

Full Length Research Paper

Challenges and opportunities for implementation of Integrated Water Resource Management in Omo-Gibe Basin, Ethiopia

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Water is an essential element for the environment, food security and sustainable development. However, uncoordinated and competitive use of the resource can lead water to face the “tragedy of the commons”. Fragmented effects done so far in watershed management did not bring significant changes. Integrated water resource management is the ideal solution for sustainable development of the basins. This paper is targeted at assessing the challenges and opportunities of implementing integrated water resource management intervention in Omo-Gibe basin. The sample micro watersheds were strategically selected considering its accessibility for four-wheel vehicle and horse transportation. Five percent of the sample respondents were randomly selected for interview. Data were collected from all relevant sources through field observation, key informants interview, focused group discussion, household survey and review of documents. The collected data were analyzed by means of descriptive statistics including chi-square and t-test, using SPSS vision 20. The evidence in the basin shows that biophysical, socio economic and hydro political factors govern the implementation of integrated water resource management. Large proportion (65%) of steeply slope and land degradation, lack of understanding of IWRM principles and practices (72%), absence of river basin authority, no habit for planning together, lack of water resource infrastructure and innovation (81.9%), and weak local institutions commitment to transfer principles into practices were the major problems of the basin. In spite of having those limiting factors, the effort of the government through making policy on water resource management is a prospect for the basin, besides harmonious cultural interaction of the community to live together with nature and themselves. The Omo-Gibe River Basin has right to exist in harmony with its ecosystem to function sustainably. Human induced factors were limiting the wise use of scarce natural resources in the basin. Therefore, successful implementation of integrated water resource management though developing river basin authority, capacity building and enabling the environment is important for the basin, and for the country at large.

Key words: Basin authority, capacity building, enabling environment, river.

INTRODUCTION

Water is an essential element for the environment, food security and sustainable development (Cox, 1987).

Rivers, lakes, swamps and wetland ecosystems have environmental value that contributes to human wellbeing

and environmental sustainability (MEA, 2005). Most of these uses of water depend on the accessible fresh water resources, which constitute less than 1% of global water resources (Chander and Prasad, 2014).

Globally, fresh water resources are under high pressure due to socio economic and demographic reasons. The rise in demographic pressure, development activity and interest in competitive demand for water brought disputes over the limited fresh water resource. This situation is worsen by social inequity (male and female; developed and less developed), economic marginalization and poverty. Lack of technology and weak innovation lead to degradation of fresh water resource (GWP, 2000; Chander and Prasad, 2014; UNESCO, 2015). As the world population increases, demand for water rises and as climate changes add to the problems, there is a real threat of water scarcity in many parts of the world in general and in Ethiopia in particular. Due to natural and man-made reasons, millions of people, particularly in developing countries including Ethiopia, have limited or inadequate access to water. Lack of quality water as well as the availability of enough quantity is challenges to development in many areas of the world, especially in developing countries. This situation is worse in sub-Saharan countries. Hence, it affects the wealth and health of human beings. Moreover, water scarcity and water quality problems are of actual concern in African countries where many countries are less developed. In this region, there is often a connection between unavailability of good water resources and poverty (Chander and Prasad, 2014; UNESCO, 2015).

An attempt to solve the problems related to availability of water resource, management approach is required for its use and reuse. Through the history of water resource management, several management strategies were used. Top down approach, sectoral approach and integrated water resource management approaches are some of them. In top down water management approach, the central government is a service provider and is responsible for all water management in the country. This approach did not give due consideration for local community and professional participation, and it is not flexible. In sectoral water management approach, different sectors manage water resources differently. This approach lacks integration, cooperation and coordination. Weak management, systemic deficiencies of related institutions and governance, absence of a long-term vision, absence of consistent economic rationale for project selection, lack of community participation, heavily construction focused and inconsistent decision making

characterize the previous water management approaches. Due to these draw backs, top down and sectoral water managements were left for integrated water resource management. IWRM approach has gotten great recognition by the International Conference on Water and Environment, Dublin 1992. The approach is participatory, involves users, planners and policy makers at all levels. Women play a central part and water is recognized as a social good and having economic value. *IWRM is a process that promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.* The concept of Integrated Water Resources Management, in contrast to “traditional”, involves fragmented water resources management at its most fundamental level and is concerned with the management of water demand as with its supply (GWP, 2000).

Considering its relative advantages, Ethiopia has been implementing IWRM. The recent water resource management policy of the country relies on the principles of IWRM, which comprehend and integrate water uses for agriculture, energy, environment, navigation, drinking, sanitation, aquatic resources and industry (MoWR, 1999). Depending on the water resource management policy, strategies were designed to implement IWRM throughout the country since 2001 (MoWR, 2001). However, in spite of having its vital role in sustainable development, the implementation of IWRM has its challenges in water resource management at the river basin level. Due to its weak implementation of IWRM, the basin of the country has been facing problems such as flood damage, upstream and downstream conflicts and water use competition. The 2006 flood damage of Omo-Gibe River basin and Dire-dawa town are the indicators of ineffective implementation of IWRM. Moreover, uncoordinated and competitive use of the resource can lead water to face the “tragedy of the commons” (Yohannes, 2012). To solve such problems, integrated water resource management has great contribution. Hence, the role of effective implementation of IWRM into practice is indispensable. However, the experiences in the field show that there is miss match between the strategies of water resource management and the realities going on. Moreover, the practice of IWRM has not been implemented as its principles (Ibid). Lack of coordination among sectors and water user groups is evident. Moreover, overlaps in responsibilities in water resource management are also evidence of the lack of IWRM in the country. In fact, there is no scientific investigation

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conducted on this topic for local situations, even at the country level except the one conducted by Yohannis (2012) in Lake Tana basin. This also worsens the problem in Ethiopia in general as well as in Omo-Gibe basin in particular. Therefore, this study is designed to identify major challenges and opportunities regarding implementation of IWRM in Omo-Gibe basin in Ethiopia, and to provide base line information as well as the fact to make management strategies for successful implementation of IWRM.

