Vulnerability Assessment

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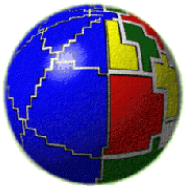

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Outline

- General concepts on Vulnerability
- Vulnerability and risk
- Vulnerability assessment
- Vulnerability/risk assements in Europe

Definitions of vulnerability

- The degree of loss to a given element at risk or set of elements at risk resulting from the occurrence of a natural phenomenon of a given magnitude and expressed on a scale from 0 (no damage) to 1 (total damage) (UNDRO, 1991).

- The conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards (UN-ISDR).

Vulnerability = (Exposure) + (Resistance) + Resilience

Exposure: at risk property and population;

Resistance: Measures taken to prevent, avoid or reduce loss;

Resilience: Ability to recover prior state or achieve desired post-disaster state.

Climate change vulnerability

The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (*IPCC WII AR5, 2014*).

IPCC vulnerability framework:

V = f(E, S, AC)

E = *Exposure*

S = *Sensitivity*

AC = *Adaptive Capacity*

Exposure

- The degree of climate stress upon a particular unit of analysis

- Climate stress:
  - long-term climate conditions
  - climate variability
  - magnitude and frequency of extreme events

Sensitivity

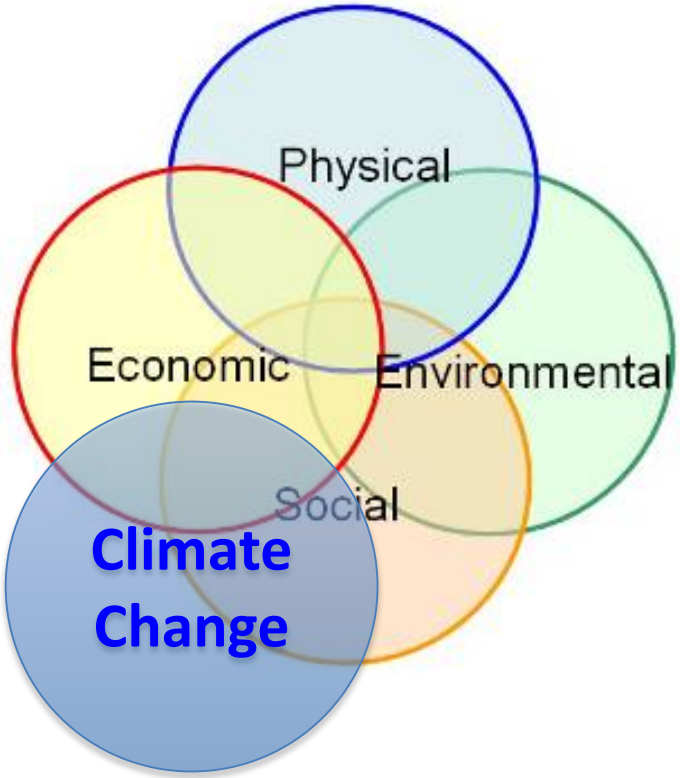
- The degree to which a system will respond, either positively or negatively, to a change in climate.

Adaptive Capacity

- The capacity of a system to adjust in response to actual or expected climate stimuli, their effects, or impacts.

Characteristics of vulnerability

- **Vulnerability is:**
  - multi-dimensional (e.g. physical, social, economic, environmental, institutional, and human factors define vulnerability);
  - dynamic i.e. vulnerability changes over time;
  - scale-dependent (vulnerability can be expressed at different scales from human to household to community to country resolution;
  - site-specific.



(Source: UN-ISDR).

