The Economics of Ecosystems & Biodiversity

TEEB Country Studies

CBD-COP 13 side event

6 December 2016, Cancun

Dr Salman Hussain

UNEP TEEB Office

UNEP United Nations Environment Programme

The Economics of Ecosystems & Biodiversity

SwedBio A programme at Stockholm Resilience Centre

This project is funded by the European Union

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The Economics of Ecosystems & Biodiversity

TEEB Country Studies

TEEB 6 step approach

STEP 1: Refine the objectives of a TCS by specifying and agreeing on the key policy issues with stakeholders

STEP 2: Identify the most relevant ecosystem services

STEP 3: Define information needs & select appropriate methods

STEP 4: Assess and value ecosystem services

STEP 5: Identify and outline the pros and cons of policy options, including distributional impacts

STEP 6: Review, refine and report: Produce an answer to each of the questions

Policy Identification:
Over-arching questions

What policy issues are critical to the host country?

1. What will the policy act *upon*?
   - Single biome; multiple biomes; single sector; cross-sectoral
2. How *valuable* is/are the biome(s)/sector(s) to the economy?
3. What is the *incremental change* brought about by the policy?
4. Who are the *key stakeholders* and governance bodies (sub-national and national)?
5. On-going research

Thank You!

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SwedBio
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TEEB - Tanzania

THE RUFIJI RIVER BASIN

Thomas J. Chali
VICE PRESIDENT'S OFFICE-Environment

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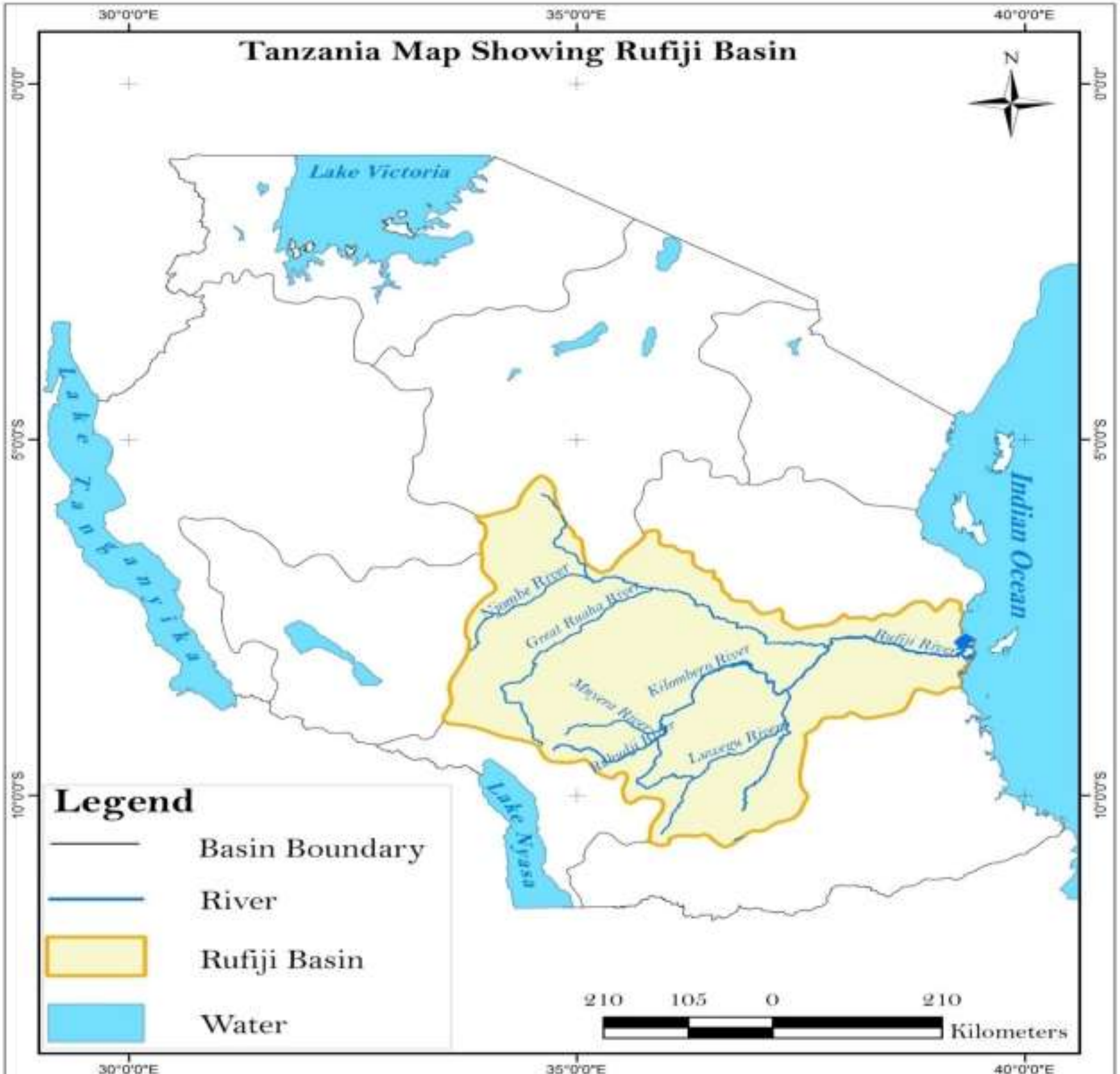
TEEB Project in Tanzania

The study aimes at creating and comparing alternative quantitative scenarios for land management of the Rufiji River Basin in Tanzania.

The Rufiji watershed is critical for Tanzania's development;

- draining 21% of the country,
- The basin offers a variety of ecosystems and biodiversity services including (food, timber, Carbon sequestration, biodiversity etc
- There are competing water use and land use options in the basin; afforestation of mountain grasslands, planned dam construction for irrigation and HEP, and water-intensive farming practices


Tanzania Map Showing Rufiji Basin
N
30°0'0"E
35°0'0"E
40°0'0"E
0°0'0"
5°0'0"S
10°0'0"S
Lake Victoria
Lake Tanganyika
Indian Ocean
Lake Nyasa
Njombe River
Great Ruaha River
Kilombero River
Luwegu River
Rufiji River
Legend
Basin Boundary
River
Rufiji Basin
Water
210 105 0 210
Kilometers

In 2010 the GoT launched **Southern Agricultural Growth Corridor of Tanzania (SAGCOT)** initiative as a PPP;

Unlocking the agricultural potentials of the basin

- 350,000 hectares in profitable production, serving regional and international markets.
- tens of thousands of smallholders become commercial farmers, with access to irrigation and weather insurance.
- at least 420,000 new employment opportunities created in the agricultural value chain

Main Objective

- “To examine major land uses/cover in the Rufiji river catchment and conduct policy scenario analyses to inform policies for better land management in the basin; through detecting long-term trends and changes in stream flows and how the changes are correlated to land use/cover changes”.

Scope of the Study

- In ***the Mountain Highland zone (*1,900 - 2,700 m.a.s.l.)**, examined and compared impacts of continued traditional conversion of mountain grasslands to *pine* and *eucalyptus* forest and agricultural expansion
- In ***the Midlands zone (1500 and 1900 m.a.s.l.)***, examined the impacts on ecosystem services under the BAU scenario, under traditional conversion of natural woodlands or forests into tea plantations, fruits plantations, as per the BRN initiative.

