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 is the largest inland body of water in the Philippines providing livelihood, food, transportation and recreation to key provinces and cities within and around the metropolitan area of Manila. 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 counter 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

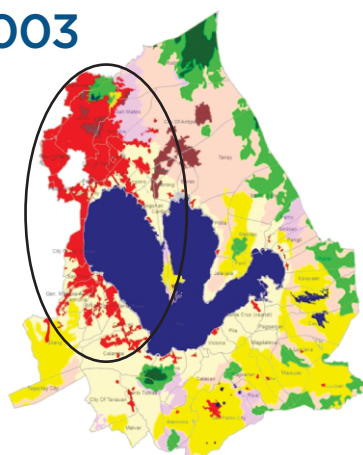- Increase in soil erosion from the watershed has changed the contours of the lake.

Water Quality

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

Fish Production

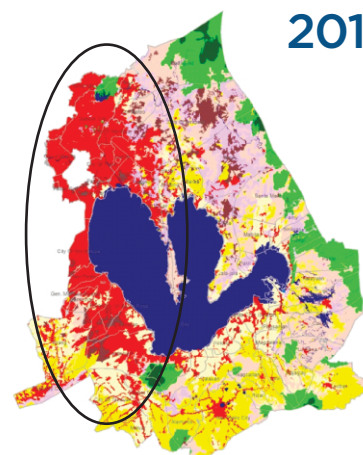- The lake can still sustain fisheries production but is threatened by pollution.

2003   **2010**

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

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Wealth Accounting and the Valuation of Ecosystem Services

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.

Flood Mitigation

- Flood risks in the lake zone have substantially increased because of an increasing population in the lake shore. Climate change factors such as an increase in extreme weather events and sea level rise will adversely affect the flood mitigation of the lake.
- Sedimentation and pollution 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.
- Improving water–retention capacity of the lake would reduce vulnerability of shoreland populations to future 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: 9 % from industrial waste; 5 % from agriculture waste, 3% from solid waste and 2% from forest waste.

- 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

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

Why Ecosystem Accounts are Important for the Laguna Lake Region

The Laguna de Bay, more commonly known as Laguna Lake, is the largest inland water body in the Philippines and the third largest in Southeast Asia. It occupies an area of 90,000 hectares. Around 100 rivers and streams drain into the lake with the largest contribution of inflow coming from the Pagsanjan River. The Pasig River through the Napindan Channel is the only outlet that drains lake waters to 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.

The Laguna de Bay Basin, together with Southern Palawan, were chosen as the pilot study areas 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.

There is rapid urbanization and industrialization in the lake region, in particular in the Greater Metro Manila area in the northwest and in the western and southern portions of the lake.

WAVES

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 km² 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). The Laguna de Bay Region includes the whole provinces of Rizal and Laguna, the towns of Carmona, Silang and General Mariano Alvarez (GMA) and Tagaytay City in Cavite, towns of Tanauan, Sto. Tomas and Malvar in Batangas, Lucban in Quezon, and town of Pateros and the cities of Muntinlupa, Taguig, Pasig, Marikina, Quezon, Caloocan, Pasay, and Manila in Metro Manila.

Laguna de Bay is a multiple use resource. Aside from fisheries which is 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, industrial cooling, reservoir for floodwaters and waste sink.

Over the past decades, conflict of interest, competing uses and unsustainable land and water uses caused the rapid deterioration and degradation of the lake and its watershed.

Taking into consideration the policy drivers and the availability of data, the following ecosystem accounts were developed for the Laguna de Bay Basin:
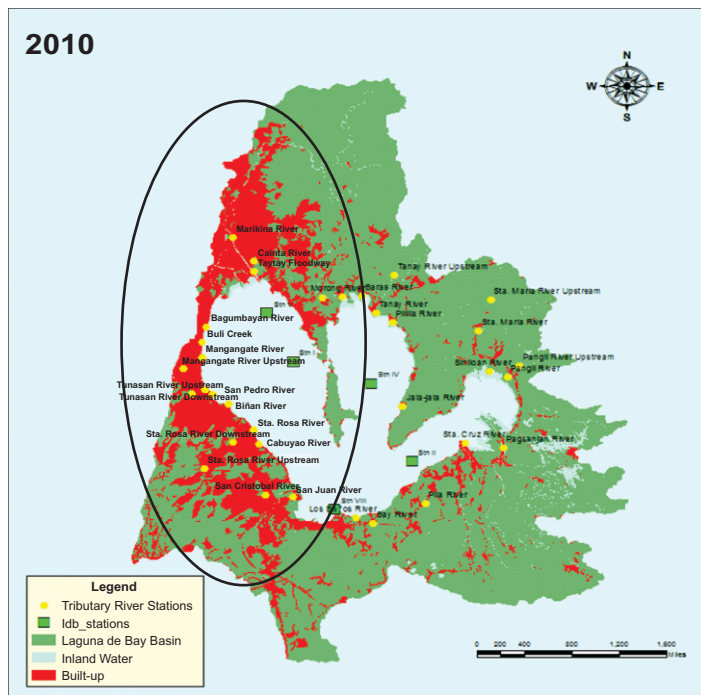
(i) **land account** containing land cover and changes;
(ii) **ecosystem condition account** indicating various water quality indicators, soil types and elevation, changes in lake bathymetry and sediment loading;
(iii) **ecosystem services production account** indicating the flow of ecosystem services such as fishery production, water supply, flood mitigation and soil erosion regulation;
(iv) **ecosystem asset account** such as water and fish stock.

