IMPROVING HYDROPOWER OUTCOMES THROUGH SYSTEM-SCALE PLANNING

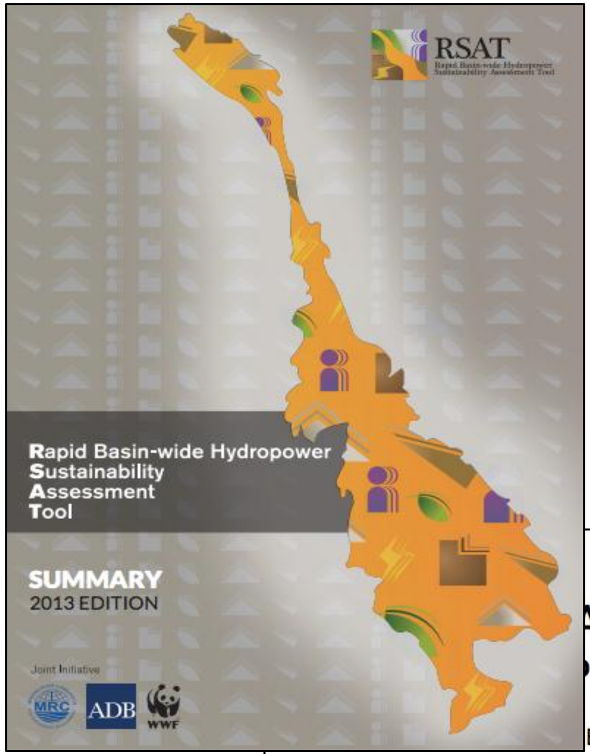
An Example from Myanmar

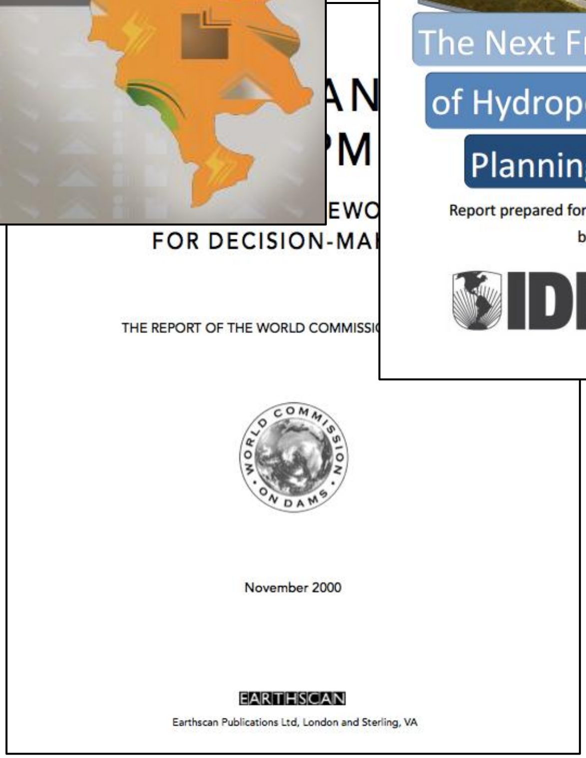
UKaid from the British people

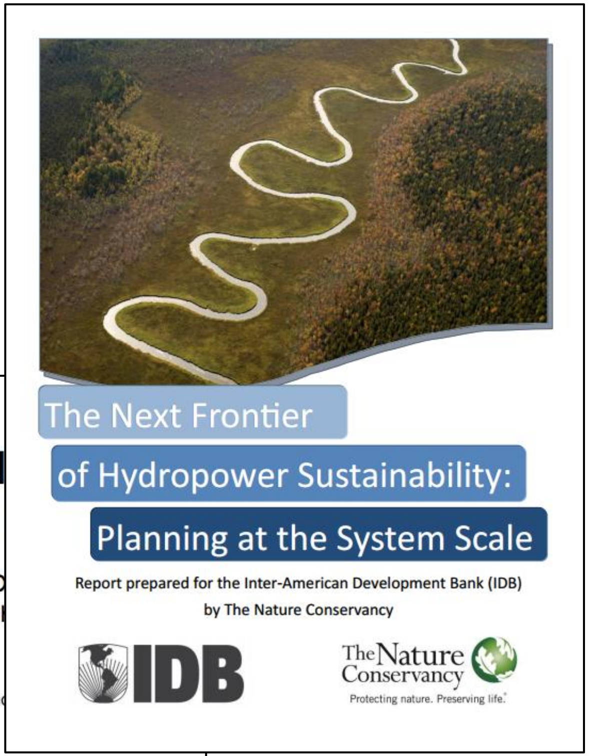
The Nature Conservancy Protecting nature. Preserving life.

