

Policy Briefing



Summary

A pilot ecosystem account was developed for the Laguna de Bay to provide information on flood mitigation capacity, water, fishery resource management; to identify priority areas for protection, regulation of pollution and sediment loading; and to inform strategies on water pricing and sustainable development planning.

Background

The development of the ecosystem accounts is based on data collection and analysis conducted by the Laguna Lake Development Authority (LLDA), the agency responsible for the water and land management of the Laguna Lake Basin.

Technical staff from the different units of the LLDA undertook the analyses supported by international and local experts under the World Bank's Wealth Accounting and the Valuation of Ecosystem Services (WAVES) Global Partnership Programme.

Ecosystem Accounts Inform Policies for Better Resource Management of Laguna de Bay

Laguna de Bay, also known as Laguna Lake, is a vital lifeline to the Philippine capital of Manila providing livelihood, food, transportation and recreation to key provinces and cities within and around the metropolitan area. Competing uses, unsustainable land and water uses coupled with population and industrial expansion have caused the rapid degradation of the lake and its watershed. The data from the ecosystem accounts can help identify the factors that are threatening the Laguna de Bay's water quality and ecology.

Land Cover Condition

- Land conversion due to urban sprawl and rapid industrial development are causing a decline in forest cover and impacting agriculture production.

Flood Mitigation

- Increase in soil erosion from the watershed has changed the contours of the lake.

Water Quality

- Pollution coming from domestic, industrial and agricultural/forest wastes contribute to the degradation of the water quality.

Fish Production

- The lake can still sustain fisheries production but is threatened by pollution.

Overview

Land Cover Condition

- Major land cover change in the Laguna de Bay Basin occurred between 2003-2010. Closed forests decreased by 35% while built up areas increased by 116%.
- Rapid urbanization and industrialization are most evident in the northwest, west and southern portions of the lake.
- In addition, unplanned urban sprawl has led to the conversion of agricultural lands to residential uses, with new settlements being constructed in zones that are vulnerable to flooding.
- The Land account will support the LLDA strategic environmental policy by providing the status and trends in the land cover condition of the watershed, influencing both the quantity and quality of water flowing into Laguna Lake.

Flood Mitigation

- Flood risks in the lake zone have substantially increased because of an increasing population in the lake shore. Such risks will be further aggravated by climate change factors such as an increase in extreme weather events and sea level rise.
- Sedimentation along with a growing population close to the 12.5-meter water level of the lake are affecting the water-storage capacity of the lake.
- The information will allow the LLDA to identify the most important areas for protection and restoration of vegetation cover and avoid sedimentation build up that leads to flooding.

Water Quality

- In 2014, around 81% of Biochemical Oxygen Demand (BOD) load comes from domestic waste
- Other sources of BOD (or organic pollution) load in the lake come from: Industrial waste (9%); agriculture waste (5%), solid waste (3%) and forest waste (2%).
- Increasing the water treatment of household sewage (approximately 92% remains unconnected to sewer lines) holds a lot of potential for improving the water quality of the lake.

Fish Production

- The dominant use of the lake is fisheries.
- The Laguna Lake produces about 80,000-90,000 metric tons of fish in a year; providing a livelihood for 13,000 fishermen.
- Invasive species threaten biodiversity and indigenous species, impacting the economic operations of fisheries.
- The lake can still sustain fisheries but is threatened by pollution.

Why Ecosystem Accounts are Important for the Laguna Lake Region?

The Laguna de Bay Basin, together with Southern Palawan, was chosen as the pilot area for the development of ecosystem accounts in the Philippines. These two areas are considered to be microcosm of the entire country in terms of richness in diversity and presence of various alarming environmental issues.

The Laguna de Bay, (also known as Laguna Lake), is the largest inland water body in the Philippines, measuring an area of 90,000 hectares. Around 100 rivers and streams drain into the lake while there is only one outlet that drains lake waters to the Manila Bay. During some summer months, when the lake level is lower than Manila Bay and when there is sufficient tidal fluctuation, the entry of saltwater through the Pasig River raises the salinity level of the lake, affecting fisheries and water quality.