- ***In the Lowlands Rufiji River Delta zone (0 to 2 m.a.s.l.)***, considered the BAU scenario involving continued traditional conversion of mangrove forest to traditional shifting paddy cultivation

Scenarios

- **Business As Usual (BAU)**

simulated to estimate projected changes in the Kilombero cluster under continuation of existing trends (e.g. population growth, agriculture) and related impacts on the environment (e.g. carbon sequestration and water yield)

- **SAGCOT Scenario**

Simulated to estimate projected changes in the Kilombero cluster under the SAGCOT strategy

Aspects: water, food, carbon sequestration, land use changes

Research Findings

- Highest sediment yield is observed in the uplands and midlands regions.
- Lowlands have lower sediment yield because the wetland acts as sediment trap.
- Between December and April the basin experiences a water surplus due to excess of rainfall over evaporation.
- Between May and October the evaporation exceeds the precipitation and results in water deficits
- Decline in carbon sequestration

Policy Implications

BAU

- Population growth is projected to increase over time following the historical trend, which will lead the number of inhabitants to double by the year 2030
- Population growth will cause a steady increase in agriculture land to cover the demand for food, which increases at the same rate as population
- Total income from agriculture, which is the sum of profits from smallholders and the labor income of farm workers, will increase at its historical rate
- Land conversion takes place to increase the amount of agriculture land and urban area to accommodate the needs of the growing population

SAGCOT

- Expansion of farmland by 52,000ha (2018-2022)
- growth in food production for domestic and export and income
- risk of overusing surface and ground water
- gains from SAGCOT may be short-lived, as side effects and competition for water could emerge in the medium term
- attractive for the population and businesses (more land for settlement and agriculture)

Policy Recommendations

- both scenarios, the expansion of agriculture land bears the risk of over-extraction of surface water especially dry months
- Need for identification of suitable crops for dry months and investments in water efficiency technologies
- Need for assessment of water budget for proper planning of the basin (hectares, crop types)

Conclusion

"There is need for TEEB project not to end up with NO or YES answers but balanced scenario (negotiated from BAU and SAGCOT) to advice the decision makers for the development path that will maximize benefits and minimize externalities to the environment"

Aknowledgement

- Institute of Resource Assessment (IRA) University of Dar es Salaam (Technical TEEB Team)
- UNEP TEEB Team (Technical Backstopping)
- Generous Support of European Commission

Thank You
Asante Sana
Mucho gracias

TEEB-Bhutan

The economics of ecosystems & biodiversity

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December 6, 2016
Cancun

Arctic Ocean
Atlantic Ocean
Bhutan
Pacific Ocean
Pacific Ocean
Atlantic Ocean
Indian Ocean
Southern Ocean
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Landlocked

Eastern Himalayas: A Fragile Mountainous Landscapes

Heavily Forested

TEEB as a PROCESS

Stakeholders involvement - KEY

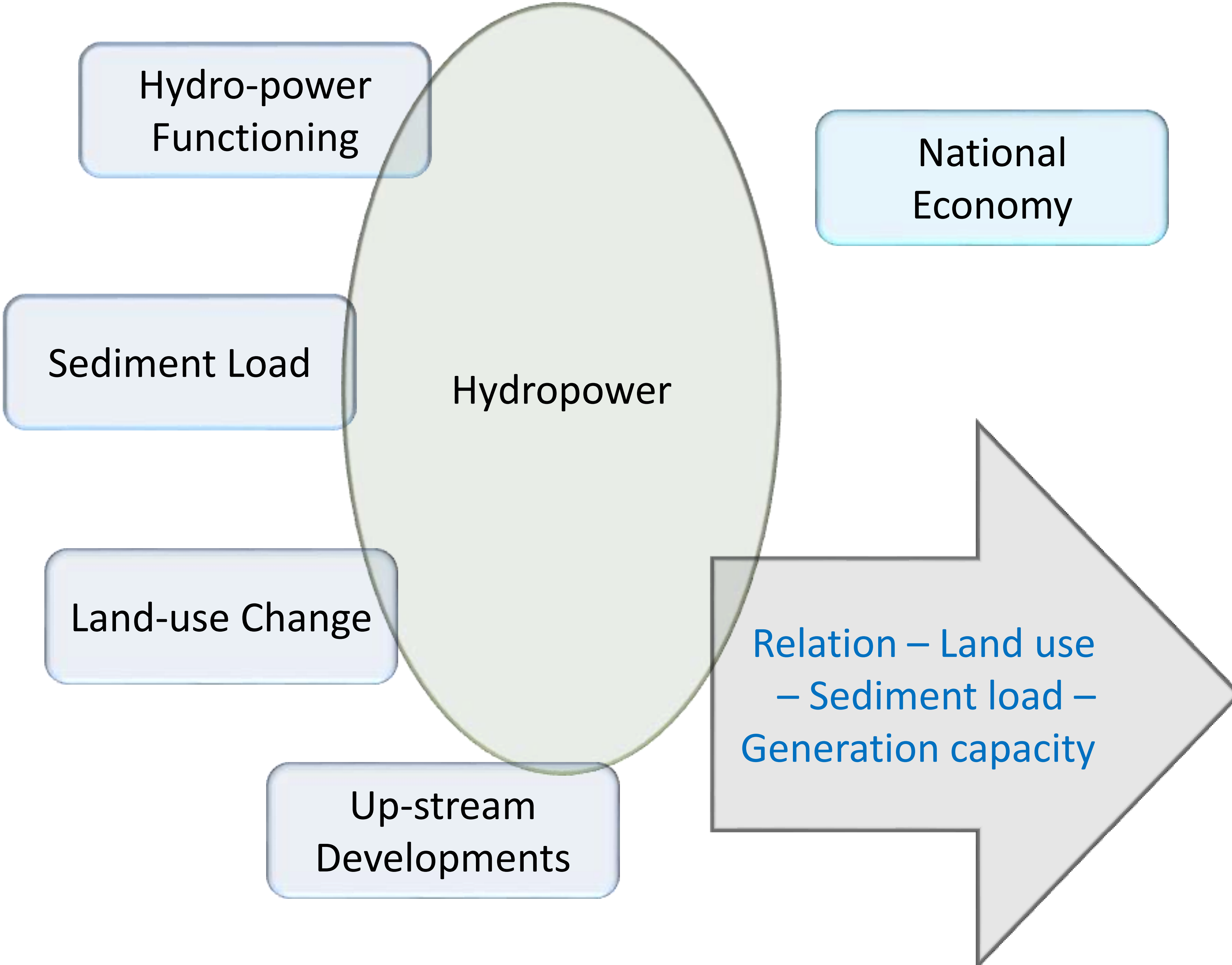
Forestry

Power Company

Watershed

Regulating Agency

Planners


Hydro-power Functioning
National Economy
Sediment Load
Hydropower
Land-use Change
Relation – Land use – Sediment load – Generation capacity
Up-stream Developments

