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Eco-DRR and valuation of ecosystem services

Presentation at SDC/HA DRR training Bern 27 August 2018 by Nadia Zuodar

Overview

- Objectives
- General concepts on Eco-DRR
- SwissRe example on Coral Reef insurance.
- How to address DRR cost-benefit analysis through ecosystem valuation
- GGGI ECBA exercice

Objectives

- **To introduce key Eco-DRR and ecosystem valuation concepts and methodologies**
- **To reflect on their use for DRR cost-benefit analysis**
- **To practice with an example**

Eco-DRR (nature-based solutions) recognition

Ecosystem-based disaster risk reduction is defined by the Partnership for Environment and Disaster Risk Reduction (PEDRR) in 2011 as the "sustainable management, conservation and restoration of ecosystems to provide services that reduce disaster risk by mitigating hazards and by increasing livelihood resilience". ISDR

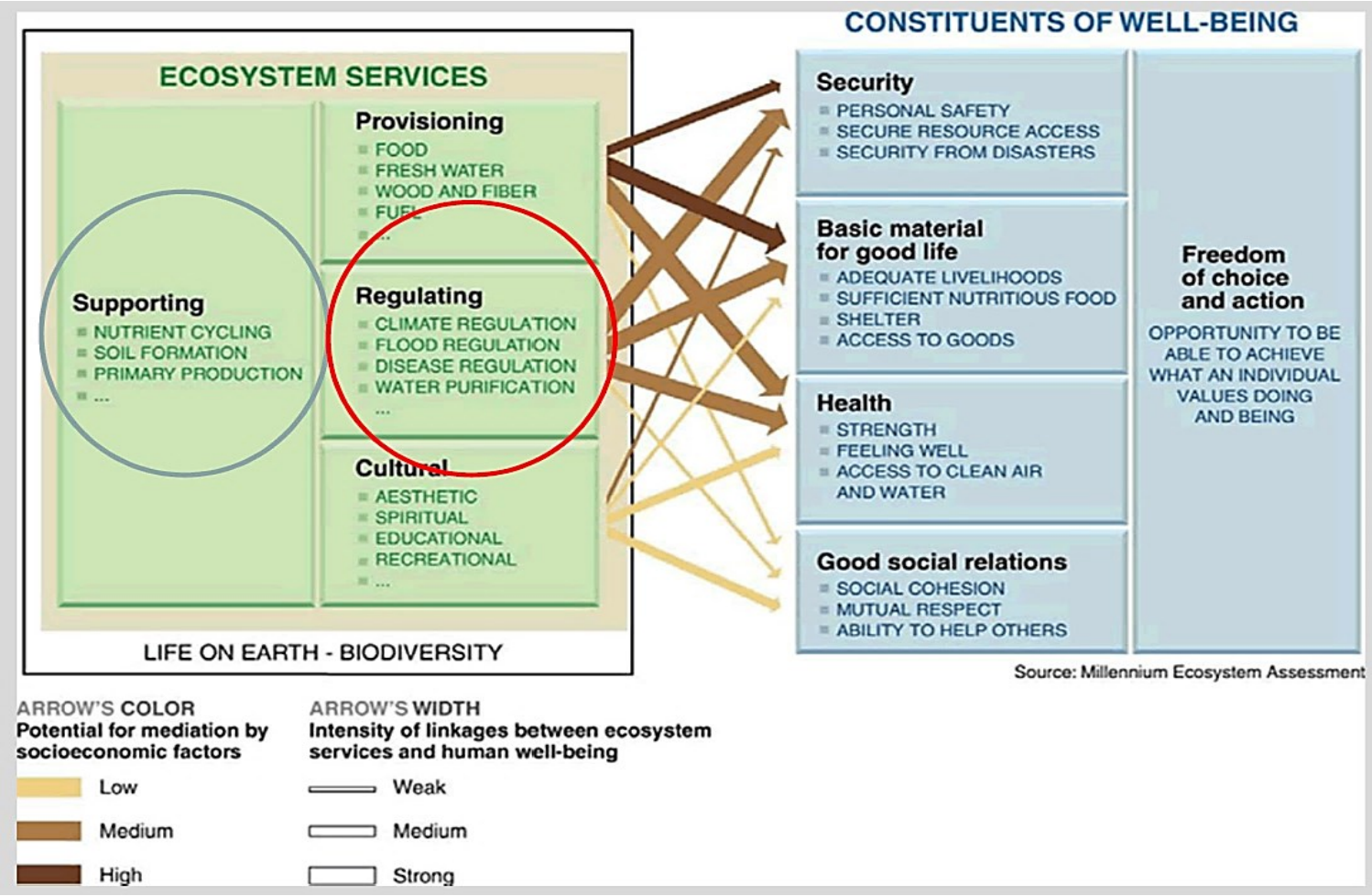
Healthy and well-managed ecosystems – such as coral reefs, mangroves, forests and wetlands – reduce disaster risk by acting as natural buffers or protective barriers, for instance through flood and landslide mitigation and water filtration and absorption. At the same time, fully-functioning ecosystems build local resilience against disasters by sustaining livelihoods and providing important products to local populations. (PEDRR)

Eco-DRR (nature-based solutions) recognition

- In the Sendai Framework ecosystems need to be considered in 3 of the 4 priority actions.
- However the use of ecosystem management as a tool for DRR is still underdeveloped and missing in DRR plans.
- Strong advocates for Eco-DRR are ISDR, UNEP, IUCN, WWF, PEDRR…

➢ **Eco-DRR brings multiple benefits, DRR is often implicit such as in PEDRR framework.**

Ecosystems services and DRR (PEDRR)



Three levels of the Common International Classification of Ecosystem Services (CICES)

