Valuing wetland ecosystem services for sustainable management of Loktak Lake, Manipur, India

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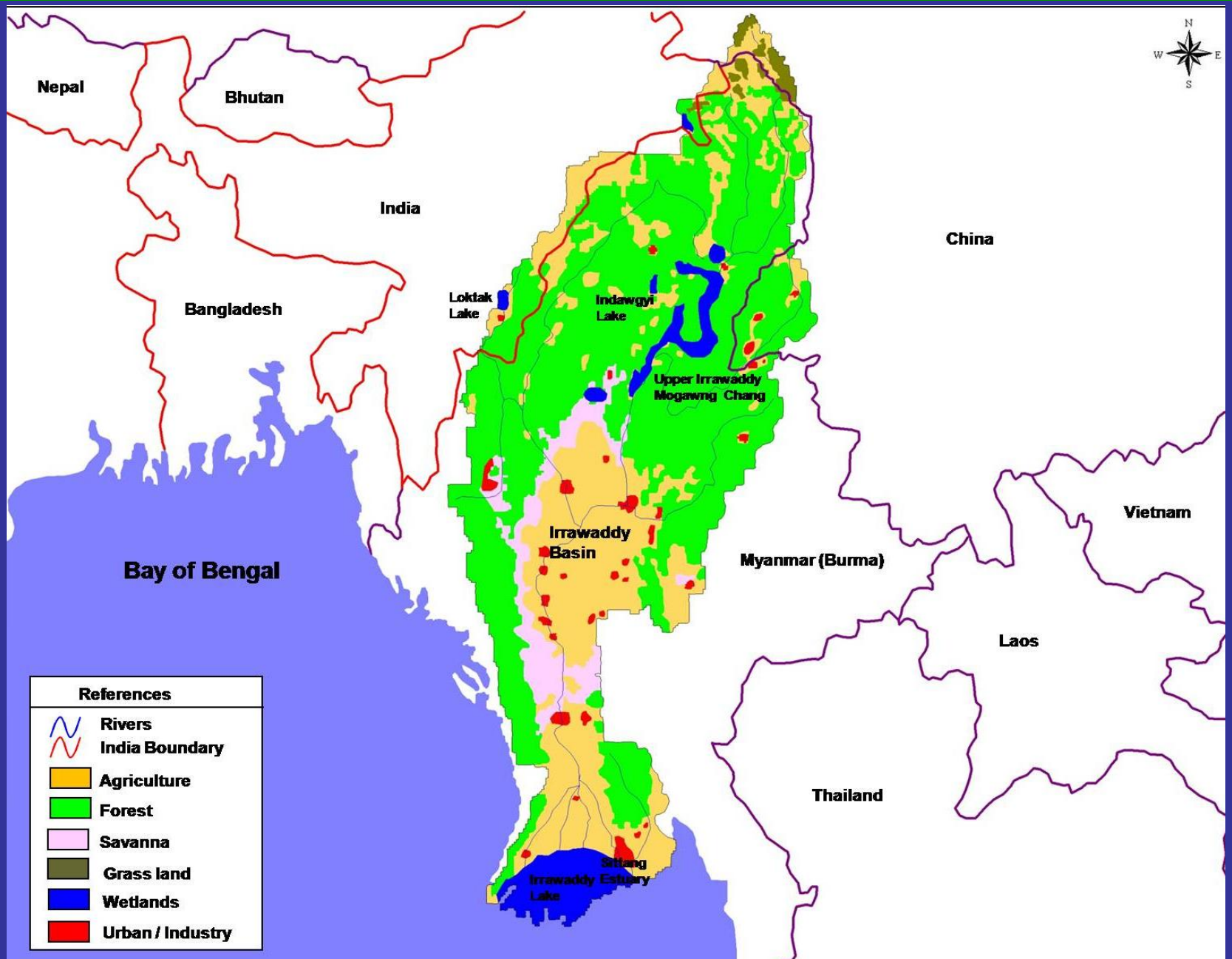
Loktak Wetlands within Manipur River Basin



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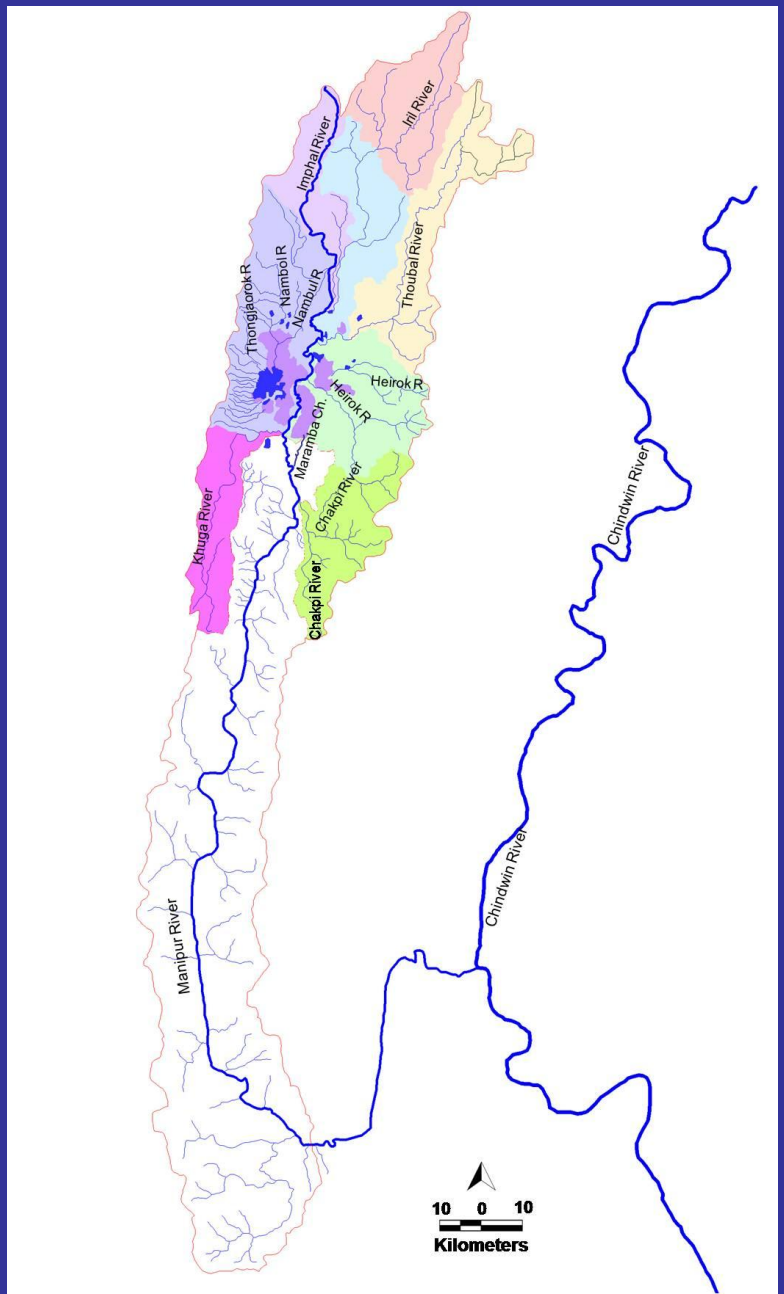
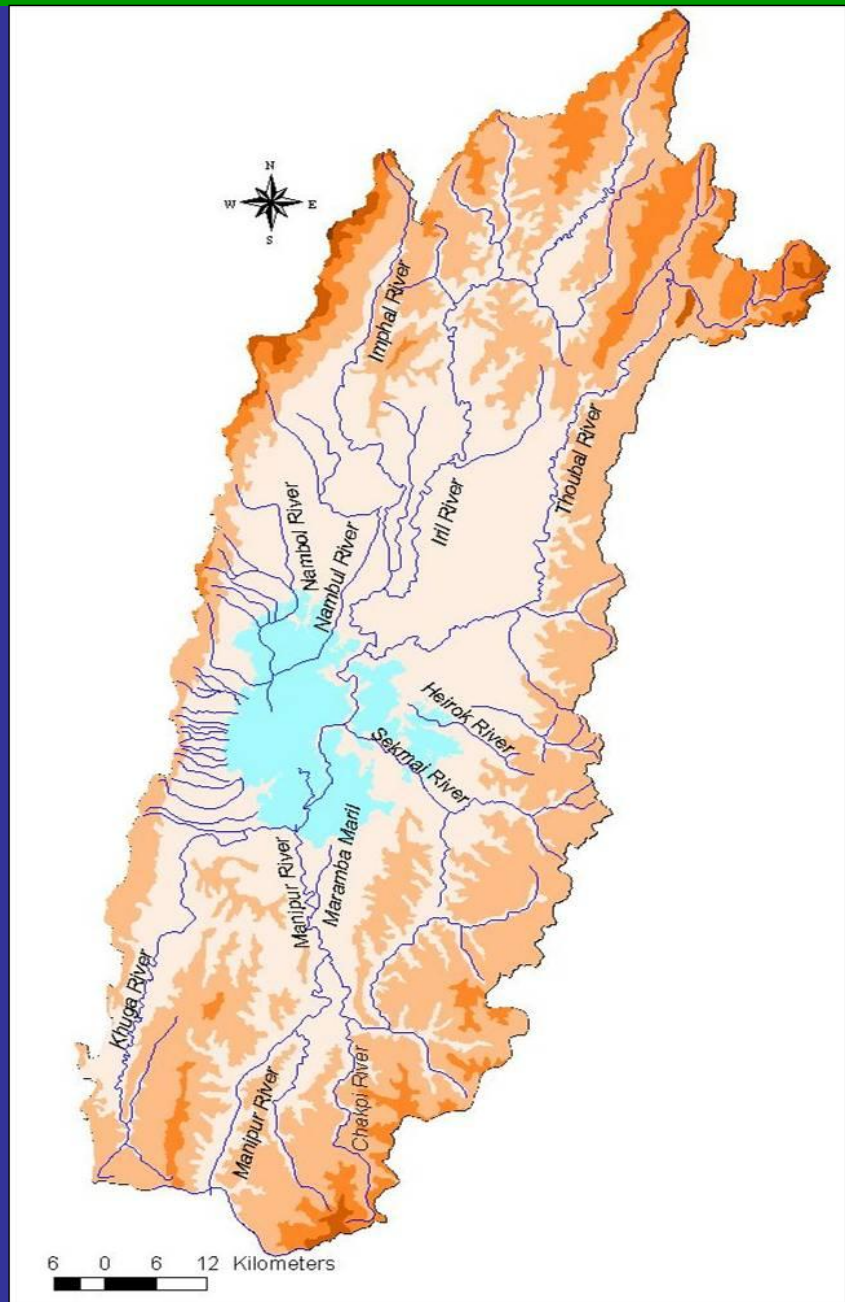
Loktak Wetlands within Manipur River Basin