Study area description

Ethiopia has twelve river basins: Abbay, Awash, Baro-Akobo, Genale-Dawa, Mereb, Omo-Gibe, Rift Valley, Tekeze, Wabe-Shebele, Afar-Denakil, Ogaden and Aysh with a total amount of 122 Billion Meter Cubic (BMC) annual runoff (Awulachew et al., 2007; Ayalew, 2018). The Omo-Gibe River basin is an important basin of Southern Ethiopia. Its course is entirely contained within the boundaries of Ethiopia, and empties into Lake Turkana on the border with Kenya. It is the principal stream of an endorheic drainage basin; the part that the Omo-Gibe River drains includes part of the Western Oromia Region and the middle of the Southern Nations, Nationalities, and People's Region (Figure 1).

The Omo-Gibe River basin has an area of 79,000 km², covering parts of the SNNPR and Oromia. The total mean annual flow from the river basin is estimated at about 17.9 BMC, that is, about 15% of the total runoff of the country. Large-scale and medium-scale irrigation potential is identified in the basin, with an estimated irrigable area of 57,900 and 10,028 ha, respectively, and a total irrigable area of 67,928 ha. In terms of hydropower development potential, it is the second largest and it is a basin in which most of the current hydropower development takes place. The basin is also endowed with a variety of wildlife, with Omo and Mago parks being located in the basin, its tourism potential will be further exploited as infrastructure develops in the area (Awulachew et al., 2007; Ayalew, 2018).

METHODOLOGY

For this study, Kaffa, Gurage, Hadiya, Wolaita and Dawuro zones as well as Yem-special district were strategically selected. The nearest district to Omo-Gibe River was selected from each zone, considering the availability of data and accessibility of the district for data collection using four wheel vehicle and horse. Following this step, two districts at most were selected from each zone. After this consideration, sample micro watersheds were randomly selected in the district. Moreover, 5% of sample respondents were randomly selected for interview from each sample micro watershed. Accordingly, about 248 heads of household interviews were conducted and sample size was constrained due to financial constraint. In addition, a total of eleven-focused group discussion was done (each comprising 6 to 12 participants). About 19 key informant's interviews were carried out. The key informants were

elders and watershed development experts. The sample micro watershed, the number of group discussion and sample respondents were summarized in Table 1.

Before the formal data collection desk review was done, available archives in the local, regional and national offices were collected and reviewed. After that, permission was requested from respective local administrations to carry out the field activities, and then the fieldwork was done. Accordingly, formal and informal discussions with leader of the zones, districts, peasant association, institutions, and villagers were conducted. Based on the information obtained from the discussions, data collection process was employed through field observation, questionnaire survey, focused group discussion and key informants interview.

Field observation was focused on observation of biophysical characteristics of watershed like land degradation, crop patterns, distribution of settlements, individual activities in the farming plots, farmers' land management practices, water resources, bush and grazing lands, and other relevant aspects of water resource management in the catchment. The observation covered all sampled micro watershed in the districts. During the field observation, river course characteristics including water quality, availability, color and odor of water, water source protection systems or mechanisms, and ecological conditions were observed. Questionnaire survey was used to collect the primary data from sample households. The survey was conducted using both open and closed ended structured questions. It was focused on to get information on stakeholder's field practices as well as the strategies of water resource management sector. Focused group discussion was conducted based on checklists and semi-structured questionnaires prepared for this purpose. In this session, the information on resource use interactions, resource allocation systems, female participation in water resource management and related issues were raised and forwarded for analysis. Key Informant Interview was carried out with leaders and experts. Identification of key informants who have deep knowledge about the area was an essential task. They have deep-rooted experience and knowledge of their environment, which is vital to know details regarding water resource management in the area. They can also play significant role in leading local institutions as they were highly respected in the community. Thus, gaining their consent was an important step. Contacts with development agents, agricultural and water resource experts are also vital to assess the extent of water management in the area. Finally, the collected data was analyzed. Initially, editing and coding of the collected data was made. The process of examining the raw data in order to detect errors and omissions and to make correction if possible was done. After completion of editing, the process of assigning numerical symbols (coding) to the responses was done and then the collected data were entered into SPSS version 20. Descriptive statistics including t-test and chi-square test were used for analysis. Moreover, population figure was predicted through geometric growth method with 3% increment rate.

RESULTS AND DISCUSSION

Water resources of Omo-Gibe Basin and its uses

The Omo-Gibe River drains to the south from Ethiopia's humid highlands of Kaffa and West Shoa zones to arid lowlands, terminating in the Omo-Delta on Kenya's Lake Turkana through passing undulating gorges of Dawuro, Gurage, Wolaita and Hadiya zones (Figure 2). It is one of the most important water resource basins in Ethiopia and carries about 17.9 BMC mean annual flow, that is, 15% of