Land Account: Declining Vegetation Cover 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 built-up 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 lake region, in particular, 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)**

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.

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	C	D	BD
San Cristobal, Calamba	D	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
Pangil	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	C	D	D
Sapang Baho, Cainta	BD	BD	BD
Manggahan Floodway, Taytay		D	BD

Built-up Areas in 2010

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.

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 mitigation service is affected by the inflow of sediments in the lake. Portions of the shore that drain back into the lake caused by rain also add to the sediment build-up of 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. Microwatershed discharges are described as the total surface run off from different river systems. Outflow of water from the lake is attributed to evaporation, river exchange (to and from Pasig River) and water usage for human activities.

Based on the simulation modelling conducted from 2000 to 2012, the stock of lake water increased only in 2005, 2007, and 2010. The rest of the years show more water loss than replenishment.

Change in bathymetry (measure of water body depth) between 1997 and 2014 was analyzed to assess how the lake volume has changed over time and to establish if and how sedimentation has affected the water storage volume of the lake. The main patterns of change is 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 decrease in 10.5m lake surface area, which can be attributed to sedimentation (and land reclamation, often following sedimentation on areas where there has been a particular build up in sediments).

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.

Analysis shows that the flood risks in the lake zone have substantially increased because of an increasing population in the lake shore.

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 lower 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)**

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)**
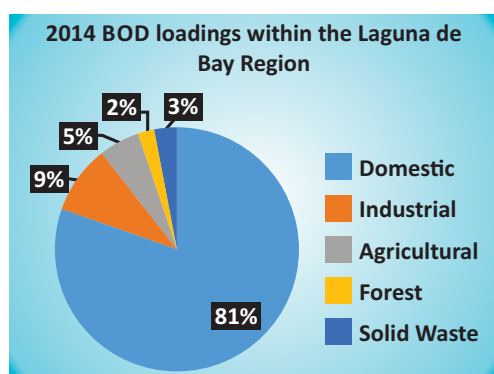

Figure 3. The highest volume of pollution flowing into the lake comes from domestic waste.
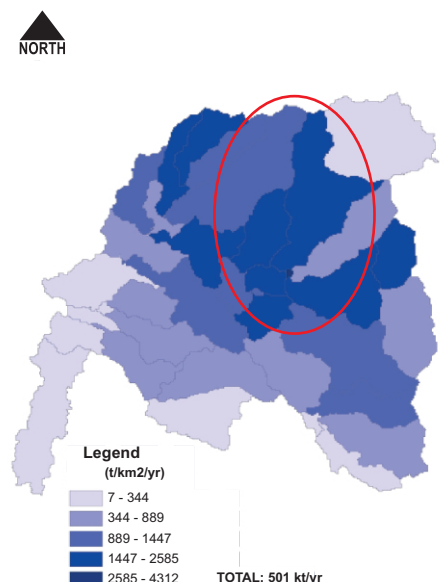

Figure 4. Detailed information on areas generating sediment loads in the Marikina sub-basin.

Ecosystem Services Account: Increasing Sedimentation of the Lake

The ecosystem service 'erosion control' was defined as the amount of sedimentation avoided because of the vegetation cover. It was calculated by comparing the erosion and sedimentation rates that would have taken place without vegetation cover with the actual erosion and sedimentation rates. 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.

With this information, analyses can be made on possible ways to improve these ecosystems and prevent further siltation in the lake basin. Furthermore, the modeling enabled identifying zones that are particularly important

as a source for sediments. This information allows the LLDA to identify the most important areas for protection and restoration of vegetation cover in order to avoid sedimentation and a subsequent decline in the flood mitigation service of the lake. **(Figure 4)**

Deteriorating Water Quality Potentially Affecting Fisheries Production

Laguna de Bay is a multiple use resource but the dominant use is for fisheries, that includes capture fisheries and aquaculture through fishpen and fishcages. 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. 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.

There are important differences between the different parts of the lake, with 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.

What Ecosystem Accounts for the Laguna Lake Region Mean for Policy

- Land conversion, is at present, not aligned with development plans or planning laws. Better enforcement of such regulations is crucial. 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 for different types of water users;

  2.) Prioritize preferential use of water

- Increasing the rate of treatment of household sewage has a lot of potential to improve the water quality of the Laguna Lake.

- Efforts should be made to improve the soil erosion control services and further prevent further degradation of land cover to alleviate the siltation in the lake basin. The accounts have identified priority areas for rehabilitation as the western part of the lake.

- 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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