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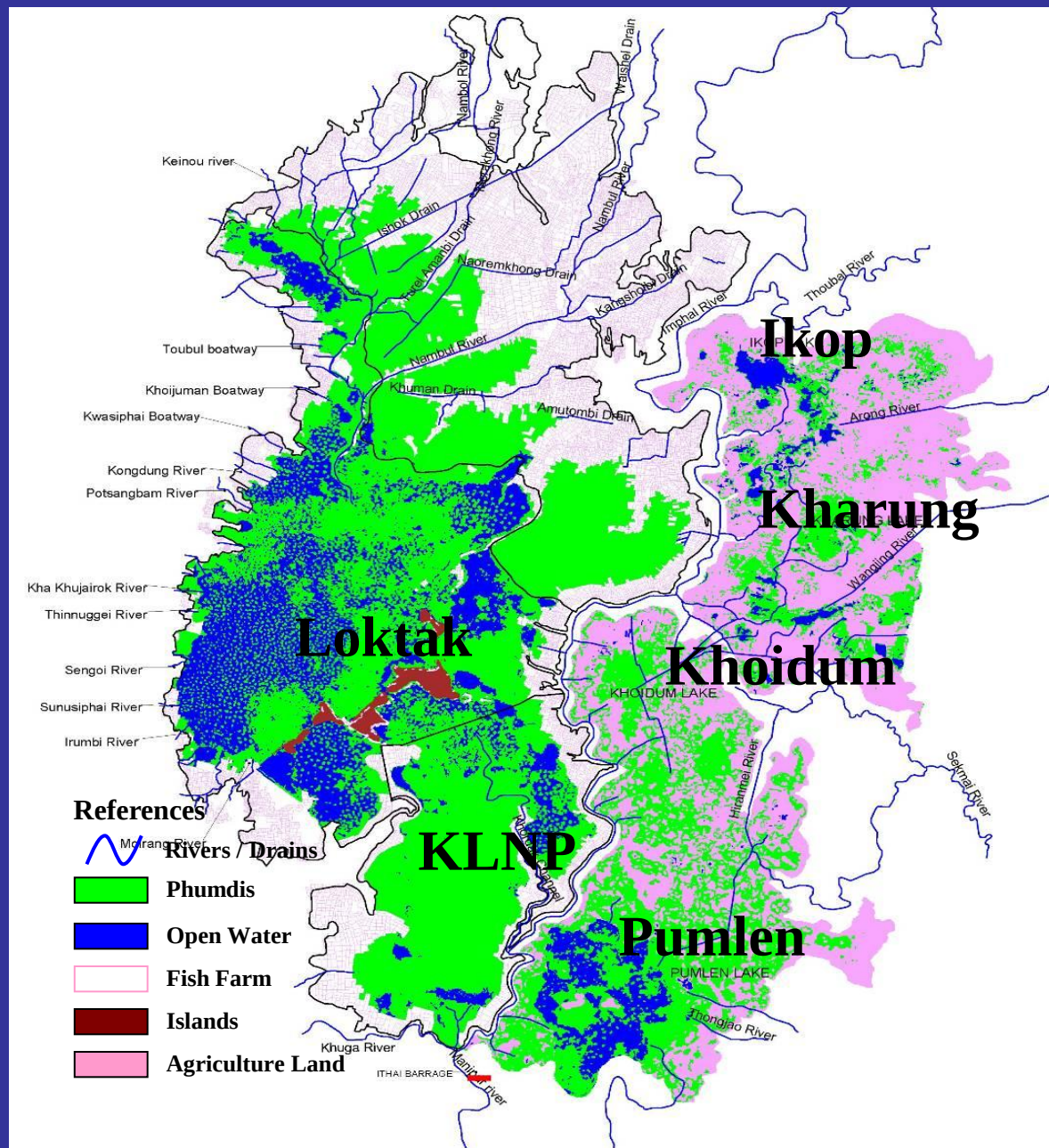
Wetlands of Manipur River Basin

- Floodplain wetlands extending to 469 sqkm
- Livelihood of 0.3 million people traditionally wisely used for fisheries and agriculture
- Loktak Lake largest wetland covering 61% of wetland area
- Occurrence of phumdi - characteristic feature
- Keibul Lamjao National Park (KLNP) habitat for *Rucervus eldii*



