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Preliminary survey of Geray reservoir, Amhara National Regional State, West Gojjam, Jabitehnan Woreda, Ethiopia: focus on wetland management

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ABSTRACT

Objective: To collect baseline information, to raise public awareness on the reservoir wetland situation, and to recommend an intervention mechanism to sustain its ecosystem services.

Methods: Survey on Geray reservoir was carried out during 2010-2011. Questionnaire survey to collect data in Geray reservoir watershed kebeles was deployed and the data included land use and land cover, livestock and human population, crop patterns, topography and soil type in these kebeles. Focus group discussion with local community to obtain indigenous knowledge was considered. Secondary data collection and relevant literature were surveyed. The collected data were analysed with descriptive statistics.

Results: Critical problems observed on the wetland and the surrounding watershed included vegetation cover removal, land degradation, wetland hardening, pressurized grazing, expansion of floating macrophytes on the reservoir, water seepage at the weir, water use management and water use conflicts, drainage structures maintenance and lack of institutional accountability. Open access and inadequate management has increased anthropogenic factors resulting amplified decline of ecosystem goods and services.

Conclusions: The reservoir is under growing stress and nearing to disappearance unless and otherwise timely measures are taken to mitigate the prevailing encroachment towards the wetland. Sustainable management of hydrological, ecological, social, biodiversity and economical values based on knowledge and experience on environment, land use, extension services and research to restore and sustain the various values and functions, calls for different stakeholders to alleviate negatively impacting factors on the wetland. Further information generation on the wetland situation on the Geray wetland specifically on wetland valuation is highly demanded.

1. Introduction

Ethiopia has wetlands that vary in size, type and location. Even though wetland resources of Ethiopia are not fully documented, it is known that they represent a significant micro-environment in many parts of the country. Studies showed that the wetlands in the various parts of the country is estimated to be 1%-1.5% of the country's area[1-3]. The area coverage appears small but the ecological and socioeconomic benefits are significant.

Amhara National Regional State is one of the regions which is endowed with various types of wetlands. Lake Tana the largest fresh water lake in Ethiopia, Fogera and Dembia Flood Plains, the Cheffa valley (Borkena), are some of the many wetlands that dominate the region's land surface. These wetlands make a significant contribution to the livelihood of many local communities in the region. According to Abye[4] the wetlands in Amhara National Regional State cover about

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288744 hectare of swamps and marshes. These wetlands are distributed all over the region. However, the largest portion of the wetlands is found in Abay River basin in Awi, West Gojjam, and South Gondar administrative zones. The Awash basin also has a significant area of wetlands, (*e.g.* Cheffa Borkena River Valley wetland) especially in South Wollo and Oromia administrative zones.

On a larger scale, anthropogenic activities impact physical, chemical and biological processes, which impair the ecosystem functioning causing decline and degradation of ecosystem services and value of wetlands. Wetlands predominantly face with change in wetland hydrology and habitat loss of catchment areas adjacent to urban growth, increasing runoff of nutrients and pollution, introduced species replacing indigenous species, land clearance and over-use of resources by losing its subsistence economies of that region mainly due to conversion. Traditionally wetlands are considered as wastelands in their natural state without considering their valuable services for environmental quality and the local community. They are often converted completely to other uses that change the services they provide ecologically, economically and socio-culturally.

The expansion of land demand for agriculture, poor land use practice in the wetland watershed, population growth and economic development are the main factors impacting wetland conversion for agriculture, urban development and other uses. Degraded wetland watershed suffers from excessive runoff which reduces infiltration of water into the watershed and water storage for slow release into the wetland to maintain dry season water supply. Current rates of soil erosion documented in Ethiopia range 16-300 tons per hectare per year[5]. The Ethiopian highlands reclamation study[6] estimated the average annual soil erosion rate of 100 tons per hectare per year for the Ethiopian highlands. The steep and rugged topography and intense rainfalls have caused severe soil erosion. The indiscriminate forest clearing, complete removal of crop residue, overgrazing, and poor soil management and land use practices further aggravate the situation.

The consequences are depletion of water resources, declining soil fertility, shortage of cultivable land, non-or under employment of the rural population and food insecurity. An increasing number of the population is becoming vulnerable to the effects of drought due to land degradation. Due to population pressure and the subsequent demand for more land resources to sustain rural livelihoods, wetlands are now under threat and in some parts of the region many wetlands have been drained for agricultural production. The benefits which may be lost are not effectively quantified in viable markets and also in terms comparable with economic services, are often specified with too little weight in policy decisions. Hence, quantifying economic values of ecosystem are essential to respite human activities apart from accounting their services in the regional planning.

