# The Ecosystem Health Report Card
# **Measuring, Communicating, Action!**

**LBSA Workshop for the Nairobi Convention GEF-WIOSAP Project**
**10 – 11 December 2018**
**Maputo, Mozambique**

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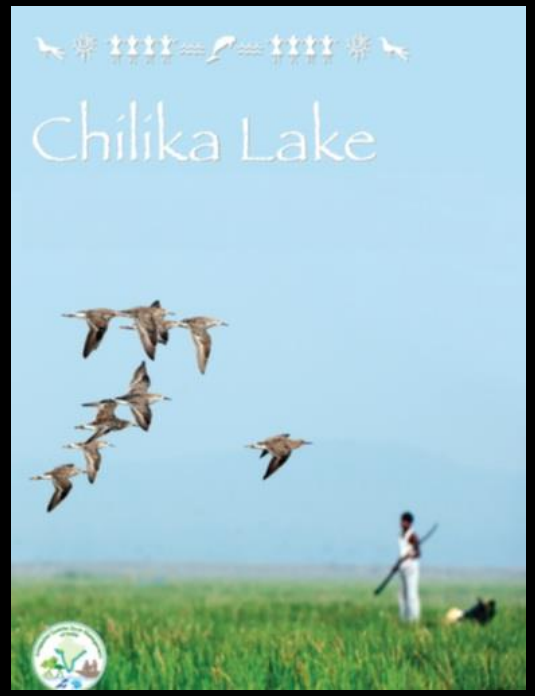
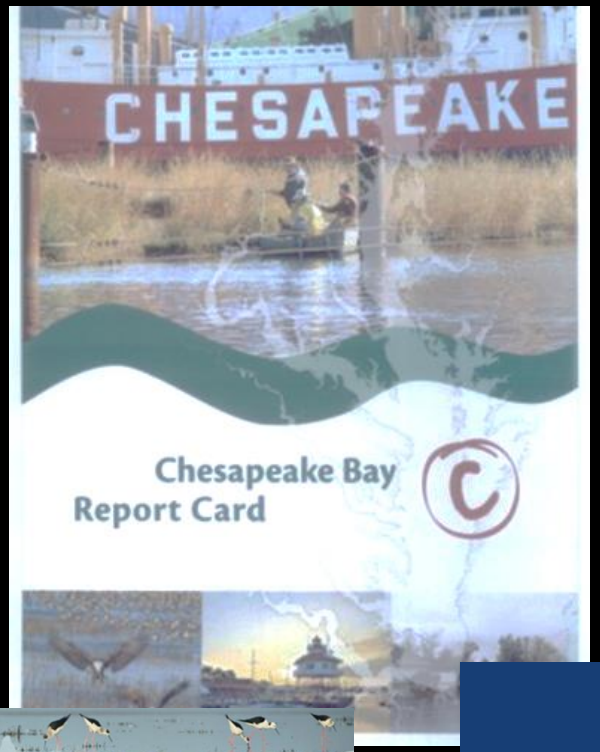
Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA)

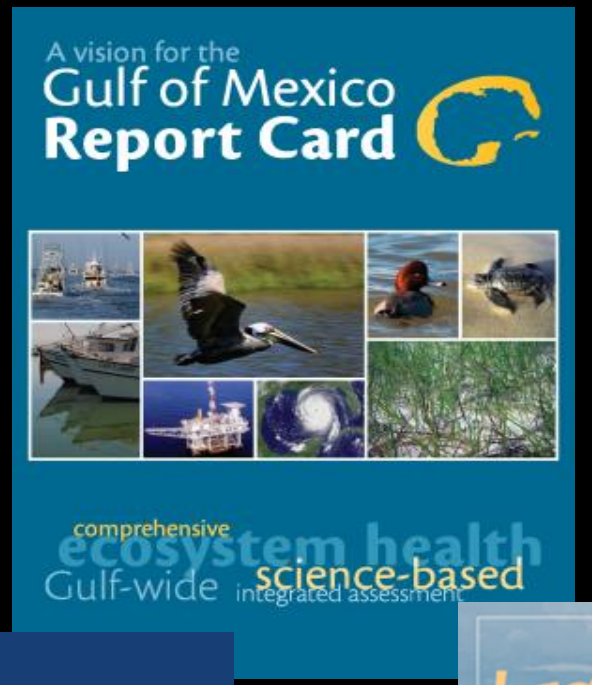
# What is an Ecosystem Health Report Card?

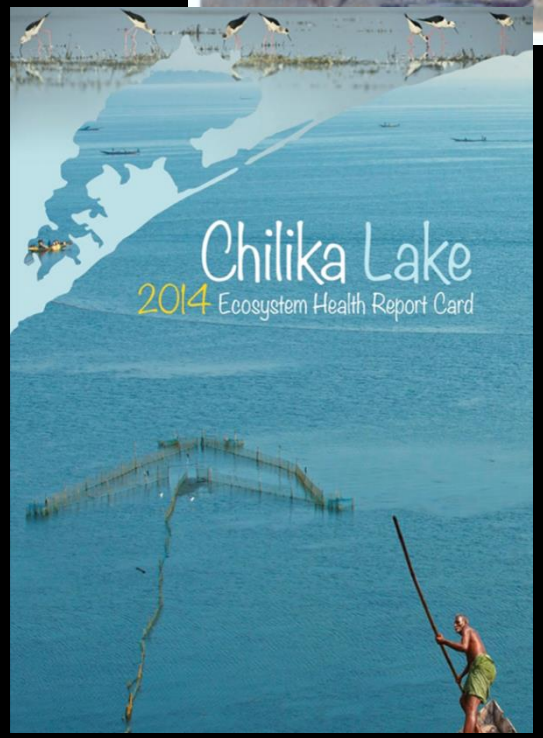
- **Broad-level assessment** of a region or a system
- **Communicates complex information** by delivering it in simple and concise form that is understandable to people and to which people can relate to.
- **Based on real data** and provides accountability as it identifies areas that need management improvement and intervention.
- Provide **knowledge for management**
- **Engages all relevant experts and stakeholders**, including the communities, in developing the contents and structure.

