STRENGTHENING INTEGRATED LAKE BASIN MANAGEMENT IMPLEMENTATION IN MALAYSIA THROUGH RESEARCH FRAMEWORK

Dr. Zati Sharip

National Hydraulic Research Institute of Malaysia / Academy of Sciences Malaysia

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INTRODUCTION

- Managing waterbodies such as lakes, reservoirs and ponds has been one of the agendas of Malaysia to ensure the waterbodies continue to provide ecosystem services and water security.
- The integrated lake basin management (ILBM) approach has been adopted by Malaysia during the preparation of a strategic plan in to address the lake eutrophication issues.
- This management approach was also included in the National Water Resources Policy 2012 as one of the management approaches for managing lakes and reservoirs in the country.
- National Policy framework: "***Lakes and reservoirs will be sustained, restored and protected through the adoption of an Integrated Lake Basin Management (ILBM) approach***"

Historical Events – Towards Sustainable lake Ecosystem

Developing the strategic plan for sustainable lake basin management in Malaysia

Preparing a more detailed action plans and governance instruments

Implementing the strategic plan

BLUEPRINT FOR LAKES AND RESERVOIR R&D

- **Objective: to prepare a common research framework and identify research areas much needed to support lake management**
- **Scope:**
  1) **Re-assessing the major issues and challenges**
  2) **Identify research clusters and interdisciplinary research**
  3) **Identify lakes requiring integrated research**
- **Methodological for development of blueprint**
  1) **Desk review of the major issues and challenges**
  2) **Stakeholder engagement**

Major Issues: Eutrophication and sedimentation

Eutrophic-Hypereutrophic

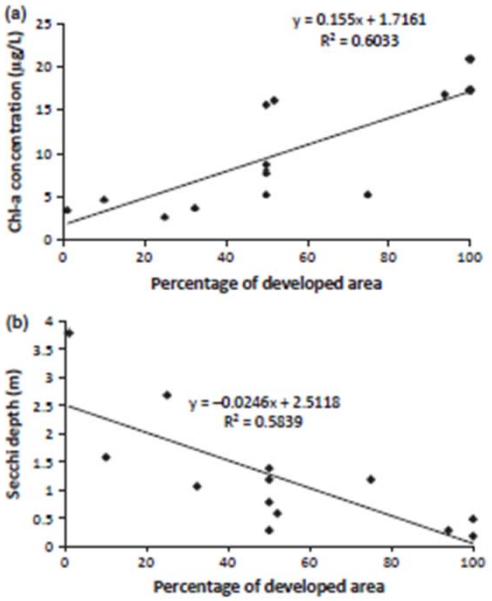


Fig. 2. Relationship between (a) mean chlorophyll-a concentration and (b) Secchi depth, with percentage of developed area in the catchment.

- Biological productivity increases with percentage of developed area in the catchment
- Water transparency decreases with percentage of developed area in the catchment

From:
Sharip et al (2014), Lakes of Malaysia: Water quality, eutrophication and its management. *Lakes & Reservoirs: Research & Management* 19 (2), 130-141