CICES for SEEA Experimental Ecosystem Accounting				
Section (1-digit)	**Division (2-digit)**	**Group (3-digit)**	**Examples of ecosystem services**	**Examples of benefits**
Provisioning	Water	Water	Water taken up for the growing of crops and animals, agricultural, mining, manufacturing and household use, etc.	Drinking water, water for crop production, livestock feed, thermoelectric power production, etc.
	Materials	Uncultivated terrestrial plants and animals for food	Uncultivated terrestrial plants and animals (e.g., game animals, berries and fungi in the forest) taken up for food	Food for human consumption
		Uncultivated freshwater plants and animals for food	Uncultivated freshwater plants and animals (e.g., plaice, sea bass, salmon, trout) taken up for food	Food for human consumption
		Uncultivated marine plants, algae and animals for food	Uncultivated marine plants, algae and animals (e.g., seaweed, crustaceans such as crabs, lobsters, crayfish) taken up for food	Food for human consumption
		Nutrients and natural feed for cultivated biological resources	Nutrient resources for uptake by crops, fodder for livestock, feed for aquaculture products	Crops and vegetable products, cultivated timber and cotton, cattle for meat and dairy products, aquaculture products
		Plant and animal fibres and structures	Plant and animal fibres and structure (e.g., natural timber, straw, flax, skin, bone, algae) to be harvested for manufacturing or domestic use	Logged timber, straw, flax, algae, natural guano, corals, shells, skin and bone for further processing in the manufacturing industry (e.g., fertilizer and chemicals) or final consumption
		Chemicals from plants and animals	Substances and biochemicals (e.g., rubber, enzymes, gums, oils, wax, herbal substances) from living organisms taken up for medicinal use, manufacturing or domestic production	Substances and biochemicals, such as rubber, enzymes, gums, oils, wax, herbs for cosmetic and medicinal use or for further processing in the manufacturing industry
		Genetic materials	Genetic materials taken up for breeding programmes (e.g., for crop plants, farm animals, fisheries and aquaculture)	Genetic materials used for breeding programmes (e.g., for crop plants, farm animals, fisheries and aquaculture)
	Energy	Biomass-based energy	Wood taken up for fuel; uncultivated energy plants, algae to be harvested for biofuel; dung, fat, oils from natural animal to be extracted for energy	Heating, light, fuel, etc.
	Other provisioning services	Other provisioning services, n.e.c.	Other provisioning services that are not classified elsewhere in this section, such as provisioning of exotic animals, tamed animals trained to harness	Work and pet animals
Regulating	Remediation and regulation of biophysical environment	Bioremediation	Chemical detoxification/breakdown of pollutants by plants, algae, micro-organisms and animals	Reduced level of pollutants/ contaminants in soil and groundwater
		Dilution, filtration and sequestration of pollutants	Dilution of municipal waste-water in rivers, removal of organic materials and nutrients from waste-water by biogeochemical process, filtration of particulates and aerosols, sequestration of nutrients and pollutants in organic sediments, removal of odours	Cleaner air, water and soil

Section (1-digit)	Division (2-digit)	Group (3-digit)	Examples of ecosystem services	Examples of benefits
Regulating (cont'd.)	Flow regulation	Air flow regulation	Natural or planted vegetation that serves as shelter belts, air ventilation services	Dust storm mitigation, shelter from the wind, improvement of ventilation and heat mitigation in urban areas
		Water flow regulation	Regulation of timing and magnitude of water run-off, flooding and aquifer recharge	Prevention of flood damage, recharge of water into surface water and groundwater, reduced damage from high water levels
		Mass flow regulation	Stabilization of soil and mudflows	Prevention of soil erosion, avalanches and mudflows
	Regulation of physico-chemical environment	Atmospheric regulation	Capture of carbon dioxide, climate regulation, maintenance of urban climate (such as temperature and humidity) and regional precipitation patterns	Reduced amount of greenhouse gases in the atmosphere, reduced impact of climate change, improvement of climate conditions
		Water cycle regulation	Oxygenation of water, retention and translocation of nutrients in water	Improvement of water quality
		Pedogenesis and soil cycle regulation	Maintenance of soil fertility and structure in the cultivated system	Improvement of soil fertility and productivity in the cultivated system
		Noise regulation	Natural buffering and screening	Reduction of noise level
	Regulation of biotic environment	Life-cycle maintenance, and habitat and gene pool protection	Pollination, seed dispersal, maintenance of habitat nursery population and habitats	Improvement of productivity of crops, habitats conservation
		Pest and disease control (including invasive alien species)	Control of pathogens	Reduced hazard level to crops, human health and the environment
Cultural	Physical or experiential use of ecosystems [environmental setting]	Non-extractive recreation	Landscape and seascape character and biodiversity of species for hiking, bird-watching, recreation	Enjoyment from hiking, birdwatching, whale watching, etc.; increased health level; increased number of visitors in the tourism industry
		Information and knowledge	Landscape character and biodiversity of species for scientific research and education	Scientific progress (e.g., such as in pollen record, tree ring record, genetic patterns); increased knowledge (e.g., subject matter for wildlife programmes and books), etc.
	Intellectual representations of ecosystems [of environmental settings]	Spiritual and symbolic	Landscape character and biodiversity of species of cultural heritage values, sense of personal and group identity (sense of place), spiritual and religious function, etc.	Increased sense of personal and group identity, national symbols, performance of spiritual and religious functions
		Non-use	Ecosystem capital for future generation of ecosystem services	Availability of biodiversity and ecosystem services to future generations

Nature-based solutions approaches..