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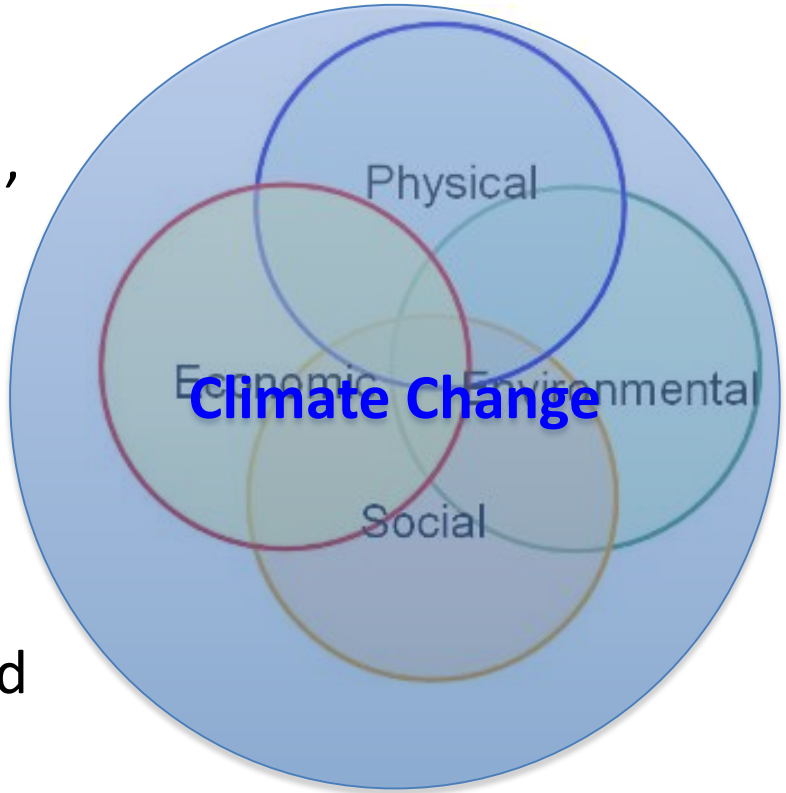
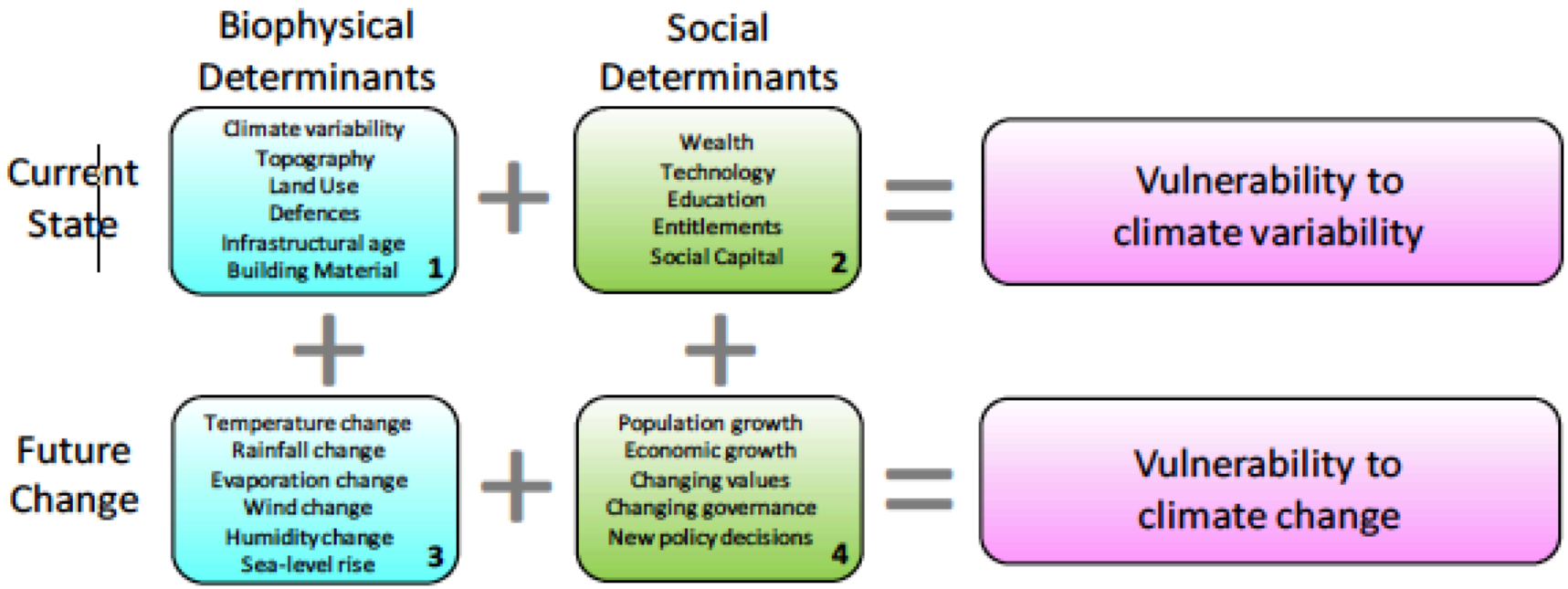


