomy

Institutions for irrigation water management for the Ethiopian case are generally diverse, but not well developed in their nature and functions. For instance, farmers' cooperatives in several schemes in Ethiopia were involved to a certain extent in the management of irrigation schemes, in addition to marketing of products and supply of inputs (Yami and Snyder 2012; Yami 2013).

There have been differences in the naming of local irrigation institutions at several irrigation schemes in Ethiopia. In the 10 schemes covered in this study, irrigation institutions existed in 7 schemes, while they were totally absent in 3 schemes. Even for those schemes with institutions, there are several differences in terms of the type, capacities, and functions of the organizations (Table 3). While institutions are totally absent at some schemes, at others they exist in name only and their impact is insignificant. Yami (2013) explains this as due to interventions of external bodies in the establishment of the IWUA bylaws and in how the determination of the responsibilities of users and IWUA committees contributed to a low level of participation. Sometimes the traditional organizations on these schemes have been replaced by or incorporated into government-promoted IWUAs. Yami (2013) further argued that the way participatory approaches are used in developing interventions and the lack of understanding of power distribution among different actors and local institutional arrangements have reduced the effectiveness of the approach in the planning and implementation of projects. This can also be comprehended from the fact that many institutions locally established by the water users themselves are working much better (Tilahun et al. 2011).

IWUAs, in principle, are self-managed and governed by their members, and the general assembly is the highest body of the IWUA (FDRE 2014; Lempériere et al. 2014). However, in the irrigation schemes in this study, irrigation institutions are not fully self-managed. The highest supervisory bodies in the existing irrigation institutions are government administrative offices (Figure 2) and also cooperatives. In this regard scholars argue that given the basic differences between the purposes of cooperatives and water users institution, it is unwise to let cooperatives run irrigation water institutions. For example, Lempériere et al. (2014) indicated the following features of IWUAs that make it different from cooperatives and other associations:

i) IWUAs are public legal organizations and their mandate is of a public interest;

ii) membership of IWUAs is compulsory;

iii) IWUAs operate on a non-profit/non-commercial basis, but they nevertheless provide services to their members, namely the provision of irrigation water, on a payment basis; and

iv) IWUAs are self-managed organizations governed by their members but due to the public interest nature of their tasks, they are subject to some form of supervision by the state.

Building up irrigation institutions in a pragmatic and socially embedded process instead of imposing cooperative framework could work better in managing irrigation schemes (Yami 2013). Generally lack of a clear-cut distinction between the roles of agricultural cooperatives and IWUAs creates confusion in the governance of irrigation schemes in Ethiopia (Yami and Snyder 2012; Amede 2014).

Figure 2. Examples of structure of irrigation institutions: Meki scheme (A); May Nigus and Wukro/Hayelom schemes (B) and Hare/Waro schemes (C).

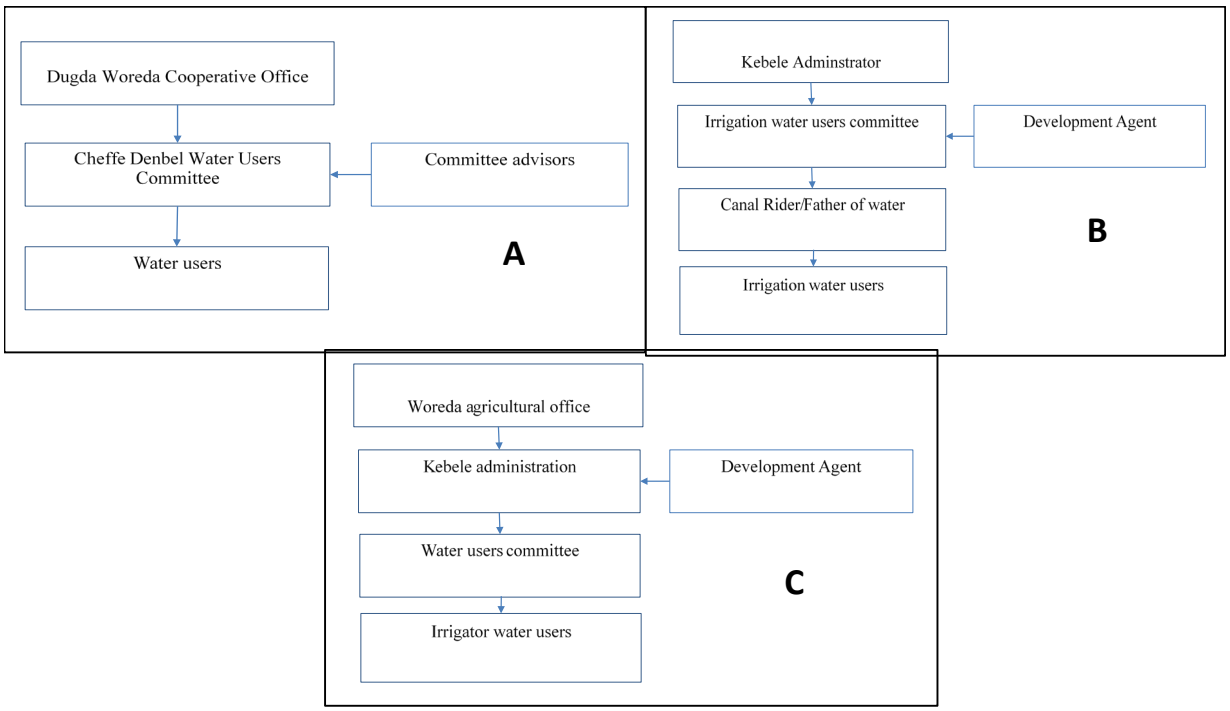


Table 3. Existence of irrigation organizations in the study schemes.

