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Danube Region

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Danube-ADAPT

Potential usability of climatological data in integrated vulnerability assessments – Development of an integrated climate vulnerability assessment framework for the Danube region

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1. Utilization of climate data in policy making
2. Objectives & aims
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5. Conclusions

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Utilization of climate data in policy making

Climate factors are ab ovo among the most important geographic endowments → influencing spatially different climate impacts and consequences → **relevance of geographic endowments and spatial aspects in climate adaptation planning, MRE** → proper **preparation and adaptation need spatially organised and oriented frameworks and interventions**

Spatially differentiated impacts → territorially different adaptation responses → spatial/territorial approach and spatial emphasis on geographic/spatial endowments, features is of key importance

<u>Spatial data need:</u> comprehensive adaptation-oriented situation analyses, CCRAs, CVAs: main tools of achieving policy objectives → CCRAs are sometimes, CVAs are basically spatial: revealing relative spatial/territorial differences

<u>Demand from spatial levels:</u> vulnerabilities appear locally → municipal, district/regional level decision makers' eminent interest is the proper planning of adaptation responses based on analysed and identified local impactst → **national level: coordination of lower spatial levels' work and adaptation directions → evidence base is needed here, too.**

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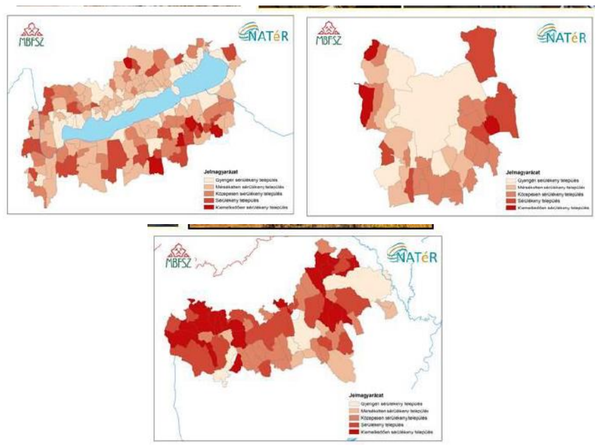
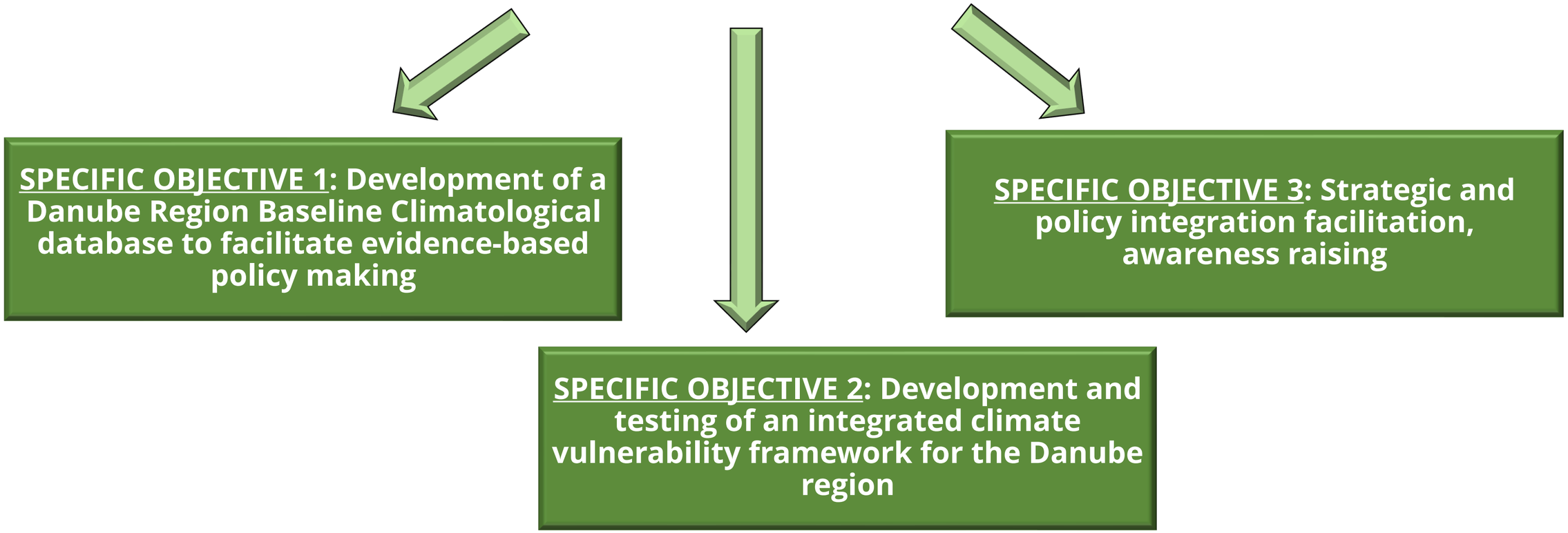


Objective system of the Danube-ADAPT project

Main objective: Assessment of Danube Region's climate change challenges based on newly developed vulnerability assessments and testing of the new method; facilitating policy-making, strategy-building and decision-making processes related to local, regional and national or transboundary adaptation measures.