Two management layers of Laguna de Bay are considered in the development of the accounts. First is the Laguna de Bay Basin which is the physical watershed, defined by the boundaries where water flows into the Laguna de Bay. The Basin which has an area of 2920 km is divided into 24 sub-basins. The other is the Laguna de Bay Region which is the administrative jurisdiction of the Laguna Lake Development Authority (LLDA) which covers the whole provinces of Rizal and Laguna and parts of Cavite, Batangas, Quezon and Metro Manila.

Aside from fisheries which are the dominant use, the lake supplies domestic water through the Maynilad Water Services, Inc (MWSI). It also supplies irrigation water for approximately 103,000 hectares of agricultural areas and hydropower to generate 700 megawatts of electricity.

The lake is also used for non-contact recreation (i.e boating), industrial cooling, reservoir for floodwaters and waste sink.

Taking into consideration the policy drivers and the availability of data, the following ecosystem accounts were developed for the Laguna de Bay Basin:

- land account** containing land cover and changes;
- ecosystem condition account** indicating various water quality indicators, soil types and elevation, changes in lake bathymetry and sediment loading;
- ecosystem services production account** indicating the flow of ecosystem services such as fishery production, water supply, flood mitigation and soil erosion regulation;
- ecosystem asset account** such as water and fish stock.

There is rapid urbanization and industrialization in the lake region, particularly in the Greater Metro Manila area and the southwestern portions of the lake.

Land Account: Declining Vegetation and Expanding Built-Up Areas

The land account clearly illustrates the major land cover change in the basin during the period 2003-2010. Closed forest decreased by 35% while builtup areas increased by 116%. Remaining forests are found, in particular, in the Mt. Makiling Forest Reserve and Sierra Madre mountain ranges, but even in these areas illegal settlements have been established.

There is rapid urbanization and industrialization in the northwest and in the western and southern portions of the lake. The spread and location of residential subdivisions are characterized by unplanned urban sprawl. This involves, among others, the conversion of agricultural lands to residential uses, and the construction of new settlements close to the lake shore, in the zone that is vulnerable to flooding. (Figure 1)

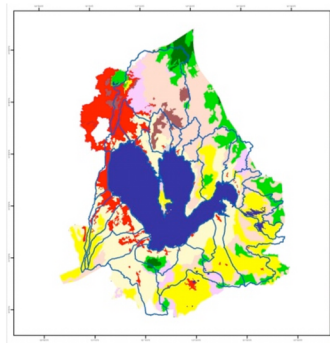
Aquatic Ecosystem Accounts: Declining Water-Retention Capacity

The flood mitigation service of the lake refers to the capacity of the lake to store water that would otherwise have led to flooding of houses and infrastructure. The flood risk is imposed, in the Laguna de Bay watershed, from rain water collected in the lake through run-off from the 24 sub-watersheds draining into the lake, in particular during high rainfall events such as typhoons. The flood mitigation service is affected by the inflow and outflow of water and sediments in the lake.

The water account records the physical stocks and flow of water in the Laguna de Bay. Inflow sources of water include microwatershed discharges, direct lake rainfall and groundwater interaction, while the outflow of water from the lake is attributed to evaporation, river exchange (to and from Pasig River) and water usage for human activities. In order to assess how the lake volume has changed over time and establish if and how sedimentation has affected the water storage volume of the lake, change in bathymetry (measure of water body depth) between 1997 and 2014 was analyzed. Results show that the average depth of the lake decreased by 11 cm from 2.54 m in 1997 to 2.43 m in 2014. The main patterns of such change are that the deeper parts of the lakes became deeper over time, in particular in the western and central part of the lake. However, the periphery of the lake became shallower, in particular in areas close to where rivers drain into the lake.

Noticeable is the potential increase in flood risk due to the decrease in 10.5m lake surface area, which can be attributed to sedimentation and land reclamation.