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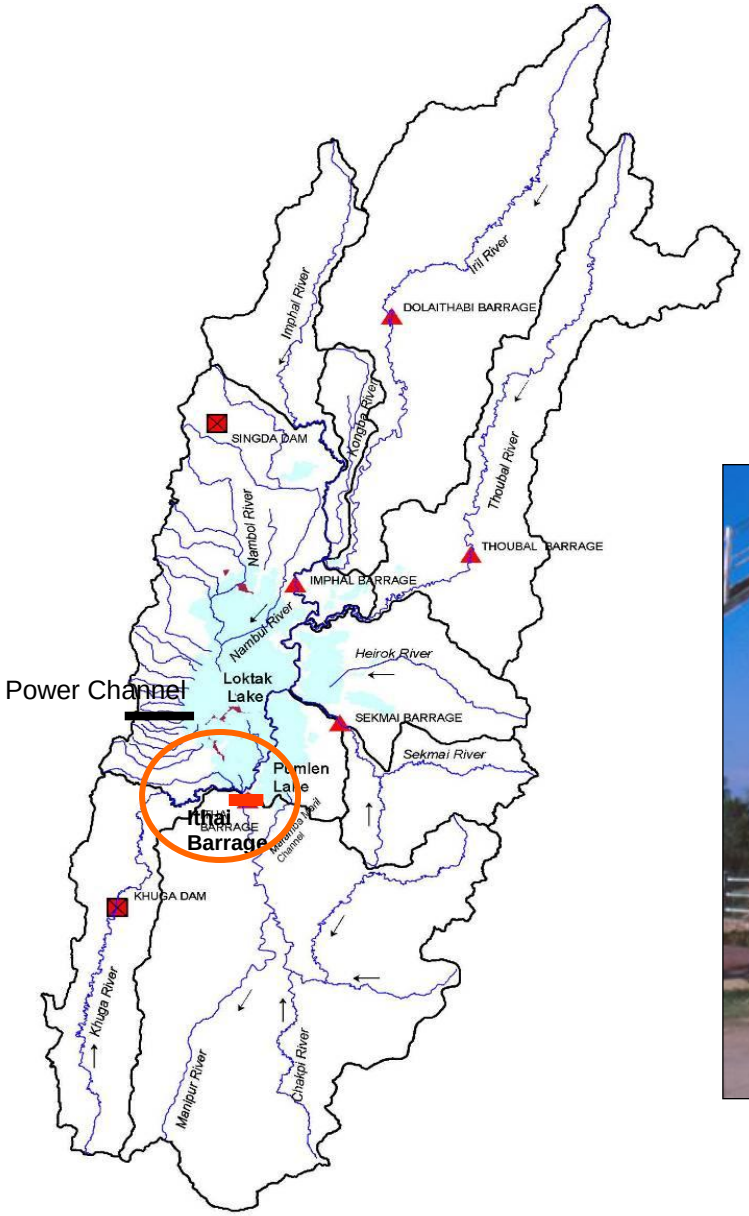
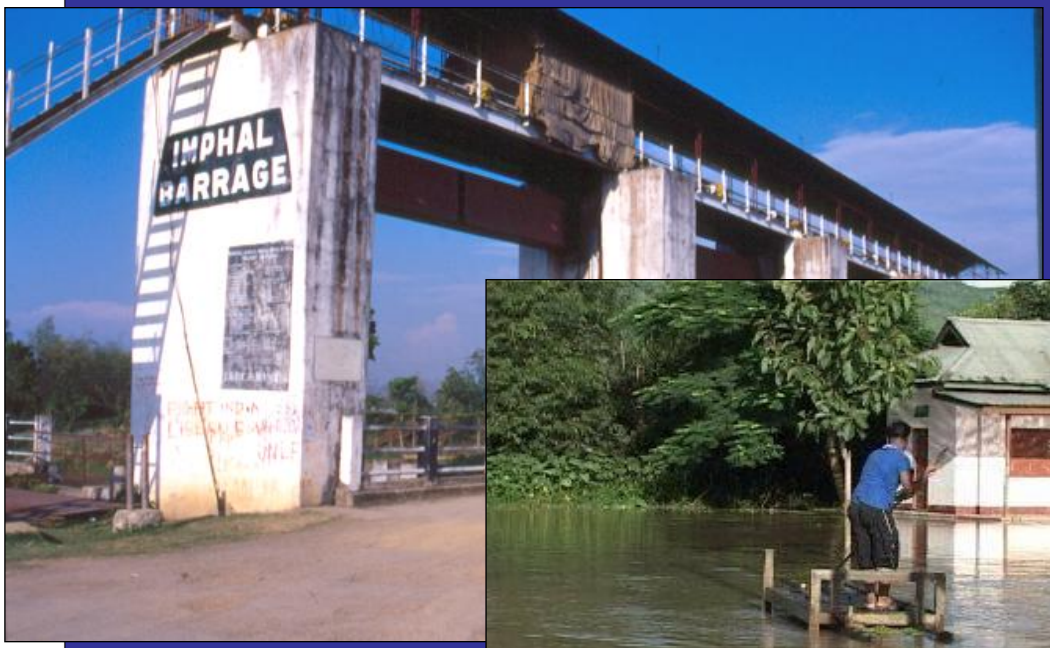
Developmental Planning



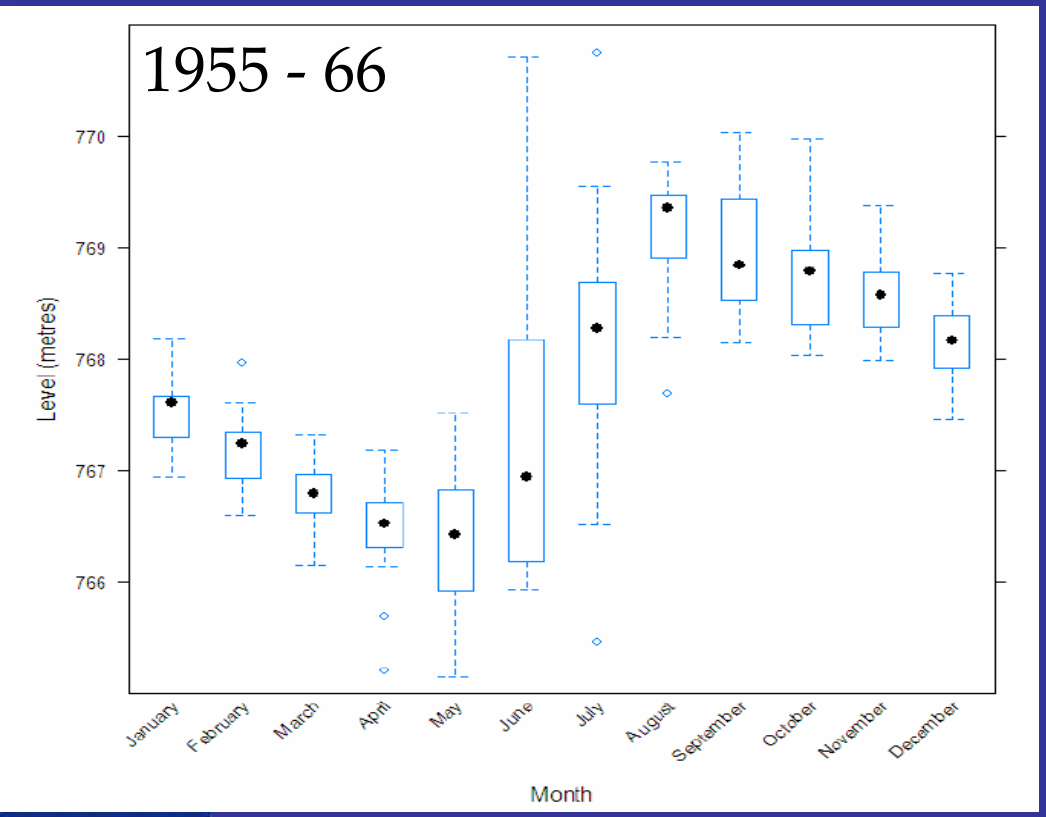
Hydraulic structures in MRB

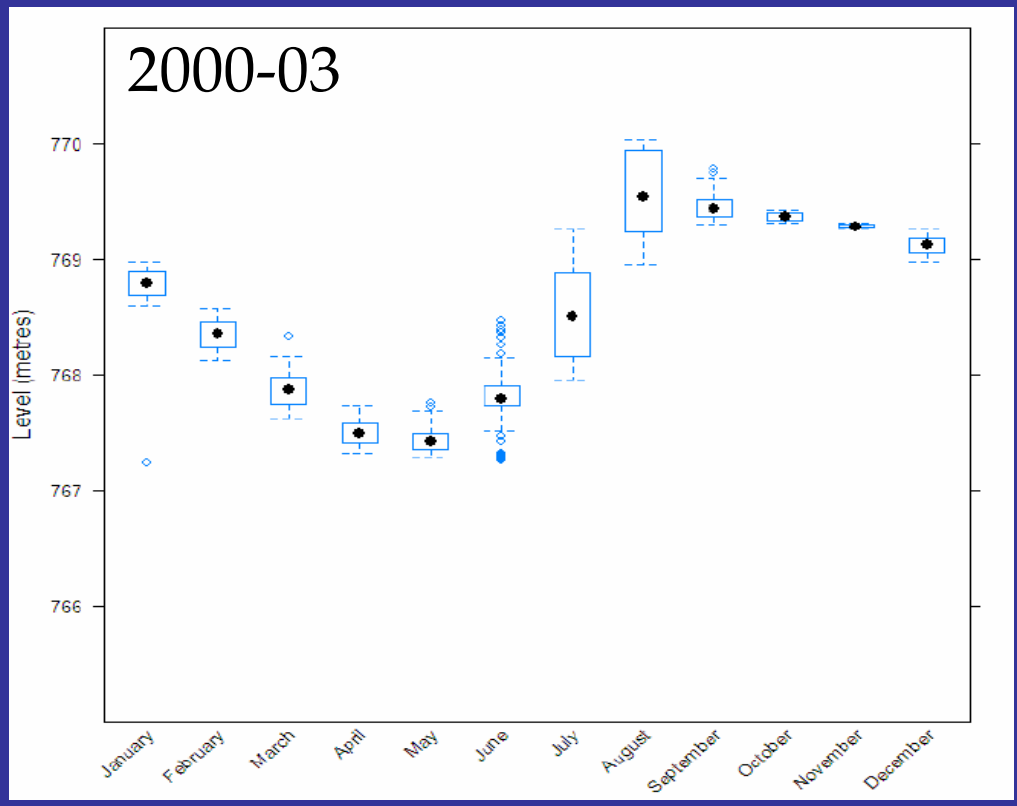
Regulation of hydrological regimes for flood mitigation, water for hydropower and irrigation



