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School of Social & Environmental Sustainability

2026 Winter Institute @ NTNU

Reducing climate-related risks in rural areas: how can nature-based solutions help?

26 January 2026, NTNU, Taipei, Taiwan

Fabrice Renaud

Outline

- Key concepts
- Reducing risks from natural hazards
- Scientific evidence for nature-based solutions (NbS)
- Importance of ecosystem services
- Towards a better acknowledgement of the role of ecosystems in DRR
- Acknowledging some limitations of NbS
- Facilitating uptake of NbS in practice
- Links to Policy
- Conclusions

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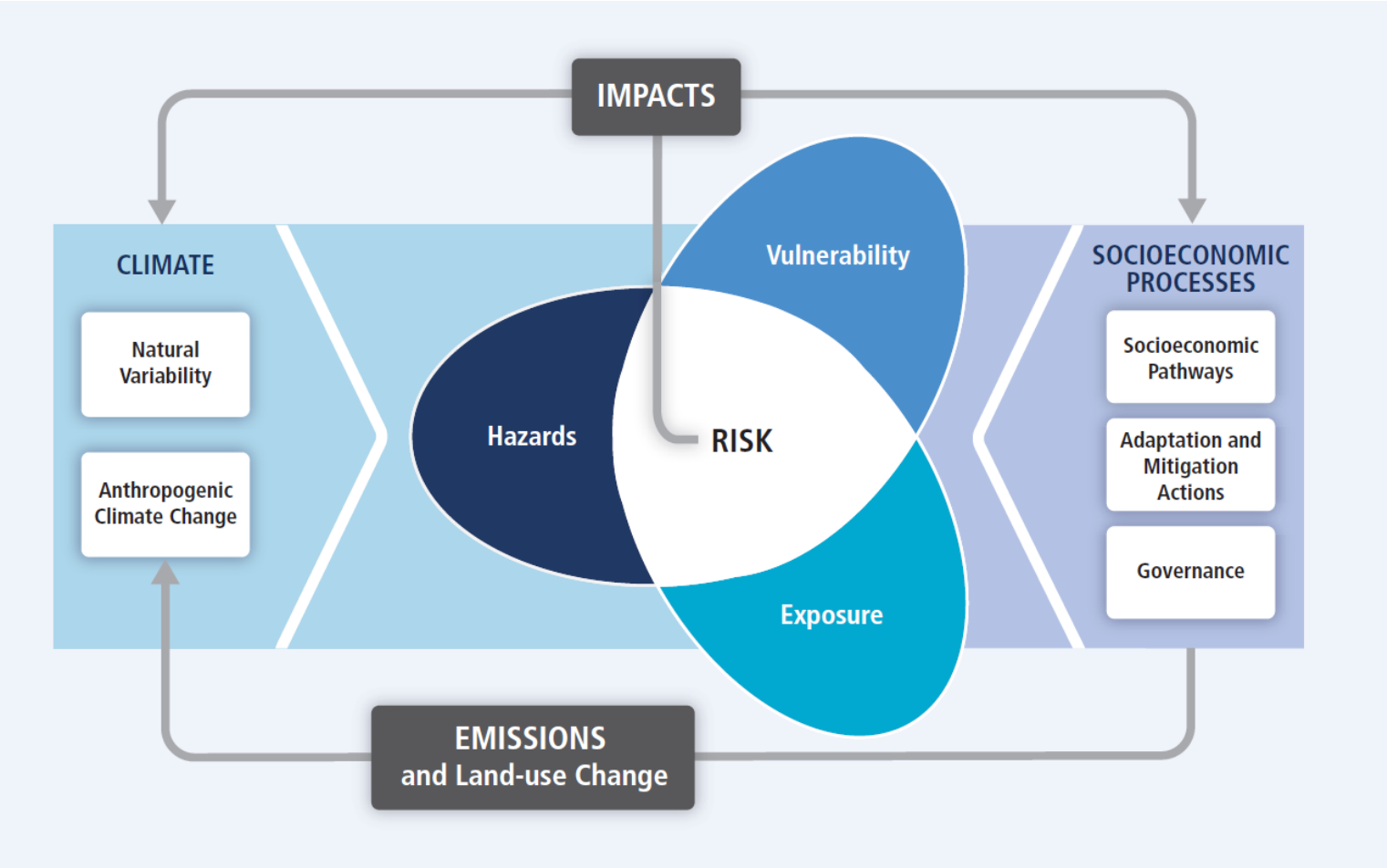
Key concepts

IPCC risk framework



Source: IPCC (2014): Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B. et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32. [Reproduction authorised]

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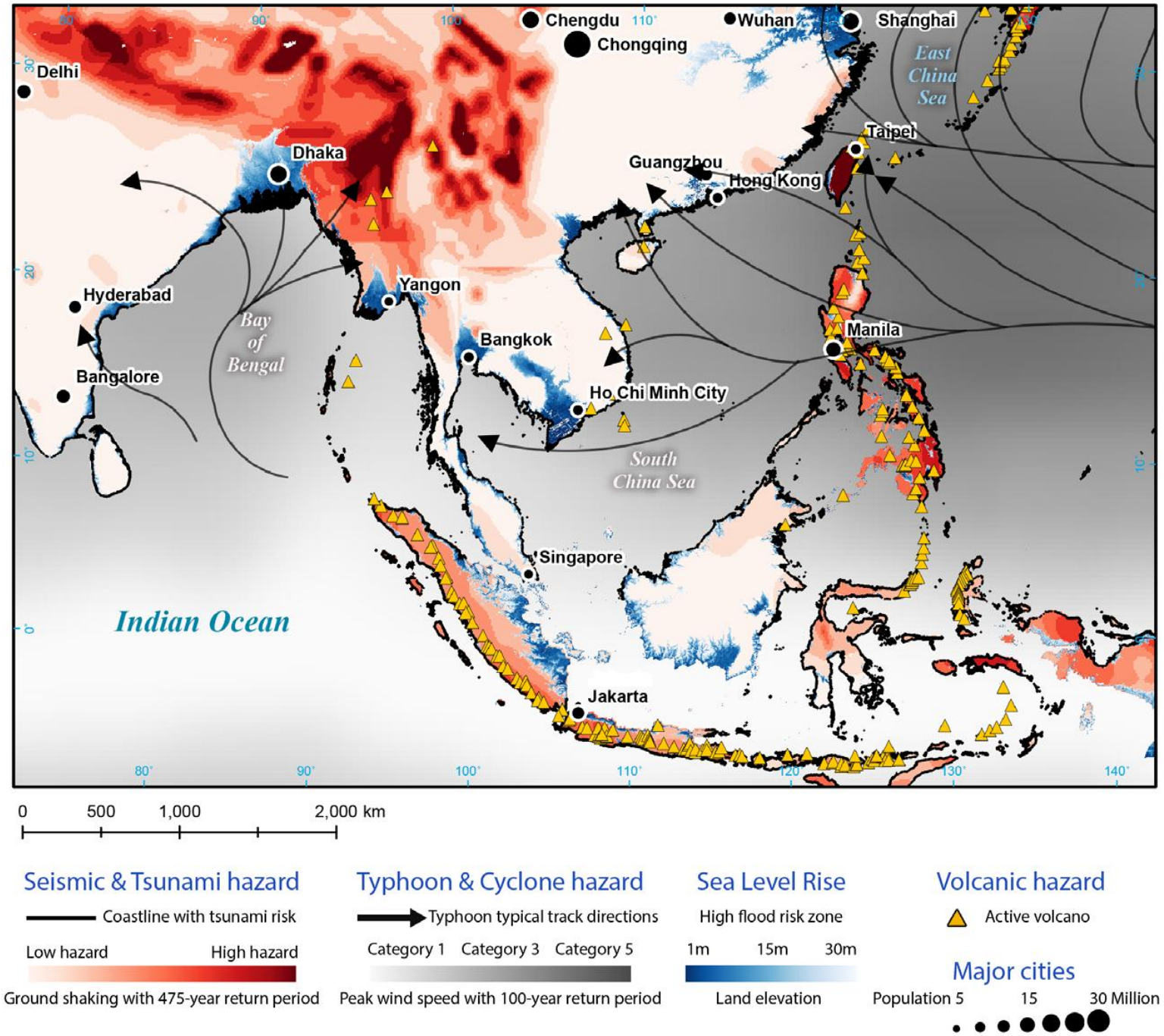
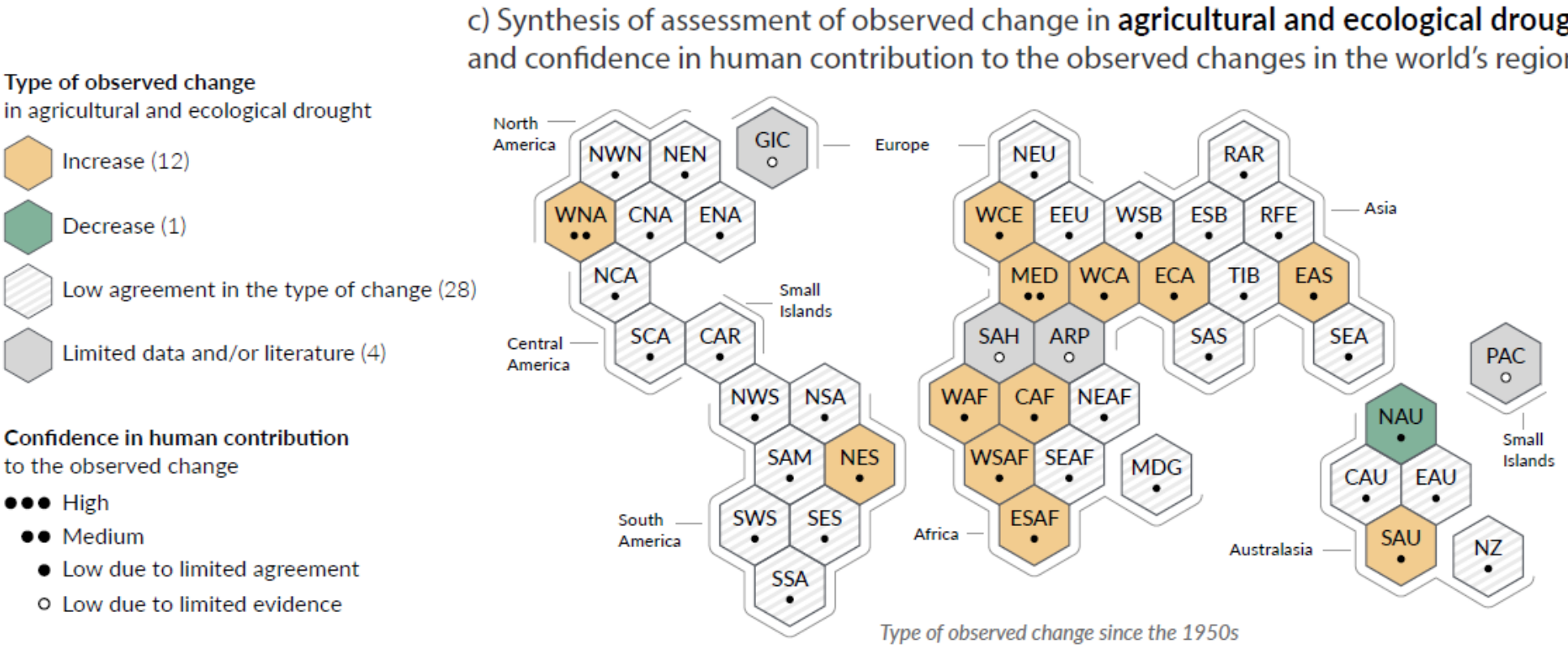
Hazards: multiple & compounding hazards



Source: Earth Observatory of Singapore (2015). Presented in Renaud et al. (2021), Adaptation and Resilience in ASEAN: Managing Disaster Risks from Natural Hazards (p30). UK Government, UK-Singapore COP26 ASEAN Climate Policy Report Series)

Hazards: agricultural and ecological drought

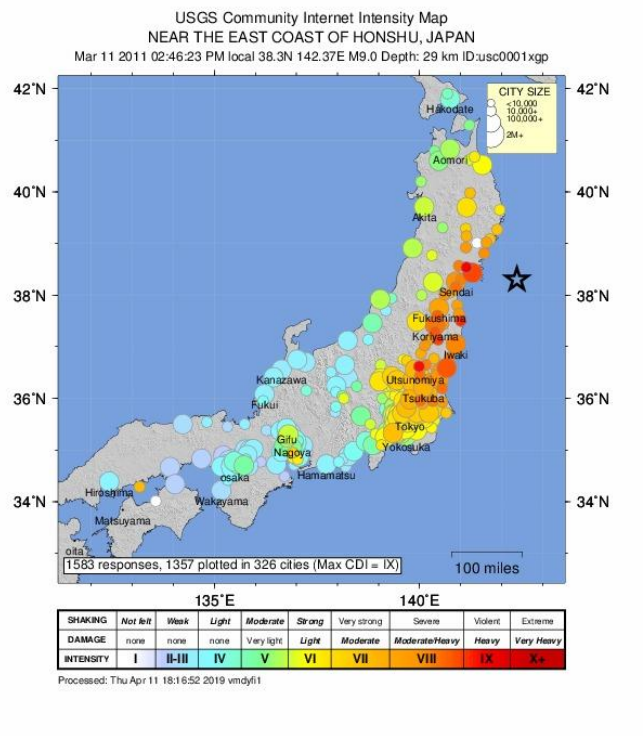


Part of Figure SPM.3: Synthesis of assessed observed and attributable regional changes (IPCC, 2021). Reproduction Authorised

Source: IPCC (2022): : Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., *et al.* (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 3–32, doi:10.1017/9781009157896.001.

Hazards: cascading hazards and impacts

"Cascading impacts from extreme weather/climate events occur when an extreme hazard generates a sequence of secondary events in natural and human systems that result in physical, natural, social or economic disruption, whereby the resulting impact is significantly larger than the initial impact."



Source: USGS – Available at https://earthquake.usgs.gov/earthquakes/eventpage/usp000hvnu/dyfi/intensity


Photo: Fabrice Renaud (UNU-EHS)


Photo: Giovanni Verlini / IAEA). CC BY-SA 2.0

Source: modified from Pescaroli & Alexander (2015) in IPCC (2022): Annex II: Glossary [Möller, V., et al. (eds.)]. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Pörtner H.-O., et al. (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 2897–2930, doi:10.1017/9781009325844.029

Exposure: Earthquake and Tsunami impact in Sendai, Wakabayashi Ward, Arahama District

Exposure: Damaged tsunami gate and consequences (Minami-Sanriku)

Source: By Anawat Suppasri, Nobuo Shuto, Fumihiko Imamura, Shunichi Koshimura, Erick Mas, Ahmet Cevdet Yalciner, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=71694780

Exposure: direct exposure and destruction of natural buffers

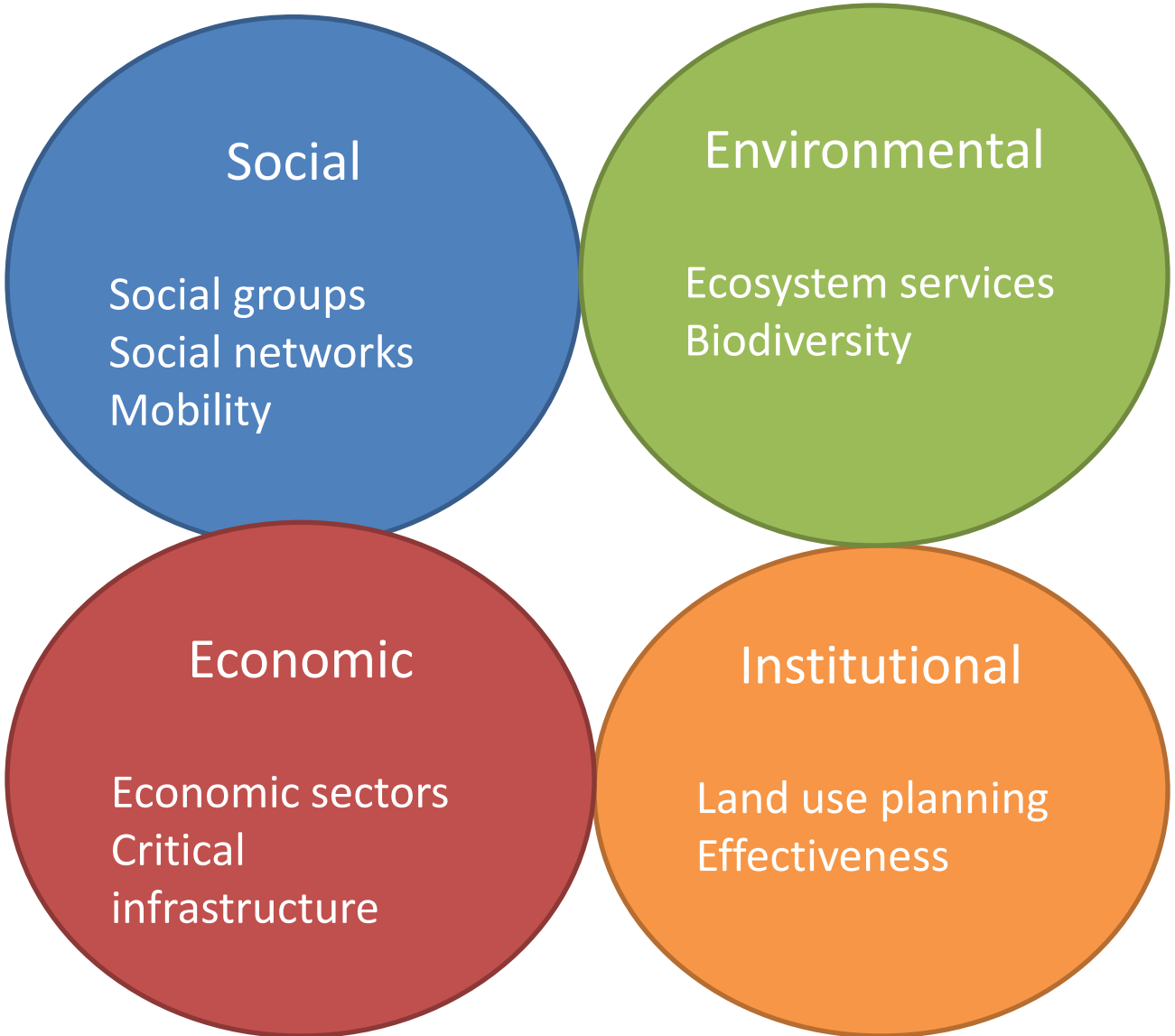
Coastal features in Sri Lanka: bottom-left: sand dune; top: houses build just above high tide range; bottom right: degraded land

Source: Fabrice Renaud/UNU-EHS and Marcus Kaplan/UNU-EHS (for bottom-right photo)

Exposure: do we always have a choice?

