Ecosystem Based Adaptation

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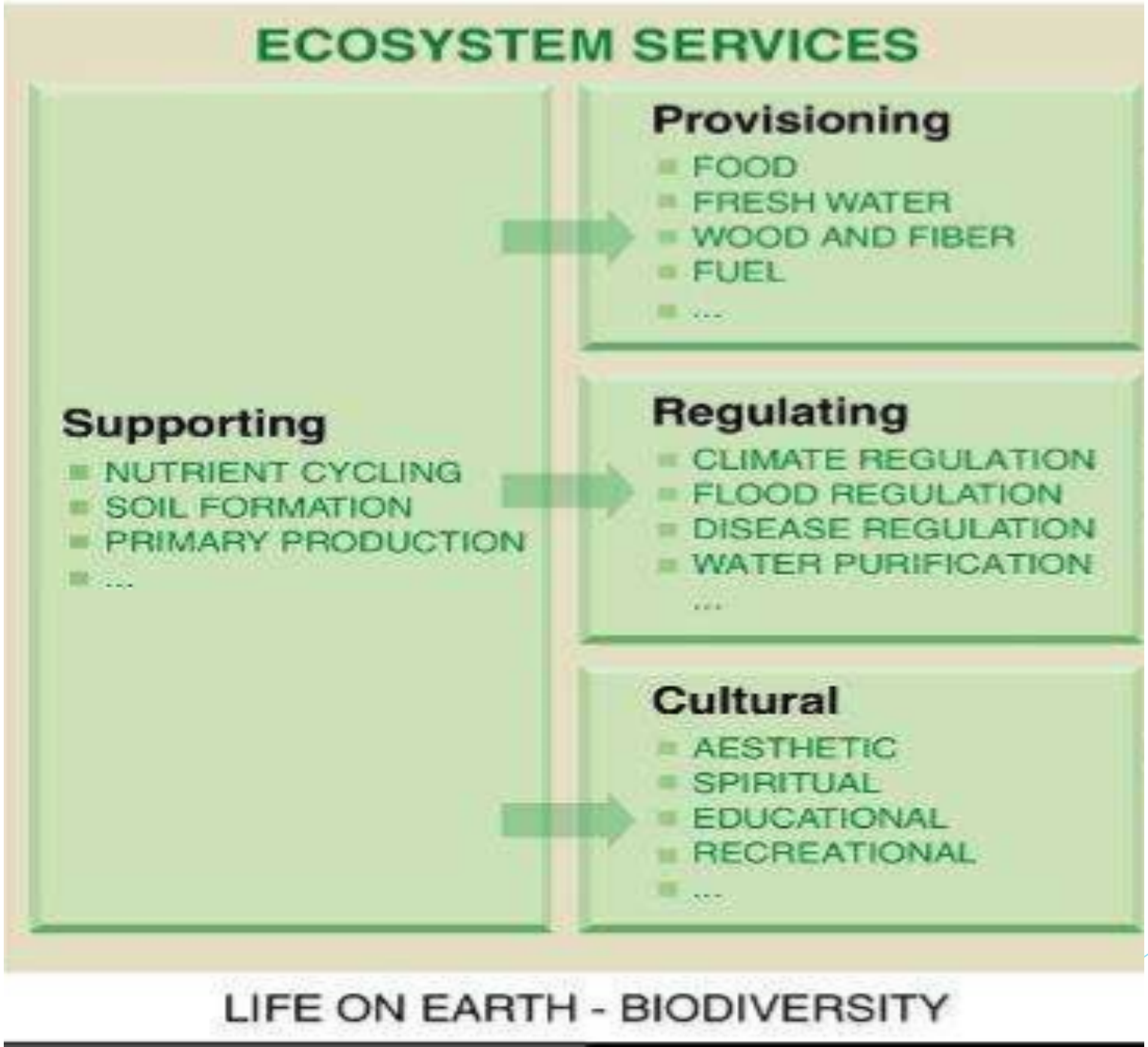
Ecosystems

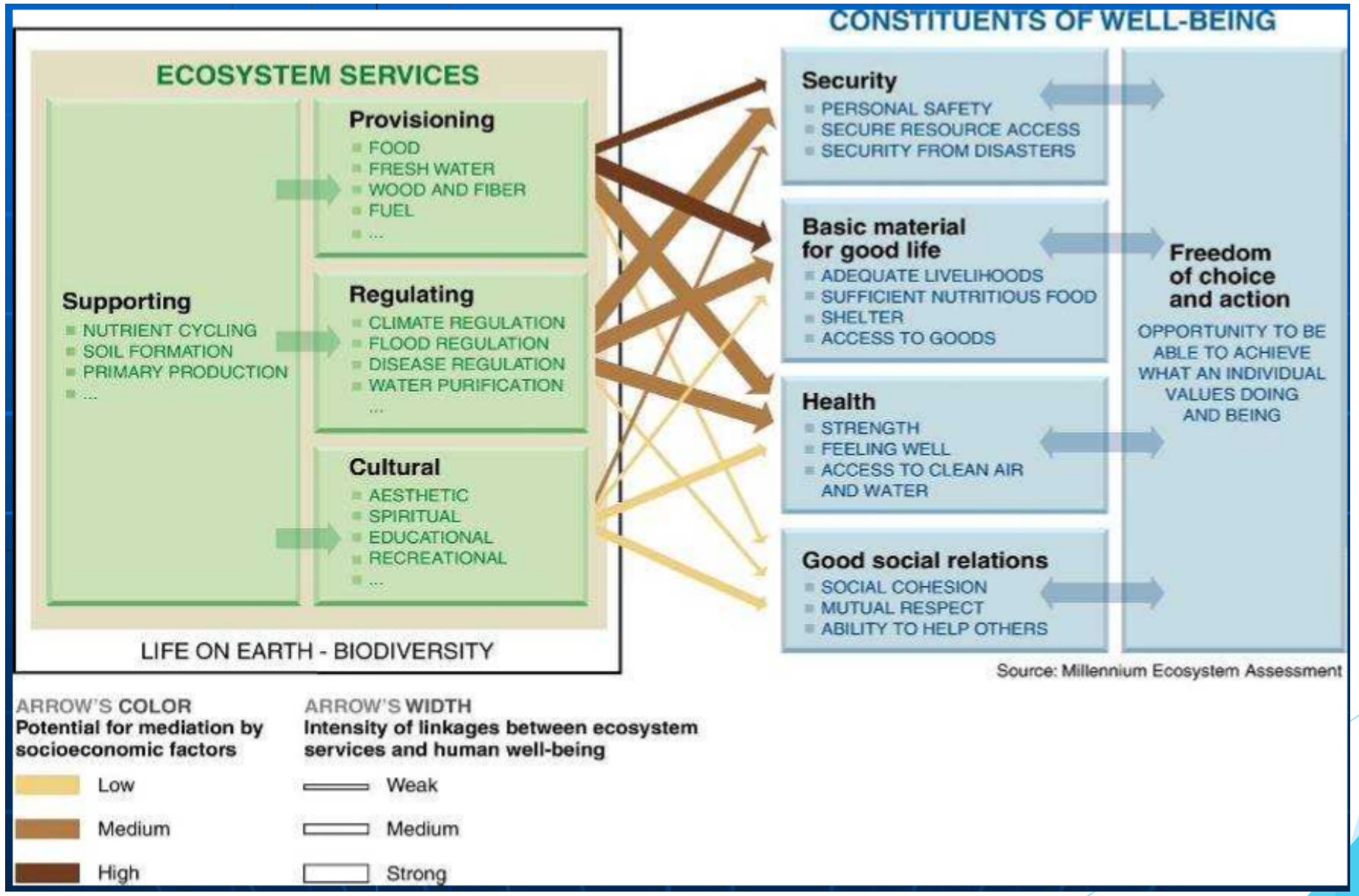
- **An ecosystem is a dynamic complex of plant, animal, and micro-organism communities and the non-living environment (air, water and mineral soil), interacting as a functional unit. Humans are an integral part of ecosystems.**
- The biotic and abiotic components are regarded as linked together through nutrient cycles and energy flows. Everything that lives in an ecosystem is dependant on other species and elements that are also part of the ecological community (**complex interactions**)
- If one part of the ecosystem is damaged or disappears, it has an impact on everything else (e.g. disappearance or destruction of a habitat).
- Ecosystems vary in size but usually encompass specific, limited spaces: although some scientists say that the entire planet is an ecosystem
- When an ecosystem is healthy, scientists say it is sustainable: i.e. all elements live in a balance and are capable of reproducing themselves.
- There is usually **biodiversity,** meaning that there are a variety of living organisms and species in that environment
- Species diversity; The more diverse species are in an ecosystem, the more healthy that ecosystem is. Stressed ecosystems have few species.