| Scheme name | Types of organization* |
|---|---|
| Koga | IWUA |
| Meki | IWUA |
| May Nigus | WC |
| Wukro/Hayelom | WC |
| Hare Weir | WC |
| Gelana | X |
| Megech | X |
| Waro | WC |
| Hare diversion | WC |
| Kelena | X |

* IWUA stands for irrigation water users association; WC stands for water committee; X stands for no institution.

In addition to the structure of the institutions, issues with membership are the major hurdle in irrigation institutions (Lempériere et al. 2014). Membership of water users in the IWUA should ideally be compulsory and is linked to the presence of irrigable land (land use rights) within the service area of the irrigation scheme (FDRE 2014). Membership of IWUAs should be compulsory because in surface irrigation systems where water flows in canals, illegal diversion and hence free riding cannot be totally avoided (FDRE 2014). Membership of water users in existing irrigation organizations at different schemes of this study is shown in Table 4. It was observed that there are non-member farmers in some of the schemes. Non-members do not pay irrigation water fees (whenever this exists) and hardly participate in maintenance activities. Generally, non-members make the enforcement of rules and regulation very difficult and thus create opportunity for free riders.

Table 4. Membership of users in existing irrigation organizations.

| Scheme | Total no. of respondents | Members | | Non-members | |
|---|---|---|---|---|---|
| | | Number | % | Number | % |
| Koga | 30 | 29 | 97 | 1 | 3 |
| Meki | 30 | 21 | 70 | 9 | 30 |
| May Nigus | 25 | 16 | 64 | 9 | 36 |
| Hayelom/ Wukro | 53 | 37 | 70 | 16 | 30 |
| Hare weir | 20 | 20 | 100 | 0 | 0 |
| Hare diversion | 20 | 20 | 100 | 0 | 0 |
| Waro | 30 | 30 | 100 | 0 | 0 |

Implicitly, the existing irrigation institutions fail to meet the criteria of self-governance and, thus, existing institutions are different from IWUAs. Users also complain about abuse of power and corruption by the officers. In fact, the new IWUA proclamation (FDRE 2014) stipulates the need for a 'supervising body'; this means the irrigation infrastructure constructed by the federal government and the state government budget need a body designated by the government that is responsible for organizing and registering associations, providing training and other technical assistance to associations. In reality, there is a top down approach and existing institutions are not empowered for self-governances (Yami 2013).

Irrigation involves multiple stakeholders with varying interests (Amede 2014; Dessalegn and Merrey 2014). Careful consideration of the context of user participation needs to be emphasized. 'Participation' is often understood in terms of the actors and stakeholders using water and their involvement in water governance (Montaña et al. 2009). It generally implies empowering users to varying degrees to take responsibility for their schemes.

## 3.2 Function of irrigation water management institutions

The tasks of irrigation water user institutions in Ethiopia are often limited to providing irrigation services and activities. FDRE (2014) suggests that IWUAs are mandated to the operation and maintenance of the irrigation infrastructure within the hydraulic boundaries of the irrigation systems, decision-making to facilitate the operation and maintenance and decision-making on finance. Lempériere et al. (2014) generally classify the task of irrigation institutions, specifically IWUAs, into three categories: governance, operation and maintenance, and financial management. The following section illustrates how these functions are performed by the water institutions in the study areas.

### Key elements of governance

Ghazouani et al. (2012) argues that water governance is a range of political, socio-economic and administrative system established for the development and management of water resources and water services in irrigation schemes. It includes establishing the rules, responsibilities, operating mechanisms, policies and users, and official accountability systems. Ghazouani et al. (2012) emphasized that effective governance is that which provides water for livelihood and economic growth, yet maintains a sustainable environment.

Governance generally relates to the roles of the general assembly of the IWUA. It includes the approval of budgets, action plans and reports, as well as the adoption and amendment of regulations governing the day-to-day operational activities of the IWUA. As depicted in Table 4, the task of existing irrigation institutions is limited to few activities. In exceptional cases, seasonal/annual budget are set and implemented across schemes where irrigation institutions exist.