Major Issues: Inadequate biodiversity information and invasive species threats

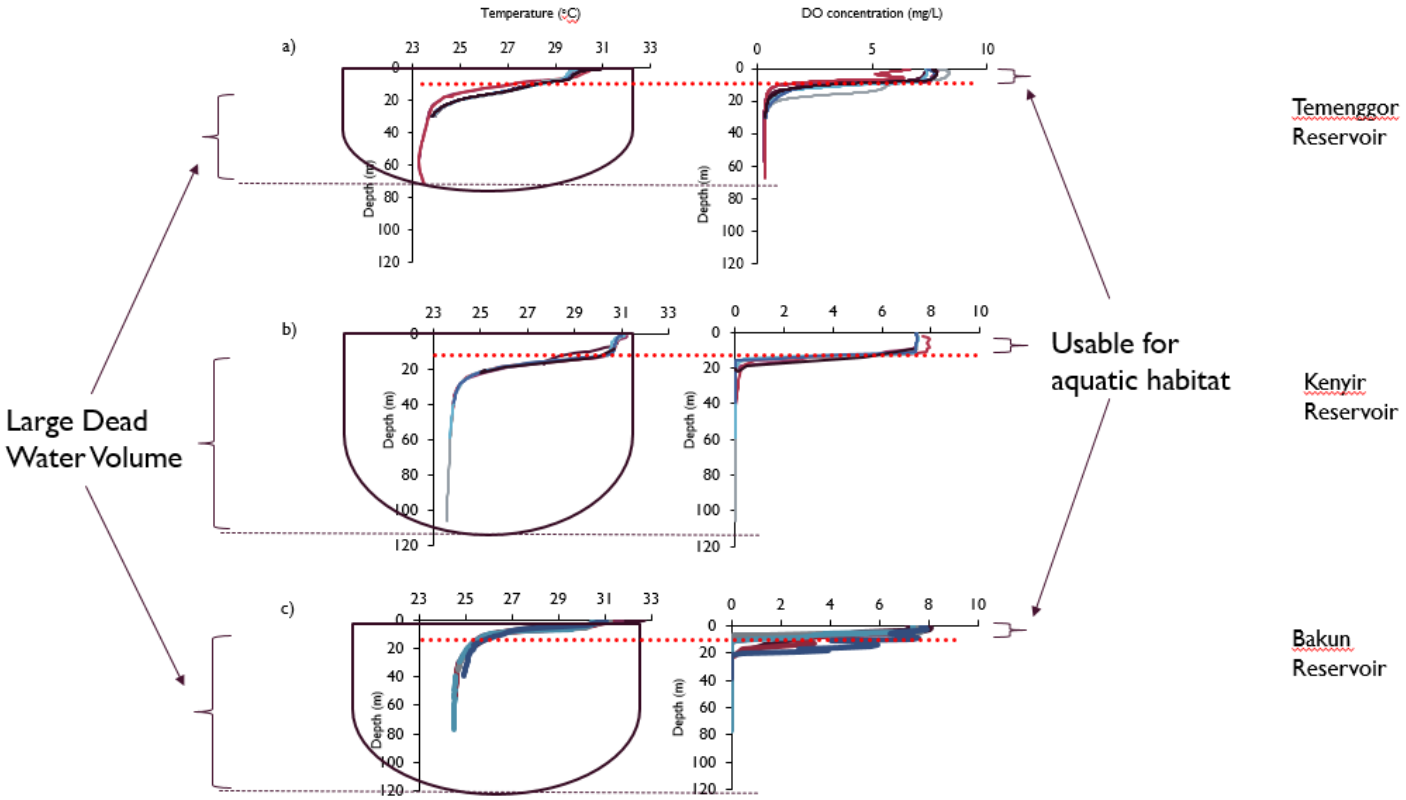
- Inadequate information of aquatic Biodiversity (aquatic plants, fish communities)

- Proliferation of non-native species
  - Plant: water hyacinth, fanwort (*Cabomba furcata*), water thyme (Hydrilla sp.), hornwort
  - Fish: tilapia, peacock bass, arapaima

Major Issues: Ecologically unfriendly dam designs

Dam Design:

- Represent barriers to fish migration
- Create permanent stratification - makes only the top ~10 -15 m of water usable to support aquatic life.
- Bottom discharge from these dams is toxic
- Large dead water volumes; represent a significant loss of a strategically crucial asset for water resources.

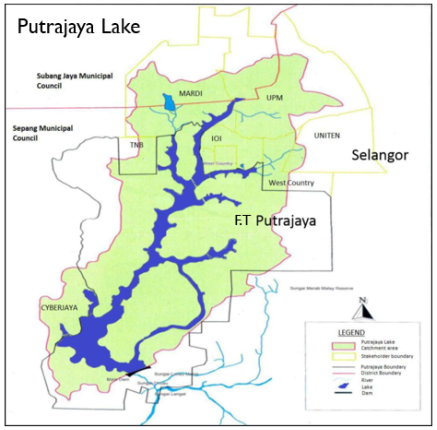


Sharip 2017, Stratification and Water Quality Variation in three Large Tropical Reservoirs. *International Journal of Ecology and Environmental Sciences*,43(3):175-184

Major Issues: Fragmentation of governance mechanisms attributed to state/federal jurisdictions & institutional mandates