Ecosystem services

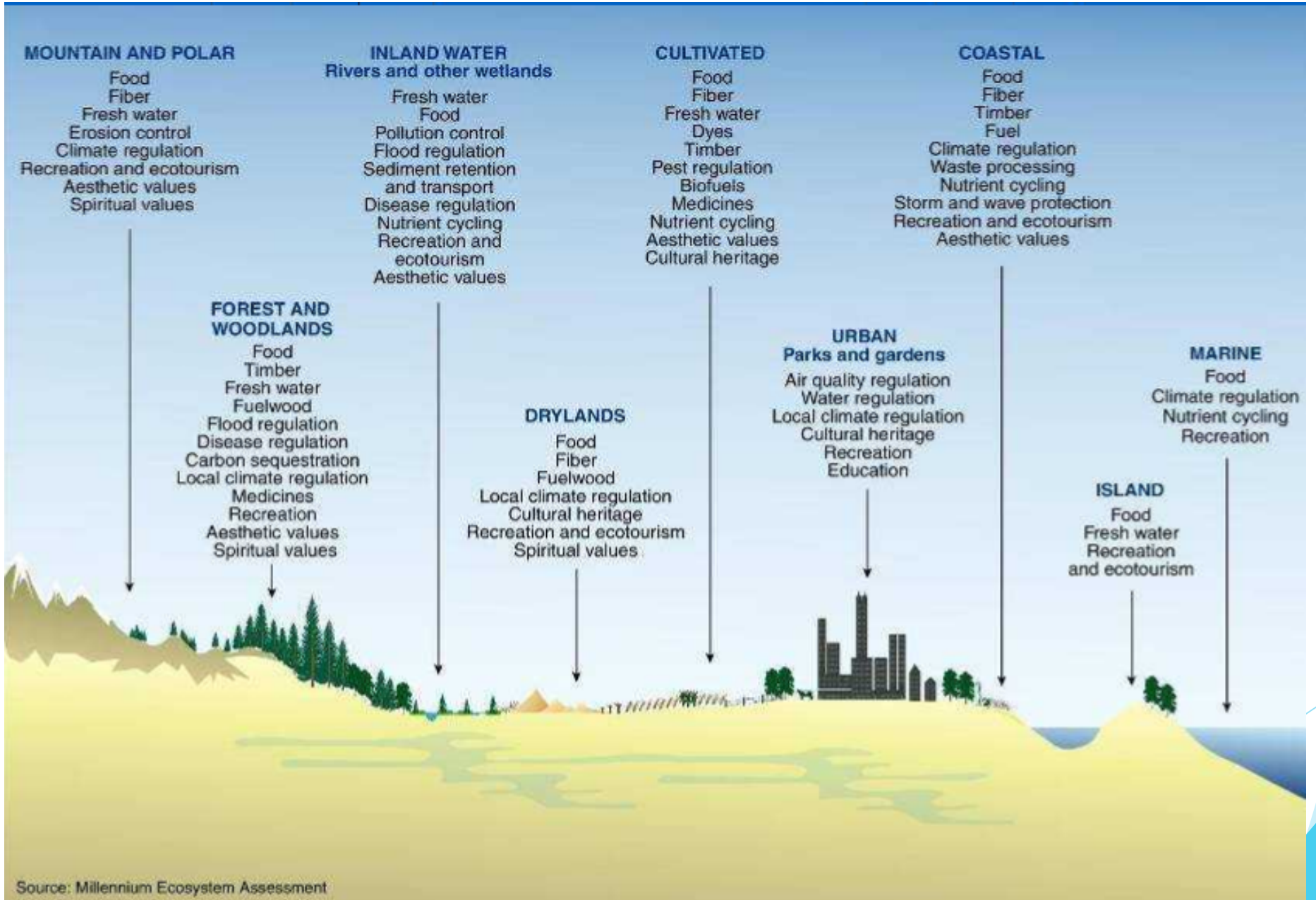
- **Ecosystem services** are the benefits provided by **ecosystems** that contribute to making human life both possible and worth living.
  - Provisioning *services* such as food and water
  - regulating *services* such as flood and disease control;
  - cultural *services* such as spiritual, recreational, and cultural benefits; and
  - supporting *services*, such as nutrient cycling, that maintain the conditions for life on Earth.
- **Biodiversity is the variability among living organisms - diversity within and among species, and diversity within and among ecosystems.**
- **Biodiversity is the source of many ecosystem goods, such as food and genetic resources, and changes in biodiversity can influence the supply of ecosystem services.**


ECOSYSTEM SERVICES
Provisioning
FOOD
FRESH WATER
WOOD AND FIBER
FUEL
...
Supporting
NUTRIENT CYCLING
SOIL FORMATION
PRIMARY PRODUCTION
...
Regulating
CLIMATE REGULATION
FLOOD REGULATION
DISEASE REGULATION
WATER PURIFICATION
...
Cultural
AESTHETIC
SPIRITUAL
EDUCATIONAL
RECREATIONAL
...
LIFE ON EARTH - BIODIVERSITY