Source: Wilfredor, CC0, via Wikimedia Commons

Key Dimensions of Vulnerability (not exhaustive)



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Reducing risks from natural hazards

Protecting ourselves from natural hazards

Sea-dyke, Mekong Delta, Vietnam

Mangrove, Mekong Delta, Vietnam

Mangrove and sea-dyke, Mekong Delta, Vietnam

Photo: Fabrice Renaud/University of Glasgow (2006-2020)

Nature-based Solutions

Nature-based solutions are defined as “actions to **protect, conserve, restore, sustainably use and manage** natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address **social, economic, and environmental challenges** effectively and adaptively, while simultaneously providing **human well-being, ecosystem services and resilience and biodiversity benefits**”

- Ecosystem restoration
  - Ecological Restoration
  - Ecological Engineering
- Issue-specific ecosystem-related
  - **Ecosystem-based Adaptation**
  - **Ecosystem-based DRR**
- Infrastructure-related
  - Natural infrastructure
  - Green infrastructure
- Ecosystem-based management
  - ICZM
  - IWRM
- Ecosystem protection approaches
  - Protected area management

Sources:
Figure adapted from Cohen-Shacham et al. (eds.) (2016): Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN.
Definition from United Nations, Nature-based Solutions for Supporting Sustainable Development, Resolution 5 of United Nations Environment Assembly Adopted on 2 March 2022,

Plantations to limit risks from erosion and landslides

Mountains in Kyrgyzstan

Source: Fabrice Renaud, UNU-EHS, 2009

Coastal protection with sand dunes

Guincho-Cresmina Dune System, Portugal

Photo: Fabrice Renaud (2016)

Artificial sand dune, Bellocchio Beach, Italy

Photo: Fabrice Renaud/University of Glasgow (2022)

Green Buildings

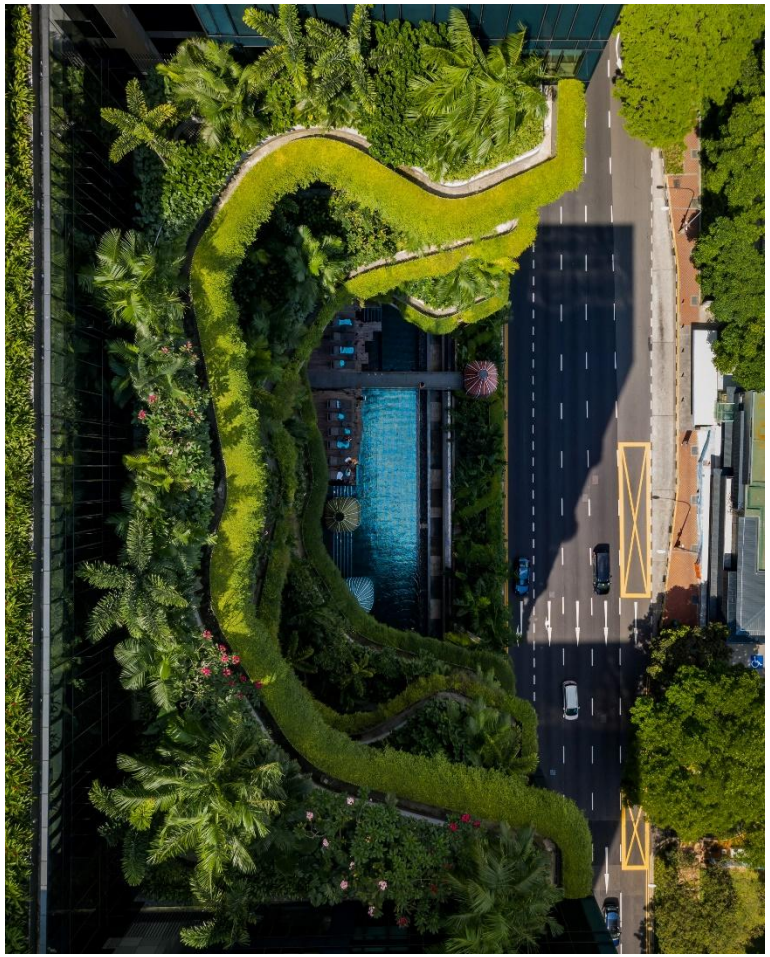
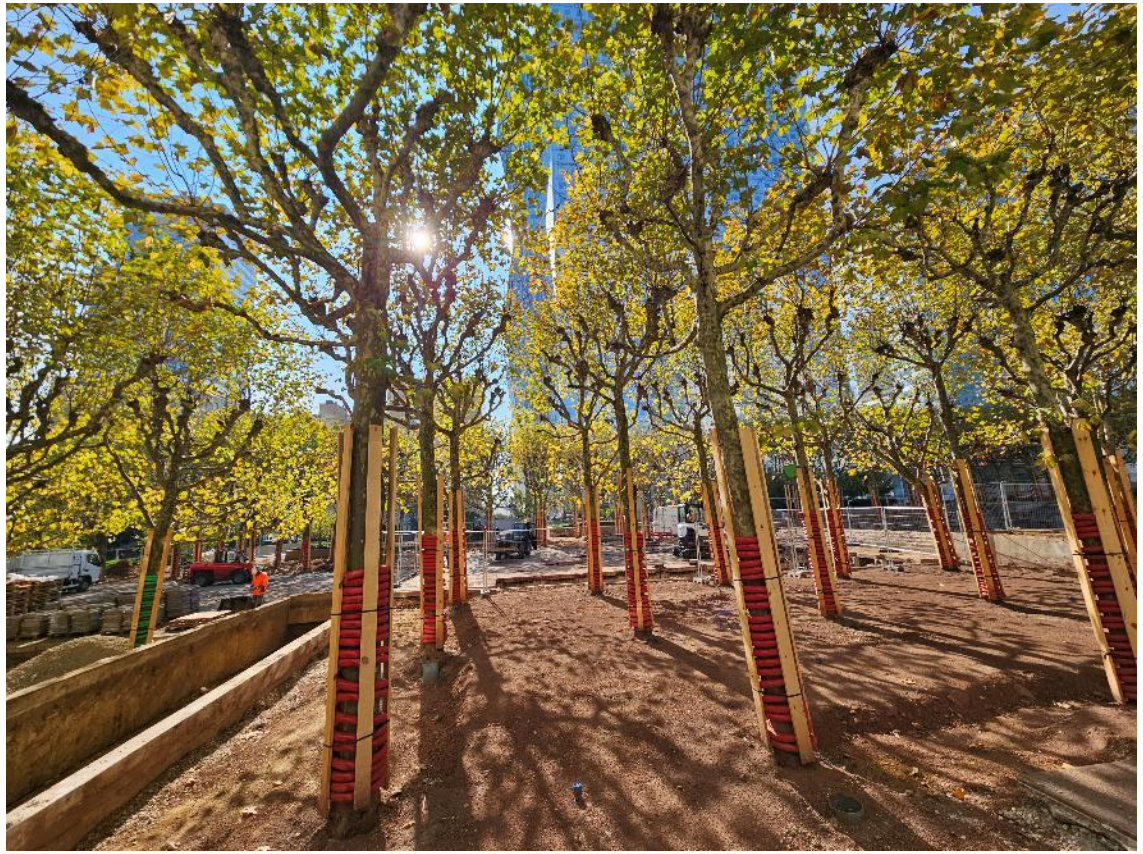


Photo by Nazarizal Mohammad on Unsplash
[re-use authorised]

Green building, Singapore
Photo: Fabrice Renaud (2014)

Increase in the development of urban parks



Setting up a green park, La Défense, France
Photo: Fabrice Renaud (2025)

Coulée verte, Nice, France
Photo: Fabrice Renaud (2025)

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Transformation of urban parks

Bishan-Ang Mo Kio Park (2008 & 2011)

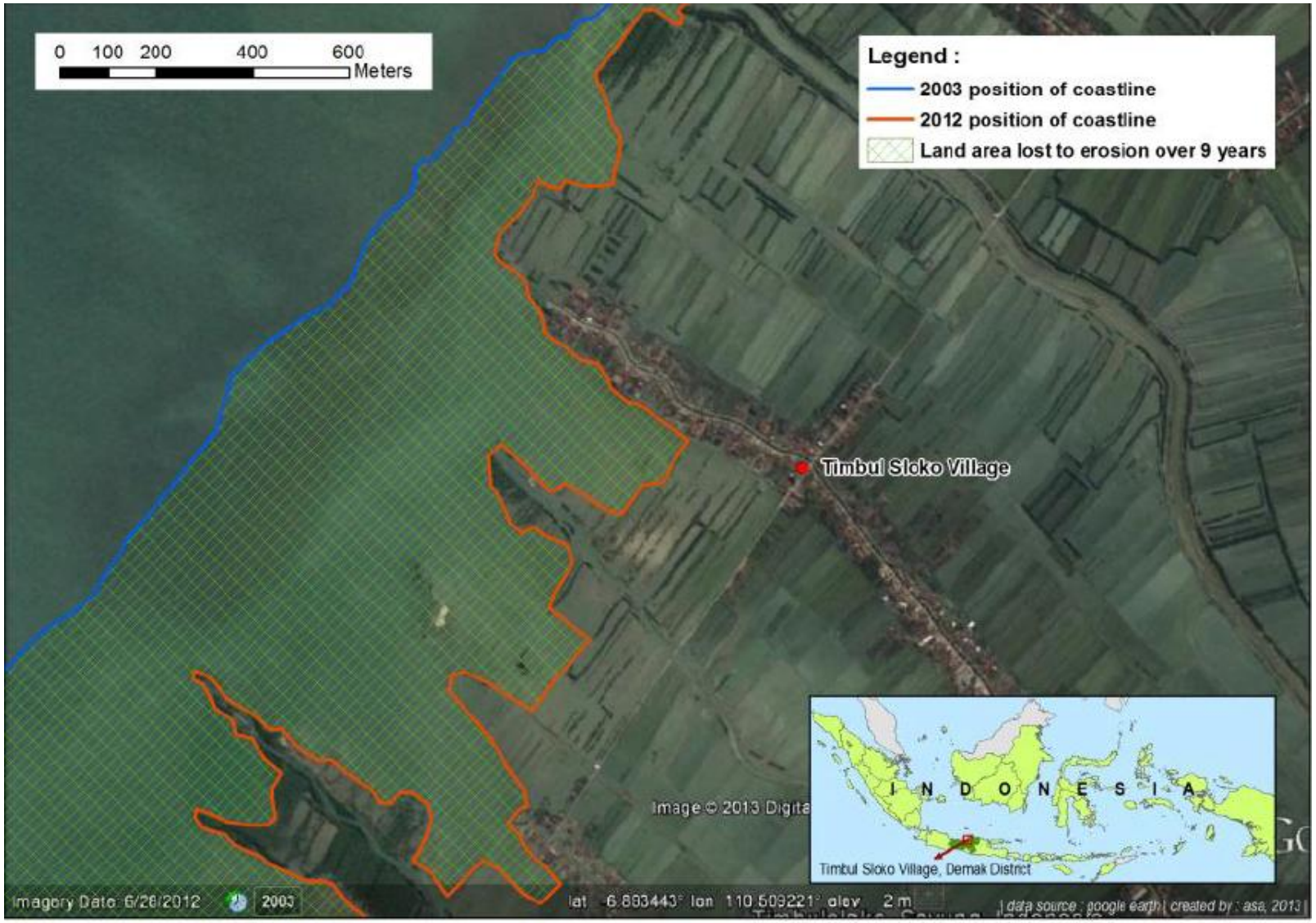
Source: By Pagodashophouse. - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=19065126

Protecting cities

Guandu Wetland, Taiwan

Photo: Fabrice Renaud/University of Glasgow (2018)

Coastal erosion in north central Java



Source: Winterwerp et al. (2014). A sustainable solution for massive coastal erosion in Central Java. Deltares and Wetlands International. Available at https://www.deltares.nl/app/uploads/2016/07/Deltares-WI-2014-Sustainable-solution-massive-erosion-Central-Java.pdf

Engineered, nature-based or hybrid solution against coastal erosion and floods?

Source: Antoni Ros Martinez MSc Research, UNU-EHS, 2016

Engineered, nature-based or hybrid solution against coastal erosion and floods?

Source: Antoni Ros Martinez MSc Research, UNU-EHS, 2016

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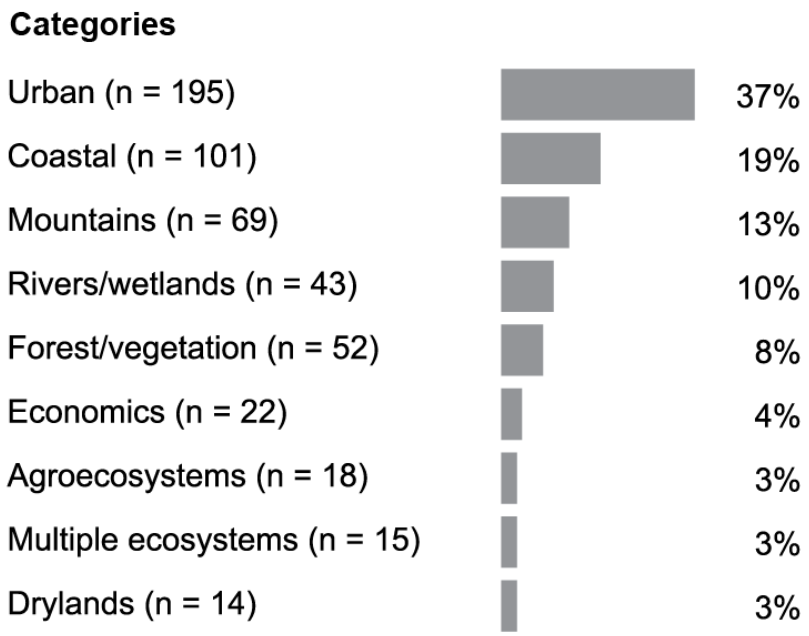
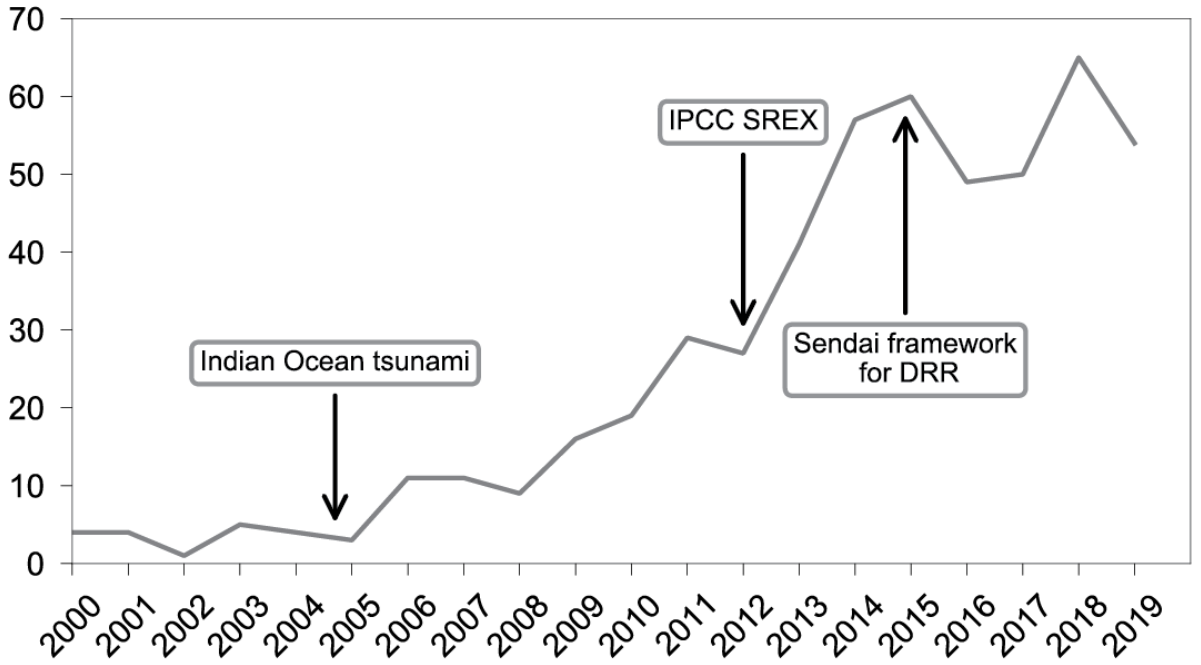
Scientific evidence for nature-based solutions

Rapid increase in the number of publications

a

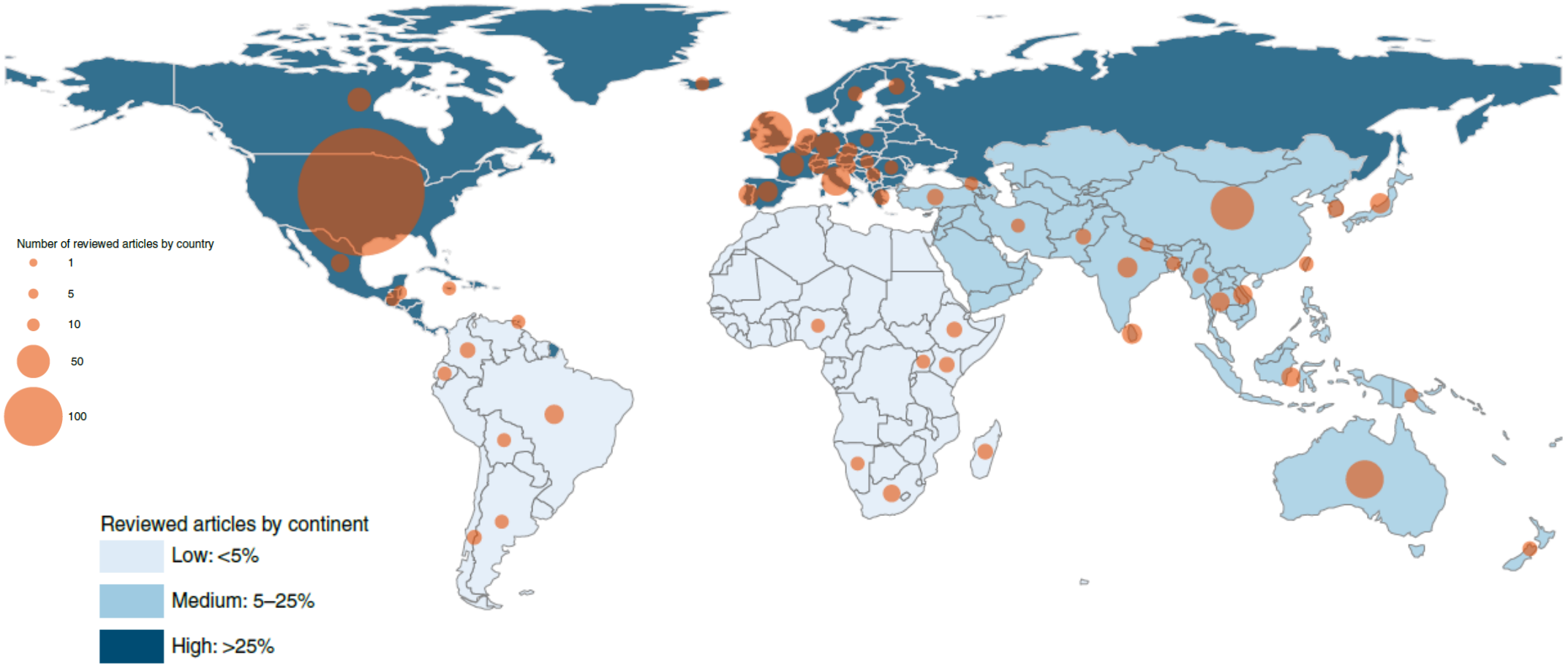


b



Source: Sudmeier-Rieux, K. et al. (2021): Scientific evidence for ecosystem-based disaster risk reduction. *Nature Sustainability 4:803-810*