3 SPECIFIC OBJECTIVES with several activities and sub-activities



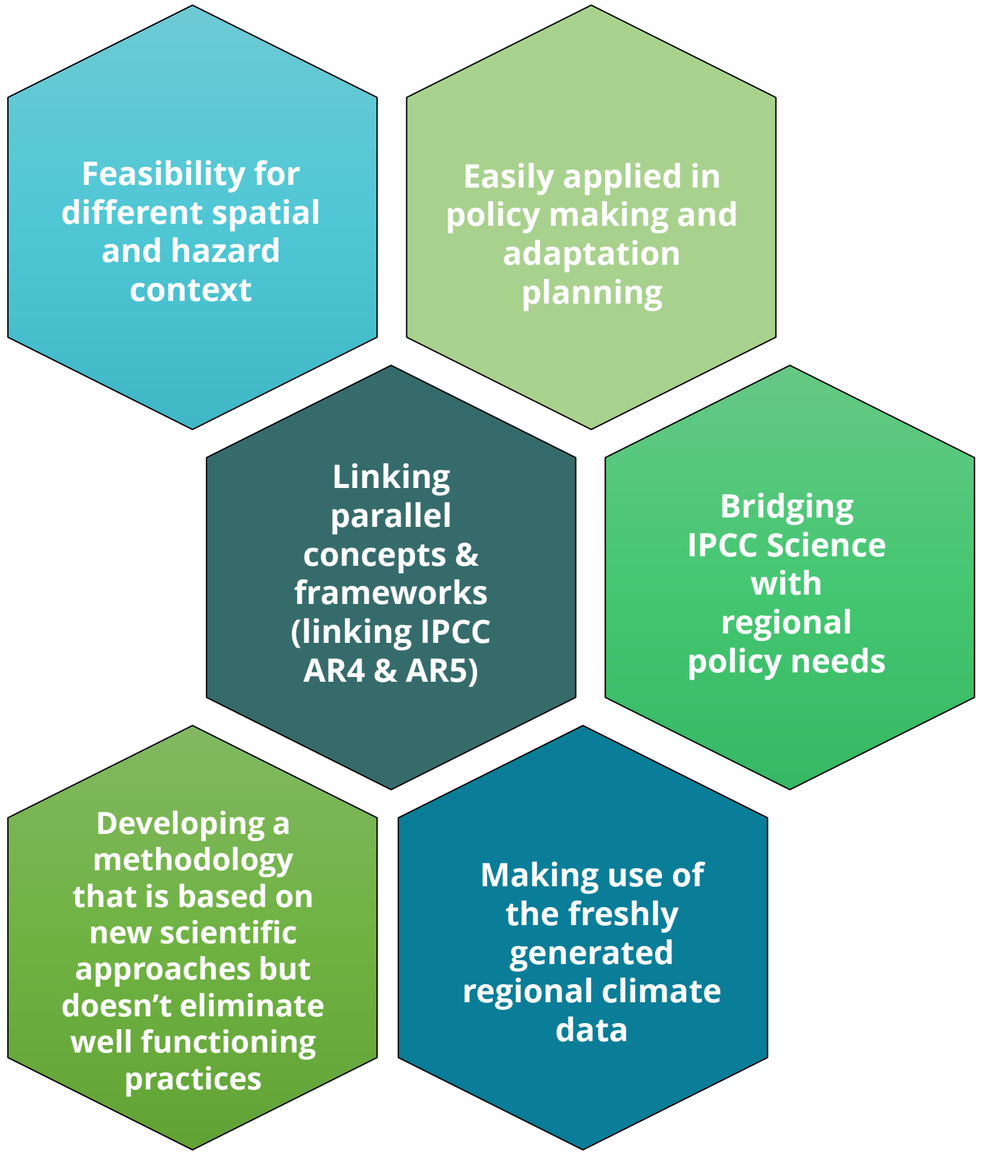
Objectives & aims

The identified methodological issue:
"Risk" vs. "Vulnerability„ as core concepts

IPCC moved away from viewing vulnerability in its direct climate change-dependency.

Focus:
Risk (IPCC AR5, 2014): Probability of consequences.

Vulnerability (IPCC AR, 2007): Structural connections between climate stressors and affected parties.



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Development of CVA methods

Early phase:

- Prior to 1990s, the CVAs were made for academic use.
- rather some expert estimations, qualitative basis due to the complexity of measuring vulnerability components especially sensitivity and adaptive capacity
- Qualitative methodology, mostly applied before the development of adaptation projects
- no clear demarcation between vulnerability, impact, exposure, resilience.

IPCC has proposed vulnerability assessment methodologies since its inception

- At the early stage sequential approach was used to assess CC vulnerability
  - problem definition method selection method testing scenario development potential impact assessment autonomous adjustment assessment evaluation adaptation strategies
- This approach covers the entire life cycle of adaptation intervention

2nd phase:

- approaches and methods becoming more complicated and robust
- Mixture of qualitative and quantitative methods

- TAR: impacts were aggregated and sorted in the literature in a „Reasons for Concern” framework
  - Vulnerability = Exposure + Sensitivity + Adaptive Capacity

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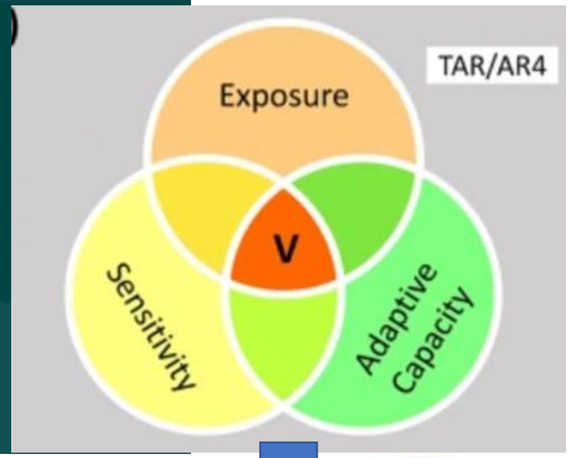
IPCC's method development



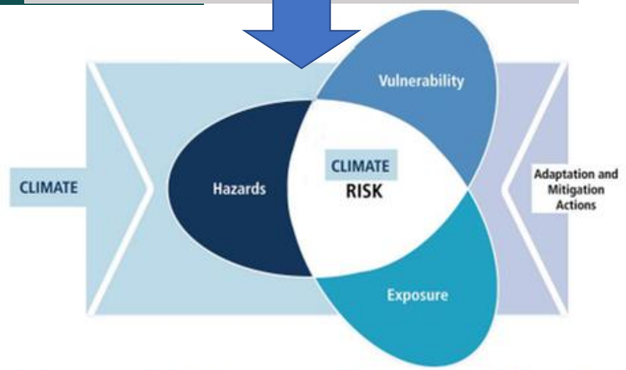
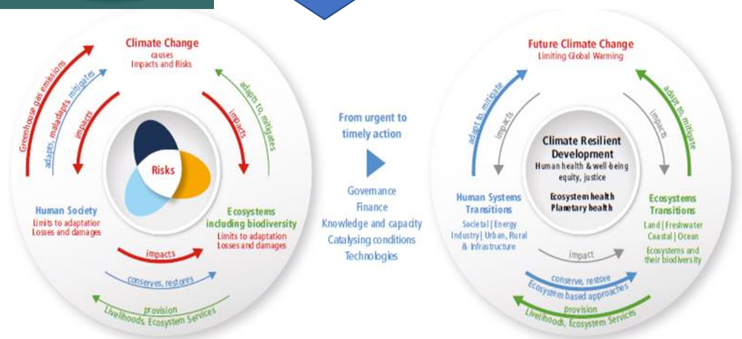