WWF

MANCHESTER 1824 The University of Manchester

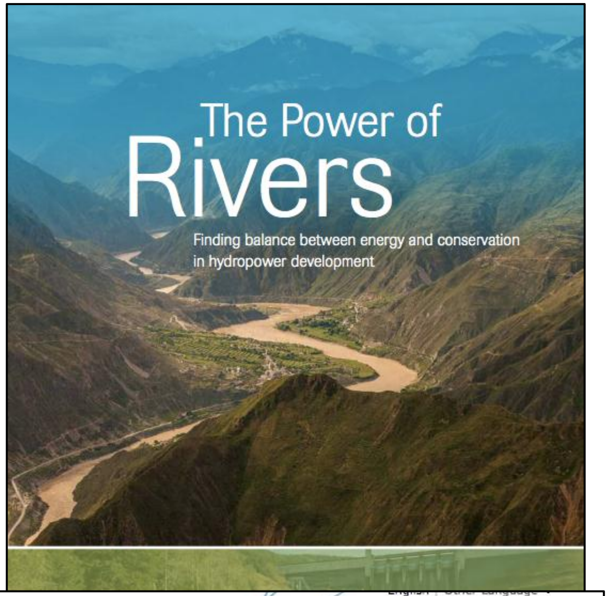






Myanmar has significant opportunities to develop hydropower, but currently lacks the data and decision support tools needed to understand the river basin-wide impacts of these developments and trade-offs of alternative development options.

World Bank: Appraisal Report for the Ayeyarwady Integrated Basin Management Project (2014)

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IFC Stresses Importance of Assessing Cumulative Impacts of Hydro

IFC environmental and social experts are urging companies and governments to consider the impact of hydropower projects from a broad, basin-wide perspective that includes planned upstream and downstream developments.

"Unless you look at cumulative impacts, you don't have a project," said Vaqar Zakaria, Managing Director, Hagler Bailey, based in Islamabad. In February, Zakaria presented his company's findings from the IFC-commissioned cumulative impact assessment (CIA) for the Gulphur Hydropower Project in Pakistan at the Sixth International Conference on Water Resources and Hydropower Development in Asia in Vientiane.

SYSTEM-SCALE PLANNING: MYANMAR

System-Scale Planning of Hydropower: Why?

Hydropower done right could make significant contributions to sustainable development

Benefits and drawbacks are highly site specific –
“Site selection is the best mitigation”

In addition, multiple design and operational alternatives

Cumulative impacts of projects depend not only on their location, design and operations, but also on how they interact with other projects in the basin

Current Reality - “Cherry Picking” by Developers

Site selection by developers is unable to deal with complexities:

- Incomplete information
- Preferences not the same as those of the host country
- Not for all sites can mitigation solutions be found
- Little information on and little interest in cumulative impacts
- Shorter time horizon than governments
- Projects in ‘wrong’ sites are irreversible

Moving to System-Scale Planning

Transparency and accountability lead to public acceptance – proponents need to be able to explain why a project is in the public interest

Governments are looking for options to reform project selection:

- Brazil – project selection and auctions by government
- Colombia – government selects between project alternatives
- Chile – government provides transparent information
- Norway – excluded half of its remaining hydro potential
- Iceland – updates its generation master plan every four years

Broad agreement about the ‘why’, uncertainty about the ‘how’

System-Scale Planning of Hydropower: How?

The overall objective of system-scale planning is sustainable development – which requires healthy, productive rivers

Current planning and assessment instruments do not yet deliver that objective, as they are not integrated across projects and across criteria

TABLE 1. The scope of existing planning and assessment instruments

	Single Project	Multiple Projects
Technical and Financial Criteria	• Pre-Feasibility Study • Feasibility Study • Financial Model • Designs and Tender Documents	• Master Plan
Environmental, Social and Economic Criteria	• Environmental and Social Impact Assessment • Cost-Benefit Analysis • HSAP Assessment • Environmental and Social Management Plans	• River Basin Management/ Development Plan • Strategic Environmental Assessment • Cumulative Impact Assessment • RSAT Assessment • High Conservation Value Assessment/ Conservation Blueprint