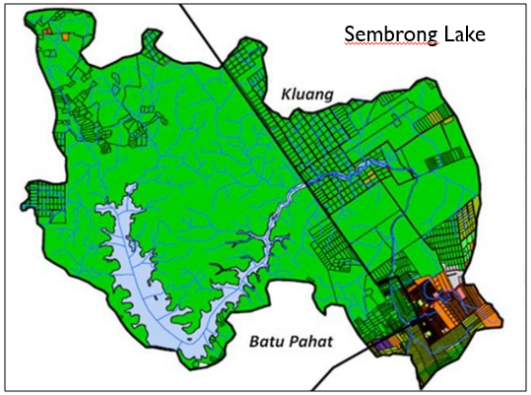
- Fragmented management been the biggest challenge in Integrated Management implementation
  - too many agencies with different institutional mandates; lack of a single management authority that can coordinate ILBM activities
  - the implementation of any Federal plan is subject to State's acceptance as management of land and water resources falls under their purview.
- Transboundary challenges remain as the drainage basin transcends over two countries/states/districts

Between states



Source: Majizat et al. (2016)

Between districts



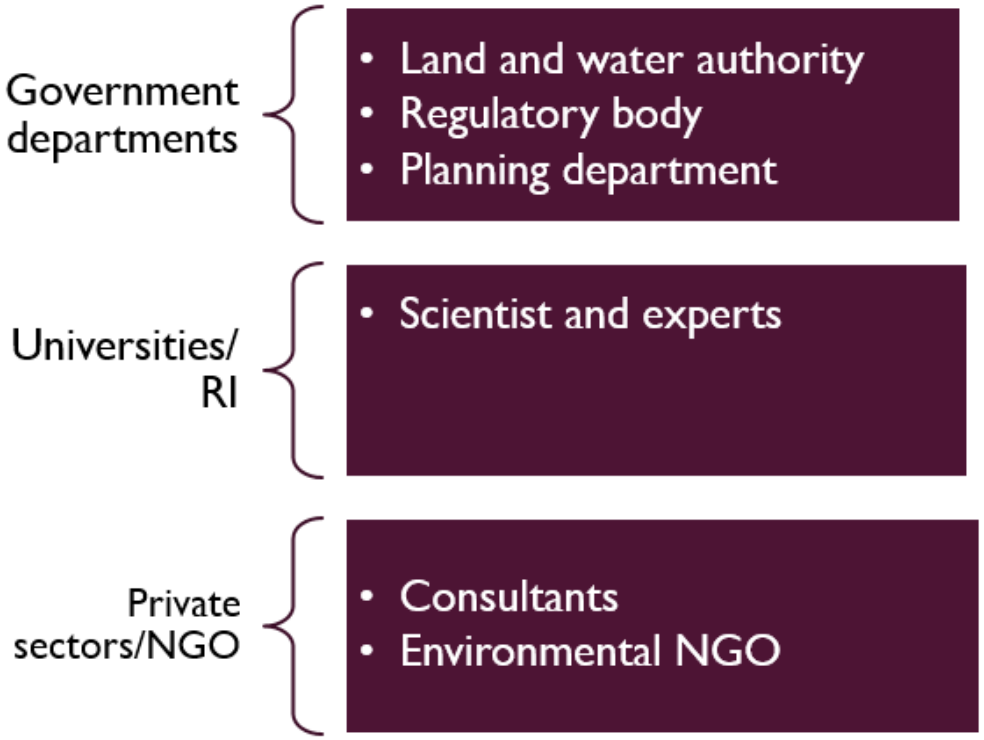
Source: NAHRIM (2016)

Major Issues: Lack of awareness of the economic value of lakes among administrators and users

Lack of awareness on the economic value of ecosystem services among lake administrator and user (public)

a. Lack of appreciation of ecosystem services i.e. unmindful on the impact of their use of lake ecosystem services or their activities to the lake
b. Insensible to the deterioration of water quality & lakes issues
c. Lack of corporate and social responsibility

Blueprint Development Process through Stakeholder Engagement



- Consensus between researchers and managers on
  - research goals and timelines
  - Focus disciplines and research program
  - Focus study areas and projects

STAKEHOLDER ENGAGEMENT PROCESS

RESEARCH CLUSTER

1. Governance
2. Biodiversity
3. Eco-hydrology
4. Socio-economic
5. Physical limnology
6. Water quality
7. Technology

Consultation

WORKSHOP

T1
T2
T3
T4
T5
T6
T7

Reconciliation of output

Draft Blueprint

Collaboration

RC RC RC

Final Blueprint

Presentation

2014 → 2015/2016

Note: RC=National Lake Research Committee

FINDINGS FROM WORKSHOP

Lake resources	• The need for greater understanding of the country's lake resources, including:
	  • Type, locations and volume
	  • The environmental services
	  • Historical and heritage values