2003



2010

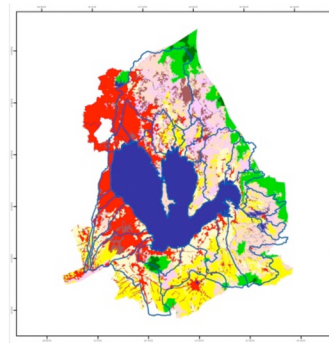


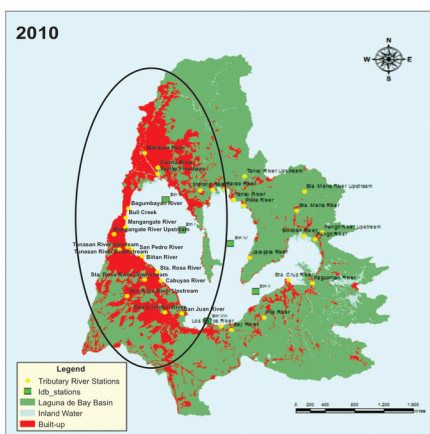
Figure 1. Areas in red illustrate the unplanned urban sprawl in the western part of the Laguna Bay region from 2003-2010

Overall, the capacity of the lake to contain water and to drain water to the Pasig channel has not markedly changed in this period, but the lake volume between 10.5 and 12.5m water level has decreased, due to backfilling of the lake with sediments deposited nearby river outlets in the lake.

Aquatic Ecosystem Condition: Deteriorating Water Quality

The LLDA conducts regular monitoring of the lake and its tributary rivers. The monitoring data indicates that the rivers on the western portion of the lake where built up area has significantly increased for the period between 2003 and 2010 has deteriorated. These rivers have worse water quality, in terms of Biochemical Oxygen Demand (BOD) concentrations, than the Class D classification as provided in the DENR Administrative Order No. 34. (Figure 2)

Population expansion, urbanization, industrialization, deforestation and land conversion have led to massive changes in the Laguna de Bay basin and the lake itself, threatening its water quality and ecology.



Built-up Areas in 2010

Laguna de Bay Sub-basins	2003	2010	2014
Marikina	C	BD	BD
Bagumbayan, Taguig		BD	BD
Buli, Muntinlupa		BD	BD
Mangangate, Mauntinlupa	BD	BD	BD
Tunasan, Muntinlupa	BD	BD	BD
San Pedro	BD	BD	BD
Binan			BD
Sta. Rosa			BD
Cabuyao		D	BD
San Cristobal, Calamba	C	BD	BD
San Juan, Calamba	C	A/B	C
Los Banos			A/B
Bay	A/B	A/B	C
Pila			A/B
Sta. Cruz	A/B	A/B	A/B
Pagsanjan	AA	A/B	A/B
Pangili	A/B	A/B	A/B
Sta. Maria			A/B
Siniloan	C	C	A/B
Jalajala			A/B
Pililla			C
Tanay	C	A/B	A/B
Baras			C
Morong			D
Sapang Baho, Cainta	BD	BD	BD
Manggahan Floodway, Taytay		D	BD

Water Quality Classification in the 24 Sub-basins of Laguna de Bay.

A - Drinking Water D - Irrigation
B - Recreation BD - Worse than D
C - Fisheries

Figure 2. Chart shows deteriorating water quality particularly in areas with expanding built up areas.

Pollution coming from domestic, industrial and agricultural/forest wastes which are continuously drained to Laguna Lake contributes to the degradation of its water quality. The pollution loading in the Laguna de Bay Region, specifically for BOD, for the different sources was estimated for the period 2003 to 2014. The results show that in 2014, 81% of the BOD load comes from domestic wastes, 9% from industry, 5% from agriculture, 2% from forest and 3% from solid wastes. This indicates that treating household wastes has a lot of potential for improving the water quality of Lake Laguna. (Figure 3)

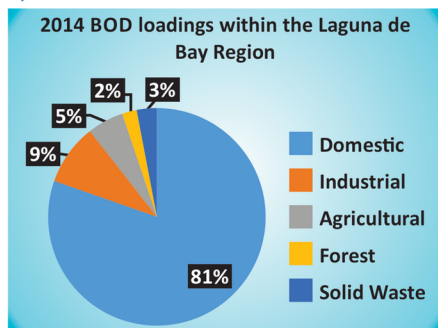


Figure 3. The highest volume of pollution flowing into the lake comes from domestic waste

Ecosystem Services Account: Increasing Sedimentation of the Lake

The siltation of the lake has been identified as one of the pressures being experienced by the lake affecting several of these services. As erosion increases, the severity of siltation also increases. This may result in reductions in lake depth affecting navigation, decrease in water quality for potable water, and potentially leading to an increase in the risk of flooding. The 'erosion control' as a key ecosystem service was included in ecosystem accounting. It was defined as the amount of sedimentation avoided because of the vegetation cover. Calculation was done by comparing the actual erosion and sedimentation rates in 2010 with the rates that would have taken place without vegetation cover (i.e., normal and simulated conditions).