Ecosystem services and human wellbeing



Ecosystem services

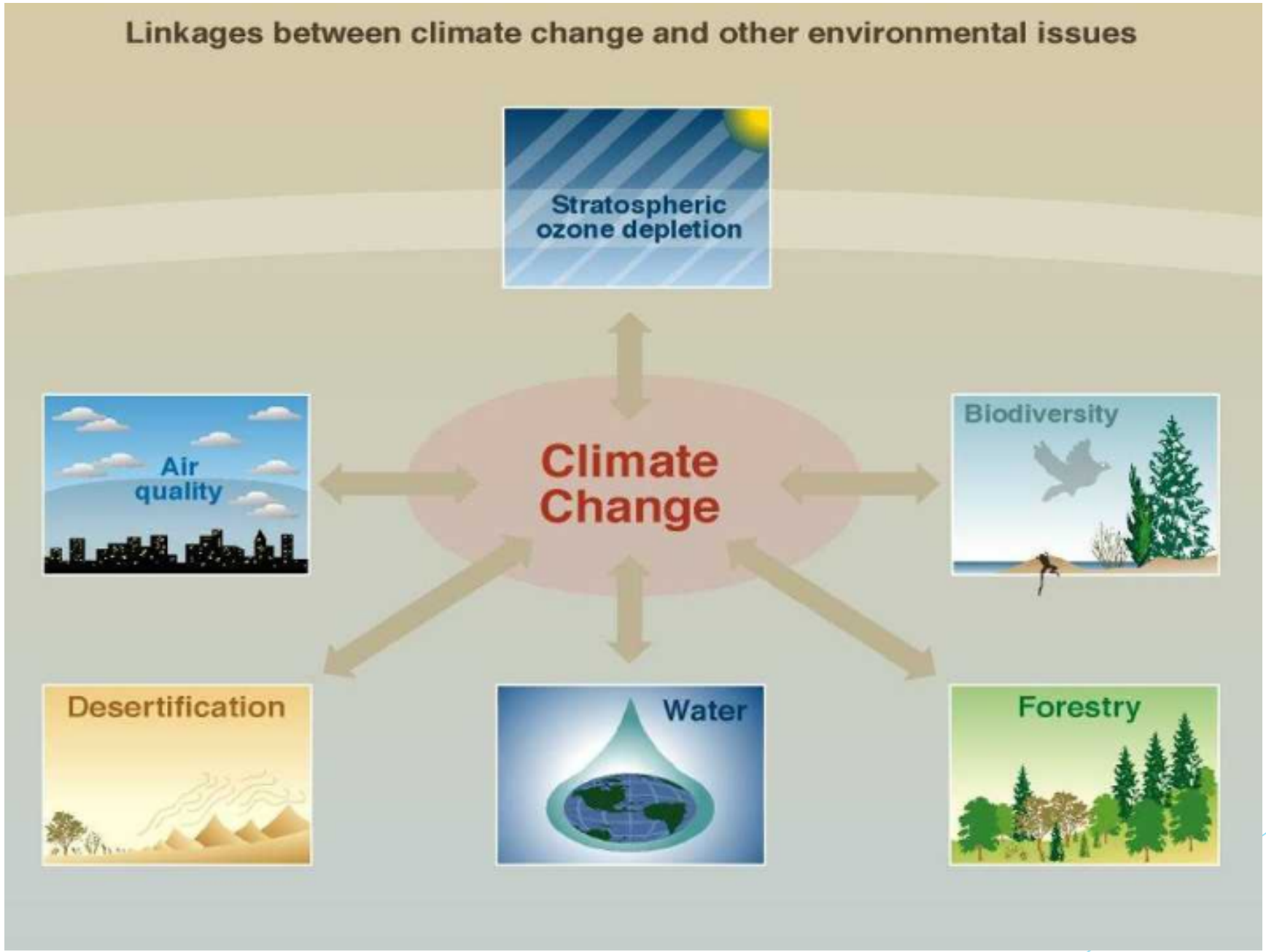


Challenge - valuation of ecosystem services

- Ecosystem services contribute to economic welfare: they contribute to generation of income and wellbeing (e.g., provisioning of food and fiber),
- Ecosystems also contribute to economic welfare through the prevention of damages that inflict costs on society: the role of ecosystem disaster risk reduction
- Valuation techniques are important to ensure that the true value of ecosystems and their services provided are taken into account when estimating the impact of human-induced climate change on ecosystems, and when making decisions on how to mitigate or adapt to climate change
- Methods for eliciting values should use a combination of economic and non-economic valuation methods
- Total Economic Value framework that takes into account both the use and non-use values individuals and society gain or lose from marginal changes in ecosystem services.

Linkages between ecosystems (biodiversity) and climate change

- Biodiversity is connected to climate change:
  1. Climate change and biodiversity interact
  2. Climate change adversely effect biodiversity at the genetic, species and ecosystem level
  3. The biodiversity conservation sector itself needs to adapt
  4. Biodiversity and ecosystems can contribute to adaptation to climate change
  5. Some climate change adaptation strategies can have negative impacts on biodiversity
  6. Ecosystem management can contribute to mitigating climate change
  7. Some climate change mitigation strategies can have negative effects on biodiversity and ecosystems
  8. Some mitigation strategies are also adaptation strategies


Linkages between climate change and other environmental issues
Stratospheric ozone depletion
Air quality
Climate Change
Biodiversity
Desertification
Water
Forestry

Climate change is already affecting bio-diversity

- Changes in climate and carbon dioxide have already had observed impacts on species and ecosystems
- Approximately 10% of species assessed are projected to be at an increasing high risk of extinction for every 1^{o}C rise in global mean temperature
- Wetlands, mangroves, coral reefs, arctic ecosystems and cloud forests are projected to be particularly vulnerable both directly (temperature and precipitation) and indirectly (pests and fires) to climate change , with the possibility of coral reefs and cloud forests ceasing to function within a few decades
- Projected changes in biodiversity and ecosystem services can have significant economic adverse effects including the loss of natural capital.

Ecosystem Based Adaptation (EbA)

- Also called **biodiversity based adaptation.**
- “The use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change.” (CBD 2009)
- “Adaptation policies and measures that take into account the role of ecosystem services in reducing the vulnerability of society to climate change” (Vignola et al. 2009)
- “Local and landscape scale strategies that enable both people and nature to adapt in the face of climate change” (IUCN 2009)
- ecosystem-based approaches for adaptation may include sustainable management, conservation and restoration of ecosystems, as part of an overall adaptation strategy that takes into account the multiple social, economic and cultural co-benefits for local communities
- Healthy, well-functioning ecosystems enhance natural resilience to the adverse impacts of climate change and reduce the vulnerability of people.

Ecosystem Based Adaptation

- EbA is human centred
- EbA - including restoration of degraded ecosystems, e.g., wetlands, mountains - improves the capacity of ecosystems to deliver ecosystem services, benefiting the poor who are often most directly dependent on ecosystem goods and services
- EbA is often more accessible and affordable to the poor than structural adaptation
- EbA options are available in nearly all sectors, in particular coastal, water, agriculture, forestry
- Ecosystem-based management offers a valuable yet under-utilized approach for climate change adaptation, complementing traditional actions such as infrastructure development.

EbA framework

1 Ecosystems for the **adaptation of society** to climate variations

2 **Sustainable management** of ecosystems for sustainable provision of services + **Adaptation of ecosystems** to climate change (if sustainable management is in place and human drivers of degradation are under control)

(Locatelli 2011)

EbA Actors

- The term EbA is mainly used by:
  - UN Agencies especially UNEP where EbA is a flagship programme on climate change adaptation. UNDP also uses EbA.
  - International Conventions: UNFCCC, Convention on Biological Diversity (CBD)
  - International NGOs especially IUCN, WWF, Care, IIED
- What about?
  - National policy makers e.g. NAPA?
  - Scientists

EbA builds on existing practices

- Integrated water resource management
- Community based natural resource management
- Community based adaptation
- Forest landscape restoration

- But, participatory assessments and vulnerability impact assessments (VIAs) are essential in
  - identifying climate change impacts
  - Vulnerability of ecosystems and ecosystem services.

Vulnerability and impact assessments are crucial

- Identify those ecosystem services whose continued or enhanced supply will be of importance for reaching the goals of adaptation over the timescale covered by the adaptation strategy.
- Assess the current and future capacity of ecosystems to deliver these services, taking into account climate projections, the current state of ecosystems and pressures acting on them, and their resilience to climate change.
- Identify areas where climate change may lead to or exacerbate a situation in which the demand for ecosystem services exceeds their availability.
- Propose adaptation measures to address identified problems, including by increasing ecosystem resilience.

EbA Principles

- Promoting the resilience of both ecosystems and communities/societies
- Promotes multi-sectoral approaches
- Operates at multiple geographical scales
- Integrates flexible management structures that enable adaptive management
- Minimizes trade-offs and maximizes benefits with development and conservation goals to avoid unintended negative social and environmental impacts;
- Based on best available science and local knowledge, and fosters knowledge generation and diffusion;
- Participatory, transparent, accountable, and culturally appropriate and actively embraces equity and gender issues.