The second most important task implemented across study schemes was arbitration and dispute settlement. For the rest of the tasks, there were apparent variations among the schemes in terms of accomplishment. For example, the election of the officer was only recorded for three; approval of annual/seasonal budgets was recorded in two schemes (Table 5). This also means officers are assigned by the local administration or in accordance with traditional

norms and procedures. A democratic process for the selection of users' representatives and a directive board seems to be a desirable feature of legal framework of IWUAs. These almost invariably have provisions for the election of user representatives as general assembly members and for board positions (president, secretary and treasurer). Democratic procedures for choosing and removing leaders and staff members are important in creating healthy relations between farmers and formal organizations, and increase the legitimacy of the latter (Ghazouani et al. 2012).

Irrigation water fees are collected from the members only at Meki scheme; this is a pumping scheme where water is pumped from Lake Ziway with large electric pumps to a large main canal from which farmers pump using small diesel pumps. Electricity costs are significant for this scheme and almost all of the fee goes towards electricity bills. For the other schemes, where there is no irrigation fee, budgets for some activities may be set in a way in which members contribute at the moment of need; however, budgets do not generally need approval. In view of the level of accomplishment of governance tasks by the study irrigation schemes, it can be concluded that irrigation institutions perform poorly and tasks are left uncompleted. Discussions with key informants also revealed that the major contributory factors to these problems were low levels of awareness and autonomy.

Table 5. Major governance tasks of organizations at schemes.

| Scheme* | Tasks | | | | |
|---|---|---|---|---|---|
| | Election of officer | Approval of annual/ seasonal budget | Setting up annual/ seasonal budget | Arbitration and settling disputes | Setting up internal regulations |
| Koga | √ | X | √ | √ | √ |
| Meki | X | √ | √ | X | √ |
| May Nigus | √ | √ | √ | √ | √ |
| Wukro/ Hayelom | √ | X | √ | √ | √ |
| Hare weir | X | X | √ | √ | X |
| Hare diversion | X | X | √ | √ | X |
| Waro | X | X | √ | √ | X |

√ shows that the irrigation institutions fulfil the evaluation criteria, while X shows that the institutions do not fulfil the criteria.

*Three of the schemes have no institution and thus not included in Table 5.

Setting internal regulations is one of the major tasks of IWUAs (FDRE 2014). Internal regulations, also called bylaws, are specific to each irrigation organization and they are set based on the existing situations in the irrigation system, including source of water, level of water scarcity, irrigated crops, irrigation service type, water fees, operation and maintenance requirements of the scheme etc. Internal regulations may generally be revised periodically. The irrigation schemes covered in the study have their own regulations which in many cases were not written or well documented. Experiences elsewhere in Ethiopia suggests that they are developed and imposed particularly when IWUAs are directly linked to cooperatives (Yami 2016). When this happens acceptability by users will be challenged. For example, as indicated on Table 6, the internal regulations are not fully accepted by the farmers. Modern and traditional schemes have the highest acceptability of regulations, while farmers at semi-modern schemes rated the regulations as comparatively less acceptable. The highest level of unacceptability was recorded for Meki scheme which has a direct linkage to a cooperative. Although we have no evidence as to who developed the regulations for Meki scheme, we argue that existing regulations could be an imposition by cooperatives (Yami 2016).

Table 6. Acceptability of internal regulations.

| Scheme | Total no. of respondents | Acceptable | | Not acceptable | | Don't mind | |
|---|---|---|---|---|---|---|---|
| | | Number | % | Number | % | Number | % |
| Koga | 24 | 21 | 88 | 1 | 4 | 2 | 8 |
| Meki | 30 | 18 | 60 | 11 | 37 | 1 | 3 |
| May Nigus | 30 | 22 | 73 | 4 | 13 | 4 | 13 |
| Wukro/ Hayelom | 56 | 53 | 95 | 0 | 0 | 3 | 5 |
| Hare weir | 21 | 16 | 76 | 5 | 24 | 0 | 0 |
| Hare diversion | 18 | 14 | 78 | 4 | 22 | 0 | 0 |
| Waro | 30 | 30 | 100 | 0 | 0 | 0 | 0 |

Discussion with farmers also clearly elucidates that water shortages and a lack of comprehensive and documented regulations are some of the major causes of conflict between users. This case is substantiated by Amede (2014) who suggested water shortages and poor upstream downstream linkage as one of the major causes of conflict across irrigation schemes. Here we considered conflict from two major angles: conflict between users and institutions (Table 7) and conflict between users themselves (Table 8).