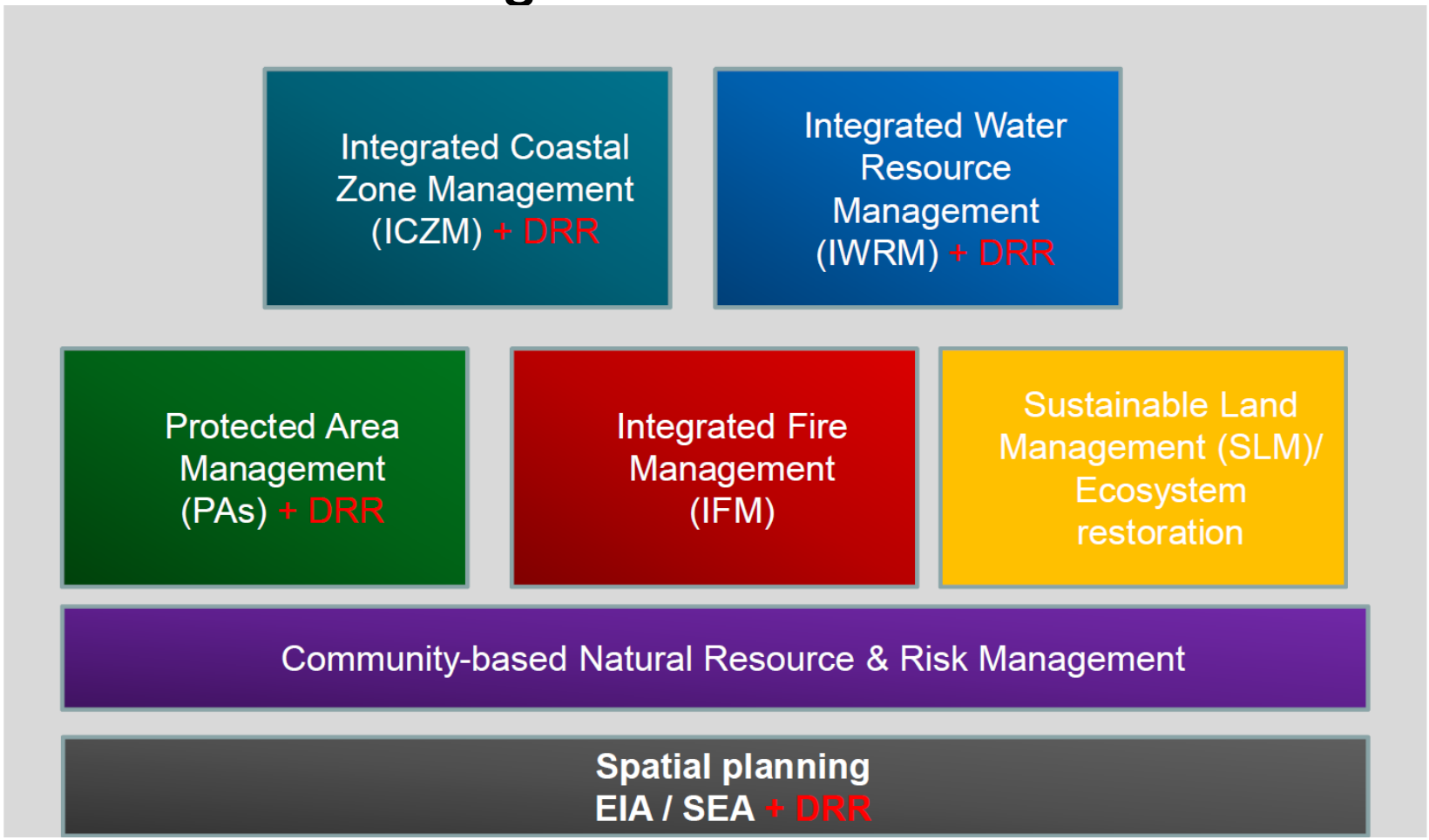
1. Ecosystem restoration approaches
   - ER
   - EE
   - FLR
2. Issue-specific ecosystem-related
   - EbA
   - EbM
   - Eco-DRR
   - CAS
3. Infrastructure-related approaches
   - GI
   - NI
4. Ecosystem-based management
   - EbMgt
5. Ecosystem protection approaches
   - AbC

Examples on how to design nature based solutions:

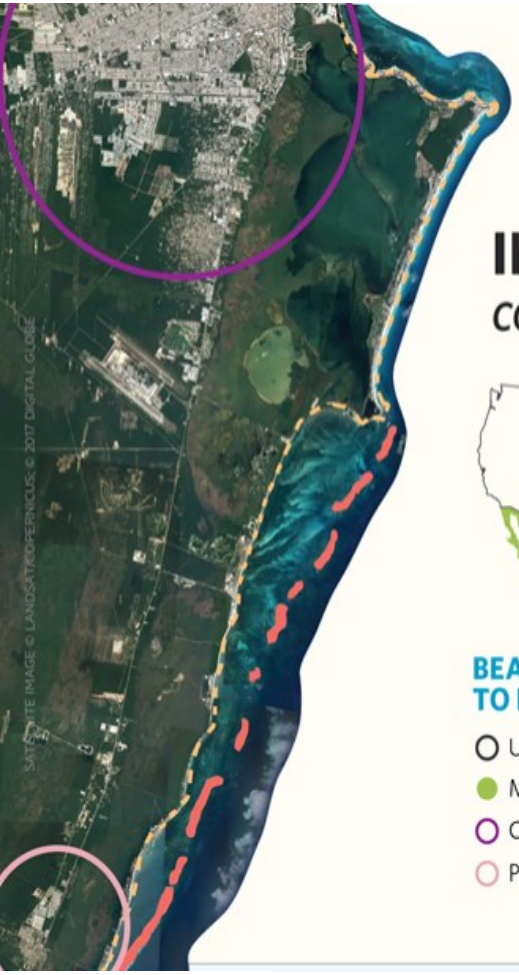
IUCN ROAM Restoration Opportunities Assessment Methodology (ROAM)

WOCAT sustainable land management solutions

Eco-DRR management approaches as entry points for interventions design.



