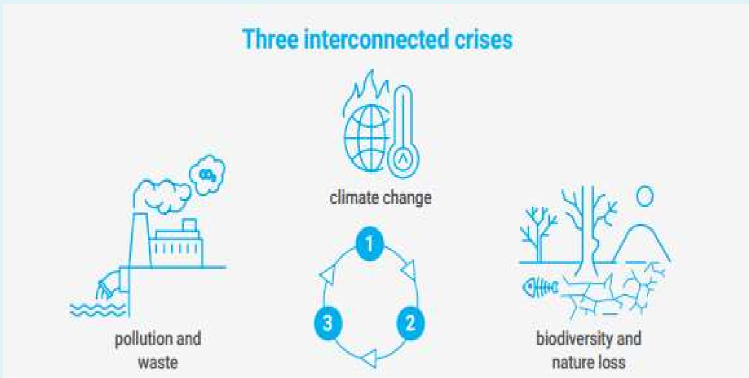
Policy Scenario Analysis using SEEA EA

SEEA EA e-learning course
2 June 2022

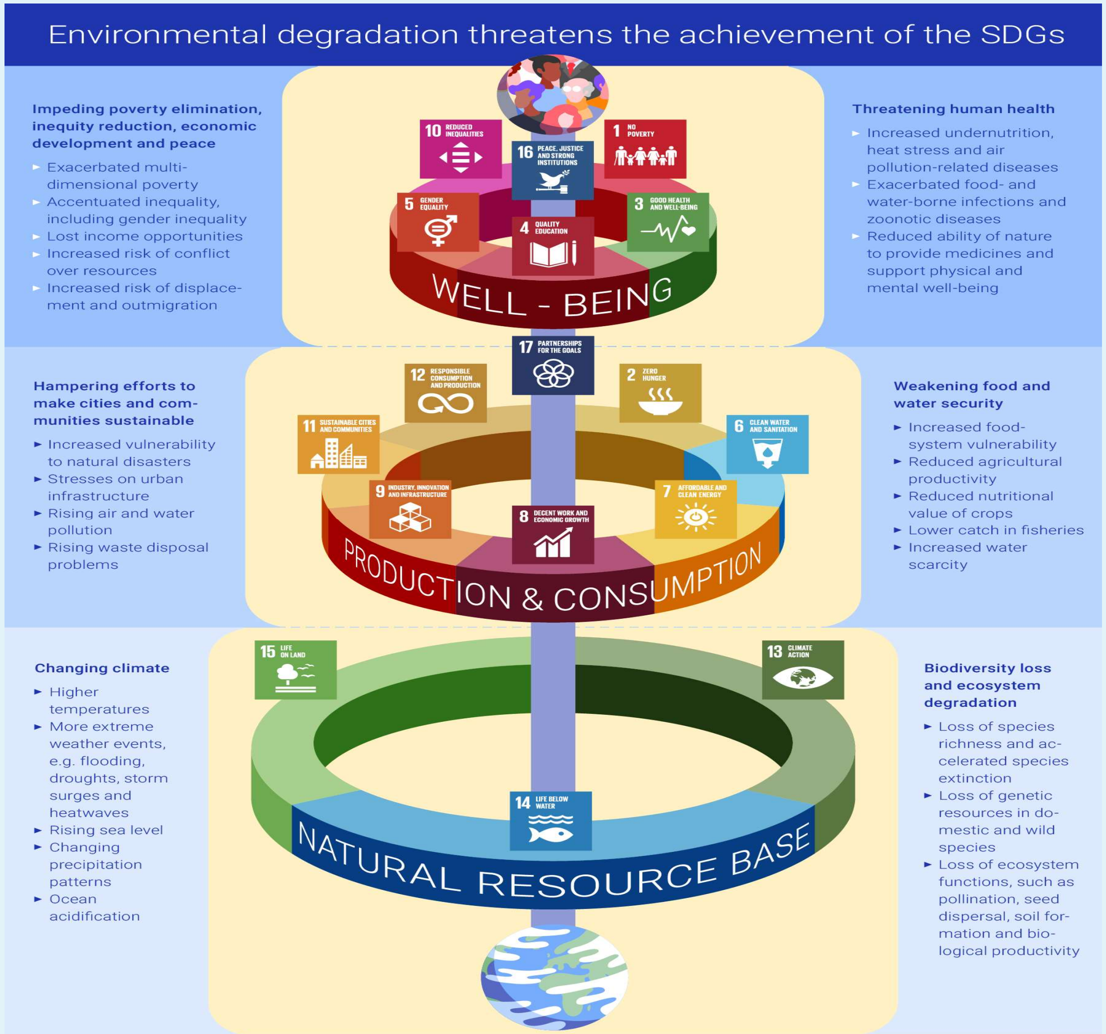
William Speller
Ecosystem for Nature Unit, Ecosystems Division

Current Policy Context for the SEEA EA



UN environment programme

Current Policy Context for the SEEA EA



Current Policy Context for the SEEA EA

Climate Action

Outcome 1:	Outcome 2:	Outcome 3:
Decision makers at all levels adopt decarbonization, dematerialization and resilience pathways	Countries and stakeholders have increased capacity, finance and access to technologies to deliver on the adaptation and mitigation goals	State and non-state actors adopt the enhanced transparency framework arrangements under the Paris Agreement

Nature Action

Outcome 1:	Outcome 2:	Outcome 3:
An economically and socially sustainable pathway for halting and reversing the loss of biodiversity and ecosystem integrity is established	Sustainable management of nature is adopted and implemented in development frameworks	Nature conservation and restoration are enhanced

Pollution and Waste Action

Outcome 1:	Outcome 2:	Outcome 3:
Human health and environmental outcomes are optimized through enhanced capacity and leadership in the sound management of chemicals and waste	Waste management is improved, including through circular processes, safe recovery of secondary raw materials and progressive reduction of open burning and dump sites	Releases of pollutants to air, water, soil and the ocean are reduced

UN environment programme

Current Policy Context for the SEEA EA

‘With science as our guiding light, UNEP seeks to ensure the link between science, policy and decision-making remains stronger than ever, sustained by strong environmental governance and supported by economic policies that can be the foundation of a catalytic response to the challenges of climate change, biodiversity loss and pollution.’

UN environment programme

Why Policy Scenario Analysis

- **Ecosystem accounts are** by nature **backward-looking**: they describe the state of affairs at some point in the past, which may be relevant for a whole range of policies.
- **Policymaking** is, by contrast, **forward-looking**: it seeks to influence future states of affairs based on decisions taken today.
- **The challenge, then, is how to marry the two.**
- **The use of backward-looking data in forward-looking policy scenario analysis** that allows policymakers to assess the possible impacts of their choices.
- Policy Scenario analysis serves the ultimate goal to improve decision making in policy areas with many variables involved. It facilitates the comparison of alternative policy interventions. Depending on the scenarios that are chosen, scenario analysis can also shed light on the likely outcomes of action and inaction.

UN environment programme

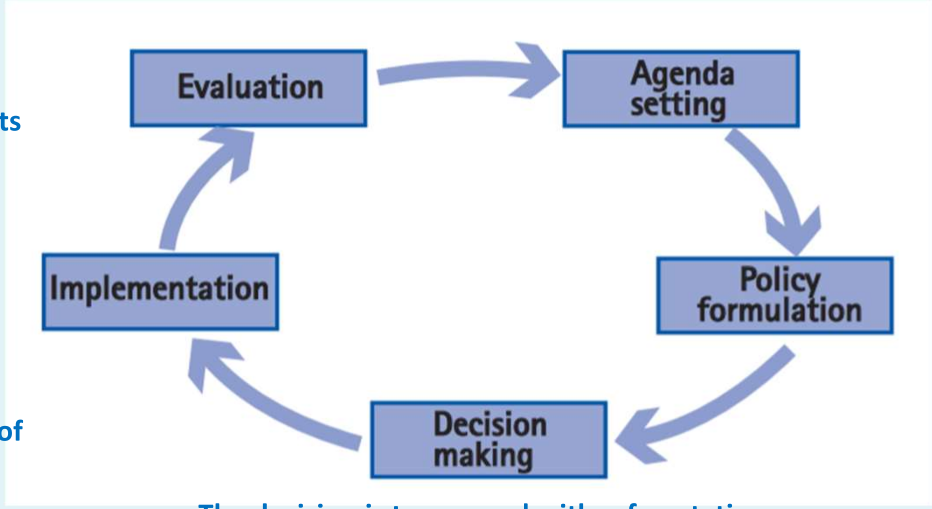
Definitional Points

- Scenario analysis is a **speculative exercise** in which several future development alternatives are identified, explained, and analysed for discussion on what may cause them and the consequences that these future paths may have on our system (e.g. a country, or a business).
- Policy scenario analysis is an exercise that **aims at informing decision-making**. It makes use of scenarios to assess the outcomes and effectiveness of various policy intervention options.
- Scenarios represent **expectations about possible future events**. They are used to analyse potential responses to new and upcoming developments.
- The scenarios can be **qualitative or quantitative** (however, in the context of SEEA EA, the latter are more pertinent).

