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Full Length Research Paper

The driving forces of Boye wetland degradation and its bird species composition, Jimma, Southwestern Ethiopia

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The aim of this study was to assess the causes of Boye wetland degradation and to identify the bird species composition of the wetland. To achieve the stated objective, group discussion with the local communities was carried out on the causes of wetland degradation and prioritizations were done. In addition, soil samples were collected from wetland and converted lands (agriculture, grazing and *Eucalyptus* plantation land). Identification and recording of avian species composition was conducted by direct observations using binoculars and standard manual for bird identification. The results of discussion revealed that agriculture land expansion, over grazing, waste disposal in the wetland from Jimma town and *Eucalyptus* plantation were the major causes for Boye wetland degradation. Statistically significant difference ($P<0.05$) was observed between wetland and converted lands for pH and EC with the highest mean value on converted land. However, a significant difference ($P<0.01$) was observed for OC (%) and TN (%) with the highest mean value at wetland. Furthermore, 36 bird species were identified; among these, two are endemic and three near endemic species. *Balearica pavonina* and *Balearica regulorum* vulnerable species and *Macronyx flavicollis* was near threatened species were also found in the wetland. To protect these birds and the biodiversity of Boye wetland, restoration and protection programs should be established to avoid further degradation.

Key words: Boye wetlands, land use change, bird diversity, conservation.

INTRODUCTION

The term 'wetland' serves as an umbrella to bring together a wide spectrum of habitats, known by different names in different parts of the world such as marshes, swamps, bogs, fens, mires, moors, mangroves, lagoons etc, which share a common characteristic of being dominated by water for at least some time during the year (Schot, 1999; Roggeri, 1995). When land use issue is taken as an issue the definition is varied among scientists and policy makers. United States Department of Agriculture (USDA) and Natural Resource Service define wetland based on soils, hydrology and crops. In the history of agricultural production, to increase crop yield, many governments (US, UK, Russia etc) have encouraged farmers to drain wetlands but, later they subsidized farmers for restoration wetland functions such as ecological, economical and social services (Hartig et al., 1997). In Ethiopia, wetlands are often considered as wastelands and are thought of as obstacles to agricultural development, human and animal health associated with nuisances and calamities such as floods, diseases like malaria and schistosomiasis (Legesse, 2007).

About 2% of the total land coverage in Ethiopia is wetland. Like other developing countries most of Ethiopian wetlands are under the risk of degradation and loss due to population growth, policy related issues, on site and off site management problems, cultivation of wetland due to fall of upland production, draining, farmers need to meet their household food requirements and occurrence of drought. These losses are affecting the rural food security, water availability, climatic variability and biodiversity. Hence, the wetland has great contribution for food security strategies (Bognetteau et

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al., 2003). The conversion of wetland to agriculture and drainage in southwestern Ethiopia is increasing through time. For example, in Illu-Abba-Bora Zone, the percentage of wetlands converted to agricultural land is 27.7% in 2003 and 65.6% in 2006, which doubled within three years (Legesse, 2007). Boye wetland is one of the wetlands found in this region specifically near Jimma town. Socioeconomic activities that take place in the area include grazing land, agriculture, bricks and different types of pottery making. Moreover, the ecological potential of this wetland is that it serves as a habitat for a variety of plant, bird and mammal species and is a water source for human and livestock consumption. But, it has been highly degraded and under the risk of loss due to poor watershed management, city solid and liquid wastes disposal, expansion of Jimma town towards the wetland and conversion to agriculture. The study conducted on the wetland by Yimer and Mengistou (2009) shows that there is a risk of flora and fauna species reduction due to the aforementioned factors. Studies conducted in various parts of the world and at different time show that 85% of wetland conversion happened due to agricultural land, 8% to urban growth and 5% to industrial development (Bognetteau et al., 2003). It indicates that loss of wetlands may decrease biodiversity such as birds and other wildlife (Idris et al., 2001; Maan and Chaudhry, 2001; Gabol et al., 2005). Concrete understanding on the effects of land use change on biodiversity will allow us to develop best management practices for sustainable use. Therefore, the objective of this study was to identify the major causes of wetland degradation and record the bird species compositions of the wetland.

MATERIALS AND METHODS

Descriptions of the study site

Boye wetland is located in Jimma Zone of Oromiya Regional State, in southwestern Ethiopia. Jimma town is the capital and administrative center of the zone, located 335 km away from the capital of Ethiopia,Addis Ababa. The zone covers a total area of about 18412.54 km^2, of which Jimma town encompasses an area of 46.23 km^2. The population of the zone is around 2 million, of which about 125569 people live in Jimma town. The town is by far the largest urban center in the zone. The population density is 138.5 persons per km^2 (CSA, 2005). The study was conducted in Boye wetland, 4 km from Jimma town. The study area receives a rainfall between 1200 and 2400 mm per annum with an average annual rainfall of 1477 mm having the heaviest concentration from June to September, and the average maximum and minimum temperature is 28.8 and 11.8°C respectively with a mean daily temperature of 19.5°C (CSA, 2005).