(Source: UN-ISDR).

Current and future determinants of vulnerability to climate variability and climate change

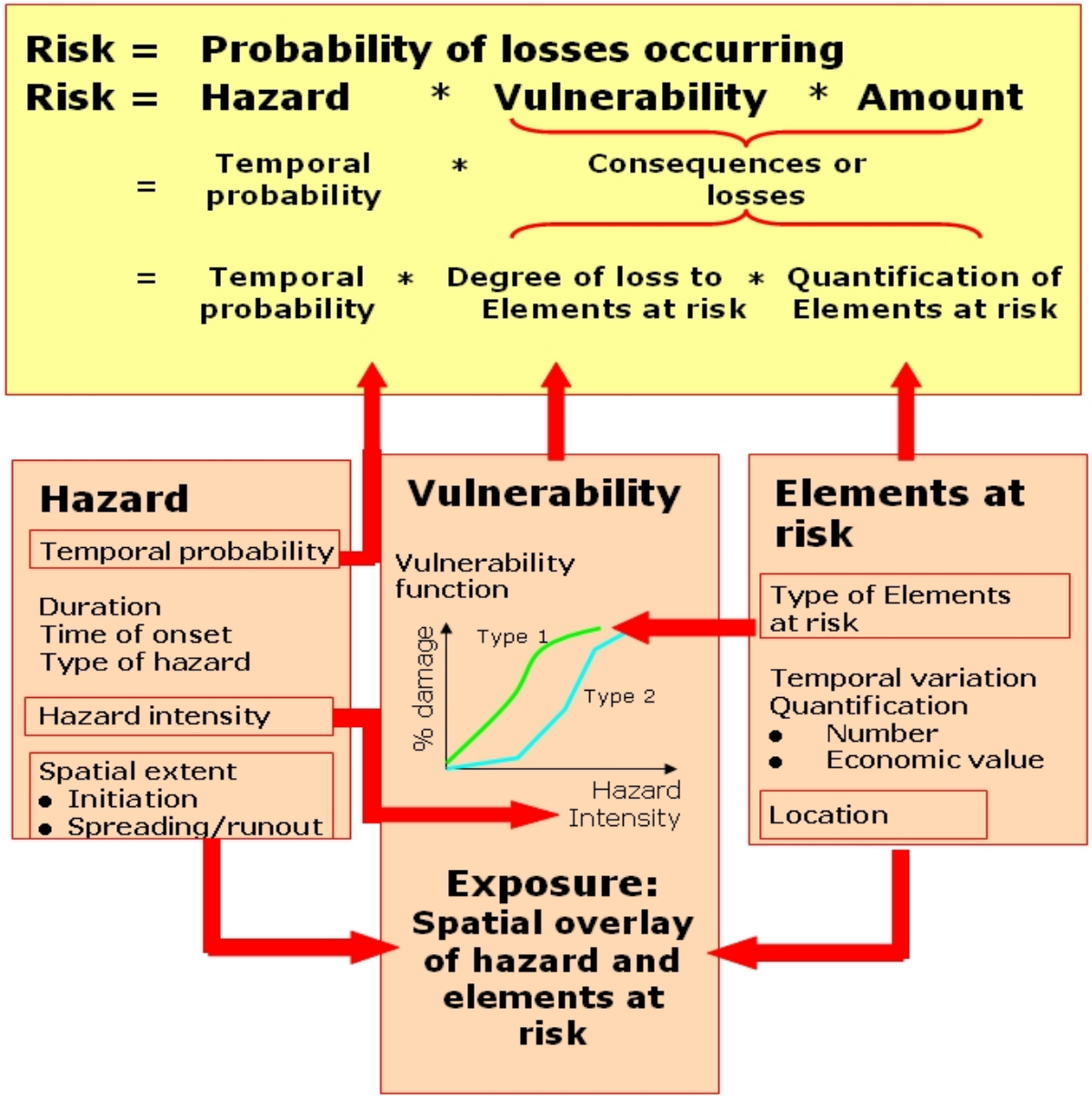
(modified from Preston and Stafford-Smith, 2009)