A Stylized Policy Formulation Process

The following indicators are monitored: hectares of land reforested, jobs created, increase in carbon storage, income from non timber forest products

The goal is climate mitigation: reduction of GHG emissions

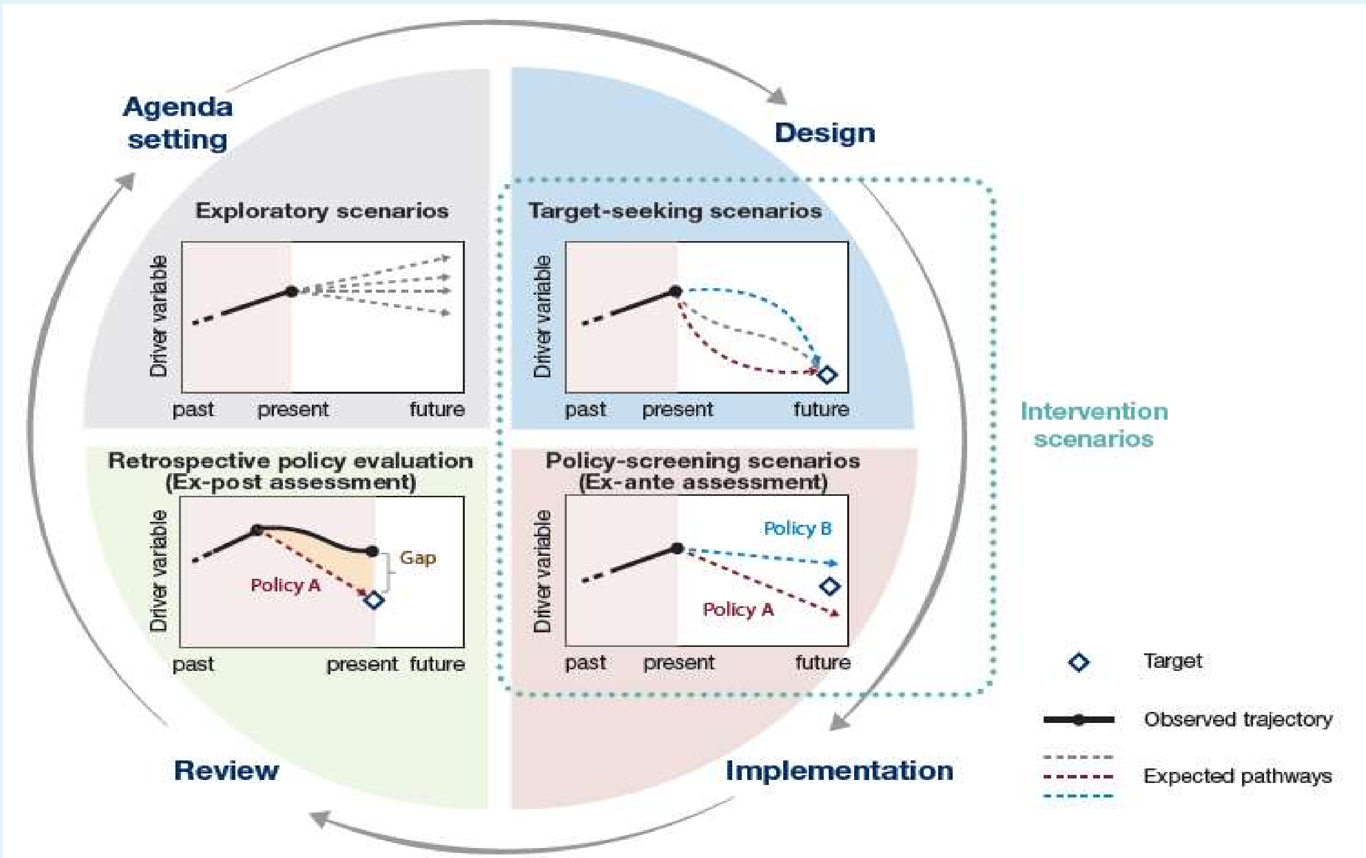


Reforestation will be implemented in coordination with local civil society organizations, in areas of strategic relevance

The policy options considered are incentives for renewable energy and reforestation

The decision is to proceed with reforestation: 500,000 hectares per year

Categories of Policy Scenario Analysis



UN environment programme

The SEEA EA and Policy Scenario Analysis

The use of SEEA EEA can inform the policy making cycle by:

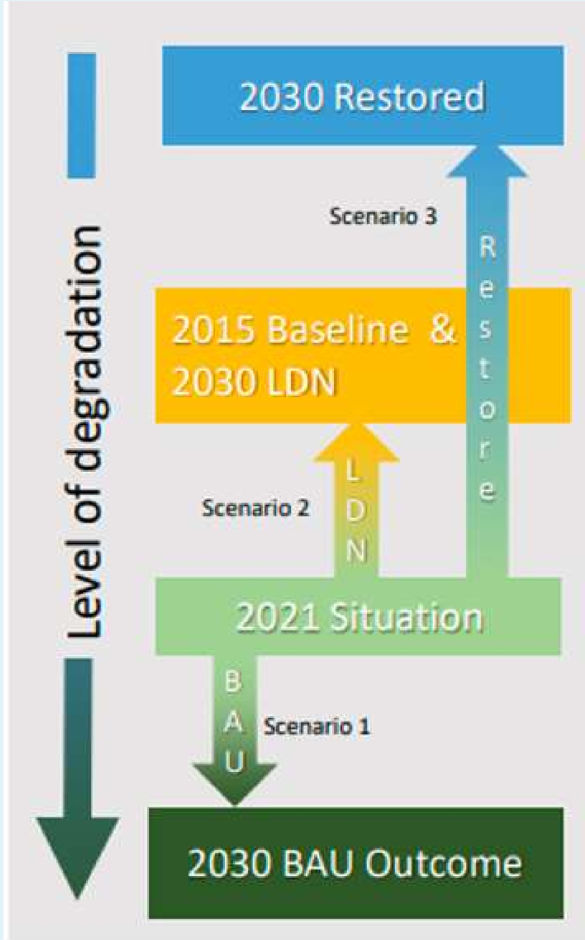
- Providing consistent and coherent input data for simulation models
- Improving the interpretation and contextualization of scenario and forecasting exercises
- Providing data for the calculation of new indicators to track progress against policy objectives
- Providing spatially disaggregated results that allow for spatially targeted policymaking, such as land-use planning.

UN environment programme

Scenarios and Business as Usual

There are **two main types of scenarios**:

- **Baseline scenarios**: elaborated to define the trends to assess performance against (e.g. population, food demand trends). This is also known as business-as-usual, because it considers the likely future path without the implementation of policies under consideration.
- **Policy scenarios**: generated to determine how the performance of a system is affected by a proposed policy change (e.g. investment in irrigation infrastructure).



Scenarios and Business as Usual

Business as usual

Beef cattle (head)	2020	2025	2035	2050
Conventional free–range	140,000	116,400	116,400	116,400
Standardized breeding	0	60,000	60,000	60,000
Combined planting–breeding	0	20,000	20,000	20,000
Ecological pasture	0	3,640	3,640	3,640

Plantation	2020	2025	2035	2050
Chemical efficiency	40.6%	45%	50%	50%
Fertilizer usage (T)	30,000	26,700 3,300	26,700 3,300	26,700 3,300
Endemic species (mu)	2,000	2,600	3,000	4,000
Under–canopy plantation (mu)	6,000	30,000	50,000	50,000

UN environment programme

Scenarios and Business as Usual

Optimistic scenario

Beef cattle (head)	2020	2025	2035	2050
Conventional free–range	140,000	116,400	96,400	86,400
Standardized breeding	0	60,000	60,000	60,000
Combined planting–breeding	0	20,000	40,000	50,000
Ecological pasture	0	3,640	3,640	3,640

Plantation	2020	2025	2035	2050
Chemical efficiency	40.6%	45%	55%	60%
Fertilizer usage (T)	30,000	26,700 3,300	25,000 5,000	20,000 10,000
Endemic species (mu)	2,000	3,000	4,000	8,000
Under–canopy plantation (mu)	6,000	30,000	50,000	X