The environment and the socioeconomic values of the wetlands of the region in general and the Geray wetland in particular are not well studied. There is no complete data and information about the extent and nature of wetlands in the region. Based on the gaps stated the research tries to generate baseline data of Geray wetland that can be used by policy makers in the region. The objectives of the research were to collect baseline information, to raise public awareness on the reservoir wetland situation, and to recommend an intervention mechanism to sustain its ecosystem services.

2. Materials and methods

2.1. Study area

Geray reservoir is located in Amhara National Regional State, West Gojjam administrative zone, Jabitehnan and Finoteselam Woredas, bordering, Shemibekuma-Yedafas and Arbaituinsesa kebeles (Figure 1). The wetland covers 10 ha with weir crest length of 105 meters, height 4 meters, 106 m^3 of water with a potential of irrigating 618 ha of arable land. The vegetation coverage differs between eastern and the northern part of the watershed. The western area is devoid of natural cover due to intensified agricultural activities whereas the eastern area is covered with natural shrubs. Preliminary survey on Geray reservoir was carried out in 2010-2011.

2.2 Data collection and analysis

Questionnaire survey to collect data in Geray reservoir watershed kebeles was deployed and the data includes land use and land cover, livestock and human population, crop patterns, topography and soil type in these kebeles. Focus group discussion with local community to obtain indigenous knowledge was considered. Other supportive secondary data were collected from Jabitehenan Woreda Agriculture and Rural Development Office. Field observation on major human impacted activities and major ecological changes for the last two and three decades was considered. Jabitehenan Woreda Office of Agriculture and Rural Development experts were contacted and consulted. Geographic information system was used for mapping to ease communication among the stakeholders. Libraries of the Amhara Regional Agricultural Research Institute and Bahir Dar Fish and Other Aquatic Life Research Center were searched for relevant literature. The collected data were analysed with descriptive statistics.

3. Results

The total annual rainfall recorded in the watershed was about 1 350 mm and most rain was observe to be from June to October and the average annual temperature is about 25 °C (Table 1). The