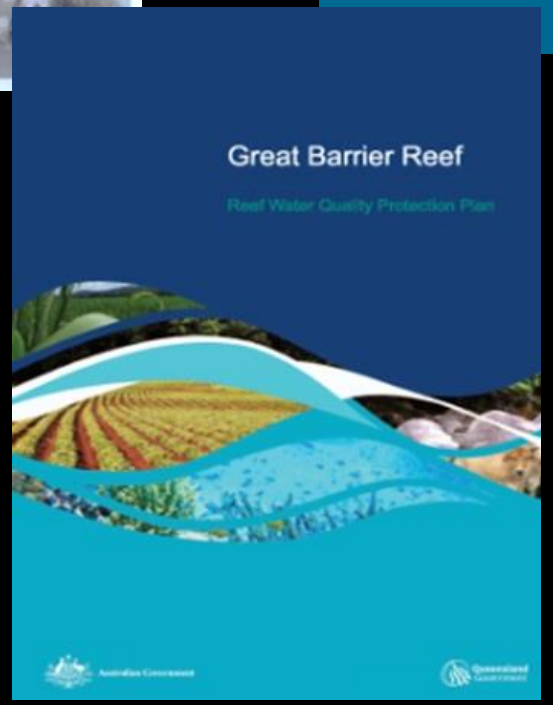
# Examples

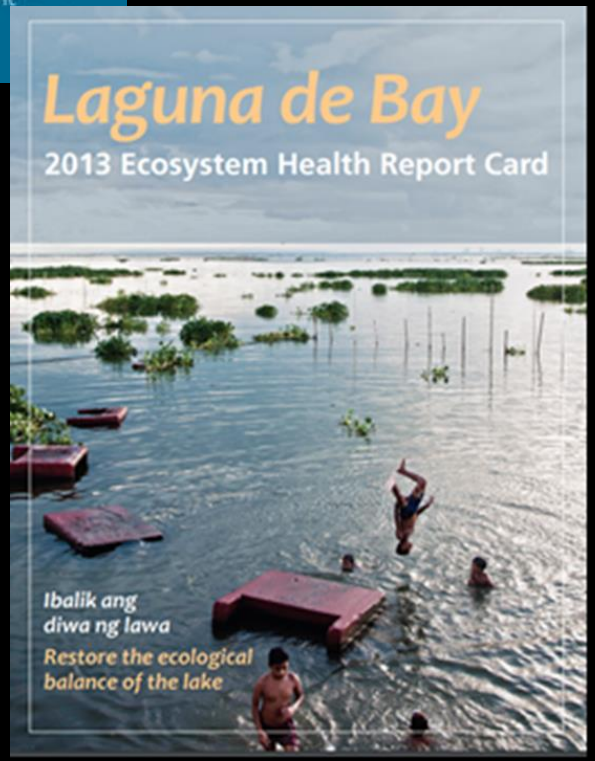

Chilika Lake


CHESAPEAKE
Chesapeake Bay
Report Card


A vision for the
Gulf of Mexico
Report Card
comprehensive
ecosystem health
Gulf-wide
science-based
integrated assessment


Chilika Lake
2014 Ecosystem Health Report Card


Great Barrier Reef
Reef Water Quality Protection Plan


Laguna de Bay
2013 Ecosystem Health Report Card
Ibalik ang
diwa ng lawa
Restore the ecological
balance of the lake

# Five-step process

## 1 What is the big picture?

CONCEPTUALIZE

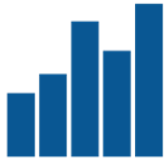
Create a framework defining key goals, values, and threats.

## 2 What do we measure?

CHOOSE INDICATORS

Select indicators that convey meaningful information.

## 3 What is healthy?



DEFINE THRESHOLDS

Define reporting regions and method of threshold attainment.

## 4 How does it add up?

CALCULATE SCORES

Calculate indicator scores and combine into index grades.

## 5 What is the story?

COMMUNICATE RESULTS

Communicate results using visual elements, such as photos, maps, and conceptual diagrams.

# Considerations in development of the scorecard

- Water quality monitoring **data collected on a regular basis**
- Use of **simple and easy-to understand water quality parameters**
- Parameters that **stakeholders can easily relate to**
  - Example: presence and abundance of an endemic species, or reduction or absence of introduced species;
- **Active engagement of stakeholders**; eg user associations, regulatory agencies, other civil society
- The **use of all forms of media in communicating results**.

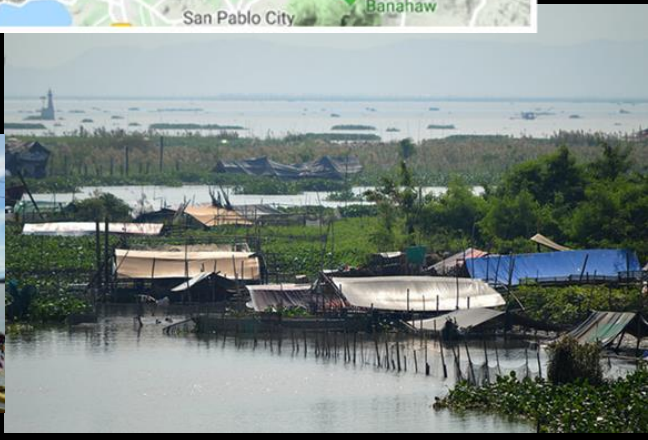
# Methodology

- Understand the **environmental characteristics**
- Identify/know the **values, pressure, stakeholders**
- Making of graphic presentation with the knowledge of ecosystem environment and activities
- **Decide indicators** based on Values and Pressures
- **Set thresholds**
  - References/ professional judgment form long term data set
- **Set gradings/scores**: By comparison of the present data with threshold values
- Presentation can be seasonal, Annual, sectoral depending on the spatio-temporal variability of environmental parameters.