UN environment programme

Scenarios and Business as Usual

Pessimistic scenario

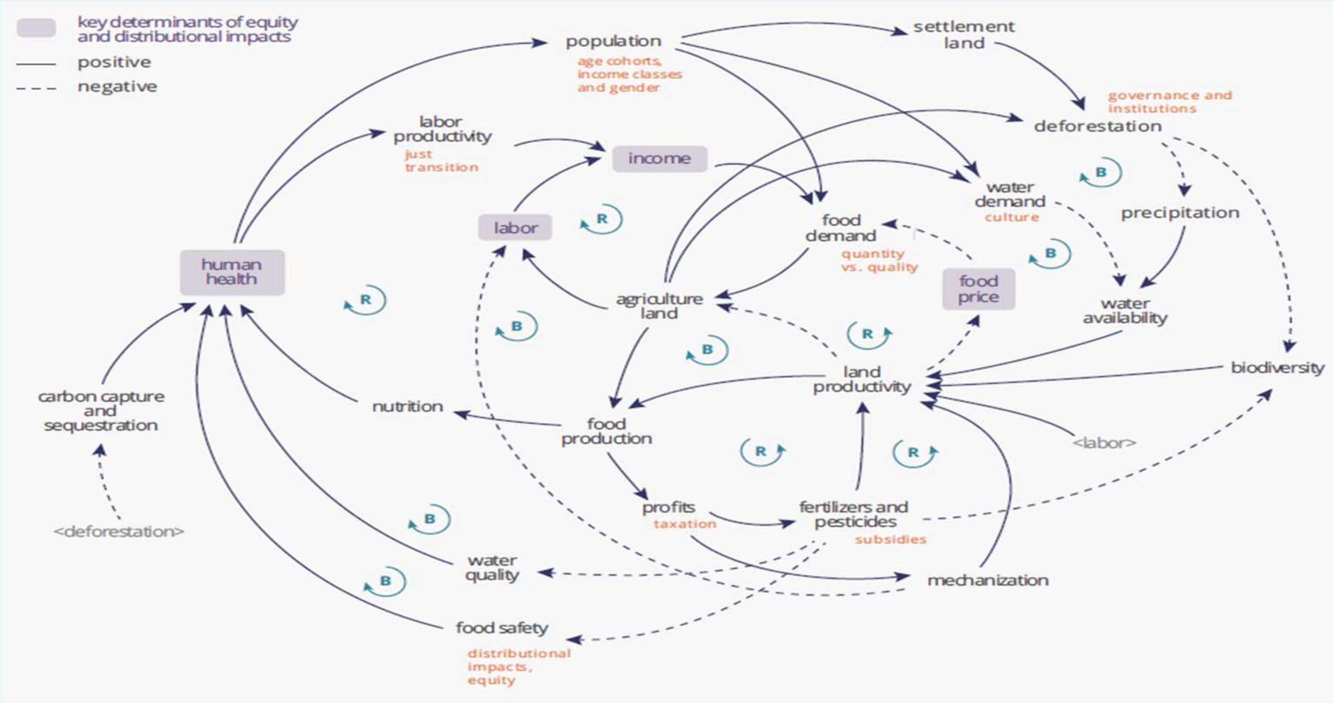
Beef cattle (head)	2020	2025	2035	2050
Conventional free–range	140,000	200,000	200,000	200,000
Standardized breeding	0	0	0	0
Combined planting–breeding	0	0	0	0
Ecological pasture	0	0	0	0

Plantation	2020	2025	2035	2050
Chemical efficiency	40.6%	40.6%	40.6%	40.6%
Fertilizer usage (T)	30,000	30,000	30,000	30,000
Endemic species (mu)	2,000	1,000	0	0
Under–canopy plantation (mu)	6,000	0	0	0

UN environment programme

Designing Scenarios

- **Qualitative models** are an important tool to **inform decision making**, because of their contribution to the creation of a shared understanding about the drivers of change, dynamics triggered, and resulting performance of a system.
- **They lack the quantification of impacts**, which is an essential step for scenario modeling in the context of policy formulation and assessment.



Causal Loop Diagram of the eco-agri-food system. Source (Zhang, 2018

UN environment programme

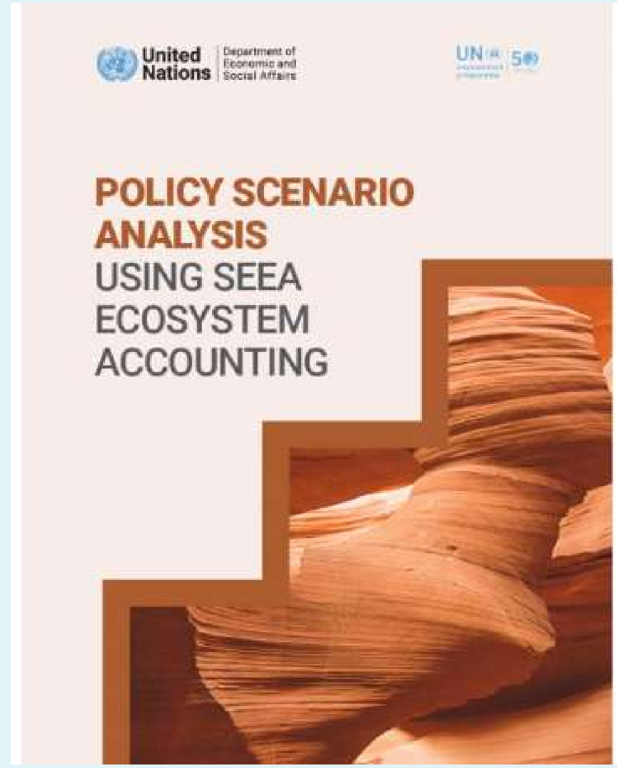
Quantitative models

Thematic models

- Land
- Ecosystem service
- Macroeconomic
- Energy
- Water
- Infrastructure

Cross-sectoral models

- Nested models
- Integrated models



Unit 2 of the Module on Policy Scenario Analysis contains extensive coverage of each with examples, based on the Scenario Guidelines.

Examples

Low Carbon development in Indonesia

Policy context and overview of the issue

- The Ministry of Planning, BAPPPENAS, in cooperation with several development partners has launched the Low Carbon Development Initiative for Indonesia (LCDi).
- The goal is to inform the country's next five-year plan with new information, so that the next mid-term development plan will balance and deliver progress simultaneously for GDP growth, employment creation and emission reduction by investing in Indonesia's natural, human, social and physical capital

Modeling approach

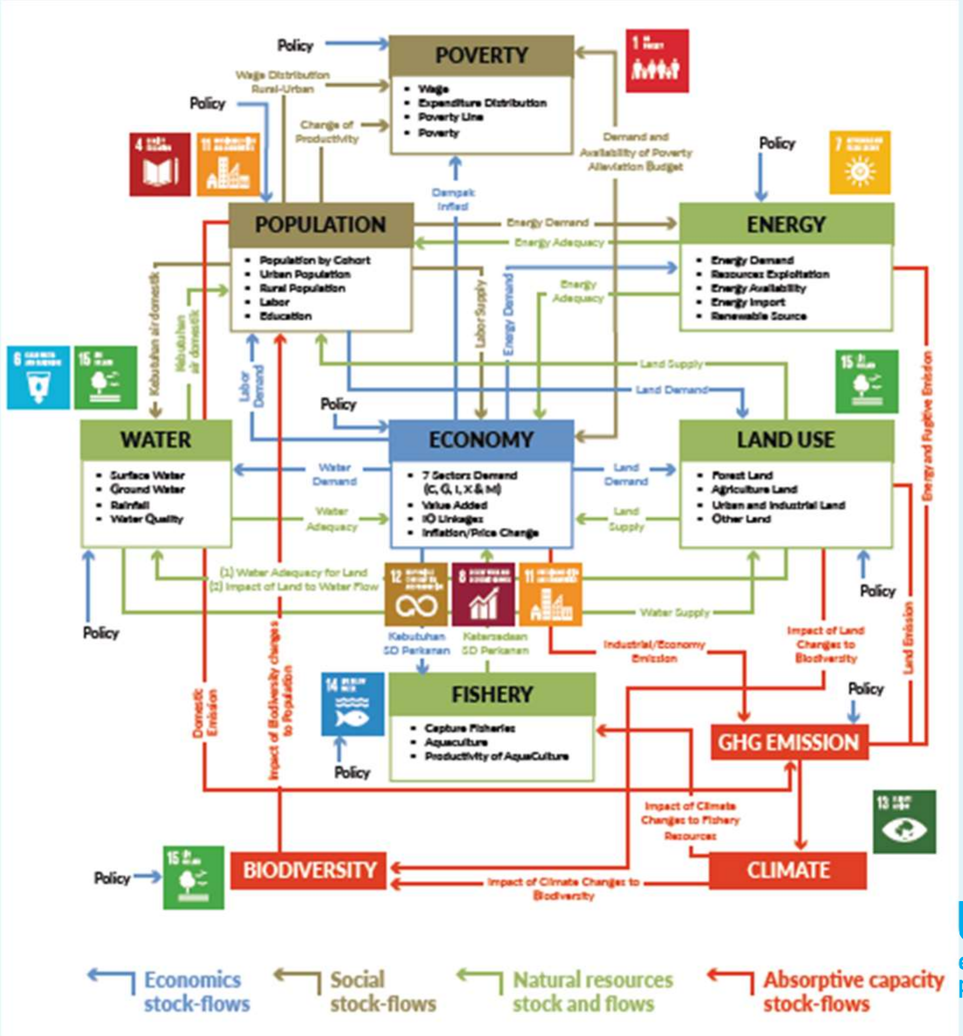
- **Integrated Socio-Economic-Environmental model, Indonesia Vision 2045 (IV2045)**: used to project growth in population, economic activity and natural resource use, resulting impacts on ecosystem services and economic productivity
- Spatial models (SpaDyn and GLOBIOM-Indonesia): used to **forecast land cover change based on projected GDP growth and changes in ecosystem services**
- Nonmarket environmental valuation methods: used to **value the external costs/benefits of losing/maintaining ecosystems and their services.**
- **Integrated Cost-Benefit Analysis**: used as a systematic process for calculating and comparing benefits and costs of a given decision.