Figure 1 The concept of climate change risk (Source: adapted from IPCC, 2014)



Source: : *IPCC, 2022: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844.*

IPCC AR4

- summarizes CVA approaches (impact-, vulnerability, and adaptation- based approaches and integrated)
- biophysical, political economy and integrated approaches were proposed by different authors (Füssel, 2005 and 2007; Carle et al., 2011; Preston et al., 2009).
- provides useful methods for policy makers on determination of impacts and vulnerabilities
  - DPSIR-based Impact Assessment framework – the most popular.
  - New ways: quantifying CVAs by using indicators to measure E,S,A and V.
  - exposure component: relatively easy to be measured climate driven indicators
  - quantitative approach based on the availability & quality of data and permission to use databases

IPCC AR5

- considered CVA methods as the tool to link biophysical, economical and social aspects
- Focus: interaction of the changing physical characteristics of the climate system + evolving characteristics of socioeconomic and biological systems
- Vulnerability +exposure: results of socioeconomic pathways and societal conditions
- Disassociated 'exposure' from vulnerability („previous conceptualization focused primarily on biophysical impacts; now vulnerability is considered as an essentially social construct of risk)

IPCC AR 6

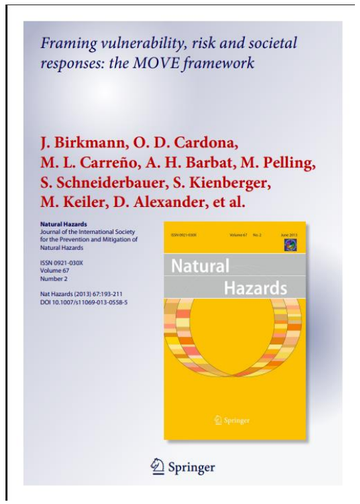
- Further development and refinement of IPCC 5 method
- integrates knowledge more strongly across the natural, ecological, social and economic sciences
- Impacts, risks, adaptation concepts are set against concurrently unfolding non-climatic global trends
- concept of risk & risk framing is central
  - Sub concepts: adaptation, vulnerability, exposure, resilience, equity and justice

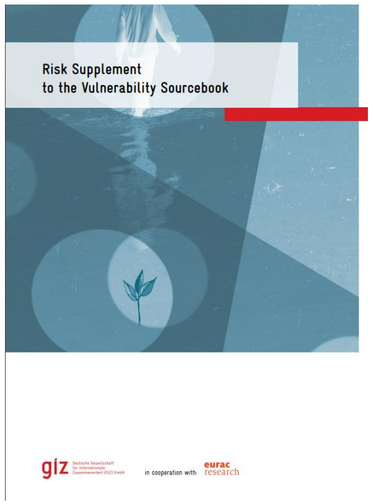
Past & Good-practices / lessons learned

- Many assessments nominally use the AR5 framework but their structure and workflow resembles the earler IPCC methodology
- Many projects develop their own understanding of the risk concept, adapting a „hybrid” practice to fit their needs
- Expert judgement and local knowledge is an important and accepted part of most assessments beyond quantitative data
- Impact-chain based methodologies are popular due to their descriptiveness and flexibility

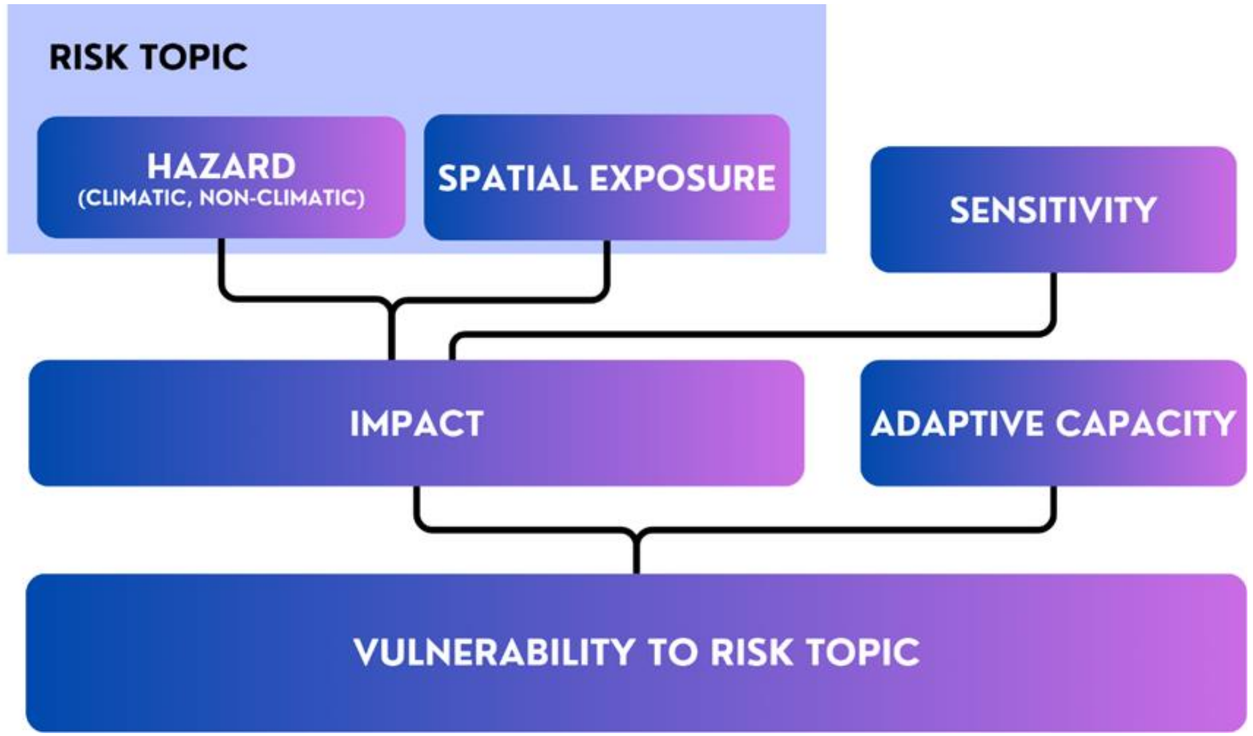
NAGiS
National Adaptation Geo-information System