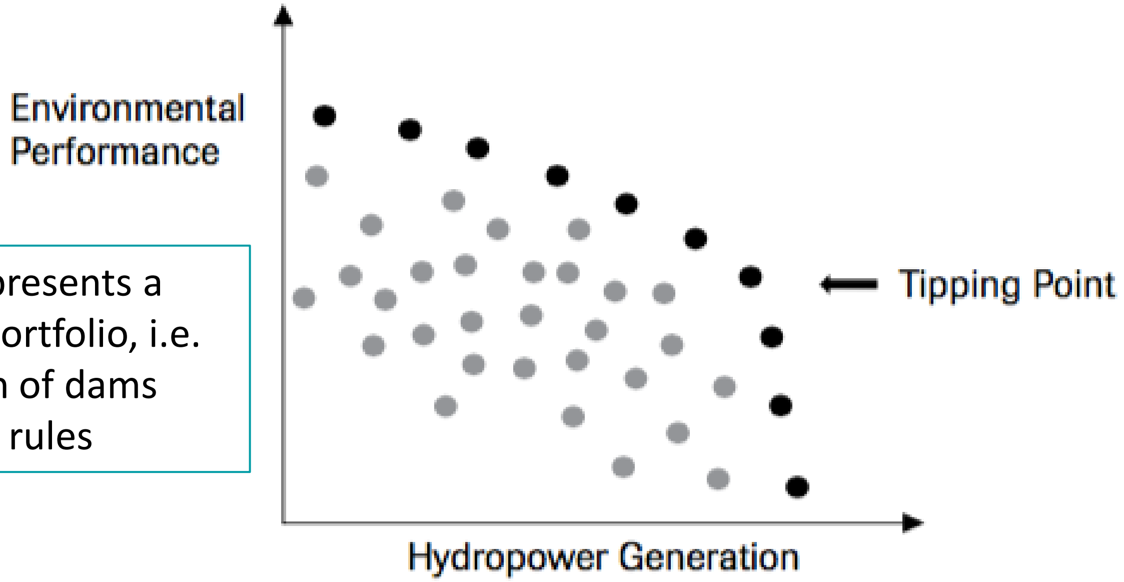
System-Scale Planning of Hydropower: How?

Different methods are available

How can a hydropower system be designed?

- Target levels of hydropower generation
- Definition of metrics
- Spatial analysis: fragmentation of rivers, affected lands
- River simulation model
- Trade-off analysis
- Negotiation

Each point represents a hydropower portfolio, i.e. A combination of dams and operating rules



Increasing Academic Interest and Cooperation with Academic Researchers

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Development of new indicators to evaluate river fragmentation and flow regulation at large scales: A case study for the Mekong River Basin

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ABSTRACT

Large hydropower schemes have recently gained renewed interest as a provider of efficient
able energy, particularly in developing countries. However, some dams may have widesprea
hydrological and ecosystemintegrity, which reach beyond the scales addressed by typical env
impact assessments. In this paper we address two main ecological impacts—reduced river c
and changes in the natural flow regime—at the scale of the entire Mekong River Basin as an
component of dam evaluations. The goal is to improve our understanding of the effect of indiv
as well as clusters of dams at a very large scale. We introduce two new indices, the River C
Index (RCI) as a tool to measure network connectivity, and the River Regulation Index (RRI
sure of flow alteration, and calculate the individual and cumulative impact of 81 proposed

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Balancing ecosystem services with energy and food security – Assessing trade-offs from reservoir operation and irrigation investments in Kenya's Tana Basin

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Abstract. Competition for water between key economic sectors and the environment means agreeing allocations is challenging. Managing releases from the three major dams in Kenya's Tana River basin with its 4.4 million inhabitants, 567 MW of installed hydropower capacity, 33 000 ha of irrigation and ecologically important wetlands and forests is a pertinent example. This research seeks firstly to identify and

point from which to tackle the interdependence and complexity of "water-energy-food nexus" resource security issues.

1 Introduction

SYSTEM-SCALE PLANNING: MYANMAR

Water Resources in Myanmar

Abundant water resources

The Irrawaddy and Salween rivers are two of the largest remaining free-flowing rivers globally

