

Full Length Research Paper

Polycentric irrigation water governance: Irrigation water users associations service delivery in Ketar subbasin, Ethiopia

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Polycentric irrigation water governance allows community institutions to deliver better irrigation services. This study examined the Irrigation Water User Associations (IWUAs) service delivery performance in the Ketar subbasin, Ethiopia, focusing on four irrigation schemes. The irrigation water user associations in the subbasin were measured on their legal registration and financial status, while the four schemes were examined on their bylaw implementation, decision transparency, water allocation, and infrastructure management. Three hundred eleven (311) randomly selected irrigators were surveyed. The study showed that 73 and 21% of the modern and traditional IWUAs in the subbasin are legally registered and collect an average ETB 1200/year/ha which is insignificant for O&M. The four schemes' water distribution disparity ranges from 3.5 to 8.4 L/s at farmers' plots. 47 and 62% of the respondents depicted their dissatisfaction with the water allocation and satisfaction with IWUAs' decision-making transparency, respectively. The study also revealed that the IWUAs are compounded with weak infrastructure management that resulted in substantial water loss ranging from 12 to 49%. Besides, 70% of respondents witnessed a lack of gender-based irrigation incentives for female irrigators. Improving these services makes the polycentric irrigation water governance play an exponential beneficial role in alleviating the consequence of unregulated water use.

Key words: Polycentric irrigation water governance, water allocation, decision making, irrigation water user association.

INTRODUCTION

Where water governance is not in place, water abstraction is a substantial risk to food security, healthy ecosystems, and water supply. Water governance at the highest level can be defined as the range of political, social, economic, and administrative systems that are in

place to develop and manage water resources and the delivery of water services at different levels of society (Rogers and Hall, 2003). At the operational level, it is set to be measured as the development and execution of norms, values, rules, incentives, informative tools, and

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infrastructure availability and management (Pahl-Wostl et al., 2008).

Different water governance principles emerged to optimize finite water resources considering the multi-use nature of water, its attributes, its finiteness, and the governance system. Polycentric water governance as one of the water governance systems that emerged from the general polycentric governance system was pioneered by Ostrom in 1961 (McGinnis and Walker, 2010). Polycentric governance is governance with a multi-power center with overlapped multiple authority layers in decision making and discursing community users play a critical role in their common resource governance at the micro-environment level (Huitema et al., 2009; McGinnis, 2013; Ostrom, 2014; Vala et al., 2014). It is a multi-level nested relationship having multiple centers among key stakeholders (Bruns, 2021; Carpenter et al., 2017). According to other researchers, it is an effective tool to solve environmental problems allowing lower-level institutions to exercise localized measures to their local conditions considering the local skill and experience (Bekele and Mekonnen, 2021; McGinnis and Walker, 2010; Ostrom, 1990).

Irrigation is the main water consumer that needs proper water governance (De Bruin et al., 2012; FAO, 2006; World Bank Group, 2016). Irrigation Water Users Associations (IWUAs) as key irrigation water governors, at the lower level of the community with other governmental and non-governmental organizations at different levels, portray the polycentric governance model. Though it is not fully demonstrated, Polycentric-Centric Irrigation Water Governance is exercised in different parts of the world as one of the water governance systems (Baldwin et al., 2018; Muchara et al., 2014; Özerol et al., 2018). In such a governance model, IWUAs get a due place in regulating, allocating, empowering irrigators, infrastructure management, and being responsible for well-defined water rights (Grigg, 2011; Veettil et al., 2011). Mapping the place of IWUAs' structural position and measuring their irrigation water governance services in terms of their capacity to regulate, allocate their meaningful transparent communication and participatory level, blended along with infrastructure management (Atosina et al., 2020) sum up the irrigation water governance status of a country.