Data collection

The study was performed from February 2010 to April 2011. To into summit, middle and lower parts. At these points, group discussion was carried out with randomly selected members of of the communities (elder and young) on causes of the wetland degradation and prioritization. At each part of the wetland, group discussion was made with three groups (composed of 9 individuals). Also, composite soil samples were collected from the wetland and drained for other practices (crop production, *Eucalyptus* plantation and grazing).

The bird species compositions were identified by following Jones (1998). The identification was carried out for 48 days (four days in each month) using 8×42 binoculars. Everyday, observations were carried out for 5 h, 6:30 to 10:00 and 16:30 to 18:00 h, during these lapses, the activities of birds became prominent. The species were recorded using direct observation, from four transects (average of 2.5 km long each). Some inconspicuous bird species were also identified based on their calls. Nomenclature and systematic order of birds follow the methods proposed by Van Perlo (1995), Stevenson and Fanshawe (2002) and Sinclair and Ryan (2003).

Soil sample preparation and laboratory analysis

Nine soil samples (three composite samples from each site) were collected from depths of 20 cm from each land used (wetland and drained lands). The soil samples were dried at room temperature, ground and sieved with 2 mm diameter sieve mash. Soil reaction (pH) was potentiometrically measured (pH-H_2O) using a glass-calomel combination electrode (Van Reeuwijk, 1992). Electrical conductivity (EC) of the samples was measured using the standard procedure described by Sertsu and Bekele (2000). Organic carbon (OC%) was determined using wet oxidation methods of Walkley and Black (1934). Total nitrogen (TN%) was analyzed using the Kjeldahl method as described by Black (1965).

Statistical analysis

SAS version 12 was employed to determine analysis of variance (ANOVA) of soil properties and the mean values were compared with least significant difference (LSD) at p value 0.005. While, SPSS version 16 was used to test the significant differences (P = 0.05) of data generated from group discussion.

RESULTS AND DISCUSSION

Driving forces of Boye wetland degradations

All of the local communities participated in the group discussion and revealed that the major causes of Boye wetland degradation were crop land expansion, over grazing, municipal waste disposal in the wetland from Jimma town and *Eucalyptus* spp. plantation at the bank of the wetland (Table 1). Statistical analysis showed no significant difference (P>0.005) on the causes of degradation at the three study points. This implies that the faulty activities of human beings and interference of high livestock populations are the major threats of Boye wetland. This result agreed with the findings of Yimer and Mengistou (2009) that agricultural land shortage resulted in conversion of wetland, mismanagement of catchments and disturbance at the broader range of the wetlands, are the major stress to wetlands.

During group discussion, the local communities

Table 1. One way ANOVA for group discussion on the driving forces of Boye wetland degradation.

Locations of group reformed	Rank of degradation causes	df	P-value
Upper wetland (n=3)	Conversion to cropland 1st Eucalyptus plantation 2nd Overgrazing 3rd Municipal waste dispose 4th	2	11.92NS
Middle wetland (n=3)	Eucalyptus plantation 1st Overgrazing 2nd Conversion to cropland 3rd Municipal waste dispose 4th	2	13.83 NS
Lower wetland (=3)	Conversion to cropland 1st Eucalyptus plantation 2nd Overgrazing 3rd Municipal waste dispose 4th	2	16.24 NS

NS=None significant difference between the groups, number in parentheses is group number.

indicated shortage of agricultural land and decrease of agricultural land productivity, forced the surrounding communities to drain the wetland for crop cultivation, in order to meet the increasing food demand of household. This is consistent with the findings of Aticho et al. (2011), that soil fertility depletion and shortage of agricultural lands are the major driving force for marginal land cultivation. In addition, they revealed that the productivity of wetland converted to agriculture and *Eucalyptus* plantation is higher for the subsequent years than the normal land. The borders of wetland were more suitable for *Eucalyptus* trees due to the fact that *Eucalyptus* demand more water. Consequently, expansion of *Eucalyptus* plantation was increased through time because people living around the wetland were growing *Eucalyptus* to generate income through supplying fuel wood and construction poles to Jimma town. In addition, the expansion of Jimma town towards the wetland and the disposal of both solid and liquid wastes were the major factors affecting the ecology of the wetland.