Impacts on wetland system

- *Catchment degradation leading to rapid soil erosion*
- *Loss of water holding capacity by 29% over last two decades*
- *Conversion of lake with fluctuating water levels into reservoir for hydropower generation*





Impacts on wetland system

- *Proliferation of phumdis*

1989 (54%)

116.4 sq km/84 sq km

217 Athaphums

1999 (59%)

2002 (74%)

134.6 sq km / 101.2 sq km

2,642 Athaphums

Communities' adaptation to high water levels :
Athaphum fishing

Number of Athaphums

1989 :	217
2002 :	2,642
2005 :	4,850

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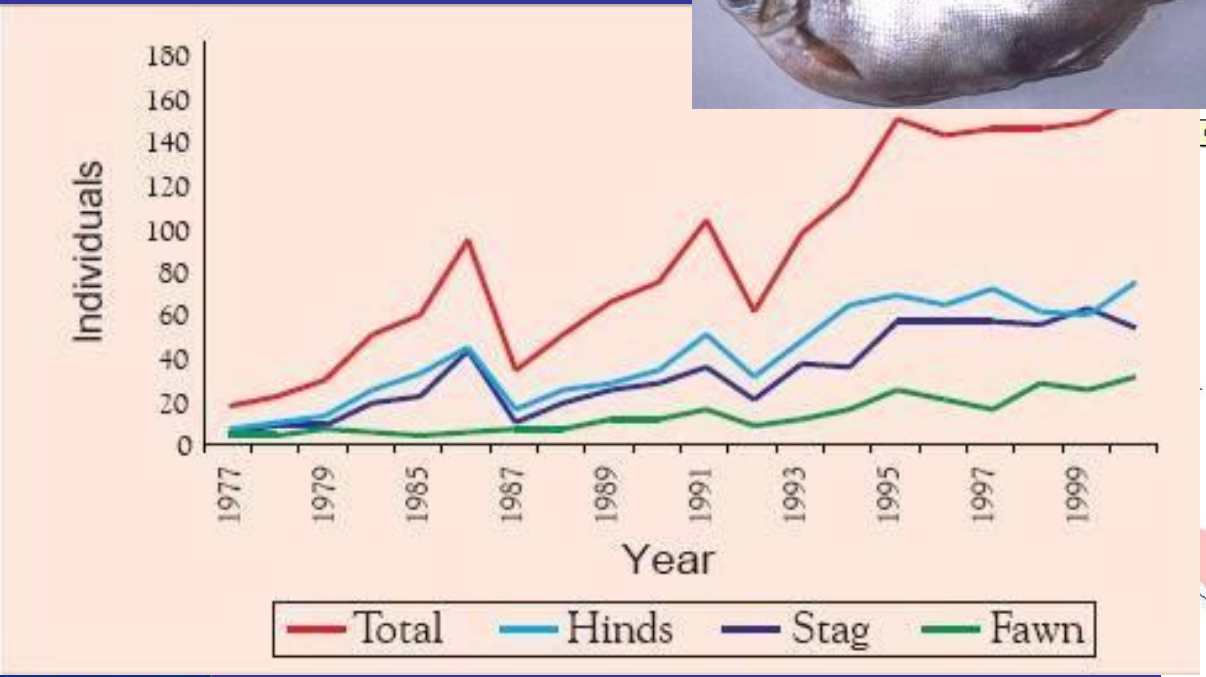
Impacts on wetland system