UN environment programme

Modelling Approach

Scenarios

- The Base Case: No new policies but reflects environmental degradation.
- The LCDI Moderate Scenario: Includes new low-carbon policy measures for 2020-45; achieves the unconditional NDC target.
- The LCDI High Scenario: Includes more ambitious policy measures than LCDI-Moderate for 2020–45; achieves the conditional NDC target.
- The LCDI Plus Scenario: Reflects LCDI-High for 2020–24, and additional, more ambitious policy measures thereafter.

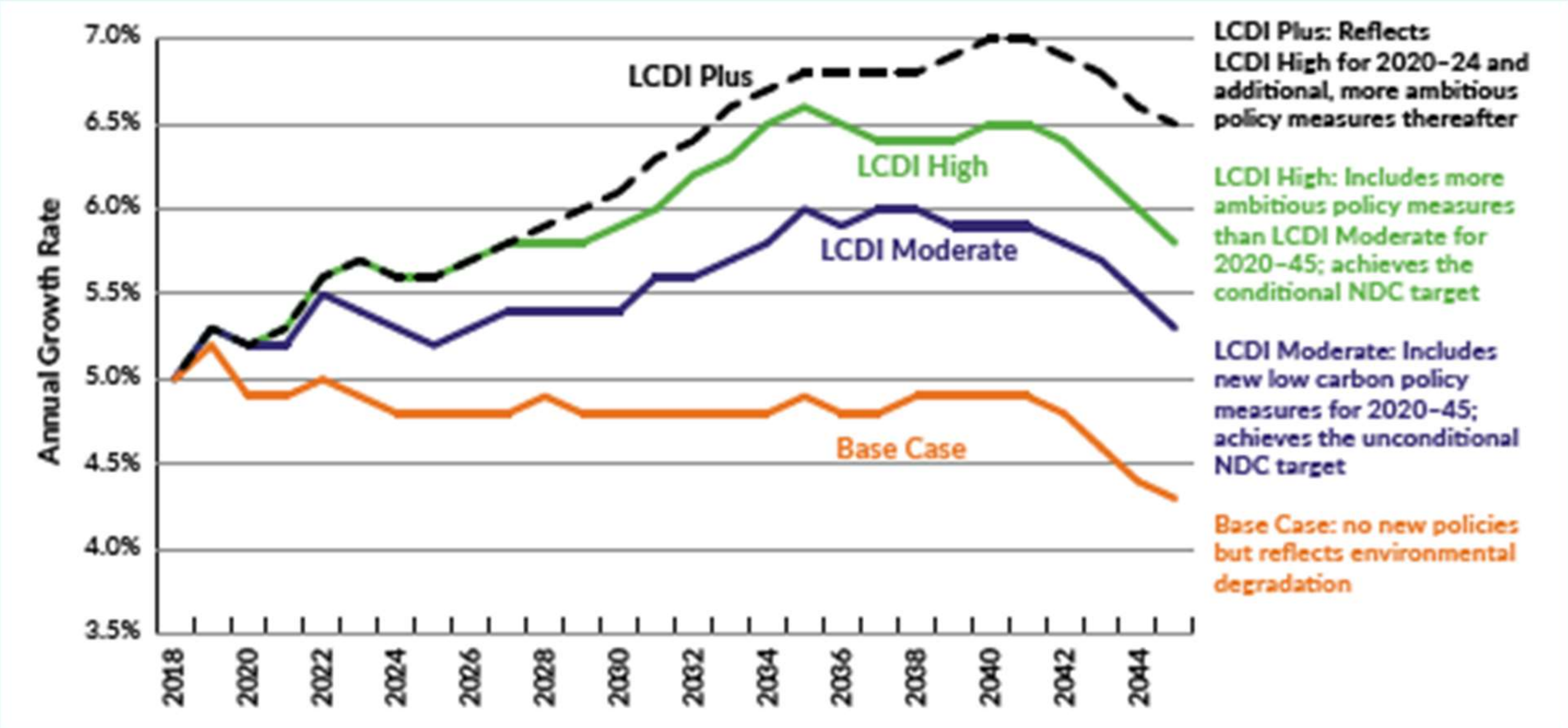


UN environment programme

Results

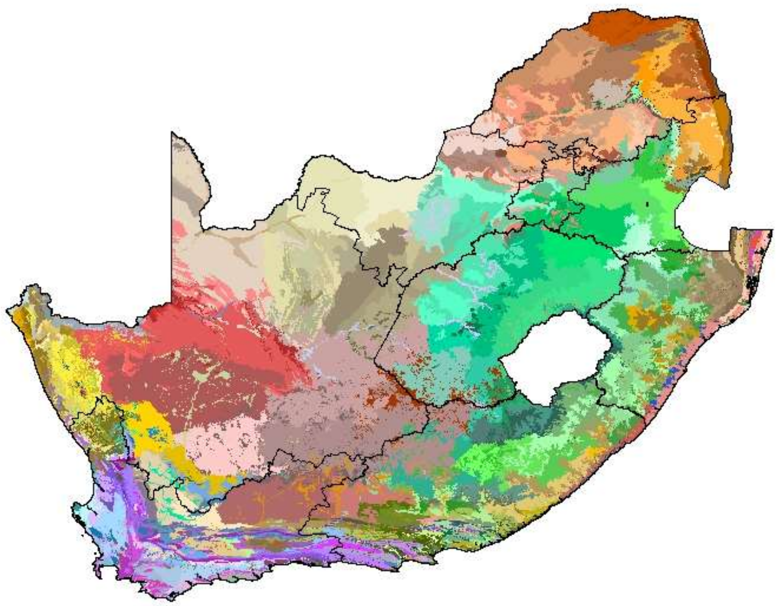
Results of the analysis

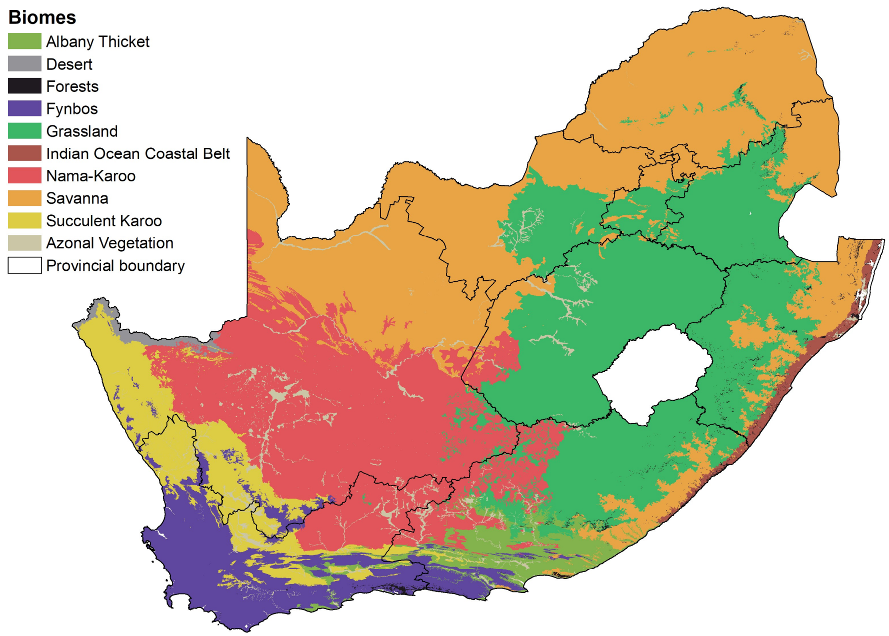
- The LCDi scenarios reduce externalities, stimulate economic growth and productivity, while reducing emissions.



Terrestrial ecosystem extent accounts – South Africa

Mapping of terrestrial ecosystem types are (a) 458 vegetation types,(b) which are aggregated into 9 biomes.