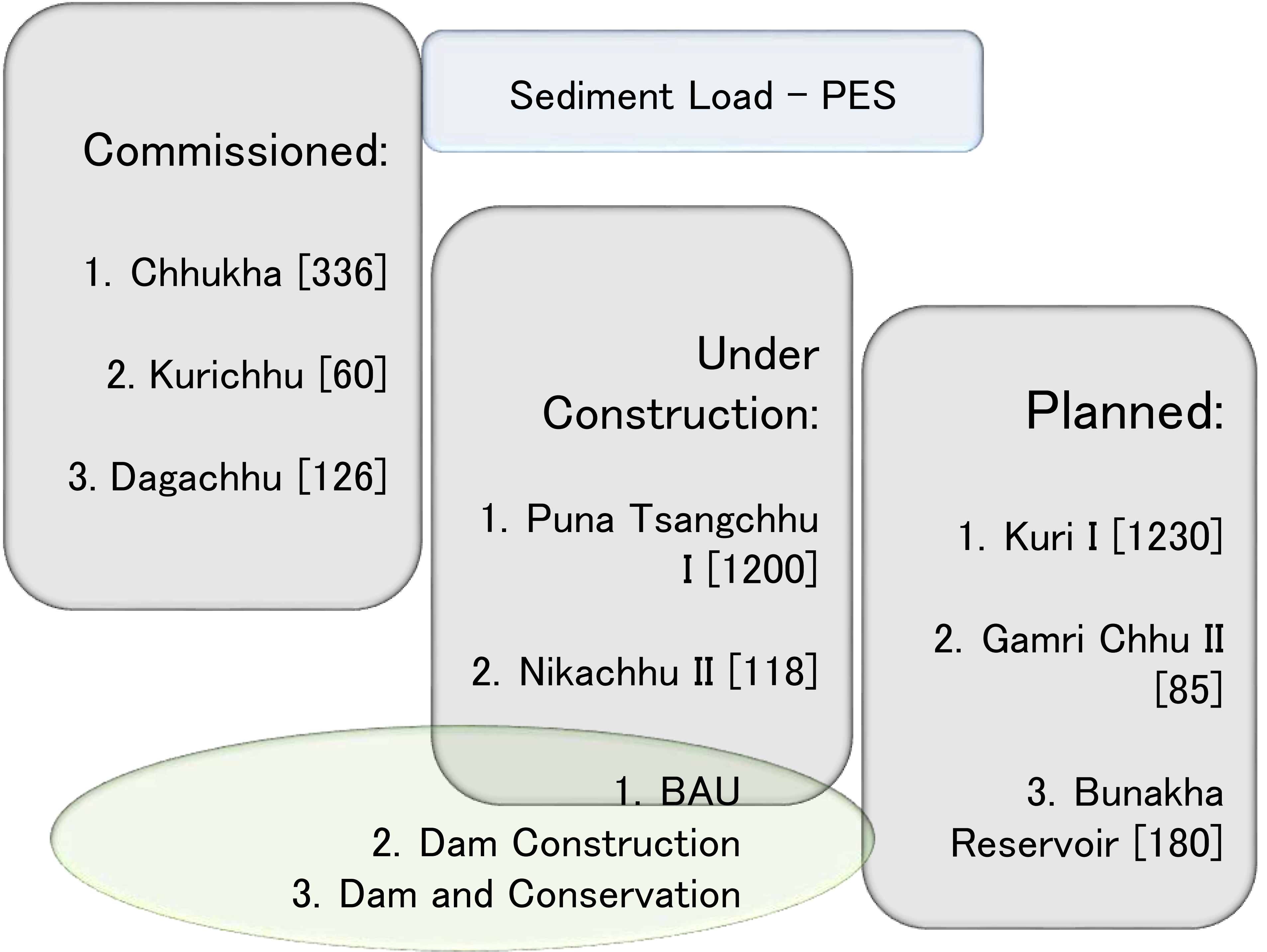
TEEB- Bhutan

- Assess changes in ecosystem services provisioning under different hydropower diversification scenarios
    - Diversification – Large; Medium; Small etc.

- Recommend instruments, including PES and royalty fee changes to ensure benefits sharing with communities

Integrated Sustainable Water Resources Management

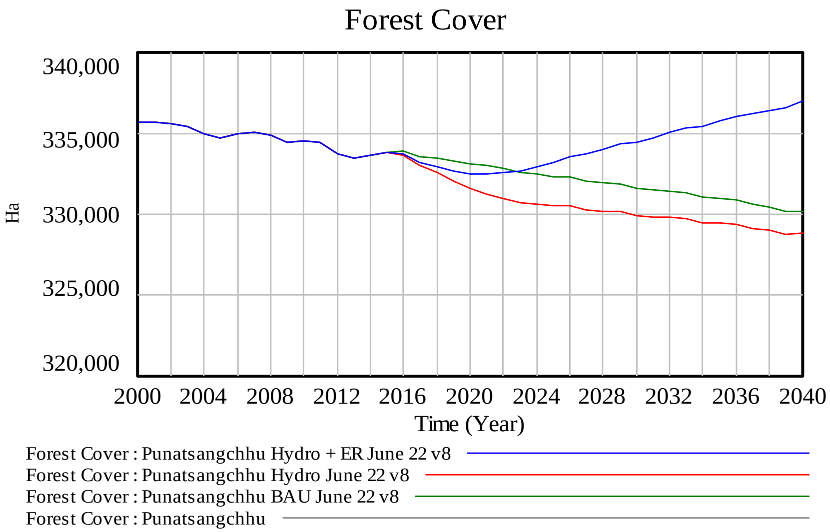
12.4 In order to utilize water resources in a sustainable manner for hydropower generation, it is important to protect water catchment areas by promoting sustainable agricultural/land use practices and nature conservation works. The MoA in collaboration with MoEA shall work out the modalities for integrated sustainable water resources management. A minimum of 1% of royalty energy in cash shall be made available on annual basis to MoA for this purpose.

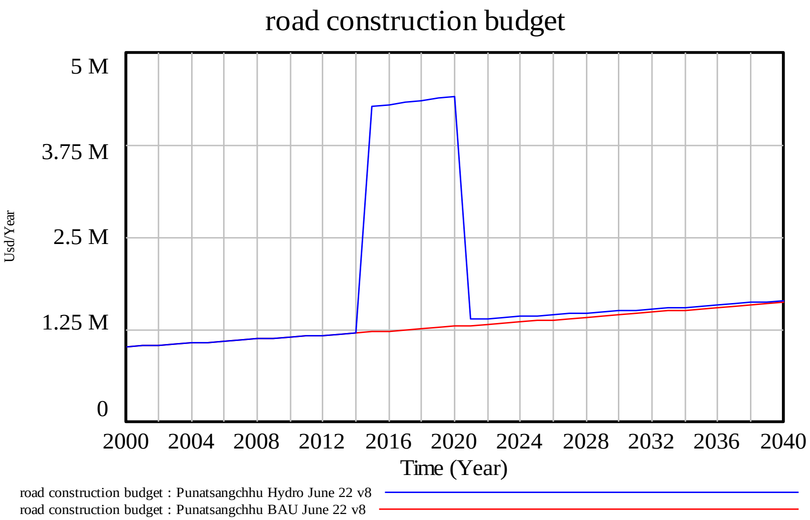

Sediment Load – PES
Commissioned:
1. Chhukha [336]
2. Kurichhu [60]
3. Dagachhu [126]
Under Construction:
1. Puna Tsangchhu I [1200]
2. Nikachhu II [118]
Planned:
1. Kuri I [1230]
2. Gamri Chhu II [85]
3. Bunakha Reservoir [180]
1. BAU
2. Dam Construction
3. Dam and Conservation

Ecosystem Services [Results]

- ❑ Bio-physical and Valuation Changes projection for 2030 for the scenarios
  - BAU
  - Hydropower Construction
  - Hydropower Construction with Ecosystem Services

- ❑ Value of ES projection for the scenarios [By How Much]





ES	Estimation			Biophysical change (2010-2030): BAU	Hydro vs BAU	ES vs BAU	Economic value per unit	Economic valuation (year 2030)		Comments
	InVEST	SD	Benefit transfer					Hydro vs BAU	ES vs BAU	
Provision of food		X		1,319 ton	-76	-80	739.86 US$/ton	-$421,692	-$424,088	Systemic approach, with endogenous changes to population and land use
					1,159	1,151		$814,442	$808,675	Sectoral approach with no change to land use, only yield
Provision of freshwater (quality) - nitrogen		X		0.0410 mg/l	-1.96%	-1.92%	-	Below health threshold	Below health threshold	Assumes that all the land-related N loadings take place in 20% of the area (concerning the estimation of concentration)
Provision of freshwater (quality) - phosphorus		X		0.0435 mg/l	-3.69%	-3.67%	-	Below health threshold	Below health threshold	Assumes that all the land-related N loadings take place in 20% of the area (concerning the estimation of concentration)
Habitat for species			X	802 ha	-26	590	5,192 US$/Ha	-$133,045	$3,065,470	Economic value per unit obtained from Kubiszewski et al. (2010)
		X		91,633 persons	-3,535	-3,511	576 US$/person	-$2,036,106	-$2,022,201	Assumes that a reduction in habitat quality has a proportional impact on tourism visits (it could also be assumed that expenditure per visit might change)
Regulation of carbon sequestration and storage	X	X		-2,211,105 ton	-81,350	154,884	43 US$/ton	-$3,498,050	$6,660,012	Upper values of carbon coefficients from IPCC Report 2006
	X	X		-123,059 ton	-2,292	52,794	43 US$/ton	-$98,556	$2,270,142	Lower values of carbon coefficients from IPCC Report 2006
Genetic resources			X	802 ha	-26	590	19 $US/ha/year	-$487	$11,218	Economic value per unit for temperate forest obtained from Kubiszewski et al. (2010)
Timber			X	802 ha	-26	590	44 $US/ha/year	-$1,128	$25,979	Economic value per unit for temperate forest obtained from Kubiszewski et al. (2010)
Biological control			X	406 ha	-164	-163	28 $US/ha/year	-$4,599	-$4,566	Economic value per unit for cropland obtained from Kubiszewski et al. (2010)
			X	802 ha	-26	590	9 $US/ha/year	-$231	$5,314	Economic value per unit for temperate forest obtained from Kubiszewski et al. (2010)
Pollination			X	406 ha	-164	-163	19 $US/ha/year	-$3,121	-$3,099	Economic value per unit for cropland obtained from Kubiszewski et al. (2010)
			X	802 ha	-26	590	376 $US/ha/year	-$9,635	$221,999	Economic value per unit for temperate forest obtained from Kubiszewski et al. (2010)

