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Original Research Article

Threats, Use and Management Interventions for Restoration of Lake Chitu in West Arsi Zone, Ethiopia

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Abstract

Lake Chitu is one of Ethiopian Flamingo Lakes known by single dominant blue green algal specie called *Arthrospira fusiformis* usually found in dense blooms. A household questionnaire survey of household respondents, key informants and focus group discussion were made in 2012 in Labu Subuqa Kebele where lake Chitu is found to see major threats for general ecosystem disturbance, the use of the lake for the surrounding community and to identify major stakeholders towards conservation of the lake as in situ conservation site in an integrated way. Deforestation of the catchment area is the main threat for the total degradation of the lake. Soil erosion occurred due to intensive loss of vegetation that increased the amount of silt in the lake. Deposition of animal debris and detergents are added to the lake because of human and cattle direct contact. The community is using the lake only for washing clothes because of its alkalinity and soap nature. They also take bath on the hot spring that immediately comes from the edge of the lake that would eventually change the nature of the lake. Recently few young associations are delivering soil salt to the market which is important in fattening. Five stakeholders have been identified for the conservation of the lake to restore the biodiversity of the lake. Institute of biodiversity conservation and Ethiopian Wild Life Conservation Authority from Federal Government, Regional, Woreda and Kebele Administrations, Woreda Kebele Agricultural Office and the community are the main responsible bodies for restoration and conservation of the lake.

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Introduction

Flamingo Lakes are part of a chain of lakes found on the floor of the eastern arm of the Great Rift Valley of Africa (Njuguna, 2000). Flamingo lakes often harbour many unique species, adapted to high alkalic and high salinity conditions (Xiong et al., 2012). Cyanobacteria are mostly observed dominantly in Flamingo Lakes. The most abundant blue-green alga is *Spirulina /Arthospira fusiformis* which is responsible for giving the Flamingo Lakes their characteristic greenish colour (Matagi, 1996; Grant, 1990).

The Ethiopian Rift Valley Lakes are alkaline where the pH value ranges from 9 to more than 10, and sodium and sodium bicarbonate compounds are in

high concentration. The lake harbors thousands of Flamingos and is characterized by high pH, high salinity and high alkalinity. Very few organisms would be expected to survive in it, and yet there are organisms, especially Cyanobacteria and microalgae, that have evolved to occupy these environments. Lake Chitu is one of the Ethiopian Rift Valley Flamingo Lakes formed due to volcanic explosion. It is one of the most saline lakes with single dominant species of algae (Desta, 1997). In Lake Chitu *Arthrospira fusiformis* is a strongly dominant species usually found forming dense blooms harbours thousands of Flamingos (Kebede, 1997; Gebremariam and Taylor, 1997). Very few organisms would be expected to survive in it, and yet there are organisms, especially Cyanobacteria and microalgae (Matangah et al., 2000).

Spirulina are multi cellular and filamentous blue - green alga that has gained considerable popularity in the health food industry and increasingly as a protein and vitamin supplement to aquaculture diets. It is recommended as a suitable protein source to combat malnutrition and protein deficiency in developing countries (Kebede et al., 1994; Habib et al., 2008). The biodiversity of the lake is threatened by both natural and anthropogenic activities. Climatic change has accelerated water stress in the lake catchment (Samuel, 2004). The study examines major value of the lake, threats for ecosystem changes and role of key stakeholders for integrated biodiversity *in situ* conservation. The Specific Objectives were (a) to identify use of the lake for the surrounding community; (b) to evaluate some factors affecting the ecosystem of the lake; (c) to identify major stakeholders towards conservation of the lake and its biodiversity; (d) to forward major interventions for sustainable conservation of the lake.

Materials and methods

Study area

Lake Chitu is one of volcanic explosion crater lakes of Ethiopian Rift Valley which is located at South of Addis Ababa in West Arsi zone Aje district of Labu Subuqa Kebele. The lake is situated at 25 km from Shashamane town with latitude 07^0 24' 26" N, longitude of 038^0 25' 33" E and an altitude of 1540 meters above sea level. The lake has an area of 0.8 km^2 and a maximum depth of 21m.

Data collection methods

Random sampling method by taking each village as a cluster was employed. There are 12 villages in the in the Kebele accordingly 10 household heads from each village were taken randomly and interviewed. For key informant interview and focus group Discussions respondents were deliberately elders are deliberately selected to get reliable information.

Primary and secondary data collections

Primary data were generated through personal interview based on semi structured questionnaires (both closed and open questions), key informant interview and focused group discussion techniques. The basic method used in this survey was questionnaire method. Subsequently, group discussions were conducted as a follow-up to the content analysis and individual interactions in interviews. The key informant interview technique is a one to one interviewing process for gathering information from local elders. About 10 key informants were selected deliberately. These are religious elders of the community, environmental committee members, district agriculture and livestock officer and natural resource committee members, Wildlife Officers and Forest Officers. During this study secondary information was collected from relevant offices and publications (on internet) and compiled with primary data to make the provided information more inclusive. All the necessary data were taken from Woreda and Kebele Bureau of Agriculture and Administration.

Data analysis

The quantitative data generated from questionnaire survey about the lake were analysed using Statistical Package for Social Sciences (SPSS 17). Descriptive statistics, charts, frequencies tables and graphs were used to present the results.