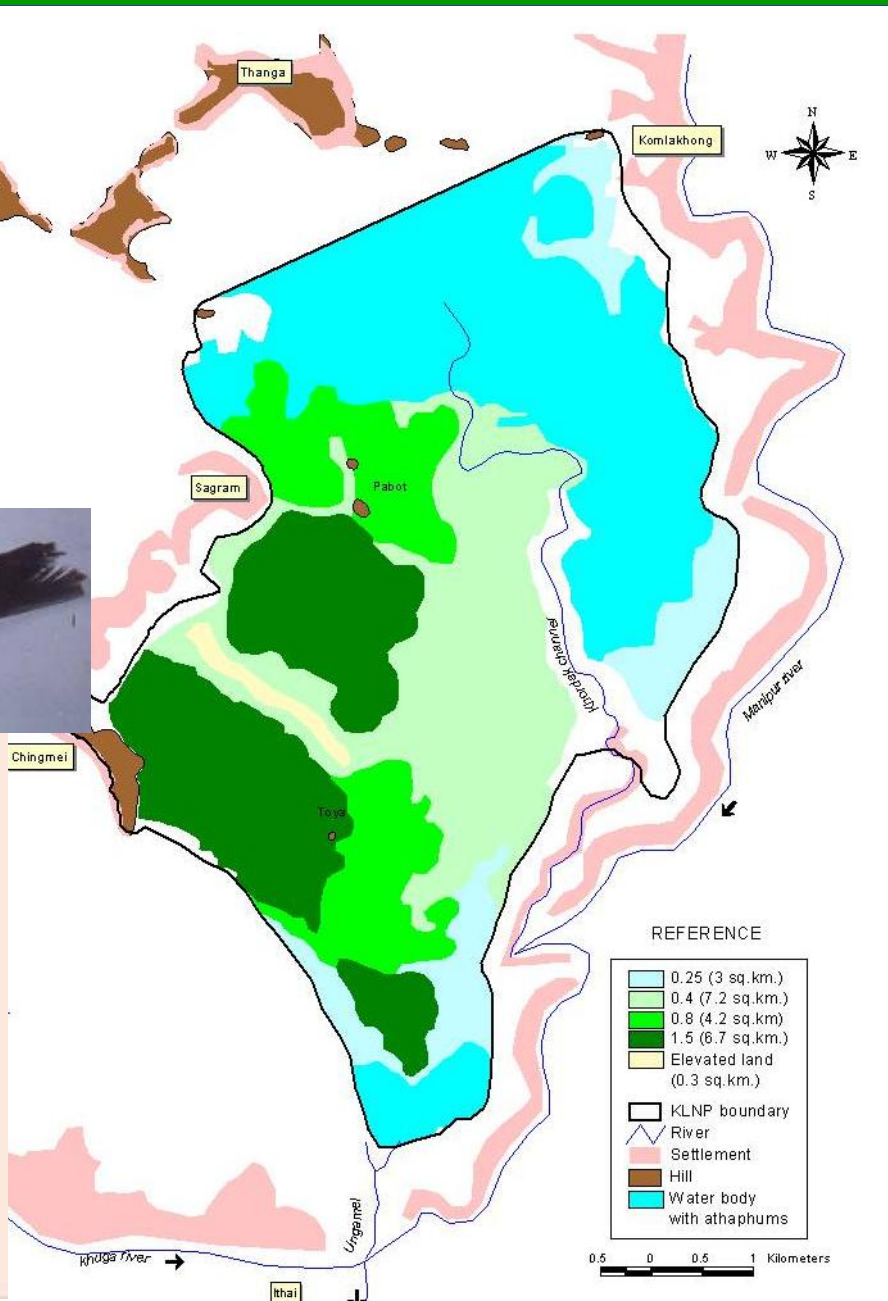
Impacts on lake biodiversity

8 fold increase in deer population, habitat reduced by 84%

Changes in species composition

Loss of migratory fish species



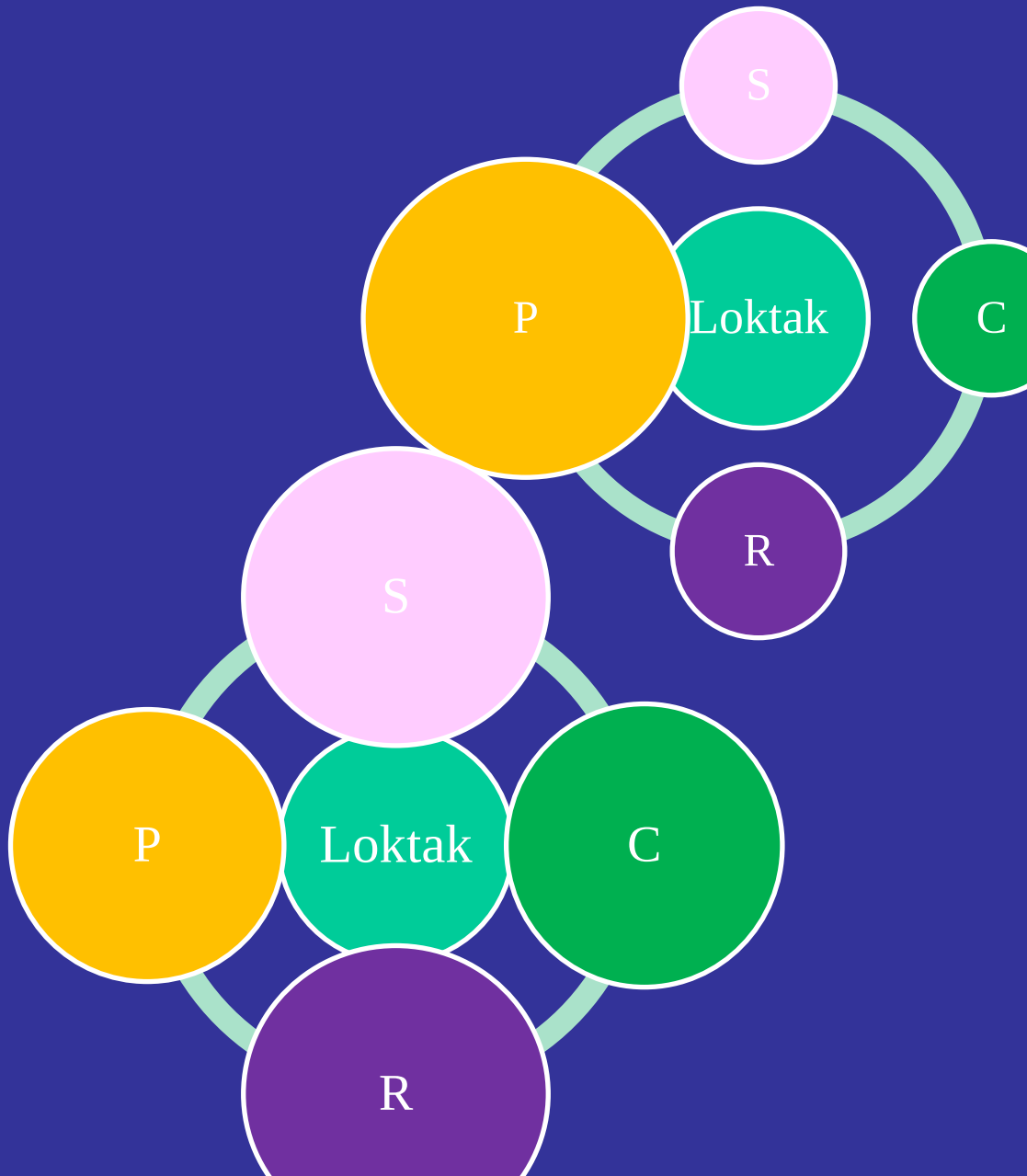


Economic Valuation

Support ***mainstreaming of Loktak ecosystem services into developmental planning processes***

Highlight the ***economic implications of current resource use pattern***

Provide options for ***rationalizing incentive systems supporting sustained provision of wetland ecosystem services***



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Recognizing ecosystem services

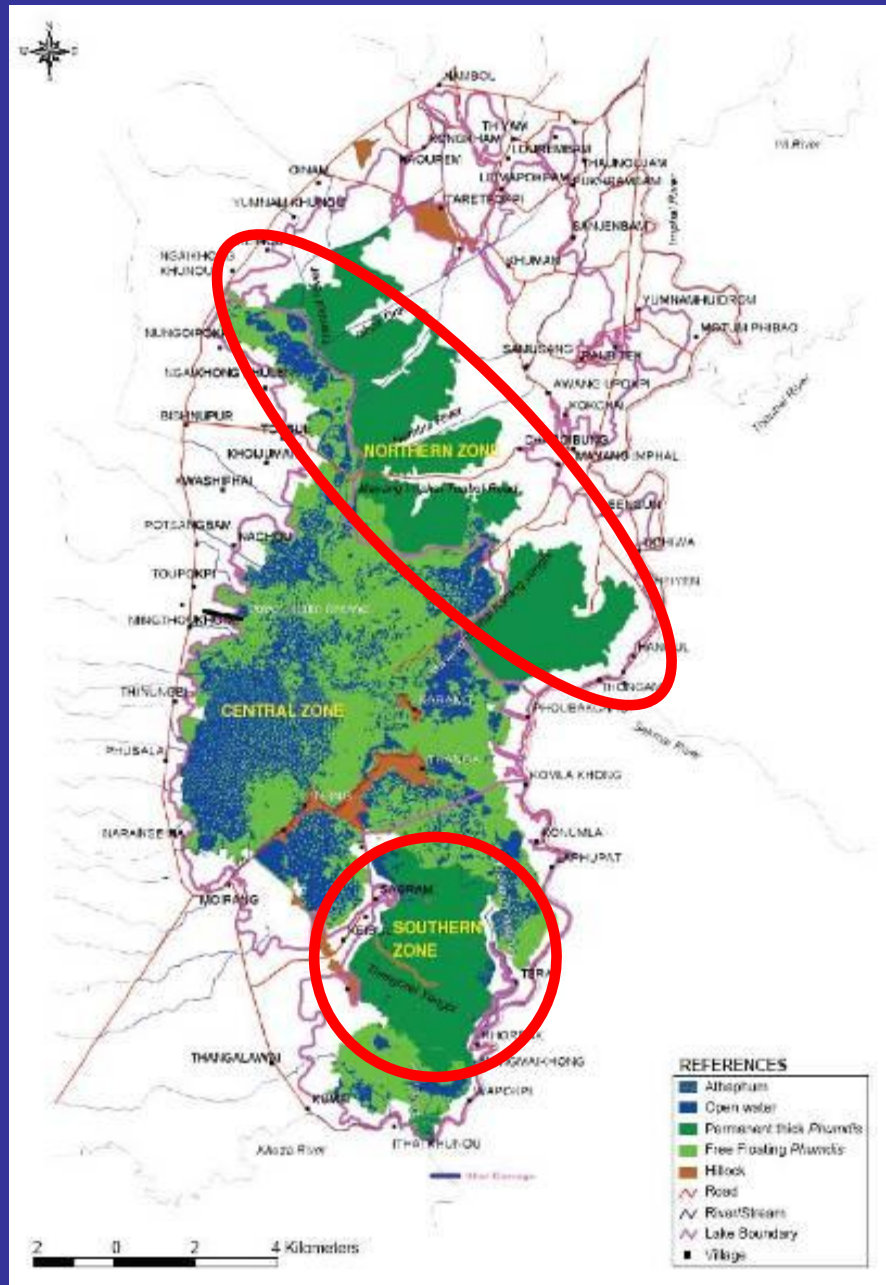
Food – Fisheries, Aquatic vegetation

Fiber for handicrafts

Water for hydropower generation

Nutrient retention

Cultural values



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Valuing ecosystem services

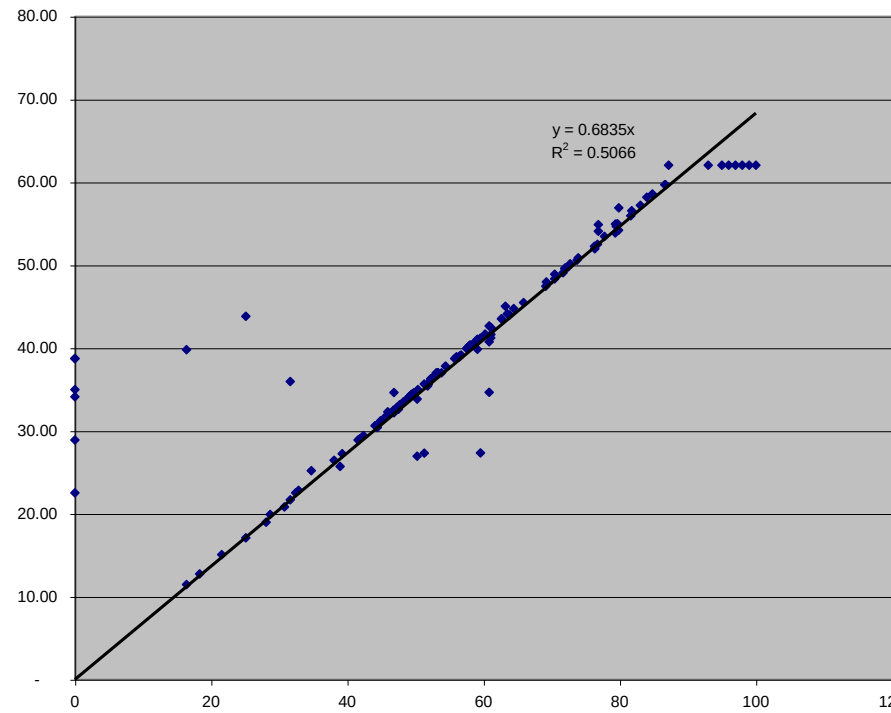
Water use for hydropower

Water from wetland as an input to hydropower production process

$$\ln(Y) = 0.866\ln(W) + 0.110\ln(M) + 0.178\ln(C)$$

Y = hydropower production (MW)
W = water usage (Mm^3)
M = costs of manpower (Rs.)
C = operational costs (Rs.)