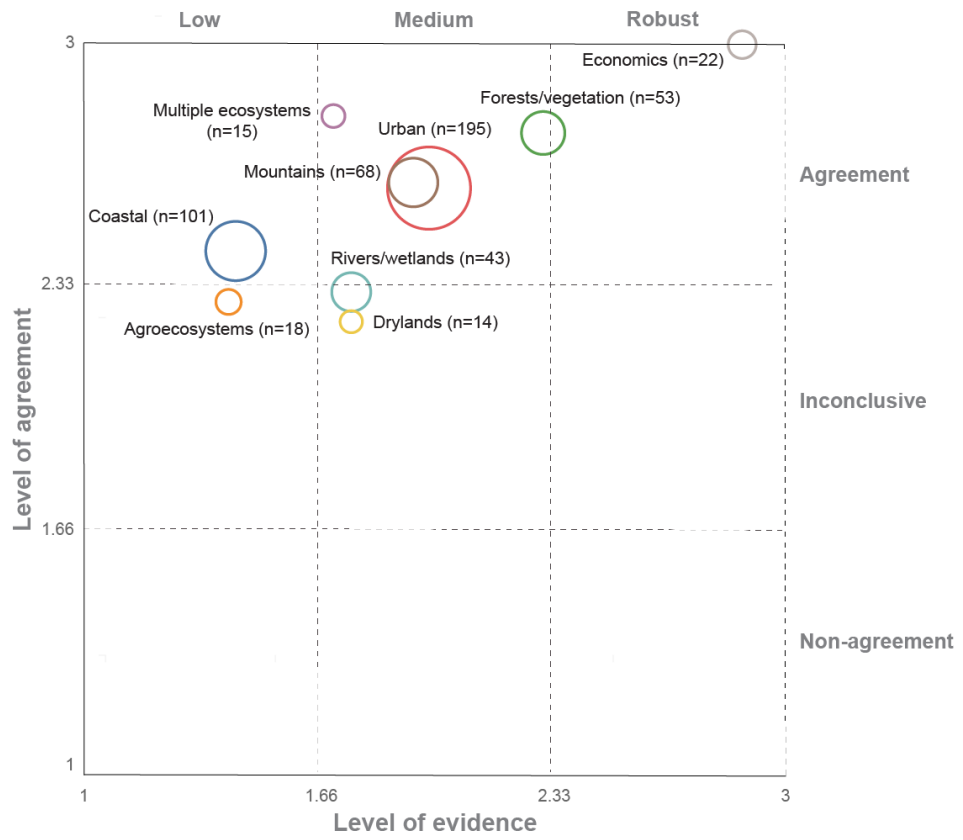
Geographic distribution of research



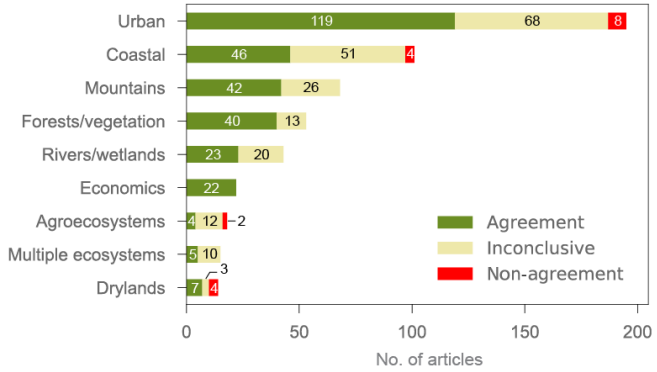
Source: Sudmeier-Rieux, K. et al. (2021): Scientific evidence for ecosystem-based disaster risk reduction. *Nature Sustainability 4:803-810*

Levels of evidence, agreement, and confidence

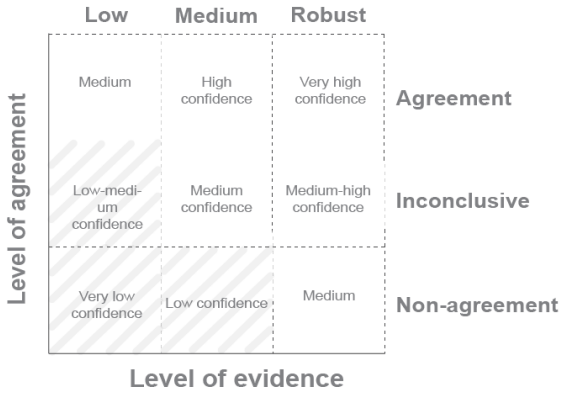
a - Level of evidence x Level of agreement



b - Level of agreement

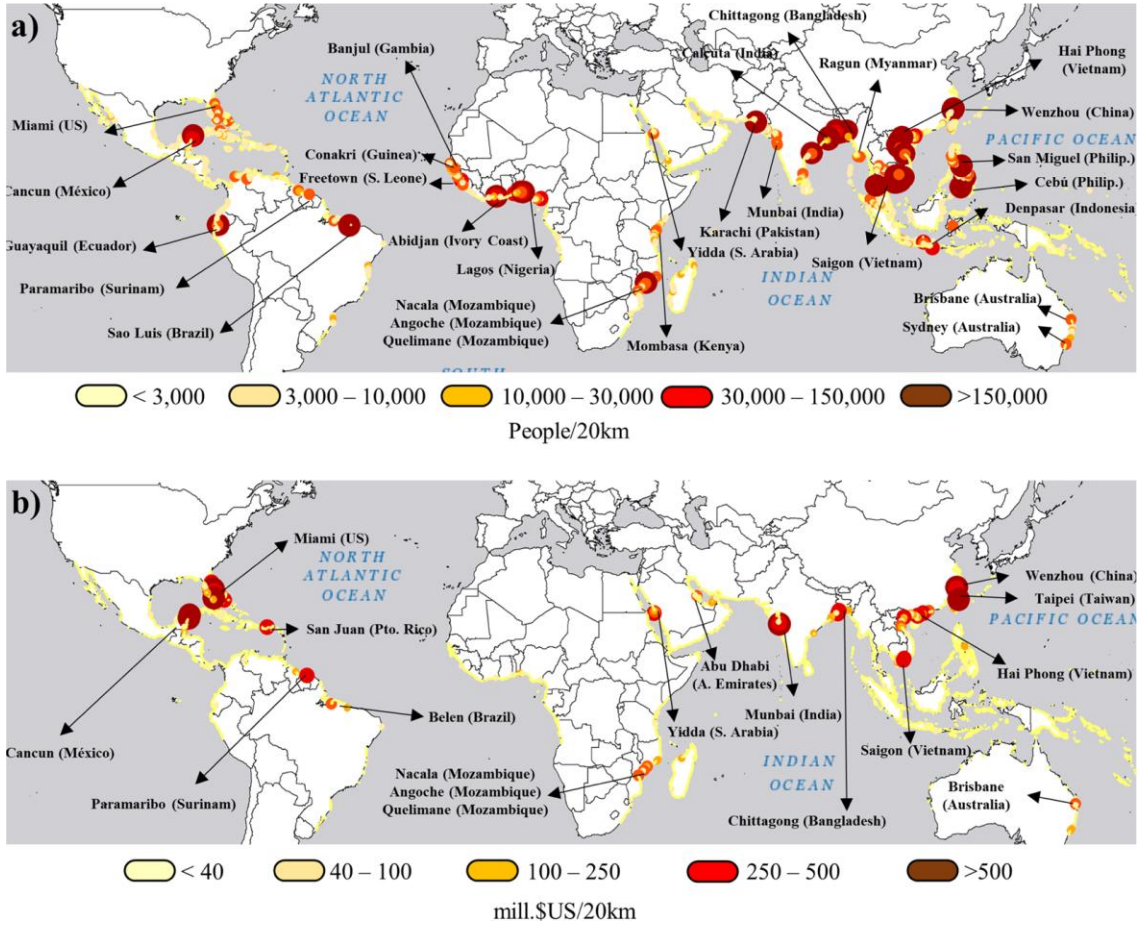


c - Level of confidence



Source: Sudmeier-Rieux, K. et al. (2021): Scientific evidence for ecosystem-based disaster risk reduction. Nature Sustainability 4:803-810

Potential protection of coastal communities from mangroves

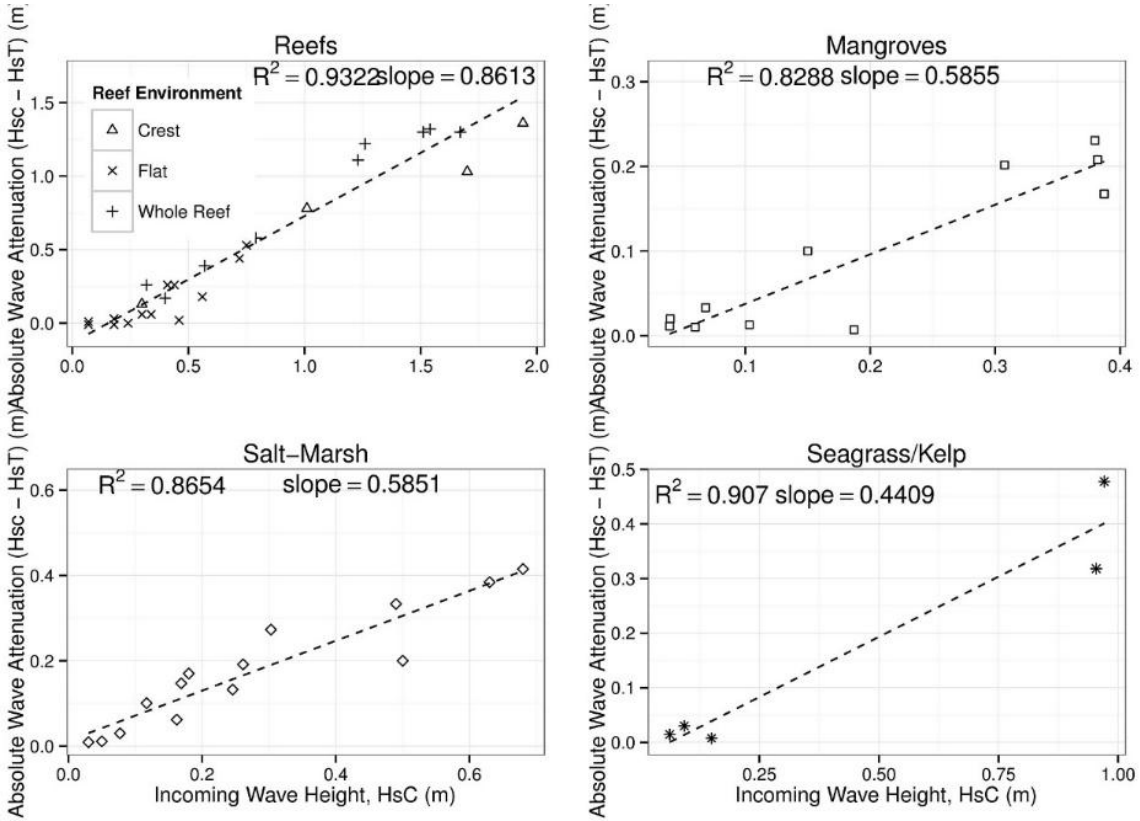


- Modelling effects of mangroves on reducing damages to people and property
- Flood protection benefits:
  - $65 billion annually in flood protection
  - protect 15 million people
  - particularly for cyclonic conditions

Source: Menéndez et al. (2020):The Global Flood Protection Benefits of Mangroves. *Scientific Reports 10:4404.* https://doi.org/10.1038/s41598-020-61136-6. [CC BY]

Ecosystems & Wave height reduction

- n = 69 studies
- Coral reefs ~70%
- Salt marshes ~72%
- Mangroves ~31%
- Seagrass/Kelp beds ~36%

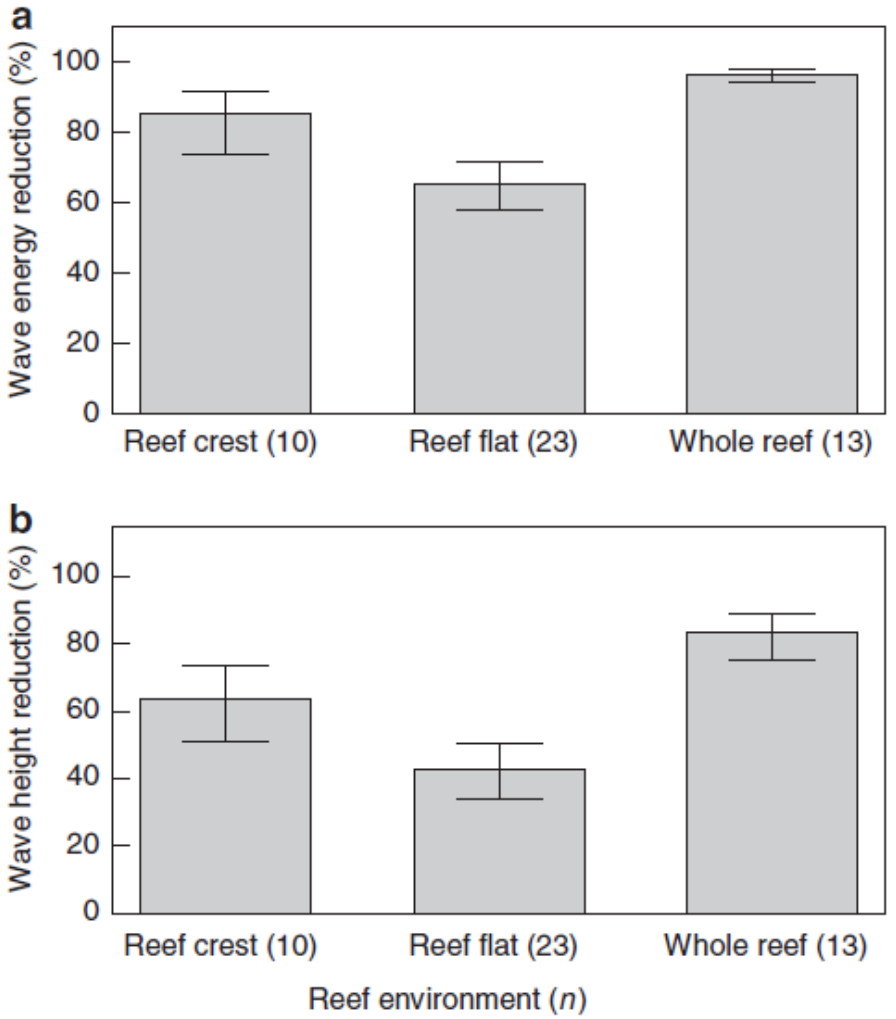


Absolute wave reduction extents are plotted against incident wave height for a) coral reefs (n = 27); b) mangroves (n = 11); c) salt-marshes (n = 14); d) seagrass/kelp beds (n = 5). This plot excludes measurements that do not report incoming wave heights.

Source: Narayan et al (2016): The Effectiveness, Costs and Coastal Protection Benefits of Natural and Nature-Based Defences. PLoS ONE 11(5): e0154735. doi:10.1371/journal.pone.0154735

Protective role of coral reefs

- Coral reefs reduce wave energy by an average of 97% and wave height by an average of 84%.....
- Providing comparable wave attenuation benefits to artificial defenses…
- Potentially protecting >100 million people…
- In a cost effectively manner (breakwaters: US$ 19,791 m^{-1} vs. Structural coral reef restauration: US$ 1,290 m^{-1})



Source: Ferrario et al (2014): The effectiveness of coral reefs for coastal hazard risk reduction and adaptation. Nature Communications DOI: 10.1038/ncomms4794

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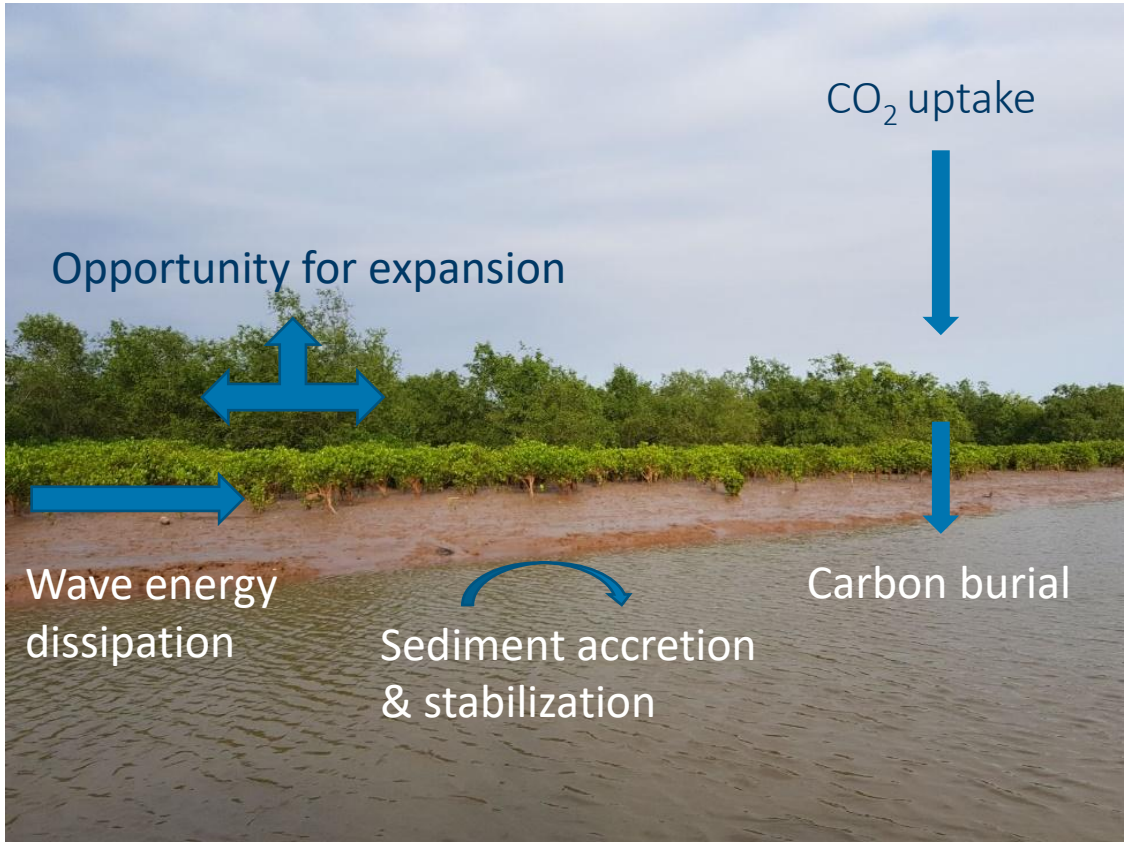
Importance of ecosystem services

Multiple ecosystem services: Examples from mangroves

- Regulating services
  - ✓Carbon storage
  - ✓Erosion regulation
  - ✓Environmental hazard regulation
  - ✓Exposure reduction



Some services provided by mangroves

Photo: Fabrice Renaud/University of Glasgow (2020)

Ecosystem services adapted from Duarte et al (2013): The role of coastal plant communities for climate change mitigation and adaptation. Nature Climate Change DOI: 10.1038/NCLIMATE1970

Multiple ecosystem services: Examples from mangroves

- Regulating services
  - ✓Carbon storage
  - ✓Erosion regulation
  - ✓Environmental hazard regulation
  - ✓Exposure reduction
- **Provisioning services**
  - ✓**Fish and seafood**
  - ✓**Fire wood**

Collecting food from mangroves
Photo: Fabrice Renaud

Checking beehives in mangrove area
Photo: Fabrice Renaud/University of Glasgow

Multiple ecosystem services: Examples from mangroves

- Regulating services
  - ✓Carbon storage
  - ✓Erosion regulation
  - ✓Environmental hazard regulation
  - ✓Exposure reduction
- Provisioning services
  - ✓Fish and seafood
  - ✓Timber
- **Cultural services**
  - ✓**Recreation & tourism**
  - ✓**Cultural heritage**