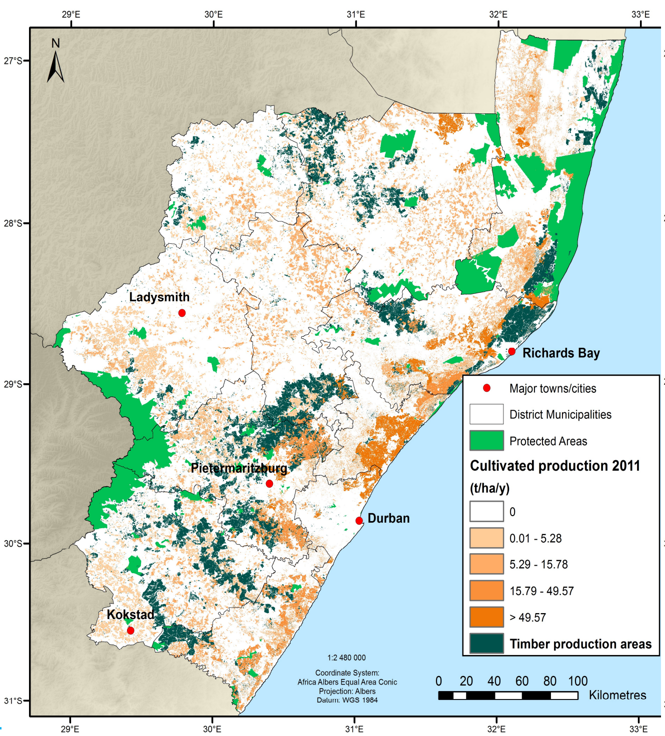


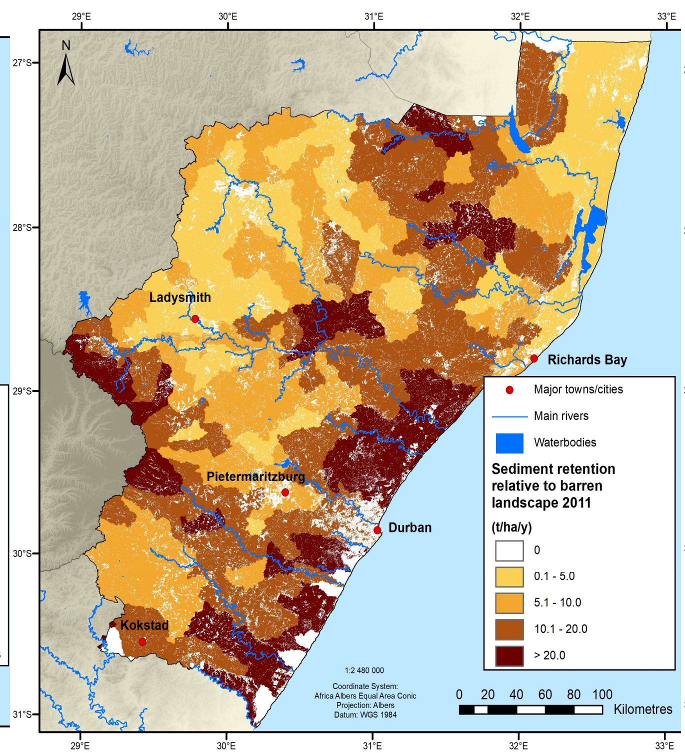


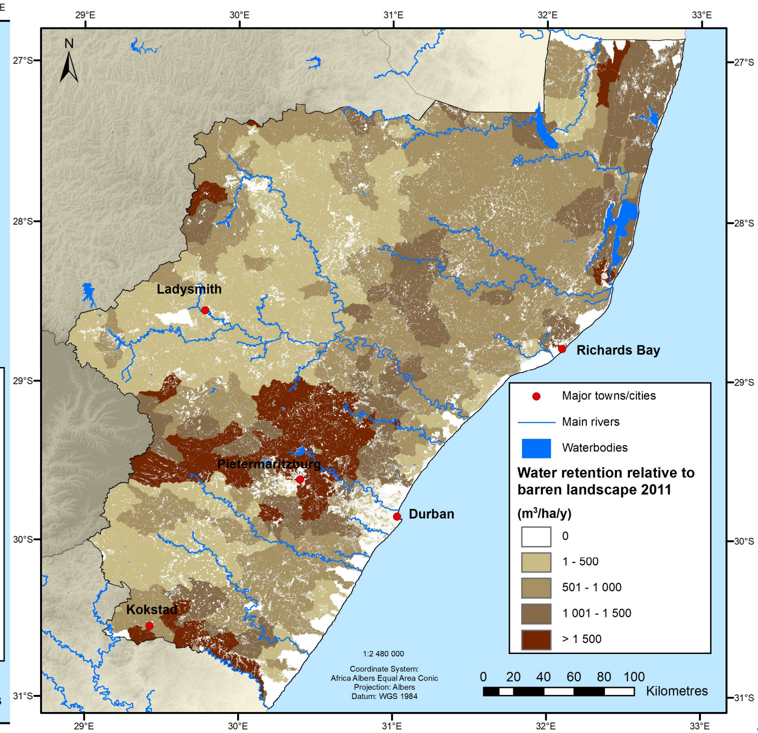
UN environment programme

Ecosystem services accounts (biophysical) – KwaZulu Natal South Africa

Spatially-explicit data on provision of ecosystem services – water retention, crop provisioning, and sediment retention shown here, but results for a suite of eleven ecosystem services