[Recommendations]

- Land use type practices up-stream

- Institution of PES to up-stream land users

- Recommendations for planned projects

Tashi Delek

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THE ECUADORIAN EXPERIENCE IN VALUING ECOSYSTEM SERVICES TEEB-ECUADOR

ecuador love life

ESCUELA SUPERIOR POLITECNICA DEL LITORAL ESPOL

ESCUELA POLITÉCNICA NACIONAL

Paul Herrera, PhD. (ESPOL)
Maria Cristina Torres, PhD. (EPN)
Study Coordinators

CONTEXT

NATIONAL POLICY FOR:

- Change of Productive Matrix
- Change of Energetic Matrix

TWO TEEB STUDIES IN PROGRESS

- Ecosystem services in the Guayas River Basin (ESPOL)
- Ecosystem services in the Coca Watershed (EPN)

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Integrating the Value of Ecosystem Services in the Cocoa Value Chain: the case of the Daule-Vinces Irrigation project in the Guayas River Basin, Ecuador.

Escuela Superior Politecnica del Litoral ESPOL

CIR Centro de Investigaciones Rurales
impulsando la agricultura del conocimiento

Paul Herrera, Ph.D.
Study Coordinator

Case identification

FIRST QUESTION MADE TO POLICEMAKERS

- What is the most important problem (decision-making) in the Guayas River Basin related to ES?

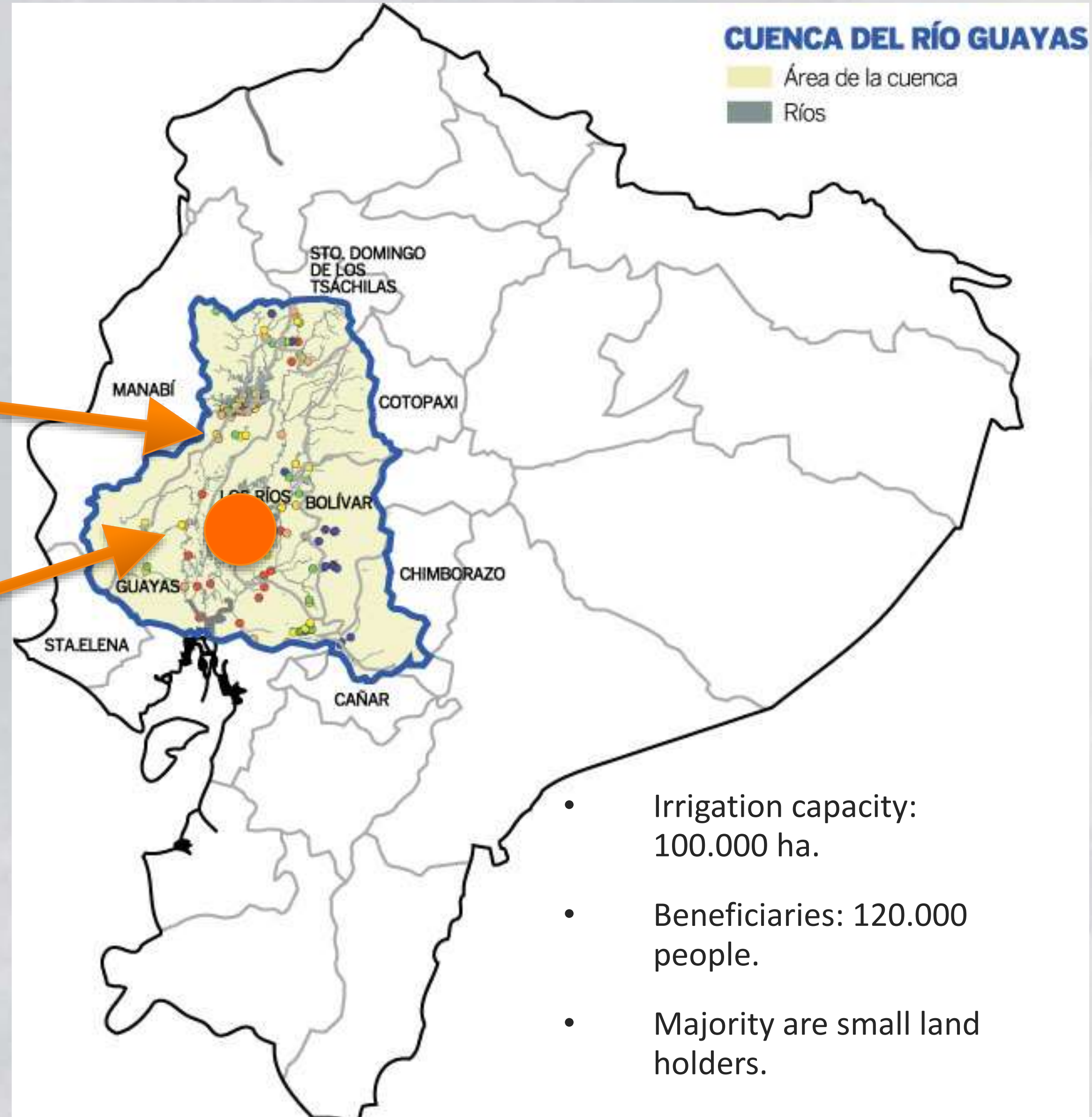
FIRST IDEAS

- Get all the benefits from the big investments made in the **Daule-Vinces (or DAUVIN) Irrigation Project**.
- No clear definition about **what type of agriculture and what type of development model can be more adequate for the area**.

Ecuador - Guayas River Basin

Guayas River Basin

Daule-Vinces Water Transfer System



- Irrigation capacity: 100.000 ha.
- Beneficiaries: 120.000 people.
- Majority are small land holders.

TEEB FRAME FOR THE STUDY

1. **IMPACT ORIENTED** ECOSYSTEM SERVICES VALUATION (POLICY)
2. FROM **BIOPHYSICAL** MODELING TO **ECONOMIC VALUATION** MODELING
3. RESULTS BASED ON **VALUATION SCENARIOS**
4. MULTI-SECTORIAL PARTICIPATION AND **COMMUNICATION**

1

IMPACT ORIENTED ECOSYSTEM SERVICE VALUATION

Based on consultations and effective collaboration

FOCUSING THE STUDY

THE ECUADORIAN COCOA

- **Ecuador** is one of the **leading** countries in **cocoa production and exports**.
- About 8% of world cocoa production is “Cacao Fino de Aroma” (Fine Cocoa Aroma).

- 80% of this cocoa is produced en LA.
- **Ecuador** alone **produces** about **70% of this cocoa**.
- About **90% are small farmer**.

CURRENT SITUATION

- **Ministry of Agriculture** started to **promote Cocoa** production in the area of the Dauvin Irrigation Project.
- **International firms** (American and European) started to **invest in the area** (collecting and processing facilities).
- Among **farmers**, there is an **increasing interest in cocoa**, based on its profitability.
- **Excellent future** perspectives in the international market, but high concern on **quality issues** associated to presence of **heavy metals** (Cadmium, Mercury, etc).

