

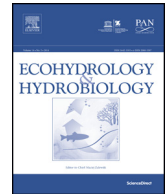


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Original Research Article

## Ecological conditions and ecosystem services of wetlands in the Lake Tana Area, Ethiopia

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### ABSTRACT

Although wetlands are known to provide vital ecosystem services, the current state of wetlands in Ethiopia in terms of their ecosystem service components remains poorly understood. Wetlands located in the UNESCO Lake Tana Biosphere reserve have been highly degraded, but possess highly valuable resources. Therefore, this study sought to assess the major ecological states and identify the main ecosystem services (ESs), along with local people's perceptions of wetland management. Nine wetlands were selected from pristine/reference, agricultural and urban land uses of the Lake Tana Area. Numerous ESs were identified, categorized into four main ecosystem services, analyzed using a conceptual model adopted for this purpose, and their ecological conditions were assessed using a range of methods. The results revealed that the provisioning and cultural services were found to surpass the regulatory and supporting services of wetlands in agricultural and urban types, as compared to wetlands located in pristine areas. Although most of the local residents positively viewed wetland regulation and supporting services, weak policy and decision support such as wetland use planning, investment interventions and communal land ownership, and poor development of diversified livelihood were found to pose major challenges to sustainable utilization of wetland resources. The range of plant species diversity among the impaired wetlands was observed to be related to the degree of disturbance, with urban and agricultural wetlands being highly degraded as compared to pristine wetlands. Moreover, these impaired wetlands were found to be invaded by upland and exotic weeds, out-competing the socioeconomically and ecologically important native species.

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## 1. Introduction

Wetlands are among the most productive environments in the world and are critical for supporting human livelihoods in Africa (Chapman et al., 2001; Rebelo et al., 2010). The goods and services they provide to human populations include food, agricultural production,

fisheries, water quality maintenance and recreation (Seelig and DeKeyser, 2006). Wetlands are also important sources of water and nutrients that support biological productivity (Schuyt, 2005) and serve as habitats for diverse species (Cooper et al., 2006). Moreover, wetlands can reduce the severity of droughts and floods by regulating stream flow (Kotze, 1996) and can provide vital water resources to support agricultural production (McCartney and Houghton-Carr, 2009). All these benefits or services that wetland ecosystems provide are essential for people's livelihoods – particularly in developing countries like Ethiopia.

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Despite their value, wetland ESs and the associated management issues remain poorly documented and under-researched in African nations, particularly as concerns Ethiopia. According to Darwall et al. (2005), the ESs that wetlands provide remain under-assessed, although assessing them is the primary step toward promoting the protection of wetlands. Overall, Ethiopia has no adequate protocols for wetland assessment, monitoring and inventory (Getachew et al., 2012), has an insufficient formal institutional setup and legal framework (Hailu, 2007), and even lacks experts specialized in wetland assessment and management. Wetland ESs are also not fully considered in environmental planning and decision-making, owing to the difficulty of expressing them in terms of monetary values (De Groot, 2006). Although there are intergovernmental drivers to support the wise use of wetlands through the obligations under the Ramsar Convention, the Convention has not yet been ratified or implemented in Ethiopia (Deribe, 2007). There is also no national standing wetland policy. Therefore, research providing scientific information on the ESs of Ethiopian wetlands is critically needed.

However, the first information that should be formulated and addressed to the local communities is about the current status of wetlands. Due to major factors such as siltation, pollution, drainage and deforestation of wetland species, wetlands are among the most vulnerable habitats (Niraula, 2012). But in Ethiopia, there is little or no awareness of the current status of wetlands, or even of the need for their conservation and sustainable utilization (Wondafrash, 2003). Therefore, for effective wetland management, the locals need to have a better understanding of the status of individual wetlands and their resource values. Additionally, development projects rarely consider the value of the local people's perceptions, even though this is a key element for successful wetland protection and management (Rahman et al., 2005). Accordingly, this study also took into account the respondents' perceptions toward wetland management.

### 1.1. General objectives

To assess the ecological conditions, ecosystem services and level of human disturbance in selected wetlands of the Lake Tana Environment.

#### 1.1.1. Specific objectives

- 1) to assess the ecological status of wetlands in relation to human disturbance,
- 2) to identify the common and most important ecosystem services (ESs) derived from the three wetland types and
- 3) to assess the perception of the local people toward wetland management.

## 2. Materials and methods

### 2.1. Study area

Wetlands are situated in the Lake Tana catchment with an altitude range from 1785 to 2047 masl (Fig. 1). The Lake

Tana catchment is known by its 4 major river sub-basins, namely the Gelgel Abbay, Ribb, Gumara, and Megech Rivers. Among the total catchment area of Lake Tana (15,000 km<sup>2</sup>), it covers over 40,000 ha of wetlands around its floodplains. All the studied wetland habitats are within the UNESCO Lake Tana Biosphere boundary.

### 2.2. Wetland selection

The nine wetlands selected for the study were as follows: Shesher, Megech River Mouth, Chimba, Ras Abbay, Avaji, Gudo Bahir, Kurt Bahir, Wonjeta and Legdiya (Table 1). They were selected based on their impact, accessibility and availability (U.S. EPA, 2002). The altitudes and area sizes of the wetlands ranged from 1769 to 2047 masl and from about 100–1816 ha, respectively (Table 1). The nine areas included three reference wetlands, three agricultural wetlands and three urban impaired wetlands, based on their land uses and their Human Disturbance Score (HDS) assessed using the protocol of Gernes and Helgen (2002).

- 1) *Agricultural impaired wetlands*: the Shesher, Megech and Chimba wetlands were selected as agricultural influenced wetlands (Table 1), and all are situated in rural catchments, where cultivation, grazing and sand mining were common activities.

**Shesher** is a semi-permanently flooded (dominated by open water and mudflats) wetland surrounded by farmlands. Water is permanently drained for agricultural purposes during the dry season.

**Megech** is a river delta wetland that receives waste effluents generated from Gondar city via the Megech River. Invasive weed infestation (Water hyacinth), sand mining, siltation, cultivation and free grazing are common practices.

**Chimba** is a riverine floodplain wetland dominated by free grazing and cultivation.

- 2) *Urban impaired wetlands*: the Ras Abbay and Avaji wetlands were selected from the Bahir Dar city area (the impact of Gondar city was assessed from the Megech wetland).

**Ras Abbay** is a riverine wetland. The Blue Nile River crossing Bahir Dar city receives untreated municipal and industrial wastewater and then drains into the mosaic of mixed wetland habitats (forested, marsh and open water) of Ras Abbay.

**Avaji** is a shoreline wetland (from Abbay Minch to Bata church) that receives storm water and domestic wastewater generated by hotels and fish landing sites from surrounding communities.

These two wetlands are subjected to urbanization and reed harvesting. Despite wetland disturbance by anthropogenic activities, these sites support a well-developed plant community.

**Gudo Bahir** is a bog type of wetland located at the western vicinity of Bahir Dar city, receiving runoff from the small degraded hill catchment and then draining partly to the Abbay River and the lake along the city canal. It is devoid of vegetation and severely affected

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