Table 7. Occurrence of conflicts between farmers and irrigation organization.

| Scheme | Total no. of respondents | Had conflicts with organization | | Did not have conflicts with organization | |
|---|---|---|---|---|---|
| | | No. of respondents | % | No of respondents | % |
| Koga | 30 | 5 | 17 | 25 | 83 |
| Meki | 30 | 0 | 0 | 30 | 100 |
| May Nigus | 32 | 7 | 22 | 25 | 78 |
| Wukro | 35 | 5 | 14 | 30 | 86 |
| Hare weir | 19 | 7 | 37 | 12 | 63 |
| Waro | 28 | 4 | 14 | 24 | 86 |
| Hare diversion | 17 | 5 | 29 | 12 | 71 |

Conflicts between farmers and irrigation organizations generally occur when the agreed irrigation services are not delivered as per the agreement or the regulations for water distribution and when deliveries are not respected. The responses of farmers on the incidence of conflicts with irrigation organizations are shown in Table 7. The proportion of farmers who did not experience conflicts with the irrigation organizations is much lower than those who experienced conflicts at each scheme. Despite low level of acceptability of internal regulation, Meki recorded a low level of conflict, posing a contrasting situation. This can probably be explained by the fact that farmers at this scheme pump water from the main canal using individual or communal pumps, and hence the irrigation organization has little mandate for water allocation and distribution. The main task of the organization is to ensure timely maintenance of the main pumping station from the lake. Farmers pay a fee of Ethiopian birr[3] 1000/ha per year which is exclusively for electricity costs and the maintenance of the pump from Lake Ziway into the main canal.

3 On 15 March 2016, USD 1 = Ethiopian birr (ETB) 21.3435.

Table 8. Incidence of conflicts between farmers.

| Scheme | Total no. of respondents | Had conflicts | | Did not have conflicts | |
|---|---|---|---|---|---|
| | | No. of respondents | % | No. of respondents | % |
| Koga | 29 | 18 | 62.07 | 11 | 37.93 |
| Meki | 30 | 1 | 3.33 | 29 | 96.67 |
| May Nigus | 32 | 6 | 18.75 | 26 | 81.25 |
| Waro | 35 | 6 | 17.14 | 29 | 82.86 |
| Hare weir | 18 | 3 | 16.67 | 15 | 83.33 |
| Wukro/ Hayelom | 17 | 5 | 29.41 | 12 | 70.59 |
| Hare diversion | 30 | 5 | 16.67 | 25 | 83.33 |
| Megech | 30 | 15 | 50.00 | 15 | 50.00 |
| Kelena | 30 | 13 | 43.33 | 17 | 56.67 |
| Gelana | 30 | 12 | 40.00 | 18 | 60.00 |

Conflicts can occur between farmers at different reaches of the scheme or farmers within the same reach or block. Conflicts between head and tail reaches is mainly due to irrigation flow cut-offs at the tail ends due to excess diversions at the head or due to water shortages at the source. Conflicts between farmers within the same irrigation blocks occur mainly due to issues related to sharing of irrigation water and water theft. More frequent conflicts between farmers indicate, among others, the weaknesses of the organization in ensuring smooth operation of the scheme and water management.

The results in Table 8 show the responses of the sample farmers on conflicts with other farmers regarding water allocation and sharing. In terms of the incidence of conflict between users, from Table 8, it is evident that schemes with no water institutions and modern schemes has the highest levels of conflict and this also holds true at typology level. One of the major reasons for the great incidence of conflict in traditional schemes is the fact that in these schemes water distribution, operation and maintenance are largely governed by unwritten regulations, which often creates ambiguity in their enforcement. Farmers also often have different levels of understanding regarding the governing regulations, and a minor breach of these leds to conflicts with the local organizations.

As suggested by Amede (2014) water shortages can be one of the major causes of conflict. In fact this underlines that the presence of organizations, regulations, traditions and rules alone will not lead to sustainable irrigation practices. A closer look at the reason for water shortages reveals a mismatch between irrigated areas and water supply (Amede 2014). Obviously, the generation of such empirical evidence by the traditional irrigators can be an impossible exercise and there is a need for some level of support by the government body as dictated in FDRE (2014). In contrast to the conflicts of users with the water institutions at Koga (only 17%), the conflict between users themselves was apparently high at Koga irrigation schemes (modern). This could be due to the fact that it is sole responsibility of the farmers within a quaternary unit to share the proportional flow allocated to them. Farmers employ either rotational water allocation within their quaternary units to their individual farms, which often causes conflict with respect to flow durations, flow volumes and irrigation turns between farmers. Moreover, farmers can do little to change the water delivery schedules at the main levels as this is the responsibility of the Abay Basin Authority.

The staff from the Abay Basin Authority are responsible for the operation and water management at the main and tertiary levels. Water is delivered to a group of farmers at a quaternary off-take, which the farmers need to share among themselves. This implies that farmers cooperate better among themselves as long as they have complete control over over the operation of the whole scheme; conflicts increase under imposed water allocation systems as farmers attempt to access more than their fair share of water.

## Operational management and level of equitable water distribution

The operational management of IWUAs includes the day-to-day activities to ensure good functioning of the irrigation scheme. The activities include planning, implementing and monitoring of water distribution works. Tasks related to maintenance planning and implementing are also part of operational management. The operational management tasks are given in Table 9. From the six tasks listed in Table 9, only monitoring equity of water distribution is implemented across all study schemes. One of the major operational mandates of irrigation institutions is to ensure the fair allocation of water to farmers based on either a pre-scheduled arrangement or on-request (FDRE 2014; Lempériere et al. 2014). Non-conformity of the water distribution to arranged delivery schedules needs to be corrected in the process of operational decision-making. Hence equity of water distribution is a major performance indicator for irrigation organizations.