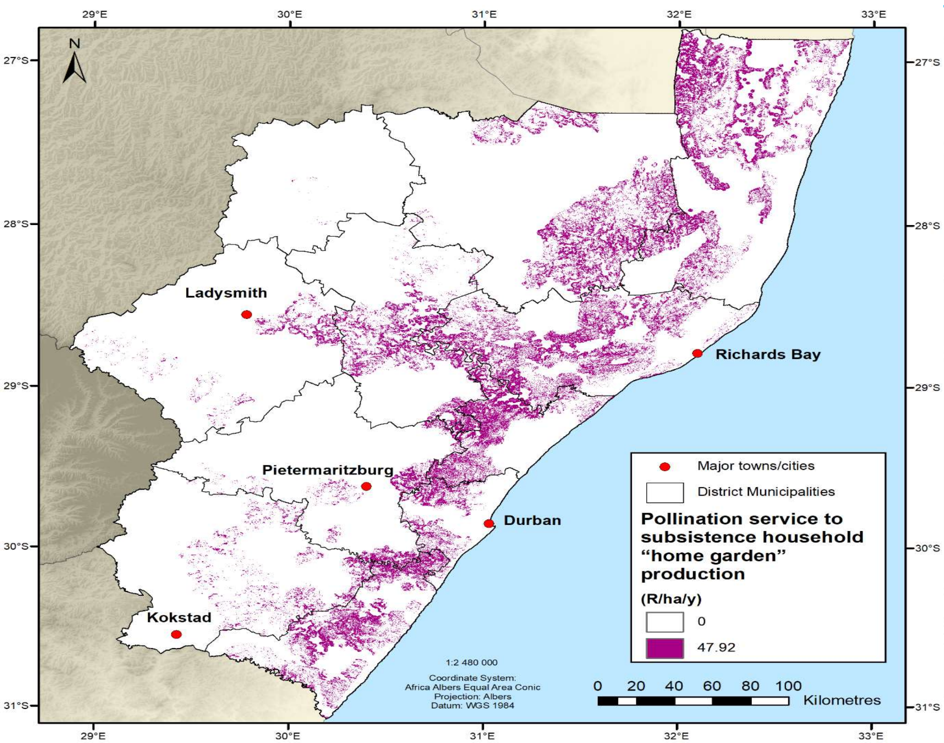




UN environment programme

Ecosystem services accounts (monetary) – KwaZulu Natal South Africa

Spatially-explicit data on value of ecosystem services, and trends over time

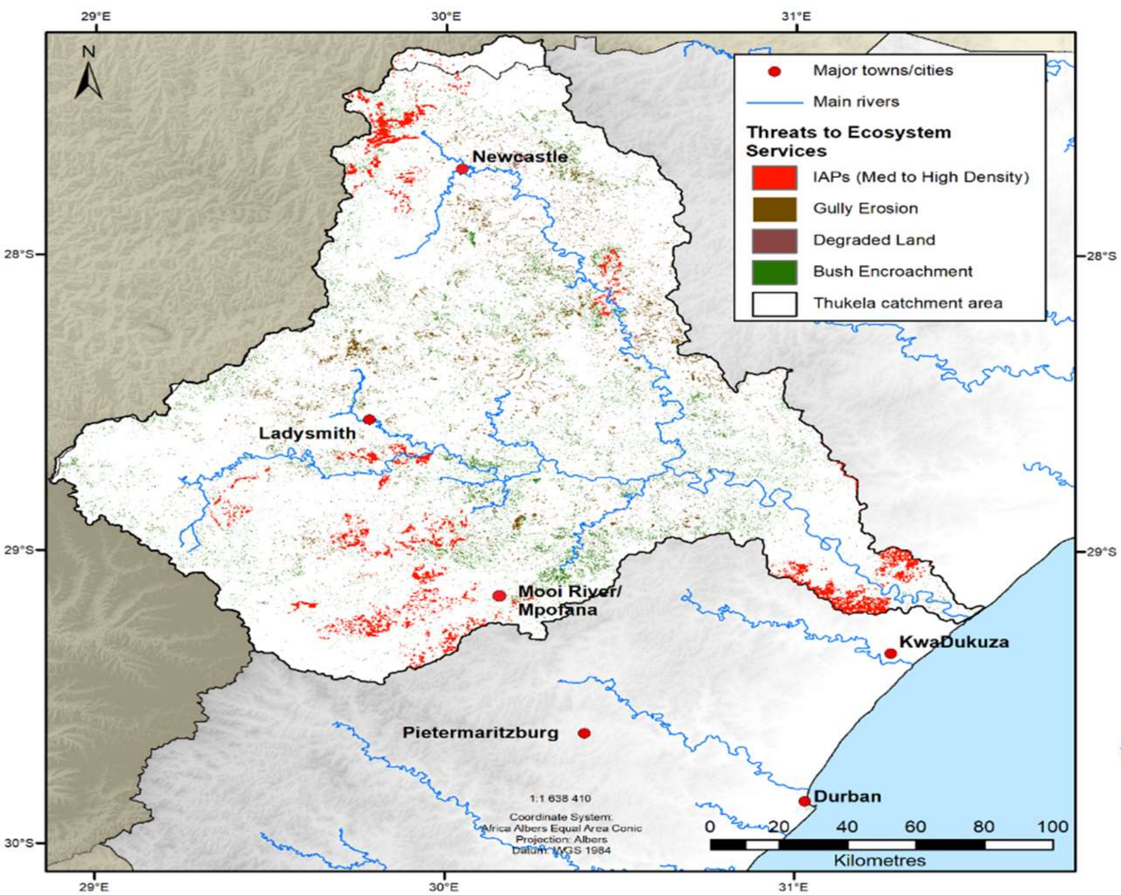


Class	Ecosystem service	2005 Annual flow R millions	2005 Asset value R millions	2011 Annual flow R millions	2011 Asset value R millions
Provisioning	Wild resources	3 722.16	32 032.23	3 180.25	28 440.48
	Animal production	1 672.99	27 100.67	1 472.87	23 859.03
	Cultivation	6 456.70	104 591.91	7 535.43	122 066.22
Cultural	Nature-based tourism	532.83	8 631.31	798.83	12 940.22
	Property	1 164.97	18 871.27	1 327.78	21 508.60
Regulating	Carbon storage (global value)	29 922.56	484 745.42	34 579.34	560 185.33
	Pollination	51.26	830.33	47.69	772.50
	Flow regulation	3 247.87	52 612.12	3 166.78	51 298.55
	Flood attenuation	31.02	502.49	23.50	380.68
	Sediment retention	435.79	7 059.28	330.40	5 352.18
	Water quality amelioration	20.40	330.46	16.03	259.67
Total		**47 258.53**	**737 307.48**	**52 478.90**	**827 063.46**
Value of flows and asset values in 2005 and 2011 when using national carbon values					
Regulating	Carbon storage (national)	236.39	3 829.49	273.18	4 425.46
Total		**17 572.38**	**256 391.56**	**18 172.74**	**271 303.59**

UN environment programme

Policy application: Ecosystem restoration in South Africa

Cost-benefit analysis of ecosystem restoration programmes in Thukela river basin, KwaZulu Natal



Policies:

Extension services

Betterment schemes

Natural Resource Management Programmes

e.g. 'Working for Water'

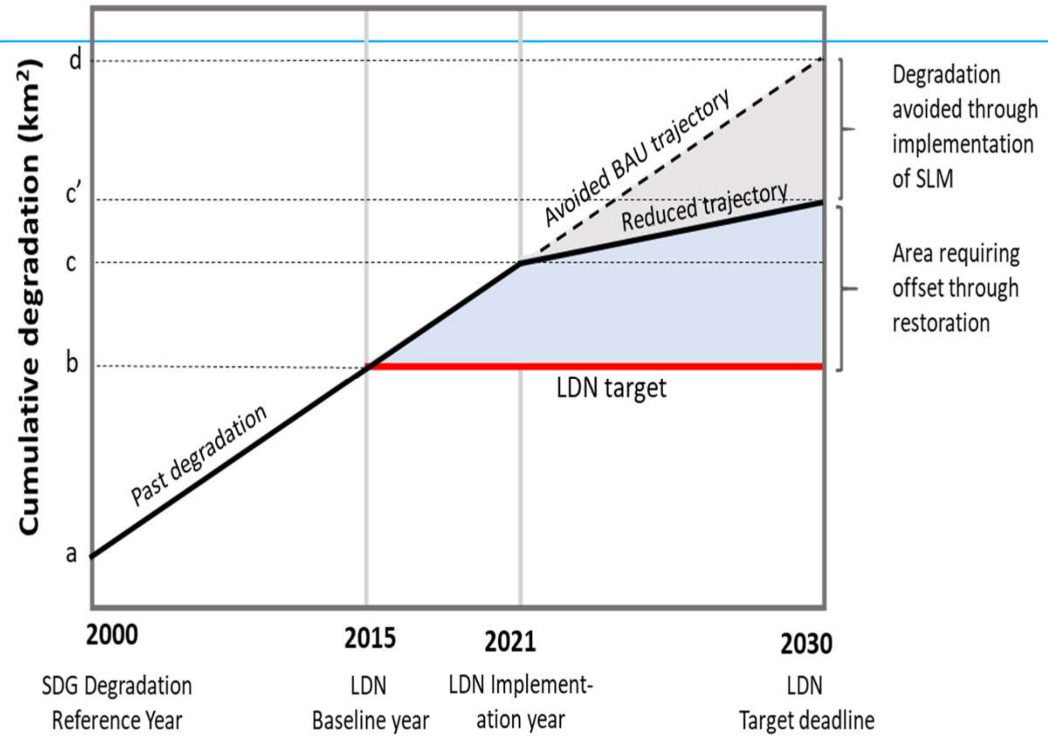
2030 Land Degradation Neutrality target, UNCCD and SDGs

UN environment programme

Policy application 2: Ecosystem restoration in South Africa

Cost-benefit analysis of ecosystem restoration programmes in Thukela river basin, KwaZulu Natal

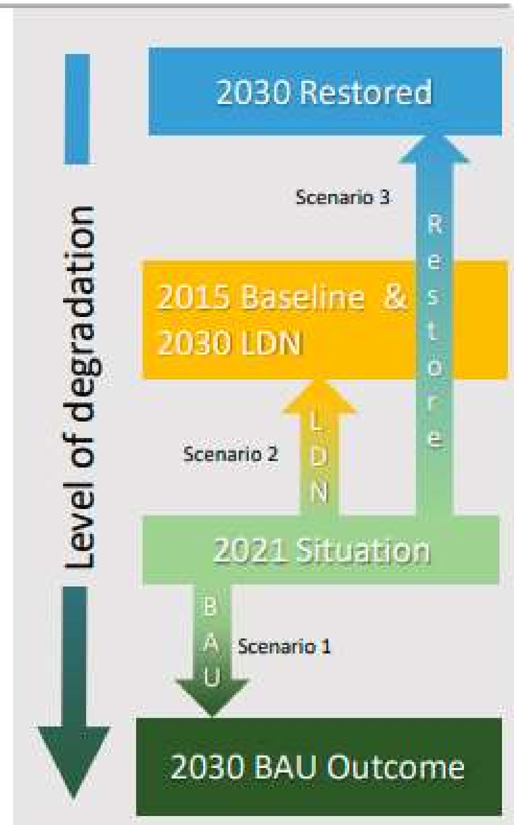
Business-as-usual (BAU) – continued degradation, projected based on past rates
Optimistic LDN - degradation at 2021 relative to 2015 is reversed and sustainable land management SLM measures stop any further degradation.
Pessimistic LDN - assumes SLM ineffective, thus requiring restoration of an area equivalent to all projected degradation from 2015-2030.
Full restoration - restores all degraded areas as at 2021 to healthy condition. Assumes SLM would stem further degradation.



UN environment programme

Study approach

- Estimation of the baseline land cover, trajectory to 2030 under BAU and resulting land cover, and the restored land cover
- Modelling of ecosystem services under BAU, LDN and restored outcomes
  - Same methods as Pilot, including SWAT model
- Costs and benefits of interventions compared with BAU Scenario
  - Costs of interventions based on literature, previous studies
  - Benefits estimated as difference in value of ecosystem services compared to BAU outcome



Policy application: Ecosystem restoration in South Africa

Cost-benefit analysis of ecosystem restoration programmes in Thukela river basin, KwaZulu Natal

	Present value (R millions)		
	LDN Scenario		Full Restoration Scenario
Costs relative to BAU	Upper bound costs	Lower bound costs	
Clearing IAPs	514.4	514.4	2 355.2
Addressing Bush Encroachment	507.2	237.6	691.1
Active restoration of grasslands, erosion	2 623.6	–	–
Sustainable land management	–	1 981.02	6 093.62
Total present value of costs	**3 645.18**	**2 733.09**	**9 139.98**
Benefits relative to BAU			
Water supply	2 591.4	2 591.4	10 757.2
Sediment retention	38.9	38.9	63.1
Tourism	121.8	121.8	243.6
Carbon storage (avoided national cost)	–274.91	–274.91	597.5
Harvested resources	70.6	70.6	2 391.3
Livestock production	620.7	620.7	1 476.9
Total present value of benefits	**3 168.6**	**3 168.6**	**15 529.6**
Net Present Value	–476.6	435.5	6 389.6
BCR	0.9	1.2	1.7

Likely a vast underestimate because many intangible benefits cannot be valued. Other studies estimate a ROI of 9 – 30.