SwissRe new insurance concept for coral reefs



QUINTANA ROO 2016•2022 · MÁS Y MEJORES OPORTUNIDADES · SEMA SECRETARÍA DE ECOLOGÍA Y MEDIO AMBIENTE · The Nature Conservancy

INSURING NATURE TO ENSURE A RESILIENT FUTURE:

COASTAL ZONE MANAGEMENT TRUST

BEACH AND REEF TO BE INSURED

- USA
- Mexico
- Cancun
- Puerto Morelos
- Beach
- Reef

This new fund is designed to bring new private capital to coral reef and beach protection and restoration—and demonstrate a replicable way to monetize the protective services of the reef and beaches to the tourism and hotel sectors of Cancún and Puerto Morelos, Mexico—through a public-private collaboration.

The fund features the first-ever insurance policy on nature—a stretch of the Mesoamerican coral reef and beach based on its protective service—that will pay out to repair and restore the reef in the event of a major storm. Building capacity to implement projects is a key component: partners developed an immediate response protocol, formed brigades to respond after a storm, created reef restoration and beach erosion management guidelines.

SwissRe new insurance concept for coral reefs

PARTNERSHIP WITH THE INSURANCE INDUSTRY NOW ALLOWS US TO MEASURE HOW MUCH RISK A REEF CAN REDUCE.

An estimated 840 million people around the world live with the risk of coastal flooding, and the health of their economies is directly related to the health of their coastal ecosystems.

HOW THE FUND WORKS

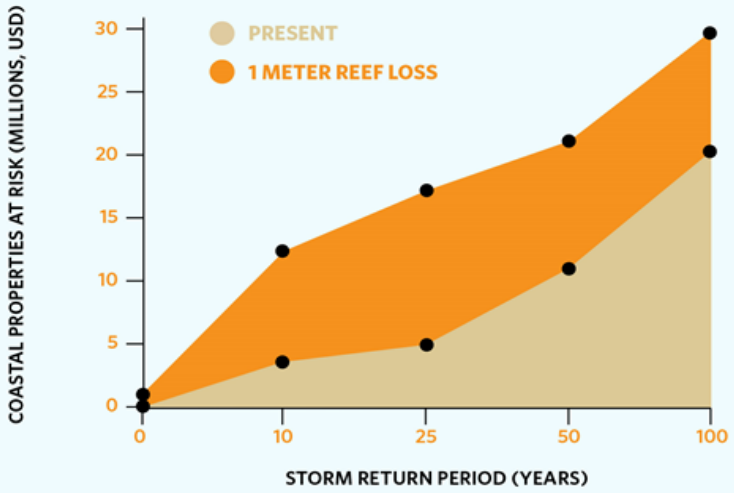
- Pay for the science-based restoration and maintenance that ensures the health of the reef and the beach.
- Pay the premium to buy a parametric insurance policy on a designated stretch of reef and beach.
- Act as "self-insurance" when the beach and reef are damaged by a storm but the policy trigger is not met and there is no payout.

KEY PLAYERS

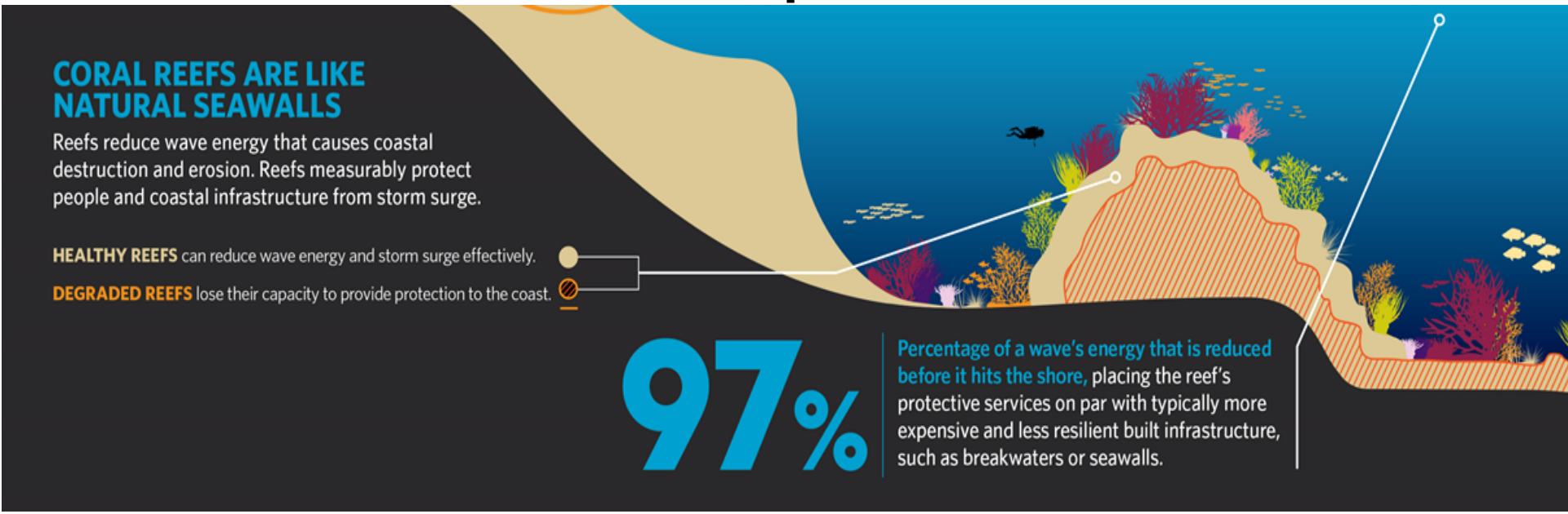
- STATE GOVERNMENT OF QUINTANA ROO, MEXICO
- PUERTO MORELOS REEF NATIONAL PARK (CONANP)
- HOTEL OWNERS ASSOCIATION
- THE NATURE CONSERVANCY

FLOODING IMPACTS ON COASTAL PROPERTIES

Preliminary studies show that a loss of 1 meter of reef crest height would increase damages to built capital up to 300% in Puerto Morelos.