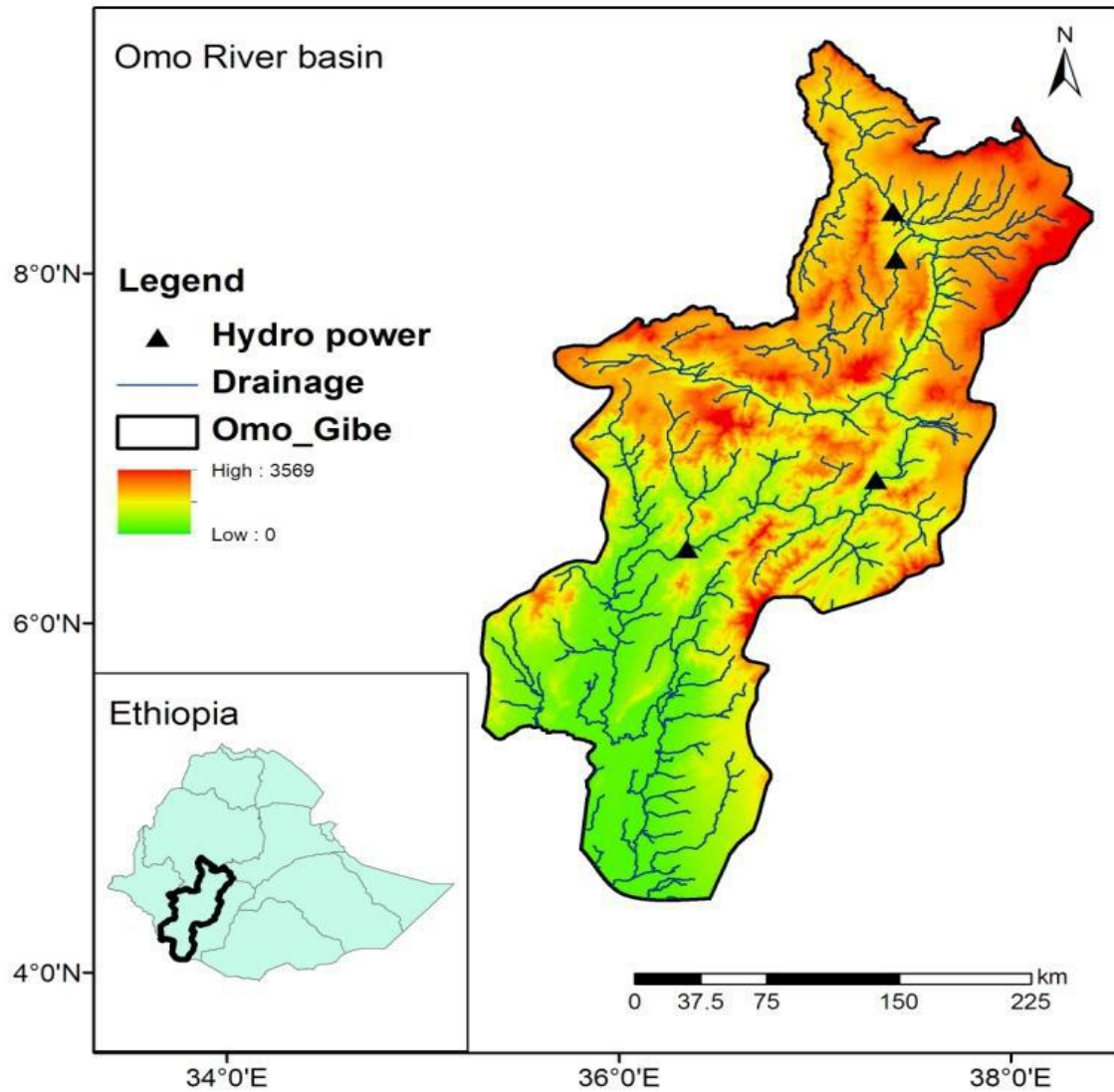


Figure 1. Omo-Gibe river basin.
Source: Eyasu et al. (2015).

Table 1. Selected sample micro watersheds and respondents distribution.

Zone/Special Woreda	District	Sample micro watershed	Sample respondents	Number of FGD	Key informants
Kaffa	Gimbo	Gojeb	20	1	2
		Dire Goma	17	1	1
Yem special Gurage Hadiya	Yem Special	Fofa	27	1	3
	Abeshige	Gibe Genet	37	1	4
	Gibe	Gibe	37	1	2
Wolaita	Kindo Koyisha	Belle	28	2	2
	Kindo Didaye	Gocce	27	1	2
Dawuro	Loma	Gessa	27	1	1
	Genna	Genna	28	2	2

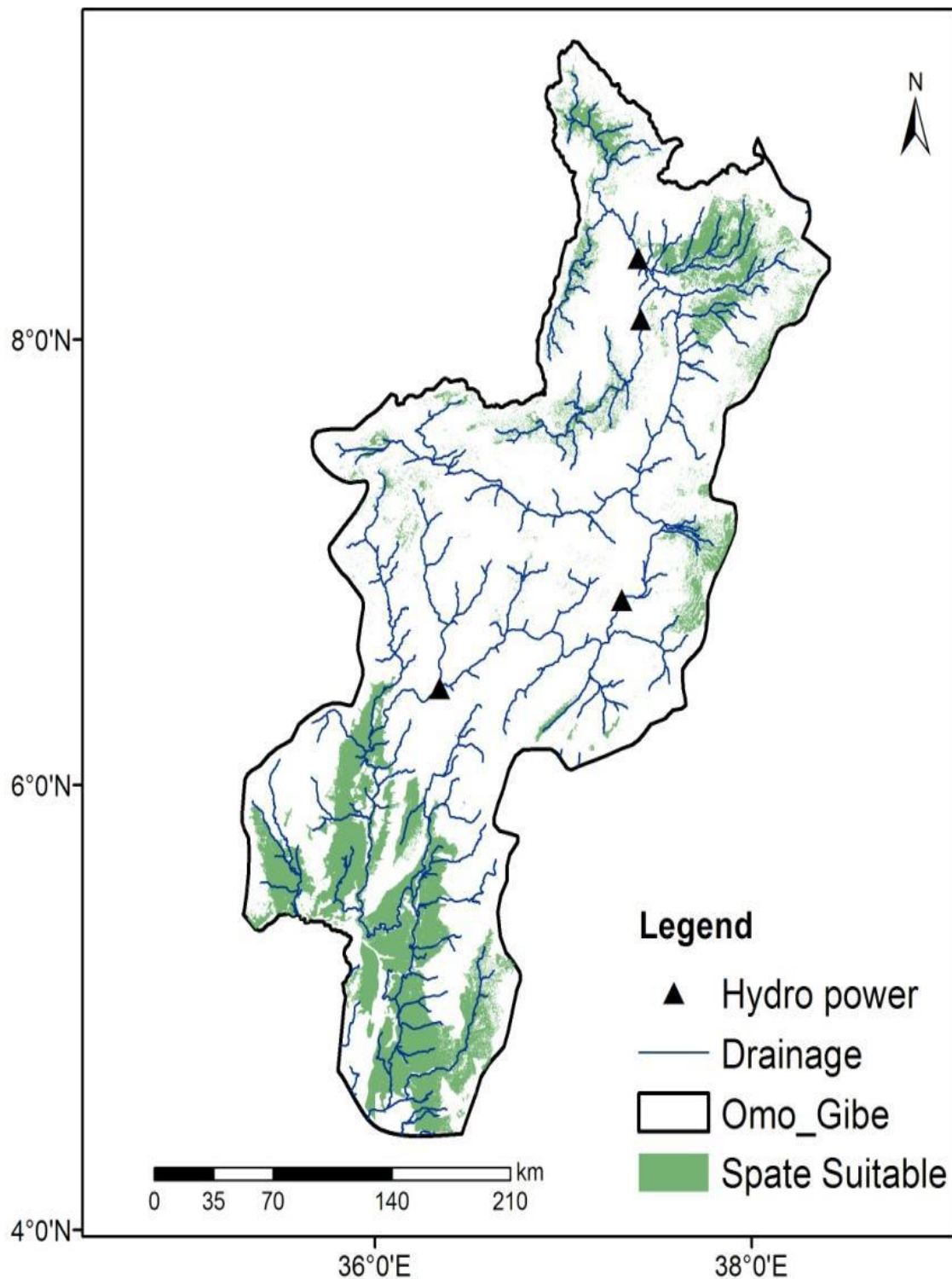


Figure 2. Drainage network of Omo Gibe basin.