EbA principles contd.

- EbA should
  - Promote resilient and healthy ecosystems
  - Maintain ecosystem services
  - Support sectorial adaptation
  - Reduce risks and disasters
  - Complement infrastructure
  - Avoid mal-adaptation

EbA Opportunities

- Multiple benefits across landscapes and sectors (environmental, social and economic)
- Biodiversity conservation and enhancement
- Contribution to mitigation
  - Conserving ecosystems for adaptation also conserves carbon
  - EBA projects may also tap carbon financing
- No-regret and flexible measures
- Cost-effectiveness
  - TEEB (The Economics of Ecosystems and Biodiversity): maintaining nature's capacity to buffer the impacts of climate change on people is often less costly than having to replace lost ecosystem functions through the use of heavy infrastructure or technology.

Environmental benefits

- EBA measures provide several environmental benefits, which in turn enhance human wellbeing:
- Water management such as restoring ponds, water sources and water channels have
  - enhanced water provision, recharged ground water, increased soil moisture and increased vegetation
  - Adaptation functions - increase agricultural and livestock production during dry spells, through increased water provision.
  - regulate flooding through channeling excess water, and to reduce the impact of landslides by capturing silt.
  - Natural water infiltration through the pond has enhanced soil moisture level and soil quality, reducing soil erosion.

Environmental benefits cont.

- EbA measures focused on sustainable grassland and livestock management, such as rotational grazing, livestock organization and planting of native grass species can:
  - enhanced vegetation cover and diversity, and increased forage
  - Restore grasslands, increase soil moisture, regulate water and increase livestock productivity.
  - adaptation functions include increased provision of grazing and forage during dry periods, regulating water and floods during heavy rainfall, and slope stabilization during landslides.
  - Increase in vegetation cover is further expected to lead to better water infiltration capacity and reduce soil cover loss.

Environmental benefits cont.

- Conservation agriculture has improved soil quality and fertility, reduced soil erosion, enhanced water infiltration and increased provision of crops
  - These enhanced ability of ecosystems to provide food during drought periods, through conservation agriculture measures that increase soil moisture, and through testing of drought resistant varieties.
  - Better land management, through measures such as grass banks and hedgerows, can reduce the impact of heavy rainfall and landslides.
  - community has been able to produce food even during periods of drought - the adopted measures reducing soil erosion and enhanced management of surface runoff water, and to piloting of drought resistant crop varieties

Social benefits

- Implementation of no regret adaptation EbA actions provide a rage of social benefits:
  - enhanced food security and healthier diet
  - access to clean water,
  - Strengthening of local organizational and technical capacities to manage natural resources
  - empowerment of women and disadvantaged groups to engage in productive activities
  - breaking down social and cultural barriers -reduction of ethnic and social tensions

Economic benefits

- Generating income to diversify livelihoods and hence economic resilience to climate change (ecotourism, bee keeping and honey harvesting, commercialization of non timber forestry products, production of unbaked bricks etc)
- Monetary profits from conservation agriculture, sale of fiber
- Savings from reduced agricultural inputs (fertilizers)
- Fodder and better pastures for animals – animal production
- Enhanced access to water stimulates agricultural and livestock production that turn into economic benefits
- Water conservation for energy generation increasing energy access.

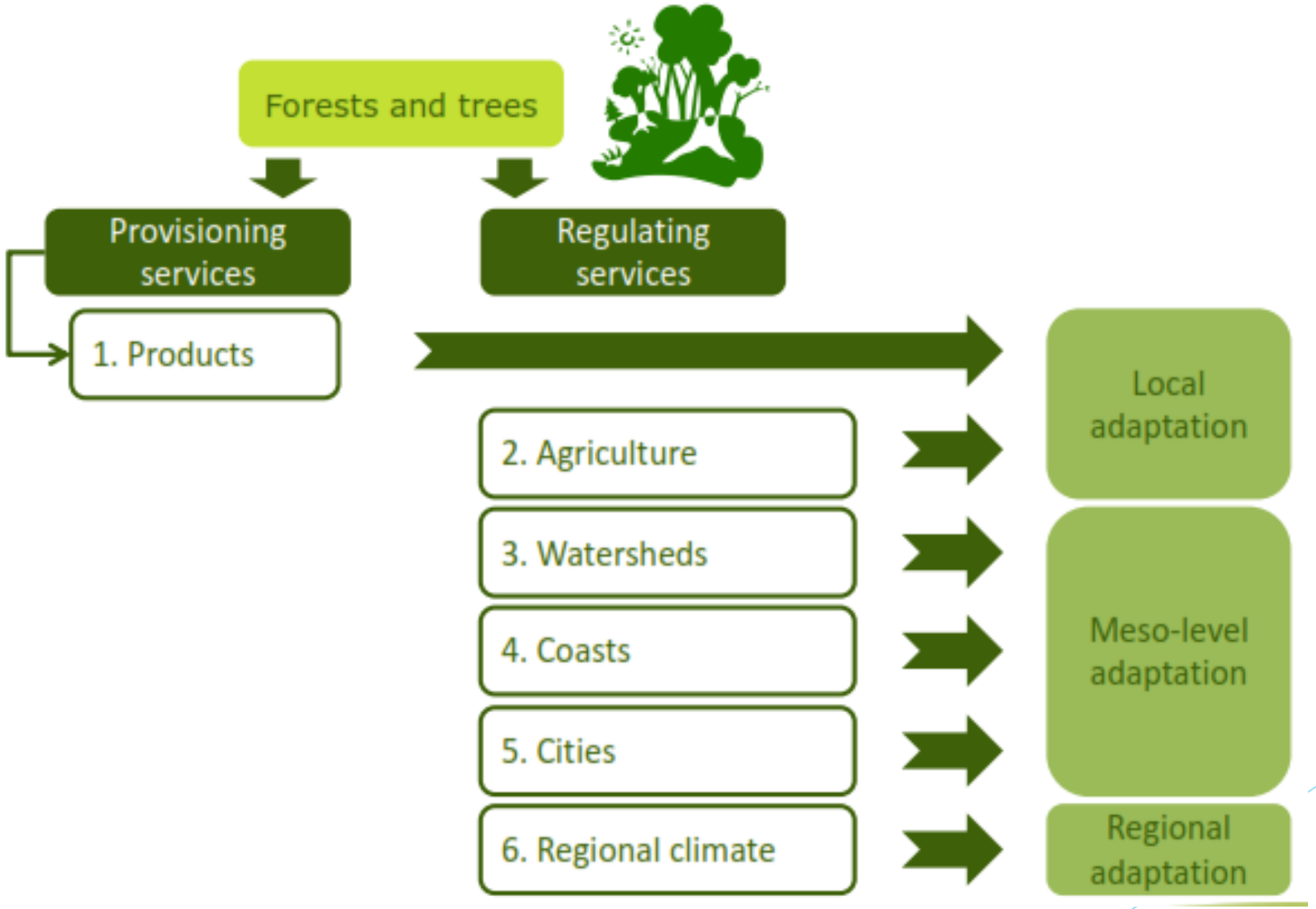
Cost-benefit analysis is essential

- Proving the cost effectiveness of EbA measures is essential to making the case for EbA to stakeholders, ranging from local communities and planners to national level decision-makers and donors.
- CBA is a decision-making tool that can help evaluate the economic feasibility of a proposed intervention that results in certain benefits and costs.
- Undertaking cost-benefit analysis can be challenging. Quantifying and estimating monetary values of any commodity can be difficult. This is even more difficult when ecosystem services and environmental resources are considered.
- It is further challenging to incorporate climate change considerations into the cost-benefit analysis.