SwissRe new insurance concept for coral reefs



- **It is estimated that 1 USD invested per hectar to protect the coral reef can reduce potential damages from cyclones worth 20 USD (ISDR).**

Links:

[SwissRe reef insurance] [Global Nature article]

Ecosystems valuation tools & cost-benefit analysis:

- **What to measure?** Ecosystem and biodiversity indicators
- **How to measure?** Various methodologies
- **How to value?** Various valuation tools and database

➢ **With the objective to constitute a baseline that can serve DRR cost-benefit calculations purpose**

Examples of methodologies and tools:

The Biodiversity Indicators Partnership (developing biodiversity indicators)

UNEP-WCMC (measuring ecosystem services)

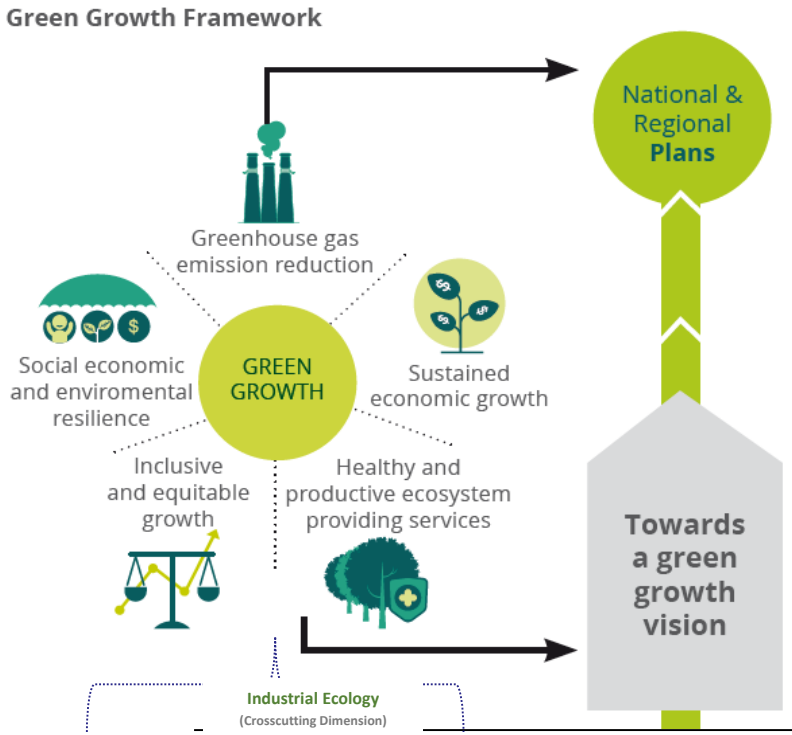
seea.un.org (system of environmental economic accounting)

Globalreporting (Incorporating ecosystem services into an organization's performance disclosure)

GIZ ValuES (Indicators for Managing Ecosystem Services)

GGGI extended cost benefit analysis (www.gggi.org)

GGGI Extended Cost-Benefit Analysis: An Extended Cost Benefit Analysis (eCBA) is a particular manifestation of CBA looking especially carefully at the social and environmental impacts; the hidden and external costs not normally accounted for in decision making.



- eCBA is a way of systematically comparing economic, social and environmental costs and benefits and helps decision makers answer questions such as:
- What is the green growth performance of the project as it is currently designed? **DRR & Resilience are an integral part of GGF.**
- What is the value to the economy, society and the environment of this performance?

GGGI extended cost benefit analysis (www.gggi.org)

The practical implementation of this extended Cost Benefit Analysis involved 7 steps

Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7
Identify project baseline	Identify small green growth options	Map impact pathways	Collect data	Extended Cost Benefit Analysis	Validate findings	Consider implications
Consult project stakeholders Review project documentation	Consult project stakeholders Literature review	Identify outputs, outcomes and impacts Assess materiality, identify scope for eCBA	Collect data from project documentation, local market, and international technology	Quantify costs and benefits of green growth interventions Value cost and benefits to society	Validate findings with stakeholders	Consider implications of results for policy Consider implications for project re-design and investment

Mamminisata Metropolitan Development (South Sulawesi)

Mamminisata Metropolitan Development (South Sulawesi)

Key activities within the baseline development scenario for KSN Mamminasata include:

- Infrastructure development: road, rail, water supply
- Solid and liquid waste management
- Reforestation
- New settlement construction
- Industrial and maritime zones
- New university campus
- Land reclamation project ("Center Point of Indonesia").

➢ Based on this metropolitan development plan, Green Growth interventions are identified and prioritized to compare their cost-benefit

Mamminisata Metropolitan Development (South Sulawesi)

Table 1: Summary Matrix for Green Growth Policy Interventions and Expected Benefits for KSN Mamminasata

Project Activity	Green Growth Intervention	Net Benefit	Benefit-Cost Ratio
Landfill Waste Management	Municipal Solid Waste (MSW) to Energy through methane gas capture from municipal waste landfill	$109m	8.9
Takalar Maritime Zone	Generating higher value-add fish products through better utilization of fish processing waste to generate higher value added products such as fishmeal and fish oil	$96m	6.5
Go Green Program / Clean Water Supply	Reforestation of Jeneberang watershed	$150m	6.1
Total		**$355m**	**6.9**

- For the group exercise we will only look into the Reforestation of Jeneberang watershed