Results and discussion

Demographic data

Eight hundred four household heads are registered in the Kebele, of which 634 Male house hold heads and 170 are female house hold heads (Table 1). In Ethiopia it is common to find rural households headed by men, if not the female household heads are widows or divorcées. Of the total 120 respondents 98 (81.6%) were male

household heads and 22 (18.4%) were female household heads. The age of the studied households ranges from 30 to 91 years. Of the entire study subject, 17(13.7%) were below 30, 31 (25.6%) were between 30-45 years, 30 (24.7%) were between the age 45-60years and 42 (35.8) respondents were above 60.

Table 1. Social structure of Lebu Subuqa Kebele.

Social Structure	No.
Female house holds	270
Total number of house holds	704
Male house holds	534
Total population	4273

Source: Woreda Administration Office.

Duration and knowledge of respondents

People who live in a certain area for a longer period of time accumulate experience and knowledge. Fortunately, 72 (60%) of the respondents have more than 45 years of residence in the study area. This indicates that the respondents are knowledgeable enough in terms of time and space to provide useful information.

Livelihood activities

Agriculture is the major livelihood practice of people living around Chitu Lake. Crop cultivation is the main economic activity around the lake community 87 (72.5%). Thirty-three (27.5%) of the respondents undergo mixed agricultural system. The contribution of livestock in the livelihood of people living around both sites is paramount. It is source of power for agricultural activities as well as income generation.

Source of drinking water

Most of the respondents 76 (63.3%) answered that they use tap water for their drinking. On the other hand, respondents 44 (36.7%) who are residing near the catchments of the lake use the spring water in addition to tap water that is coming from the immediate mouth of the lake and use it after cooling, more over the tap station is very far from their home, this is especially to villages near to the catchments.

Use of lake for the community

All respondents 120 (100%) answered that they use lake water only for the sanitation purpose. They wash their clothes on the lake water because of its soap nature. They also take bath at the edge of the lake using spring water that would eventually change the nature of the lake. From this response we can conclude that the decrease in size of the lake from time to time has no connection with the use of the lake. Recently few young associations are delivering soil salt to the market which is important in fattening.

Major threats of the lake

Deforestation of vegetation from catchment area is the main threat for the disturbance the lake ecosystem according to this study. The lake was surrounded by natural forest which was unique in its species composition. Participants recalled that wood and non-wood products for household consumption and income generation are extracted from the forest, since the establishment of villages. However, excessive cutting of trees was traced back over a short period of time, especially during the transition periods, and it has contributed a lot to the depletion of the forest. Deforestation has also been resulted in destruction of the total biodiversity of the lake and its catchment which lead to local extinction of several flamingos, seasonal immigrating birds and other wild animals. Soil erosion is another major threat for the lake. There is a decrease in water volume from time to time because of siltation, sediment loading, animal grazing, and deposition of animal and plant debris. Addition of detergents and toxic substances that would eventually change the chemistry of lake. As a result, drastic water quality changes because siltation.

Stakeholders identification to ensure sustainability of the lake

The major stakeholders were identified for the restoration of the lake biodiversity. Ethiopian Biodiversity Institute and Ethiopian Wild Life Conservation Authority from Federal Government, Woreda Administrations, Woreda Agricultural Office, local NGO (ANCDA) and community were identified as the main responsible bodies for the restoration of biodiversity of the lake ecosystem.

Major steps taken by stakeholders

Based on the findings of this study stakeholders come together and design some rehabilitation measures to restore the biodiversity of the lake. Accordingly, more than 10,000 seedlings of indigenous tree species were planted. Awareness rising was made to the community through full engagement of stakeholders.

Fig. 1a, b: Awareness sessions before plantation.

The government has given special attention towards the conservation of biodiversity and to minimize carbon emission to zero and for further green revolution development. This is the main input for restoration of natural resources. As a result, there is high demand for restoration of lake from local community, authorities and stakeholders. Ongoing natural resources conservation activities such as afforestation, watershed works led by the Ministry of Agriculture are a good opportunity for the restoration. Fig. 1 shows the awareness sessions before plantation and Fig. 2 shows plantation of trees by local communities.

Fig. 2-a, b: Pictures during plantation of lake catchment.

The way forward for sustainability of lake

Drilling of water for the community solves most of the problems complained by the respondents and focus group discussion participants. Therefore, all stakeholders must work for the sustainable water source of the community in order to save the lake. All respondents agreed that they are ready to incorporate the lake conservation strategy to their annual natural resource conservation program which is led by the government. They are also ready for planting trees and keeping from human and cattle interference. Vegetation cover will ensure moisture content and retain siltation formed by erosion; therefore, any meaningful vegetation coverage of eroded areas must be done for maintaining of the lake biodiversity. National Parks are a source of foreign revenue through tourism so increasing the protected status of the lake is mandatory.

Conclusion

Drastic change of the lake environment is due to deforestation of the catchment area. Excessive cutting of trees occurred during the previous two transitional periods of governments, as a result the total biodiversity of the lake is lost and highly affected. The main problem for the lake is siltation because of erosion. The community complained that due to

shortage of agricultural land they left their animas on the catchment for grazing which contributes a lot for erosion and high deposition of silt in the lake. They did this as they have been no any alternative field for the pasture. Detergents and chemicals are added to the lake from different directions that would eventually distract the algal community. The spring water that constantly flows to the lake is also adding detergents and waste materials to the lake which affect its chemical nature. The continued loss of biodiversity, unless urgently will be addressed, severely constrain the efforts of governments for development. The consequences of biodiversity loss and mismanagement as well as ecosystem disruption severely affect the communities. The progress towards development will only be possible in the future if biodiversity is preserved.

Conflict of interest statement

Authors declare that they have no conflict of interest.

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