Financing EbA

- Can be challenging; already the NR sectors are critically under funded, less than than 3% of the budget
- Protected areas are ideal to be ideal entry points for planning, financing and implementing landscape-level EbA
- Public financing through national budgets – build on budgets for water, forestry, agriculture, environment etc.
- Engaging local governments: EbA is implemented at landscape and ecosystem level – integrate in local government budgets, across the sectors.
- Payment for ecosystems services (PES) model/mechanisms. ECOTRUST and IUCN have piloted this modality in Mt. Elgon region.
- Community economic and environmental incentive schemes.

Six major stories

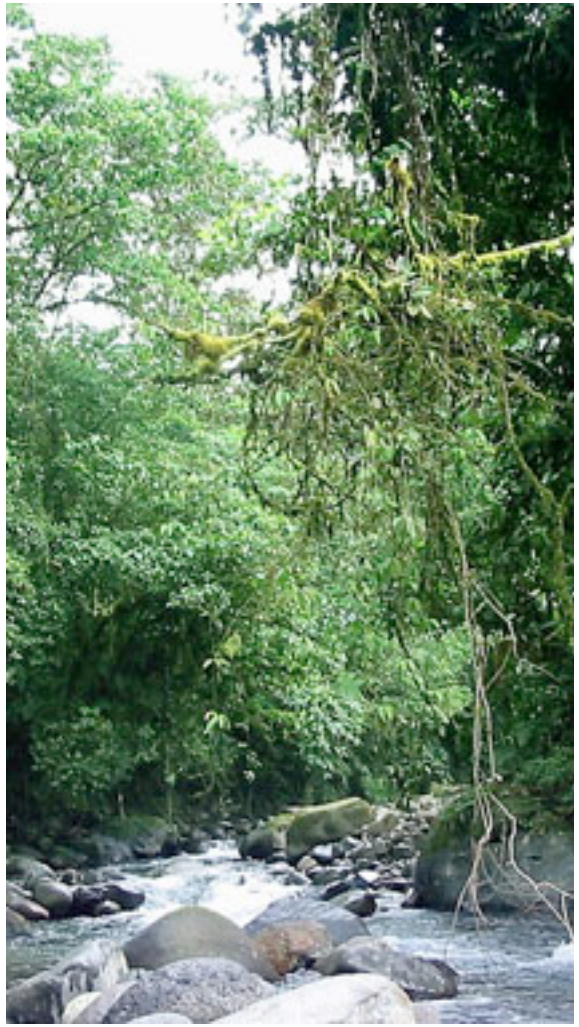


1. Products

- Forests and trees
  - Provide safety nets for local communities coping with climate shocks
  - Increase livelihood diversification (anticipatory strategy)
- Examples:
  - the poorest and the least-educated can rely more on forests for their coping strategies after a flood (Liswanti et al. 2011)
  - Honduras – smallholders sold timber to recover from asset loss due to Hurricane Mitch (McSweeney 2005)
- Issues:
  - Poverty trap? (out of the forest, out of vulnerability?)
  - Sustainability of natural resources for adaptation
  - Property rights and access

2. Agriculture

- Trees in agriculture
  - Maintain production under climate variability and protect crops against extremes
  - Local shade cover, soil fertility and moisture, wind breaks, water infiltration
- Examples:
  - Coffee systems shaded by trees may not significantly affected by drought because of shade and water uptake from the trees
  - Agroforestry shows modest yields during drought
- Issues:
  - Trade-offs: Production vs. resilience

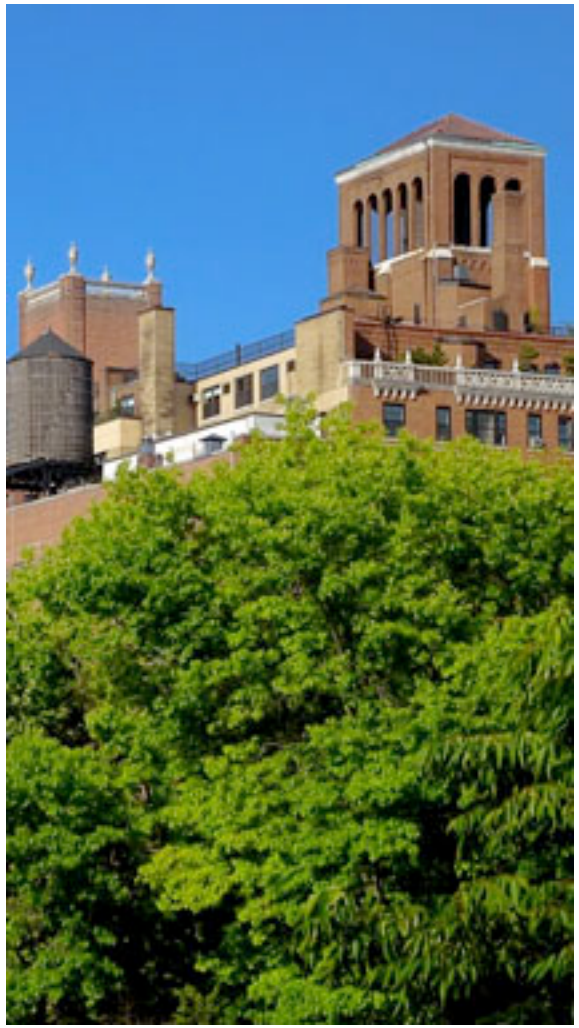


3. Watersheds

- Forests in watersheds:
  - Regulate base flows (dry seasons), peak flows (intense rainfall), and stabilize soil (landslide risks)
- Examples:
  - Agrarian communities near forested watersheds in show lower impacts and higher profits during droughts
  - Reduction of landslide risks with forest plantations and regeneration
- Issues:
  - Trade-offs between services (e.g. more regularity but less total water)
  - Not enough evidence, many studies based on common wisdom, controversies (e.g. floods and forests)

4. Coasts

- Coastal forests
  - Absorb and dissipate wave energy and stabilize coastal land
  - Protection from tropical storms, sea level rise, floods and coastal erosion
- Examples:
  - India (Orissa) – Cyclone protection. Villages behind mangroves suffered less losses of life, property and crops during the 1999 cyclone (Badola and Hussain 2005)
  - Vietnam – Reducing dyke maintenance costs. Benefits of US$70–130 per ha/year (Tri et al. 1998; Das and Vincent, 2009)
- Issues
  - What level of protection from extremes do they provide?