Water for hydropower production accounts for 86% of value = US$ 5.16 m per annum



Valuing ecosystem services

Nutrient retention

Replacement cost using constructed wetland technique

Area required for achieving same level of nutrient removal fucntion = 3,100 ha

Capital cost = US$ 18,000 / ha

Operation cost = US$ 400 / ha at 1993 prices

Replacement cost = US$ 0.9 million / annum

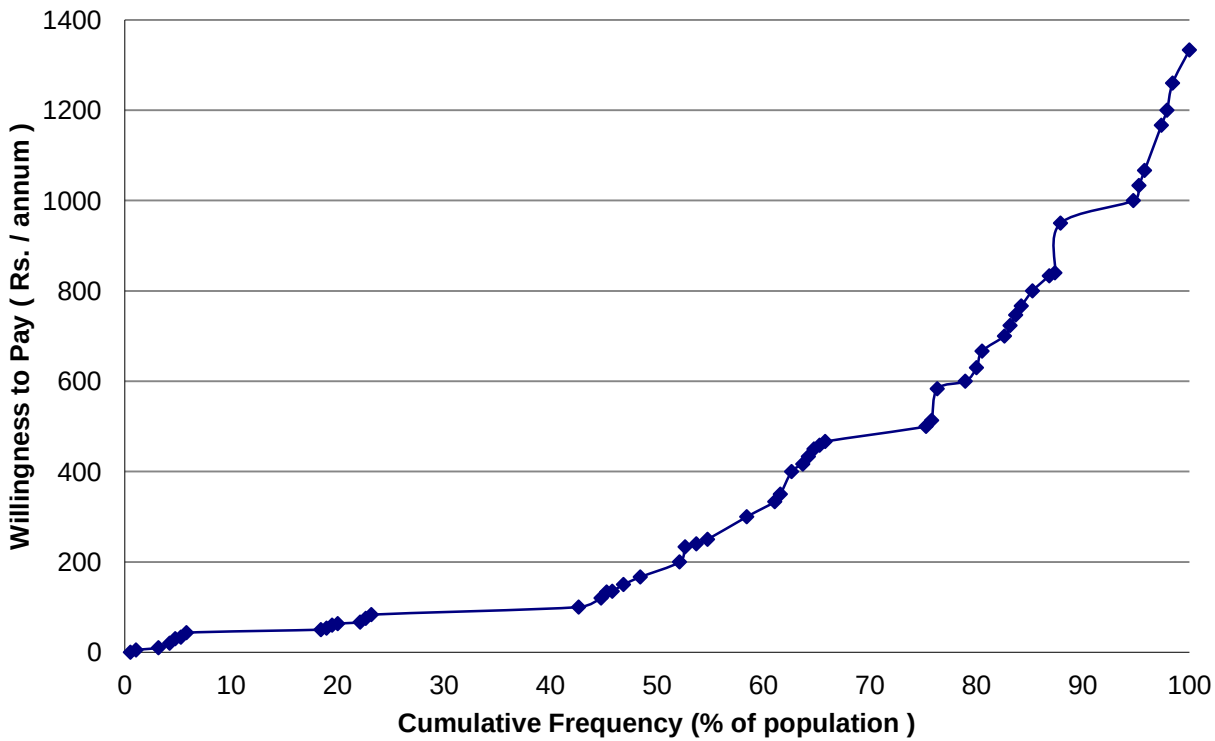
Valuing ecosystem services

Existence Values

Willingness to pay for non-use benefits

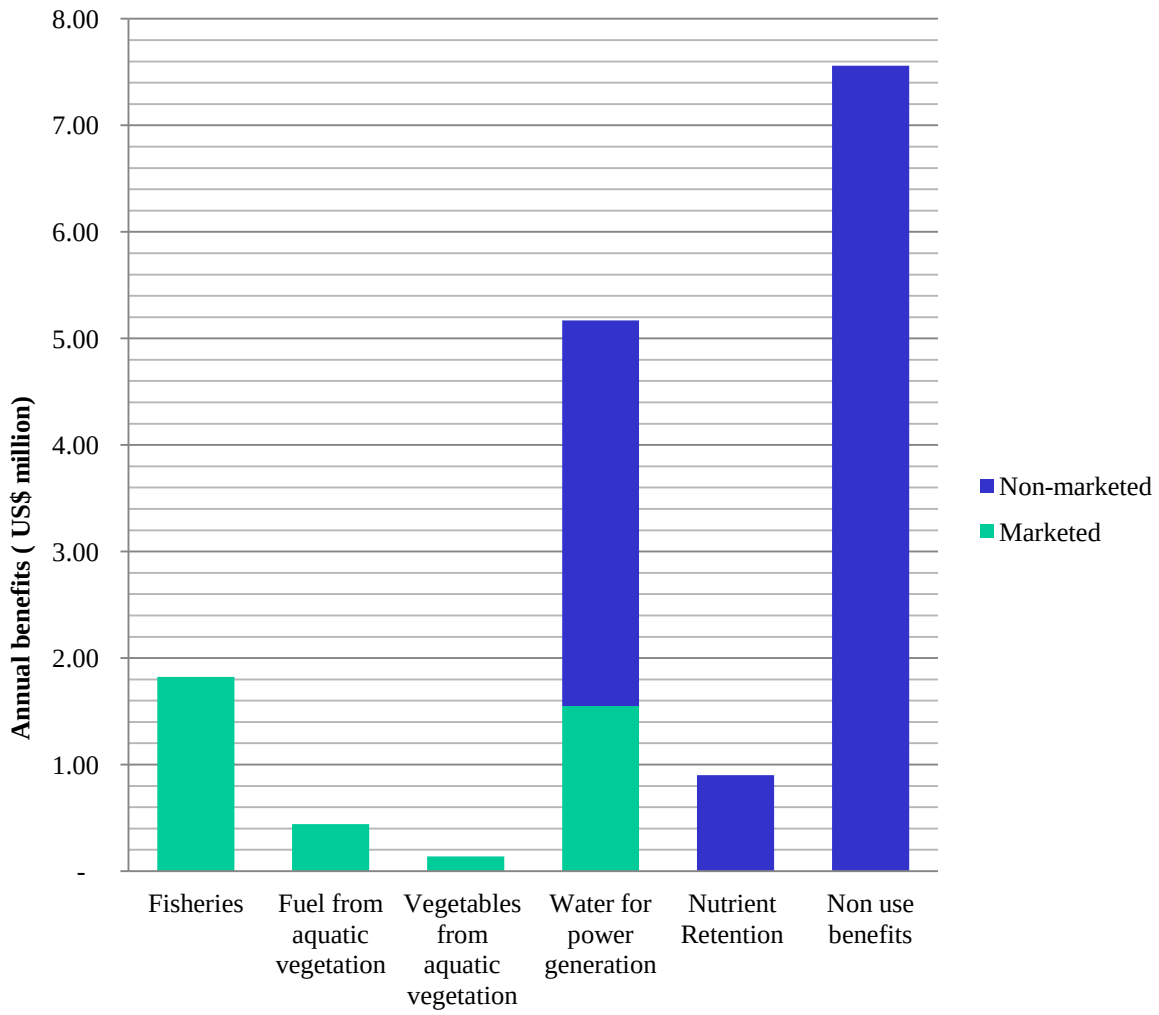
$$ln\,(WTP) = a + b_1 ln(income) + b_2\, ln(age) + b_3\, ln(HHSize) + b_4\, ln(impact) + b_5(change) + b_6\,(pers\_role) + b_7(gov\_role)$$

Annual value = US$ 7.56 millions



Valuing ecosystem services

- Non-use values comprise 47% of overall wetland benefits
- Water use for power generation dominates wetland uses accounting for 73% of direct benefits
- Underestimation of contribution of hydrological and ecological functions primary reason for under allocation of resources