Management strategies	• The need to look at lake management strategies in relation to:
	  • Optimising lake use by various management agencies without compromising the environmental services.
	  • Catchment management, spatial planning and land use.
	  • The totality of ecosystem services and their values - direct use values and indirect use values

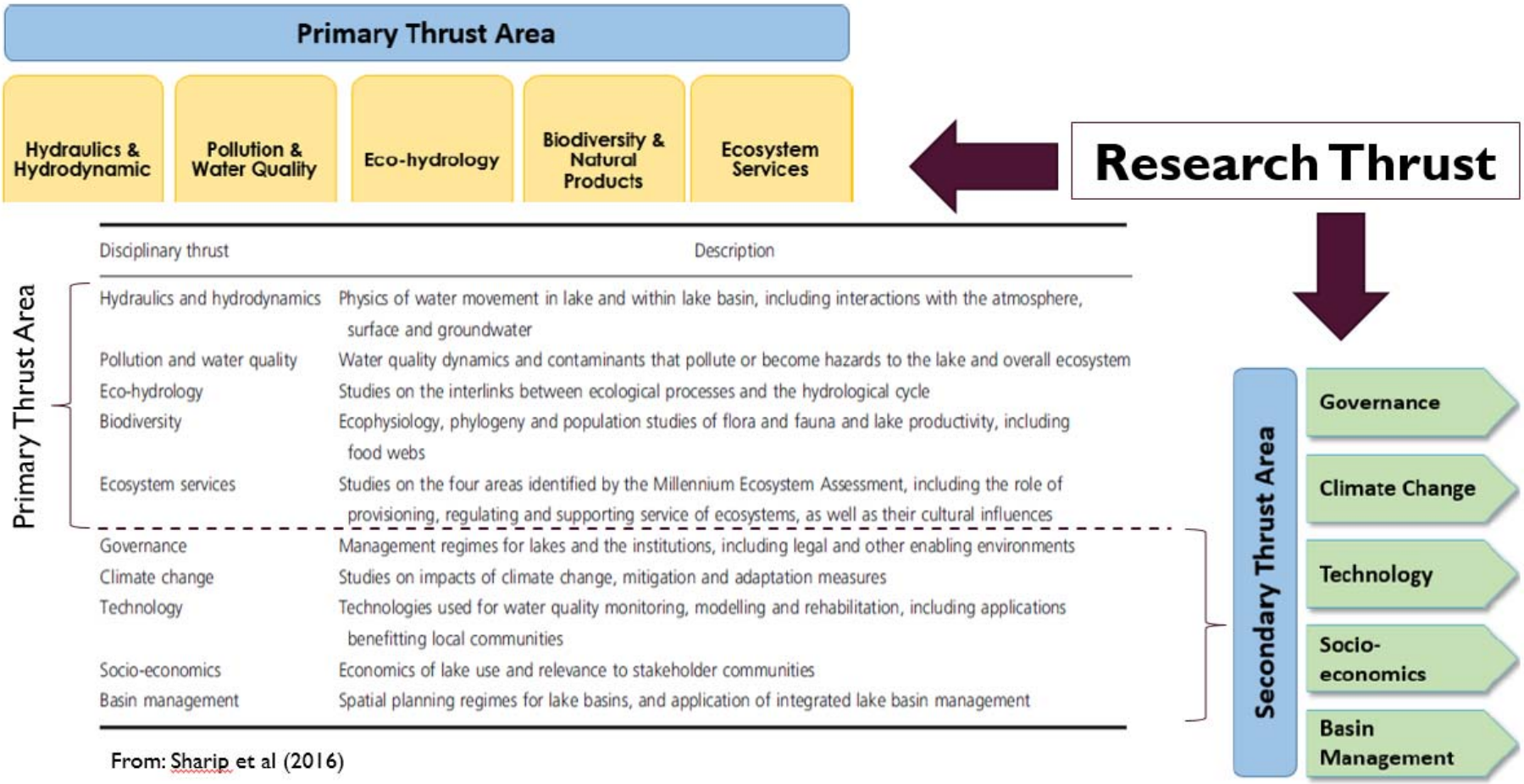
Governance	• Governance issues that needs to be addressed
	  • Establishing a Federal coordination mechanism that brings all lake managers together under a single umbrella
	  • Incorporating lake management prerogatives as part of statutory plans
	  • Addressing current deficiencies in the legal regime