CLIMAAX
climate ready regions



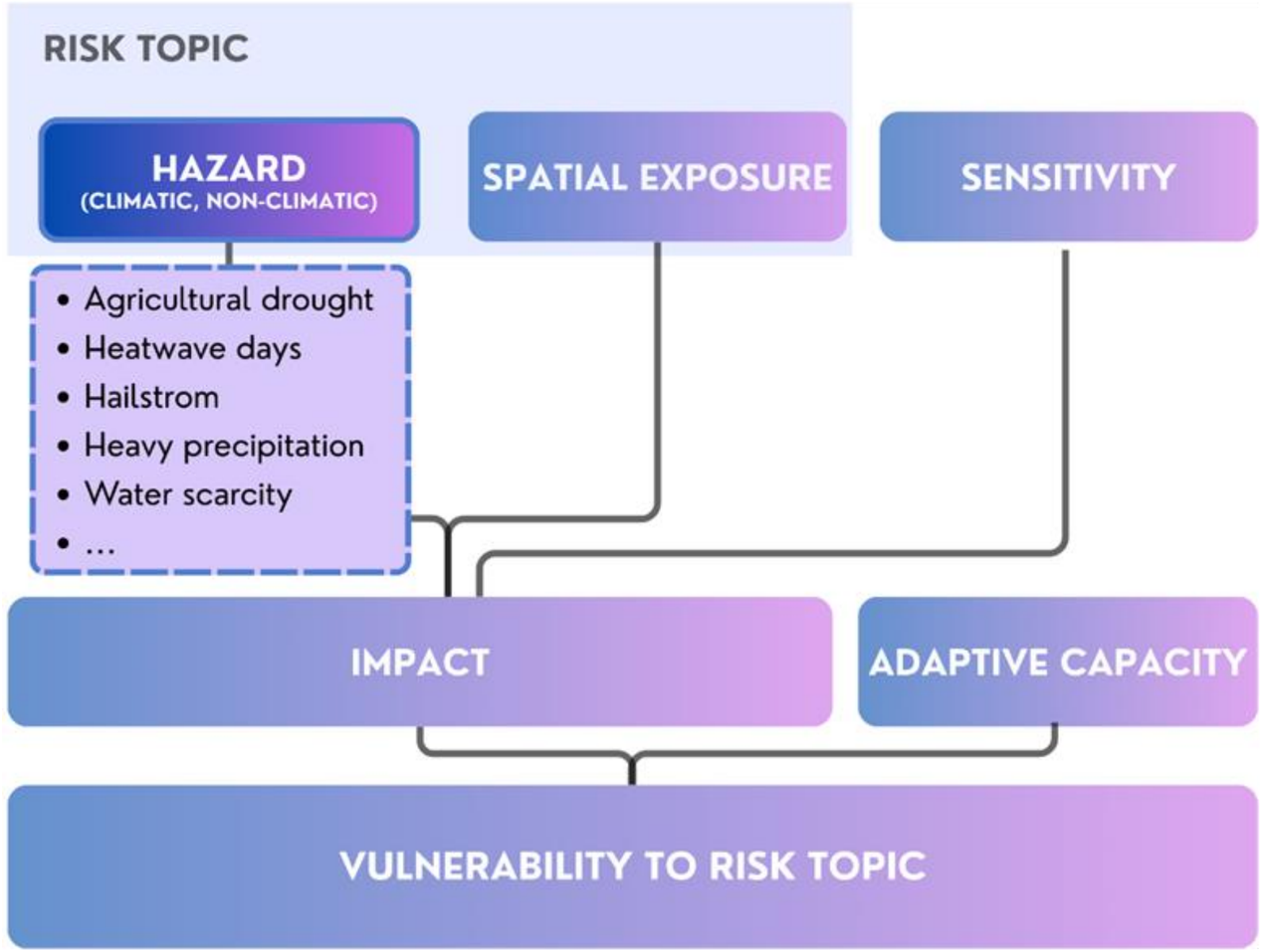


The recommended methodology



- Impact-chain structured
- Indicator-based
  - The main index, produced by a linear combination of de-dimensionalised, normalized variables.
- Semi- quantitative

Component 1: **Hazard**



Definition: Climatic (external) pressures, drivers acting on the system.

- Aligns with AR5 & AR6 – but utilized more according to AR4

- **Focus**: Climatic events, trends

- **Data source:** Mostly the harmonized regional database from SO1 or other high resolution source e.g. ERA-5

- **Selection Criteria:** area specific, climate-change related, consistent across the DR