506 fish species, about the same number as all of Europe

Sharing the Irrawaddy

Important for fisheries, navigation, irrigation and biodiversity

Flooding, sedimentation and erosion issues in lowlands and delta

Water Resources and Hydropower in Myanmar

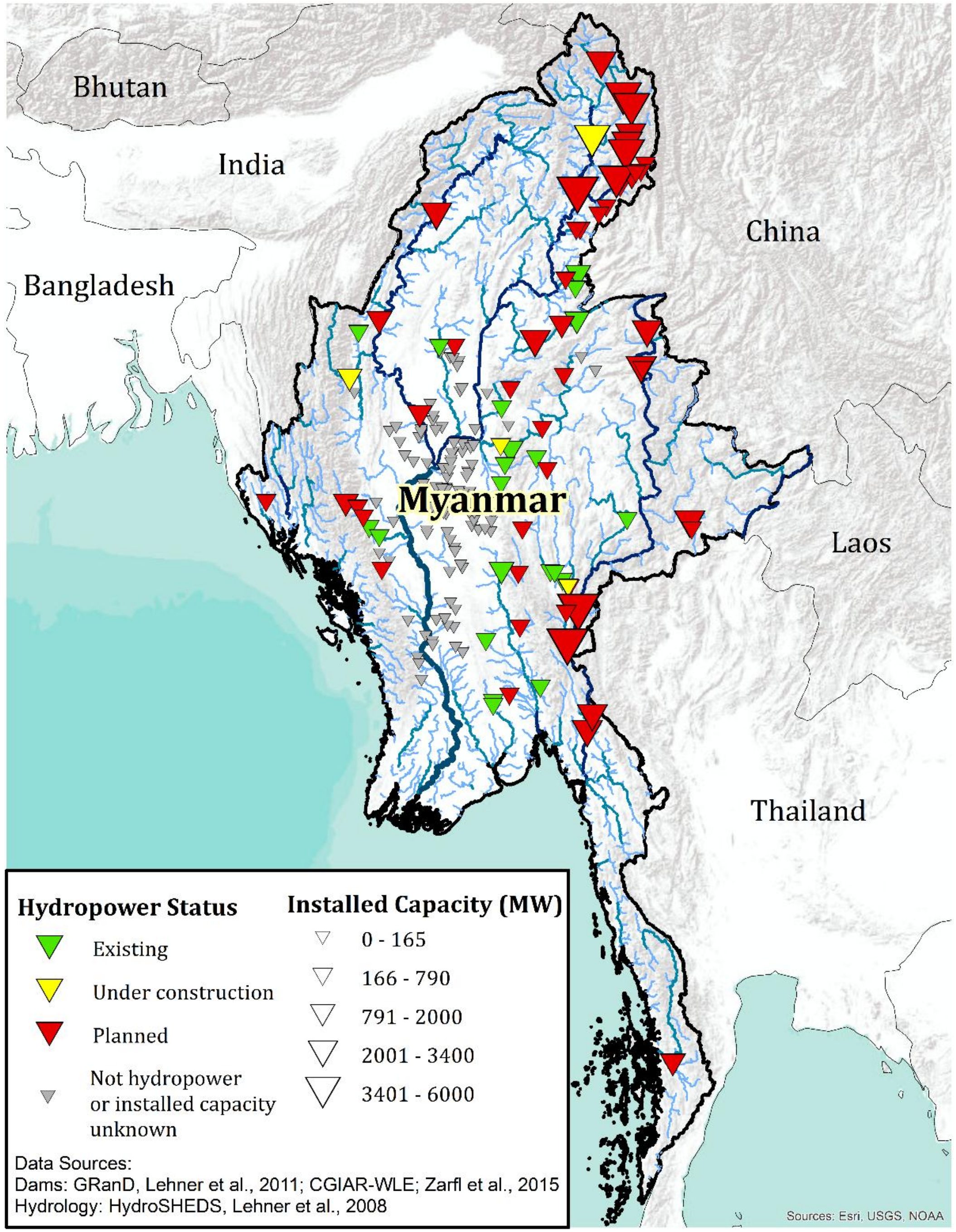
Only 1/3 of population has access to power

Consumption per capita only 153 kWh/year

100 GW hydropower potential

25 projects in operation (Total 3.2 GW)