2

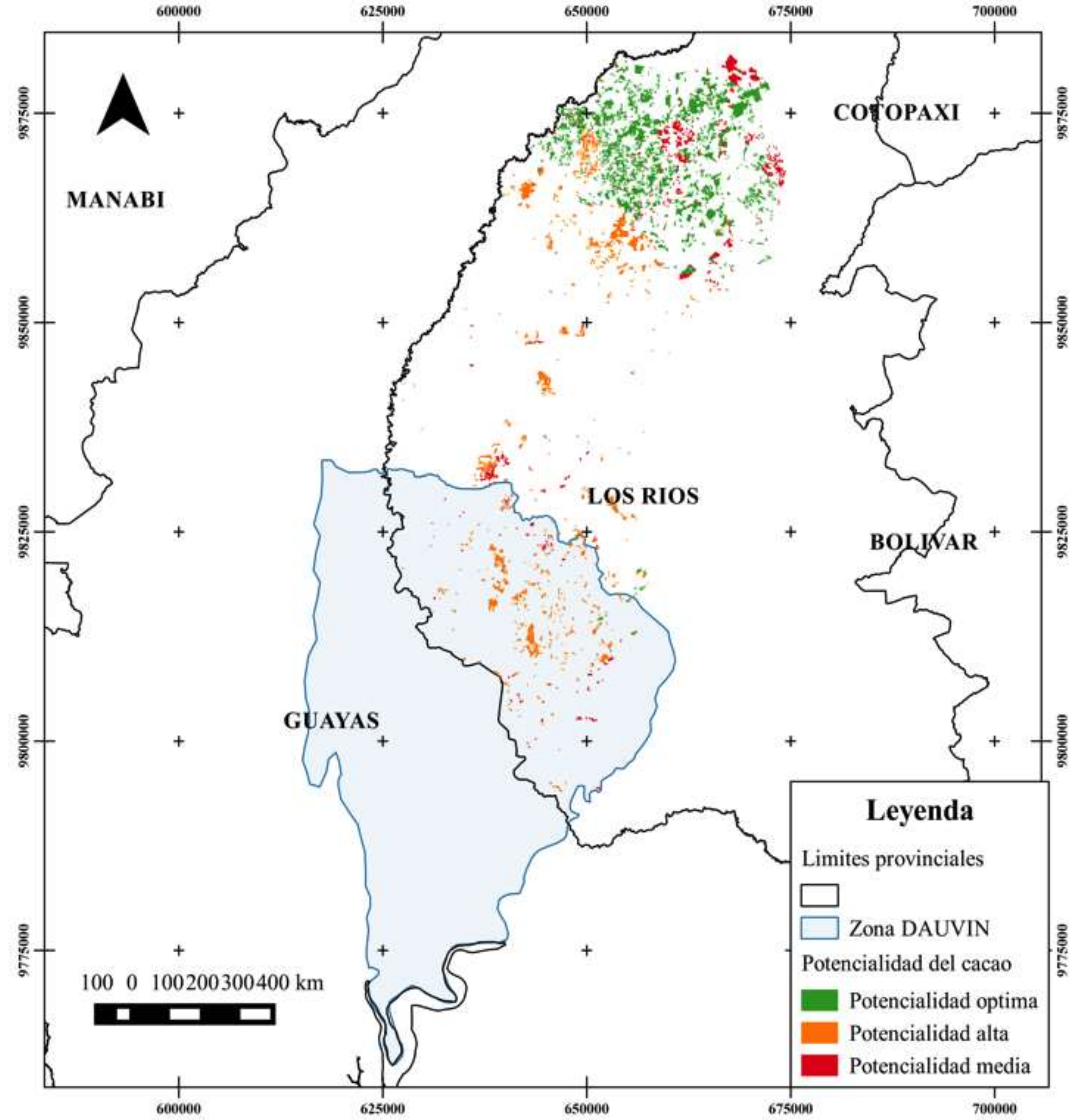
FROM BIOPHYSICAL TO ECONOMIC MODELING

Based on a multidisciplinary approach

Categories:

1. Optimal
2. High
3. Medium
4. Low (not shown)

About 13.000 has.



The Biophysical-Economic model

The Economics of Ecosystems & Biodiversity

AGRICULTURAL PRACTICES → **IMPACTS** → **CONSEQUENCES**

AGRICULTURAL PRACTICES

IMPACTS

CONSEQUENCES

The Biophysical-Economic model

Agricultural Practices in Cocoa production

- Which affect soils
- Which affect water
- Which affect the plant and the quality of the cocoa beans

Ecosystem services affected

- Soil fertility
- Water quantity and quality

Economic consequences

- Low crop yield
- Limited access to markets and low prices
- Low farmers income
- Poor living conditions

Biophysical model based on…

ANALYSIS OF CERTAIN BIOPHYSICAL KEY PARAMETERS

Elements in soil:

- Nitrogen (total)
- Phosphor
- pH
- Organic matter
- Texture and humidity
- Heavy metals: Cadmium, lead
- Microorganisms in soil and total

Elements in water:

- Nitrogen (total)
- Phosphor
- pH
- Electric conductivity
- Heavy metals: Cadmium, lead

Elements in the cocoa tree leafs:

- Cadmium, lead

150 samples were collected in cocoa farms and analyzed in ESPOL labs.
Results are being reviewed and processed.

Economic model based on…

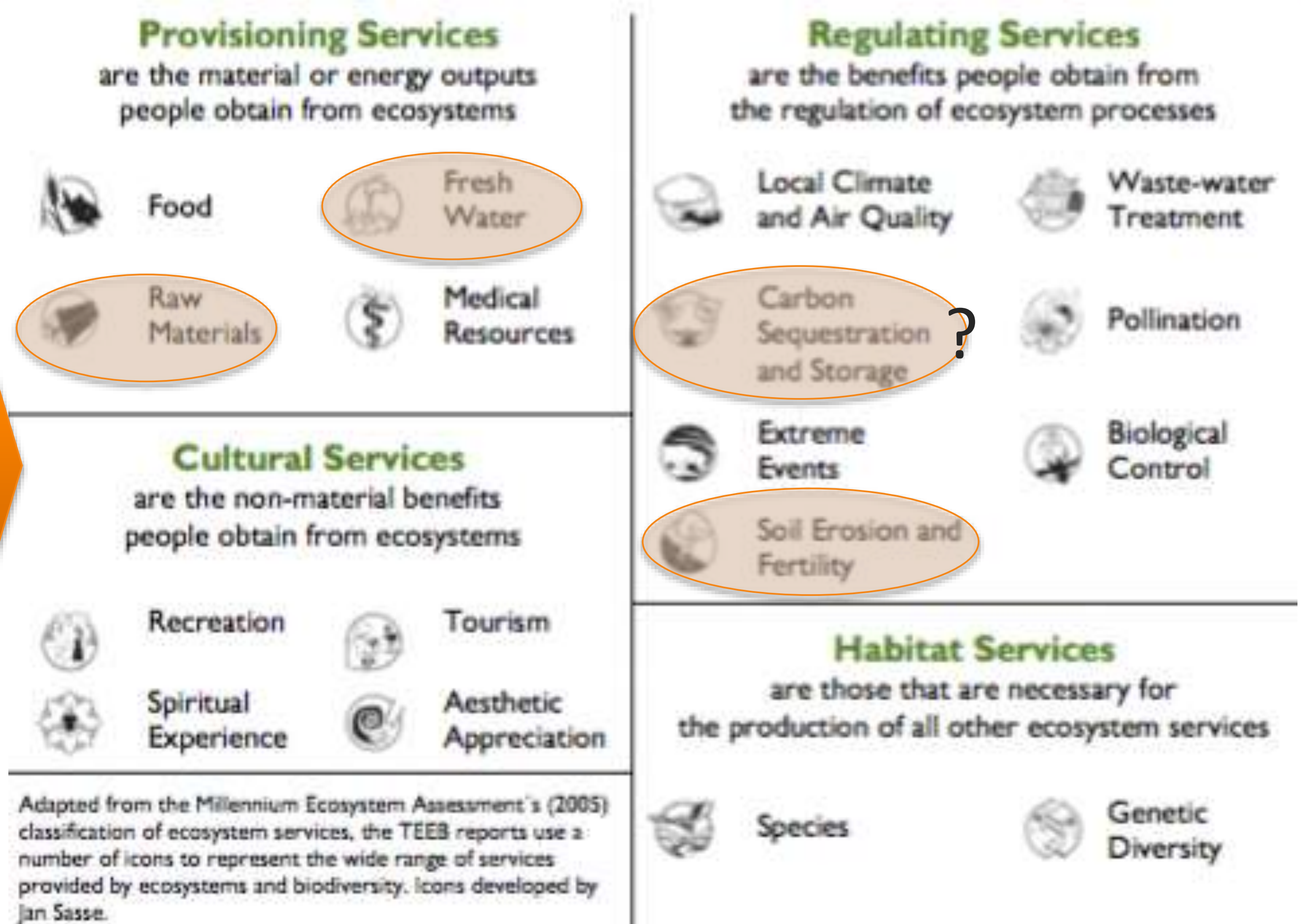
A survey campaign based on a:

- Sampling plan that includes the 150 initial sampled points, plus 350 points inside and outside the Dauvin irrigation project area (Organic producers as control).
- Format included questions about agricultural practices, farm structure and assets, economic aspects of cocoa production, as well as some idiosyncratic variables.

510 questionnaires were completed and are being analyzed by experts in statistics and economic valuation

ES under analysis

Ecosystem Services to be valued



3 RESULTS BASED ON VALUATION SCENARIOS

Based on data analysis and stakeholders participation

VALUATION SCENARIOS

BASED ON THE CONSTRUCTION OF A TYPOLOGY OF AGRICULTURAL PRACTICES IN COCOA PRODUCTION.

Group	Profile	Description	%
1. Small farmers	1	Use of modern and non-modern irrigation techniques; Exclusive use of chemical pesticides and fertilizers. Low yield.	50.25
	2	Non use of irrigation nor chemical pesticides or fertilizers. Low yield	45.24
2. Medium-Big size farmers up to 100 has.	1	Big size farmer, with technical use of irrigation. High use of chemical pesticides and fertilizers. Medium to high yield.	2.30
	2	Medium size farmers, with technical and non-technical use of irrigation. High use of chemical pesticides and fertilizers. Medium yield.	1.23
	3	Medium size farmers, with non-technical or non-use of irrigation and/or chemical pesticides and fertilizers. Low yield.	0.98

Key aspects for definition of Valuation Scenarios

- Not necessarily small farmers are ES friendly as neither medium or big farmers
- The higher the size of the farm the higher the importance of productivity (which may demand more agricultural inputs)
- Trade off between practices that improve productivity but may affect Ecosystem Services
- Differences in capacity to adopt agricultural practices that are ES friendly

VALUATION SCENARIOS

	BAU	Scenario 1	Scenario 2
Increase of production area	Marginal increase	Significant increase	Significant increase
Change in agricultural practices	No change	No change	Practices change
Benefits of Irrigation project (productivity)	No benefits	Benefits (increased productivity)	Benefits (increased productivity)
Improving economics conditions of rural poor	No improvements	Improvements	Improvements
Improving living conditions of rural poor related to ES dependencies	No improvements	No improvements	Improvements
ES provision / health	? (+/-)	? (-)	? (+)

4

MULTI-SECTORIAL PARTICIPATION AND COMMUNICATION

Based on a defined strategy

QUESTIONS FOR POLICY DESIGN

Which technologies for cultivation, irrigation, crop protection, harvest, etc, should be promoted in the area?

Which practices can help to reduce the impact over the ecosystems?

Which institutional arrangements can help to have a sustainable irrigation system?

What socio-environmental aspects should be considered to reduce conflicts and improve the resilience of the eco-systems in the Dauvin area?

Local collaborations from…

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ESPOL

Ministerio de Agricultura, Ganadería, Acucacultura y Pesca

Ministerio del Ambiente

Secretaría Nacional del Agua

INEC

instituto nacional de estadística y censos

Farmer's participation

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TEEB: The Philippine Country Study

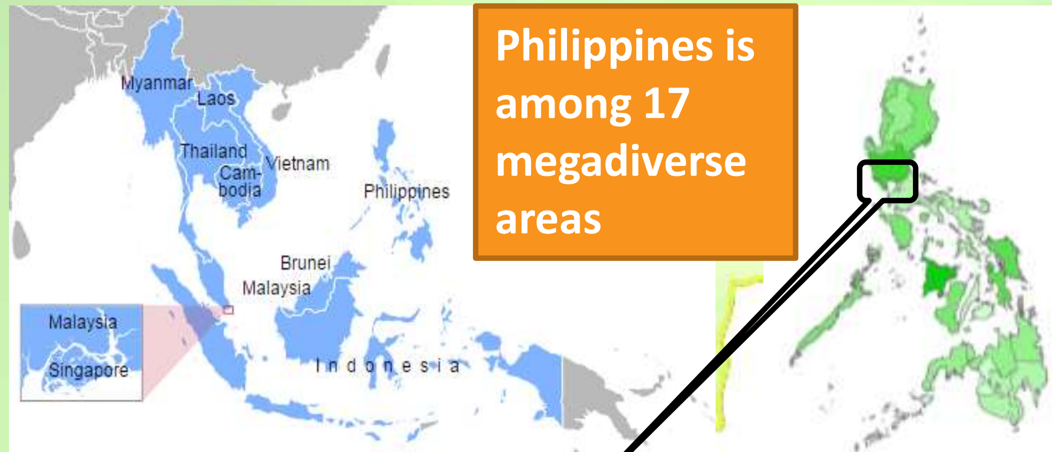
CBD COP 13 Cancun, Mexico December 2016

European Commission

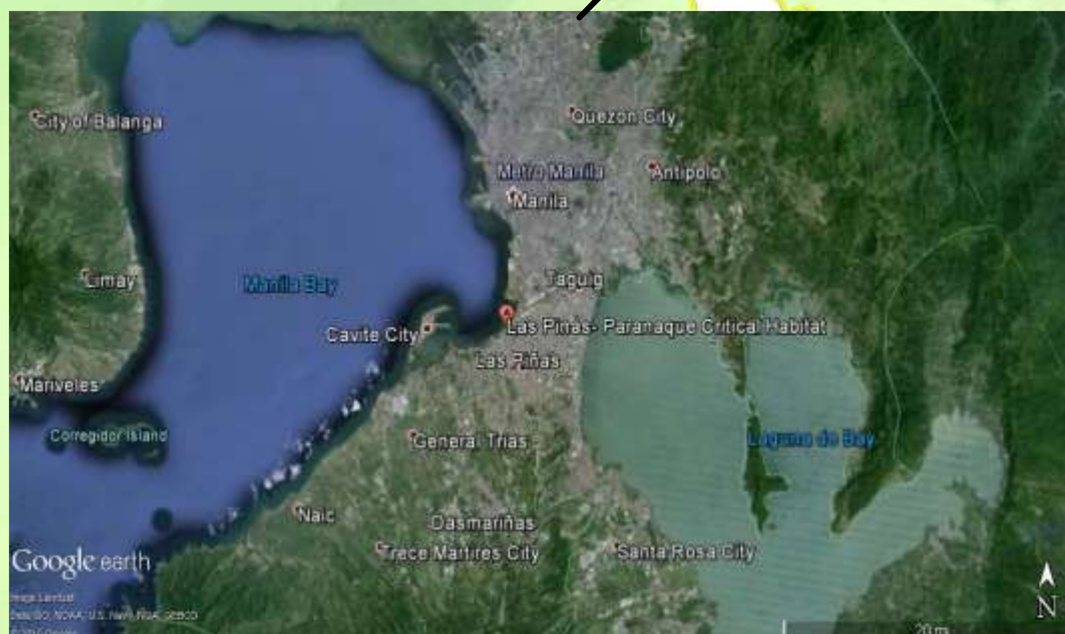
Project Scope

Manila Bay

- 30 % of the country's population (of 100+ M) is in Manila Bay watershed area,
- Contributes as much as 52% of GDP
- Economic value estimated at PhP 8 Billion/year (PEMSEA, 2005) – focused on losses due to decline in water quality
- Supreme Court December 18, 2008 writ of continuing mandamus "to rehabilitate, restore, and conserve the Manila Bay at the earliest possible time?