the annual surface water resource of the country. The river provides about 90% of Lake Turkana's annual inflows and it sustains the ecology (Awulachew et al.,

2007; Avery and Turton, 2012; Eyasu et al., 2015). The major water use interests in the area are water for Agricultural, Domestic, Hydropower and Recreation uses.

Table 2. Observed challenges in the basin.

Factor	Response		Percentage	
	Yes	No	Yes	No
Demographic pressure	248	0	100.0	0.0
Lack of understanding of IWRM principles and practices	179	69	72.2	27.8
Inadequate information and data management	151	97	60.9	39.1
Lack of basin authority	248	0	100.0	0.0
Environmental degradation	248	0	100.0	0.0
Gender disparities	155	93	62.5	37.5
Lack of water resource infrastructure and innovation	203	45	81.9	18.1
No habit for planning together	221	26	89.1	10.5
Weak in risk management	167	81	67.3	32.7
Weak institutional commitment to transfer principles in to practices	245	3	99	1

Agricultural water demand for irrigation is dominant in lower parts of the basin, unlike in the upper and middle parts. This is because of unsuitable undulating topography for irrigation development. The water use for irrigation is relatively fewer than other uses. Similarly, the previous studies showed that the irrigation potential of this basin is less than 10% of the catchment total area (Awulachew et al., 2007).

The water use for hydropower is well known in the basin since Gibe I, II and III are functioning. The government of the country also proves to construct new dams in this basin including Gibe IV and Gibe V. The key informants stated that there are additional potential sites for hydropower in the basin, which is expected, be used in the near future. Gilgel Gibe III (Gibe III) hydroelectric power project was constructed on the Omo-Gibe River and it is the second largest in the country with a potential of 1,870 MW, that is, estimated production capacity of 6,500 GWh a year. Moreover, several other dams were constructed in the basin including Gibe I and Gibe II (Velpuri and Senay, 2012).

Recreational use of water in the area is also common. There were several sites which are known for its waterfall like Ajora waterfall, Gibe Dam I, II and III. These are potential tourists' sites in the basin. In addition, the dams are used as pot spot for fishing, through which local community members participate in fishing activities for food and market use. Despite these huge potentials of water resources, the people of Ethiopia in the basin have benefited trifling so far. The management of the water resource is governed by several hindering factors; hence, the region is under water stress, while having huge water resource potential. People are still demanding for water in the basin despite having huge water resources.

Challenges of IWRM implementation in the basin

The result of the study shows that the implementation of IWRM is governed by biophysical, socio economic and

hydro political factors. Undulating topography, climate variability, population pressure, deforestation, financial constraints, and lack of basin authority were the major challenges (Table 2).

The identified factors were interlinked, forming complex interaction. Detailed explanations and analysis of specified factors are presented as follows.

Biophysical challenges for IWRM in the basin

The undulating terrain of the basin hinders effective implementation of IWRM (Figure 3 and Table 3). The elevation at which the river flows is below 700 m.a.s.l, while the suitable land for cultivation by means of irrigation is found in highlands above 1200 m.a.s.l. Due to these reasons, Omo-Gibe River did not serve as irrigation in the upper and middle parts of the basin. Even if, an area of 2000 ha of lands is suitable for irrigation in the catchment at which the elevation is between 700 and 1200 m.a.s.l, it will be impossible to cultivate the region due to shortage of technology so far. This result is consistent with the findings of previous studies (Awulachew et al., 2007; Eyasu et al., 2015).

Moreover, recurrent land sliding due to undulating topography leads to land degradation. This in turn leads to water ecosystem pollution in the middle parts of the basin. The terrain feature in the basin also hinders satisfying water demand for domestic water uses; hence, integrating water demand with existing water potential is impossible in the catchment until today.

The basin potential is estimated to be 16.6 up to 19 BMC and the consumptive annual water demand is estimated to be 0.132 BMC, excluding hydropower and recreational use (Table 4).

It was noticed that an insignificant proportion of water is needed for use, while people are in demand for water in the basin. The Amharic proverb *Ye Abayin Liji Wuha Temawu*, meaning having huge resource with people in demand, is true in Omo Gibe Basin. It explicitly implies