Reforestation of Jeneberang watershed

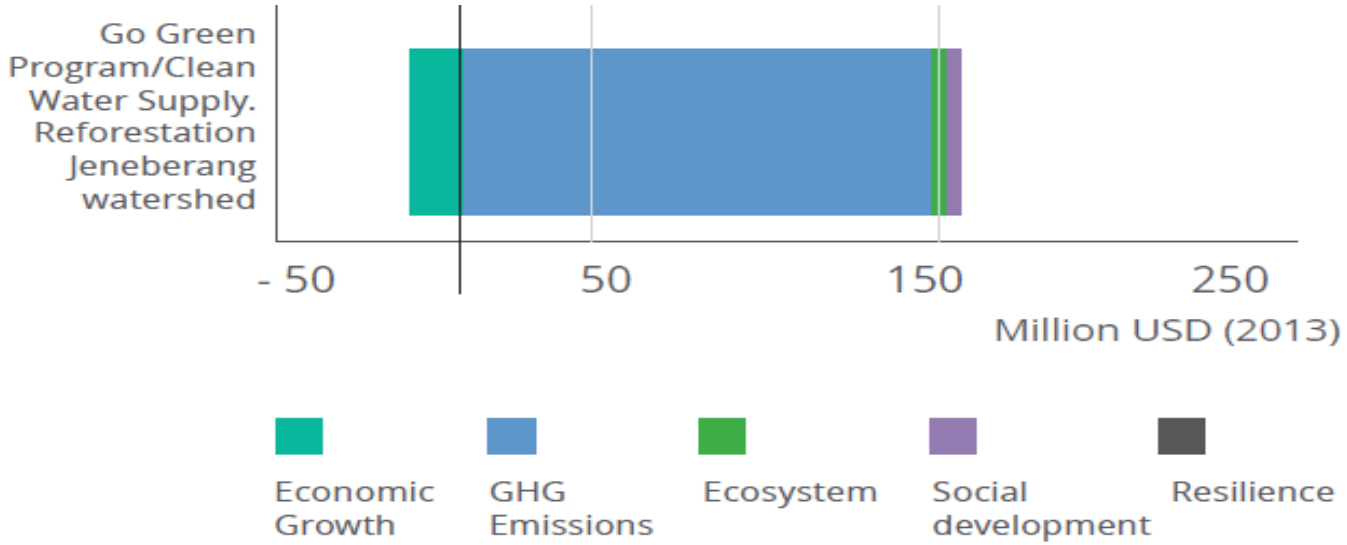
Go Green Program / Clean Water Supply
USD 150m

Reforestation of Jeneberang watershed

Baseline activity: The Go Green Program aims to plant 25,000 hectares of forest across the four districts in KSN Mamminasata to compensate for historical deforestation in and around Makassar. One key related activity is to increase the supply of clean water from the Jeneberang river, passing through the Bili-Bili dam downstream. After treatment, this water will increase the volume of piped water provided to households and businesses in the region. However, the Bili-Bili Dam has suffered from high sedimentation levels due to deforestation in the Jeneberang watershed, upstream of Bili-Bili, potentially increasing costs of water treatment or making it not a feasible option.

Proposed green growth intervention: Rehabilitation of the upper region of Jeneberang watershed to reduce sedimentation at the Bili-Bili dam. This will have positive impact and support the provision of clean water supply to households and businesses in the region.

Reforestation of Jeneberang watershed: results



Costs and Benefits

Benefit: Cost Ratio	Economic Rate of Return	Net benefits	GHG Emissions	Economic Growth	Social Development	Ecosystems	Resilience
6.1	n/a	$150m	$151m	-$12m	$4m	$4m	$2m

Reforestation of Jeneberang watershed: results & conclusion

The largest return in absolute terms comes from the Go Green Program and Clean Water supply intervention which generates USD 150m in total benefits. This result strongly influences the overall cross-portfolio results, where the largest benefit category is GHG emissions.

- But ecosystems and resilience benefits amount to 6 mio.
- **To promote DRR interventions within the scope of a Green Growth model, it is necessary to account for all the benefits and not only the DRR benefits, at least in this specific case.**
- **DRR benefits are multifacets, one should not only compare the CB of an intervention versus another but also the multiplication effect a range of interventions can have to optimize DRR results.**

Methodology: Project costs

Go Green Program / Clean Water Supply	•*Forest rehabilitation*	Cost of planting community forest ('rebioization')	USD 44/ha	*Peraturan Dirjen Bina Pengelolaan DAS dan Perhutanan Nasional No P6/V-SET/2011 tentang Ancar-ancar Harga Satuan Pokok Penganggaran Pembangunan Bidang PDAS&PS Tahun 2012*
		Cost of maintaining (year 1)	USD 271/ha/yr	
		Cost of maintaining (years 2-5)	USD 77/ha/yr	
		Annual dredging required at Bili-Bili due to over-sedimentation	1,200,000 m^3/year	*Ministry of Public Works, Balai Besar Wilayah Sungai*
		Dredging costs	USD 2.64/m^3	
		Time taken for new forest to reach full natural capital value in Table above	20 years	*SME-based assumption*
		Carbon stock in forest after 20 years	50 tC/ha	*SME-based assumption*

Methodology: ecosystem valuation

Forest ecosystem valuation (secondary forest)	***Direct***		Guideline Economic Valuation Forest Ecosystem, KLH (2010) *Note: Except, Carbon sequestration based on Social Cost of Carbon above and value for carbon stock in Table below. Carbon stock in forest after 20 years, not an ecosystem service flow ($/ha, not $/ha/yr)*
	- Timber	693USD/ha/yr	
	- Non-timber forest products	500USD/ha/yr	
	- Firewood	2 USD/ha/yr	
	- Water supply regulation	5 USD/ha/yr	
	Indirect		
	- Erosion control	518USD/ha/yr	
	- Carbon sequestration	14,300**USD/ha**	
	- Flood protection	317USD/ha/yr	
	- Water transport	0 USD/ha/yr[24]	
	- Biodiversity	71 USD/ha/yr	
	Non-use		
	- Intangible: option & bequest	38USD/ha/yr	
	- Social cost: conflict & safety	60USD/ha/yr	

