Managing Lakes and Their Basins for Sustainable Use in Malaysia

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ILBM Platform Development
ILEC International Collaboration Project on ILBM-Governance

- Hosted by: Faculty of Environmental Management, Prince of Songkla University

- Organized by: Research Center for Sustainability and Environment, Shiga University, Japan (RCSE-SU) and International Lake Environment Committee (ILEC)

- Financially supported by: Ministry of Education, Culture, Sports and Science, Japan

ILBM-GOVERNANCE MEETING IN THAILAND
PRESENTATION OUTLINE

- Status of ILBM Programs – Malaysia
- Tasik Cini – UPDATE
- Putrajaya Lake and Wetland - UPDATE
- Tasik Timah Tasoh – UPDATE
- Tasik Pedu and Muda – UPDATE
- Tasik Merah - UPDATE
Managing Lakes and Their Basins for Sustainable Use in Malaysia

Lake Briefs Report Series No. 1
LAKE BRIEFS REPORT SERIES NO. 1

1. Bukit Merah, Perak
2. Tasik Kenyir, Terengganu
3. Loagan Bunut, Sarawak
4. Tasik Pedu and Muda, Kedah
5. Tasik Putrajaya and Wetlands, Putrajaya
6. Tasik Chini, Pahang
7. Tasik Terip, Negeri Sembilan
8. Tasik Timah Tasoh, Perlis
CONTENT OF LAKE BRIEFS

- ILEC’S guidelines

1. Description of the lake
2. Management of the lake and the basin
3. Major impact stories of the lake
4. Major lake basin governance issue
5. Key challenges to lake governance
TASIK CHINI UPDATE
SIP AND REHABILITATION PROGRAMME OF TASIK CHINI

Pusat Penyelidikan Tasik Chini,
Universiti Kebangsaan Malaysia

Tasik Chini Research Center,
National University of Malaysia
Highest point: Bukit Chini 641 m

Deepest point: Laut Gumum
- 3 m (normal season)
- 6 m (wet season)

Lake size:
- 202 ha (normal season)
- 300 ha (wet season)

7 Active feeder rivers

Tasik Chini Watershed

Tasik Chini State Park
BACKGROUND

Pusat Penyelidikan Tasik Chini, PPTC (Tasik Chini Research Center), Universiti Kebangsaan Malaysia has studied the impact of various development on Tasik Chini, the only other natural freshwater lake in Peninsula Malaysia.

The long term monitoring research of 6 years has strongly indication that without proper lake management, the lake and its catchment is going towards a disastrous environmental degradation which might not be reversible.
GOVERNANCE AND POLITICAL WILL

The report and support from the public and the media has initiated the state Government to undertake conservation measures.

East Coast Economics Region Development Council (ECERDC) has been given the task to undertake the conservation and rehabilitation which entrusted UKM-PPTC to look into Master plans for the Strategic Implementation Plan (SIP) of Tasik Chini, which include the Integrated Management Plan (IMP), as well as its Environmental Economic Valuation of the region.

The blueprint will be reported to the Economic Planning Unit at the Prime Minister’s Department. (Details will be released by ECERDC.)
IMPLICATIONS

The use of scientific finding has been utilized by both the state and federal government for conservation and rehabilitation initiatives.
POLICY

Since Tasik Chini is the first Malaysian UNESCO Biosphere Reserve, the proposed management are based on and its zones which basically comprise of 3 main zones. The Core Zone, The Buffer Zone and The Transition or Cooperation zone. Biosphere Reserves are protected areas of representative terrestrial and coastal environments which have been internationally recognized under the UNESCO MAB Programme for their value in conservation and in providing the scientific knowledge, skills and human values to support sustainable development (UNESCO, MAB).

The planning concept has integrated the gazette of Tasik Chini as an Environmental Sensitive area Rank 1, under the National Physical plan. In view of the various concepts of preservation, IUCN protected areas and ILEC model of the 5 pillars, have been incorporated as part of the policy and the management study.
ACTIVITIES WITHIN TASIK CHINI

Rehabilitation is the top agenda to commence conservation in Tasik Chini and its catchment.