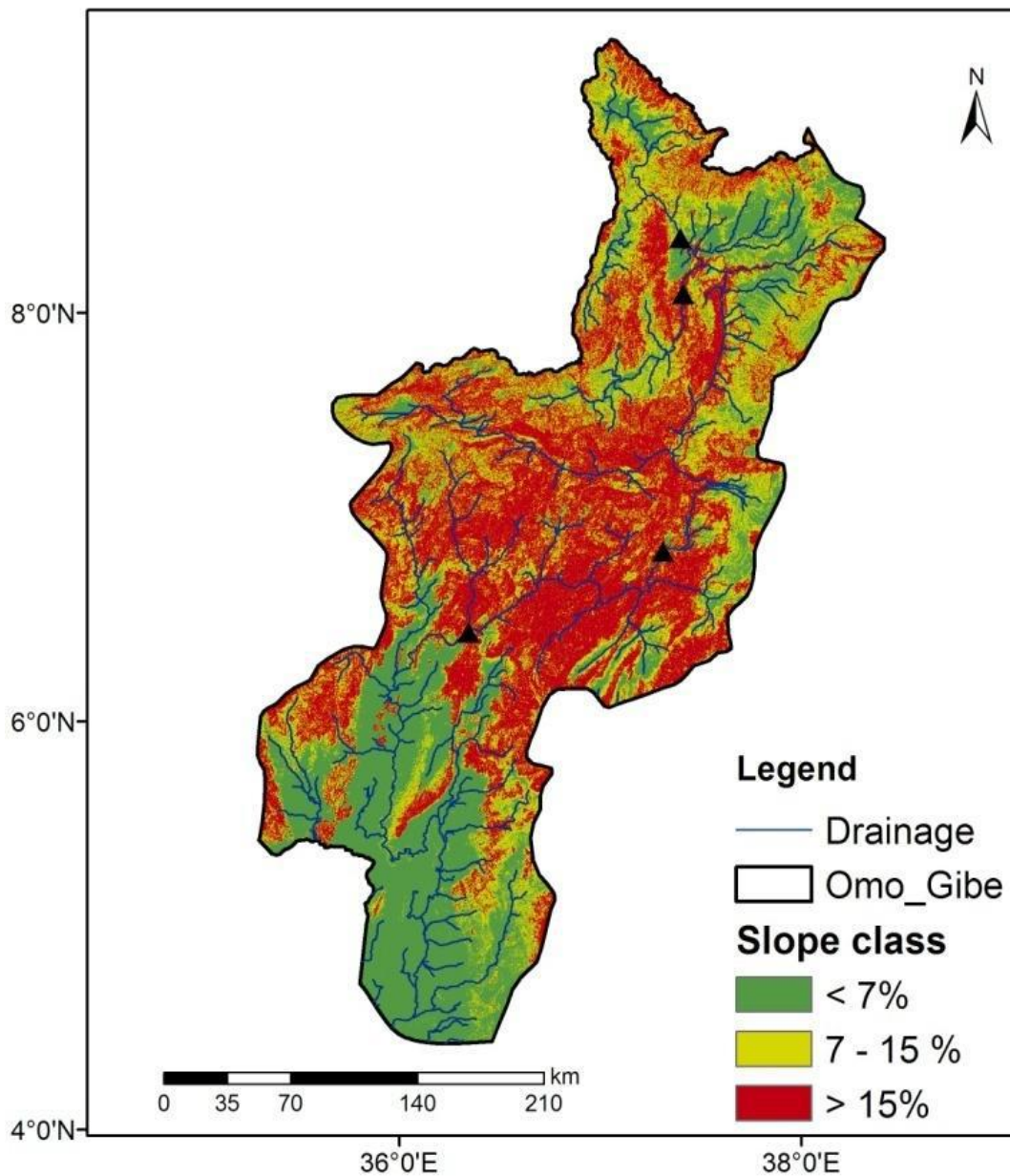


Figure 3. Slope classes in Omo Gibe basin.

Table 3. Respondents characterization of their land topography (slope).

Slope class	Respondents frequency	χ^2 (P value)
Steeply	162 ^b	0.000
Moderate	51 ^a	
Flat	35 ^a	

The different superscript letter indicates significance differences.

that the existence of ample amount of water only does not guaranty the wise use of water resources, the capacity, skill and knowledge also matters. Environmental

degradation through destruction of indigenous tree species due to implementation of development projects was also encountered in the basin.

Table 4. Annual consumptive water demand at basin.

Zone	Region	Water demand (m ³)							Total
		Population	Domestic	Industrial	Institutional and commercial	Livestock	Irrigation	Recreational	
Bench Maji	SNNPR	692271	3790183.73	379018.4	568527.56	379018.4	758036.7	189509	6064293.96
South Omo	SNNPR	608358	3330760.05	333076	499614.01	333076	666152	166538	5329216.08
Hadiya	SNNPR	1306176	7151313.6	715131.4	1072697.04	715131.4	1430263	357566	11442101.8
Kaffa, Sheka	SNNPR	1139439	6238428.53	623842.9	935764.28	623842.9	1247686	311921	9981485.64
KembataTembaro, Halaba	SNNPR	722300	3954592.5	395459.3	593188.88	395459.3	790918.5	197730	6327348
Dawuro	SNNPR	519393	2843676.68	284367.7	426551.50	284367.7	568735.3	142184	4549882.68
Konta Special	SNNPR	96379	527675.025	52767.5	79151.25	52767.5	105535	26383.8	844280.04
Wolaita	SNNPR	1592530	8719101.75	871910.2	1307865.26	871910.2	1743820	435955	13950562.8
Gurage	SNNPR	1357577	7432734.08	743273.4	1114910.11	743273.4	1486547	371637	11892374.5
Yem Special	SNNPR	85601	468665.475	46866.55	70299.82	46866.55	93733.1	23433.3	749864.76
East Welega	Oromia	1393170	7627605.75	762760.6	1144140.86	762760.6	1525521	381380	12204169.2
Jimma	Oromia	3115472	17057209.2	1705721	2558581.38	1705721	3411442	852860	27291534.7
West Shoa	Oromia	2389265	13081225.9	1308123	1962183.88	1308123	2616245	654061	20929961.4
Total					-				0.132 BMC

The key informants and focused group discussion strongly state that the development intervention significantly affects the natural ecosystem and it costs the biodiversity. The choice between environmental expenses and development is of the government, they suggest that it has to be sustainable development. The climate variability, which is manifested by its recurrent occurrence of extreme events like Flood and Drought, are common in the basin. Most respondents (86%) from the basin agree that drought and flood are the common challenges in the basin. Endalamaw (2015) cited in Eyasu et al. (2015) in a previous study reported that more than 19, 000 ha of land with 2.5 m depth of flooding happened in lower parts of the basin. Besides, there are hostile effects on irrigation development; the prevalence of malaria disease due to flooding is a major health challenge for the nearby community in the area.