Irrigation water governance in Ethiopia is set at two tiers, national and regional levels. The national level institutions, the Ministry of Water and Energy (MoWE) and the Ministry of Irrigation and Low Land Development (MoILD) are mandated to regulate and set the country's water resources and irrigation development policies, respectively. Likewise, regional states govern intra-region water resources in their respective areas through the regional, zone, and Woreda water and irrigation development mandated offices. At a micro-environment level, the IWUAs are accountable for irrigation water governance and development.

Irrigation in Ethiopia, size-wise, is classified as small

(<200 ha), medium (200-3000 ha), and Large (>3000 ha) scale (MOWR, 1999). Besides, irrigation in the country is also classified as traditional¹ and modern². The IWUAs are responsible for field-level water governance for large and medium irrigations and for scheme administration of small-scale irrigations that includes infrastructure management, water governance, and the micro-environment. IWUAs in the Ethiopian case are legal bodies for the micro-environment level irrigation governance (MoWIE, 2014; ORNG, 2017). Besides, they are key determinants for new irrigation development and up and downstream water management.

This paper tried to show the irrigation water governance in Ethiopia at a community level; IWUAs' service delivery performance as a community-level irrigation water governor entity. The study was conducted taking all irrigation schemes in the sub-basin while focusing on four irrigation schemes, namely; Ketar Fowfowte, Ketar Genete, Ketar Torben Unsho, and Arta Small Scale Irrigations (SSI). First, the study compared the legal registration status and financial capacity of the irrigation schemes in the subbasin to show the selected IWUAs' legal and financial capacity compared to other irrigation schemes in the subbasin. Then, zooming into the selected four schemes, it examined in-depth the bylaws implementation, water allocation, IWUA planning and decision-making transparency, irrigation infrastructure management, and gender-based irrigation incentives to show their service delivery performance in the eyes of their members.

The study was conducted on the proposition that community-level irrigation water governance effectiveness demands more empowerment of irrigation users technically, financially, in planning and decision making, and in beneficiaries' participation. Thus, the findings of this study give an in-depth sight of Ethiopian IWUAs' irrigation water governance for the Ethiopian government and academia, including the Sub-Saharan Africa Region (SSA) community. Local, regional, and national governments can learn about the strong side, and the missing and weak links of the existing practices. Moreover, the study contributes to the betterment of water governance in general and irrigation water governance in particular.

MATERIALS AND METHODS

Primary and secondary data were generated based on qualitative and quantitative methods. Two types of primary data were collected; irrigation water governance status perception water data at the scheme and farmers' plot level. The perception data were collected from 311 randomly selected respondents from four schemes, Ketar Fowafwote (K. Fowafowate), Ketar Genete (K. Genete), Ketar Torben Unshoo (K. T. Unshoo) which have one

¹Traditional Irrigation scheme is where the water is diverted and supplied by the community with their own local knowledge and local material

²Modern irrigation in Ethiopia context is schemes that has undergone through scientific studies and constructed by professionals

common water abstraction structure and system, and from Arata Irrigation located in the same sub-basin but a different stream. The projects were selected to represent the sub-basin in consultation with zone-level³ government officials. Respondents were selected from Ketar Fofwote, Ketar Genete, Ketar Torben Unshoo, and Arata as 71, 81, 77, and 78, respectively proportionally based on their irrigation user members. The total sample size for this study is determined by Yamane Taro (1967):

$$n = \frac{N}{1 + N(\alpha)^2}$$

where N is the total number of irrigation household units in the selected SSI (Ketar and Arata) which is 1398, n is the sample size, and α is the level of significance for the present study and it is fixed at 5%.

Based on the formula, the sample size for the study is determined.

$$n = \frac{1398}{1 + 1398(0.05)^2} \approx 311$$

The perception of satisfaction on water allocation and distribution service, bylaw implementation, and decision-making by the IWUAs committee was measured on Likert scale as excellent, very good/very satisfied, good/satisfied, bad, and very bad (Likert, 1932). The flow data were collected from randomly selected ten farmers' plots from the four schemes using a 3-inch Parshall flume and float method at canals to verify the water allocation equity and the infrastructure management. GPS was used to collect the scheme's location, water measured points and farmers' plot locations.

