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A preliminary survey of the ecohydrological management challenges faced by Lake Gudera, Sekela woreda, West Gojjam, Ethiopia

Miheret Endalew[1], Goraw Goshu[2], Wondie Zelalem[1]

[1] Amhara Regional Agricultural Research Institute, Bahir Dar Fish and Other Aquatic Life Research Center, P.O. BOX, 794. Bahir Dar, Ethiopia,
e-mail: miheretendalew@yahoo.com
[2] BahirDar University, College of Agriculture and Environmental Sciences,
P.O. Box 1701, BahirDar, Ethiopia, e-mail: gorawha@yahoo.com

Abstract

Lake Gudera, a highland lake, is highly degraded by agricultural activity, but still serves the local community for irrigation and livestock watering. Preliminary investigations indicated chemical composition of NO_3 (0.7 mg dm^{-3}), turbidity (26 NTU) and conductivity (78 μs cm^{-1}) with poor floristic and faunistic composition. The Community Elders explained that the wetland encroachment started in 1986/1987, was aggravated in 2002/2003 and now had resulted in 25% littoral zone macrophyte loss. Wetlands had been converted for agriculture, leaving reduced filtering capacity of the lake which impacted on the ecosystem services. Now there are growing calls for sustainable management for the various values and functions, involving different stakeholders to alleviate negatively impacting factors.

Key words: biodiversity, degraded, ecosystem, open access, watershed, wetlands.

1. Introduction

Ethiopia is a country which is vulnerable to extreme climate variability, due to inadequate management and investment in natural resources development. The country is constantly struggling with recurrent shocks to its economy from floods and droughts hindering growth and progress from poverty. A key solution to reduce vulnerability from high climate variability (floods and drought) is to develop sustainable management of the country's natural resources based on participatory approach that empowers the local communities and stakeholders. Ecohydrology is an important paradigm in that development.

The watershed ecosystem services of Lake Gudera – water, land, livestock, forests, and cultural assets – offer considerable social and economic benefits to the livelihoods of its local people scattered in the bordering kebeles, particularly livestock grazing areas around the lake and within its basin. The lake and its wetlands are high in biodiversity – providing a habitat for many birds, but the lake is also used as a sink for the disposal of agricultural wastes.

The growing population pressure, predominantly landless young generation, demanding ag-

ricultural land and livestock are mainly dependant on the Gudera wetlands for grazing. This is the dominant factor responsible for serious natural resources degradation. The resources use of the wetland of Lake Gudera as open access, in the absence of regulatory framework for allocating, managing and protecting it, is contributing to the emerging conflicts over resource use and threatens the lake ecosystem. Inadequate policy framework to manage the resources in the lake basin and inadequate scientific knowledge on socio-economic, ecohydrological and other biological resources are important issues to be considered for the management of the Lake Gudera watershed.

The hydrology of Lake Gudera needs future review, to estimate average annual inflows into the lake from tributary runoff and direct rainfall, and outflows downstream as flooding is high at upstream. The local communities traditionally believe that Lake Gudera has some hydrological connectivity with Geray reservoir located downstream in Jabitehinan woreda due to topographic difference.

Based on the gaps and the emerging problems, a preliminary survey was carried out in November 2007. The objectives of the survey were (1) to collect basic baseline information, (2) to raise public awareness of the lake's situation and (3) to create intervention mechanisms in development, management, research and extension services in the watershed of Gudera to sustain its ecosystem services.

2. Materials and methods

2.1. Study area

Lake Gudera is located in Sekela woreda, in West Gojjam administrative zone. It is bordering Asewagudera and Zegizatengefa kebeles. It is a highland freshwater lake with estimated area of 140 ha with shallow depth of about 2.5 m and has an elevation of 2352 meters above sea level (preliminary measurement taken in November 2007). Lake Gudera is an important water source for the local community especially during dry season for irrigation and livestock watering. The average annual rainfall of Sekela woreda is about 1700 mm (Sekela Woreda Office of Agriculture and Rural Development) and is concentrated in the period from June to October. The major crops grown on about 23 687 hectares of cultivated land in Sekela woreda are cereals (77.4%), pulses (7%), and vegetables, root crops and fruits (15.6%). The watershed vegetation coverage differs between the lower and the upper area; in the upper being devoid of the natural cover due to heavy agricultural activity, and the lower covered with natural shrubs due to non-agricultural activity. The shoreline macrophytes are decreased from time to time due to high pressure for agriculture activities within the wetland of the lake.

2.2. Data collection and analysis

Fish were sampled and environmental parameters measured on the lake in November 2007, between 9:00-10:00 am. Three sites representing the inshore zone, river mouth and central part of the lake were selected and water samples taken. The values of each physico-chemical parameter for the three sites was averaged and reported. Minimum and maximum values were also reported. Phytoplankton and zooplankton samples were collected using 55 and 80 μm plankton nets from an integrated water sample of the three sites. Gillnets with different mesh size (60 mm, 80 mm, 100 mm, and 120 mm) were used for fish data collection.

In-situ measurements of electrical conductivity, pH, dissolved oxygen, temperature and total dissolved solids were carried out. pH and temperature were measured with coupled pH/mV/Meter (Wagtech Int., Model CE 370 pH meter 01186, EU). Electrical conductivity and TDS were measured with Cond/TDS meter (Wagtech Int., Model CE 470 Cond Meter 01189) and dissolved oxygen with an oxygen meter (Wagtech Int., Model CO-411). Measurements were taken by dipping the probes about 3-5 cm below the water surface.

Analyses of water samples for turbidity, chlorides, total hardness, ammonia, nitrite and nitrates were conducted immediately with a mobile water analysis kit (Wagtech Int., Palintest Transmittance Display Photometer 5000, Palintest Ltd., UK) after they were filtered through a 0.45 μm mesh membrane filter. The dilution was undertaken for high values. Absorbance of the developed color complex was measured under a specified wavelength (640 nm for NH_3, 520 nm for chloride and $N0_2$ and turbidity, 570 nm for total hardness and $N0_3$ and the reading (% transmittance) was converted into concentration of the parameter under consideration. The standards are already prepared by the manufacturer and there is calibration chart (regression model, concentration versus absorbance) for each parameter provided by the manufacturer (Wagtech, Palintest Transmittance Display Photometer 5000). The detection limits for ammonia, total hardness, nitrite, nitrate and chloride are (0-1 mg dm^{-3} N), (0-500 mg dm^{-3} $CaCO_3$), (0-0.5 mg dm^{-3} N), (0 -20 mg dm^{-3} N) and 0-50 mg dm^{-3} Cl respectively.

Integrated phytoplankton and zooplankton samples were treated with 4% formalin and Lugol's solution and transported to laboratory for quantitative analysis. Identification keys including Komarek and Anagnostidis (2000; 2005) were used for identification up to genus level where possible.

The indigenous knowledge of the local community was collected through focus group