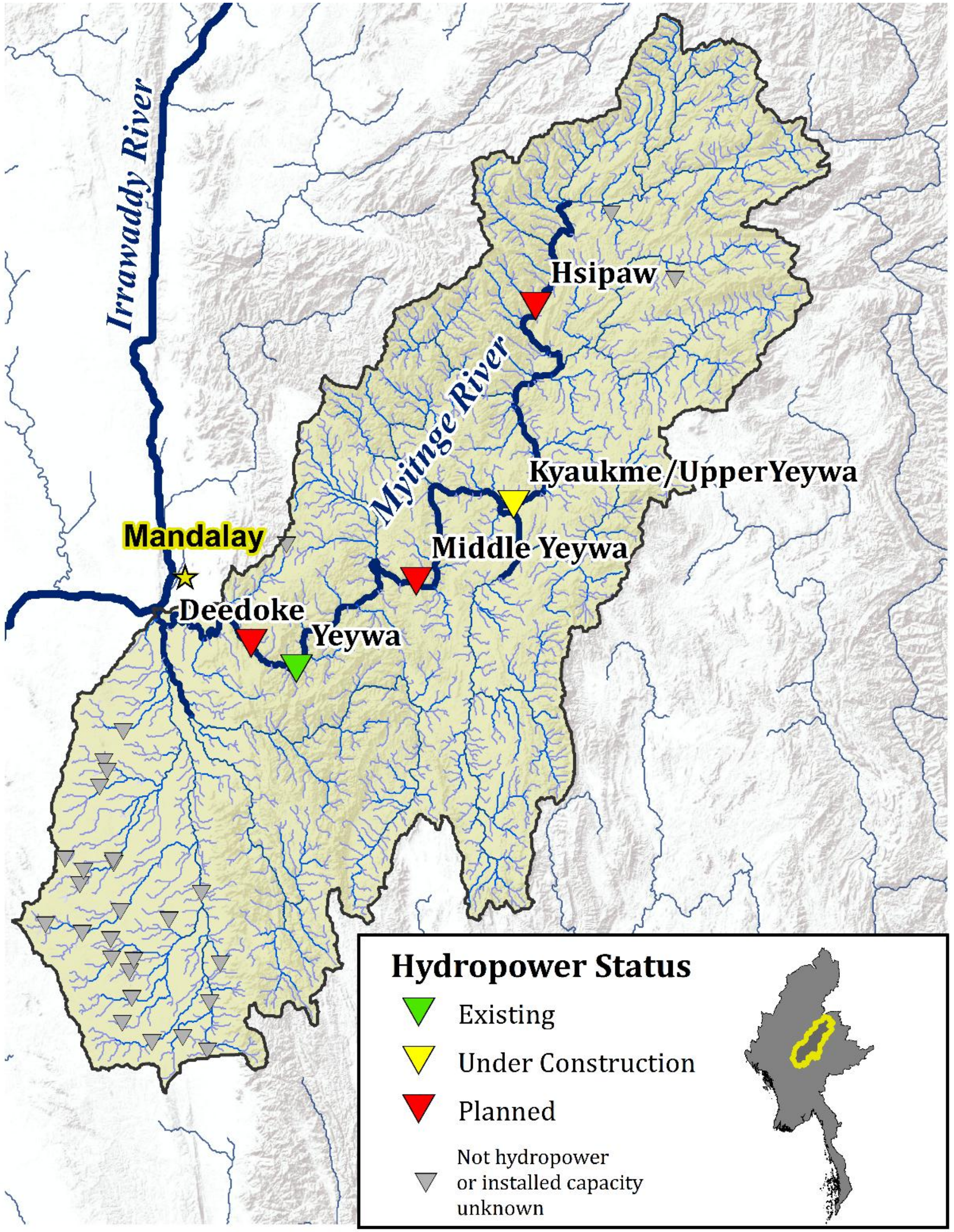
45 projects in preparation (Total 40.5 GW)



Myitnge River

Sub-basin of the Irrawaddy river

5-dam cascade possible, with some design and many operational alternatives



Assessing Hydropower Trade-Offs in the Myitnge Basin: Building the Model

1. Hydrological series
2. Portfolios, metrics, data, assumptions
3. Simulation model with search engine to identify well-performing portfolios
4. Visual display of results (two or three dimensions)

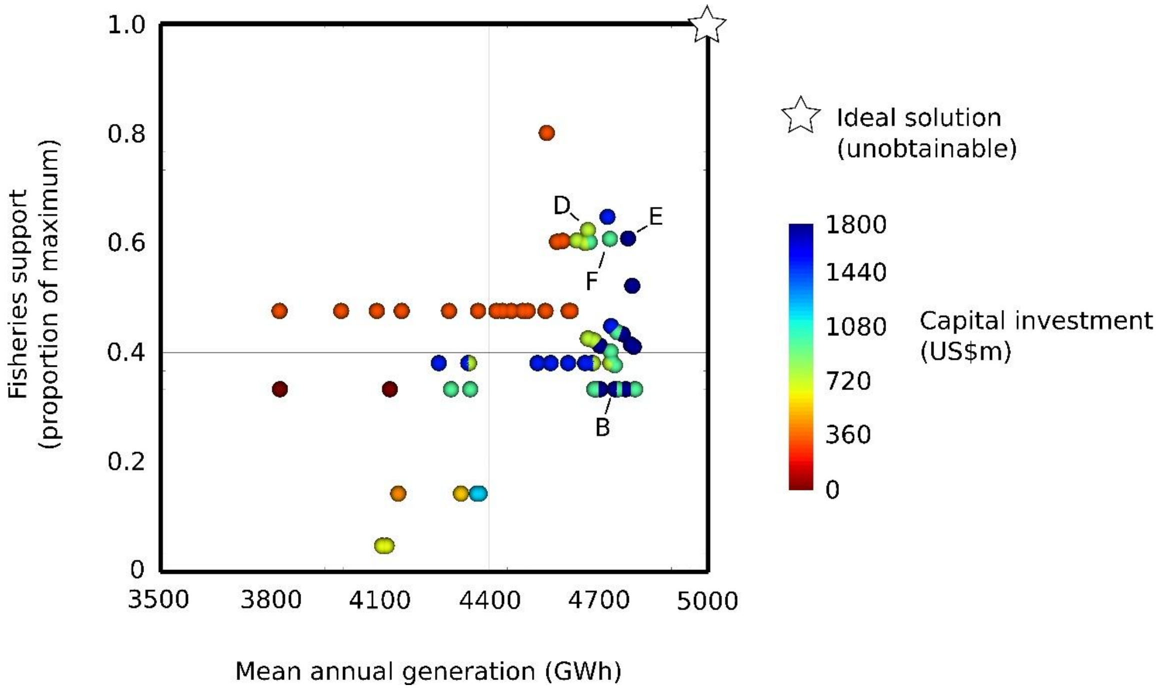
TABLE 4. Performance metrics, definitions and search goals