Apart from it being under the environmental sensitive area (ESA) category, its status as a biosphere reserve, Tasik Chini has also been gazette by the state government as a tourist destination. Therefore, the water quality of the lake and the water balance are urgent areas that needed immediate rehabilitation.
1. Monitoring Stations

Seven monitoring stations for ecohydrology, water quality and climatology stations have been built and constructed at strategic locations so as all on-line data to the laboratory can be received and documented. This will ensure that sedimentation, environmental flows, water quality and microclimate of the area are been monitored at all times. The data received could assess the status of water quality of the area, the water balance and the micro climate that is important to the tourist industry and the socioeconomic of the community living in the area.
2. **Fish population study**

Fish population study is another aspect to ensure that the establishment of fish population to reach the carrying capacity in the lake is achieved. The purpose of the study was to survey and to collect data on the fish population of the lake, identify any problems with the fish population and formulate a fisheries management plan for the lake. Currently fish nurseries are being built and fish are reared. Fish rehabilitation will commence end of March 2011.
3. Slope rehabilitation programme

The work will commence in March when the weather is drier. Embankments of Sungai Chini the main outlet of Tasik Chini which has been constantly eroded by boating activities needed to be restored before the whole river system collapse and the only gateway for water transport would be in a mess.
4. Laboratory complex

Will be constructed in August 2011 to protect, maintain and conserve Tasik Chin and its catchment.
STATUS OF TASIK CHINI WATERSHED

Environmental Sensitive Area (ESA) (Rank I)

- By law
- By administration
- By zonation
- By control development
- By effective management

NATIONAL ECOTOURISM DESTINATION

BIOSPHERE RESERVE AREA

NATURAL RETENTION POND

CRITICAL ISSUES IN GOVERNANCE
Situation of Lake Chini is serious. Intervention is heard between the canal and the lake. There are illegal logging and mining activities. The issues are sometimes overlooked. Those are needed to be involved in decision making.

Regulating services of ecosystem services is especially important. For the 4 types of ecosystem services, industries in Malaysia have been gaining resource provision services. But there are resource services have associated with tourism, livelihood of indigenous people. Those are related to regulation services, such as food chain. It is difficult to transfer these values in economic system by themselves. Regulation services are crucial for resource provision services. This is key for Lake Chini.
We need to take it as a national issue but not only the lake-basin and local state. Economy development and lake conservation need to be balanced, especially for Lake Chini case. Intangible value is important but difficult to be valued and the consensus is therefore important for policy making in the national government level, as a decision to balance with national economic policies.
How that can be done in terms of institution, participation, policy aspects? That is the immediate challenge for Lake Chini, Unless looking at the entire Pahang river system, and gradually catching the long-term view, it is not possible to take care of the fundamental issues. Without knowing the silt it is difficult to know how much impact for the lake in a long term.

This should therefore be regarding as a long term issue, especially in terms of regulation services, in land, fishery, water supply.
PUTRAJAYA LAKE AND WETLAND - UPDATE

Bahagian Alam Sekitar, Tasik dan Wetland.
Perbadanan Putrajaya, Malaysia

Environmental, Lake and Wetland Section,
Putrajaya Corporation, Malaysia
The management focus on areas of concern with regards to stormwater quantity and quality

- Sungai Langat Basin: 2423 km²
- Length of River Langat: 247 km
- Putrajaya Catchments: 50.9 km²

The Putrajaya Lake and Wetland Catchments as part of the bigger Sungai Langat River Basin
THE PUTRAJAYA WETLAND

The Wetland is 200 hectares in size


- Wetland functions as a natural filtration system for the lake

- Planted with more than 70 species of wetland vegetations totaling 12 million number of plants
THE PUTRAJAYA LAKE

The Lake is at the southern part of the wetland. It covers an area of 400 hectares, creating 38 kilometers of shoreline.

The lake water quality is of paramount important as its location is in the heart of the city and also a centre for water sports, recreation and tourism.
PUTRAJAYA LAKE AND WETLAND

- The largest constructed wetland in the tropics;
- It is an integrated lake and wetland catchments management system;
- Being in the middle of the city of Putrajaya, one of the constructed wetlands and lake of national importance in Malaysia;
- They perform many vital functions similar to natural wetlands
STATUS OF BIOLOGICAL ASPECTS AND WATER QUALITY

Phytoplankton
Zooplankton
Macrobenthos
Fish
Assessment of Vegetation
Assessment of Fauna
Assessment of Bird
Water Quality
## MONITORING PROGRAM