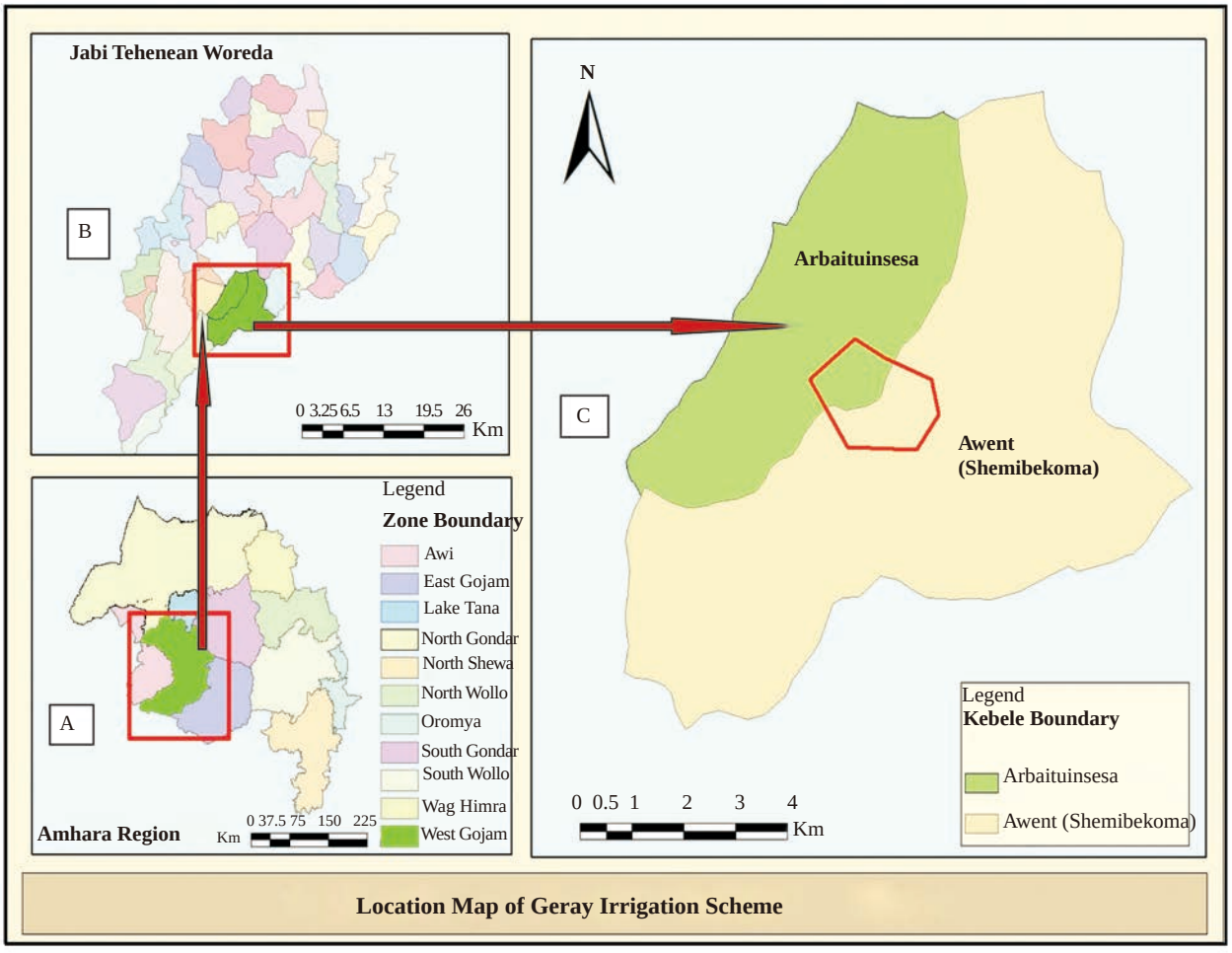

Figure 1. Map of Geray irrigation scheme.
A: Amhara National Regional State and West Gojam zone; B: Jabitehenan Woreda with Kebeles boundary; C: Geray reservoir bordering kebeles.

Table 1
Agroecology, elevation, temperature, and rain fall of Geray wetland.

Names of kebeles	Agro-ecological			Elevation (m)			Temperature (°C)			Annual rain fall (mm)		
	Kolla	W/Dega	Dega	Max	Mini	Aver	Maxi	Av	Mini	Maxi	Aver	Mini
Shemibekoma		100		1 880		1 860	24	23	22	1 600	1 300	1 200
Arbaituinsesa		100		2 300	2 100	2 200	31	28.5	27	1 600	1 400	1 200

topography of Geray wetland watershed (Table 2) consists of 97% plain, 3% mountainous and valley. The topography varies greatly on the peripherals of south and north sides of the watershed. It is generally flat on the east and west side of the wetlands. Undulating slopes exist on the outer northern and southern parts. In areas with flat topography, stream flow is relatively slow, and floodwaters tend to spread out into adjacent lands such the floodplain around the wetland.

Table 2
Topography and soil type (%).

Name of kebeles	Topography				Soil type		
	Plain	Mountain	Rigid	Valley	Red soil	Brown soil	Black soil
Shemibekoma	95	5			75	5	20
Arbaituinsesa	99			1	50	17	33

The land use pattern consists of 90.00% farmland, 6.72% forest and bushes, 2.94% grazing and 0.34% construction (Table 3). The undulating slopes and soils types facilitate the natural erosion and landslide problems that exist in the western and northern high lands (Table 2.). The soils of the watershed consist 63% red, 11% brown and 26% black. The undulating slopes increase rain water runoff rates, which can increase erosion and sediment in the wetland, and deposit sediments in down streams. The agro-ecological zone of the wetland watershed consists of the traditional category 100% Woina Dega (Table 1).

Table 3
Land use pattern.

Names of kebeles	Watershed	Area (ha)	Cultivated (ha)	Forest (ha)	Grazing (ha)	Constrution (ha)
Shemibekoma	Upper	1606	1451	101	51	3
Arbaituinsesa	Lower	2517	2261	176	69	11
Total		4123	3712	277	120	14
Percentage (%)			90.00	6.72	2.94	0.34

The major crops grown in the wetland watershed were cereals (68.25%), pulses (6.34%), oilseeds (1.2%), spices (8.94%) and vegetables and horticulture (15.27%) (Table 4). The livestock population in Geray watershed was estimated to be 10 413 in number (37.83% cattle, 6.2% equine, 12.49% sheep and goat, 5.52% apiculture and 37.96% poultry) (Table 5). The human population of Geray watershed is around 8014 (Table 6). Critical problems observed on the wetland and the surrounding watershed included vegetation removal, land degradation, wetland hardening, pressurized grazing, expansion of floating macrophytes on the reservoir, water seepage at the dam, water use management and water use conflicts, drainage structures maintenance and lack of institutional accountability.

Tables 4

Land tenure and crop pattern.

Names of kebele	Tenure in hectare			Quantity in quintals and percentage				
	Max	Mini	Aver	Cereals	Pulses	Oilseeds	Spices	Vegetables & horticulture
Shemibekoma	1.00	0.10	0.55					
Arbaituinsesa	2.75	0.25	1.50	2626.85	244.12	46.00	344.25	587.90
Total average	1.875	0.175	1.025	68.25	6.34	1.20	8.94	15.27

Table 5

Livestock population.