5. Cities

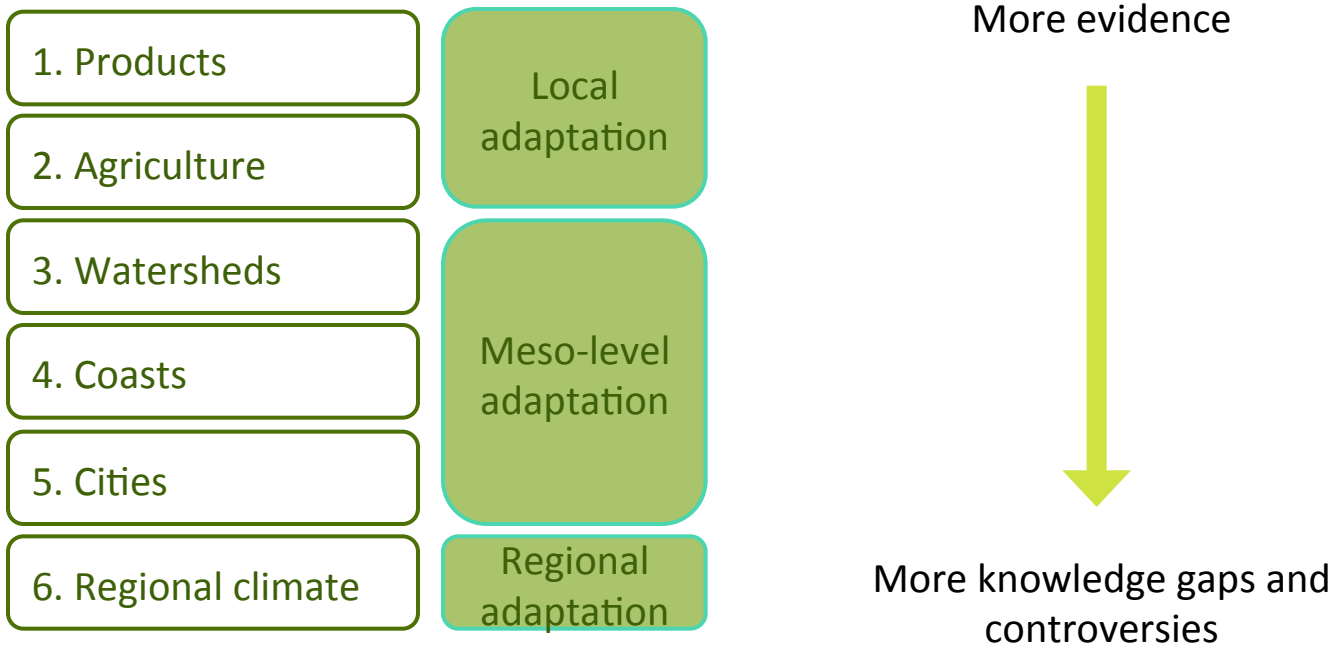
- Urban forests and trees
  - Regulate temperature and water for resilient urban settlements
  - Services: Shading, evaporative cooling, rainwater interception, storage and infiltration
- Examples
  - Manchester (UK) – Reducing urban flood risk. Trees can reduce volume of surface runoff (by 5 to 6%) (Gill et al. 2007)
  - New Jersey (USA) – Reducing “urban heat island” effect and heat stress. Areas with mature canopies are 2.7–3.3°C cooler than areas without trees (Solecki et al. 2005)
- Issues
  - Opportunity costs
  - Studies almost only in developed countries

6. Regional climate

- Forests can influence regional climate:
  - Cooling effect through increased evaporation and cloud cover
  - Influence on precipitation: water pumping and rainfall recycling
- Examples:
  - Amazon and West Africa – 40% of rainfall come from evapotranspiration over land (Ellison et al. 2012)
  - Sahel – Biotic pump effect of forests, facilitating movements of water vapor from the Gulf of Guinea to the Sahel (Makarieva et al. 2007)
- Issues
  - Controversies
  - Multiple scales involved (local, regional, global)
  - => How policies could address this role of forests?

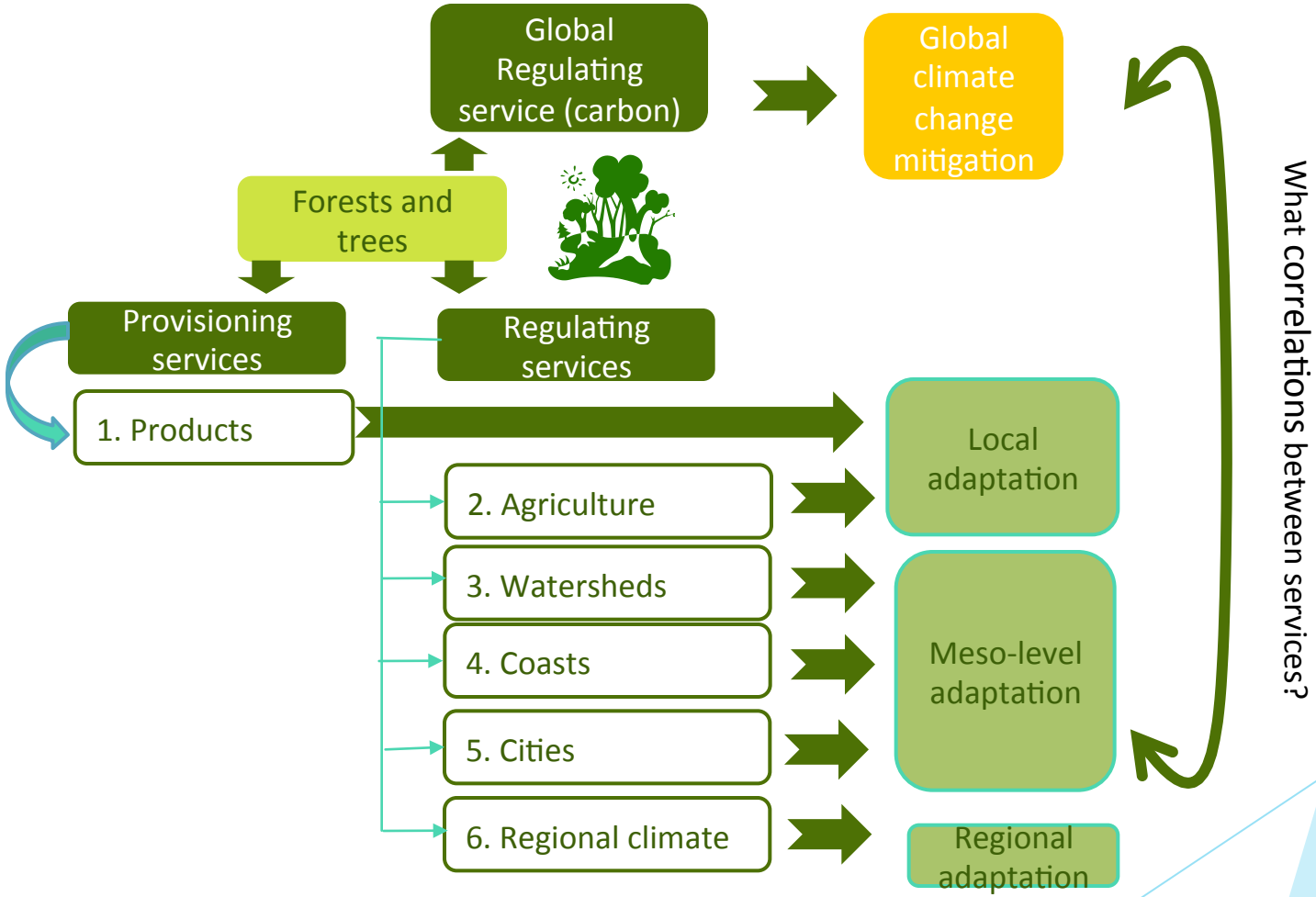
What do we conclude from this ?