Secondary data were collected from MoWE, Ministry of Agriculture (MoA), Oromia region, Zone, and Woreda water and irrigation offices in the sub-basin. The data collected included the spatial and policy mandate of the institutions, water availability, water allocation mechanism, equity, crop and plot data, planning and decision transparency, operation and maintenance fee, conflict management, and water use rights in ten focus groups (FGDs), five Key Informant Interviews (KIs) and literature review. The FGDs were conducted with 29 different experts and IWUA committee leaders in the selected scheme areas.

The data collected were tested for validity and reliability and analyzed using Stata. All the determinant variables were analyzed qualitatively, in descriptive statistics and Arc GIS (Geographic Information System), and compared within and across the irrigation schemes. The results are presented in narratives and infographics and governance maps.

RESULTS AND DISCUSSION

Demographic result

Sex and age of respondents

Age and education play a significant positive and negative relationship in technology adaptation and leadership role in irrigation governance (Deressa et al., 2009; Hamidov et al., 2015).

The respondents from K. Fowafowate, K. Genete, K.T. Unshoo, and Arata schemes are 90% male and 10% female, where 5, 5, 4, and 16 females in number are female, respectively. Age-wise 15% of the respondents were between 21-30 years of age, 42% were 31-45 years, 29% were 45-60, and the remaining 13% were above 61 years of age and the mean age considering all the schemes is 43.5 years.

Education and irrigation experience of respondents

Nine percent of respondents have no regular school exposure, neither can they read nor write, 54% were categorized between grades 1-8 (elementary school in Ethiopian case), 33% were between grades 9-12 (high school) and only 3% joined technical vocational school or college. Of women respondents, 6% were found only between grades 1-8 while 4% have completed high school. According to this study all respondents, male and female, have more than ten years of irrigation experience.

Marital status and family size

Of the respondents of this study in general 2.9% are single, 89.7% are married, 1.9% are divorced, and 5.47% are widowed. The average family size of the respondents is 6, 6.7, 7, and 5.7 at K.Fowafowate, K.Genete, K.T.Unshoo, and Arata, respectively with an average of 6.3 for all schemes, which is above the average rural family size of the 2007 Ethiopian census that is 5.1.

Irrigation land holdings

Nine-two percent of the respondents have irrigation land, 7% are rented, and 1% got the land in investment (at Arata SSI). The average total agricultural land of a respondent in the four schemes is 2 ha and an average irrigation land holding for the schemes is 0.5 ha. Females in the four schemes have an average of 1.6 and 0.38 ha of total agriculture and irrigation land holding, respectively. The irrigation land holding of the country, specifically the Oromia region, allows irrigators to have a maximum of 0.5 ha on government-built irrigation developments (ONRS, 2007) (Figure 1).

Irrigation water governance at the microenvironment level

Irrigation water users' structural position in Ethiopia

IWUAs in Ethiopia is the center of irrigation water governance where they are accountable for scheme operation and maintenance (O&M), scheme level water

³Ethiopia is classified as a federal state with National, Regional, Zone, Woreda and Kebele administrative units.