Metric	Targeting to Maximize or Minimize	Definition
Fish Biodiversity	Max	Number of species in Myitnge sub-basin
Navigation	Max	Lowest monthly average flow, in m^3/s
Annual Generation	Max	Average annual generation in kWh
Flood Control	Min	Highest monthly average flow, in m^3/s
Firm Generation	Max	Monthly generation that can be reached in more than 90% of all months, in kWh
Capital Expenditure	Min	Capital expenditure on additional dams, in USD
Fishery Support	Max	Contribution of Myitnge sub-basin to overall fish biomass in the Irrawaddy basin
Sediment Load	Max	Sediment delivery, tons/year
Displaced People	Min	Number of people living in reservoir area
Forest Loss	Min	Hectares of forest in reservoir area

Assessing Hydropower Trade-Offs in the Myitnge Basin: Discussing the Results

Visualizations show how portfolios perform against several objectives

Portfolios that represent an acceptable balance between objectives can be found by stakeholders and decision-makers



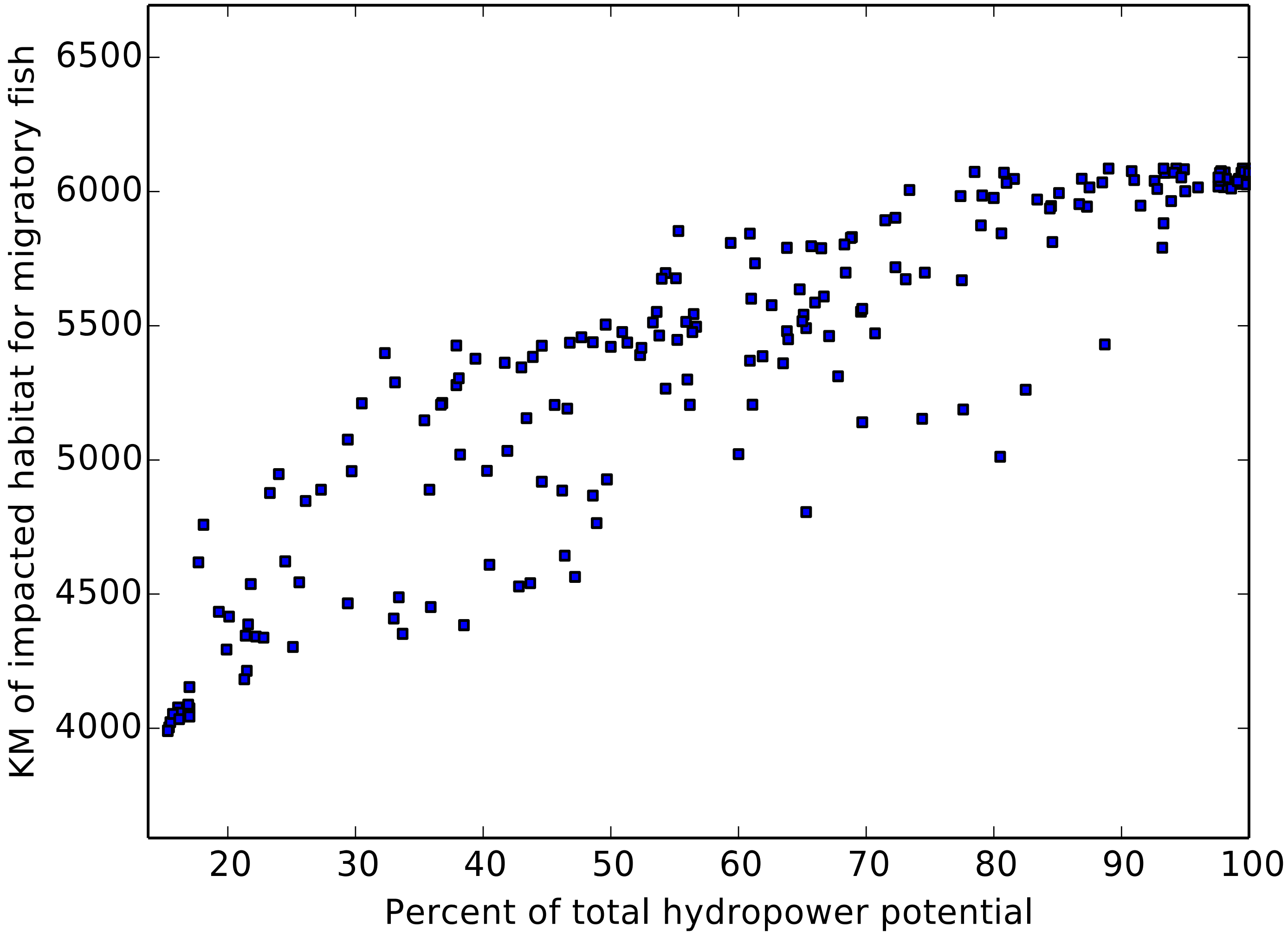
Example:

Trade-offs between power generation, fisheries productivity, and investment costs.