# Case example:
# Laguna de Bay, the Philippines

- Largest inland waterbody in the Philippines, adjacent to metro Manila
- **Many values**
  - **water** for agriculture, industry, and drinking; **supporting fisheries**; recreational opportunities; **sanctuary** for migratory birds
- Under threat from the densely populated and rapidly growing catchment
  - **Eutrophication is a main concern**
  - Lake receives **untreated sewage**, other **nutrient pollutants** from agriculture, industry, and mining.
  - Suffers from **invasive species** which threaten native fish and saltwater intrusion

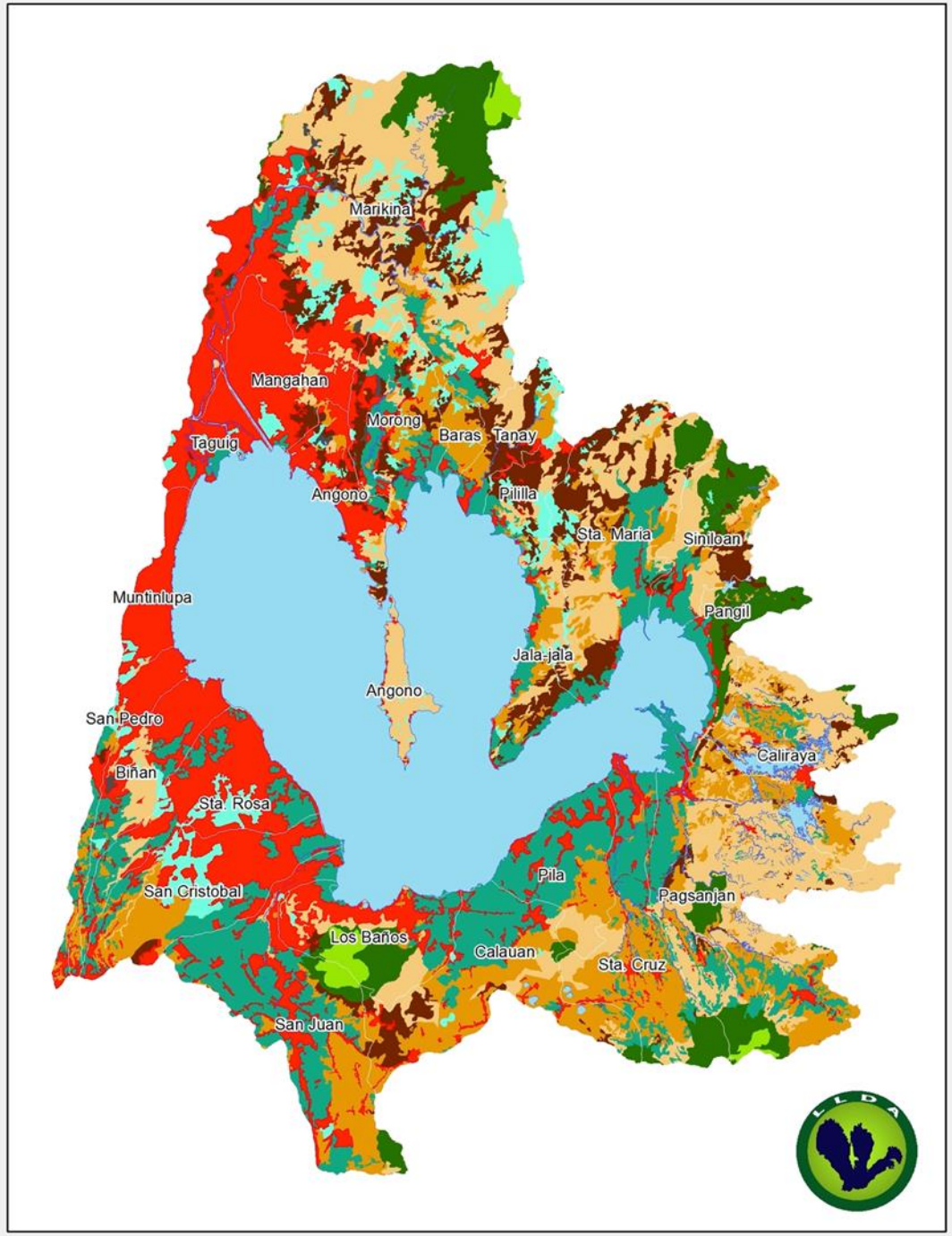




# Landuse

## *Watershed of Laguna de Bay*

Diverse landscapes with multiple intensive uses within drainage basin




| Land Cover | Area (ha) | Percentage |
|---|---|---|
| Urban | 51962.005 | 16.98 |
| Forest | 27508.01 | 8.99 |
| Arable Land | 33379.274 | 10.91 |
| Plantation | 50555.323 | 16.52 |
| Grassland | 48467.553 | 15.84 |
| Brushland | 74913.958 | 24.49 |
| Marsh | 2649.84 | 0.87 |
| Water | 2319.941 | 0.76 |
| Unclass | 13539.179 | 4.43 |
| Cloud | 647.156 | 0.21 |
| Total | 305942.239 | 100.00 |

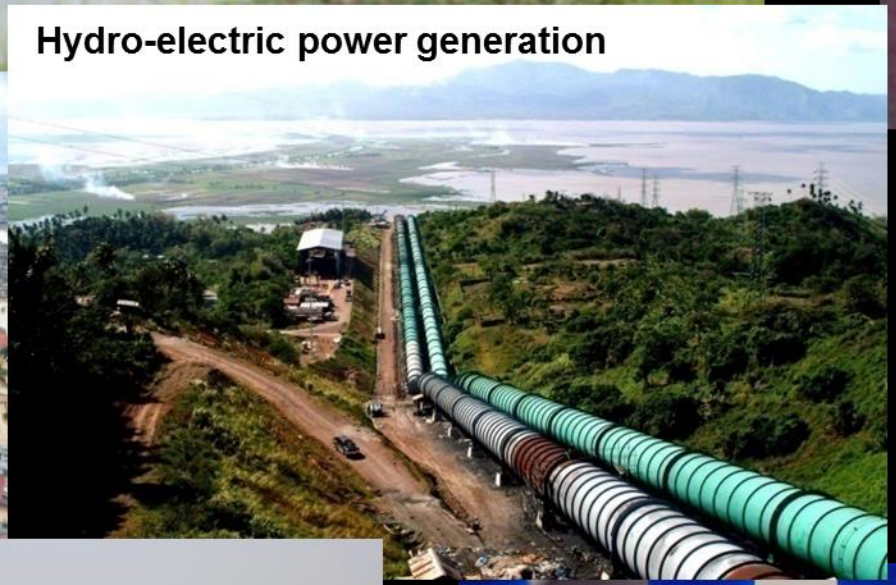
**Legend:**

- Closed forest, broadleaved
- Open forest, broadleaved
- Forest plantation, broadleaved
- Mangrove forest
- Other land, built-up area
- Other land, cultivated, annual crop
- Other land, cultivated, perennial crop
- Other land, natural, barren land
- Other land, natural, grassland
- Other land, natural, marshland
- Other wooded land, shrubs
- Other wooded land, wooded grassland
- Other land, fishpond
- Inland water