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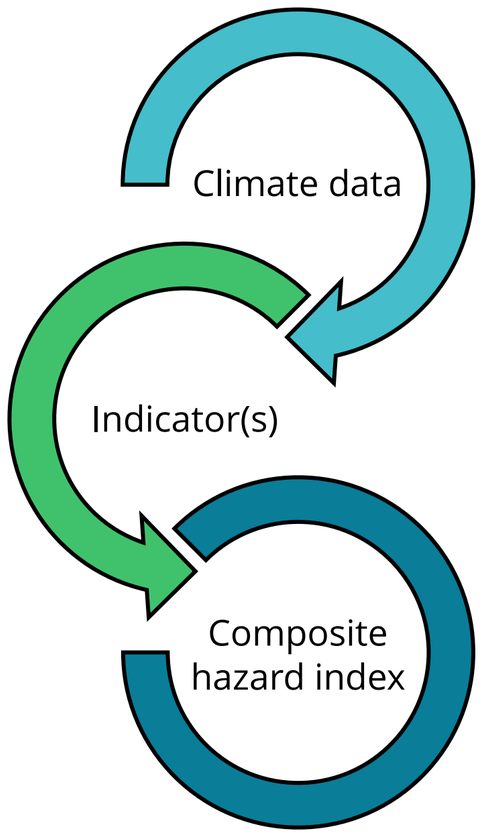
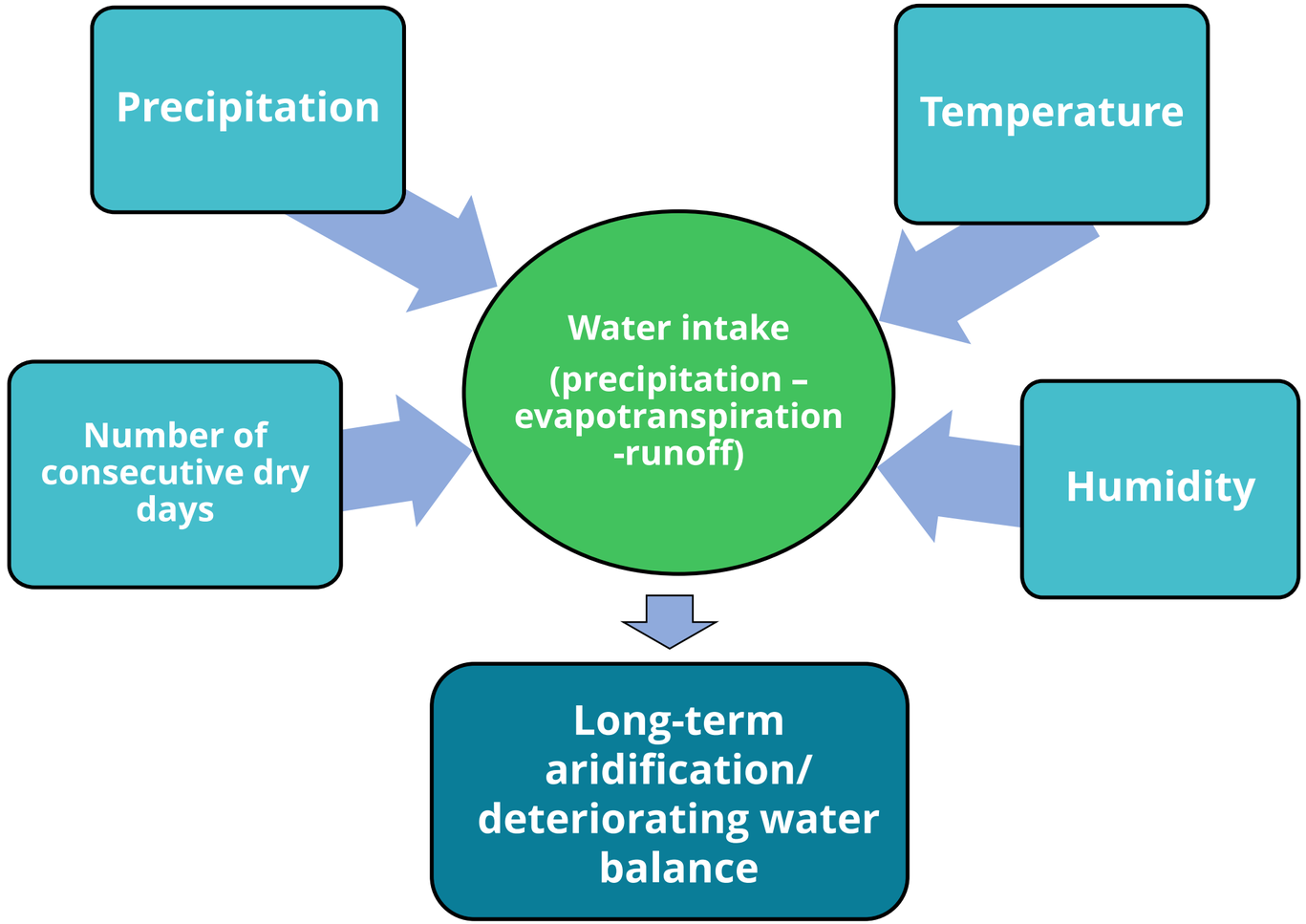
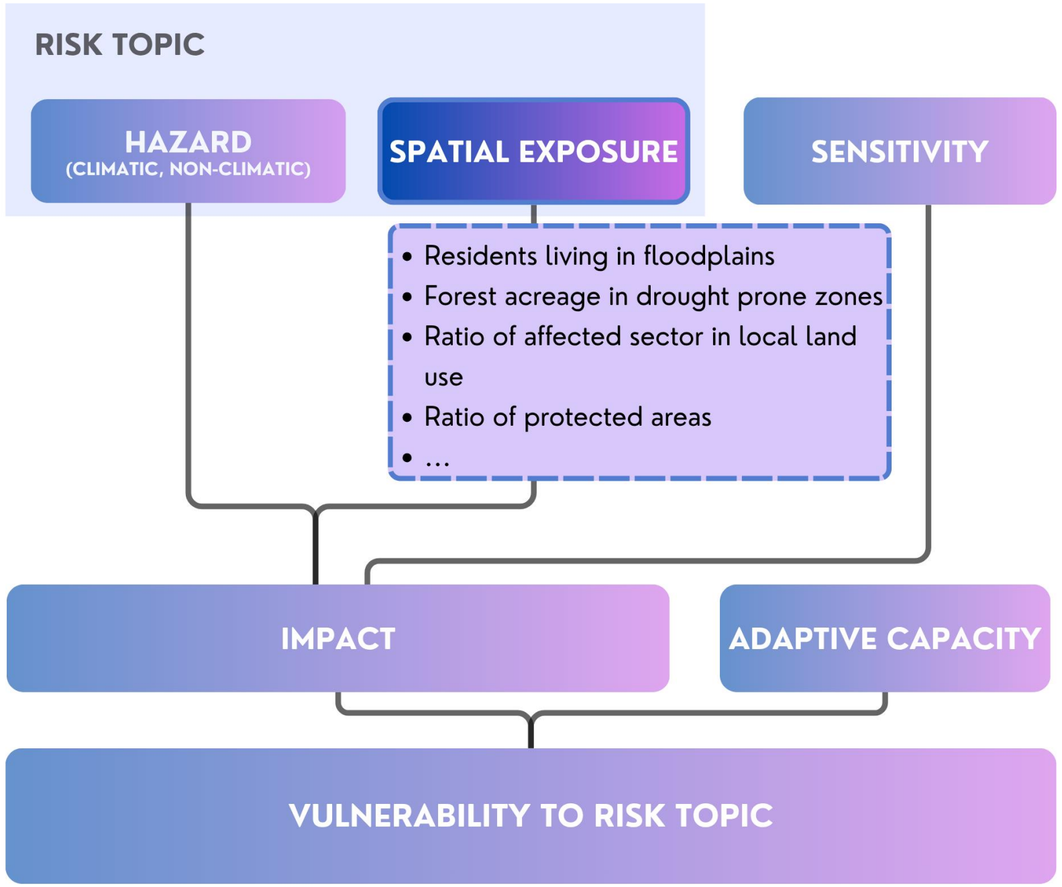
Component 1: **Hazard (2)**