Weak enabling environment

The commitment of Ethiopian government to implement IWRM at grass root level is less, while development of water resources policy and environmental protection policy of the country are part of the government's IWRM worth. Lack of basin authority, lack of skilled manpower in the water sector, less development in water research and water research institutions, as well as weak water resource conflict resolution were noticed. Also, they govern the implementation of the integrated river basin management in the area. Moreover, weak government institutional integration is observed in this basin. They plan, the needs, integration and coordination of the institution separately. The division is clearly observed in the upper and lower catchment. This finding is in line with the findings of a previous study (Yohannis, 2012). As a general principle,

strong enabling environment is an important factor for sustainable water resource management. Moreover, in many instances, only a few people in the hierarchy of water management know and understand IWRM and often there is insufficient technical support to operationalize it. Most experts who were nominated for Water Management in the Woreda were not familiar with principles of IWRM. It indicates that the lesson for capacity building is essential for better implementation of IWRM. There are few studies and data on ground water resource. The previous empirical study of Eyasu et al. (2015) establishes that inconsistency and absence of data are the challenges in the basin.

Weak community participation

Weak community participation in the development

intervention and wrong traditional perspectives in relation to water use is a challenge for the basin. Local community thinks the *Water is a free gift from God* (Table 5).

This thought contradicts with the guiding principles of IWRM. Hence, they are not willing to pay for water uses. The community does not consider the opportunity costs of water. In line with this, Meshesha and Birhanu (2015) found weak community participation in Chena Woreda, Kafa Zone, south west parts of Ethiopia. Similarly, the finding of Meshesha and Birhanu (2015) concludes that watershed management practice is embedded with weak community participation. In contrast with this, Wolancho (2015) concludes that achievement in rehabilitating degraded lands are seen as excellent lessons for future efforts and the participation of community in watershed development was acknowledged. In line with this finding, the study in watershed management intervention in Berki watershed in northern Ethiopia revealed that step-by-step community participation has created a sense of ownership. Moreover, several studies witnessed that the northern parts of the country was recognized with its high level of community participation in the country (Jembere, 2009). Most previous studies including all aforementioned literatures agree that, in spite of having different status of community participation in water management intervention, their use trend shows that users are extracting high amount of water resources than their demand. Similarly, users are cost less amount than the benefit they get. Therefore, it was agreed that the recent use cost of water will not guarantee the sustainability of its future uses.

Lack of basin authority and weak capacity building

Water resource boundaries do not coincide with political boundary. Water flows from upstream to downstream through gorge, while politics form boundaries suit its interest. The regional boundary delineation of Ethiopian government classified Omo- Gibe basin into two regional states: Oromia and SNNPR. The Oromia regional state includes Jimma, East Welega and West Shoa zones, and SNNPR includes Kaffa zone, Gurage zone, Hadiya zone, Dawuro zone, Wolaita zone, Gamo-Gofa zone, South Omo zone and Yem special Woreda (Figure 4).

This indicates that the basin boundary and regional boundary are different. It was discovered that different regions and different zones in the same region manage water resource differently. There were no officially recognized body to bring those different interests into common interest and no one is responsible to integrate water management in the basin, except Ministry of Water, Electric and Energy at federal level. In spite of having 12 river basins in the country, only three, Awash, Abay and Rift Valley, basins have their own basin authority. However, Omo-Gibe basin do not have the central

planning basin authority. This is one of the limiting factors for success implementation of IWRM. Integrated water management seeks grass root management institution rather than ministerial office. Lack of skilled manpower in water resource management sector is another hindering factor of IWRM. Most of the respondents (99.99%) assured that there are only few experts at zonal in this sector. None of the respondents report about the presence of expert in kebele level, while experts are in high demand.

Demographic pressure

The population pressure is also the challenge for the catchment. The middle part of the basin is densely populated as compared to the entire parts of the country (Table 6).

Increase in population growth leads to utilizing of forest resources beyond its carrying capacity. Similarly, pervious study shows that the increased demands for water and land in Indonesia as a consequence of the population growth and economic development has reportedly have been accelerated from year to year (Fulazzaky, 2014). All respondents associated the deforestation of natural forest with human population pressure in their locality. Hence, the expansion of agricultural land is responsible for environmental degradation and forest resources in the basin. Shifting cultivation is used in Kaffa zone, in which large natural forests were destroyed. Finally, this has led to pollution of water resource through erosion, which worsens water quality and uses.

Land use land cover change and environmental degradation

Deforestation, Land sliding, Flooding and Drought are also repeatedly reported by respondents in the basin.

During the field observation, it was observed that Bushlands were cleared and used for charcoal production (Figure 5, Table 7), since the land is required for laying water for hydropower development (Gibe III).

Other empirical studies also states that poor land management, flood and drought lead to complications in the basin. Change in climatic condition result in huge form of flooding and rise in evaporations. Geo hazard problems like landslides, gullies and siltation are some of the anticipated challenges and environmental problems threatening the long benefits of the dam in Omo Gibe basin (Kebede, 2012).

Financial constraints and poverty

According to a focused group discussion, poverty is one

Table 5. Community understanding about water.

Variable	Response frequency		Percentage	
	Yes	No	Yes	No
Water is finite resource	103	145	58.46774	41.53226
Water is social good	248	0	100	0
Water has economic value	96	152	61.29032	38.70968
Water is free gift of God	248	0	100	0