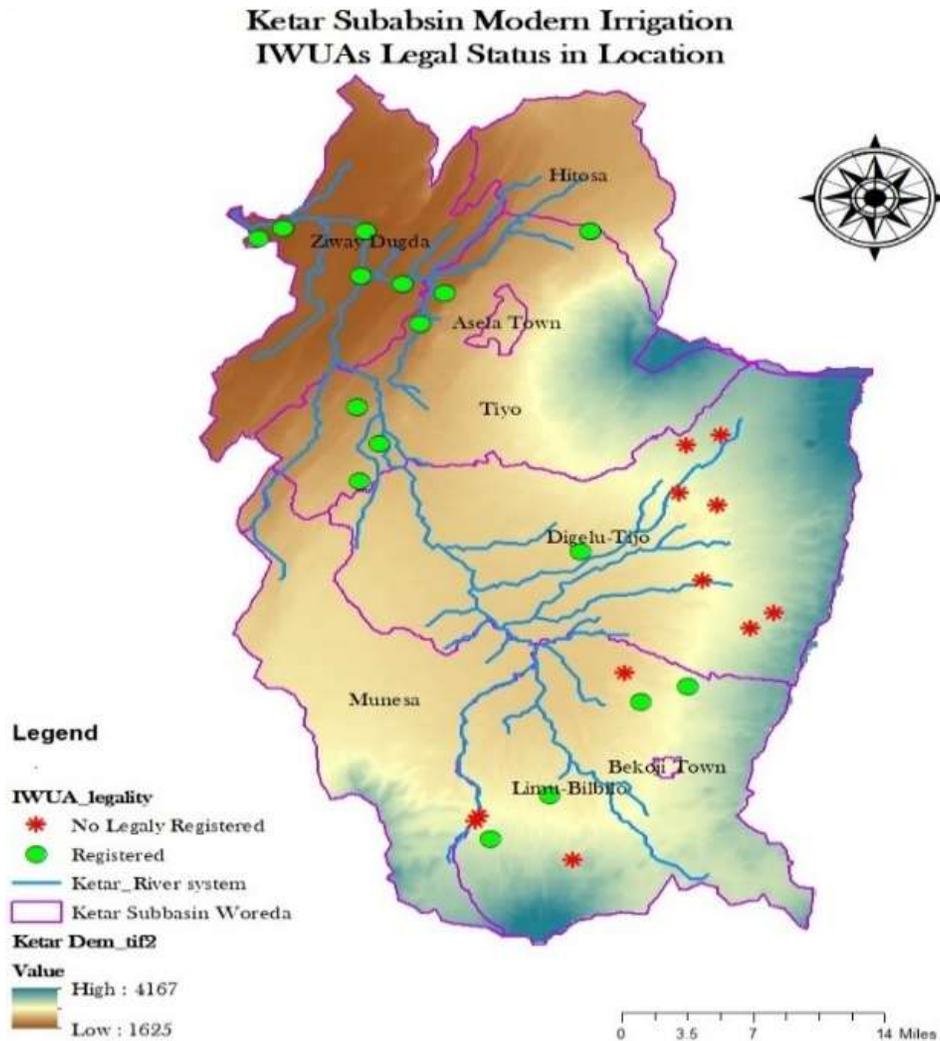


Figure 3. IWUAs legally registered and non-registered locations in Ketar subbasin.
Source: Arsi Zone Agriculture office

among the registered ones. Most of the registered modern irrigation schemes IWUAs are located downstream of the subbasin (Figure 3). Kii indicated that the downstream irrigators respond to the irrigation policy and rules better than upstream farmers because of their drought proneness, downstream water use right, and more dependency on irrigation than the upstream users. According to these findings, modern irrigation IWUAs are more legally registered than traditional irrigation IWUAs in the subbasin. The FGD with the government officials and IWUA committees showed that the traditional irrigations IWUAs are not much interested in legal registration unless they want to upgrade and modernize their scheme and need irrigation extension services by government or nongovernmental organizations.

Studies made in different parts of Africa like Kenya, Tanzania, and Mozambique showed that IWUAs are required legally to be recognized like the Ethiopian case (Aarnoudse et al., 2018; Richards, 2019). Moreover,

these studies depicted, IWUAs not legally registered, theoretically, do not benefit from legal water use rights, banking systems, and legal financial audit support (Aarnoudse et al., 2018). However, these studies argue that no evidence showed that legalization produces a better governance capacity or service delivery. In the Ethiopian case, the registered IWUAs have an advantage in project fund access for upgrading or new development and to have a bank account in their own association name rather than individuals name and to get legally access to loan.