Figure 3 shows the equity levels of water distribution based on farmers' perceptions. According to farmers' responses, unfair water distribution prevailed in Meki, followed by the Mai Nigus and Hare diversion schemes. For Meki, this can be accounted for by the absence of a water distribution system. Field observation and discussion with users clearly indicated that secondary and tertiary canals and structures for water distribution and control were not constructed at the Meki scheme. Hence, water can hardly advance down the scheme, leaving the tail end users facing serious water scarcity. Farmers pump water from the main canal to their fields using small private pumps. Irrigation organisations exist at the scheme; however, they have limited responsibilities for water distribution. They are more focused on the collection of annual fees for pumping costs (electricity) from the lake to the main canal. Hence, head users generally have a generous water supply, causing excessive use on farms at the head, while water does not reach tail users (Agide et al. 2015, in press).

Many of water distribution structures even in the main reach are damaged, causing significant off-farm losses (Figure 4). Though farmers' claim maintenance is ineffective either due to a lack of technical knowhow and a limitation of financial resources for canal maintenances, this contrasts with Ethiopian government water policy which stipulates the need for cost recovery of irrigation schemes (MoWR 1999). The existing irrigation organization at Meki scheme lacks the main function of an IWUA and requires reformulation of the mandate of the association to perform the major task of operational management (water allocation and distribution) for its members. In fact, in many cases, the literature also attributes such poor performance to linkages with cooperatives (Figure 3) which usually develop regulations without the proper engagement of the users (Yami 2013). Initially, when designed, the May Nigus scheme water used to reach tail users.

Table 9. Major operation and maintenance tasks of irrigation institutions across study schemes.

| Scheme | Tasks | | | | | |
|---|---|---|---|---|---|---|
| | Prepare operation plan | Implement operation plan | Monitor equity of water distribution as per the plan | Prevent water wastage | Prepare and implement maintenance plan | Inspect irrigation structures regularly |
| Koga | X | X | √ | √ | X | X |
| Meki | √ | √ | √ | X | √ | X |
| May Nigus | X | √ | √ | √ | √ | √ |
| Wukro/ Hayelom | | √ | √ | √ | √ | √ |
| Hare weir | √ | X | √ | √ | √ | √ |
| Hare diversion | √ | X | √ | √ | √ | √ |
| Waro | √ | X | √ | √ | √ | √ |

√ shows that the irrigation institutions fulfil the evaluation criteria, while X shows that the institutions do not fulfil the criteria.

Figure 3. Responses of farmers on equity of water distribution at different schemes.

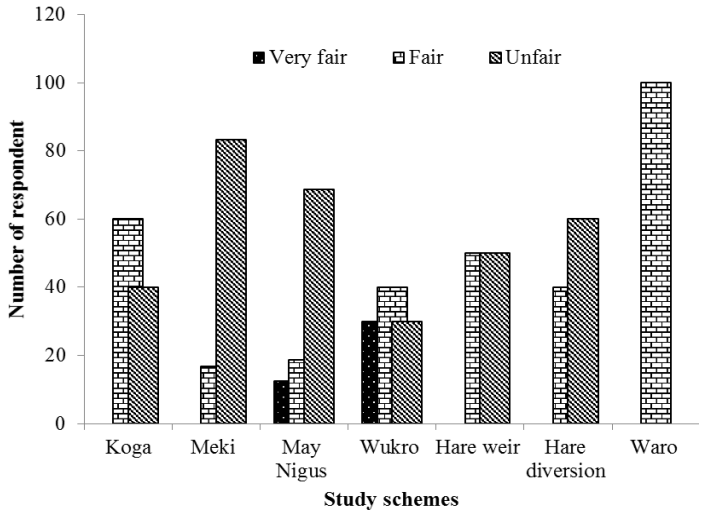


Figure 4. Damaged water distribution structure in the head reach of Meki scheme.

However, over time, water failed to reach the tail ends due to a deterioration of the water distribution systems and reduced storage capacity of the May Nigus reservoir due to sedimentation (Figure 5). The farmers also revealed the decline of the annually irrigated area. Poor maintenance of irrigation canals (Figure 6) and hence huge seepage losses add up to increase high inequity levels. The irrigation institution that exists at May Nigus scheme has limited capacity particularly for timely maintenance and equitable water allocation. On the contrary, Figure 3 shows that about 13% of respondents, apparently those users at the head, assessed the equity level at May Nigus scheme as very fair.

Figure 5. Sedimentation at the intake structure of May Nigus reservoir.

Hare diversion is a traditional scheme where water is being diverted using stones and soil bunds to irrigated farms in two *kebeles*. There are no modern flow control structures and water distribution is unfair and apparently favours head users; this argument is also substantiated empirically by the highest proportion of water users (60%) who evaluated the water distribution as unfair. Figure 7 shows the main canal of the Hare diversion scheme (Dorga kebele) with no permanent water flow control structures.