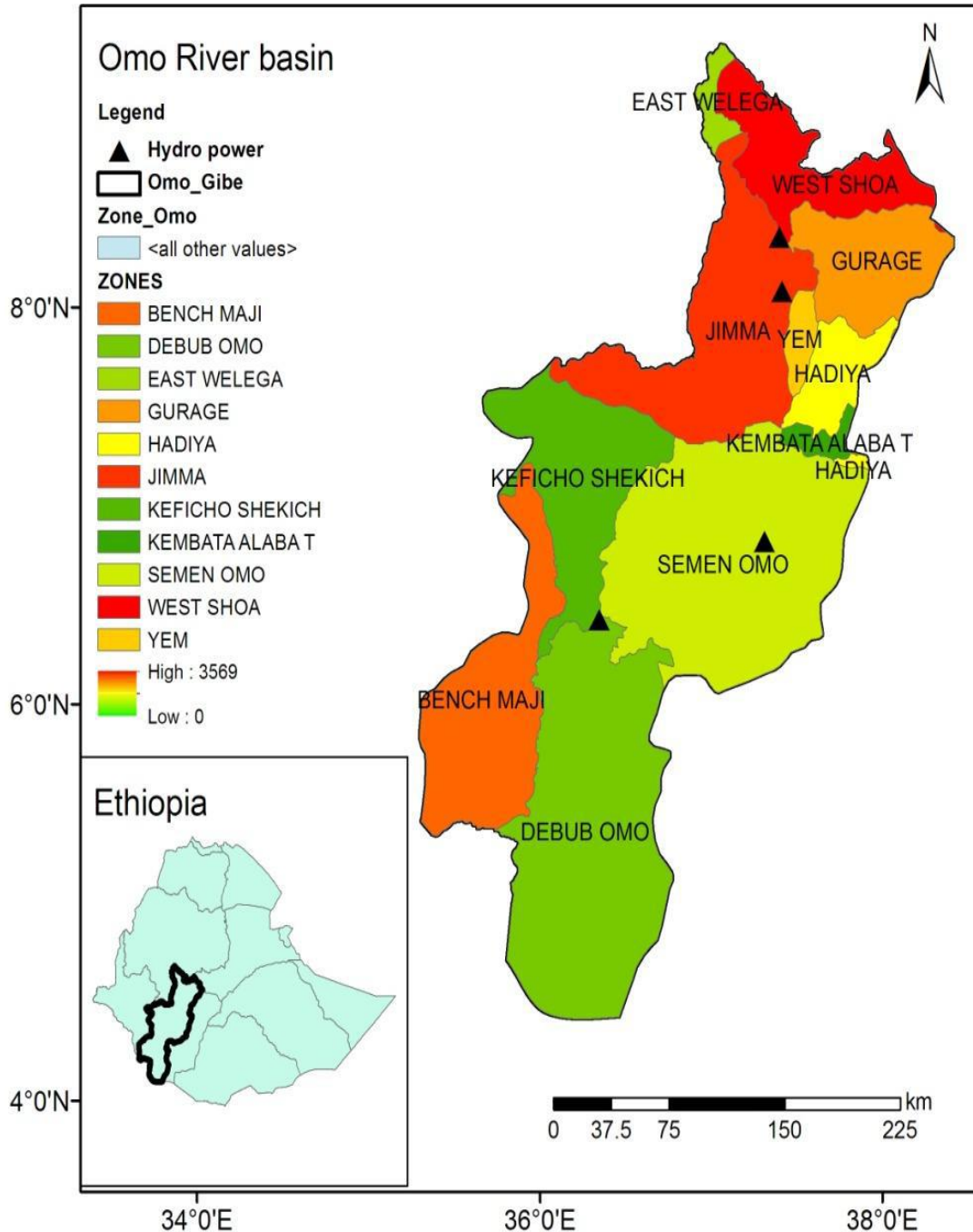


Figure 4. Political administrative boundaries in Omo-Gibe Basin. Source: Eyasu et al. (2015).

Table 6. Population of Omo-Gibe Basin.

S/N	Zone/Woreda	Region	2007 (from CSA)	2017	Projected for 2027
1	Bench Maji	SNNPR	652531	672107	692271
2	South Omo	SNNPR	573435	590639	608358
3	Hadiya	SNNPR	1231196	1268132	1306176
4	Kaffa, Sheka	SNNPR	1074030	1106251	1139439
5	Kembata Tembaro, Halaba	SNNPR	680837	701263	722300
6	Dawuro	SNNPR	489577	504265	519393
7	Konta Special	SNNPR	90,846	93572	96379
8	Wolaita	SNNPR	1501112	1546146	1592530
9	Gurage	SNNPR	1279646	1318036	1357577
10	Yem Special	SNNPR	80687	83108	85601
11	East Welega	Oromia	1313196	1352592	1393170
12	Jimma	Oromia	2936631	3024730	3115472
13	West Shoa	Oromia	2252111	2319675	2389265
Total			14155835	14580516	15017931

For 2027 is projected using 2007 CSA census data

**Figure 5.** Bushlands firing for site clearance.**Table 7.** Land cover dynamics of the basin.

S/N	Land use type	Area km ² (2010)	Area km ² (2015)	% of land use type
1	Woodland	23794	13794	30.02
2	Intensive cultivation	23637	24038	29.82
3	Bushlands	7978	3125	10.06
4	Forest	6722	6320	8.48
5	Grassland	5906	3890	7.45
6	Moderate cultivation	5609	5950	7.08
7	Marsh	2103	1570	2.65
8	Shrubland	1111	250	1.4
9	Bare soil	1037	1037	1.31
10	Plantation and fallow	1001	1001	1.26
11	Open water	321	18242	0.41
12	Afro-Alpine	38	38	0.05
13	Urban	18	20	0.02

of the major challenges in the basin. This in turn leads to financial constraints to have modern technologies in water resource management. As most key informants stated that the challenge is not budget shortage, but also unwise use through improper allocation is also prevalent. Long transaction of budget from Federal to local government is confronted for the basin. Besides, the corruption of public budget is the bottleneck for the catchment in particular and for the country at large. Similarly, the previous studies in Africa with particular focus on Ethiopia conclude that Ethiopia faces a range of challenges in water management, with levels of service provision for water supply and sanitation that are amongst the lowest in the world. There are very low levels of irrigation development and challenges in areas such as hydropower development, disaster mitigation and ecosystems management (Jembere, 2009; Dowa et al., 2007) in the country.

Gender disparities in the basin

Watershed management is an important planning unit for sustainable natural resource management, in which the roles and responsibilities of women and men has to be clearly mainstreamed and benefited equally. Empowering women in water resource management and development is essential. Women and men use water for many purposes such as drinking, domestic purposes, livestock, gardening, irrigation, tree growing, fisheries, food processing and other cultural and business purposes. The evidences found from this study shows that the responsibility of fetching water is the obligations of women. The responsibility of women is rounded with homestead activities. The involvement of women in formal water management is less, compared to men. The involvement of women in decision making for watershed management is invisible. Moreover, the representation of women in water resource management sector is still very small; nevertheless, they are the guardians of family health and hygiene and providers of domestic water. Women, therefore, are the primary stakeholders in the homes as far as the issue of water provision and safeguarding is considered. Yet, men in the basin mostly make decisions on water systems. Contrary to this, as a general principle of IWRM, women play a central part in the provision, management and safeguarding of water (GWP, 2000).