Fishing


Irrigation


Transportation


Hydro-electric power generation

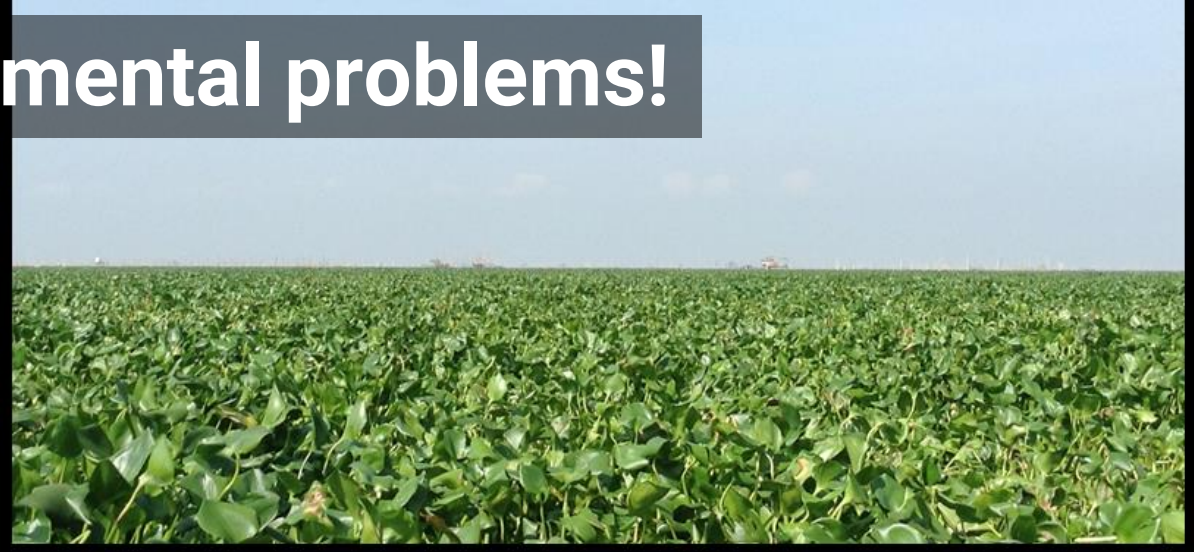
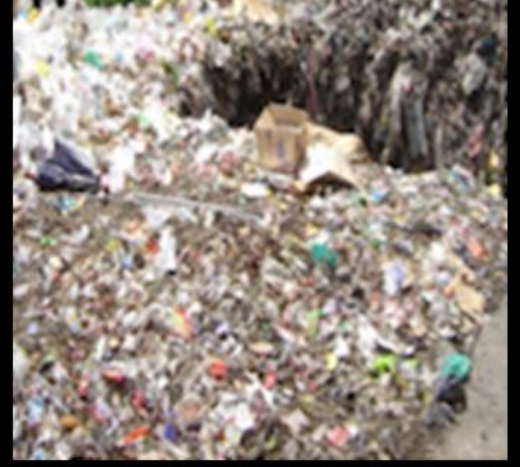

Laguna de Bay
Taytay Rizal
Cainta
Manggahan Floodway
Pasig City
Floodwater retention
AC Santos-Borja


Industrial Cooling


Recreation


R.O. WATER
M.F. WATER
RAW WATER
Drinking Water

# Massive environmental problems!

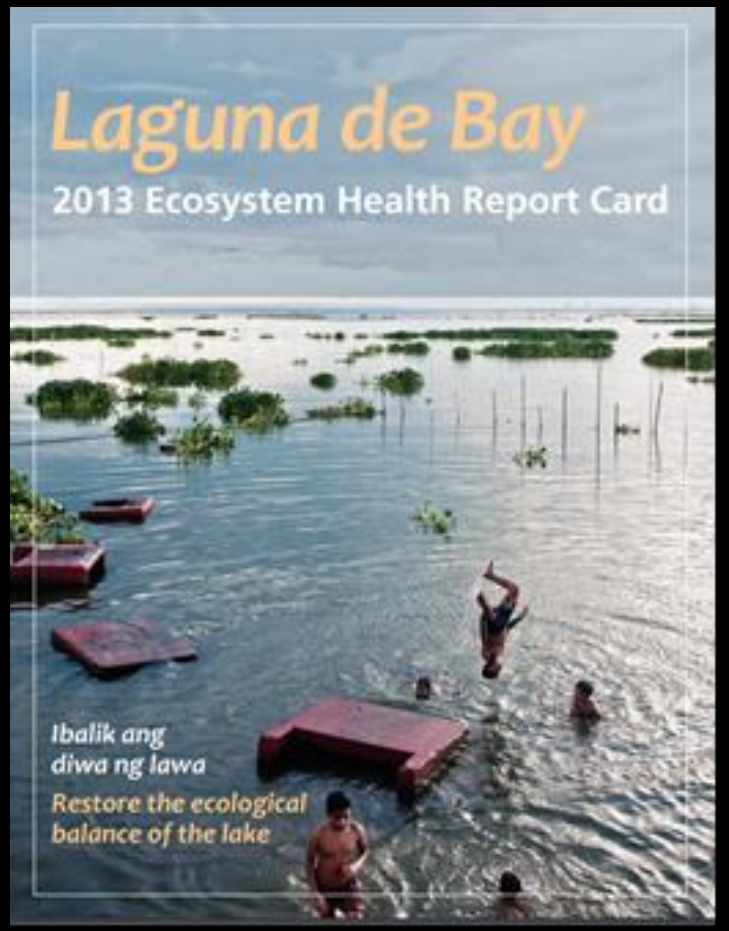









# Case example:
# Laguna de Bay, the Philippines

- Led by the Laguna Lake Development Authority (LLDA);  partnership with:
  - PEMSEA; external experts from Marine Science Institute of the University of the Philippines-Los Baños
  - University of Santo Tomas
  - Bureau of Fisheries and Aquatic Resources
  - University of Maryland Centre for Environmental Science
- Supported under the GEF-Global Nutrient Cycle Project
  - Global Programme of Action, UN Environment