Figure 6. Poor canal maintenance is responsible for inequitable water distribution and water losses at May Nigus scheme.

Figure 7. Earthen canal at Hare diversion scheme with no flow control structures.

It is interesting to note the divergent responses of the farmers on fairness of water distribution at Waro (Figure 3). Waro is a traditional irrigation scheme with no permanent water diversion and control structures. Farmers use locally available materials, such as stones, soils and crop residue, for flow control. Still, they ensured equitable water distribution and all the farmers were satisfied with it. Waro is a typical example of a traditional scheme with excellent irrigation water management by the community with their own established regulations. All the respondents assessed the water distribution as fair. Hence, the lesson here is that it is not only the existence of physical infrastructure that guarantee equity. Good water distribution can also be achieved with little or no modern structures provided particularly when there is good communication and social cooperation among farmers. In community-managed irrigation schemes, cooperation is essential for pooling labour and other resources to construct and maintain canals, allocate and share water, regulate and monitor the provision and use of water, and facilitate other necessary joint ventures (Dessalegn and Merrey 2014).

Figure 8 shows a traditional cross drainage used at Waro scheme for conveying water over a depression indicating labour input as the major cost to run these schemes. On the other hand, there is large unwillingness to make financial contribution for maintenance at Waro scheme. Farmers at Waro indeed have managed their schemes well by themselves. Farmers' responses as unwilling to contribute are probably because they are satisfied with the existing irrigation services and infrastructure level. The fact that annual maintenance cost for such schemes, as mentioned above, demand more of human labour than material cost can explain why Waro scheme users are unwilling to contribute.

Figure 8. Method of conveying water over a depression at Waro scheme.

At Koga (modern scheme), the record of level of fairness was the second highest. Recent water delivery and on farm water management analysis suggest that there is an oversupply of irrigation water at scheme level (Agide et al. 2015; Haileslassie et al. 2015, in press). As the scheme is new, the water control and delivery infrastructure is in good shape and there are minimum water losses (except for evaporation). Probably, the perceived unfairness can be accounted for by the way IWUA is established and level of accountability given to them. For example, all the operational management of the scheme is undertaken by a government organization (Abay Basin Authority) and the farmers' contribution to maintenance planning and implementation is insignificant and their role is mainly limited to the fourth canal in terms of organizing and managing water users.

In principle, such a role needs the understanding of the volume of water flow in the canal and the duration required to irrigate a given crop. From discussions with farmers and water users' team leaders, farmers generally lack awareness and the tools that enable them to make informed decisions. This creates a gap so that water users manipulate the gates of the fourth canal to get more water and thus the tail farmers get less water or those waiting for their turn will experience delays.

From the analysis, it is evident that the major ingredients of effective service delivery (e.g. infrastructure, institutional settings and capacity) never coincided. In schemes with better infrastructure (e.g. Koga) the institutions are not capacitated to take over the full responsibilities of running the schemes. However, in schemes with poor levels of infrastructure (including water flow regulation and distribution canals) the institutions and associated social norms were strong and thus level of equity is fair. But the two categories also share a common problem: water wastage and consequently threaten the suitability of the schemes.

## Financial management and farmers willingness to contribute

The main source of income for IWUAs is fees collected from its members (irrigation service fees or/and maintenance fees). For the IWUAs to be self-sufficient and financially sustainable, sound financial management is crucial. The idea of water pricing and hence the introduction of irrigation water fees is stipulated in water resources policy of Ethiopia (MoWR 1999), but the practical application is new to the country. Empirical evidence on irrigation water pricing supporting the enforcement of the policies are virtually absent with the exception of Awash basin (Malik et al. 2014). As such, even at the schemes with irrigation organizations, irrigation fees have not yet been introduced. In addition to the lack of empirical evidence indicated above, the following are cited as some of the major obstacles to the introduction of irrigation fees:

i) farmers' have no experience with water pricing and the perception of water as a free commodity prevails;

ii) farmers' resistance to the payment of fees and their preference for contributing labour instead;

iii) generally poor irrigation service levels; and

iv) poor capacity of irrigation organizations for financial management (Malik et al. 2014).

Despite these important roles of financing, establishing the amount to be paid by farmers is a perilous task. In the absence of empirical evidence as to who used how much water and fees for water, infrastructure or services, the situation gets more complicated; this is the situation in Ethiopia in general and specifically for the study schemes. This level of sophistication (especially because the full costs calculated are invariably not commensurate with farmers' incomes and ability to pay), always gives way to more mundane political arbitrage whereby water prices are a compromise between actual O&M costs and what farmers will accept to pay (Ghazouani et al. 2012).