Awareness and public perceptions	• The need to emphasise awareness and public perceptions of lakes and their management including:
	  • Awareness among the general public - value and importance of lakes
	  • Awareness among lake managers - threats to lake environments
	  • Awareness among senior planners - economic values of lakes
	  • Awareness among politicians - strategic value and importance of lakes

ILBM RESEARCH PHILOSOPHY AND AREAS

- Demand-driven research for sustainable governance and management:
  - ❑ Ecosystem services and socio-economic
  - ❑ Governance
- Application of basic research for determining carrying capacity
  - ❑ water quality and pollution
  - ❑ physical limnology and hydrodynamic
- Sustainable lake resources management based on ecosystem approaches
  - ❑ biodiversity and natural products
  - ❑ eco-hydrology and basin management
- Innovation and sustainable rehabilitation and management
  - ❑ Sustainable technology

From: Sharip *et al.* (2016)



	Disciplinary thrust	Description
Primary Thrust Area	Hydraulics and hydrodynamics	Physics of water movement in lake and within lake basin, including interactions with the atmosphere, surface and groundwater
	Pollution and water quality	Water quality dynamics and contaminants that pollute or become hazards to the lake and overall ecosystem
	Eco-hydrology	Studies on the interlinks between ecological processes and the hydrological cycle
	Biodiversity	Ecophysiology, phylogeny and population studies of flora and fauna and lake productivity, including food webs
	Ecosystem services	Studies on the four areas identified by the Millennium Ecosystem Assessment, including the role of provisioning, regulating and supporting service of ecosystems, as well as their cultural influences
Secondary Thrust Area	Governance	Management regimes for lakes and the institutions, including legal and other enabling environments
	Climate change	Studies on impacts of climate change, mitigation and adaptation measures
	Technology	Technologies used for water quality monitoring, modelling and rehabilitation, including applications benefitting local communities
	Socio-economics	Economics of lake use and relevance to stakeholder communities
	Basin management	Spatial planning regimes for lake basins, and application of integrated lake basin management

From: Sharip et al (2016)

Subject in need of research	Example of much needed research projects	Research outcomes
Sustainable lake development and conservation governance	Development of sustainable governance framework for lake conservation and development	Uniform standards and practices for sustainable lake conservation and development
Ecosystem services and stakeholder management directed towards sustainable lake development	Trade off analysis between lake management, proposed development project and ecosystem services	Human population understanding and identifying the importance of lakes
Water quality status and classification of water bodies	Effect of land use changes on water quality	New corpus of knowledge on water quality in catchment areas and lakes
Physical limnology and hydraulic modelling	Determination of carrying capacity	Determination of rehabilitation and management measures
Eco-hydrology and basin management	Identification & control of non-point source pollution from lake basins; Determination of soil erosion and sedimentation rate	Sustainable lake resources management; Implementation of best land-use management practices
Sustainable biodiversity assessment and development of natural products	Potential of freshwater resources as source of novel products; Freshwater macrophytes and terrestrial plants conservation, function, ecology and diversity	New resource recovery products for the nutraceutical and pharmaceutical industry; Effective management and conservation of terrestrial plant, invertebrate fauna, macrobenthos, avifauna and wetland
Treatment and lake water quality improvement using green technology	Lake remediation studies	Restoration and rehabilitation of lakes and reservoirs

From: Sharip *et al.* (2016)

FOCUSED AREAS

- 30 lakes of different depth, size, status and issues covering each state of Malaysia

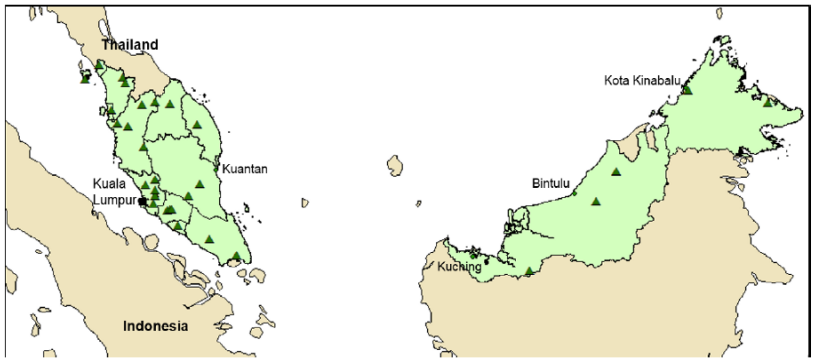


Fig. 2. Location of study lakes (Triangles).