The by-law implementation status of the four IWUAs

The by-laws, IWUAs members developed and ratified internal law, mainly consisted of and focused on penalizing for absence from meetings, maintenance programs, water theft, extravagant water use, illegal

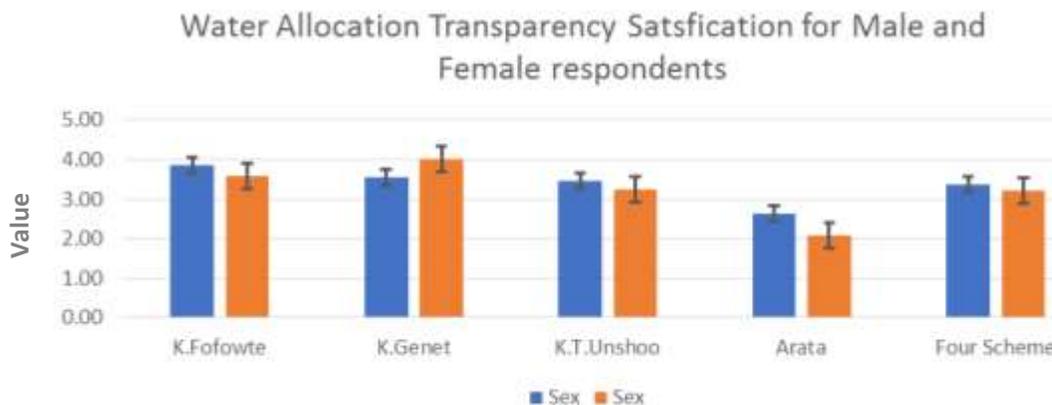


Figure 4. Irrigation water allocation transparency. Source: survey result

water abstraction, and delay or lack of regular fee payment. It has no water allocation modality except the principle of fairness in water allocation. During the FGD with IWUA committees, the participants emphasized that water theft and absence from maintenance are taken as significant indicators for the by-law implementation.

The descriptive statistics result shows the transparency of bylaw implementation in each scheme with a mean value of 3.3, 2.9, 2.5, and 3.5 for K.Fowafowate, K.Genete, K.T. Unshoo, and Arata, respectively with similar std. error of 0.1. Gender-wise, this transparency is rated as 3.01 and 3.04 mean values for the Likert with std of 0.06 and 0.02 for male and female respondents, respectively. The result showed that Arata and K.Fowafowate are relatively more satisfied than the other two. This is due to the fact that both schemes are located the upstream of Ketar and Arata rivers where there is relatively more water. Gender-wise, the result showed the absence of significant difference, both male and female irrigators were equally satisfied with the current by-law implementations.

IWUAs transparency in planning

The study made regarding the planning transparency of the IWUAs on the four schemes showed the IWUAs in each respective scheme is transparent in planning. 86% of the respondents witnessed that they are called for an annual planning and review meeting twice per year. However, 20% of the respondents, though there is a call for planning and review and participation, have explained their grievances in the planning process.

Irrigation water use right

In all four schemes, water is allowed and allocated only for self-use. Selling, lending, and transferring once self-

use-turn is not allowed. According to the discussion made with irrigation users and IWUA committees of the four schemes, irrigation turn for one user is once per week for 24 h regardless of the land size and crop type. According to the FGD, this type of water allocation is due to the capacity limitation of the IWUA's in crop water requirement and water measuring knowledge and infrastructure. However, the water turns can be modified by the IWUA committees when water scarcity occurs.

IWUAs water allocation and distribution decision-making transparency

The water allocation and decision-making transparency were by the level of satisfaction of the respondents with the water allocation transparency and decision-making of the IWUAs committee on five scales likert. The result indicated that 53 and 47% Ketar Fofwote and Ketar Genete respondents were dissatisfied while the dissatisfaction with K.T.Unshoo and Arata Irrigation schemes is 35 and 10%, respectively. The dissatisfaction at K.T. Unshoo and Arata is relatively small than the other two; the FGD discussion accounted for these results to "the more the water is scarce, the better the water allocation transparency". The latter two schemes are located at a downstream location where water is relatively scarce and needed critical governance.