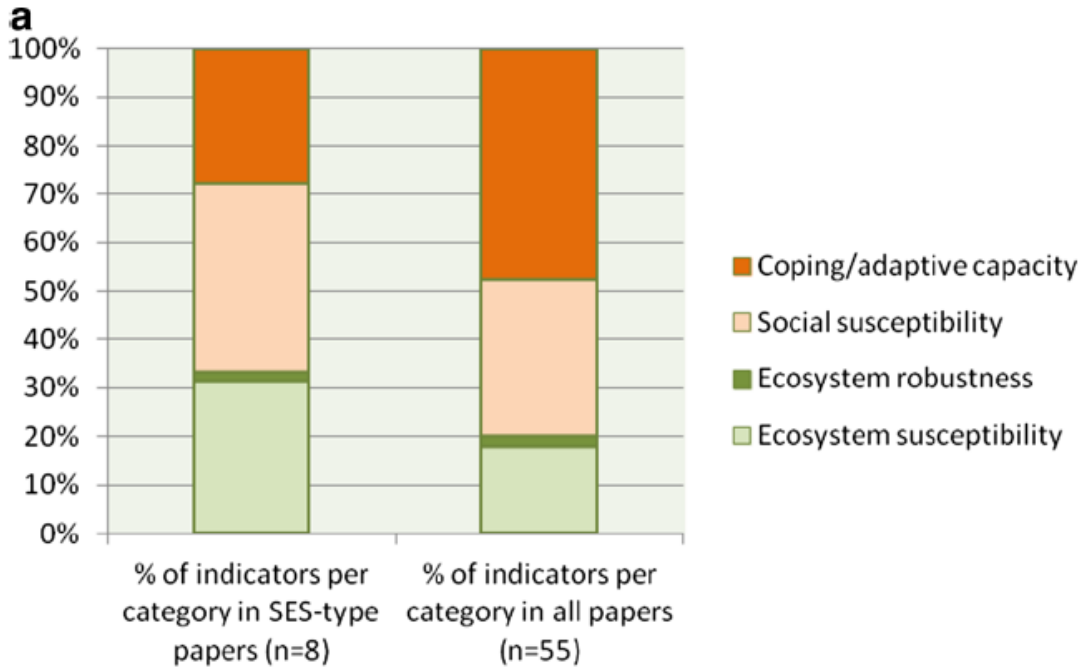
Photos: Fabrice Renaud

Ecosystem services in mountain forest

▶ ***Forests on steep slopes***	• Protection against avalanches, particularly during the snow melt • Protection against landslides and rock fall, particularly following storms or sudden earth movements • Slowing rate of flood waters • Slope stabilization

Source: Dudley, N., Buyck, C., Furuta, N., Pedrot, C., Renaud, F., and K. Sudmeier-Rieux (2015). Protected Areas as Tools for Disaster Risk Reduction. A handbook for Practitioners . Tokyo and Gland, Switzerland: MOEJ and IUCN., photo: Sudmeier-Rieux

The role of ecosystems is under-represented

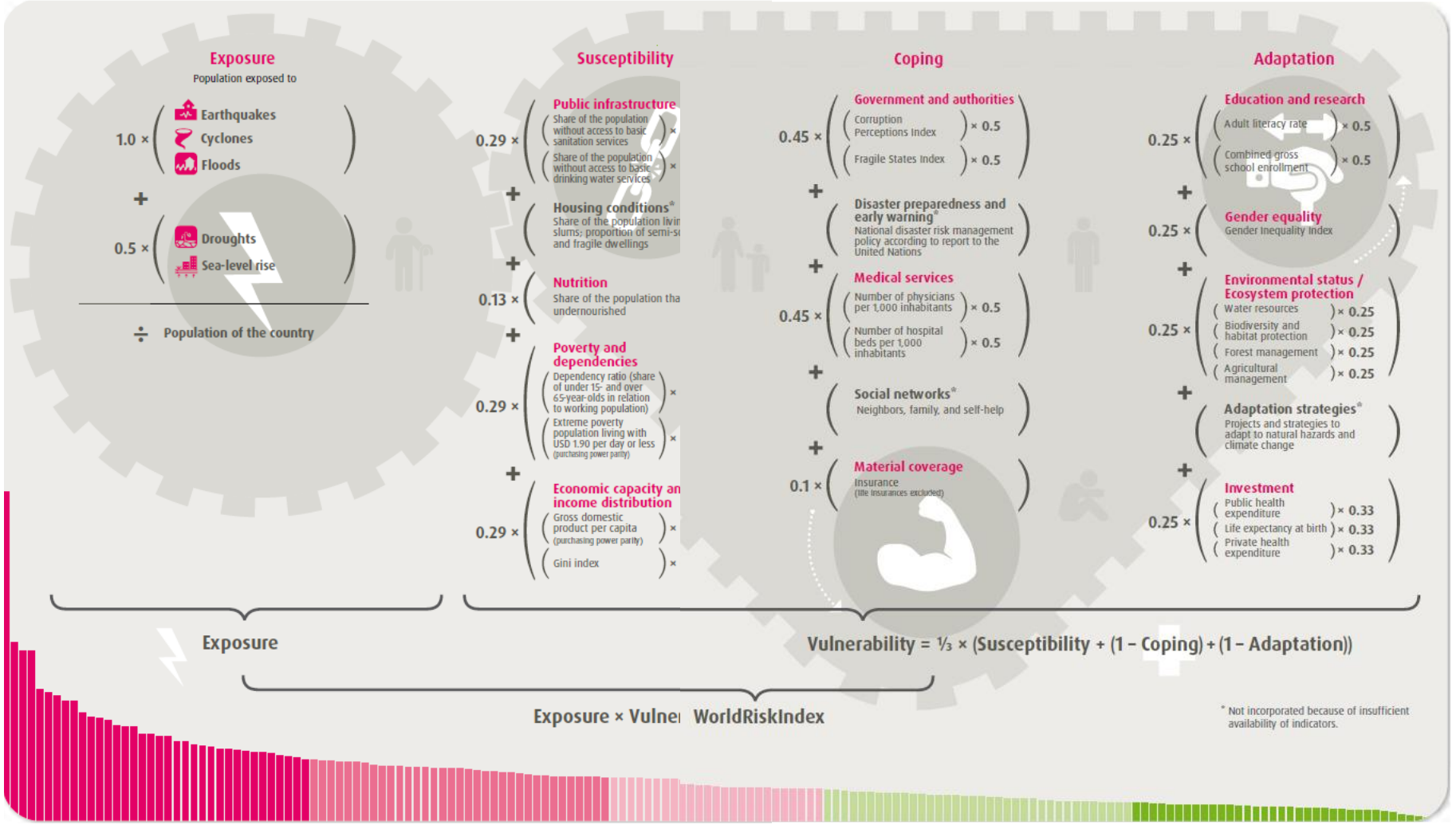


- Hagenlocher et al. (2019)
  - 9/62 Environmental dimension
  - 8/62 Farming practice dimension
- Shah et al. (2020)
  - 39% of reviewed indicators focus on ecological systems

Source: Sebesvari, Renaud et al. (2016). A review of vulnerability indicators for deltaic social–ecological systems. DOI 10.1007/s11625-016-0366-4

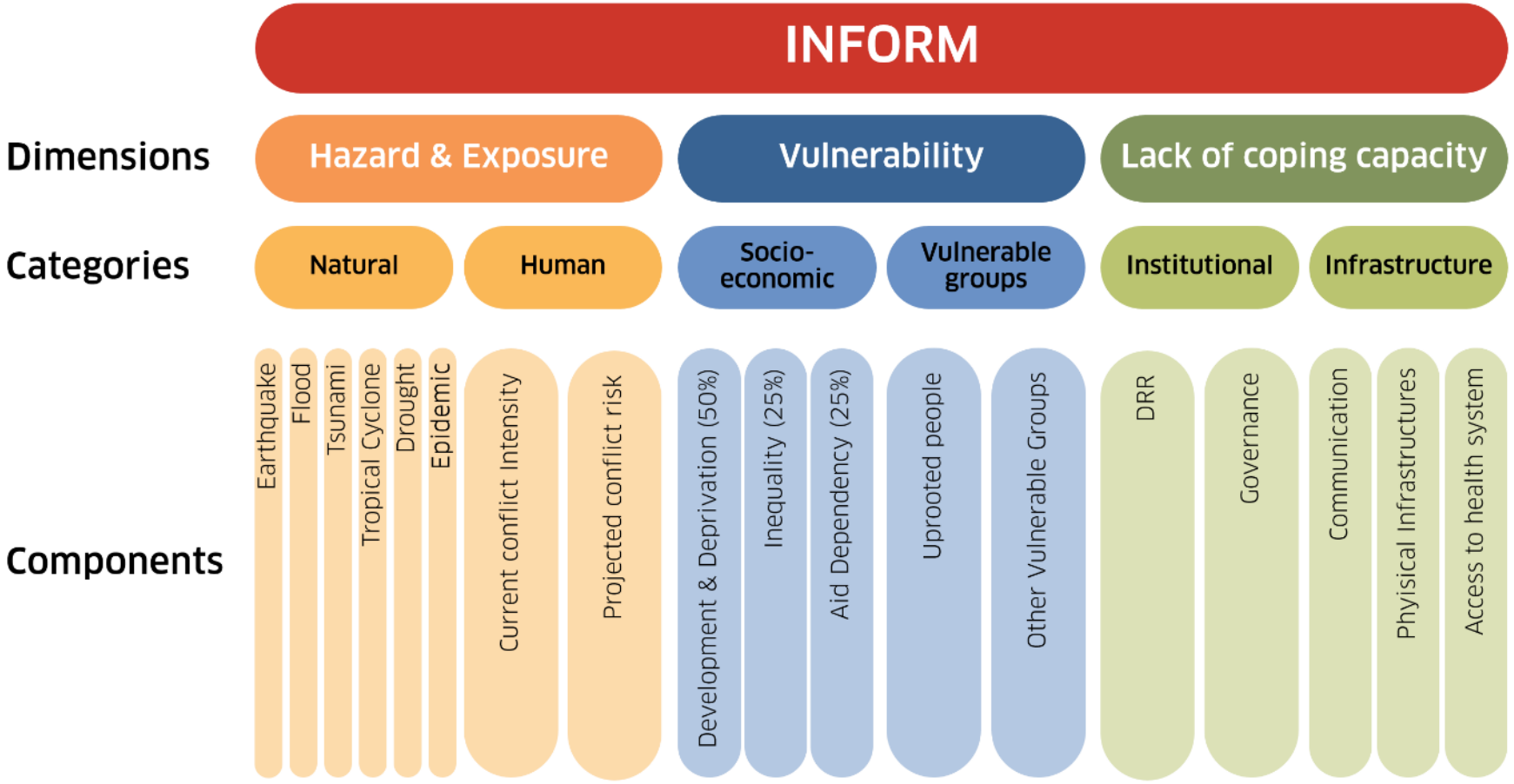
Hagenlocher et al. (2019): *Environ. Res. Lett. 14:083002*
Shah et al. (2020): *International Journal of Disaster Risk Reduction 50:101728*

WorldRiskIndex



Sources: Alksandrova, M. et al. (2021): WorldRiskReport 2021. Bündnis Entwicklung Hilft, Bonn, Germany. Available at https://www.welthungerhilfe.org/news/publications/detail/worldriskreport-2021/

INFORM: Index for Risk Management



$$Risk = Hazard\&Exposure^{1/3} \times Vulnerability^{1/3} \times Lack\ of\ coping\ capacity^{1/3}$$

Sources: Marin-Ferrer, M., Vernaccini, L. and Poljansek, K. (2017): Index for Risk Management INFORM Concept and Methodology Report — Version 2017, EUR 28655 EN, doi:10.2760/094023. See https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk/Methodology

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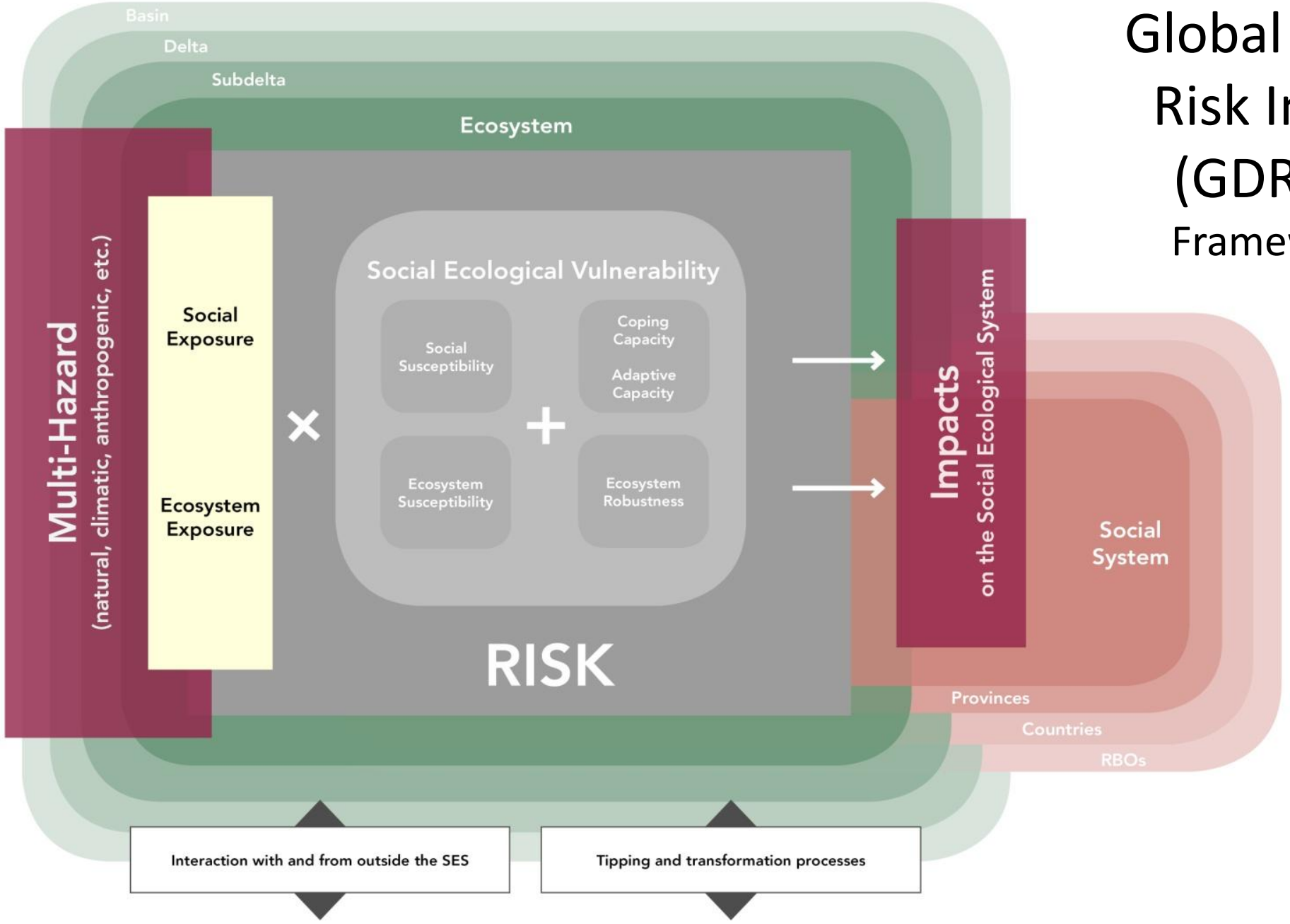
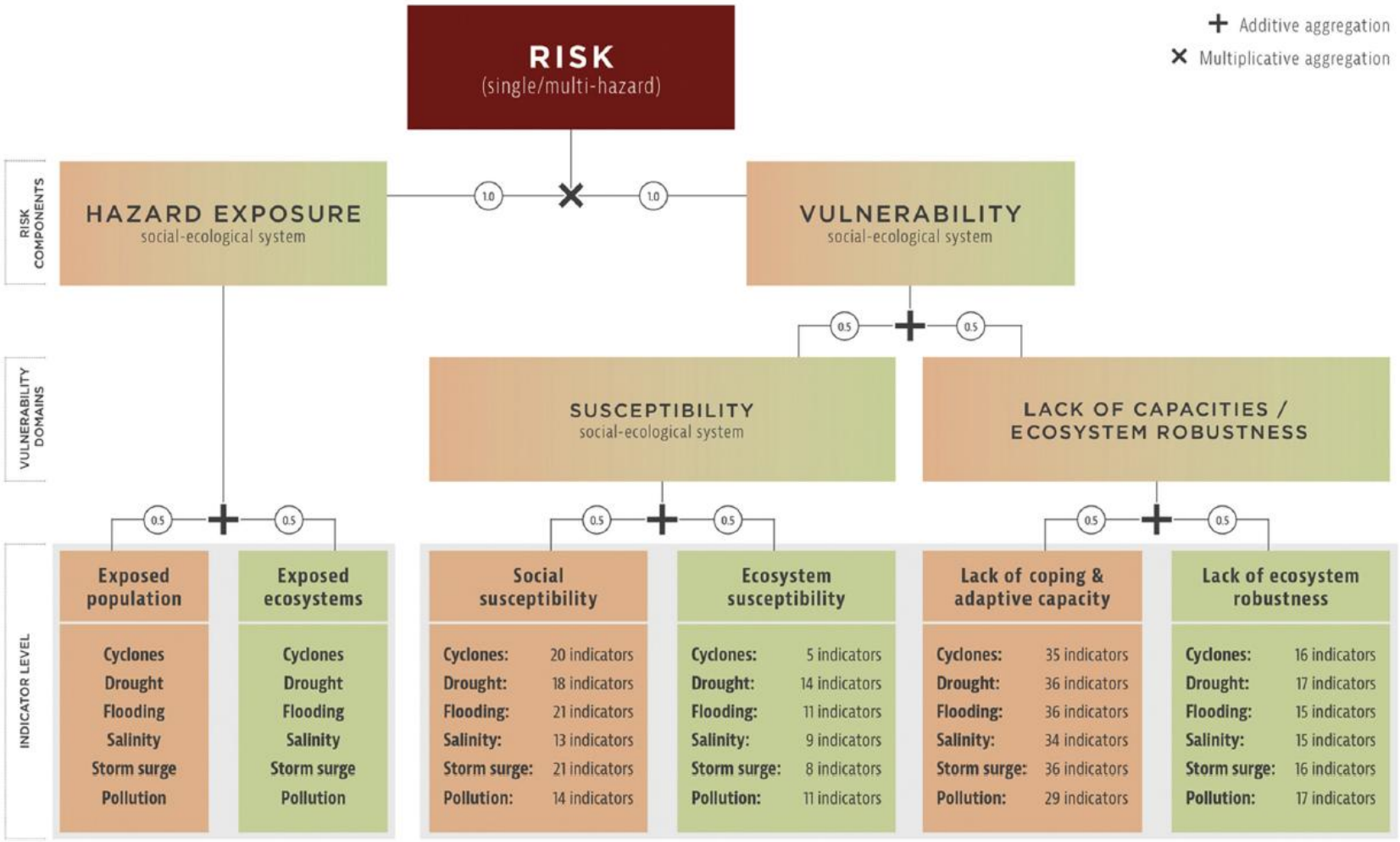
Towards a better acknowledgement of the role of ecosystems in DRR

Global Delta Risk Index (GDRI) – Framework



Source: Sebesvari, Renaud et al. (2016): Sustainability Science, DOI 10.1007/s11625-016-0366-4 , based on Turner et al. (2009), Garschagen (2014), Kloos et al. (2015)