Table 10. Major financial management-related tasks of institutions at schemes.

| Scheme | Tasks | | | | | |
|---|---|---|---|---|---|---|
| | Assess and collect fee irrigation | Sanctions for late payment or denial of payment | Sanctions for stealing water | Maintain financial records | Prepare financial reports | Hire and suspend temporary staff |
| Koga | x | x | x | x | x | x |
| Meki | √ | √ | x | √ | x | √ |
| May Nigus | √ | √ | √ | √ | x | x |
| Wukro/ Hayelom | x | x | √ | √ | x | x |
| Hare weir | x | x | x | x | x | x |
| Hare diversion | x | x | x | x | x | x |
| Waro | x | x | x | x | x | x |

√ shows that the irrigation institutions fulfil the evaluation criteria.

X shows that the institutions do not fulfil the criteria.

Of the schemes studied, irrigation water fees exist only at Meki and May Nigus (Table 11). In view of the above argument on the lack of proper irrigation water pricing, it is likely that water fee payment is based on area of land irrigated, and therefore there is no incentive for a farm to select water saving practices. Even at these two schemes, the tasks of IWUAs related to financial management are limited. Financial self-sufficiency for operation and maintenance and hence issues of irrigation service fees are important in view of the earlier argument (Ghazouani et al. 2012). Hence, enhancing the willingness of farmers to contribute to the operation and maintenance of their schemes is key to ensuring sustainability (Amede 2014). The willingness of farmers to contribute to O&M (maintenance fee, labour or both) was surveyed at each scheme.

Table 11 shows the results of the willingness of farmers at different schemes to contribute to the operation and maintenance. The overall result is encouraging, except for traditional schemes where a significant proportion of respondents are unwilling to contribute. The point is how this can be operated given the low enforcement capacity of the institutions. Equally important is understanding how much is enough to meet the financial needs of irrigation schemes under the irrigation scheme cost recovery scenarios.

Table 11. Willingness of farmers to contribute to operation and maintenance (fee or labour).

| Scheme | Total number of respondents | Willing | | Unwilling | |
|---|---|---|---|---|---|
| | | Number | % | Number | % |
| Koga | 30 | 27 | 90 | 3 | 10 |
| Meki | 29 | 22 | 76 | 7 | 24 |
| May Nigus | 32 | 21 | 66 | 11 | 34 |
| Wukro | 35 | 33 | 94 | 2 | 6 |
| Waro | 27 | 14 | 52 | 13 | 48 |
| Hare weir | 20 | 20 | 100 | 0 | 0 |
| Hare diversion | 20 | 20 | 100 | 0 | 0 |
| Megech | 30 | 21 | 70 | 9 | 30 |
| Kelena | 30 | 25 | 83 | 5 | 17 |
| Gelana | 30 | 27 | 90 | 3 | 10 |

However, these aggregated values do not give a clear view of the willingness to pay (contribute), as for instance, farmers at Hare diversion (traditional scheme) are 100% willing to contribute to operation and maintenance, while the willingness at Waro (traditional) is 52%. The willingness of farmers to pay (contribute) for O&M apparently depends on the income they earn from their irrigated plots. For instance, farmers at Hare weir and Hare diversion are 100% willing, which might be due to the better outputs from perennial crops (banana and mango). Waro is a traditional scheme with good performance in terms of sustainability of irrigated land and water delivery equity, but the farmers are less willing to contribute. This could be mainly due to the fact that famers maintain their schemes and manage their water themselves according to their own established norms that ensures equity, and hence they are less willing to accept the involvement of external actors.

## Role of women in irrigation organizations

Irrigation organizations provide services to their members who have land use rights within the irrigation service area. Whether women manage their own farms or are family labourers in a particular rural society, there are key underlying gender issues (Lempériere et al. 2014). In the irrigation schemes in this study, society of course does not give men and women equal opportunities for decision-making in irrigation, farming activities and access to land. In such a society where women are significantly excluded from economic farm opportunities, in terms of access to land, skills, inputs, capital, markets etc., providing irrigation water alone can hardly ensure equitable access to agricultural income. Even access to water by women and men farmers in many irrigation schemes in Ethiopia is not the same and favours the latter (compare also Yami 2013). As such, involving and empowering women in all aspects of decision-making in rural economic activities is required to ensure equitable benefits for all community segments.

Table 12 shows the responses of farmers on their perceptions of the role of women in decision-making in the irrigation associations at different schemes.

Table 12. Farmers' perception on the role of women in their irrigation institutions.

| Scheme | Total no. of respondents | No. of responses | | |
|---|---|---|---|---|
| | | None | Insignificant | Fair |
| Koga | 26 | 14 | 5 | 7 |
| Meki | 30 | 30 | 0 | 0 |
| May Nigus | 32 | 15 | 7 | 10 |
| Wukro/Hayelom | 35 | 20 | 7 | 8 |
| Hare weir | 23 | 1 | 22 | 0 |
| Hare diversion | 17 | 0 | 17 | 0 |
| Waro | 30 | 28 | 0 | 2 |

The role of women in the organizations at all schemes is generally very low according to farmers' opinion (Table 12). This perception of farmers on the role of women was highest at May Nigus scheme followed by Koga and Wukro. Although it is not possible to draw straightforward conclusions for the regions concerned, women's role in irrigation organizations was observed to be better for the schemes in Tigray and Amhara regions. It is also of note that for the schemes in Oromia (Meki and Waro), nearly all the respondents stated that women have no role in decision-making in the irrigation organizations. This is in line with Yami (2013) who argued that the lower status given to women in relation to decision-making processes has hindered the benefits of having women on IWUA committees. According to Yami (2013), this gap in balancing the decision-making power of men and women demands the intervention of the local authorities and local non-governmental organizations (NGOs) in changing perceptions and attitudes on gender equity towards sustaining the positive outcomes of irrigation for livelihoods at household and community levels.