In the water allocation service transparency, female respondents, except for K.Genet, in each scheme are less satisfied. In general, the female respondents rated the service as 2.8 mean value while male respondents rate 3.4 with std. error of 0.05 and 0.01 for females and males, respectively. Women irrigators are less satisfied than male irrigators; female irrigators complain the water allocation does not suit their additional domestic burdens and there is no special water allocation modality for female irrigators (Figure 4).

In terms of the volume of the water allocation, the result

Table 1. Water allocation disparity by IWUAs at plot level.

Scheme	Owners	Plot location (UTM)		Crop planted	Average flow plot level (L/s)	Plot area (ha)	Water supplied in one season (m ³ /plot)	Water supplied in one season (m ³ /ha)	FAO-CWR estimate (m ³ /ha)
		East (X)	North (Y)						
Ketar	P. A	503414	866394	Potato	8.4	0.75	7257	9676	5000-7000
Fowfote	P. B	502744	865626	Wheat	3.5	0.25	982	3931	4500-6500
Ketar	P. C	502492	867610	Wheat	4.2	0.25	1209	4838	4500-6501
Genete	P. D	501957	868530	Potato	5	0.25	1728	6912	5000-7000
Torben Unshoo	P. E	501473	868803	Onion	4.2	0.05	347.6	6955	3500-4500
	P. F	501442	869068	Wheat	5	0.036	270	7500	4500-6500
	P. G	501319	869110	Potato	3.5	0.036	252	7000	5000-7000
Arata Cufaa	P.H	507066	882593	Cabbage	5.8	0.25	1044	4176	3500-5000
	P. I	505428	881973	Potato	5	0.25	1440	5760	5000-7000
	P. J	504893	881516	Potato	5	1	4320	4320	5000-7000

Analysis Result

found by measuring water distributed, using the Parshall flume at ten randomly selected irrigation users in the four schemes, showed big variability (Table 1). The water allocation and distribution vary ranging from 3.5 to 8.4 L/s and 4320 to 9676 m³ flow amount in one irrigation season regardless of the type of crop.

Empirical studies of SSA regarding IWUA's capacity in water allocation and distribution decision-making transparency verify similar results. Most SSA IWUAs are suffering from capacity limitations to be transparent and give due decisions to their members with a lack of professional support and little know-how about irrigation water management (Mutambara et al., 2016).

The financial status of IWUAs

In the observation made on IWUAs and FGD at the zone level, all irrigation schemes in the Ketar subbasin collect irrigation operation and maintenance fees from their members on their members' decisions, based on landholdings. The amount of money collected by all IWUAs in the subbasin including the four schemes is very small ranging from ETB⁴ 200 to ETB 2000/year/ha. The study made on the four selected schemes confirmed the same result; Ketar Fowofte collects 1600 ETB/year/ha, Ketar Genete 800 ETB/year/ha, Torben Unshoo 1800 ETB/year/ha, and Arata 2000 ETB/year/ha. Still the two downs stream schemes Ketar Torben Unsho and Arata contribute relatively higher fees. However, according to the woreda irrigation office, all four IWUAs' fee collection is below the required amount for their yearly critical operation and maintenance costs.

⁴1USD is equivalent to 46.00 ETB

Gender inclusiveness

The study also looked at if any gender and other inclusiveness principles and implementations are in the bylaws and their implementations. The IWUAs establishment documents encourage women to be in the position of the IWUA leadership to play a significant role and benefit from irrigation water governance. However, the result showed that each of the four IWUAs has only one woman member on its committee. In the survey, 70% of the respondents explained the absence of any gender-related incentive instruments in their IWUAs. The result is the same across each scheme. The FGD decision showed that this is due to the community attitude, and the overburden of the women in the community.

Irrigation infrastructure management as governance indicator

The water abstraction, water conveyance, division, and distribution infrastructures management of irrigation in the Ketar sub-basin are under the mandate of IWUAs. The irrigation infrastructure of the four schemes is broken, breached, and deteriorated. Water is leaking, seeping, and overtopping here and there, earthen canal's shape is completely distorted from its original design and capacity.