From: Sharip *et al.* (2016), A national research and development blueprint for sustainable lake basin management in Malaysia. *Lakes & Reservoirs: Research & Management* 21: 269-283

State	Lakes	Issues	Depth, size, status
Perlis	Timah Tasoh	Catchment pressures, water quality issues	S, L, E
Kedah	Pedu	Catchment pressures, water quality issues	D, L, E
	Muda	Catchment pressures, water quality issues	D, L, M
	Dayang Bunting	Uniqueness, tourism potential	S, S, M
Penang	Mengkuang	Catchment management	D, L, E
Perak	Chenderoh	Catchment pressures, artisanal fishing	D, L, E
	Temenggor	Catchment pressures, recreational fishery and aquaculture	D, L, M
	Bukit Merah	Catchment pressures, multiple function, fish sanctuary	S, L, E
Selangor	Sg Selangor	Water shortage problems	D, L, M
	Batu	Catchment pressures	D, L, M
	Bestari Jaya (Horas 600)	Alternative water resources	D, L, n.a
Kuala Lumpur	Tasik Botani Perdana	Catchment pressures, water quality issues	S, S, n.a
Putrajaya	Putrajaya	Catchment pressures	S, L, M
Negeri Sembilan	Sg Terip	Water shortage problems	D, L, E
	Kelinchi	Water shortage problems	D, L, E
	Upper Muar	Water shortage problem, catchment pressures	D, L, E
Melaka	Durian Tunggal	Catchment pressure, water shortage problems	S, L, E
Johor	Sembrong	Catchment pressure, algal and macrophyte blooms, multiple functions	S, L, E
	Layang	Catchment pressure, water quality issues	S, L, E
Pahang	Ringlet	Catchment pressure, sedimentation, macrophyte blooms	S, S, E
	Chini	Uniqueness, catchment pressure, infestation of non-native macrophytes	S, S, E
	Bera	Uniqueness, catchment pressure, support biodiversity	S, L, E
Terengganu	Kenyir	Catchment pressures, tourism potential, recreational fishery and aquaculture	D, L, E
Kelantan	Pergau	Catchment pressure	D, L, M
	Tok Uban	Uniqueness	S, L, n.a
Sabah	Babagon	Catchment pressure	D, L, M
	Danau Pitas	Uniqueness, support biodiversity	S, S, n.a

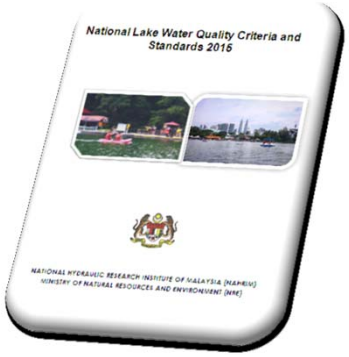
depth: S, shallow; D, deep; size: S, small; L, large; status: M, mesotrophic/medium; E, eutrophic/poor; n.a, not available.

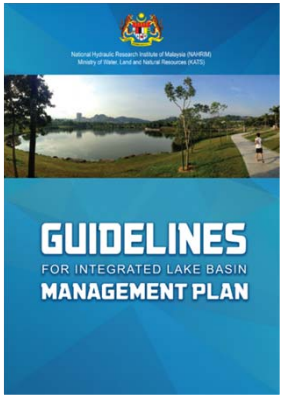
IMPLEMENTING PHASES

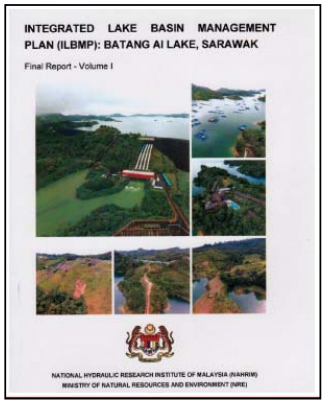
- To support research and management of lakes
  - A standardized criteria based on lakes uses (2015) was approved for implementation in August 2017.
- The standard promotes monitoring of parameters important for lakes and of concern to human health or ecosystem.