Results of sedimentation analysis show that around 2,000 kilotons (kt) of total suspended sediment was discharged to the lake in 2010. Despite the current state of the ecosystem, the semi-natural and natural ecosystems are still capable of preventing around 7,000 kt of sediment per year from being deposited into the Laguna Lake Basin. This information can be used to identify policies and interventions to prevent further siltation thereby improving the ecosystem. For example, the analysis identifies zones that are particularly important sources of sediment, which the LLDA should prioritize for protection and vegetation restoration. (Figure 4)

Deteriorating Water Quality Potentially Affecting Fisheries Production

Fisheries, which includes capture fisheries and aquaculture, is the dominant use of the Lake. An estimated 13,000 fishermen depend on the lake for their livelihood. The Laguna Lake produces about 80,000- 90,000 metric tons of fish in a year.

In 1999, the LLDA implemented a Zoning and Management Plan (ZOMAP) to ensure the equitable distribution of the lake's fishery resources. The ZOMAP allotted 10,000 hectares for fishpens, 5,000 hectares for fishcages, areas for sanctuary and navigational lanes and the rest for open water fishing.

The western part as the most profitable for both capture fisheries and the two types of aquaculture. This is due to the regular intrusion of salt water, creating a brackish water environment that is suitable for milkfish.

The lake can still sustain fisheries but is threatened by contamination from pollution. Likewise, invasive species threatens not only the biodiversity but also poses an alarming impact on indigenous species and on the economic operation of fisheries in the lake.

Further, the information in the account are meant to serve as basis for formulating policies that would be crucial in addressing issues pertaining to the dominant use of the lake for fisheries and in rationalizing the fishpen fee and fishcage fee (resource user fees).

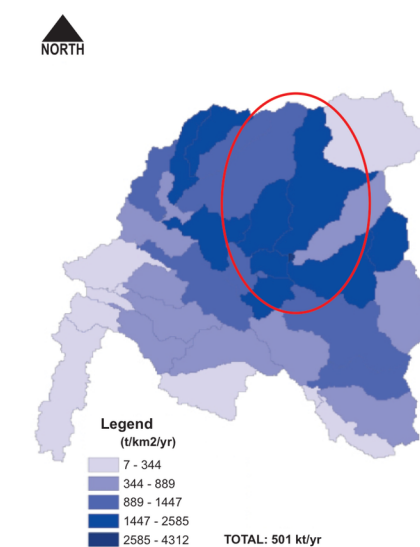


Figure 4. Detailed information on areas generating sediment loads in the Marikina sub-basin.

What Ecosystem Accounts for the Laguna Lake Region Mean for Policy

- Present land conversion is not aligned with development plans or planning laws. Information on land accounts can provide planners and users with information on the availability and usability of land sources to facilitate orderly development and judicious land use.
- There is a need to further strengthen water resources management and development through an integrated and holistic approach to water use and allocation. The following are needed:
 - 1) Maintain an optimum volume of lake water and craft a policy for water allocation for different types of water use and users;
 - 2) Prioritize preferential use of water
- There is immense potential in improving the water quality of the Laguna Lake by increasing the rate of treatment of household sewage.
- Efforts should be made to improve the soil erosion control services and prevent further degradation of land cover to alleviate the siltation in the lake basin. The western part of the lake has been identified as a priority area for rehabilitation.
- Improve water-retention capacity of the lake to reduce vulnerability of shoreland populations to future extreme weather events. A key issue is that more new homes are being built close to the 12.5-meter water level. These homes are extremely vulnerable, especially during high rainfall events and in particular during typhoons.

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