<table>
<thead>
<tr>
<th>SCOPE OF WORK</th>
<th>FREQUENCY</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phytoplankton Monitoring</td>
<td>Monthly</td>
<td>To identify phytoplankton species distribution to the highest taxonomic level possible.</td>
</tr>
<tr>
<td>Zooplankton Monitoring</td>
<td>Monthly</td>
<td>To identify zooplankton species distribution to the highest taxonomic level. Possible and count and enumerate zooplankton density.</td>
</tr>
<tr>
<td>Macrobenthos Monitoring</td>
<td>Monthly</td>
<td>To identify macrobenthos species living in the Putrajaya Lake and wetlands ecosystem</td>
</tr>
<tr>
<td>Mosquito Assessment</td>
<td>Twice yearly</td>
<td>To determine the mosquito species present and assess their population status</td>
</tr>
<tr>
<td>Assessment of Fauna</td>
<td>Twice yearly</td>
<td>To develop biodiversity profiles (including distribution, ecological aspect, species and population density) based on survey conducted on terrestrial fauna in the Putrajaya lake and wetlands area.</td>
</tr>
<tr>
<td>SCOPE OF WORK</td>
<td>FREQUENCY</td>
<td>DETAILS</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Water Quality</td>
<td>Daily</td>
<td>Observation of pollution condition</td>
</tr>
<tr>
<td></td>
<td>Biweekly</td>
<td>Batch sampling of water at designated sampling points for the analysis of selected water quality parameters</td>
</tr>
<tr>
<td></td>
<td>Monthly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yearly</td>
<td></td>
</tr>
<tr>
<td>Pollution Event</td>
<td>As /when</td>
<td>Field sampling team is to inform the PjC upon observation of any event of pollution or drastic deterioration of the lake/wetland condition</td>
</tr>
<tr>
<td>Diurnal / Depth Profile</td>
<td>Yearly</td>
<td>In situ measurements of selected water quality parameters at specific depths and time intervals at the designated sampling points</td>
</tr>
<tr>
<td>Groundwater Sampling and Monitoring</td>
<td>Twice yearly</td>
<td>In situ measurements of selected water quality parameters at the two designated well</td>
</tr>
</tbody>
</table>
Diversity Index (DI)

Water Quality Index (WQI)

Trophic State Index (TSI)
**LAKE TROPHIC STATE CLASSIFICATION**

**Trophic State Index (TSI)**

The concept of trophic status is based on the fact that changes in:

<table>
<thead>
<tr>
<th>Trophic class</th>
<th>Chl</th>
<th>P</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oligotrophic</td>
<td>0-2.6</td>
<td>0-12</td>
<td>&gt;4</td>
</tr>
<tr>
<td>Mesotrophic</td>
<td>2.6-20</td>
<td>12-24</td>
<td>2 - 4</td>
</tr>
<tr>
<td>Eutrophic</td>
<td>20-56</td>
<td>24-96</td>
<td>0.5 - 2</td>
</tr>
<tr>
<td>Hypereutrophic</td>
<td>56-155+</td>
<td>96-384+</td>
<td>&lt;0.25 - 0.5 +</td>
</tr>
</tbody>
</table>

Relationships between chlorophyll (Chl $\mu g \ L^{-1}$), phosphorus (P $\mu g \ L^{-1}$), Secchi depth (SD, m) and trophic class (Carlson & Simpson 1996)
<table>
<thead>
<tr>
<th>Water</th>
<th>Dominant Algae</th>
<th>Other common algae</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oligotrophic</strong></td>
<td>Slightly acidic</td>
<td>Desmids, Staurodesmus, Staurastrum*</td>
</tr>
<tr>
<td></td>
<td>Neutral to slightly alkaline; nutrient poor</td>
<td>Diatoms: Cyclotella*, Tabellaria; Chrysophytes,</td>
</tr>
<tr>
<td></td>
<td>Neutral to slightly alkaline; productive at certain seasons</td>
<td>Chrysophytes: Dinobryon*, Mallomonas</td>
</tr>
</tbody>
</table>