Component 2: **Spatial exposure**



- **Definition:** the presence of affected parties (people, ecosystem, assets etc.), in the place that could be adversely affected
- Who / what is in the way of the hazard?
  - Conceptual shift from AR4 in AR5
- **Data source:** GIS, Remote sensing, national statistical databases etc.
- **Primary Focus:** who / what is affected

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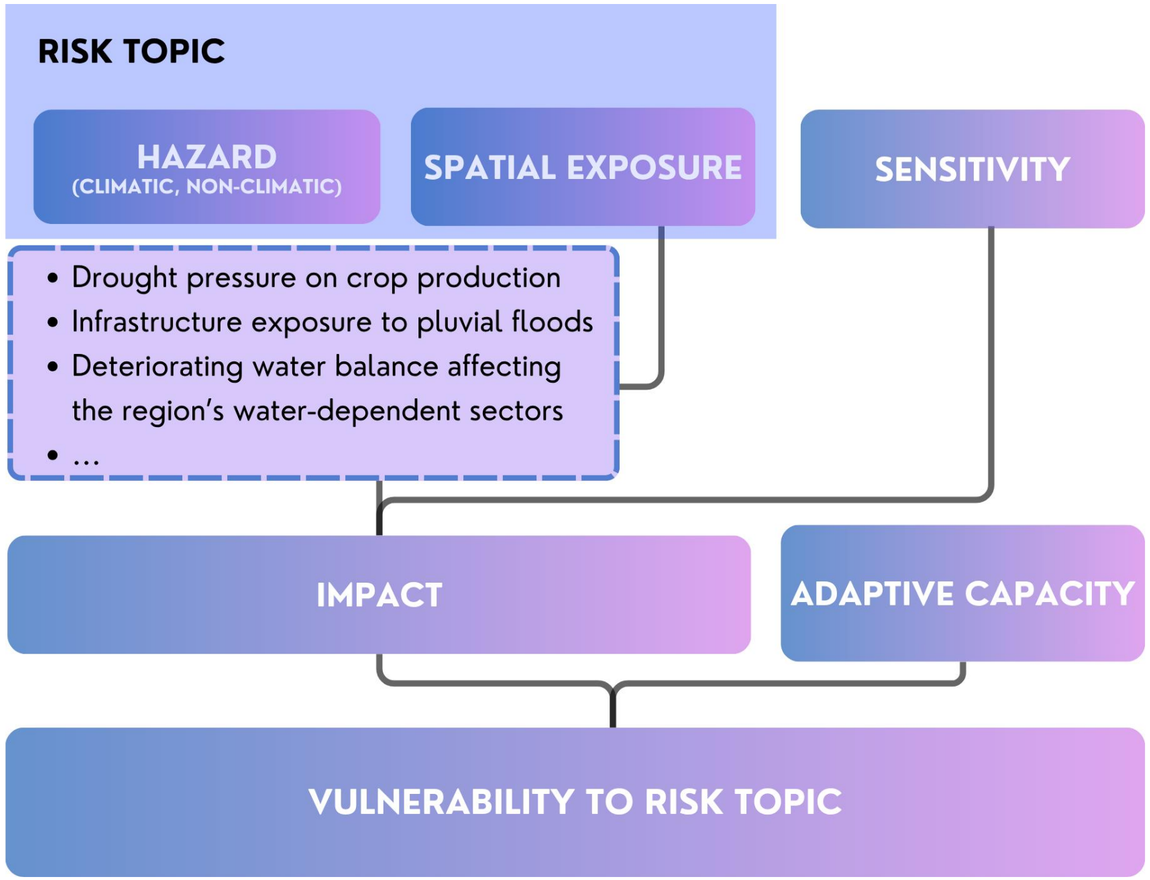
Intermediate & descriptive component: **Risk Topic**