- Scales and evidence on EbA



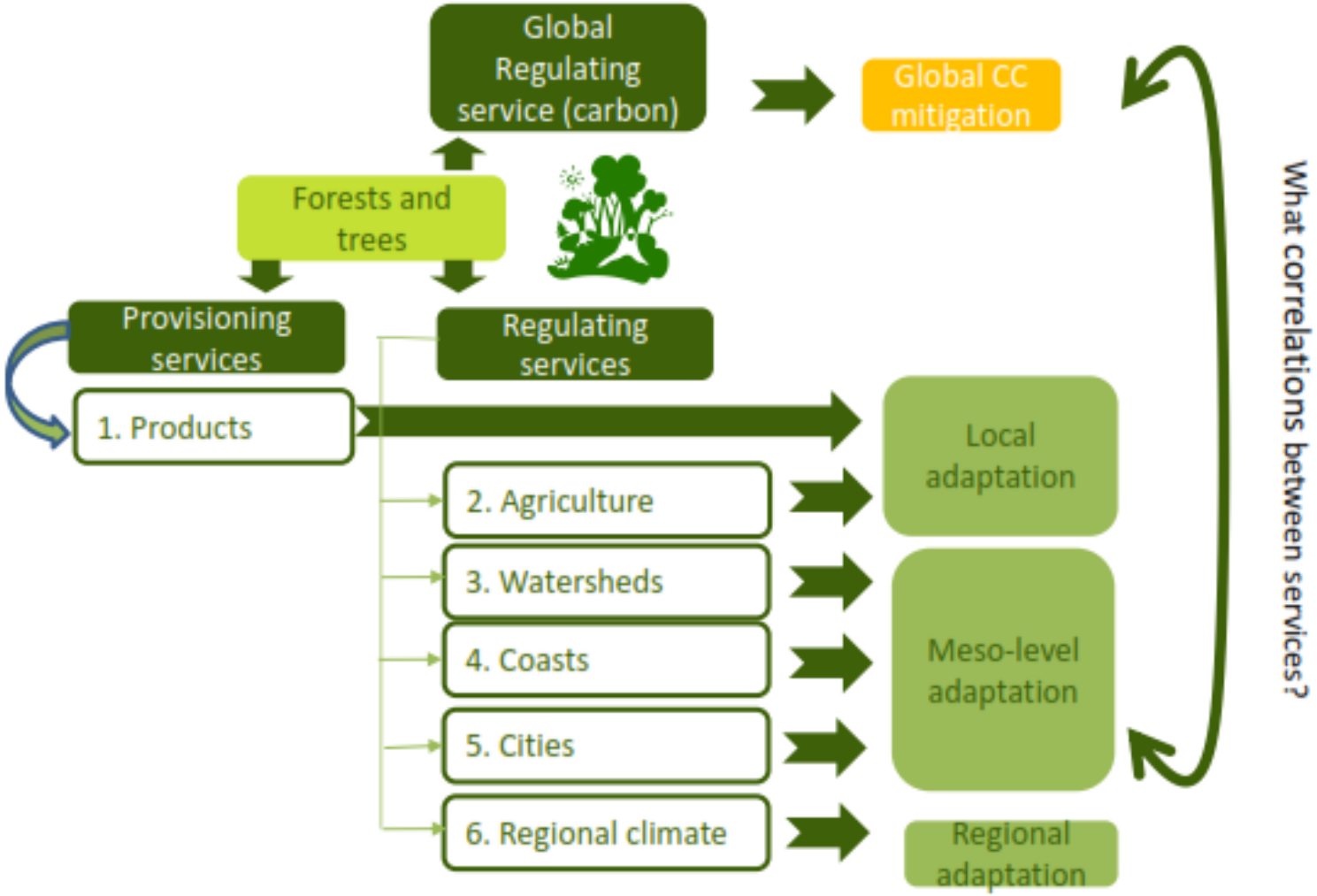
- The knowledge (e.g. on forest hydrology) should be revisited with a climate change adaptation lens
- Uncertainties on some benefits of EBA to adaptation but need to consider co-benefits (biodiversity, climate change mitigation)

Conserving ecosystems for their 'adaptation services' can contribute to conserving its 'mitigation service'

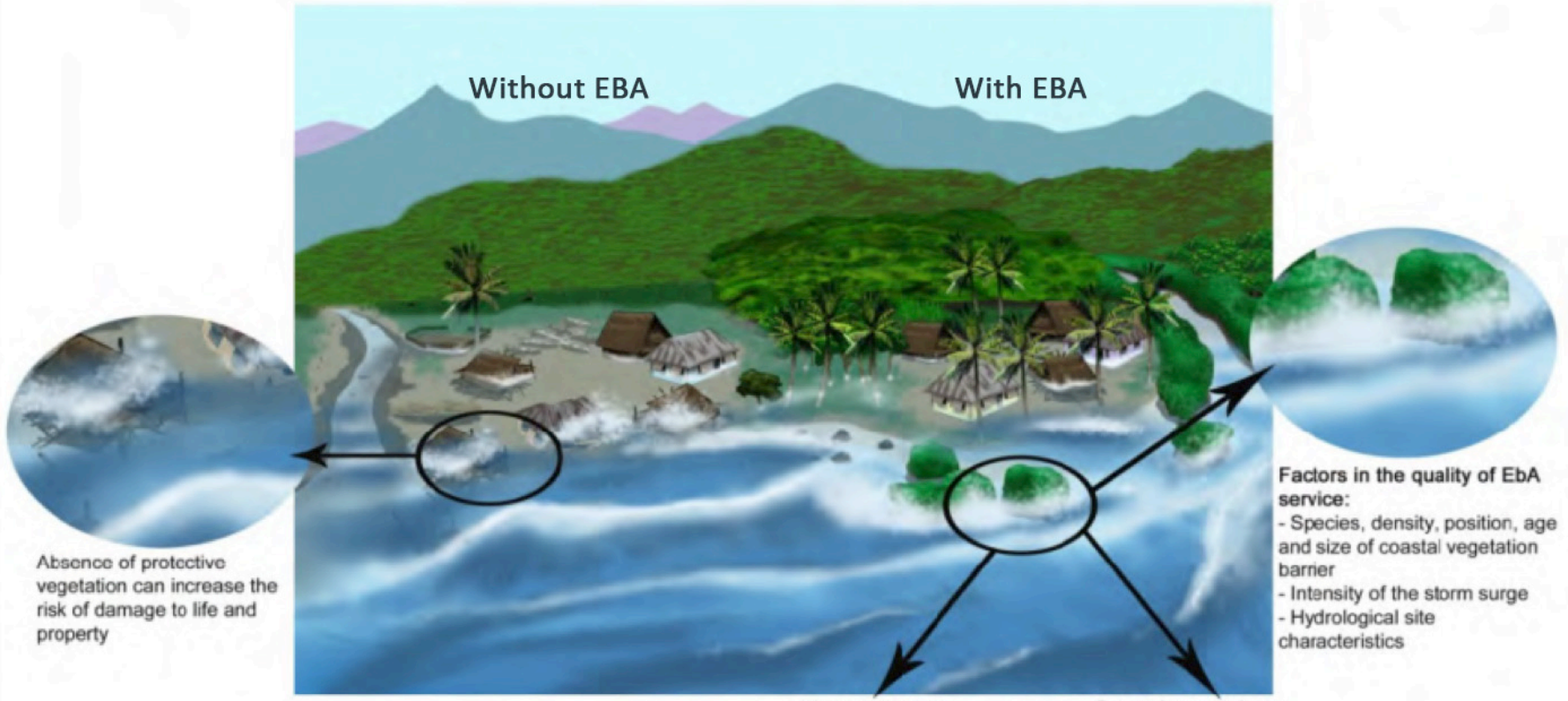


What correlations between services?