Names of kebeles	Cattel	Equine	Sheep	Goat	Apiculture	Poultery
Shemibekoma	2181	356	316	391	0	857
Arbaituinsesa	1758	289	322	272	575	3096
Total	3939	645	638	663	575	3953
Percentage (%)	37.83	6.20	6.12	6.37	5.52	37.96

Table 6

Human populations.

Names of kebeles	Human population in number and gender percentage		
	Male	Female	Overall total
Shemibekoma	1468	1284	2752
Arbaituinsesa	2 702	2560	5262
Total	4170	3844	8014
Percentage (%)	52	48	100%

4. Discussion

The Geray wetland is poorly protected due to lack of integrated watershed management practices which resulted in natural resources degradation. The wetland is encroached from time to time, for agricultural activities losing its natural filtration and buffering capacity enhancing the silt load from the poorly protected watershed. There is no systematic monitoring and control of point and non point sources of pollution from farm lands, grazing lands, domestic and runoff in Geray watershed. The sediment loads in Geray influences the wetland ecosystem by increasing turbidity and reduce water transparency and productivity contributing to aging and changes in the morphology of the wetland.

Critical problems currently observed in the wetland of Geray are the floating macrophytes and wetland shrinkage that reduces the bio-filtering role and habitat degradation for its biota. The basin wide problem of Geray includes soil erosion particularly on the northern and western part of the basin where agricultural activities and deforestation are intensely practiced when compared with the eastern part which is covered with shrubs and bushes. Poor land use and clearing of forests in the wetland basin induces sedimentation that can reduce the water storage capacity of the wetland.

Previous studies confirmed that, the major sources for nutrient overload causing cultural euthrophication in Ethiopian lakes emerge from natural runoff, inorganic fertilizer and manure runoff from the farming system, soil erosion from poor land use and poor watershed management[7-10]. There are cases of natural lakes in Ethiopia which either disappeared or nearing to disappear as a result of mismanagement[11-13]. Lake Alamaya, Lake Kilole and Lake Gudera as well as man-made dams that are completely or nearly silted up as a result of over abstraction, poor land use and sedimentation can be mentioned in Ethiopia. Excessive exploitation and water withdrawal can lead to a total collapse of the resources as evidenced in Lake Alemaya in Eastern Ethiopia[14].

The wellbeing of wetlands is of vital importance for people and the environment in Ethiopia. Their contribution to poverty reduction and ensuring food security is massive especially in rural areas. They also play significant role in nationwide development endeavors. In addition to this local contribution, the wetlands of Ethiopia play a great role in providing a stopover ground for transcontinental migratory birds and ameliorating climatic changes/global warming through carbon sequestration. However, these resources are exposed to anthropogenic impacts due to various problems, some of which are lack of a national wetland policy/strategy and a lead institution that coordinates the efforts of wetland affiliated stakeholders. Capacity limitations, absence of adequate information sharing system and weak integration among the stakeholders are also fueling wetland degradation. Policy makers at various levels are short of information on the multidimensional values of wetlands in poverty reduction and sustainable development.

Participatory management approach and use of indigenous knowledge of the local community and experience of the stakeholders in extension services, research and management is the priority measure for Geray resources management to sustain its ecosystem services for the present and the next generations.

The wetland issues of Ethiopia stated at national and regional level in natural resource management policies and strategies such as, in water resources development, forestry development, agricultural and rural development, land use and environmental protection are diffused and overpowered by these broader objectives of the sectors. This further hinders to protect, conserve and sustain the existing ecosystem functions and values of wetlands. There is a need of advocacy for a stand-alone,

unique wetland policy drawing which gives considerable attention to wetland issues particularly by legislators.

The bad experiences learnt from Ethiopia and Africa lakes should alarm us to take preventive and mitigative measures before things went to irreversible situation in the other wetlands of Ethiopia in general and the wetland of Geray in particular. Thus, Geray and its basin are a fragile and a complex ecosystem under growing stress and nearing to disappearance unless and otherwise timely measures are taken to mitigate the prevailing encroachment towards the wetland. Sustainable management of Geray wetland basin for its ecological, social, biodiversity and economic values require attention from its stakeholders in maintaining maximum benefit for the present and future generations.

The loss of wetlands and their resource will affect those who are directly and indirectly dependent on the resources for their livelihoods. A core area and a buffer zone demarcation are highly demanded confirmed with stand alone wetland policy, legal and institutional framework for wise use and safety of wetlands. Sustainable management of hydrological, ecological, social, biodiversity and economical values based on knowledge and experience on environment, land use, extension services and research to restore and sustain the various values and functions, calls for involving different stakeholders to alleviate negatively impacting factors on the wetland. Further information generation on the wetland situation on Ethiopia in general and the Geray wetland in particular specifically on wetland valuation are highly demanded.

Conflict of interest statement

I declare that I have no conflict of interest.

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