Changes in soil chemical properties of wetland conversion

The percentage of organic carbon and total nitrogen content of the soils was decreased significantly ($P<0.01$) when wetland was changed into other land use types (Table 2). On other land use types (*Eucalyptus* plantation, grazing and agriculture) the rates of organic matter decomposition become higher owing to drainage of the wetland. Consequently, the percentage of organic carbon and nitrogen were smaller on the converted lands. Also, for soil aeration (pH) and electrical conductivity (CE) a significant difference ($P<0.05$) was observed between wetland and converted soils. Unlike the organic carbon and total nitrogen percentage the higher value of soil pH and electrical conductivity was observed on converted land. This takes place due to leaching of basic cations beyond sampling depth in wetland and transportation of basic cations with moving water during high rainfall season. Besides, the acidity of the wetland was increased as a result of release of organic acid from organic carbon deposition in the wetland.

Bird species composition in the Boye wetland

A total of 36 bird species were recorded during the surveys (Table 3). Among these, two species; *Poicephalus flavifrons* and *Macronyx flavicollis* are endemic to Ethiopia. Some of the species limited only to Ethiopia and Eritrea were also inhabited in Boye wetland such as; *Bostrychia carunculata, Dioptrornis chocolatinus* and *Corvus crassirostris.* According to IUCN, (2010) among the recorded species *Balearica pavonina* and *Balearica regulorum* were vulnerable while *M. flavicollis* was near threatened. These species will be endangered within a short period of time (Yimer and Mengistou, 2009) unless the necessary actions are taken. Based on the diversity of bird species found Boye wetland was one of the potential habitat for diverse bird species. Despite this fact, the wetland is highly degrading due to different driving forces. Therefore, to maintain the bird diversities and other biodiversities the wetland should be protected.

The Boye wetland drainage for agricultural and other land use types has had an adverse effect on the bird species due to the alteration of the ecosystem. The local

Table 2. Mean comparison of soil properties of wetland and converted lands.

Land use	pH	EC (µS/cm)	OC (%)	TN (%)
Wet land (n=9)	4.09+0.07[b]	142.10+5.03[b]	12.83+.50[a]**	1.07+0.32[a]***
Wetland drained (n=9)	5.17+0.12[a]*	196.53+6.62[a]**	3.04+0.42[b]	0.62+.12[b]

SD = Standard deviation; EC = electrical conductivity; OC = organic carbon; TN = total nitrogen; * significance at P<0.05; ** significance at P<0.01.

Table 3. Bird species in Boye wetland.

Common name	Scientific name	Status (IUCN, 2010)	Remark
Great egret	*Casmerodius albus*	Least concern	
Wattled Ibis	*Bostrychia carunculata*	Least concern	
Cattle Egret	*Bubulcus ibis*	Least concern	
Black Crowned-crane	*Balearica pavonina*	Vulnerable	
Wattled Crane	*Bugeranus carunculatus*	Vulnerable	
Grey Heron	*Ardea cinerea*	Least concern	
African Sacred Ibis	*Threskiornis aethiopicus*	Least concern	
Hamerkop	*Scopus umbretta*	Least concern	
Hadada Ibis	*Bostrychia hagedash*	Least concern	
Village Weaver	*Ploceus cucullata*	Least concern	
Wattled Ibis	*Bostrychia carunculata*	Least concern	Near endemic
Pied Kingfisher	*Ceryle rudis*	Least concern	
Abyssinian Slaty Flycatcher	*Dioptrornis chocolatinus*	Least concern	Near endemic
Cape Crow	*Corvus capensis*	Least concern	
Speckled Mousebird	*Colius striatus*	Least concern	
Thick-billed Raven	*Corvus crassirostris*	Least concern	Near endemic
Bronze mannikin	*Lonchura cucullata*	Least concern	
Abyssinian Citril	*Serinus citrinelloides*	Least concern	
Yellow-fronted Parrot	*Poicephalus flavifrons*	Least concern	Endemic
Long-crested Eagle	*Lophaetus occipitalis*	Least concern	
Egyptian Goose	*Alopochen aegyptiaca*	Least concern	
Augur Buzzard	*Buteo augur*	Least concern	
Lemon dove	*Aplopelia larvata*	Least concern	
Yellow-billed Duck	*Anas undulata*	Least concern	
Spur-winged Goose	*Plectropterus gambensis*	Least concern	
African Darter	*Anhinga rufa*	Least concern	
Speckled Pigeon	*Columba guinea*	Least concern	
Black-headed Heron	*Ardea melanocephala*	Least concern	
African Jacana	*Actophilornis africanus*	Least concern	
Abyssinian Longclaw	*Macronyx flavicollis*	Near threatened	Endemic
Purple Heron	*Ardea purpurea*	Least concern	
Black Kite	*Milvus migrans*	Least concern	
Malachite Kingfisher	*Alcedo cristata*	Least concern	
Striped Kingfisher	*Striped Kingfisher*	Least concern	
Saddle-billed Stork	*Ephippiorhynchus senegalensis*	Least concern	

communities indicated due to changes made in the wetland, both population and species composition of birds was reduced. This justification agrees with the findings of Sande (2000), which indicates that avian species diversity differs according to changes in ecological characteristics and that different bird species

have varying responses to changes in habitat.