* Common in Putrajaya waters

**Cyclotella ocellata**

* Diameter: 3 – 5 μm

**Dinobryon**
# PHYTOPLANKTON STATUS
## - INDICATORS OF TROPHIC LEVELS

<table>
<thead>
<tr>
<th></th>
<th>Water</th>
<th>Dominant Algae</th>
<th>Other common algae</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mesotrophic</strong></td>
<td>Neutral to slightly alkaline</td>
<td>Dinoflagellates</td>
<td>Mixed</td>
</tr>
<tr>
<td><strong>Mesotrophic</strong></td>
<td>Neutral to slightly acidic</td>
<td>? Putrajaya lake – Green algae, Chodatella?</td>
<td>? Putrajaya lake Desmids</td>
</tr>
<tr>
<td><strong>Eutrophic</strong></td>
<td>Usually alkaline, enriched tropical lakes</td>
<td>Blue-green algae: Oscillatoria, Anabaena</td>
<td>Euglenophytes if organically polluted</td>
</tr>
</tbody>
</table>

*Chodatella subsalsa: 13 x 8 u*

*Oscillatoria spp.*

*Anabaena spp.*
Ecosystem is slowly changing towards mesotrophic and eutrophic

Oligotrophy → Mesotrophy → Eutrophic → Hyper-eutrophic
PUTRAJAYA LAKE WATER QUALITY

Water Quality Index – (Yearly 2001 to 2010)

WQI - 2001 to 2010

Year

2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

WQI

65.0 67.5 70.0 72.5 75.0 77.5 80.0 82.5 85.0 87.5 90.0 92.5 95.0 97.5

WQI

Class I NWQS

Class II NWQS
PUTRAJAYA LAKE WATER QUALITY

Water Quality Index – Yearly 2009 and 2010

<table>
<thead>
<tr>
<th>Year</th>
<th>WQI</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>67.0</td>
<td>I</td>
</tr>
<tr>
<td>2010</td>
<td>77.0</td>
<td>I</td>
</tr>
</tbody>
</table>

WQI Percentage of Putrajaya Lake (Jan 2009 - December 2009)

- WQI Class I = > 92.7
- WQI Class II = 76.5-92.7

WQI Percentage of Putrajaya Lake (Jan 2010 - December 2010)

- WQI Class I = > 92.7
- WQI Class II = 76.5 - 92.7
WQI CLASS I – 2009 VS 2010

The graph shows the percentage values for Class I (2009) and Class I (2010) across various stations. The stations are labeled as PLa1, PLa2, PLb1, PLb2, PLc1, PLc2, PLd1, PLd2, PLe1, PLe3, PLf1, PLf4, PLf5, PLg1, PLg2, PLg3, PLg4. The percentage values range from 0% to 120%. The graph compares the values for the two years, highlighting the differences and similarities in water quality across the stations.
Figure 1. Ecosystem Services Provided by Lakes and Reservoirs
One proposed framework of ecosystem services is that of the Millennium Ecosystem Assessment. Resource Provision Services are valued monetarily, while other services (Regulating, Cultural and Supporting Services) are difficult to value in monetary terms and their degradation is often neglected.
ECOSYSTEM SERVICES PROVIDED BY PLW

- Flood mitigation
- Irrigation
- Tourism/Recreational
- Sports activities
- Relaxation/Aesthetic
- Waterfront properties
- Microclimatic stabilisation
- Employment
- Education and research
- Drinking water

Pic: Spillway of the lake

Pic: Cruise activity in the lake.
PLW - ACTIVITIES

AN ATTRACTION FOR WATER SPORTS, RECREATION & TOURISM

Active activities
- Cruise & dining boats
- Canoeing & rowing
- Sailing

Passive activities
- Fishing
- Bird watching
- Walking
- Jogging
- Cycling
PLW - ACTIVITIES

AN ATTRACTION FOR WATER SPORTS, RECREATION & TOURISM

International F1 Powerboat

International water ski competition

International dragon boat competition

Sailing Regatta
ECOSYSTEM SERVICES OF PLW

• Lake and Wetlands are the areas where water play important role in the development of adapted plants and animals and in controlling the environment and associated life.