Portfolio d could be considered a good compromise.

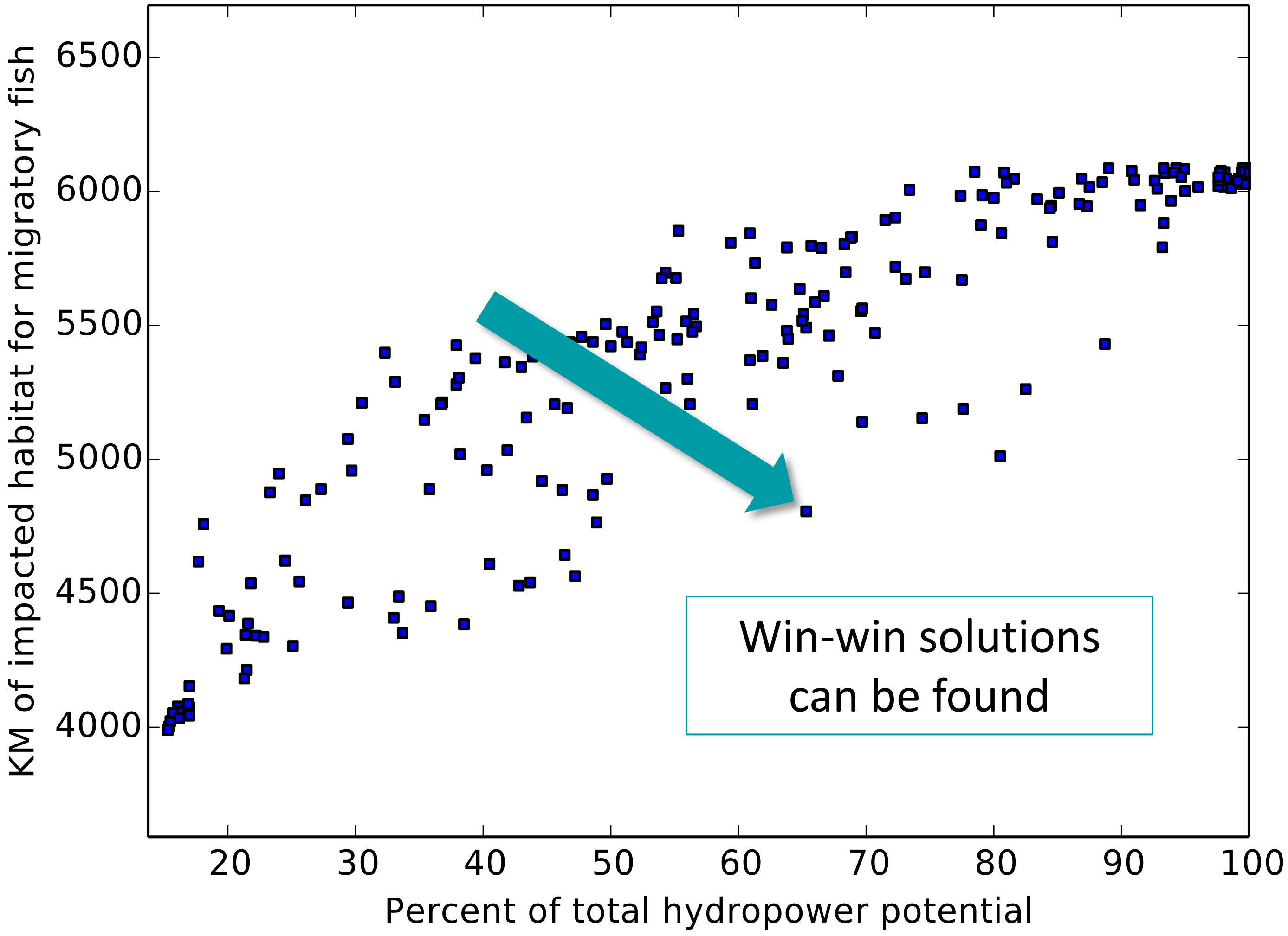
SYSTEM-SCALE PLANNING: MYANMAR

Trade-Offs at the Scale of the Irrawaddy



SYSTEM-SCALE PLANNING: MYANMAR

Trade-Offs at the Scale of the Irrawaddy



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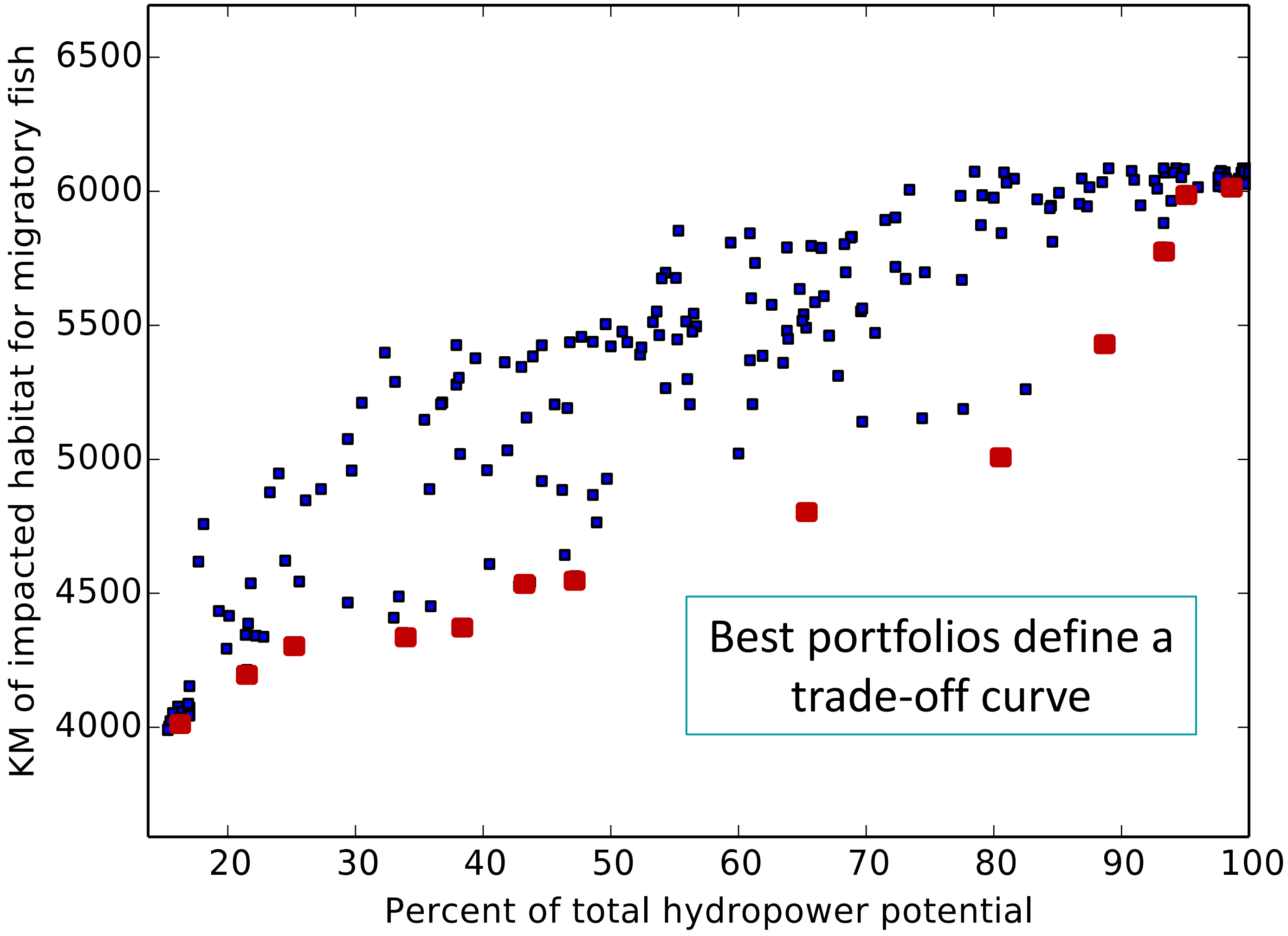

Implications for Myanmar

‘Hydropower by Design’ can lead to better outcomes, compared to project-by-project decisions

Clearly desirable from a public policy perspective, but also beneficial for developers

Can help new democratic government of Myanmar take fresh look at hydropower

Short-, medium- and long-term applications:

- Project screening
- Strategic environmental assessment
- Building of domestic planning capacity

Implications for Myanmar and other Countries

Technical models are evolving, can adapt to different contexts

Simpler spatial analysis may be sufficient where fragmentation and land impacts are biggest issues

Simulation models may be required where there are multiple interests in water resources management

Governance implications:

- ‘Hydropower by Design’ always has to be introduced in a specific political and institutional context
- Opportunity to make decisions more accountable and transparent
- Encourage discussion, negotiation, compromise

Next Steps

TNC and WWF are committed to further develop the methods and collaborate with partners to spread system-scale planning

Broad uptake of system-scale approach can be promoted through:

- Institutional reforms
- Training and capacity building
- Data acquisition and analysis
- Funding