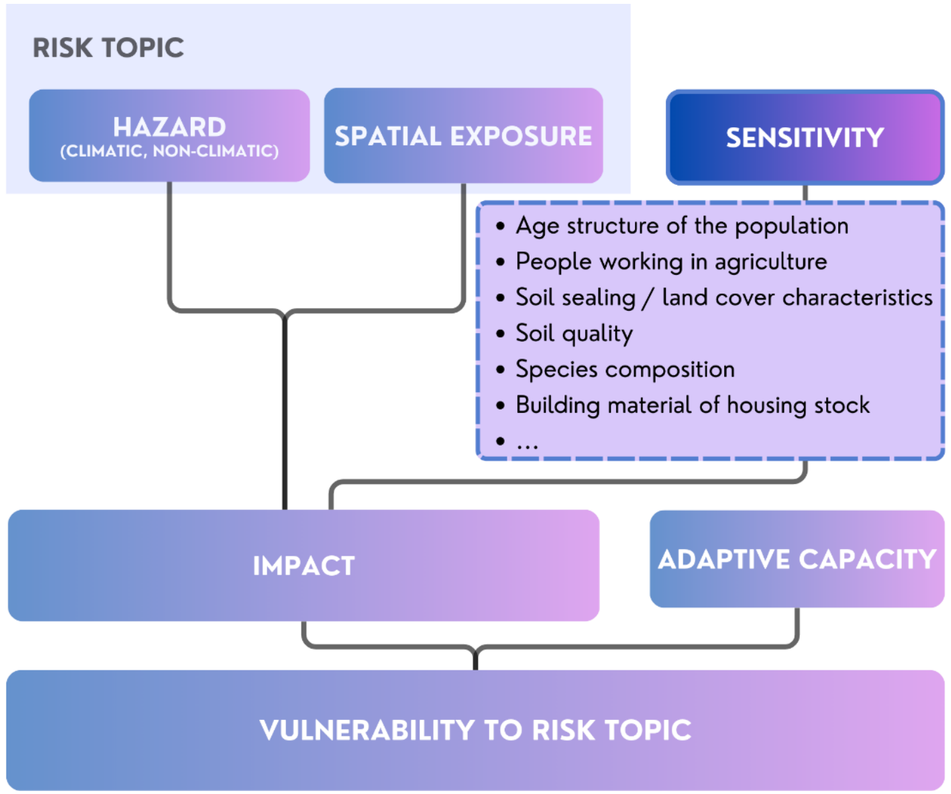


- **Definition:** The theoretical possibility of harm arising from the interaction of **Hazard** and **Spatial Exposure,** ***before*** considering the system's / affected parties' internal state.

- **Function:**
  - Identifies where damage could happen as a tool to link the concepts of „**Risk**" and **Vulnerability**"
  - Identifies national / regional „hotspots" for action.
  - „Excludes" the severity of the damage (severity or consequences become „visible" after the assessment of sensitivity and adaptive capacity

  It is not quantified as the other components.

Component 4: **Sensitivity**



- **Definition:** Inherent characteristics that determine how a system reacts to a hazard. It refers to the inherent physical, ecological, or social characteristics of the exposed system (such as topography, age structure, or land cover). It measures the degree to which a system is predisposed to be damaged by the **Risk topic / challenge**, independent of its ability to cope or adapt.
    - Aligns with both AR4 and AR5

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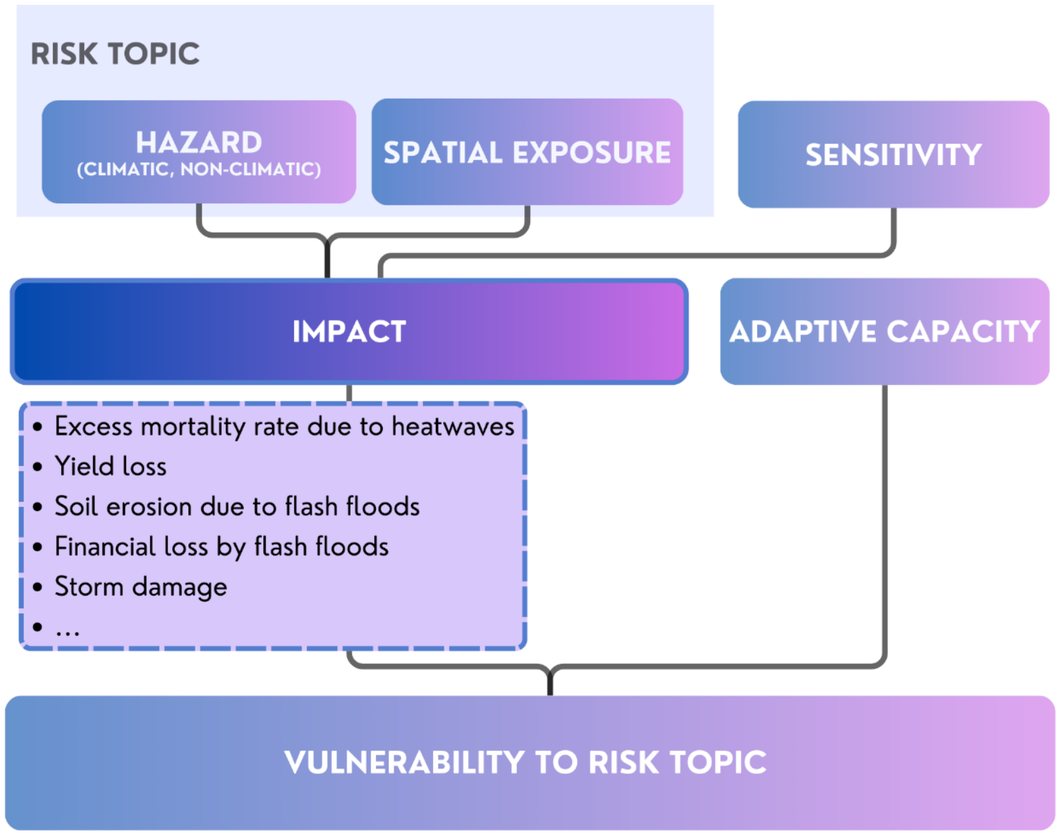
Component 5: **Impact**



- **Definition:** The level of damage or harm without the consideration of adaptive capacities.
- It depends on the presence and severity of a *potential risk (risk topic / challenge),* and on the sensitivity of the parties.

- Composite index of Hazard, Exposure and Sensitivity or direct quantities that show the damage on the affected parties itself e.g. excess mortality rate due to heatwaves, Yield loss)

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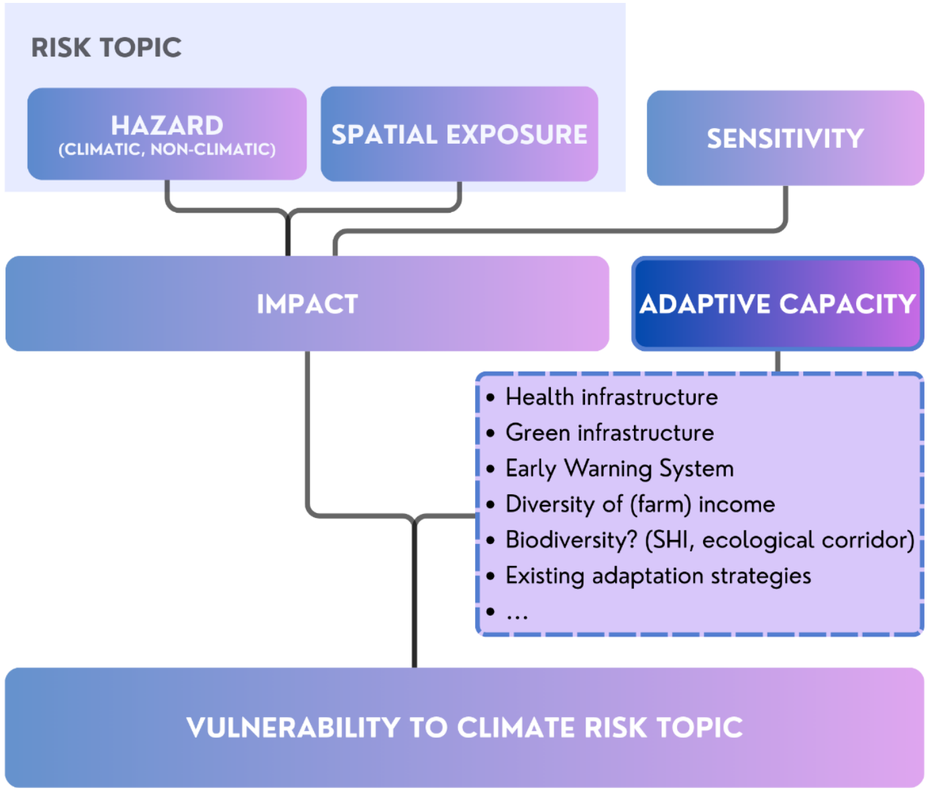
Component 6: **Adaptive capacity**