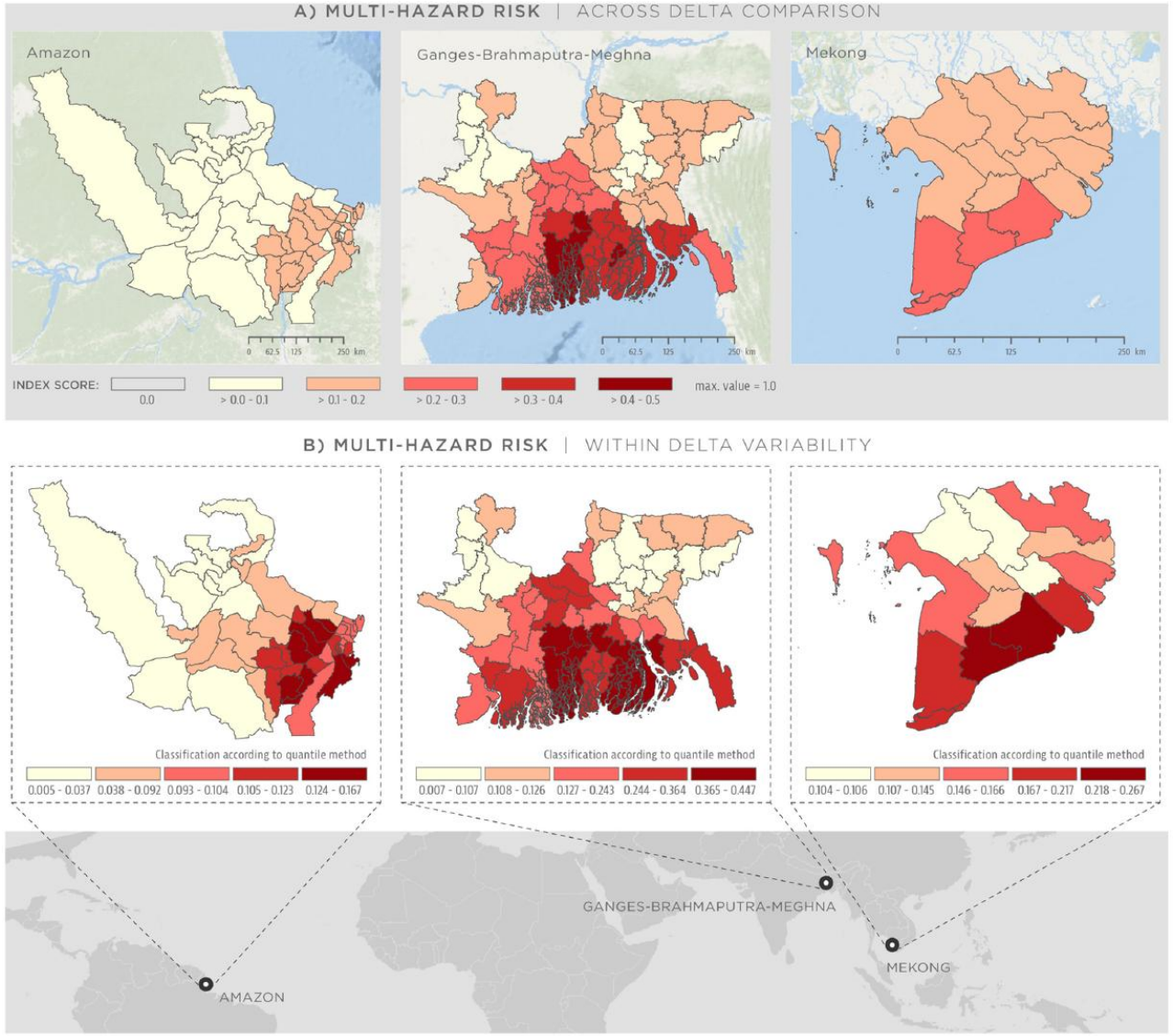
Global Delta Risk Index (GDRI) – Structure



Source: Hagenlocher, Renaud et al. / Science of the Total Environment 631–632 (2018) 71–80

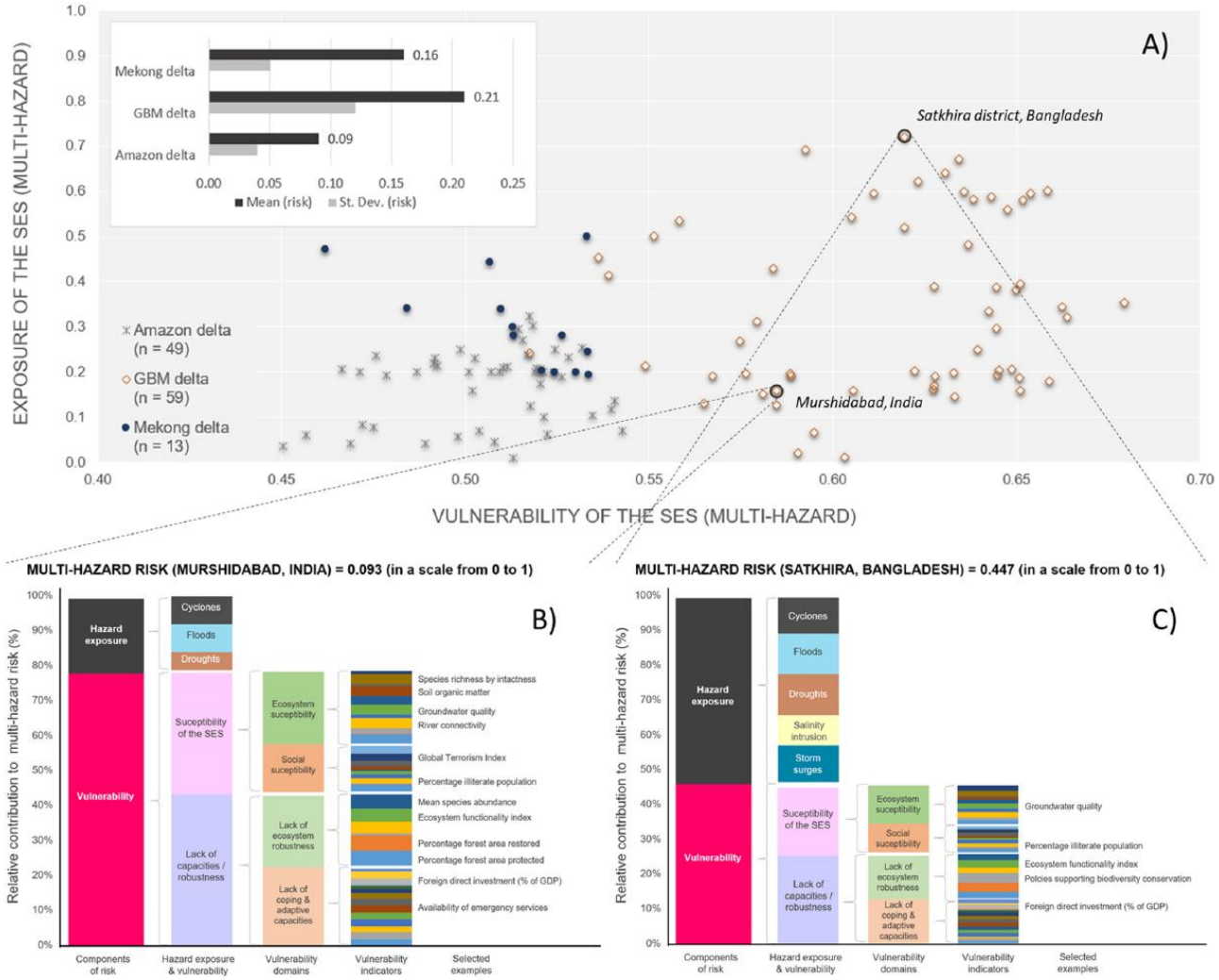
Global Delta Risk Index (GDRI) –

Results: multi-hazard risk of the SES



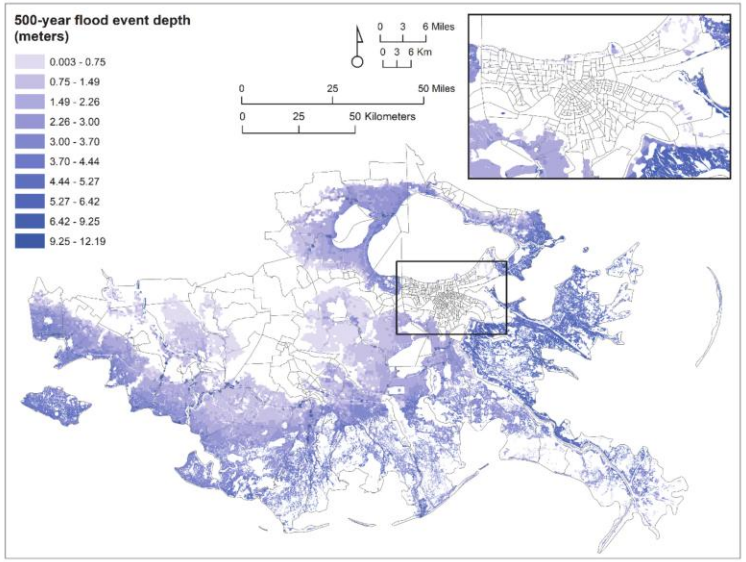
Source: Hagenlocher, Renaud et al. / Science of the Total Environment 631–632 (2018) 71–80

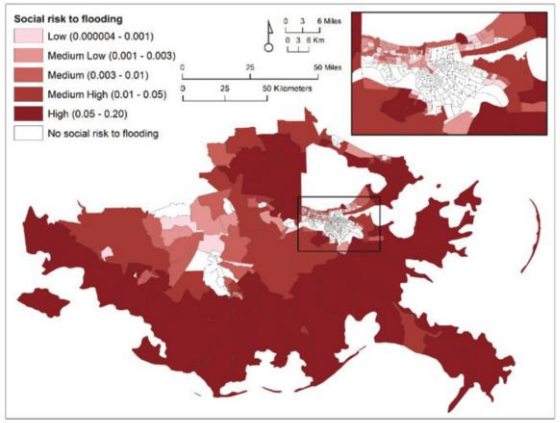
Global Delta Risk Index (GDRI) –
Results: risk profiles

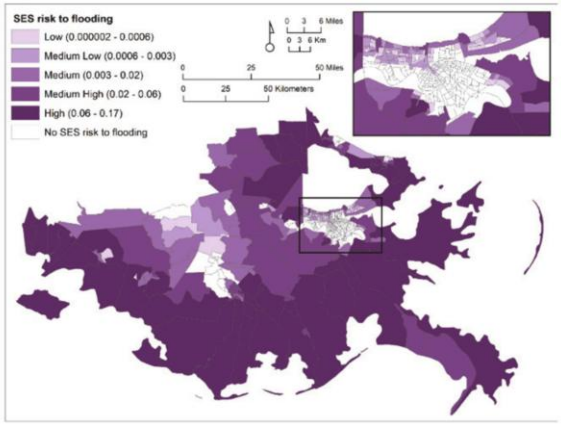


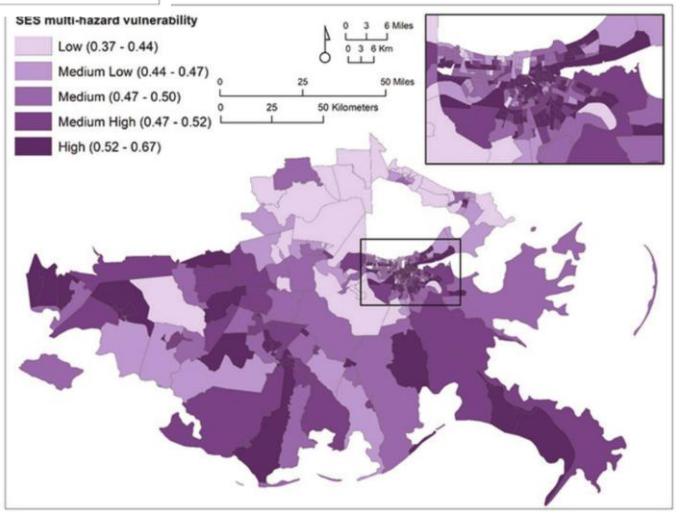
Source: Hagenlocher, Renaud et al. / Science of the Total Environment 631–632 (2018) 71–80

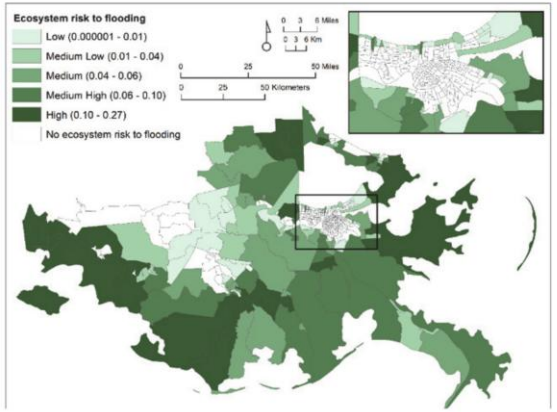
Risk to Flooding – Mississippi Delta





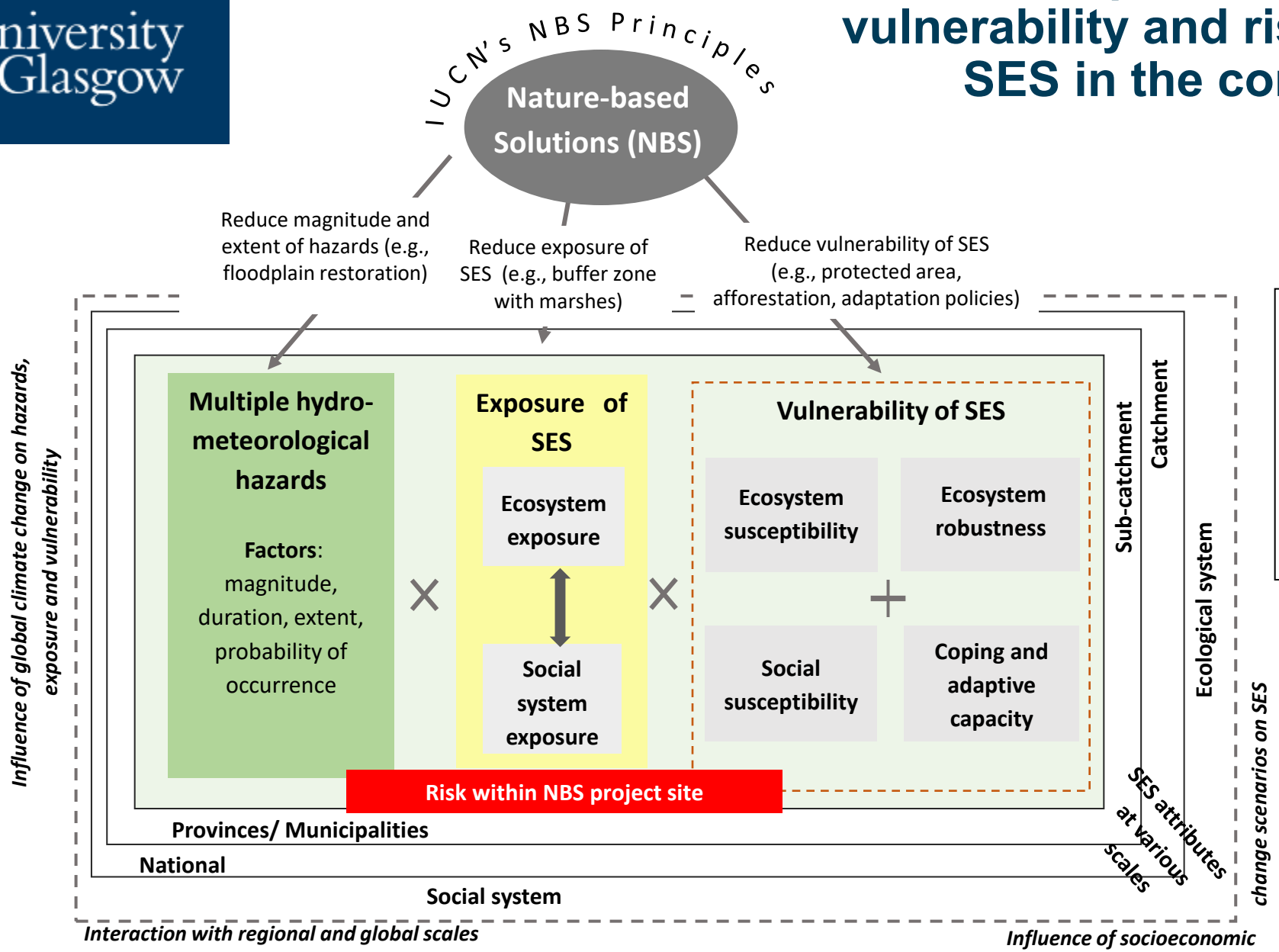






Source: Anderson, Renaud et al. (2021): Assessing Multi-Hazard Vulnerability and Dynamic Coastal Flood Risk in the Mississippi Delta: The Global Delta Risk Index as a Social-Ecological Systems Approach. *Water13, 577.* https://doi.org/10.3390/w13040577. [CC BY 4.0]

Conceptual framework for vulnerability and risk assessment of SES in the context of NbS

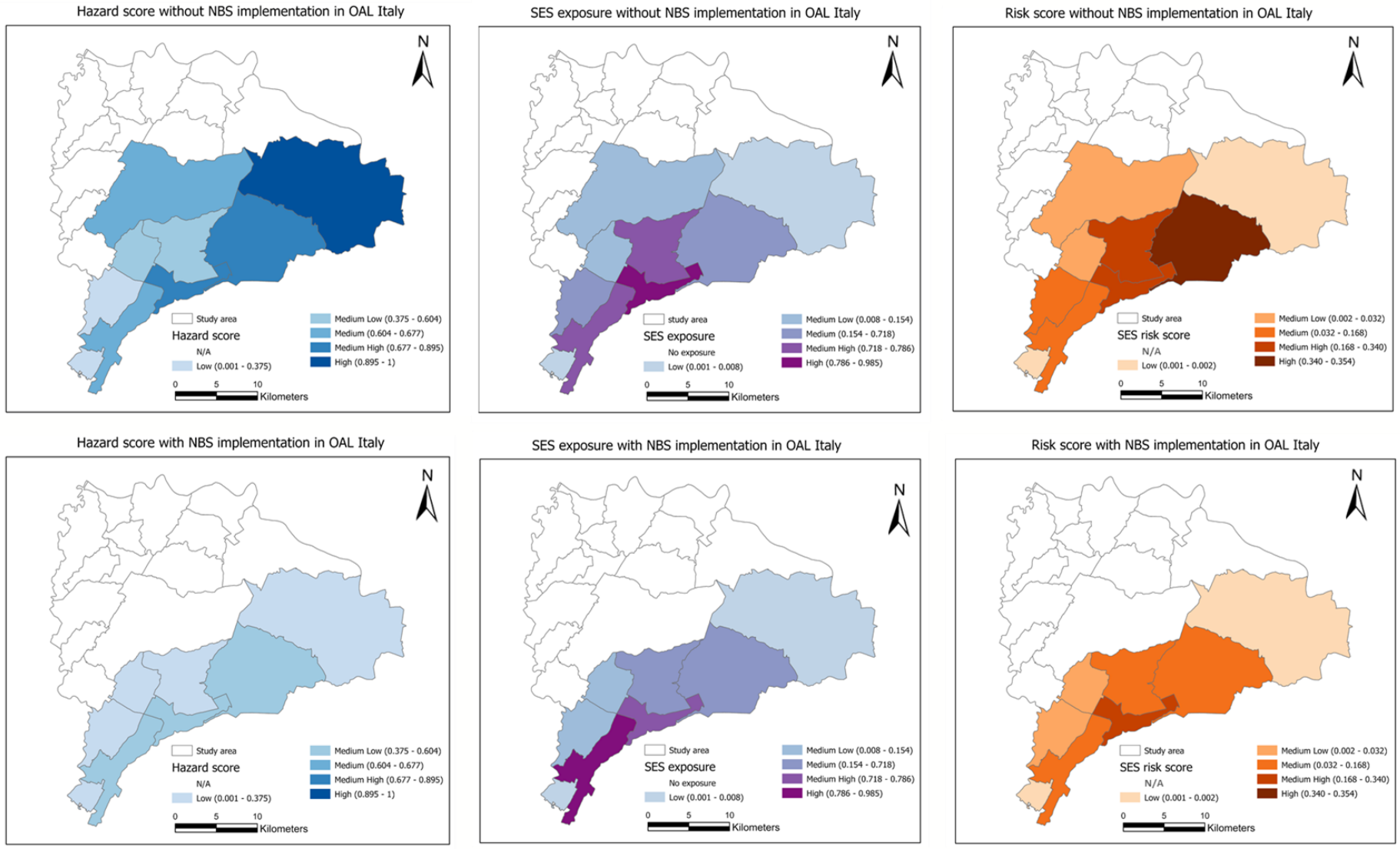


IUCN's NBS principles

P1	nature conservation
P2	synergy with all solutions
P3	site-specific contexts
P4	transparency & participation
P5	diversity and evolve over time
P6	landscape scale
P7	tradeoffs within SES
P8	policy integration