Arata irrigation scheme diversion weir is completely silted. The upstream of the weir which was constructed for water regulation is serving currently as an illegal irrigation plot by private investors. Ketar Fowfowete's main canal, especially the sheet metal aqueduct was constructed to convey 1 m³/s. The measurement conducted using Parshall flume at the outlet and floating method indicated currently showed it is conveying only



Figure 5. Breached structures, stone-regulated offtake, fully silted diversion weirs, and multi-use supply canal at Ketar and Arata Irrigation schemes. Source: Pictures taken in March 2021 as a part of data collection by the researcher.

0.875 m³/s which is a reduction of 12.5% from the design. This reduction of flow can be accounted for by the deterioration of the structure. The maintenance of this structure is beyond the IWUAs capacity in terms of finance and skill.

The hydraulic assessment for the conveyance and main canal structures conducted in flow measurement showed 31% water loss at K. Fowowte before the water reaches K.Genete due to canal breaching, and seepage; 12% additional loss at K. Genete due to the earthen canals deterioration, breaching, and domestic and livestock consumption before it reaches K.T. Unshoo; and a total of 49% water loss which is a 0.37 m³/s water loss at K.T. Unshoo was observed. All these losses are due to the irrigation infrastructure governance drawbacks in terms of rehabilitation and regulation. These have resulted in inequity in water distribution among its members and depicted the weak water management of the IWUAs'. Similar studies made on irrigation infrastructure management as a cause for poor irrigation water governance witnessed the same results (Akuriba et al., 2018; Dirwai et al., 2019; Fufa, 2017) (Figure 5).

Conclusion

The study looked at the IWUAs position in the Ethiopian irrigation water governance structure that constitutes the polycentric governance model. According to this study, the IWUAs are the key role players in irrigation water governance. However, there are rooms to be an improvement to make the IWUAs more productive. The result of the IWUAs performance at the microenvironment level, taking four irrigation schemes in the Ketar subbasin as a showcase, portrayed the determinants variables to

get due attention for better irrigation water governance.

IWUAs becoming legal entities is a positive finding to enhance the Irrigation water governance in the area of capacity building in finance, knowledge, and skill. In addition, the legal registration gives room for the IWUA to have a legal mandate to get a loan. On the hand, the bylaw implementation of the IWUAs tends to the punishment rather than equitable water distribution and infrastructure management. The IWUAs are stronger in conducting a planning and review meeting at least two times per year. However, some of the irrigators showed a limitation in the planning process and the participation level.

The IWUAs irrigation water governance performance in terms of water allocation and distribution has a disparity at the scheme level between users, and male and female irrigators. The water allocation and distribution of all four schemes did not account for plot location, canal length, conveyance time, and crop type. This is ascribed to the IWUAs' financial, knowledge, skill, equipment, and technical capacity gap.

In general, even though polycentric irrigation water governance which gives a key role to the local community was supposed to deliver better governance service at a local level, the findings of this study showed a mixed result; encouraging results in by-law implementation, and planning and drawbacks in water allocation, infrastructure management, water management, and fee collection services.

Recommendations

To make irrigation water governance more result-oriented and satisfactory, IWUAs should be empowered in water

distribution and measuring infrastructures and equipment, O&M fee collection, water allocation basics, and gender inclusiveness. The IWUAs should be supported by the government and other stakeholders in installing water measuring structures and water allocation recording for equitable water distribution services which should be based on land size, crops, and plot locations rather than blanket allocation and distribution. In addition, women irrigators should get due attention in the irrigation governance leadership and water use. The government should assign irrigation experts in proximity based on irrigation size, water scarcity, and the density of irrigation on water resources.

For the water governance of the country in general and in particular the irrigation water governance to be improved, the IWUAs should be capacitated with incentives for good water governance.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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