- **Definition:** It is the current ability of a system to adjust to, prepare for, and recover from climate impacts using already existing resources, infrastructure, and governance structures. It captures the resilience traits (such as economic strength or mobility) that can mitigate the system's Sensitivity.

- **„Fields" of adaptive capacity:**
  - Knowledge
  - Institutions
  - Technology
  - Economy

Focuses only on existing capacities, planned measures are not part of it (but the existence of strategies, policies can be).

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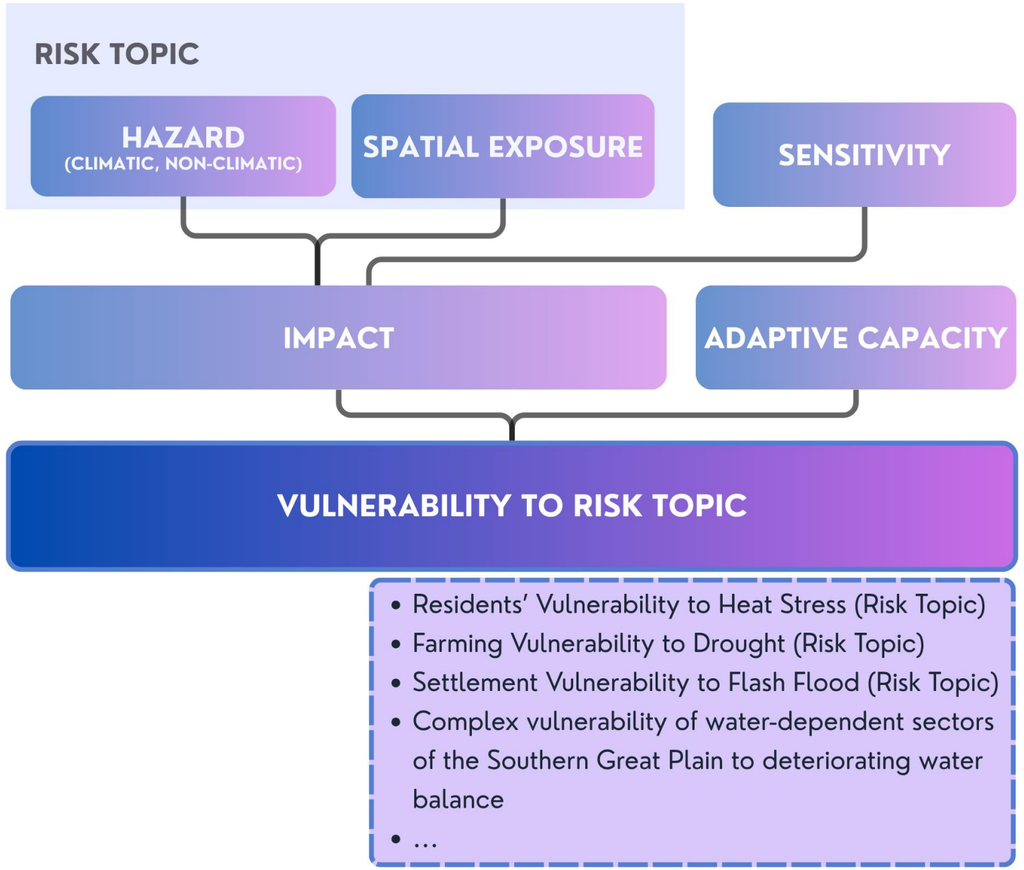
The output of the assessment:

Vulnerability to Risk Topic



- **Definition:** An index identifying where and to what degree specific systems are susceptible to specific hazard.
- The degree to which a system is susceptible to, and unable to cope with, adverse effects of ***specific climate change risk topics.***

- Vulnerability is understood as the dynamic interaction between the climatic driver (Hazard) and the spatially defined System.

- The concept bridges the vulnerability- and risk-centred frameworks:

→ from AR4 it retains the logic that vulnerability must be evaluated in close relation to a clearly defined hazard

→ from AR5/6 it integrates elemets of a risk-approach (certainty & confidence) and its spatial explicity (separate spatial exposure component)

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Conclusion:

- **Hybrid approach:** While IPCC AR5/6 introduced new theoretical concepts, they often appear to be too abstract for practical application. The project will adopt a framework that preserves the operational strengths of AR4 while integrating valuable innovations and terminology from AR5/6.
- **Adoption of impact chains:** The often used impact chain solution (utilizing quantitative data where possible) is recommended as the core methodological approach.
- **Integration of projections:** the framework fits the involvement of more dynamic data, such as socio-economic projections
- **Focus on vulnerability outcomes:** The project should maintain an outcome-based view of vulnerability (AR4 logic) specifically targeted at determining susceptibility to distinct risk topics (e.g., heat, flood).
    - linking vulnerability directly to location-specific climatic drivers makes it highly valuable for spatial planning and regional policy making
- The framework must remain **climate-focused** and **spatially explicit, as we have the most up-to-date and regionally harmonized data for them.**

Thank you for your attention!

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