# 4 Conclusions

Irrigation development in Ethiopia, as elsewhere in sub-Saharan Africa, Asia and beyond, is hindered by serious problems related to water management. As a result, unfair water distribution within the schemes and inefficient water use are common in Ethiopia. Storage structures (e.g. dams, reservoirs etc.) and primary and secondary channels are not properly maintained due to a lack of resources. These phenomena are the result of the absence or weakness of irrigation institutions.

This study made an assessment of existing irrigation institutions at 10 irrigation schemes of LIVES intervention areas. The study evaluated service delivery of irrigation institutions in terms of governance, operation and maintenance, and financial management using selected indicators. In view of the findings, the following conclusions are drawn:

- Establishing IWUAs with roles in water allocation and conflict resolution, collecting water fees etc. (FDRE 2014) is a step in the right direction. Besides implementing appropriate legislative decisions of putting the establishment of IWUAs on a legislative footing, these irrigation institutions need to be strengthened through appropriate government support, such as capacity building measures. Given the appropriate capacity development support to ensure limited government interference and proper governance structures, only then will water institutions be in a position to assume the roles of defining the rules of water development, allocation and utilization (Saleth and Dinar 2004). This study supports Saleth and Dinar's (2004) suggestion that African governments need to begin by enhancing the wealth-creating potential of smallholder irrigated farming by strengthening market access, promoting high-value crops, and improving systems for providing extension and technical support to smallholder irrigators. However, the study is cognizant of the risks of establishing multiple-tasked water institutions with mandates broader than water distribution and conflict resolution, marketing, extension, etc. (Malik et al. 2014).
- Irrigation institutions are available in about 70% of the studied schemes and there is apparent diversity in terms of the way they are organized. In view of their current reporting relationship with local public administrations, and the minimal support offered to these institutions, existing irrigation institutions do not fulfil the standards set for IWUAs.
- In many cases membership in irrigation water institutions, contrary to the current legislation, is not compulsory and very often the rules and regulations are not documented. This creates opportunities for free riders; put differently some individuals in the user group either consume more than their fair share of water, or pay less than their fair share of the cost of this common resource. The consequence, as revealed in many cases of the study schemes, is increased inequity.
- The irrigation organizations at the study schemes do not bear their full responsibilities regarding all aspects of the management of IWUAs that ensure sustainable operational and financial management of the irrigation schemes. Existing organizations have very limited capacity to provide effective irrigation services in a sustainable way. This also means there is no accountability for the required service delivery and as a result sustainability is threatened. The issue emerged here was also the technical knowhow and capacity limitations of both service providers (government institutions) and clients (water users) in terms of the irrigation service types and delivery. Probably, this triggers the questions as to how to standardize and operate services required for the sustainable management of irrigation schemes. In this regard, capacities of both service providers and clients need to be strengthened.

- Irrigation service fees are only paid in few schemes and only member users are paying. Problems associated with lack of empirical evidence guiding what to pay for and how much to pay are the prevailing questions. An absence of capable institutions for financial management and hence irrigation services was one of the major reasons for non-sustainability and hence poor maintenance. As a result, it was observed that even minor failures and maintenance needs cause significant water distribution chaos at several of the schemes. In contrast, many farmers are willing to contribute, particularly those at modern schemes. The question is how to exploit these opportunities and make the service delivery of irrigation schemes sustainable is most pressing. Water pricing is a way of ensuring the sustainability of the irrigation infrastructure and irrigation services, and can also serve as a mechanism for enhancing the efficiency of water use. Suitable levels of irrigation service fees differ from one scheme to another based on existing local conditions, gender disparities in income and incentives gained from irrigated crop types, irrigation infrastructure, and maintenance needs. The widely applied flat rates, fixed amount per household or per unit area, does not offer an incentive to prudently use water or invest in productive water technologies and therewith improve equity. Hence the assessment of irrigation water pricing and exploration of payment modalities are needed.
- Women as users and decision-makers in most irrigation schemes were found to have minimal roles. In most cases, they are not seen as major actors in male-dominated irrigation farming though they are the ones who contribute most of the labour and routine activities related to irrigation farming. Female-headed households are hardly encouraged to engage in labour and capital intensive irrigation farming due to a lack of finance, labour, inputs and services, and above all have less access to market related information and informal networks that usually shape the market situation for irrigated crops.

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