Global foundations for reducing nutrient enrichment and oxygen depletion from land based pollution in support of the
Global Nutrient Cycle

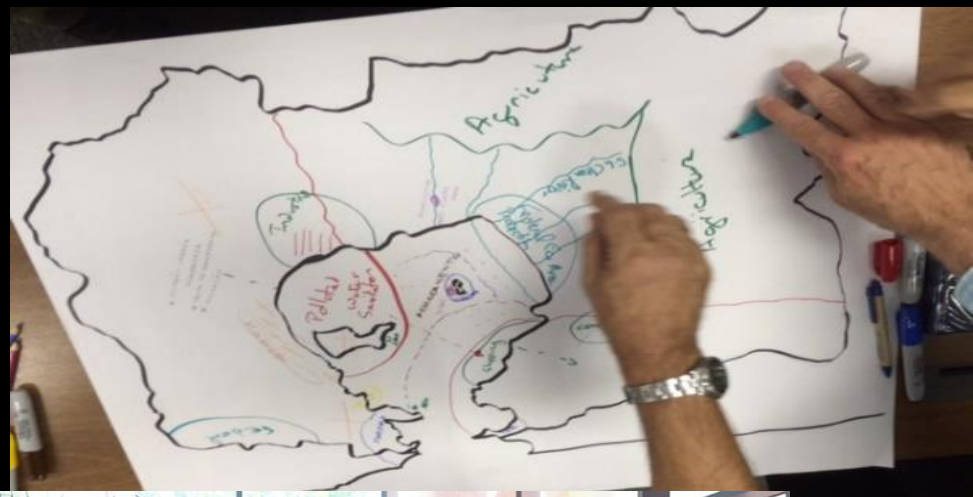
# Case example:
# Laguna de Bay, the Philippines

## Steps Taken

- Create a **Technical working Group** (TWG) within LLDA
- Engage Technical Experts;
- **Review and analyze** 10-year data sets - period 2004-2013
  - water quality/physico-chemical parameters,
  - phytoplankton and chlorophyll-a,
  - zooplankton and fisheries
- Recommend **indicators and thresholds**
- Provide guidance and assistance to TWG
  - Plan, build consensus and finalize report card.

# Case example:
# Laguna de Bay, the Philippines

- **Initial planning Workshop**
  - **Identify target audience** for the Ecosystem Health Report Card
  - **Define & agree on methodology** for developing Report Card
  - **Define appropriate indicators** in consideration of values and uses of Laguna de Bay
  - **Determine ways to communicate significance** of the report card to target audience and **encourage their involvement**



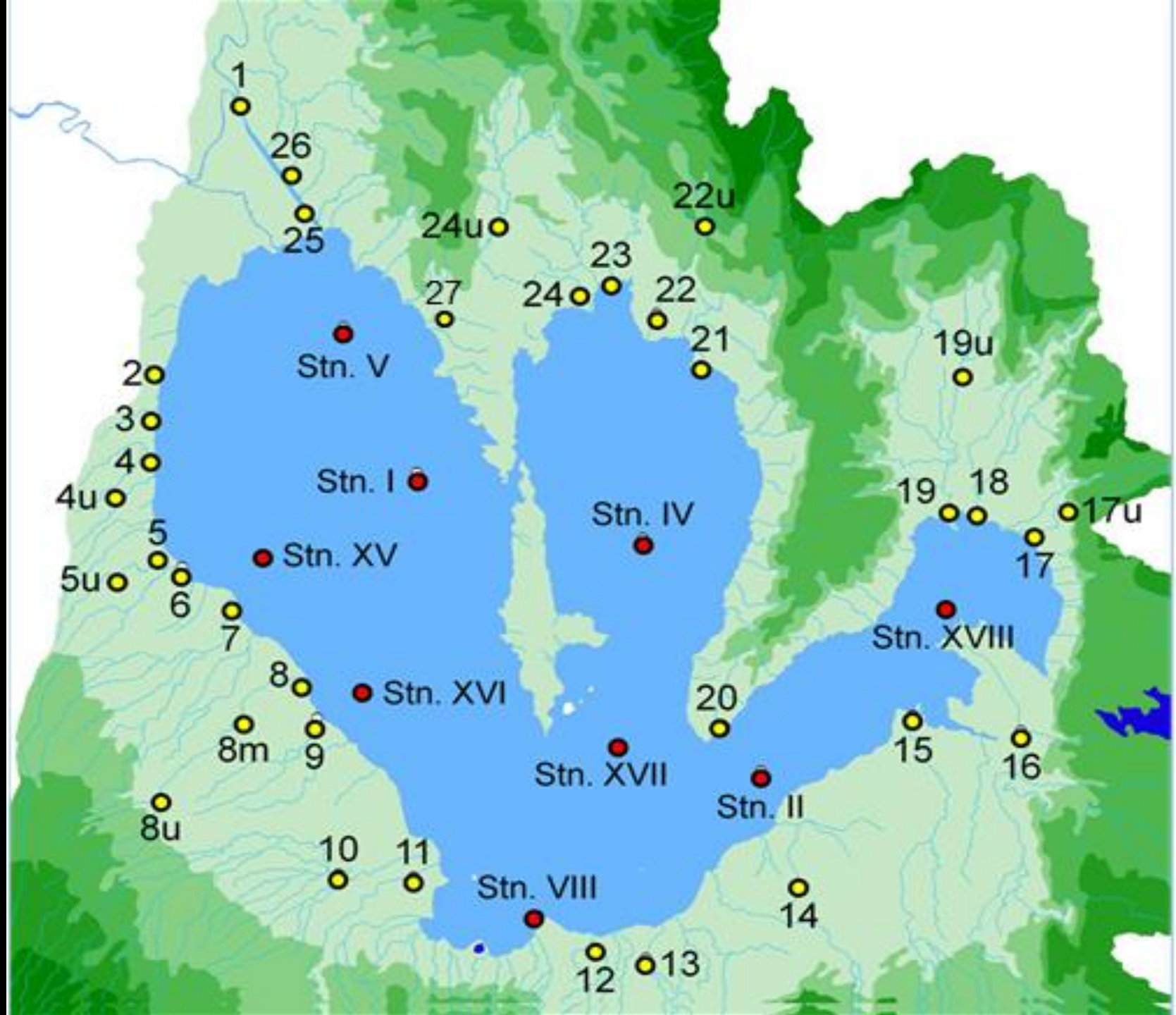
# Case example:

# Laguna de Bay, the Philippines

## Identify **values and threats**


# Laguna de Bay Monitoring Stations

| | |
|---|---|
| I | Central West Bay |
| II | East Bay |
| IV | Central Bay |
| V | Northern West Bay |
| VIII | South Bay |
| XV | West Bay-San Pedro, Laguna |
| XVI | West Bay-Santa Rosa, Laguna |
| XVII | Fish Sanctuary |
| XVIII | East Bay -Pagsanjan, Laguna |



# Case example:
# Laguna de Bay, the Philippines

## Second Workshop

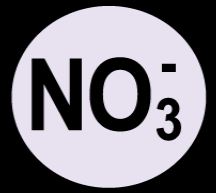
- **Finalize indicators & thresholds** per sector based on available data and sources
- Develop **methodology for scoring and grading**
- Determine **key messages** for the first Ecosystem Health Card
- Come up with **first draft** of the Ecosystem Health Card

# Case example:
# Laguna de Bay, the Philippines

## Determining Scores

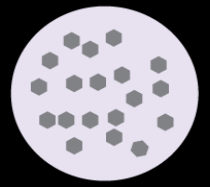
- Scores calculated by **comparing four water quality indicators** to Class C Water Quality Criteria in local regulation
- Other indicators including 3 fishery indicators were **compared to a historical benchmark**
- Each area of the lake - East, Central, East, and South received a score for both water quality and fisheries by **averaging individual scores** of its respective indicators.
- **Overall grade is the average grade** of all four areas

# Water Quality Indicators




**Nitrates** in excess amounts cause dramatic increases in aquatic plant growth and changes in the types organisms that live in the lake. Sources include fertilizers, drainage from livestock feeds, as well as domestic and industrial discharges.

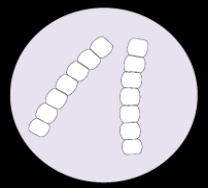

**Phosphates** come from agricultural runoff, animal waste and sewage.



**Chlorophyll a** measures the amount of phytoplankton that can cause algal blooms. Algal blooms by blue-green algae are an indicator of deteriorating water quality and polution.


**Dissolved oxygen (DO)** is vital for the survival of fish and benthic organisms in the lake.


**Biological oxygen demand (BOD)** is the amount of oxygen required by microorganisms for stabilizing biologically decomposable organic matter in water under aerobic conditions. High BOD levels are associated with organic pollution, such as sewage.



**Total coliforms** is a measure of animal bacteria that enters the lake by direct deposition of waste in the water and runoff from areas with high concentrations of animals or humans.

# Fisheries Indicators

**Zooplankton ratio** can be used to indicate changes in the trophic state of the lake, level of eutrophication and warming history. Decreasing calanoid to cyclopoid ratio indicates deteriorating trophic state; the lower the calanoids, the higher the trophic state of the lake. In Laguna de Bay, the only remaining calanoid copepod is the invasive *Arctodiaptomus dorsalis*, which has already displaced previously recorded native calanoid species in the lake.

**Native fish species composition** measures the proportion of native against introduced/invasive species in major catch composition.

**Catch per unit effort (CPUE)** is computed from the average total daily catch and the total number of fishing hours.

# Case example:
# Laguna de Bay, the Philippines

## Regulation: DENR AO 2016 - 08

| Water Quality Guidelines for Class C Waters | |
|---|---|
| Nitrate as NO3-N | 7 mg/L |
| Phosphate | 0.5 mg/L |
| Ammonia as NH3-N | 0.05 mg/L |
| Fecal Coliform | 200 MPN /100 mL |

| Effluent Standards for Class C Waters | |
|---|---|
| Nitrate as NO3-N | 14 mg/L |
| Phosphate | 1 mg/L |
| Ammonia as NH3-N | 0.5 mg/L |
| Fecal Coliform | 400 MPN /100 mL |

# Grade and Scoring

Example: Biological Oxygen Demand (BOD)

| Month | Measured BOD **Concentration** (mg/l) | Grade<br>100 when **below** threshold<br>0 when **above** threshold<br>**Threshold: 7 mg/l** |
|---|---|---|
| January | 6 | 100 |
| February | 5 | 100 |
| March | 5 | 100 |
| April | 7 | 100 |
| May | 9 | 0 |
| June | 9 | 0 |
| July | 8 | 0 |
| August | 7 | 100 |
| September | 10 | 0 |
| October | 3 | 100 |
| November | 7 | 100 |
| December | 6 | 100 |
| **Average** | | **67** |

**Score** calculated as simple average of grades assigned over observation period

# Case example:
# Laguna de Bay, the Philippines

## Grades for water quality - definitions

**A**

**91–100%: All indicators meet desired levels**

- Water quality of water **very good**; most often leading to **preferred habitat conditions** for aquatic life.

**B**

**83-90%: Most indicators meet desired levels**

- Water quality tends to be **good**, often leading to **acceptable habitat conditions** for aquatic life.

**C**

**75 - 82%: Mix of good and poor levels of indicators**

- Water quality tends to be **fair**, leading to **sufficient habitat conditions** for aquatic life

**D**

**70 -74%: Some or few indicators meet desired levels**

- Water quality tends to be **poor**, often leading to **degraded habitat conditions** for aquatic life.