Origin in the academia

As its name indicates, IWRM require multidisciplinary and/or interdisciplinary research and development intervention. However, in Ethiopia in general and in Omo-Gibe Basin in particular, water resources management teaching and research is considered within the exclusive

domain of the natural sciences. Particularly, IWRM is under the umbrella of the fields of engineering and natural sciences. This is because of its origin in the academia, where it is considered as pure natural science discipline and excluding social sciences. To be effective, IWRM requires socio-economic and political concern in its implementation. However, the social science disciplines are discouraged, to say the least, from playing the vitally needed role. Similarly, Yohannis (2012) suggest an interdisciplinary and thematic research development in Lake Tana basin.

Opportunities for implementation of IWRM in the basin

Contrary to its hindering factors, Omo Gibe River basin has numerous opportunities that has to be used for further intervention and development of the region. To mention some, policy support of the principles of IWRM, local community cultural integration, tourism development potential of the basin, commitment of government on watershed management and development of international collaboration and support for IWRM were commonly reported potentials of the basin.

Cultural integration

The integration of the society of upstream and downstream, through long time cultural development like in marriage, has great contribution for the effective implementation of IWRM. The Kafficho society has culturally bonded with Dawro and Yem society, Dawro with Wolaita and Hadiya, Hadiya with Gurage and Yem. This cultural bondage has potential positive contribution for IWRM, since the society has a long time relationship in the basin through helping each other. According to FGD and Key informants, this integration had significant contribution in conflict resolution and wise resource sharing in the basin.

Water resource policy support of IWRM

The rule of law in the country, Constitution of the Federal Democratic Republic of Ethiopia (1987), gives due focus on IWRM; therefore, it has constitutional support and legal ground as stated under Article 40/3, 51/5, 51/11. Moreover, it has policy support. The presence of well-designed water resources policy of the country is an opportunity for IWRM. Considering water as a social and economic good, the principle of cost recovery, acceptance of the basin as a unit of planning, decentralized management, equitable and reasonable water allocation, capacity building, and research and development are the most important concepts

incorporated in the policy (MoWR, 1999). In addition, the Ethiopian Water Resources Management Proclamation No. 197/2000 also has special provision for integrated water resource management. The purpose of the Proclamation is to ensure that the water resources of the country are protected and utilized for the highest social and economic benefits of the people of Ethiopia, to follow up and supervise that they are duly conserved, to ensure that harmful effects of water are prevented, and that the management of water resource is carried out properly. The policy and legal support gives due recognition to IWRM and promotes sustainable utilization of the resource. In addition, previous studies (Yohannis, 2012; Awulachew et al., 2007; Meshesha and Birhanu, 2015) support this result.

Development of international collaboration and support for IWRM

This basin encompasses several well-experienced universities including Arbaminch, Jimma, Wolyita-Sodo, Bonga and Jinka. The research collaboration among these universities in the basin is good opportunity. These institutions did not only make local collaboration but also international. For instance, Jimma University collaborated with Heinrich Boll Foundation and they are working on Environment and Capacity building. Arbaminch University had long time teaching and research experience on water sector and great potential of the basin for academia. The newly emerging universities (Bonga and Jinka) have collaboration initiation with higher institution both at national and international level. In addition, United States government supported a project that promotes IWRM in Ethiopia. Good international integration and diplomacy with neighboring a country, Kenya, using Win-win approach for water resource sharing is an opportunity not only for the basin, but also for the country.

Tourism potential of the basin

The development of tourism industry in the basin also has positive contribution on IWRM. Diverse topography, diverse ecosystem and diversity of natural and human made resources were special attraction of tourism industry in the basin. This industry also opens the door for locals to get financial resource for further development.

Watershed management initiatives of Ethiopia

Watershed management campaign, which was initiated by the government in Ethiopia in general and in Omo Gibe basin in particular, has positive contributions on IWRM. The previous studies conclude that watershed

management campaign has a successful accomplishment in the basin (Wolancho, 2015).

Conclusion

The Omo-Gibe River basin has the right to exist in harmony with its ecosystem to function in a sustainable manner. The human intervention through complex and interconnected linkage has been compromising the ability of the basin to function in its natural role. Depletion of the basin is the diminution of community. The Omo-Gibe River basin has experienced different computing water demands including water for agriculture, domestic uses, hydropower, irrigation and recreational uses. IWRM is the art of solution for sustainable water resource management. In Omo-Gibe River basin, several factors limit the successful implementation of IWRM. Rapid population growth, environmental degradation, steep topography, climate variability, lack of river basin authority, conflict of interest over natural resources, gender disparity, origin of academia, lack of skilled manpower, unwise uses of financial resources and poverty, are the hindering factors for IWRM. The government of the country officially recognized IWRM as a vital tool and adopted in its policy document. Nevertheless, the efforts done so far in the basin and the implementation of IWRM are not satisfactory. On the other hands, there are also several success factors for effective implementation of IWRM in the area. There are cultural integration, water resource management policy in the country, and tourism development in the basin; thus, development of watershed management campaign in the country has been considered as a good opportunity for IWRM. Therefore, effective implementation integrated water resource management is an important tool for the sustainability of the basin.

Recommendation

Through understanding a number of hindering factors of the implementation of IWRM in Omo-Gibe basin, the following recommendations were forwarded:

- (1) Establishing the Omo Gibe River Basin with the full mandate of managing the resources in the basin is important so that the government, that is Ministry of Water, Electric and energy, could play its managerial role through actualizing the authority in the basin.
- (2) Capacity building through establishing water research institutions and proving training at higher level is also essential.
- (3) An enabling environment should be translated from principle into practice, to bring the stated objectives into policy in the country.

(4) Further investigation has to be conducted on the constraints and factors hindering integrated water resource management.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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ABBREVIATIONS

BMC, Billion cubic meters; **CSA**, Central Statistics Agency; **FGD**, focused group discussion; **IWRM**, Integrated Water Resource Management; **MEA**, Millennium Ecosystem Assessment; **MoWR**, Ministry of Water Resources; **SNNPR**, Southern Nation Nationalities and Peoples Region; **SPSS**, Statistical Package for Social Science; **WGP**, Global Water Partnership.

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