Methodology Exercise

- Do the calculation for 20'000 ha forest replanted

	Year 0	Year 1	Year 2
Capital costs (USD)			
Cost of reforestation			
A. Total Capital Costs (Annual)			
B. Total capital Costs (Cumulative)			
Revenue costs			
Cost of maintaining forest			
C. Total revenue costs (Annual)			
D. Total revenue costs (Cumulative)			
E. Total Costs (Annual) (=A+C)			
F. Total costs (Cumulative) (=B+D)			
Benefits			
Avoided dredging costs			
Other TEV of Forest			
Use Value			
Direct use:			
- timber			
- firewood			
-non forest timber			
-water supply regulation			
Indirect use:			
- erosion control			
-carbon sequestration			
flood protection			
-water transport			
-biodiversity			
Non use value			
- intanbile: option & bequest			
-social costs: conflict and safety			
G. Total Benefits (Annual)			
H. Total Benefits (Cumulative)			
Net undiscounted cost (=E-G)			
Discount factor @ 3.5% p.a			
Net Present cost (Annual)			
Net Present cost (Cumulative)			
Total Net Present cost			
Total net present value			
Economic rate of return			

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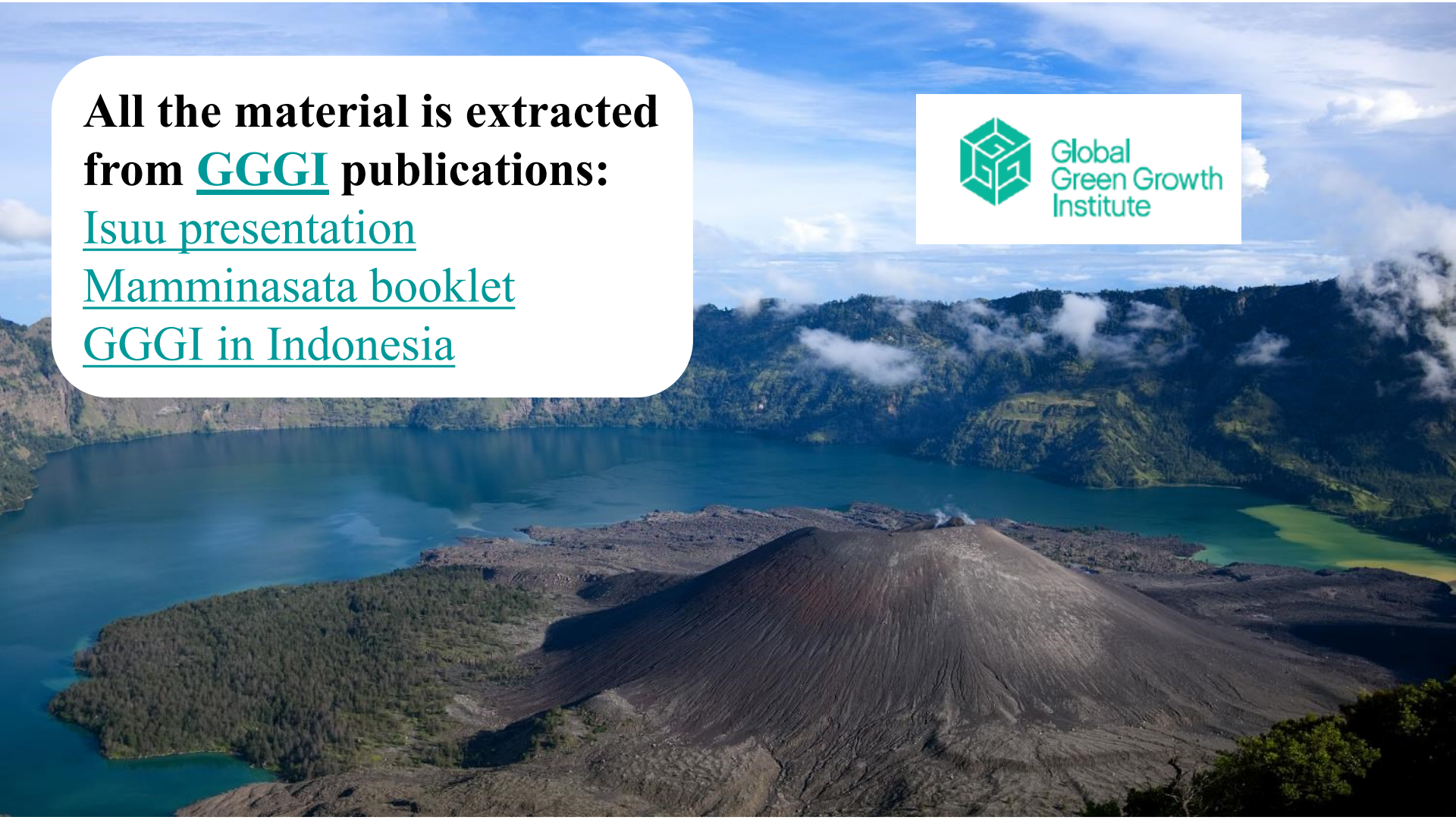
Methodology results

	Year 0	Year 1	Year 2
CAPITAL COSTS (£ 000s):			
Cost of reforestation	$ 11,629,592		
A. Total Capital Costs (Annual)	$ 11,629,592	$ -	$ -
B. Total Capital Costs (Cumulative)	$ 11,629,592	$ 11,629,592	$ 11,629,592
REVENUE COSTS (£ 000s):			
Cost of maintaining forest		$ 5,802,479	$ 1,645,282
C. Total Revenue Costs (Annual)	$ -	$ 5,802,479	$ 1,645,282
D. Total Revenue Costs (Cumulative)	$ -	$ 5,802,479	$ 7,447,761
E. Total Costs (Annual) (=A+C)	$ 11,629,592	$ 5,802,479	$ 1,645,282
F. Total Costs (Cumulative) (=B+D)	$ 11,629,592	$ 17,432,071	$ 19,077,353
BENEFITS (£ 000s):			
Avoided dredging costs		$ 1,489,529	$ 1,489,529
Other TEV of forest			
Use Value			
Direct use:			
- timber	$ -	$ 79,465	$ 158,930
- firewood	$ -	$ 233	$ 466
- non forest timber	$ -	$ 57,390	$ 114,781
- water supply regulation	$ -	$ 630	$ 1,259
Indirect use:			
- erosion control	$ -	$ 59,402	$ 118,804
- carbon sequestration			
- flood protection	$ -	$ 36,310	$ 72,621
- water transport	$ -	$ -	$ -
- biodiversity	$ -	$ 6,871	$ 13,741
Non use value			
- intangible: option & bequest	$ -	$ 4,363	$ 8,727
- social cost: conflict and safety	$ -	$ 6,871	$ 13,741
G. Total Benefits (Annual)	$ -	$ 1,741,064	$ 1,992,599
H. Total Benefits (Cumulative)	$ -	$ 1,741,064	$ 3,733,663
NET UNDISCOUNTED COST* (=E-G)	$ 11,629,592	$ 4,061,414	$ -347,317
DISCOUNT FACTOR @ 3.5% p.a.	1.00	0.91	0.83
NET PRESENT COST* (Annual)	$ 11,629,592	$ 3,692,195	$ -287,039
NET PRESENT COST* (Cumulative)	$ 11,629,592	$ 15,321,787	$ 15,034,748
TOTAL NET PRESENT COST* =	**$ -51,904,719**		
TOTAL NET PRESENT VALUE =	**$ 51,904,719**		
ECONOMIC RATE OF RETURN	n/a		