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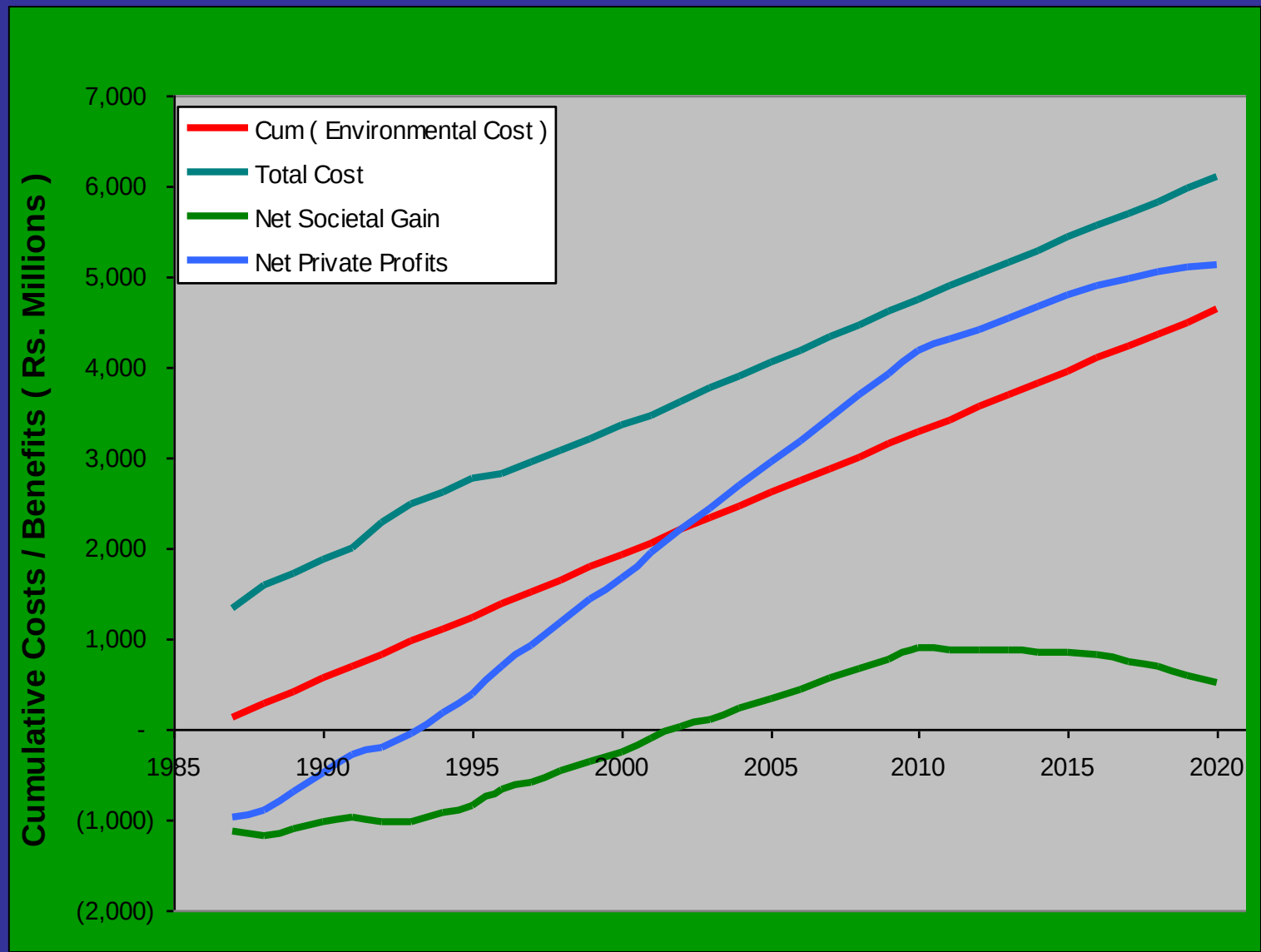
Valuing ecosystem services

- Actual costs of water use is 400% more than present cost (Rs. 5.16 / unit against Rs. 0.96 / unit actually charged
- Present form of water use highly unsustainable



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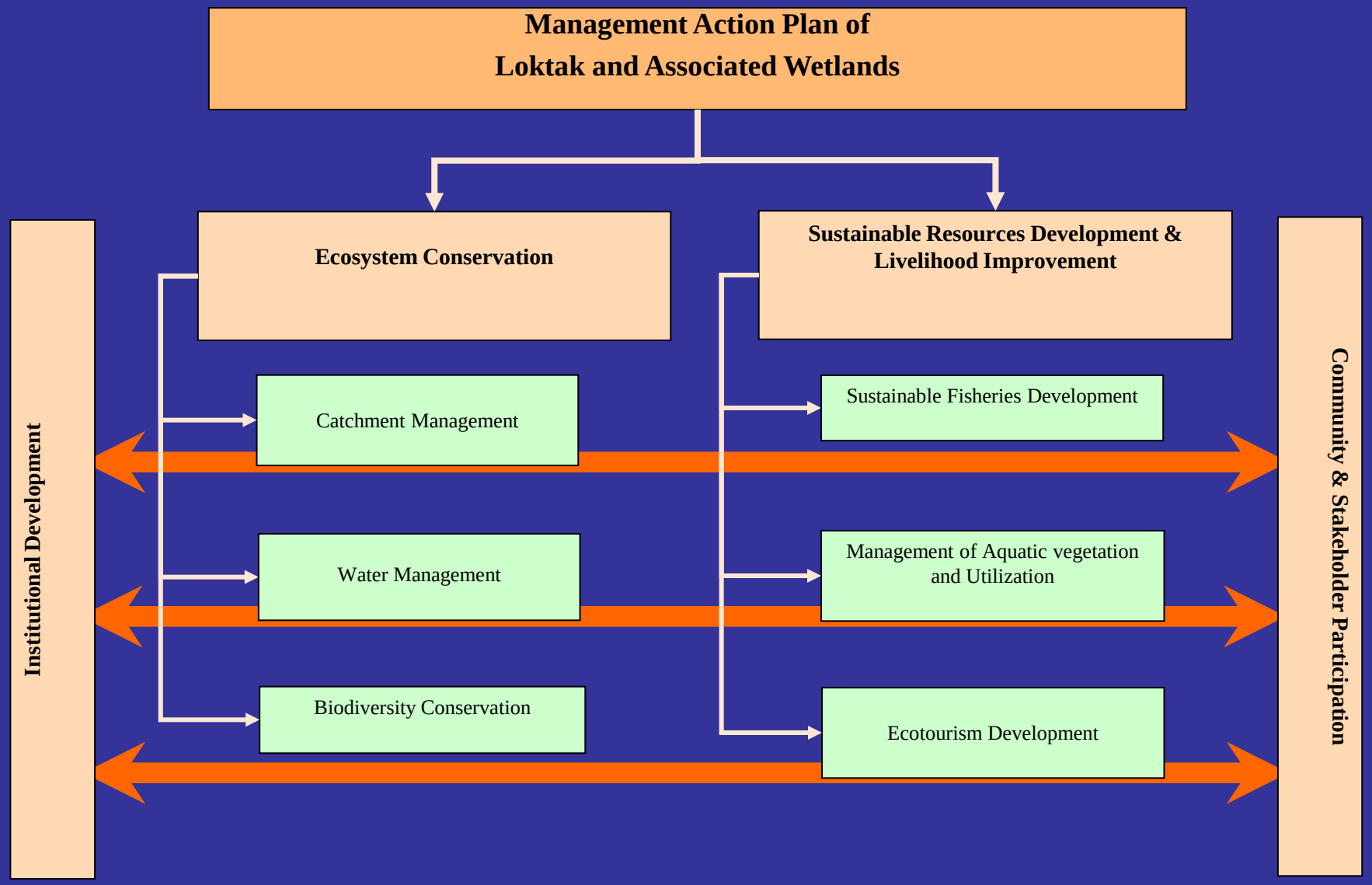
Capturing ecosystem services



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Capturing ecosystem services

Conservation & Management of Loktak and Associated Wetlands

Ecosystem Conservation

	Catchment Conservation	Water Management	Biodiversity Conservation
STAP	1. Loktak 2. Thoubal 3. Heirok WS	1. Phumdi Management – Loktak 2. Selective desilting and dredging 3. Water allocation policy	1. Waterbird monitoring 2. Capacity building
LTAP	1. Khuga WS 2. Iril Lower and Upper WS 3. Imphal WS	1. Regulator at Ungamel 2. Solid Waste Management 3. Sewage treatment	1. Alternate home for Sangai 2. Conservation of floristic species 3. Re-establishment of migratory fish species

Sustainable Resources Development & Livelihood Improvement

	Fisheries Development	Livelihood Improvement	Ecotourism Development
STAP	1. Construction of new hatcheries around Loktak 2. Operationalization of existing hatcheries	1. Focus on Loktak	
LTAP	1. New hatcheries around Pumlen , Waithou, Ikop, Kharung 2. Post harvest and value addition	1. Focus on Pumlen, Ikop, Kharung, Waithau	1. Interpretation center 2. Education and recreation infrastructure development 3. Marketing

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Capturing ecosystem services