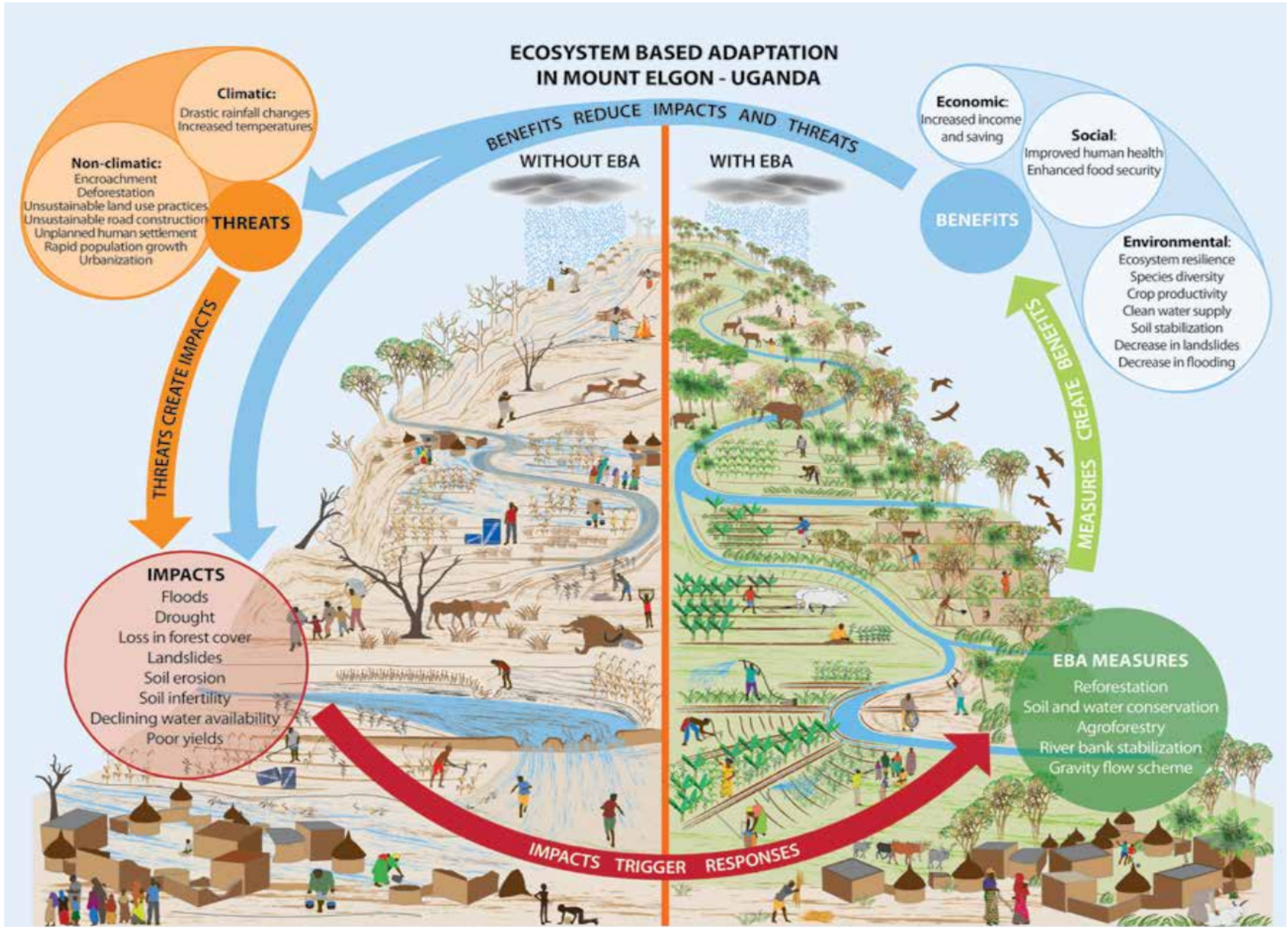
Conserving ecosystems for their 'adaptation services' can contribute to conserving its 'mitigation service'



Vegetation barrier for storm protection



In Uganda, UNEP, UNDP and IUCN
are implementing EbA measures in Mt. Elgon region
(Bulamburi and Sironko districts)


ECOSYSTEM BASED ADAPTATION
IN MOUNT ELGON - UGANDA
Climatic:
Drastic rainfall changes
Increased temperatures
Non-climatic:
Encroachment
Deforestation
Unsustainable land use practices
Unsustainable road construction
Unplanned human settlement
Rapid population growth
Urbanization
THREATS
THREATS CREATE IMPACTS
IMPACTS
Floods
Drought
Loss in forest cover
Landslides
Soil erosion
Soil infertility
Declining water availability
Poor yields
BENEFITS REDUCE IMPACTS AND THREATS
WITHOUT EBA
WITH EBA
Economic:
Increased income
and saving
Social:
Improved human health
Enhanced food security
BENEFITS
Environmental:
Ecosystem resilience
Species diversity
Crop productivity
Clean water supply
Soil stabilization
Decrease in landslides
Decrease in flooding
MEASURES CREATE BENEFITS
EBA MEASURES
Reforestation
Soil and water conservation
Agroforestry
River bank stabilization
Gravity flow scheme
IMPACTS TRIGGER RESPONSES

EbA measures	Location / Implementer	Multiple benefits (observed and expected)		
		Environmental	Economic	Social and cultural
Soil & water conservation	Nabuzo / UNDP 1840 masl	▪ Provision of a cool environment for proliferation of fauna ▪ Enhanced forest ecosystem from reduced influx of communities	▪ Increase in income from enhanced agricultural productivity as a result of increased soil fertility	▪ Increase in community cohesion and resilience as farmers help each other ▪ Increased cultural values of the forests as less people go to the forests to collect forest products
Reforestation and green infrastructure (terracing, contours)	Bugitimwa / UNDP 1800 masl	▪ Increased species diversity with increase in pollination and productivity ▪ Enhanced tree cover and decrease in degraded land and soil erosion	▪ Agricultural livelihood protected from landslides and flooding	▪ Protection from landslide risks
Agroforestry and reforestation (incl. Payment for Environmental Services Scheme)	Kaptpkwoi & Budadiri / UNDP & IUCN 1,600 masl	▪ Enhanced soil stability, productivity, fertility and moisture retention => less soil erosion ▪ Provision of shelter for other plants, especially coffee and banana	▪ Increase in income from enhanced agricultural productivity from increased soil fertility ▪ Enhanced income prospects for ecotourism and PES scheme	▪ Enhanced food security => improved human health ▪ Increased community cohesion and resilience, as farmers help each other
River bank stabilization	Kaptpkwoi & Budadiri / IUCN & UNDP 1,200 masl	▪ Reduced soil erosion leading to better nutrient recycling ▪ Improved rainwater formation cycle ▪ Enhanced ecosystem resilience from reduced flooding	▪ Enhanced income from fuel wood and simple building poles	▪ Decrease in risk to human well-being from prevention of flooding
Community Gravity Flow Scheme, rainwater harvesting and reforestation	Sanzara / IUCN 890 masl	▪ Provision of steady water supply for both human consumption and agriculture ▪ Improved health and variety of crops from steady and sufficient water supply	▪ Improved agricultural livelihoods and more income from increased local commercial sale of more varied and healthier crops, enabled by the catchment-scale approach ▪ Income could further be increased, if additional support was provided to access markets beyond local scale	▪ Increased cohesion & social capital among all involved parish actors from establishing water community groups and jointly planning and implementing activities ▪ Improved health from stable water supply, sufficient food and better nutrition ▪ Decrease in time spent in search for water
Alternative livelihoods (beekeeping, unbaked bricks and fuel-efficient cook stoves)	Implemented In different locations and altitudes / UNDP & IUCN	▪ Enhanced ecosystem restoration from reduced deforestation ▪ Increased species diversity and crop productivity from enhanced pollination	▪ Increased savings from s pending less on firewood ▪ Additional sources of income	▪ Women spend less time on cooking and collecting firewood ▪ Improved human health from decrease in soot/smoke and healing properties of honey ▪ More money for education of children ▪ Empowerment of women

Sources: Developed by T. Rossing and N. Ikkala Nyman based on analysis of Global Technical Learning Workshop of the Mountain EbA Programme (2015), IUCN Uganda (2012a and b), NaFORRI (2012 and 2013), Rizvi et al. (2014), and R Gafabusa, S Kutegeka, and P Nteza, 2015, personal communications.

Thank you for your attention