• Lake and Wetlands are the most productive ecosystem due to:
  1. high biological diversity
  2. high land productivity
  3. attractive to many wildlife species:
     • provide diverse habitat types
     • protection from predators
     • abundant food resources
     • provide different types of breeding grounds
ECOLOGICAL SERVICES OF PLW

HABITAT FOR FAUNA

- Life support habitats
- Provide food chain system
- For breeding nesting and rearing young birds, reptiles, fishes
ECOSYSTEM SERVICES OF PLW

The lake and wetland perform many vital functions similar to natural wetland:

- Water capacitors, buffers and connectors
- Stabilizers of local climatic conditions
- Nutrient regulators
Ceberra odollam, 
Melaleuca cajaputi dan 
Dilennia sufruticosa – 
healthy growth
BENEFITS OF CONSTRUCTED PLW

- Cost-effective treatment of non-point-source of pollution;
- Opportunities for enhancement of habitats and biodiversity revitalization;
- Clean / healthy water storage to be recycle (i.e: for irrigation purposes);
- Reduction of flood hazards and erosion;
- Opportunities for space enhancement for development recreational amenities (i.e: for community, school children)
- Tourism and community recreation amenities;
- Reduction of operation and maintenance costs relative to conventional water treatment plants;
Leppironia articulata
THREATS TO PLW

- Siltation
- Solid waste pollutants
- Sewage leakage
- Encroachment
- Landscaped area runoff
- Weeds & eutrophication
- Over use - boating
- Increasing population - awareness
- Release of fish of animals - religious
- Hospital waste

Pic: Flow of sewage & siltation from adjoining colonies.
DISCUSSION

PUTRAJAYA TOWARDS GREEN CITY STATUS

• UNIVERSITY OF TECHNOLOGY MALAYSIA
• KYOTO UNIVERSITY, JAPAN
**DISCUSSION**

**TOTAL ECONOMIC VALUE**

- **Use Values**
  - **Direct Use Values**
    - Marketed outputs
      - crops
      - Meat/fish
      - Timber
      - Renewable energy
      - industrial
    - Unpriced benefits
      - recreation
      - landscape
      - Aesthetics
  - Ecological Function values
    - Benefits
      - Flood control
      - **Carbon storage**
      - Water storage
      - Waste assimilation
      - Ecological diversity
  - Future option values
    - Benefits
      - Future drugs
      - Potential gene pool
      - Recreational options
  - Existence values
    - Benefits
      - Satisfaction from knowing the resource exists
  - Bequest values
    - Benefits
      - Passing benefits to future generations

Adapted from Hodge and Dunn (1992)
Currently the world is emitting about 6 billion tons of carbon dioxide into the atmosphere annually and 60-percent of this are attributed to human activities.

Highly industrialized nations lead the emission race with the United States on top, registering a carbon emission rating of 19.1-percent.
DISCUSSION

Taking from Prof Mitsch’s estimate of 200 grams of carbon per square meter per year for constructed wetland carbon sink

The Putrajaya Wetland capacity of carbon sink could be:

\[200g \times 600\text{ha} \times 10,000\text{m}^2 = 1,200 \text{tonC/year}\]
Urban Ecology: Nature in the urban fabric
Putrajaya Wetlands: Habitat of diversified Flora and Fauna
The Evaluation Committee classified the project according to the following criteria:

Global Reference Projects:
Show best practice in EH principles (dual regulation, integration) and serve as a model for other projects

Operational Projects:
Are implementing EH principles and involved with stakeholders in project management.

Evolving Projects:

Emerging Projects:
Recommendations from the Committee:

Give more detail on future plans, project timeline and stakeholder collaboration process.

Eco-Hydrological principle of integration e.g. mechanism that can merge co-ordination and seek cooperation not only across sectors, but also political and administrative borders.

Category: Operational project
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- Lake Briefs Report Series No. 2
LAKE BRIEFS REPORT SERIES NO. 2

1. Tasik Bera, Pahang - PERHILITAN
2. Paya Indah Wetland, Selangor - PERHILITAN
3. Empangan Semberong, - JPS
4. Empangan Beris, - JPS
5. Tasik Ringlet, Pahang - TNB
6. Tasik Chenderoh, Perak - TNB
7. Empangan Kelang Gate, Selangor - LUAS
8. Empangan Sungai Selangor, Selangor - LUAS
NEXT:
SEMINAR ON LAKE BRIEFS
SERIES NO: 2

03 - 04 MAY 2011

OR

10 – 11 MAY 2011

ILEC MEMBERS ARE WELCOME

OTHER MEMBERS ARE WELCOME TOO!
TERIMA KASIH

Thank You