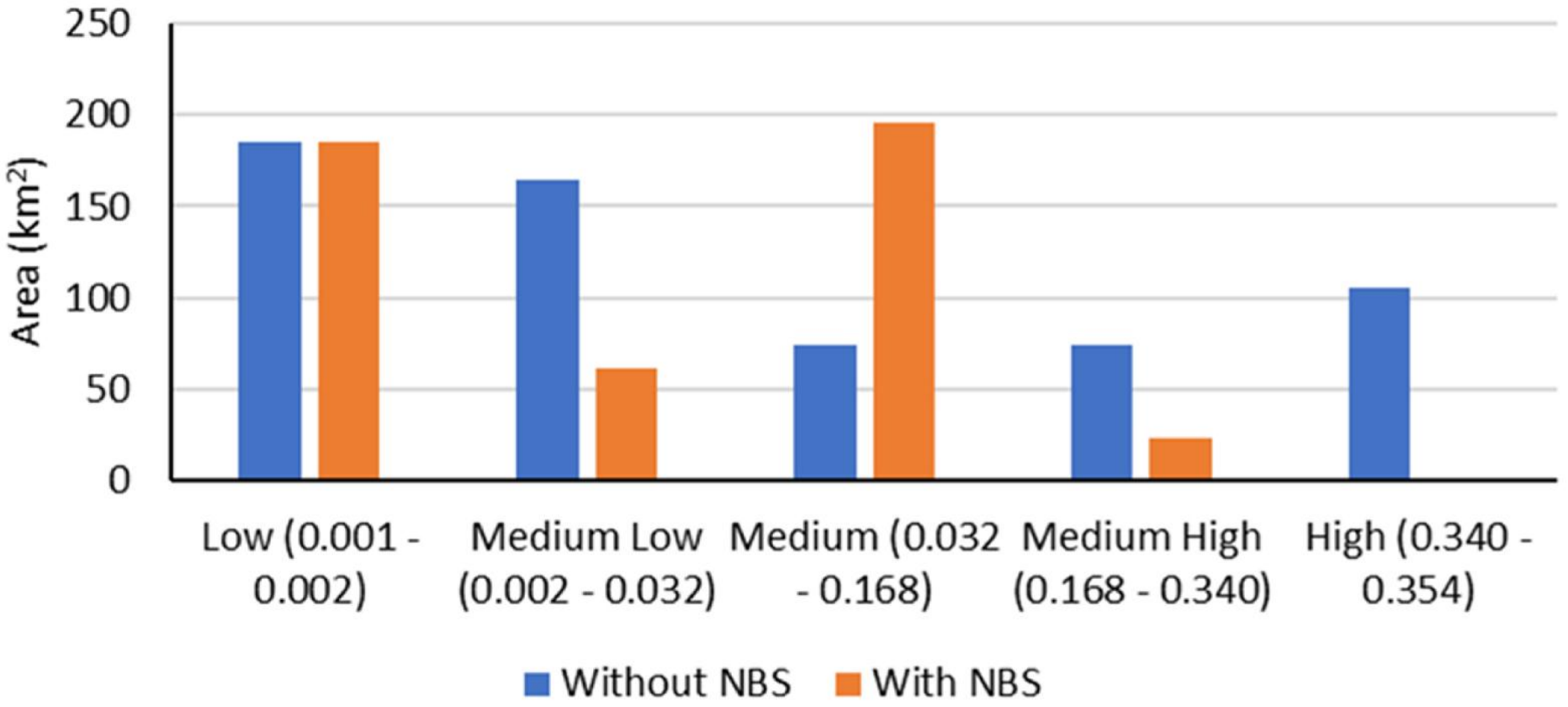
Adapted from Shah, Renaud *et al.* (2020). A review of hydro-meteorological hazard, vulnerability, and risk assessment frameworks and indicators in the context of nature-based solutions. IJDRR, 50, 101728. [CC BY 4.0]. Based on Sebesvari, Renaud et al. (2016).

Flood risk reduction with NbS - Panaro River, Italy, using an indicator-based approach 1/2



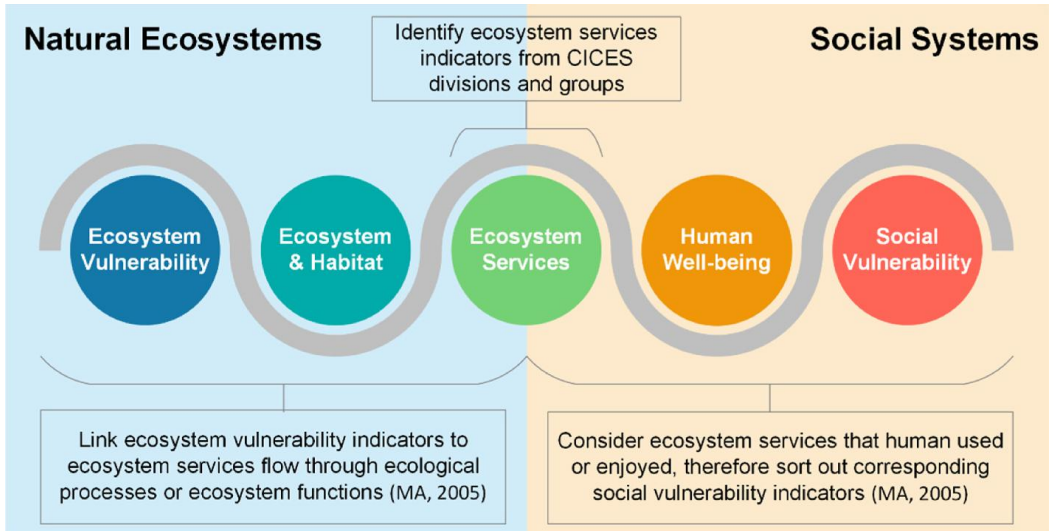
Adapted from Shah *et al.* (2023): Quantifying the effects of nature-based solutions in reducing risks from hydrometeorological hazards: Examples from Europe. *International Journal of Disaster Risk Reduction 93 :103771*. [CC-BY]

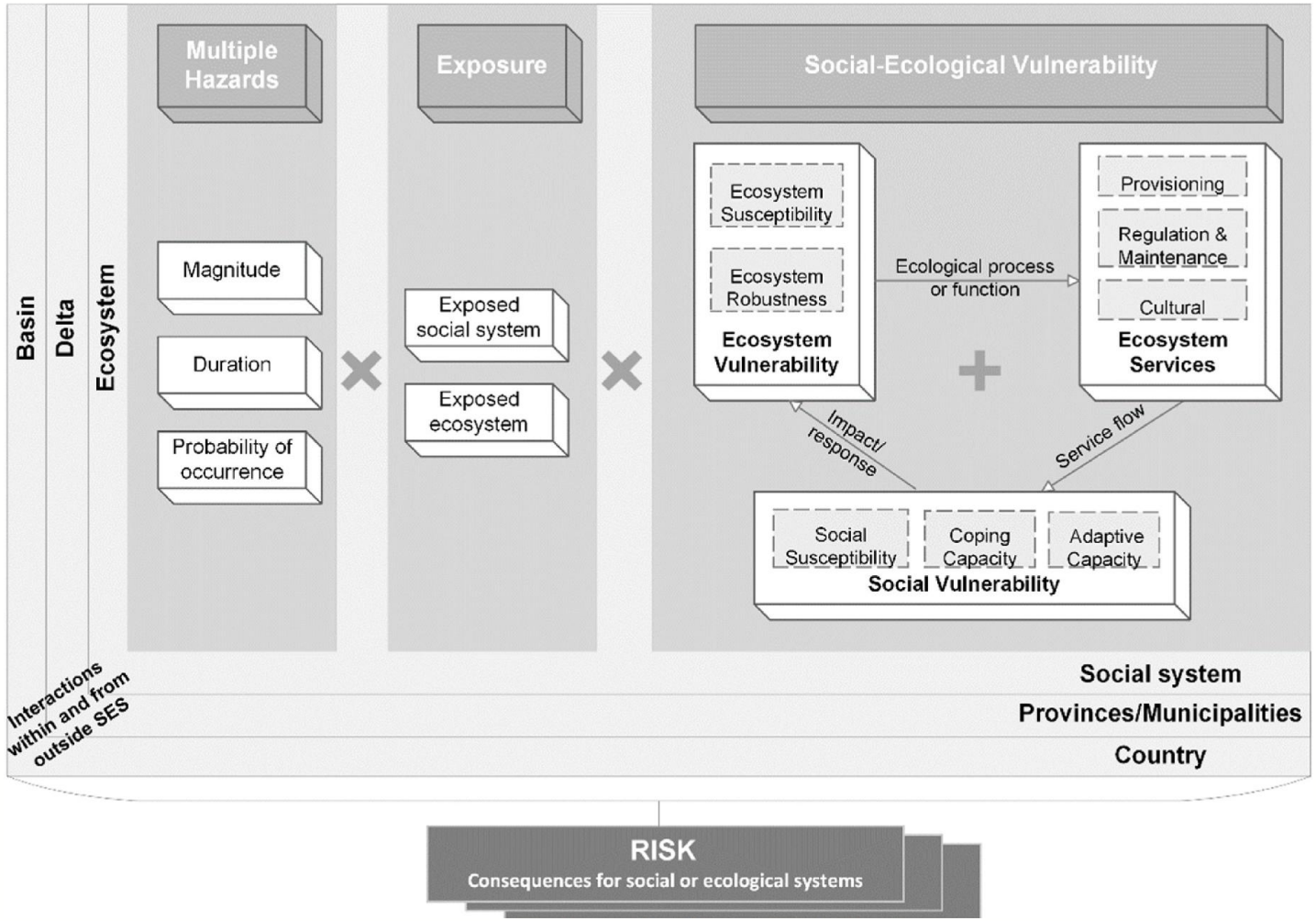
Flood risk reduction with NbS - Panaro River, Italy, using an indicator-based approach 1/2



Shah *et al.* (2023): Quantifying the effects of nature-based solutions in reducing risks from hydrometeorological hazards: Examples from Europe. *International Journal of Disaster Risk Reduction 93 :103771.* [CC-BY]

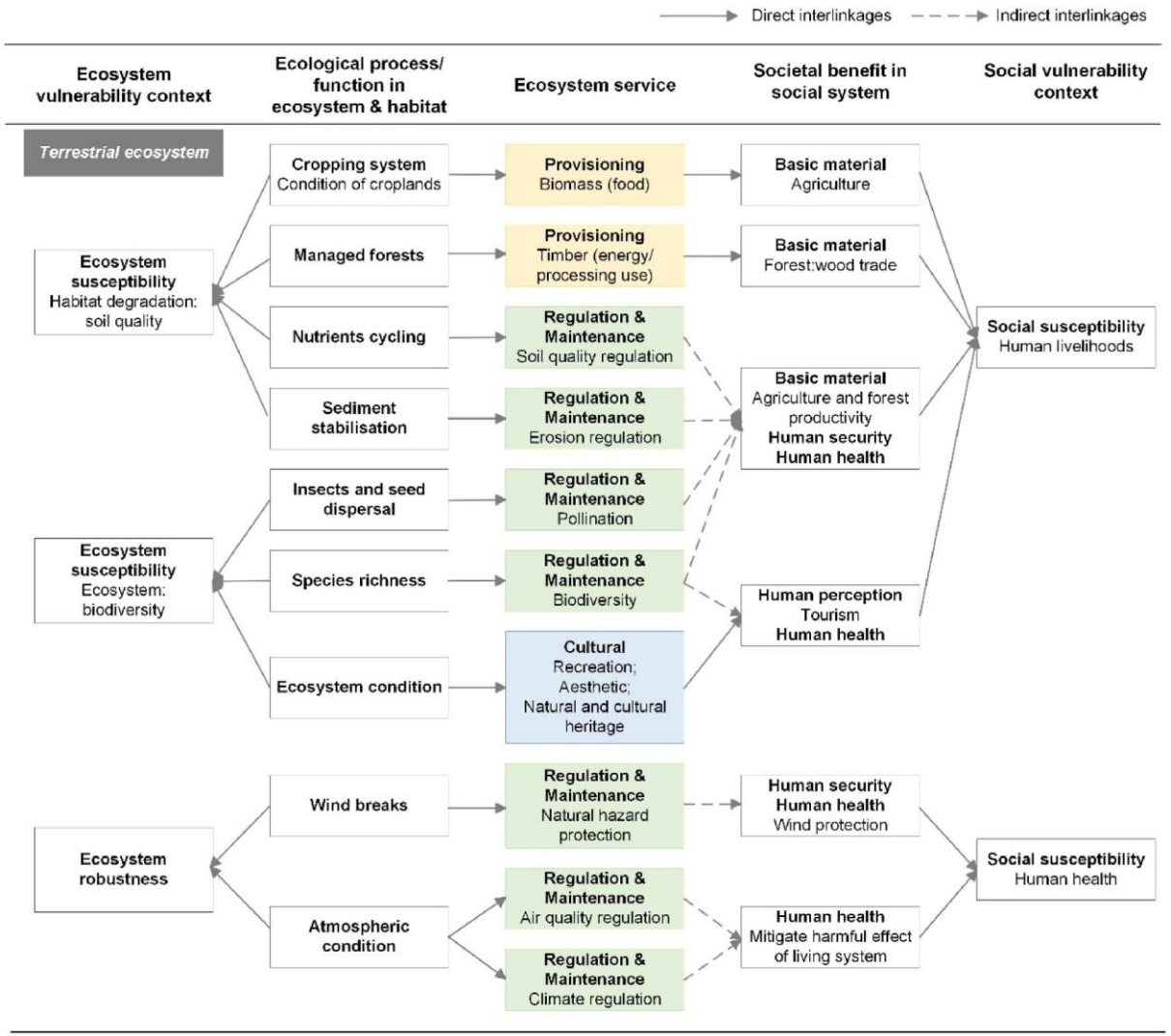
Next step – Incorporating Ecosystem Services more explicitely





Source: Peng, Welden & Renaud (2023). A framework for integrating ecosystem services indicators into vulnerability and risk assessments of deltaic social-ecological systems. *J. Env. Management 326:116682* [CC BY 4.0]. . https://doi.org/10.1016/j.jenvman.2022.116682.

Incorporating Ecosystem Services Adding complexity



Source: Peng, Welden and Renaud (2022): A framework for integrating ecosystem services indicators into vulnerability and risk assessments of deltaic social-ecological systems. *Journal of Environmental Management 326:116682*. https://doi.org/10.1016/j.jenvman.2022.116682. [CC BY 4.0]

Can lead to more explicit ecosystem-based recommendations

Key sector	Agriculture	
	Related services: Agriculture production; Soil quality regulation	
EbA strategies	**Possible benefits from strategies**	**References**
Agricultural diversification; Agro-forestry; Climate-smart agriculture; Agroecology	Food security; income benefits; risk reduction (erosion, floods, etc): target hazard and vulnerability	[59–61]
Connect to current policy	SDG 1 (no poverty) & 2 (zero hunger); Global Biodiversity Framework: Target 10 (emphasis on sustainable management of agriculture and forestry) National Climate Change Adaptation Strategy 2035: enhance the climate resilience of agricultural ecosystems; establish a climate-adaptable food security system; China National Biodiversity Conservation Strategy and Action Plan (2011–2030): sustainably utilizing bio-resources in the fields of agriculture, forestry, fishery and animal husbandry.	
Priority/effective zones	PRD: Zhaoqing, Huizhou, Dongguan, Shenzhen; YRD: Jiangsu Province (except for Nanjing, Wuxi), Zhejiang Province (Wenzhou, Jinhua, Zhoushan, Taizhou), Anhui Province (Chuzhou, Xuancheng)	
Key sector	**Forestry** Related services: Forestry production	
EbA strategies	**Possible benefits from strategies**	**References**
Sustainable forest management: Site-adapted mixed species; Multi-functional forests; forest restoration	Water security; income benefits; risk reduction (floods, cyclones, etc): target hazard and vulnerability	[62–64]
Connect to current policy	SDG 6 (clean water and sanitation), 13 (climate action), & 15 (life on land); Global Biodiversity Framework: Target 10 (emphasis on sustainable management of forestry) National Climate Change Adaptation Strategy 2035: strengthen the protection of typical ecosystems and the restoration of degraded ecosystems; Master Plan for Major Projects to Protect and Restore China's Major Ecosystems (2021–2035): protection of natural forest resources; Yangtze River Key Ecological Zone	
Priority/effective zones	PRD: Zhaoqing, Jiangmen; YRD: Anhui Province (except for Tongling)	

Source: Peng, Welden & Renaud (2025). Ecosystem-based adaptation strategies to multi-hazard risk reduction and policy implications in the Pearl River and Yangtze River deltas, China. *International Journal of Disaster Risk Reduction 116:105053* [CC BY 4.0]. https://doi.org/10.1016/j.ijdrr.2024.105053.