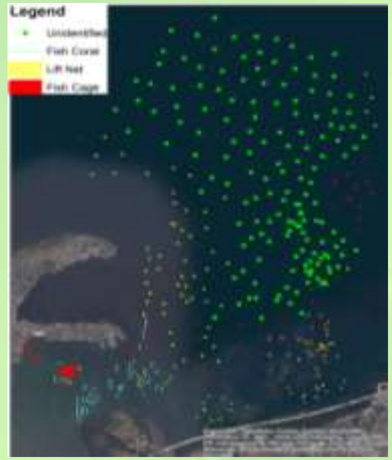
Philippines is among 17 megadiverse areas



European Commission

Why topic was chosen..

- Coastal ecosystems conversion including reclamation, particularly in the Manila Bay coastlines
- Increasing pollutants causing algal blooms and fish kills
- Rapid loss of ecosystems and biodiversity
  - Rapid expansion of settlements,
  - infrastructure development,
  - coastal developments

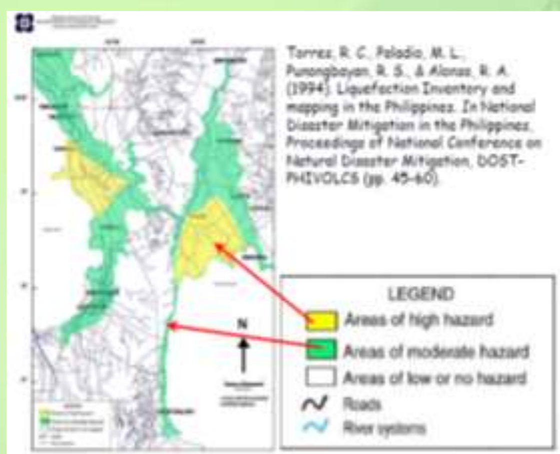


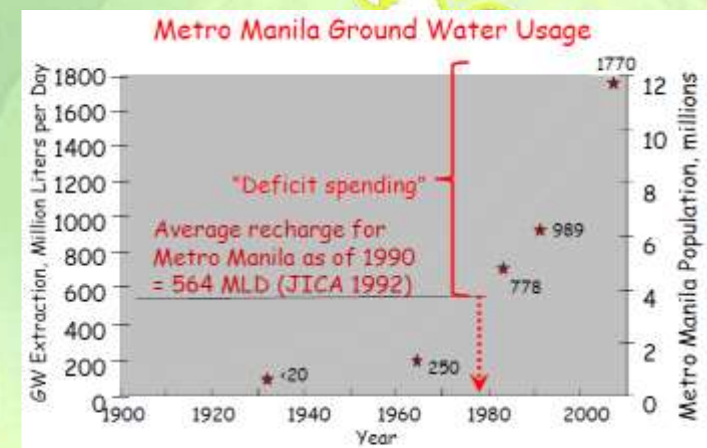
Why the topic was chosen..

- **National Reclamation Plan (NRP), 102 reclamation projects nationwide;**
  - Thirty eight (38) of these reclamation projects encompassing 26,234 hectares, or 70% will be implemented in Manila Bay.

- Reclaimed coastal areas are susceptible to **liquefaction and enhanced ground-shaking during earthquakes** (Torres et al., 1994).

- Metro Manila's coastal areas are sinking as fast as 9 cm/y (Rodolfo et al. 2003, Siringan and Rodolfo 2003, Rodolfo and Siringan 2006)
- **Subsidence, liquefaction and seismic ground acceleration are critical hazard factors in near shore reclamations**
- subsidence is worsening both floods and high - tide invasions.
- Global warming has raised sea level by about 3 mm/y from 1993 - 2009





Kelvin Rodolfo, 2014. Commentary: On the geological hazards that threaten existing and proposed reclamations of Manila Bay. Philippine Science Letters Vol. 7 No. 1 2014

Stakeholder Engagements

Training/Workshop on scenario development March 30, 2016, Hotel Jen.

Metro Manila Development Authority (MMDA),
Department of Public Works and Highways (DPWH),
Philippine Reclamation Authority (PRA),
Local Government Unit of Paranaque,
Biodiversity and Management Bureau (BMB),
Environmental Management Bureau (EMB),
Ecosystems Research and Development Bureau (ERDB),
National Mapping and Resource Information Authority (NAMRIA),
Manila Bay Coordinating Office (MBCO) and more

Workshop on Biophysical Data Assessment June 6, 2016

European Commission

Ecosystem Services Identified

Provisioning Services

1. Fishes, Invertebrates, other fishery products from open waters
2. Seaweeds from open waters
3. Wood raw materials from mangroves

Cultural Services

1. Recreation services of beach areas
2. Ecotourism of mangrove and mudflats
3. Aesthetic of the habitats and the bay
4. Scientific and educational value of bay ecosystems
5. Heritage and cultural services of the Bay

Regulating Services

1. Water quality maintenance of open waters
2. Habitat for migratory and local birds
3. Flood regulation of mangroves
4. Storm urge protection by coral reef, seagrasses and mangroves
5. Sea Level Rise protection by coastal habitats (coral reef, seagrasses and mangroves)
6. Waste dilution and assimilation services of open waters and mudflats
7. Carbon sequestration and storage by mangroves
8. Sediment retention by mangroves
9. Filtering values of mudflats and ponds

Data Inputs from Stakeholders

1

Ecosystems and corresponding data

- Mudflats
- Mangroves
- Open waters
- Fishponds
- Fish pens and fish cages
- Critical Habitat and Ecotourim Area
- Completed, on-going and proposed reclamation
- Ponds
- Lagoons
- Sand and Beach areas
- Coral reefs and seagrasses
- Bathymetry data
- Prior years topographic maps

2

Compilation of biophysical and monetary values

Data Sources	Maps	Socio-demographic	Monetary Values	Cost Data	Biophysical Data	Legal Documents	Management and Regulatory Information	Other Information
Department of Environment and Natural Resources - National Capital Region								Manila Bay Project reports, thesis, surveys, assessments
DENR-Biodiversity Management Bureau								
DENR-Manila Bay Coordinating Office	Manila Bay Atlas			Dikes and Breakwaters	Manila Bay Atlas		Management plan, informal settlers	
Metro Manila Development Authority		Informal Settlers						
Department of Agriculture - Bureau of Fisheries and Aquatic Resources					Fish Biomass Study			
National Mapping and Resources Information Administration	Bathymetry, Land Cover Map, Topographic Map							
Department of Public Works and Highways			Damage data				Flood Management Master Plan	
Laguna Lake Development Authority					Hydrodynamic modeling			
Department of Interior and Local Governments		Informal Settlers						
Philippine Reclamation Authority	Sketch maps of existing and proposed reclamation areas						National Reclamation Plan	
Philippine Statistical Authority		Demographic data			Fishery production			
REECS	Site visits, Google earth digitization	Focus group discussion	Focus group Discussions, estimates of mangrove carbon	Focus group discussion	Birds Census, fishers interviews, Aerial surveys			
Exiting Literatures, Reports, Journals	Earthquakes, subsidence, water supply			Research Reports				Modeling

3

Transforming these into map layers for spatial assessment of ecosystem extent, condition and supply of ecosystem services

Systems Modeling and Scenario Analysis

Spatial Assessment of Economic Values of Marine and Coastal Ecosystem Services

SCENARIO 1 — Business as Usual
- No PRA Approved Reclamation;
- Current Implementation of Site Management Plan not approved by PRA and partial Enforcement of Policy EO 1412-A