UN environment programme

Policy application: Eco-compensation schemes in China

Inter-provincial compensation Xijiang River Basin – Guangxi, Guizhou, Yunnan, Guangdong

“We will improve systems for regeneration of croplands, grasslands, forests, rivers, and lakes, and set up diversified market-based mechanisms for ecological compensation.” President Xi’s speech to 19th National Congress of the Communist Party of China

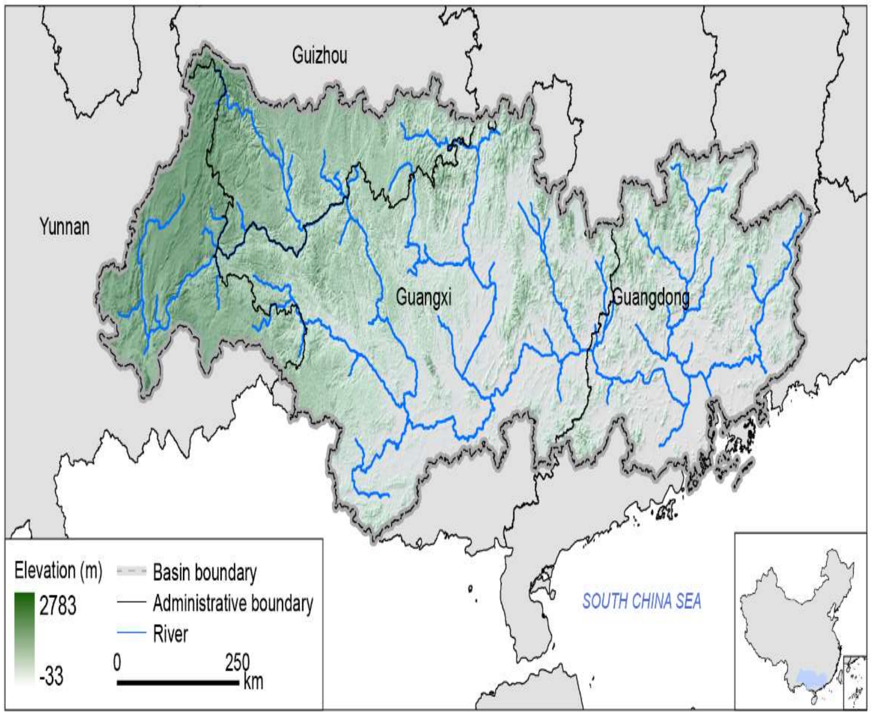
- Various pilot schemes for eco-compensation trailed (grain-for-green, sloping land conversion, grassland restoration etc.). A central question remains: how much should ‘users’ of ecosystem services compensate ‘providers’?

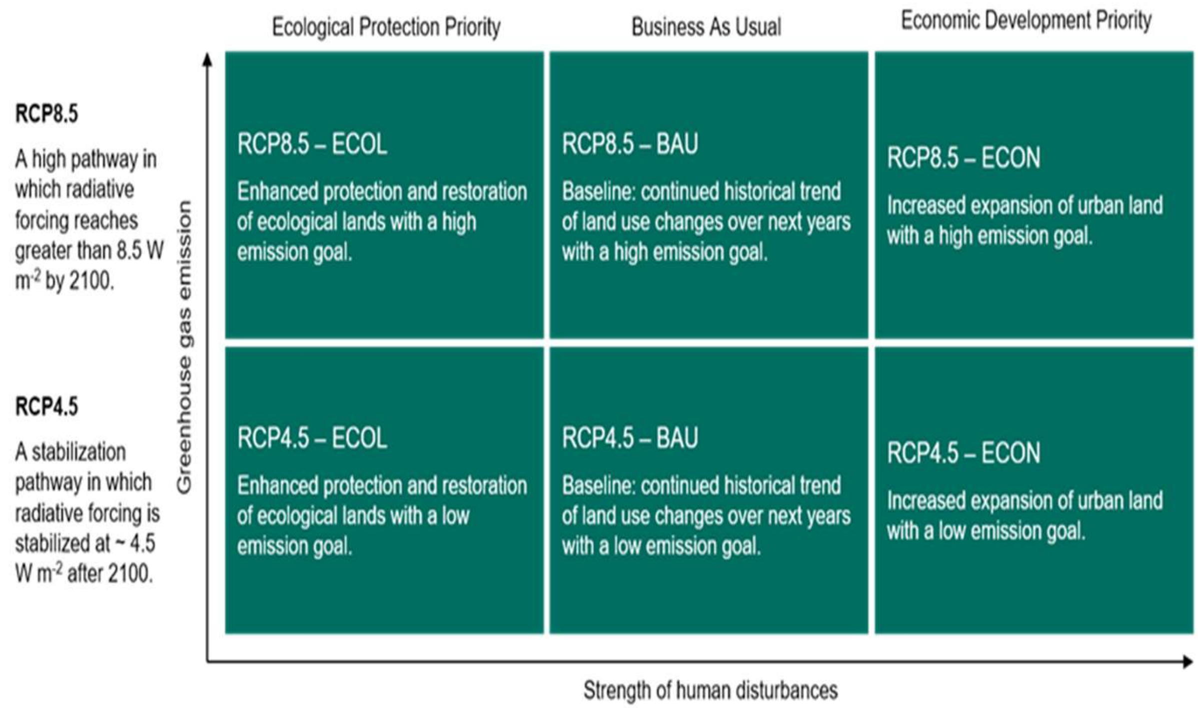
→ Role for SEEA EA to map and value ecosystem services to calibrate compensation

UN environment programme

Policy application: Eco-compensation schemes in China

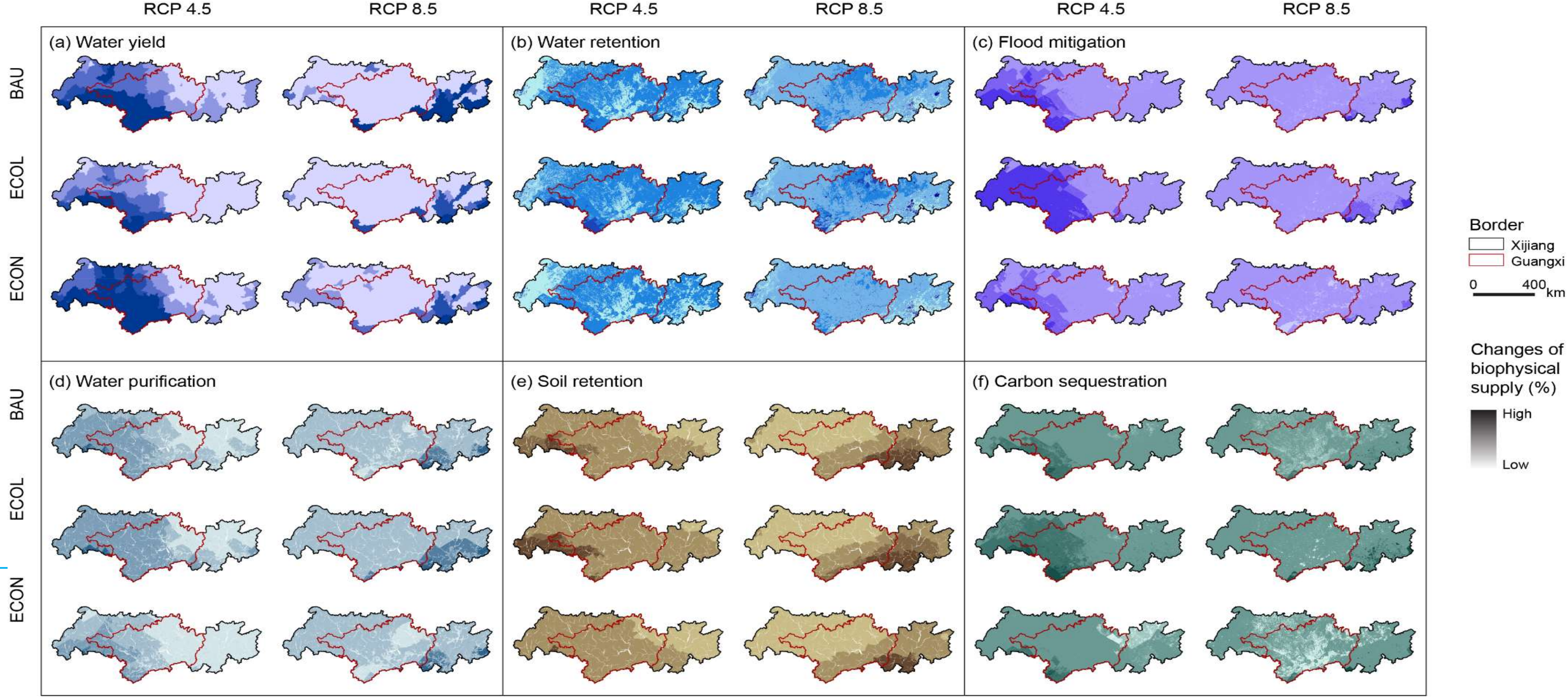
Inter-provincial compensation Xijiang River Basin – Guangxi, Guizhou, Yunnan, Guangdong provinces