One step further: Integrating risk and SDG indicators in final computation

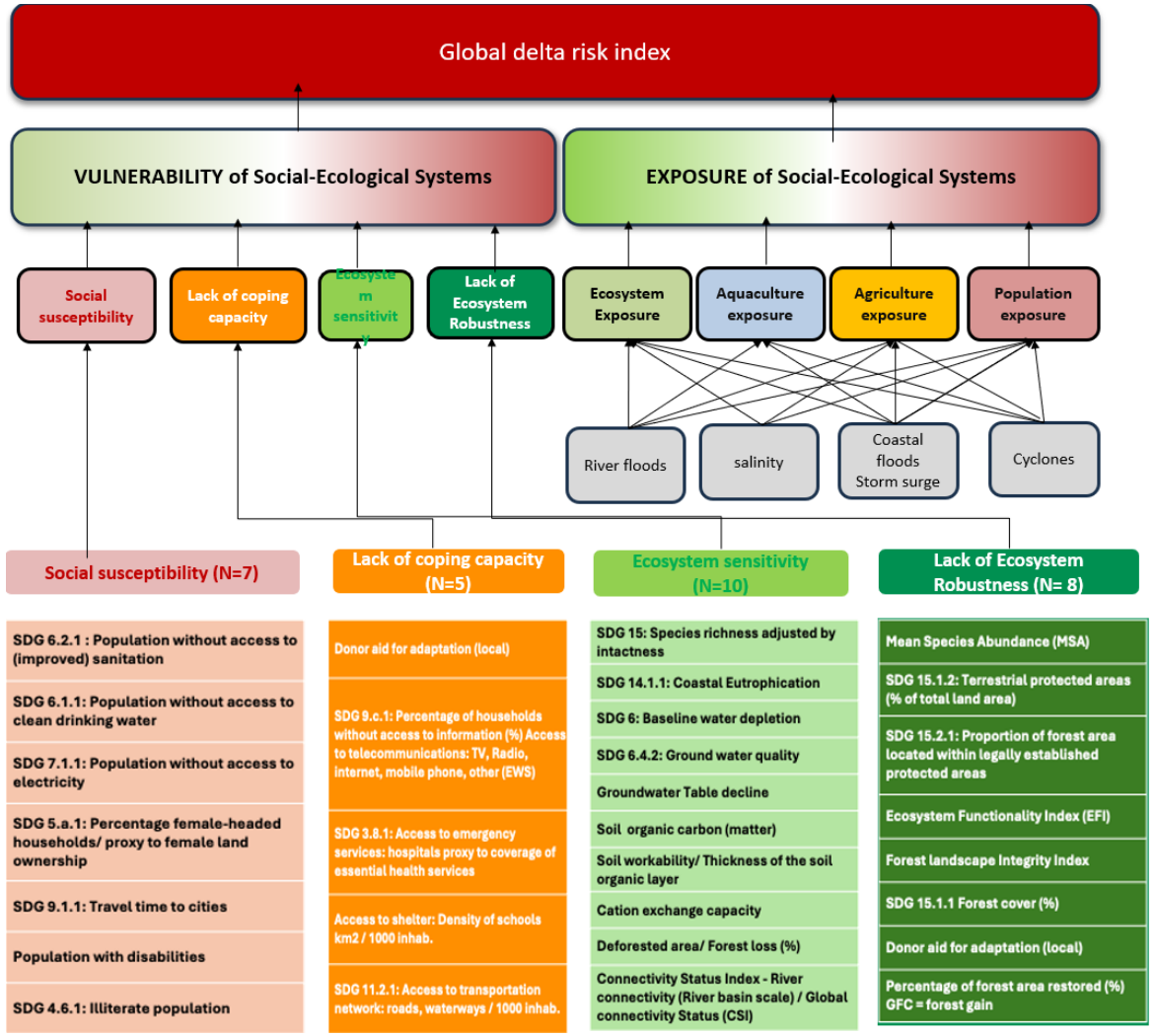
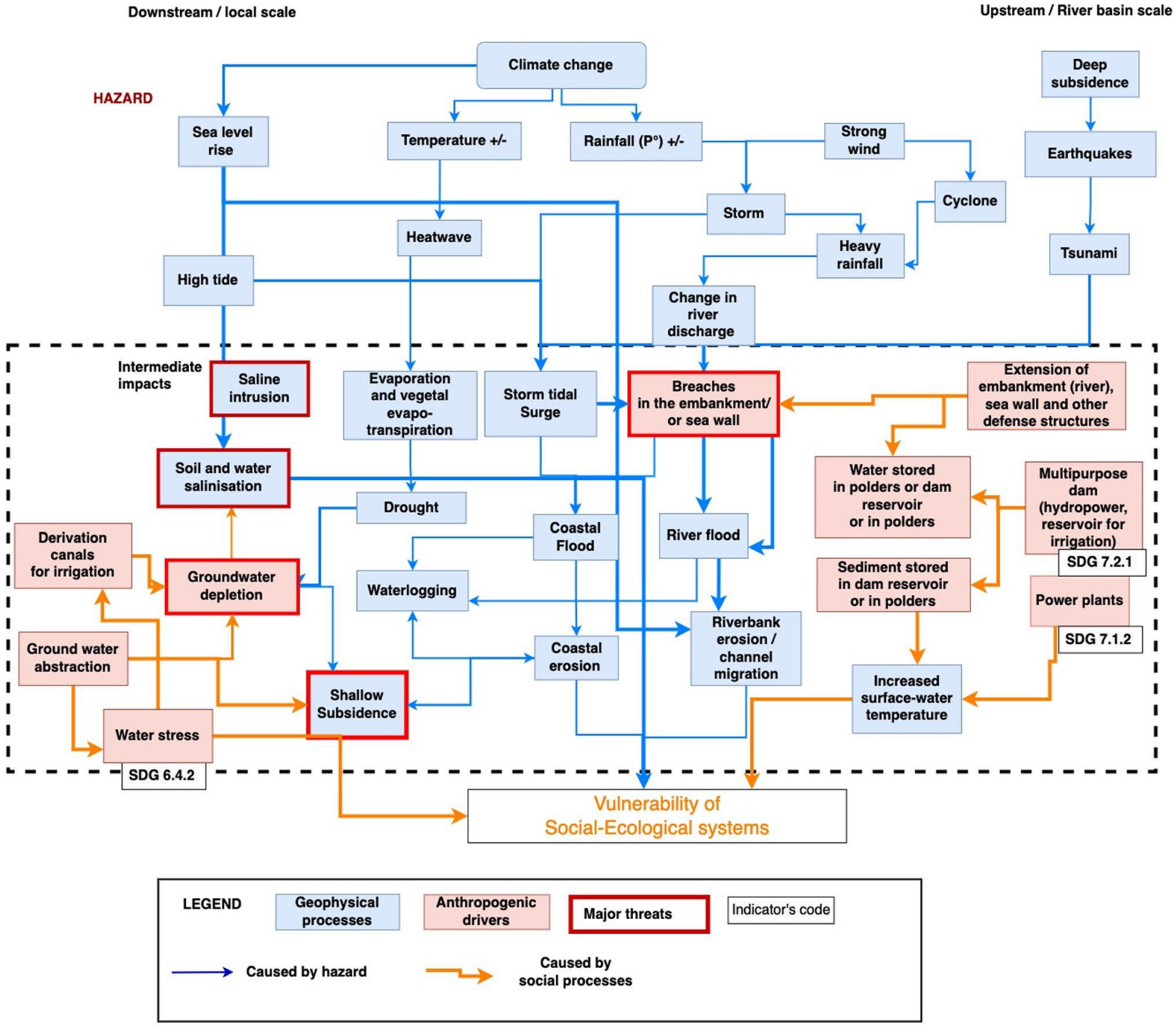


Figure by Dr Emilie Cremin et al (2025) Unpublished for now so do not reproduce

What we hope to achieve is:

- To explicitly link disaster risk reduction, climate change adaptation and sustainable development concepts to…
- Propose solutions that are fully integrated thus…
- Breaking silos and…
- Reducing risks of ‘maladaptation’

Hazard components of an impact chain



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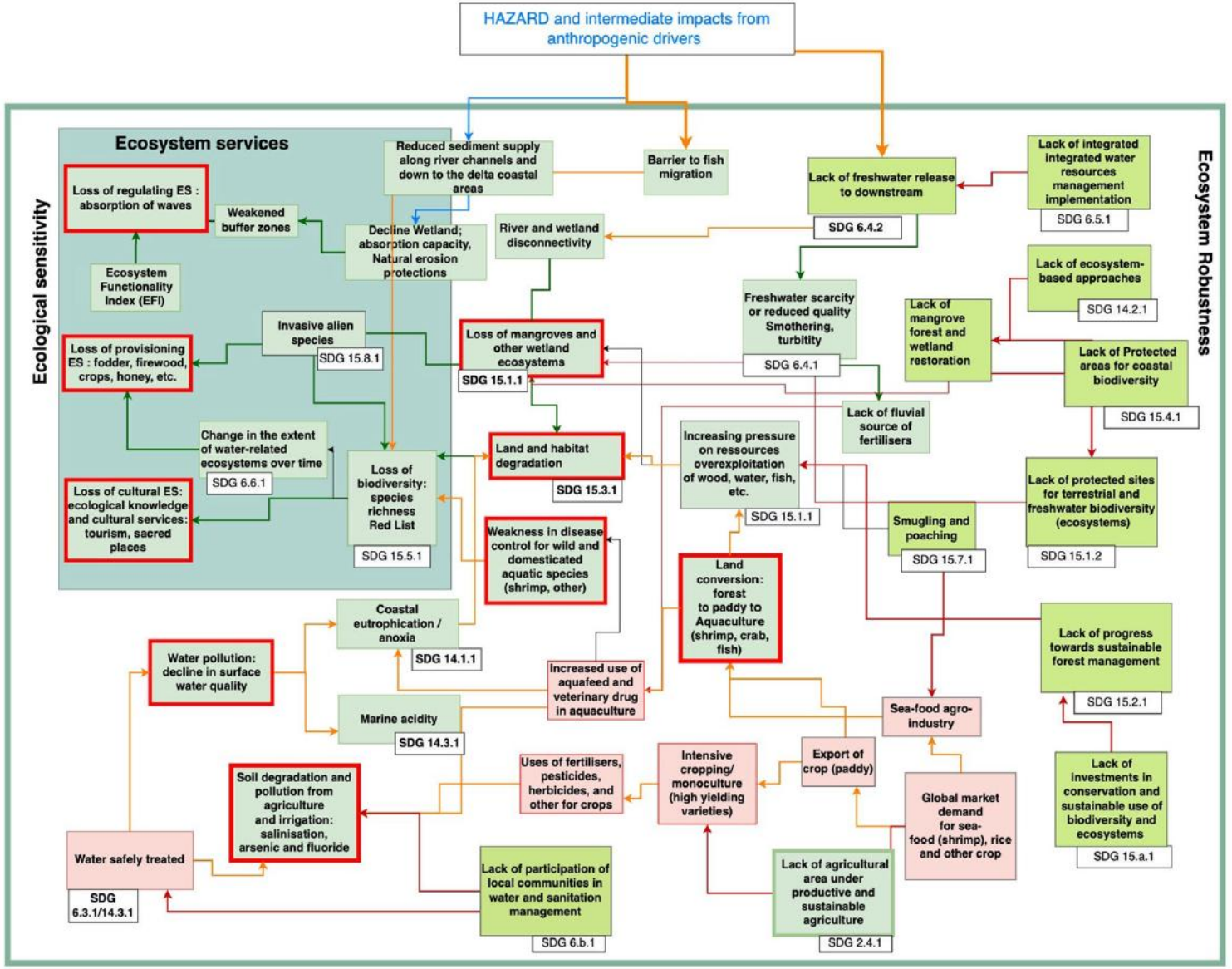
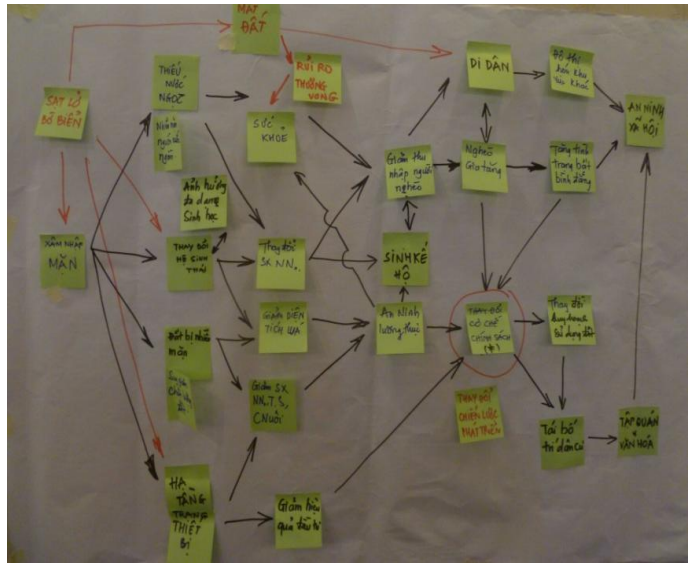
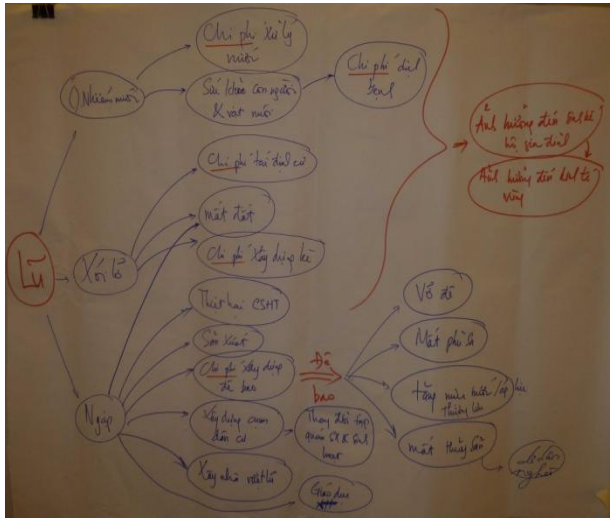
Ecological vulnerability using the revised GDRI framework



Cremin et al (2023): Aligning the Global Delta Risk Index with SDG and SFDRR global frameworks to assess risk to socio-ecological systems in river deltas. *Sustainability Science 18:1871–1891* https://doi.org/10.1007/s11625-023-01295-3.

Developed with stakeholders





Diagrams and postits used to develop impact chains

Source: Fabrice Renaud/UNU-EHS/University of Glasgow

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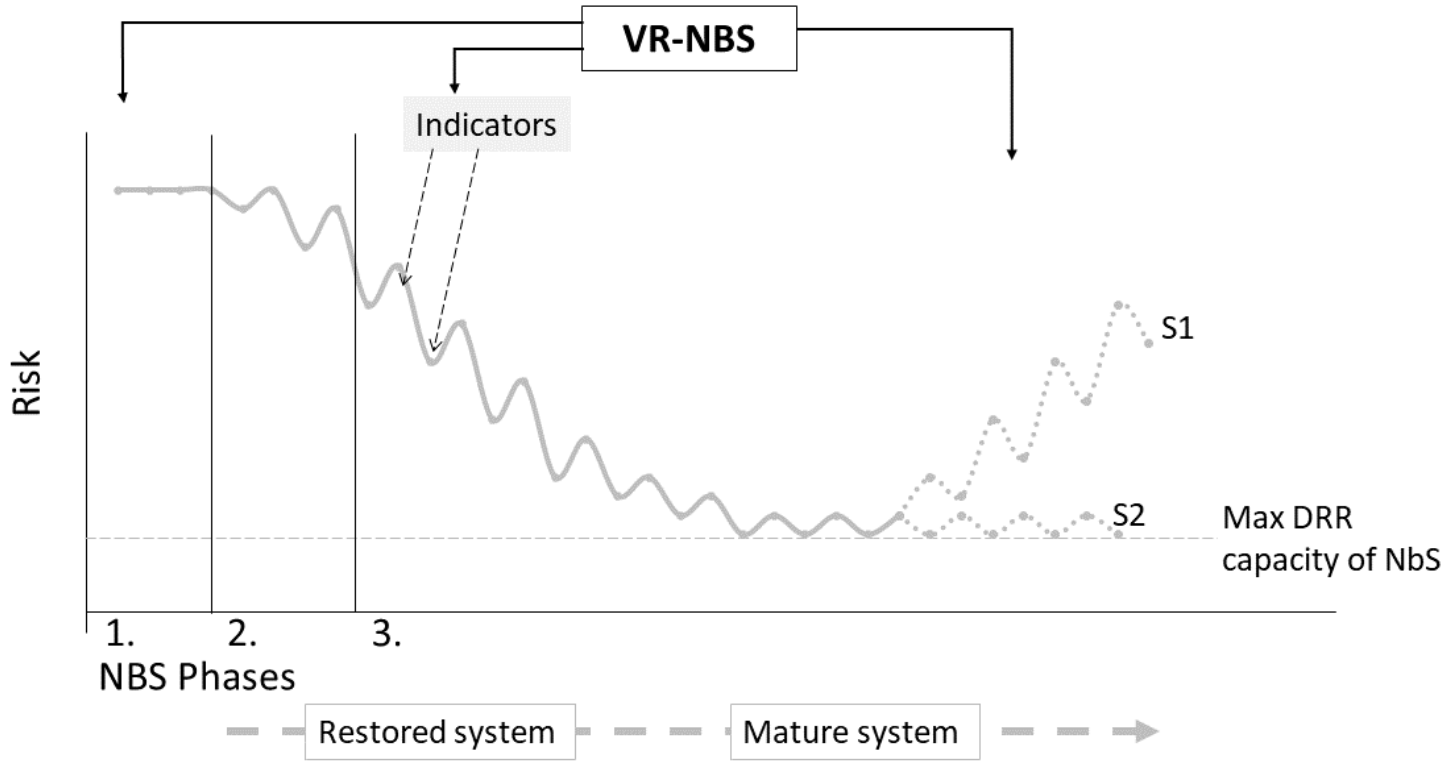
Acknowledging some limitations of NbS

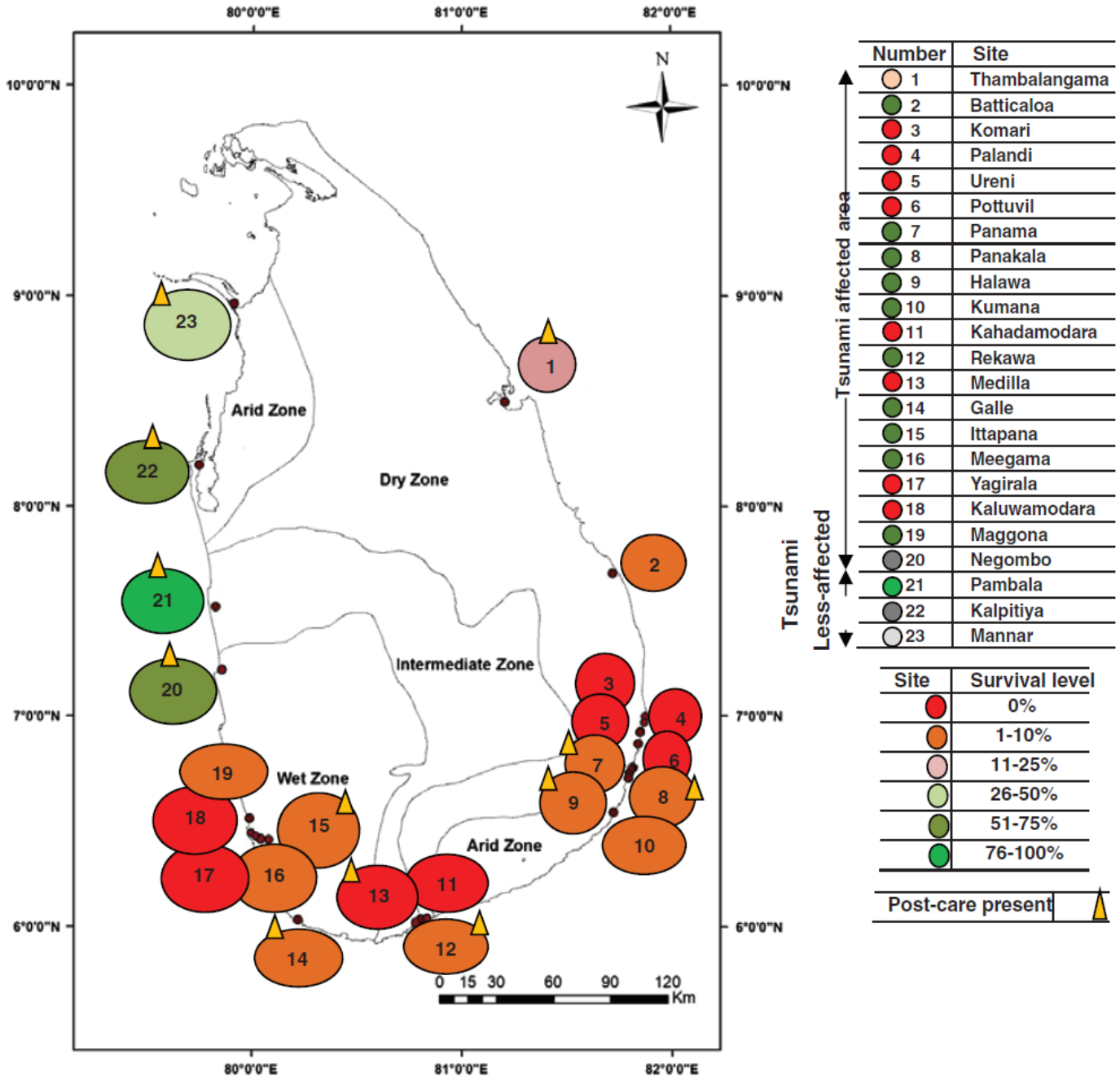
Risks at different stages of NbS implementation



1.Design and planning
2.Implementation
3.Monitoring, maintenance, and evaluation

S1. Lack of sustained monitoring and maintenance
S2. Sustained monitoring and maintenance
NbS affected by seasonal variation

Adapted from Shah, Renaud et al. (2020). A review of hydro-meteorological hazard, vulnerability, and risk assessment frameworks and indicators in the context of nature-based solutions. IJDRR, 50, 101728. [CC BY 4.0]



Source: Kodikara et al (2017): Have mangrove restoration projects worked? An in-depth study in Sri Lanka. Restoration Ecology, doi:10.1111/rec.12492

Ecosystem disservices

"Ecosystem disservices are the ecosystem generated functions, processes and attributes that result in perceived or actual negative impacts on human wellbeing"

- Examples: pollen allergens, snake bites, crop pests….