**F**

**0–69%: Very few or no indicators meet desired levels**

- Water quality tends to be **very poor**, most often leading to **unacceptable habitat conditions** for aquatic life

# Water Quality – Overall Score

| Indicator | Score | Overall Score | Grade |
|---|---|---|---|
| Nitrate | 100 | 76 | C- |
| Phosphate | 59 | | |
| Chl a | 0 | | |
| DO | 100 | | |
| BOD | 100 | | |
| Total Coliforms | 99 | | |

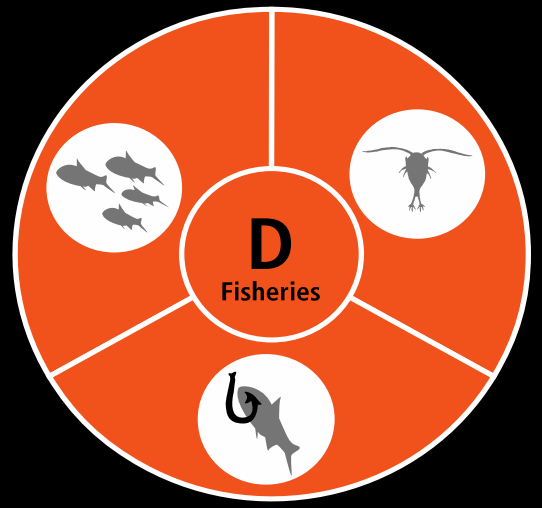
| | Score range | | Assigned Score |
|---|---|---|---|
| A | 96.00 -100.0 | Excellent | A+ |
| | 94.00 - 95.99 | Superior | A |
| | 91.00 - 93.99 | Very Good | A- |
| B | 89.00 - 90.99 | Good | B+ |
| | 86.00 - 88.99 | Very Satisfactory | B |
| | 83.00 - 85.99 | High Average | B- |
| C | 80.00 - 82.99 | Average | C+ |
| | 77.00 - 79.99 | Fair | C |
| | 75.00 - 76.99 | Pass | C- |
| D | 70.00 - 74.99 | Conditional | D |
| F | 0.00 - 69.99 | Failing | F |


**Based on DENR Class C Water Quality Criteria:*
*Nitrate: 10mg/L  Phosphate: 0.05mg/L  Chl a: 10ug/L  DO: 5mg/L  BOD: 7mg/L  Total coliforms: 5000MPN/100ml*

# Fisheries – Overall Score

| Fisheries Index | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | A | 80-100% | B | 60-80% | C | 40-60% | D | 20-40% | F | 0-20% |

| Indicator | % Score | % Sub Score | Grade |
|---|---|---|---|
| Percent composition of Fish Native Species | 39 | 30 | D |
| Zooplankton ratio | 29.75 | | |
| CPUE | 21.6 | | |




**Graded using a Fisheries Index; scores subject to change pending additional data and data normalization*

# 2013 Laguna de Bay ecosystem health report card

## LAGUNA DE BAY


Laguna de Bay scored a passing mark, 76%, a C-, in water quality. The bay consistently is within the Department of Environment and Natural Resources (DENR) guidelines for class C waters in DO, BOD, Nitrate, and Total Coliforms. However, it scored 0% in Cholorophyll and 59% in Phosphate. Water quality was affected by high population and industralization.


The lake received a D in Fisheries (30%), with a 39%, 30%, and 22% scores in fish native species composition, zooplankton ratio, and catch per unit effort (CPUE), respectively. Invasive fish species and competition among fisher folks contributed to the low scores.

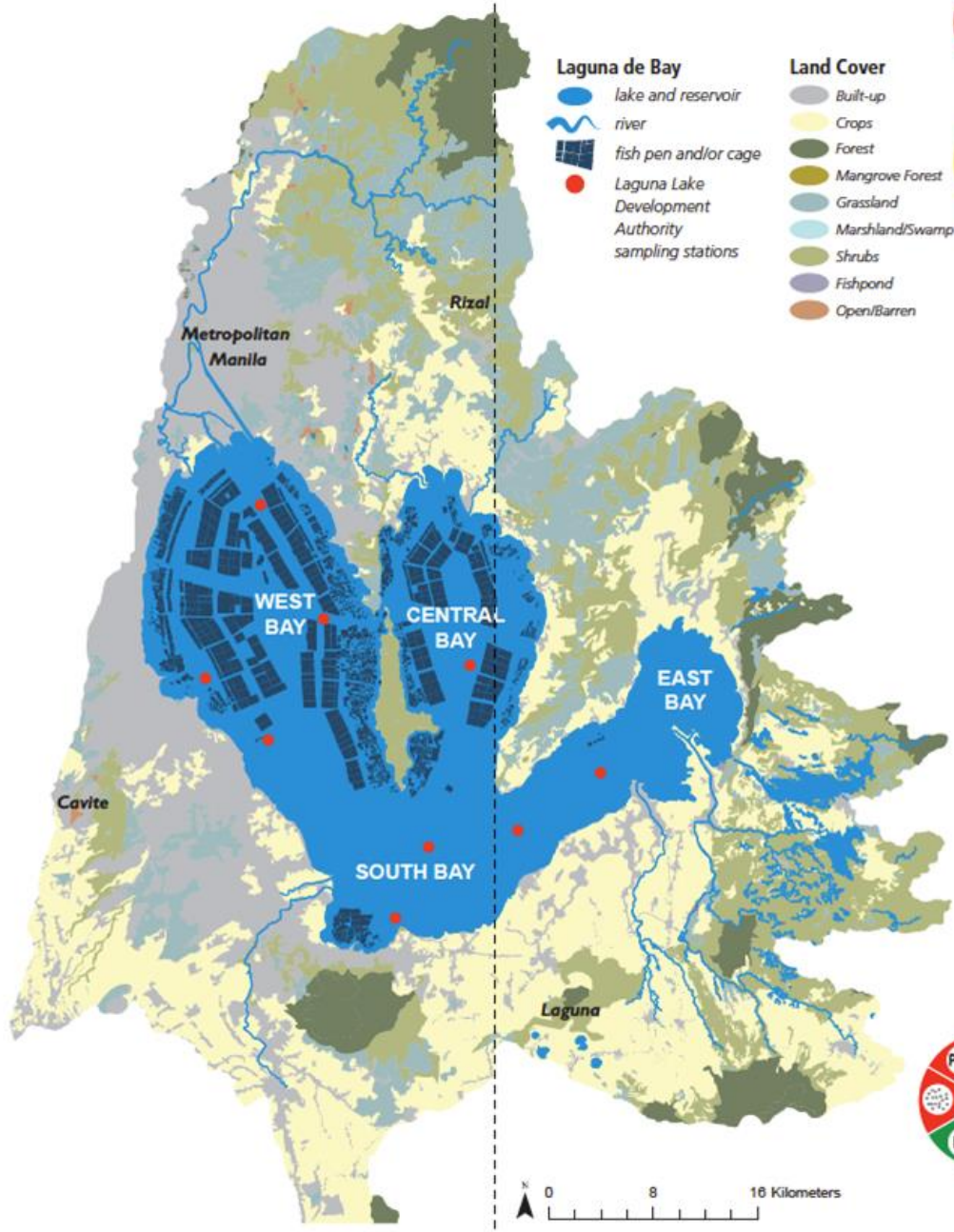
The chlorophyll a, phosphate, and zooplankton scores show that the lake is highly eutrophic. These results have a negative impact on the fisheries of Laguna de Bay. Overall, these scores are not only a cause of concern for fisheries, but the whole community and all the industries supported by the lake.