Source:

Carter, T.R. and Mäkinen, K. 2011. *Approaches to climate change impact, adaptation and vulnerability assessment: towards a classification framework to serve decision-making*. *MEDIATION Technical Report No. 2.1*, SYKE, Helsinki, Finland, 70 pp.

Vulnerability and risk



Risk:

The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values.

Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur.

Risk results from the interaction of vulnerability, exposure, and hazard.

Source: IPCC WGII AR5 (2014)

UN Our Hope for Humankind
ITC an Associated Institution of the UNITED NATIONS UNIVERSITY

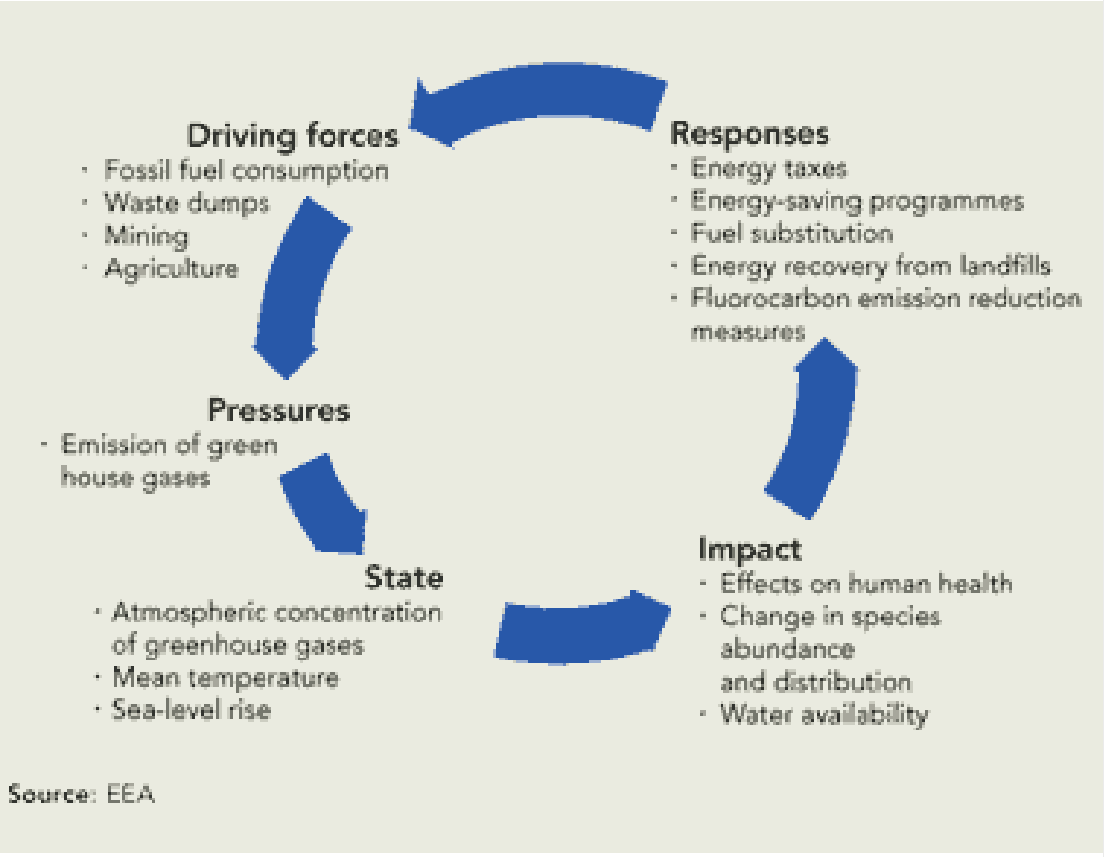
Why measure vulnerability?