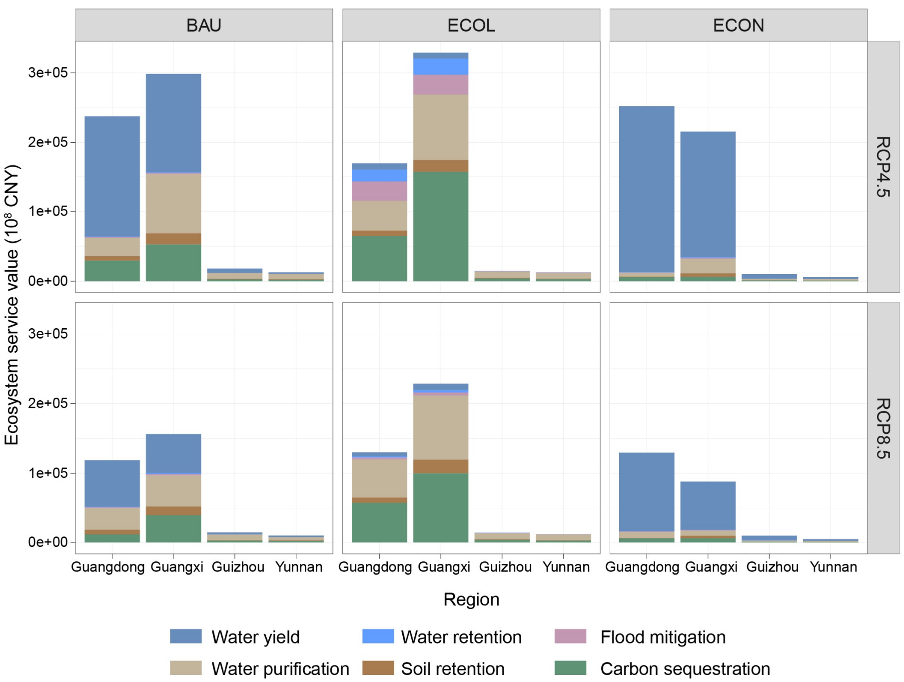
Policy application: Eco-compensation schemes in China

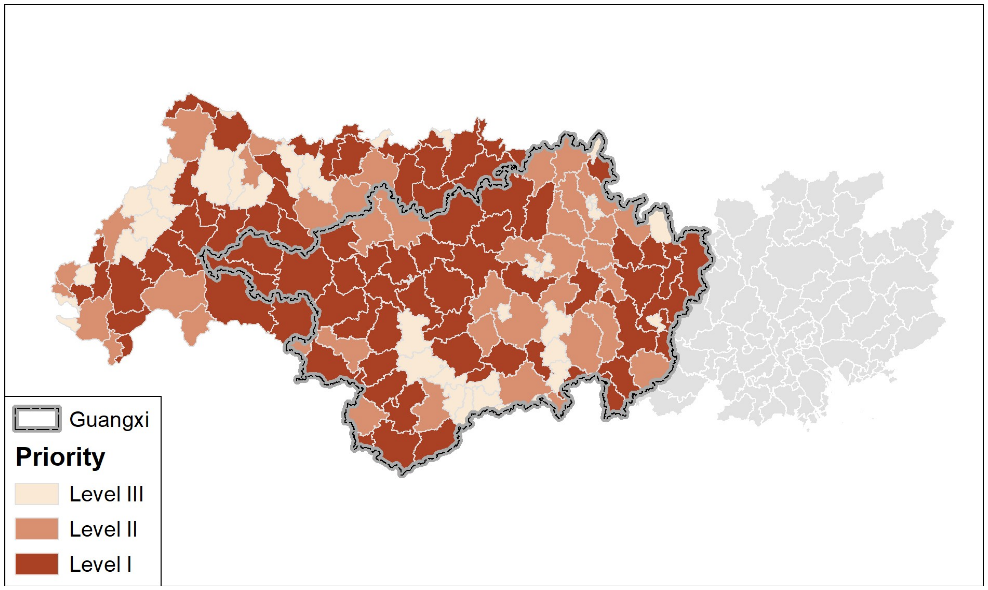
Changes in the spatial distribution of the biophysical supply of ecosystem services for 2035 under different climate and land cover scenarios



Policy application: Eco-compensation schemes in China

Ecosystem service values for different regions of Xijiang basin under different climate and land cover scenarios in 2035 is used to map priority areas for ecological compensation, to more accurately calibrate the scheme.





Further Reading

Database of examples of scenario analysis using SEEA:
https://seea.un.org/ecosystem-accounting/policy-scenario-analysis

Publications

Supplementing the technical report, the following case studies enable policy-makers to evidence the use of ecosystem accounts (and associated data) in environmental policy formation and evaluation, through deployment of the SEEA Ecosystem Accounting statistical framework and different types of modelling approaches.

Key Case Studies

- Green Economy Models applications in Indonesia, Mauritius, Cambodia, and Mozambique (Bassi, 2015)
- Green Economy Modelling of ecosystem services in the Dawna Tenaserim Landscape, in the Greater Mekong (Bassi et al., 2014)
- Economic value of ecosystem services in Pelly's Lake and the Stephenfield reservoir, Manitoba, Canada (Bassi et al., 2019)
- Economic value of restoring the ecological health of Beira Lake in Colombo, Sri Lanka (IISD, 2019)
- Analysing conservation options using the Sustainable Asset Valuation Methodology in Lake Dal, India (IISD, 2018)
- Analysing aquatic rehabilitation options for Lake Dal in Srinagar, India (IISD, 2018)
- Sustainable asset valuation of irrigation infrastructure in the Southern Agricultural Growth Corridor of Tanzania (IISD, 2018)
- Biophysical modelling and economic valuation in the Rufiji River Basin and Kilombero Valley, Tanzania (TEEB, 2018)
- Low Carbon Development Initiative for Indonesian natural, human, social, and physical capital (BAPPENAS, 2019)
- Integrated economic-environmental modelling framework for Guatemala's forest and fuelwood sectors (Banerjee et al., 2016)
- Forest certificates markets for cost-effective biodiversity conservation in São Paulo State, Brazil (Bernasconi et al., 2016)
- Mapping LULC in the Cerrado-Atlantic Forest ecotone region, in the Prata River Basin, Brazil (da Cunha et al., 2020)
- Estimating crop water needs for sustainable water resources management in Kerala, India (Surendran et al., 2017)
- Modeling landscape dynamics of policy interventions in Karnataka State, India (Setturu and Ramachandra, 2021)
- Ecosystem services and Sumatran tiger conservation and habitats (Bhagabati et al., 2014)
- Integrated fisheries management in Belize and The Bahamas (Arkema et al., 2019)

The Economics of Ecosystems and Biodiversity (TEEB)

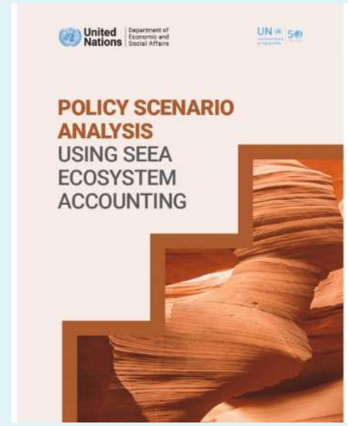
A TEEB Country Study (TCS) the ecosystem services that are vital to meeting the country's policy priorities and makes recommendations on how these services can be integrated into policies. These recommendations depending on the country context can include policies for poverty alleviation, subsidy reform, land use management, protected area management, securing livelihoods, investment in natural infrastructure restoration and national accounting to include natural capital. Examples for Bhutan, Ecuador, Philippines, Liberia and Tanzania and other TEEB-inspired studies are available on the TEEB website: http://teebweb.org/where-we-work/.

The TEEB for Agriculture and Food project applies scenario analysis to policy decisions in the food and agriculture sector: http://teebweb.org/our-work/agrifood/

Other Examples

- Achieving the SDGs of zero hunger and clean water and sanitation in Guatemala, applying IEEM platform (Banerjee et al., 2019)

https://seea.un.org/content/policy-scenario-analysis-using-seea-ecosystem-accounting



https://www.unep.org/resources/making-peace-nature

Thank you for listening.

Questions and Discussion welcomed.

William Speller
Economics for Nature Unit
william.speller@un.org

United Nations Avenue, Gigiri
PO Box 30552 – 00100 GPO Nairobi, Kenya

www.unep.org