### How are the scores calculated and what do they mean?

The 2013 Laguna de Bay report card measured indicators for water quality and fisheries for the West, Central, East, and South bays. Six water quality indicators were compared to the Department of Environment and Natural Resources (DENR) guideline for class C (aquaculture) waters which were then combined and then represented as a percent score for each bay.

The three fisheries indicator were calculated as ratios or percentage that are then combined for each bay. The scores are then normalizede to form a fisheries a index.

- **A** 91–100%: All the indicators meet desired levels. Quality of water in these locations tends to be very good, most often leading to preferred habitat conditions for aquatic life.
- **B** 83–91%: Most indicators meet desired levels. Quality of water in these locations tends to be good, often leading to acceptable habitat conditions for aquatic life.
- **C** 75–83%: There is a mix of good and poor levels of indicators. Quality of water in these locations tends to be fair, leading to sufficient habitat conditions for aquatic life.
- **D** 70–74%: Some or few indicators meet desired levels. Quality of water in these locations tends to be poor, often leading to degraded habitat conditions for aquatic life.
- **F** 0–70%: Very few or no indicators meet desired levels. Quality of water in these locations tends to be very poor, most often leading to unacceptable habitat conditions for aquatic life.




## WEST BAY


The West Bay has the second lowest water quality score (76%). It is the most heavily developed side of Laguna de Bay and most populated. For 2013, its DO, BOD and Nitrate were within DENR's guideline for class C waters (100%) and its total coliform at 98%. However it has the second lowest score in phophate (56%) and like all the bays, received a 0% in chlorophyll. This scores reflect its high population density with relatively few people connected to a waste water treatment plant.

The West Bay also has the second highest fisheries score of 39% (D+), scoring the highest in zooplankton ratio (35%) and CPUE (35%) and the second highest score in native fish species composition at 47% (C). This region has the highest concentration of commercial fish pens and cages, and an estimated fishing ground allocation of 1 fisherman/101 ha.

## CENTRAL BAY


The Central bay has the lowest water quality score at 71%, however, its 40% (C-) score in Fisheries is the highest. Although it scored 100% in nitrate, DO, BOD, and total coliform, it had the lowest score in phospate with 25%, and a 0% in chlorophyll a.

The Central Bay has the highest percentage of native fish in catch composition, with a score of 59% (C) and the second highest CPUE. It has approximately 1 fisherman/110 ha of fishing ground allocation.

## EAST BAY


The East Bay has the highest water quality score at 81%. It received an A in all water quaity indicators except for cholorophyll a (0%, an F). However, the East Bay scored the lowest in fisheries with 17%, the only bay that received an F. It had the lowest scores in zooplankton ratio and CPUE with 22% (D-) and 3% (F), respectively.

The low score in CPUE can be attributed to higher number of fishermen operating in a smaller fishing area with a fishing ground allocation of only 1 fisherman/28 ha. It also has the highest concentration of the invasive knife fish.

## SOUTH BAY


The South Bay has the second best score in water quality at 77%, with 100% in nitrate. DO, BOD, and total coliform. Like all the bays, it has a 0% in chlorophyll a and an F in phosphate at 63%. However, it had the second lowest score in fisheries, 25%, (D) with the lowest score in native fish species composition at 24%. A designated fish sanctuary is located within the South Bay.

First Laguna de Bay Ecosystem Health Report Card Dissemination Forum
October 2015


Formal Laguna de Bay Ecosystem Health Report Card Launch Event with the GPNM
February 2016

# Case example:
# Laguna de Bay, the Philippines

- **Lessons: People can make a difference!!**
- Youth being educated and getting involved
  - CLEAR (Conservation of Laguna de Bay's Environment and Resources) Youth Network

- Government agencies and local communities work together to address invasive Knife Fish
- A new technology helps restore water quality
  - Aquatic Macrophyte Biosorption System





# What can we take from this?

- Highly effective at **assembling data into readily accessible format**; understandable by wide audiences
- **Enhance knowledge** on the state of environment
- Assist to **mobilize community action**
- Assist to **mobilize high-level policy commitment and action**
- **Ease of replication**
- Integrate within the SDG national assessment processes – Goals 6 and 14 in particular

# Contribution to… SUSTAINABLE DEVELOPMENT GOALS

**Core SDG targets:**

- Target 6.3 – good ambient freshwater quality
- Target 14.1 – reduced pollution in the marine environment



# Resources and contact information

**Leads in global development**

- **Heath Kelsey**, hkelsey@umces.edu; University of Maryland Center for Environmental Science

**Contacts for applications in the Philippines**

- **Adelina Santos-Borja,** lennieborja@yahoo.com; **Jocelyn Sta. Ana**, jgs_llda@yahoo.com.ph; Laguna Lake Development Authority, The Philippines

**Contacts for applications in India**

- **Ramesh Ramachandran**, rramesh_au@yahoo.com;  National Centre for Sustainable Coastal Management, India
- **Susanta Nanda**, susanta64@yahoo.com; Chilika Lake Development Authority, India

**Contact at United Nations Environment Programme**

- **Christopher Cox**, christopher.cox@un.org; UN Environment

# For more information visit us at

https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/addressing-land-based-pollution

UN environment

United Nations Environment Programme

GPA

Global Programme of Action for the Protection of the Marine Environment from Land-based Activities