SCENARIO 2 — Without Approved PRA Reclamation
- Site Management Plans Fully Enforced and Implemented (EO 1412-A)

SCENARIO 3 — With Approved PRA Reclamation
- All PRA planned reclamations push through
- With infra development (residential areas) right on the buffer zone

SCENARIO 4 — With Approved PRA Reclamation, Restoration of Ecosystems and Habitats
- With integrated on-site enhancement of biodiversity
- Restoration of ecosystem functions to enhance DRR potentials and local fishery production

Fish Biomass Trend Modeling

Manila Bay Sedimentation Modeling

Habitat and migratory bird population dynamics

Climate change models : Storm surge and sea level rise

Wetlands, Other Habitats and Water Quality Modeling

RISK MODELING: LIQUEFACTION AND LAND SUBSIDENCE

TEEB:
PHILIPPINE COUNTRY STUDY

Policy relevance

- Integration of ES and biodiversity valuation and accounting in local land use and climate change related action planning
- Inclusion of ES sustainability and biodiversity among indicators of natural capital and national wealth
- Inclusion of ecosystem services impacts in the implementation of the EIA and inform proposed reclamations

CLIMATE CHANGE COMMISSION · PHILIPPINES ·

Philippine Economic-Environmental and Natural Resources Accounting

LAWS AND POLICIES
Environmental Impact Assessment

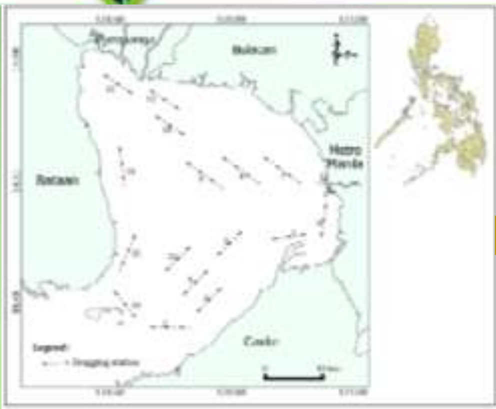
PHILIPPINE RECLAMATION AUTHORITY
We increase our nation's resources and accelerate its development for future generations by creating new frontiers reclaimed from the sea.

UNEP REECS European Commission

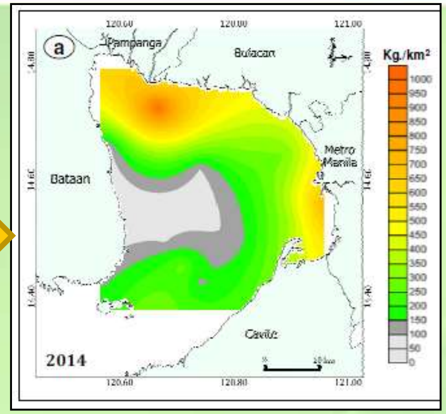
Targeted Policy Processes and Intitutionalization

- Improvement of the EIA process
- Integration of biodiversity and ecosystem considerations in local land use planning such as estimating its direct and indirect contributions to economic and other human activities
- Institutionalizing ecosystem and biodiversity accounting in the Philippine Statistical Authority

Biophysical and Economic Modeling



Manila Bay Fish Trawling Survey Locations



Demersal Fish biomass distrib. in Manila Bay

Species	Type	Biomass (kg/km2)	Relative Abundance Estimate
1 *Encrasicholina devisi*	P	59.85	15.2%
2 *Sardinella gibbosa*	P	51.16	13.0%
3 *Sardinella fimbriata*	P	40.25	10.2%
4 *Rhabdamia cypselurus*	D	39.63	10.1%
5 *Sardinella lemuru*	P	25.69	6.5%
6 *Photololigo edulis*	I	23.7	6.0%
7 *Johnius belangerii*	D	19.77	5.0%
19 *Parastromateus niger*	D	3.38	0.9%
20 *Stolephorus indicus*	P	3.31	0.8%
Other species (126)		39.43	10.0%
Total		392.86	100.0%

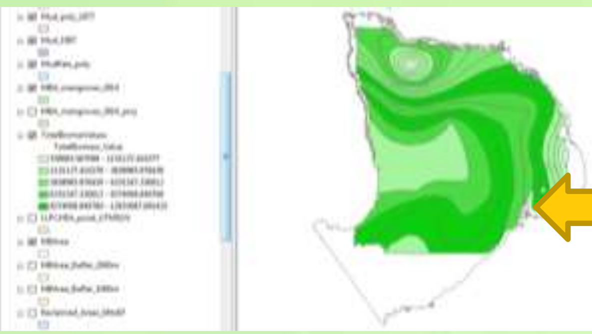
Rel. abundance estimate of demersal and pelagic fish

		Total				Pelagic	Demersal	Invertebrates
Biomass Range, kg/km2	Area, hectares	Biomass, kg/km2, max of range	Total Demersal Biomass based on max of range	Biomass, mt/km2	2014 Biomass Total Based on demersal fish data	51%	40%	9%
0-100	19,000	50	9,500	0.05	23,750	12,113	9,500	2,138
100-150	19,000	150	28,500	0.15	71,250	36,338	28,500	6,413
150-200	20,000	200	40,000	0.20	100,000	51,000	40,000	9,000
200-250	19,000	250	47,500	0.25	118,750	60,563	47,500	10,688
250-300	12,300	300	36,900	0.30	92,250	47,048	36,900	8,303
300-350	8,800	350	30,800	0.35	77,000	39,270	30,800	6,930
350-400	9,200	400	36,800	0.40	92,000	46,920	36,800	8,280
400-450	9,500	450	42,750	0.45	106,875	54,506	42,750	9,619
850-900	946	900	8,516	0.90	21,289	10,858	8,516	1,916
900-950	264	950	2,512	0.95	6,280	3,203	2,512	565
Grand Total	150,248		480,950		1,202,375	613,212	480,950	108,214

Total fish biomass distribution per biomass range, kg/km2

2014 Data, kg		Demersal Fishes		Pelagic	Invertebrates	Other
Biomass Range, kg/km2	Total Biomas, 2014	Swellow tail cardinal fish	Belanger's croaker	Devi's anchovy	Swordtip squid	Species
	100%	10.1%	5.0%	15.2%	6.0%	11.7%
0-100	23,750	2,398	1,195	3,618	1,423	2,780
100-150	28,500	2,875	1,434	4,342	1,719	3,336
150-200	40,000	4,035	2,015	6,094	2,413	4,682
200-250	47,500	4,792	2,390	7,236	2,888	5,559
250-300	36,900	3,722	1,837	5,622	2,226	4,319
300-350	30,800	3,107	1,550	4,692	1,858	3,605
350-400	36,800	3,712	1,852	5,606	2,220	4,307
400-450	42,750	4,312	2,151	6,513	2,579	5,003
450-500	38,500	3,884	1,937	5,865	2,323	4,506
500-550	34,100	3,440	1,716	5,195	2,057	3,991
550-600	27,600	2,784	1,389	4,205	1,665	3,230
600-650	34,803	3,511	1,751	5,302	2,100	4,073
650-700	30,727	3,100	1,546	4,681	1,854	3,596
700-750	14,250	1,437	717	2,171	860	1,668
750-800	9,600	968	483	1,463	579	1,124
800-850	7,582	765	382	1,157	458	889
850-900	8,516	859	429	1,297	514	997
900-950	2,512	253	126	383	152	294
Total	495,300	49,954	24,920	75,441	29,874	57,958

Total value of fish biomass per biomass range, kg/km2



Spatial dist. of fish biomass values per biomass range, kg/km2

Based on Bendaño AP, FSB Torres Jr., GDV. Lopez, MA Perez and M.D. Santos. 2016. Biomass trends, species composition, distribution and exploitation of dominant fisheries species in Manila Bay using experimental trawl survey . National Fisheries Research and Development Institute Corporate 101 Bldg., Mo. Ignacia Ave. South Triangle, Quezon City 1103 Philippines

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