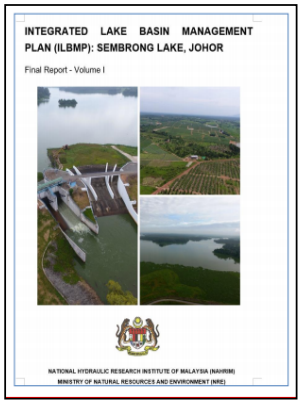
- Developed Integrated Lake Basin Management Plan for lakes listed in the research blueprint

- Developed Guideline for Developing Integrated Lake Basin Management Plan

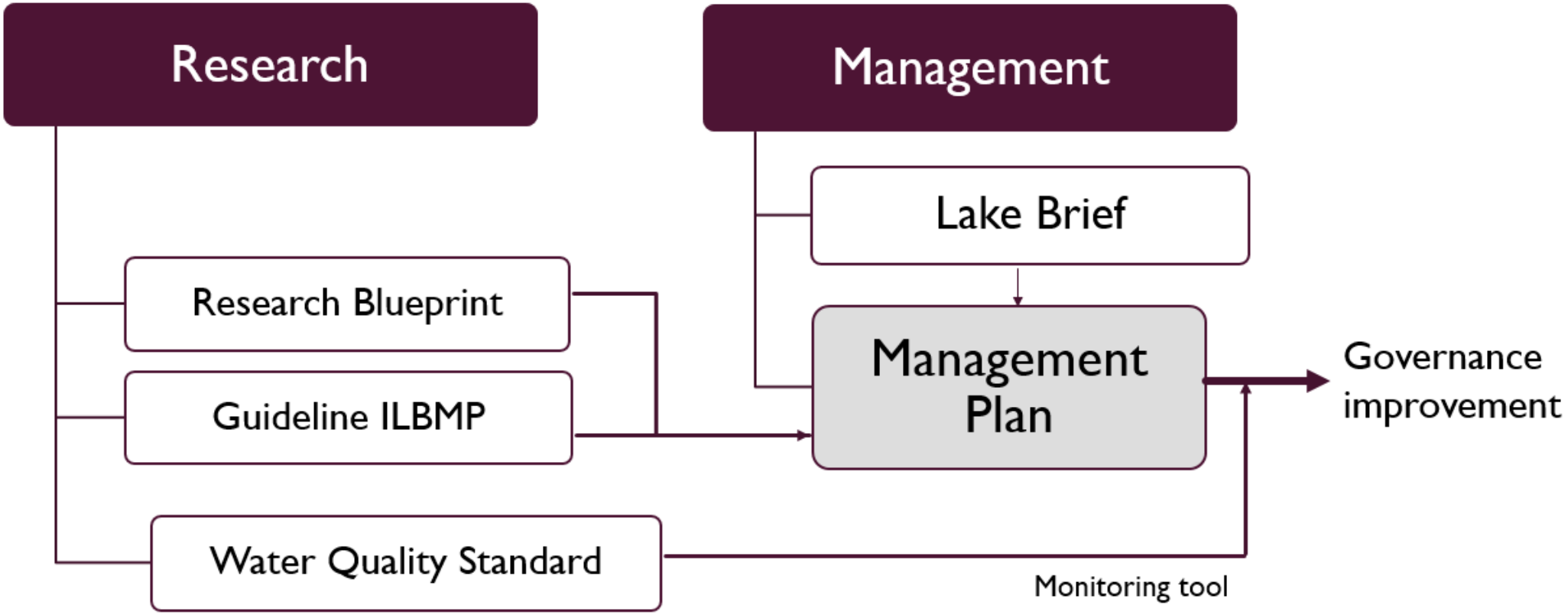








LINKAGES BETWEEN RESEARCH AND LAKE MANAGEMENT



GOVERNANCE IMPROVEMENT MANAGEMENT

- Management plan is generally a tool to aid in decision making and developing strategies for the management.
- A success in integrated lake basin management depends on the capacity of the targeted central authority to enhance their management role as well to understand the specific lake basin issues.
- Long term, adequate investments in R&D, rehabilitation and management

Conclusions

- ILBM implementation has evolved from strategic planning into implementing phases
- Integrated research framework to develop sound management plans based on ILBM principles are in place
- Implementing phase – Began with two lakes; Sembrong, Johor & Batang Ai, Sarawak
- Requires a long-term commitment from every stakeholder to achieve a common goal in managing lakes and their basins.
- Continuous efforts in monitoring, capacity building and awareness programmes at all levels of stakeholders

THANK YOU

zati@nahrim.gov.my; ztsharip1@gmail.com