* A minus sign in these rows denotes a Net Present Value rather than a Net Present Cost.



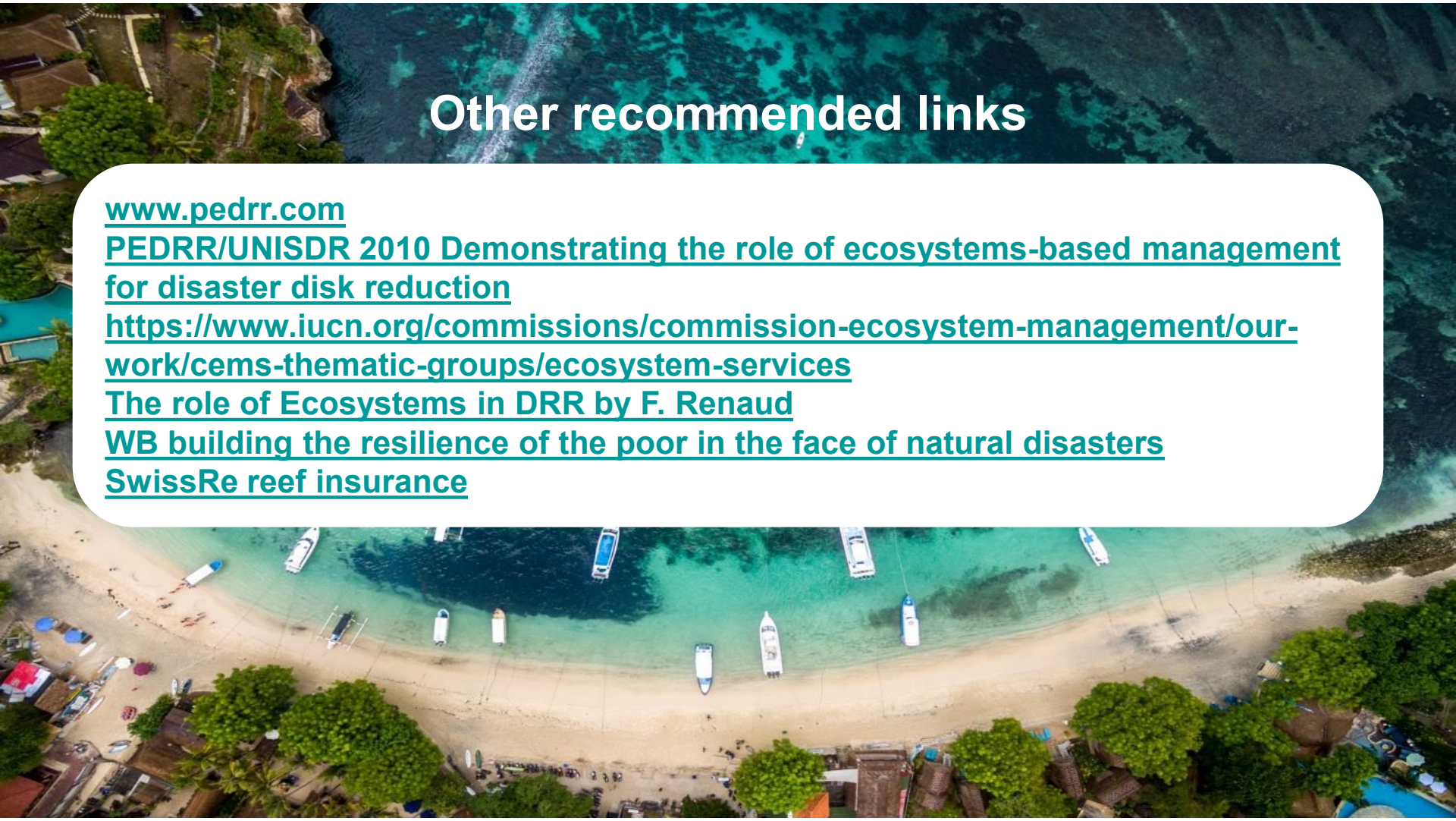
All the material is extracted from GGGI publications:

Isuu presentation

Mamminasata booklet

GGGI in Indonesia

Global Green Growth Institute



Other recommended links

www.pedrr.com
PEDRR/UNISDR 2010 Demonstrating the role of ecosystems-based management for disaster disk reduction
https://www.iucn.org/commissions/commission-ecosystem-management/our-work/cems-thematic-groups/ecosystem-services
The role of Ecosystems in DRR by F. Renaud
WB building the resilience of the poor in the face of natural disasters
SwissRe reef insurance

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Federal Departement of Foreign Affairs FDFA
Swiss Agency for Development and Cooperation SDC
Multi-H Division/ DRR Network

Thank you!

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