Conclusion

Boye is one of the potential habitats for bird diversity. But, the wetland has been degrading with time owing to agricultural land expansion, Jimma town expansion towards the wetland, eucalyptus plantation at the bank of the wetland, waste deposition in the wetland and overgrazing were the major driving forces causing degradation of Boye wetland. When we compare the ecological, economical and social advantages of the wetland maintenance with conversion to other land use types, maintaining the wetland was by far greater than conversion to other land use types to obtain short term benefits.

Among the 36 species identified, the two vulnerable species (Wattled crane and black crowned crane) commonly depend on Boye wetland. Therefore, to protect these species and the others, conserving and restoring the wetland has high ecological and economical value. As a result of the proximity of Boye wetland to Jimma town and its bird composition, bird watching ecotourism is the activity that should be encouraged in the site as a source of income for the community and environmental conservation.

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REFERENCES

Aticho A, Elias E, Diels J (2011). Comparative analysis of soil nutrient balance at farm level: A Case Study in Jimma Zone, Ethiopia. Int. J. Soil Sci., ISSN 1816-4979/DOI:10.3923/ijss.

Black C (1965). Methods of soil analysis. Part I. American Society of Agronomy. Madison, Wisconsin, USA, 9: 1572.

Bognetteau E, Wood P, Afework H, Legesse T (2003). Wetlands and food security in South-West Ethiopia: An economic, ecological and institutional analysis for sustainability. EWNRA, Addis Ababa, Ethiopia.

CSA (2005). Ethiopian statistical abstract. Federal Democratic Republic of Ethiopia, Addis Ababa, Ethiopia.

Gabol K, Mehmood S, Yasmin N, Tariq M, Tabassum R (2005). Distribution, Status of Migratory Resident Waterfowls of Drigh Lake (Sindh) Wildlife Sanctuary. Int. J. Zoo. Res., 1(1): 37-40.

Hartig E, Grozev O, Rosenzweig C (1997). Climate change, agriculture and wetlands in Eastern Europe: Vulnerability, adaptation and policy. Clim. Change, 36: 107-121.

Idris B, Gonzaga D, Zaneedarwaty N, Hasnah T, Natasha Y (2001). Does habitat disturbance has adverse effect on the diversity of parasitoid community? J. Biol. Sci., 1(11):1040-1042.http://www.researchgate.net/publication/46030117.

Jones M (1998). Study Design. In: Expedition Field Techniques, Bird Surveys, Bibby, C., M. Jones and S. Marseden (Eds.). Royal Geographical Society with the Institute of British Geographer, London, pp. 15-34.

Legesse T (2007). The dynamics of wetland ecosystems: A case study on hydrologic dynamics of the wetlands of Ilu Abba Bora Highlands, South-West Ethiopia. Master Thesis, Human Ecology, Brussels.

Maan A, Chaudhry A (2001). Wildlife diversity in the Punjab (Pakistan).Punjab Wildlife Research Institute. J. Biol. Sci., 1(5): 417-420.

Roggeri H (1995). Tropical Freshwater Wetlands: A guide to current knowledge and sustainable management, Kluwer Academic Publishers, Dordrecht, p. 349.

Sande E (2000). Understorey bird species diversity and abundance in three forest types of Semuliki National Park. Uganda Ostrich, 71: 64-68.

Schot PP (1999). Wetlands. In Environmental Management in Practice, edited by B. Nath, L. Hens, P Compton and D. Devuyst, 3: 62-85.

Sertsu S, Bekele T (2000). Procedures for Soil and Plant Analysis. National Soil Research Centre, Ethiopian Agricultural Research Organization, Addis Ababa, Ethiopia, p. 110.

Sinclair I, Ryan P (2003). Birds of Africa South of the Sahara. Princeton University Press, Princeton.

Stevenson T, Fanshawe J (2002). Field Guide to the Birds of East Africa: Kenya, Tanzania, Uganda, Rwanda and Burundi. T and A D Poyser Ltd., London.

Van-Perlo B (1995). Birds of Eastern Africa: Collins Illustrated Checklist. Harper Collins Publishers Ltd, London.

Van-Reeuwijk P (1992). Procedures for Soil Analysis. 3rd Edn. International Soil Reference and Information Center (ISRIC), Wageningen, The Netherlands, p. 34.

Walkley A, Black A (1934). An examination of the Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Sci., 37: 29-38.

Yimer D, Mengistou S (2009). Water Quality Parameters and Macro Invertebrates Index of Biotic Integrity of the Jimma Wetlands, Southwestern Ethiopia. J. Wetlands Ecol., 3: 77-93.