Water management objectives

Established through Stakeholder Meeting , March 2009

- 1: Hydropower Generation
- 2: Maintenance of KLNP Habitat
- 3: Reduction in lake sedimentation
- 4: Providing water for irrigation
- 5: Reduction in flooding in peripheral settlements and agricultural lands
- 6: Phumdi management
- 7 and 8: Supporting fisheries (culture and capture)
- 9: Maintaining lake aesthetics for ecotourism and sports

For each, established required water regime and lake condition

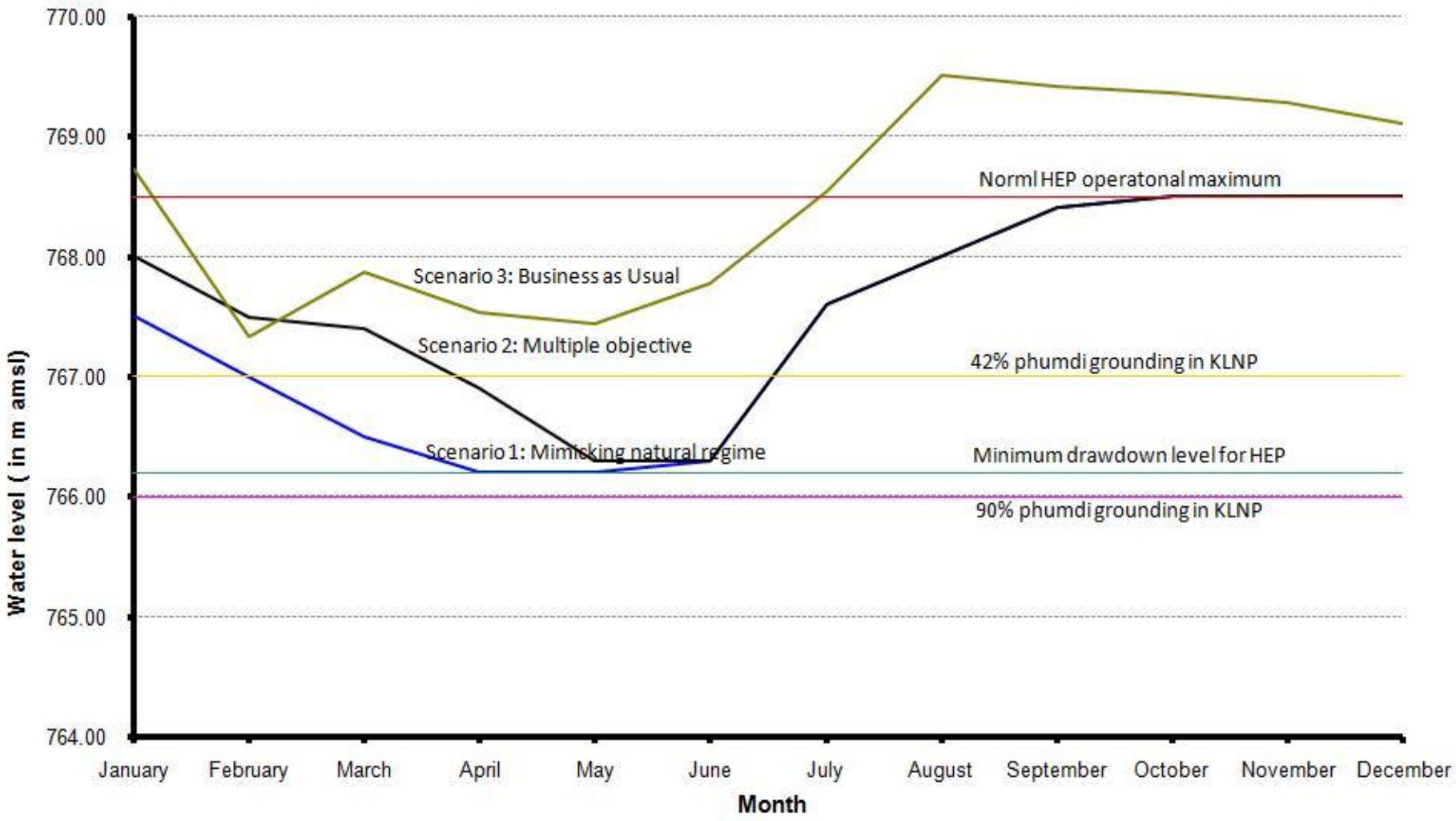
Water Management Scenarios

Conflicting lake regime requirement – some need a regulated regime (hydropower), others natural fluctuation (KLNP)

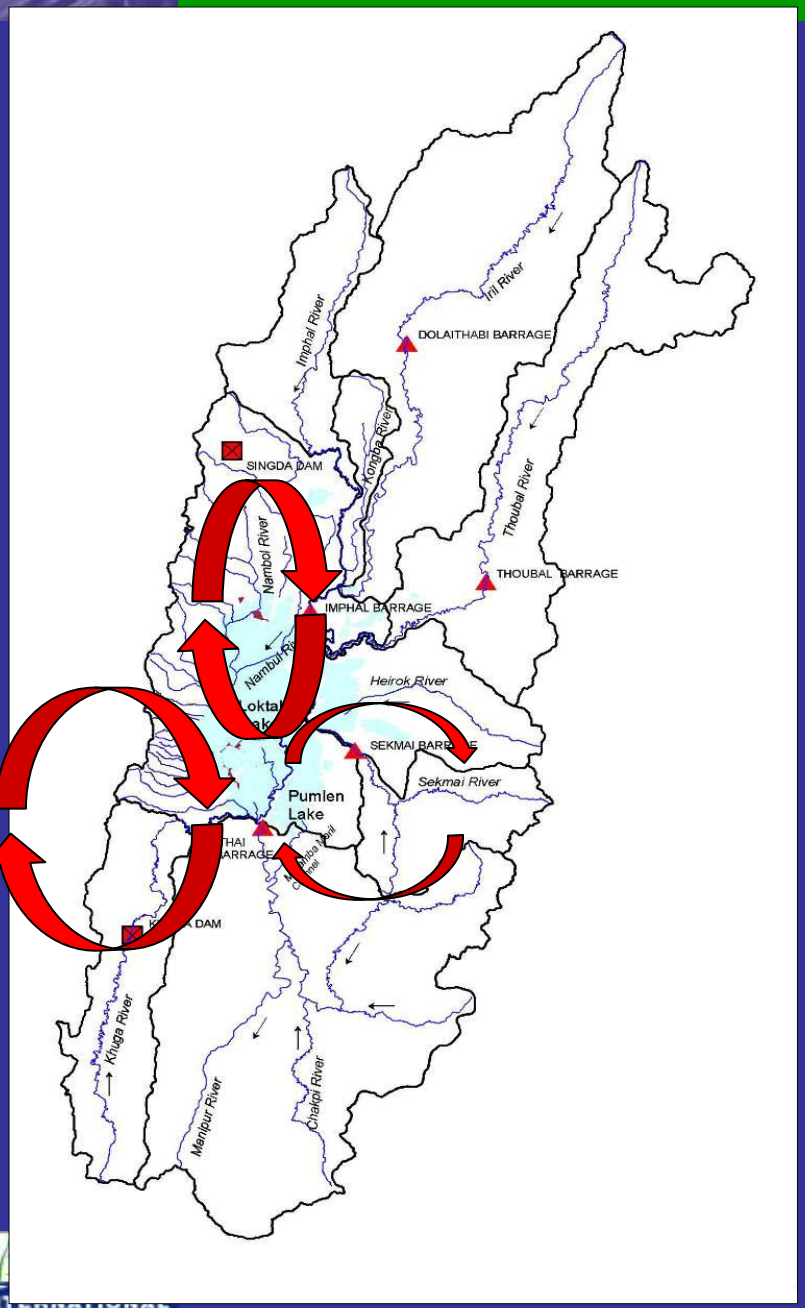
Assessing options through scenarios

- 1: Mimicking natural regimes – prioritizing maintenance of ecological character
- 2: Multiple objective – ecological character, flood protection, hydropower and irrigation
- 3: Business as usual – prioritizing hydropower generation

Capturing ecosystem services



Capturing ecosystem services



ES based transfers

1: Hydropower company to lake management – sustainable water allocations

2: Catchment communities to lake management – Restricting siltation practices

3: Athaphum fishers to lake management – Restricting harmful fishing practices

Challenges

- Nested socio-ecological system
- PES/RES embedded within ecosystem management – restoration as a template
- Political connotation of ‘compensation’ – societal disincentive
- Building trust – lowering transaction costs
- Capacities

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Lessons Learnt

- Economic valuation embedded within larger conservation and development context
- Adaptiveness – role of learning cycles on ecological and political time scales
- Bundled ecosystem services – stakeholder prioritization as guides to decision making
- Transformation needs time and commitment – moving out of project cycles to institutional change

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THANK YOU !