Source: Shackleton et al (2016): Unpacking Pandora's Box: Understanding and Categorising Ecosystem Disservices for Environmental Management and Human Wellbeing. *Ecosystems 19: 587–600*

Other examples per categories:

- Health impacts: Wild animal attacks; Disease transmission
- Economic impacts: Damage to infrastructure
- Ecological impacts: Carbon or other greenhouse gases released

Source: Shackleton et al (2018): Looking into Pandora's Box: Ecosystem disservices assessment and correlations with ecosystem services. *Ecosystem Services 30:126–136*

Timescales: What should be monitored, at what frequency, for how long, and by whom?

What?

- Characteristics of the ecosystem vs. risk reduction functions?
- Which ecosystem function or service should be prioritized?

What Frequency?

- Variable (e.g. more frequent during maturation phase and less thereafter)?
- Different frequencies for different parameters (rapid vs. slow changing variables)?

How long?

- Short-term vs. long-term monitoring?
- Funding mechanisms?

By whom?

- Researchers or project implementers? → short-term monitoring
- NGOs or other non-governmental actors? → short- to mid-term monitoring
- Communities? → At what point does it become “boring”?
- National/Local Government agencies? → Long-term monitoring

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Facilitating uptake of NbS in practice

Key Principles for NBS 1/2

1. Embrace nature conservation norms
2. Can be implemented alone or in an integrated manner with other solutions to societal challenges
3. **Are determined by site-specific natural and cultural contexts that include traditional, local and scientific knowledge**
4. **Produce societal benefits in a fair and equitable way, in a manner that promotes transparency and broad participation**

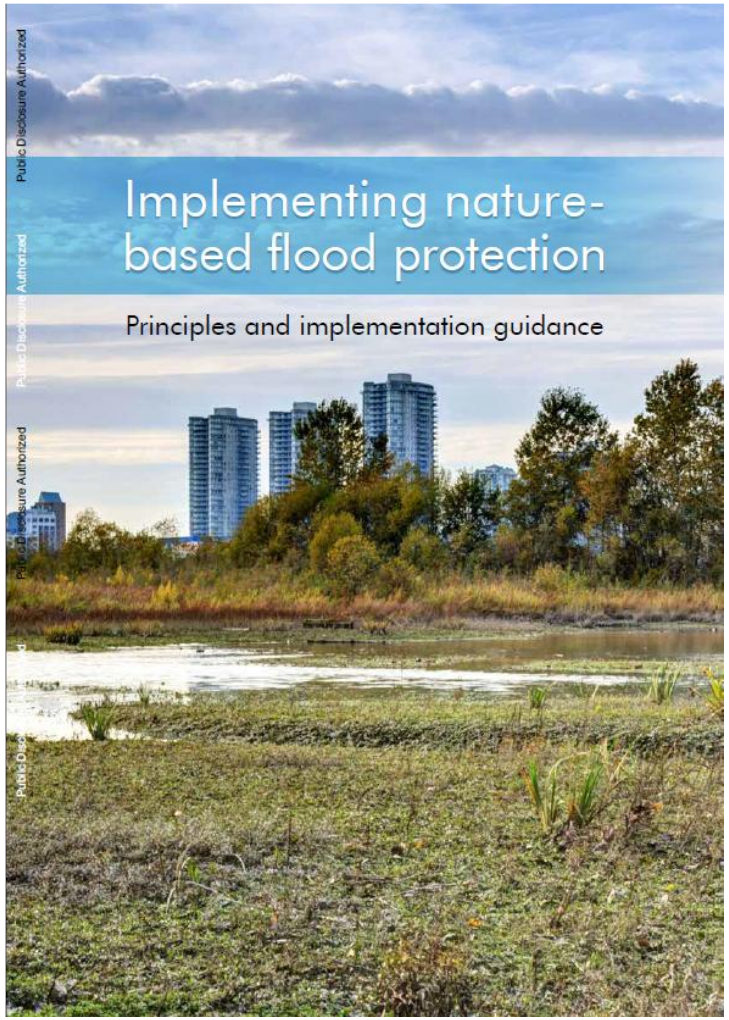
Source: Cohen-Shacham, E., Walters, G., Janzen, C. and Maginnis, S. (eds.) (2016). Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN.

Key Principles for NBS 2/2

5. Maintain biological and cultural diversity and the ability of ecosystems to evolve over time
6. **Are applied at a landscape scale**
7. Recognise and address the trade-offs between the production of a few immediate economic benefits for development, and future options for the production of the full range of ecosystems services
8. **Are an integral part of the overall design of policies, and measures or actions, to address a specific challenge**

Source: Cohen-Shacham, E., Walters, G., Janzen, C. and Maginnis, S. (eds.) (2016). Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN.

Nature-based flood protection



Key principles

- Take a System-scale perspective
- Assess risk and benefit of full range of solutions
- Carry out standardized performance evaluation
- Integrate with ecosystem conservation and restoration
- Implement adaptive management

Source: World Bank. 2017. Implementing nature-based flood protection: Principles and implementation guidance. Washington, DC: World Bank.

Qualification criteria, quality standards and indicators for EbA

Qualification criteria:

- Reduces social and environmental vulnerabilities
- Generates societal benefits in the context of CC adaptation
- Restores, maintains or improves ecosystem health
- Is supported by policies at multiple levels
- Supports equitable governance and enhances capacities

Qualification Criteria	Quality Standards	Continuum of EbA quality				Example indicators
		Very strong	Strong	Weak	Very weak	
#1. Reduces social and environmental vulnerabilities	1.1 Use of climate information	Yes, short-, medium-, and long-term			Very limited or not at all	• Extent of information about future climate change used • Quality of climate data sources
	1.2 Use of local and traditional knowledge	Yes			Very limited or not at all	• Extent and relevance of local resources consulted (individuals, communities, NGOs) • Participation of affected natural resource users during planning process • Quality of consultation process
	1.3 Taking into account findings of vulnerability assessment	Yes, clearly integrating findings of climate change vulnerability assessments			Yes, but only marginally	• Extent to which information from VA is being considered • Consideration of climate risk reduction potential • Extent to which ecosystem services are assessed by the VA
	1.4 Vulnerability reduction at the appropriate scale	Land/seascape scale or larger			Local scale	• n or % of population with reduced vulnerability • Effects from different scales of ecosystems are considered

Source: Bertram, M et al (2017): Making Ecosystem-based Adaptation Effective: A Framework for Defining Qualification Criteria and Quality Standards (FEBA technical paper developed for UNFCCC-SBSTA 46).

Handbook for NBS impact assessment

Handbook Objective: ”to support the adoption of common indicators and methods for assessing the performance and impact of diverse types of NBS”

Focus: Urban Environments

Indicators for 12 societal challenge areas:

1. Climate Resilience
2. Water Management
3. Natural and Climate Hazards
4. Green Space Management
5. Biodiversity
6. Air Quality
7. Place Regeneration
8. Knowledge and Social Capacity Building for Sustainable Urban Transformation
9. Participatory Planning and Governance
10. Social Justice and Social Cohesion
11. Health and Well-being
12. New Economic Opportunities and Green Jobs

Source: Dumitru, A. & Wendling L., Eds (2021). Evaluating the Impact of Nature-based Solutions: A Handbook for Practitioners. European Commission

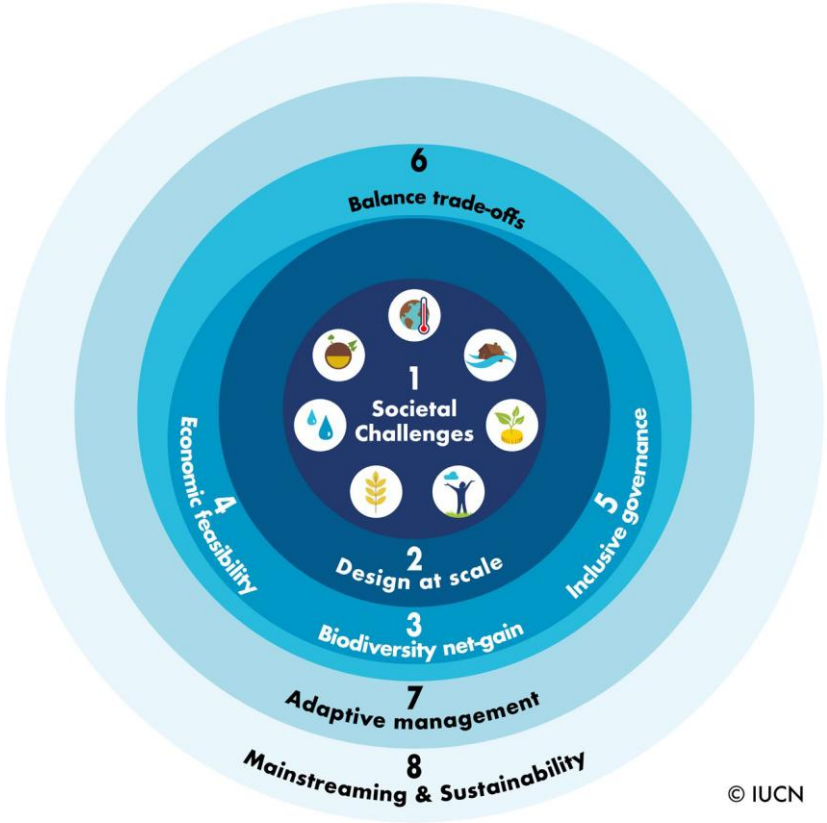
IUCN NBS Global Standards

- Achieve clarity of what the concept entails and what is required so it is deployed successfully
- It is a systematic learning framework so that lessons can improve and evolve the applications
- Create a global user community that helps:
  - guide implementation on the ground,
  - accelerate policy development
  - create conservation science on NbS
- It is a consistent approach to designing and verifying concrete solutions-orientated outcomes.

Source: IUCN (2020). Global Standard for Nature-based Solutions. A user-friendly framework for the verification, design and scaling up of NbS. First edition. Gland, Switzerland: IUCN

IUCN NBS Global Standards

8 criteria and 28 indicators



- C-1.3 Human well-being outcomes arising from the NbS are identified, benchmarked and periodically assessed
- C-2.3 The design of the NbS incorporates risk identification and risk management beyond the intervention site
- C-3.2 Clear and measurable biodiversity conservation outcomes are identified, benchmarked and periodically assessed

Source: IUCN (2020). Global Standard for Nature-based Solutions. A user-friendly framework for the verification, design and scaling up of NbS. First edition. Gland, Switzerland: IUCN

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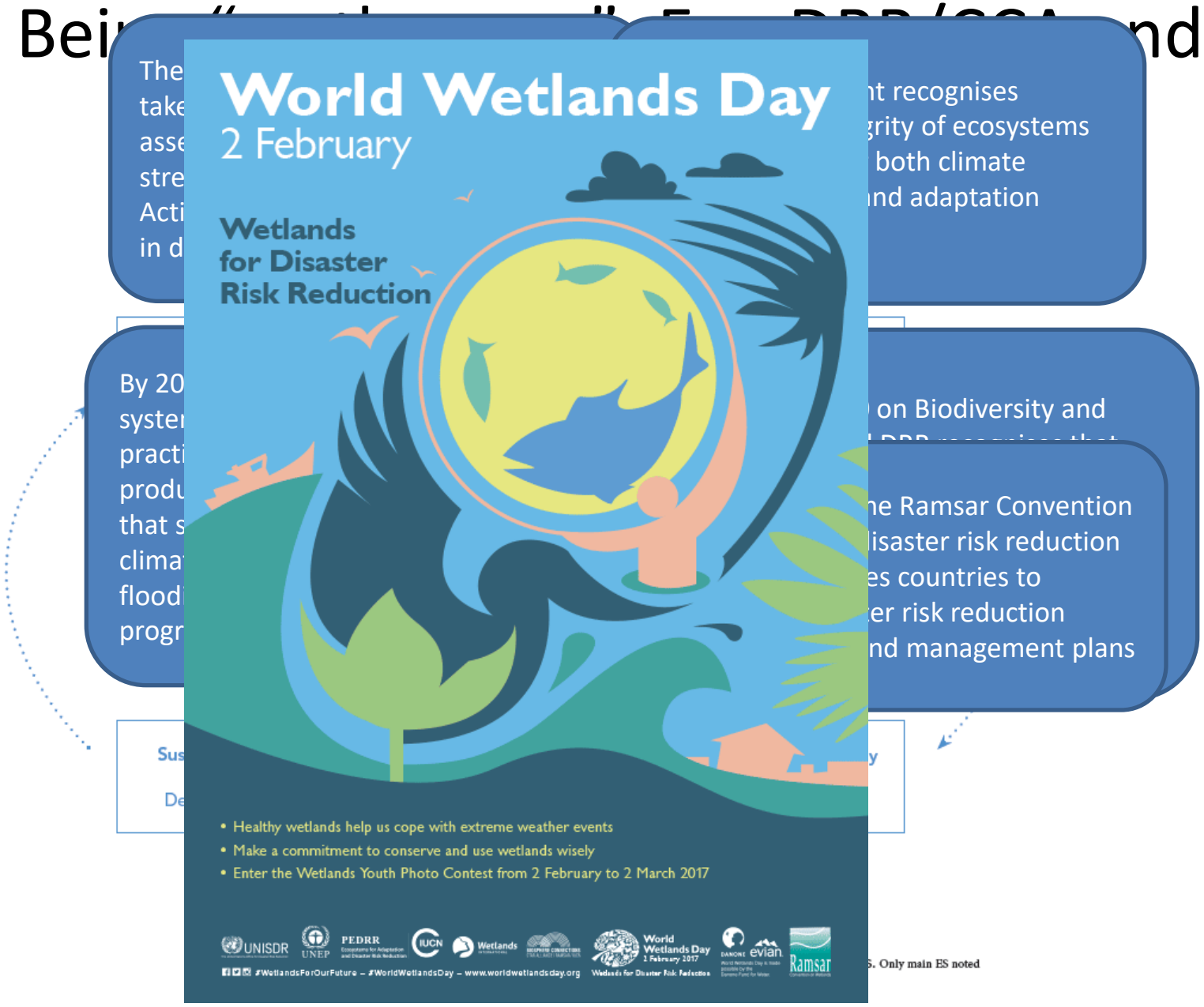
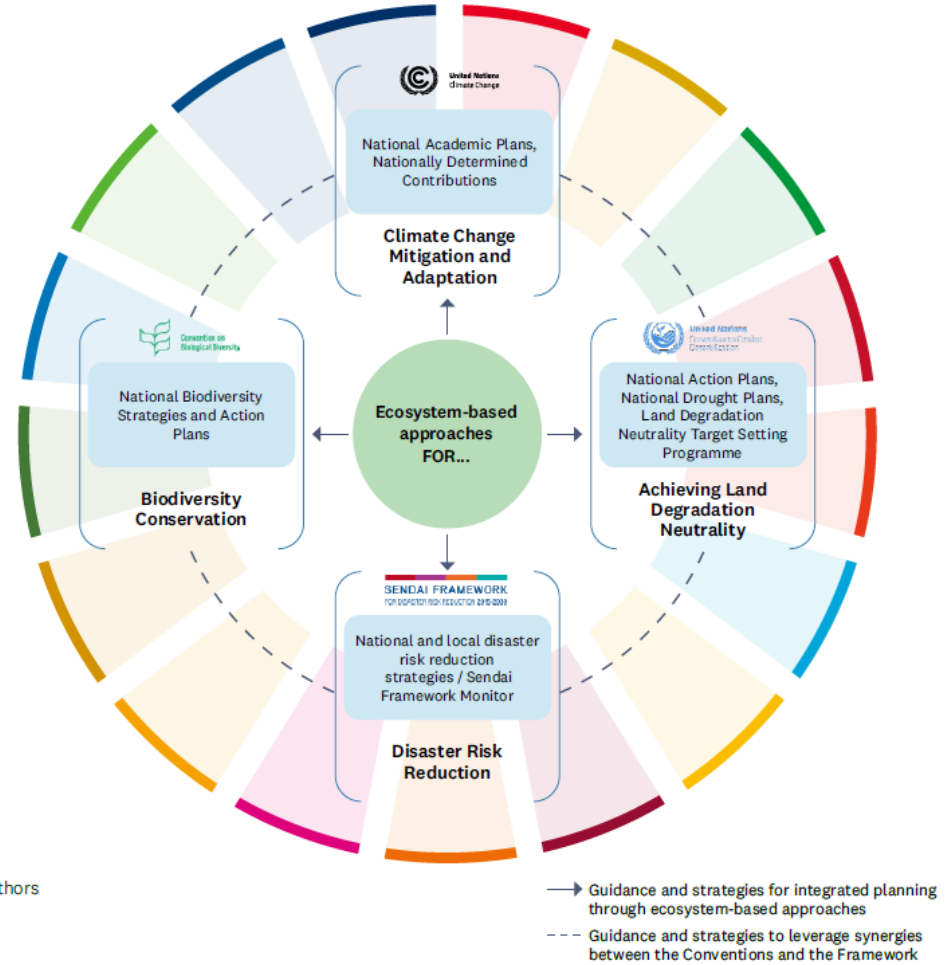
Links to Policy

Bei…nd major



Source: Adapted from Chapters 1 and 24 of Renaud et al (2016): Ecosystem-Based Disaster Risk Reduction and Adaptation in Practice, Springer. DOI 10.1007/978-3-319-43633-3_1cc

Linkages between the Rio Conventions and the Sendai Framework, through ecosystem-based approaches, in support of SDG implementation



Source: Walz et al (2024): Ecosystem-based approaches for integrating disaster risk reduction, climate, land and biodiversity goals. PEDRR Policy Brief No. 15, United Nations University Institute for Environment and Human Security, Bonn, Germany.

Kunming-Montreal Global Biodiversity Framework (GBF)

- "[The GBF] aims to catalyze, enable and galvanize urgent and transformative action by Governments, and subnational and local authorities, with the involvement of all of society, to halt and reverse biodiversity loss"
- 4 global goals for 2050:
  - Goal A: Protect and Restore
  - Goal B: Prosper with Nature
  - Goal C: Share Benefits Fairly
  - Goal D: Invest and Collaborate

Source: https://www.cbd.int/gbf [Accessed September 2025]

Kunming-Montreal Global Biodiversity Framework (GBF) – 23 Targets

Kunming - Montreal
GLOBAL BIODIVERSITY FRAMEWORK

GBF HOME // TARGET 8

Target 8

Minimize the Impacts of Climate Change on Biodiversity and Build Resilience

Minimize the impact of climate change and ocean acidification on biodiversity and increase its resilience through mitigation, adaptation, and disaster risk reduction actions, including through nature-based solution and/or ecosystem-based approaches, while minimizing negative and fostering positive impacts of climate action on biodiversity.

Kunming - Montreal
GLOBAL BIODIVERSITY FRAMEWORK

GBF HOME // TARGET 11

Target 11

Restore, Maintain and Enhance Nature's Contributions to People

Restore, maintain and enhance nature's contributions to people, including ecosystem functions and services, such as regulation of air, water, and climate, soil health, pollination and reduction of disease risk, as well as protection from natural hazards and disasters, through nature-based solutions and/or ecosystem-based approaches for the benefit of all people and nature.

References to Nature-based Solutions, disasters

Source: https://www.cbd.int/gbf/targets [Accessed September 2025]

Conclusion

- NbS are being increasingly considered and deployed globally

- In the field of disaster risk reduction:
  - Their effectiveness is increasingly demonstrated in many different contexts
  - There is an increasing number of principles, guidelines, standards and indicators

- They are not a panacea and will only be successful and sustainable if:
  - The hazard, climate change, bio-physical, economic, and socio-cultural settings are perfectly understood
  - All relevant stakeholders/rightsholders are on board
  - Long-term monitoring is in place
  - Transparent reporting is implemented
  - Ensure guidelines/standards are followed to avoid unintended consequences and ensure safeguarding is in place

See also Nature-based Solutions Conference 2022 Report (www.naturebasedsolutionsinitiative.org) for additional key recommendations related to NbS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