1. Identify magnitude of threats, such as climate change;
2. Guide decision-making for adaptation to climate change;
3. Prioritize aid for climate change adaptation;
4. Identify measures to reduce vulnerability.

Can vulnerability be measured?

- Vulnerability is a characteristic or condition; not readily measured or observable, thus we need indicators and indices;
- Vulnerability is relative, not absolute;
- Everyone and every place is vulnerable, but some are more vulnerable than others;
- Defining levels of vulnerability that prompt actions or interventions is a scientific , social and political process.

DPSIR framework for climate change



Standard criteria for indicator development

- Measurable
- Relevant, represent an issue that is important to the relevant topic
- Policy-relevant
- Analytically and statistically sound
- Understandable
- Easy to interpret
- Sensitivity, be sensitive and specific to the underlying phenomenon
- Validity/accuracy
- Reproducible
- Based on available data
- Data comparability
- Appropriate scope
- Cost effective

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Source:
EEA 2004; Birkmann 2004

Methods of Measuring physical vulnerability

Group	Method	Description
Empirical methods	**Analysis of observed damage**	Based on the collection and analysis of statistics of damage that occurred in recent and historic events. Relating vulnerability to different hazard intensities.
	Expert opinion	Based on asking groups of expert on vulnerability to give their opinion e.g. on the percentage damage they expect for a particular sector having different intensities of hazard/impact.
	Score Assignment	Method using a questionnaire with different parameters to assess the potential damages in relation to different hazard levels.
Models	**Climate/impact/adaptation Models**	Projection of potential future climale and potential future physical, ecological, social and economic impacts.

Vulnerability Assessment

Vulnerability assessments synthesize and integrate scientific information, quantitative analyses, and expert-derived information in order to determine the degree to which specific resources, ecosystems, or other features of interest are susceptible to the effects of climate change

Before beginning a vulnerability assessment, evaluate what information already exists and identify knowledge gaps that may need to be

What is the **scope** of the assessment?

What is the **geographic scale** of the assessment?

Who will **be involved** with the assessment?

What type of **modeling** will be used in this assessment ?

Not all vulnerability assessments are equal. The assessment should address specific resources of concern, be applied at an appropriate scale, and consider budgets, timelines, and intended applications

A climate vulnerability assesment:

- **Trend of various climate variables** based on one or ideally on a range of different climate scenarios;
- **Expected (direct and indirect) impacts (threats, opportunities)** by identifying the **most relevant hazards** as well as **the areas of the country, region or city** that are at **most risk** given an overlay of spatial distribution of total population, vulnerable populations, economic activities and economic value;
- **Timescale,** with differentiated impacts expected in the **short-term (2020s), medium-term (2050s), and long-term (2080s/2100);**
- **An indication on the level of confidence** (e.g. high, medium, low) for such impacts, with a view of facilitating the decision making process given the degree of uncertainty attached to the results;

Assessment of the socio-economic development and other non-climatic factors
Such factors, *e.g. megatrends such as demographic change, use of resources, market trends*, have a significant influence on a vulnerability to climate change

The assessment must be prepared introducing requirements for policy-relevant outcomes and end-user involvement. Policy-science interfaces can be fostered for a continuous dialogue on priority issues.

The traditional approach: IPCC seven step guidelines to assessment

1. **Definition of the problem**, requiring identification of the specific goals of the assessment, the sectors, systems and regions of interest, and the time horizon and data needs of the Study.
2. **Selection of the method**s, which depends on the availability of resources, models and data, ranging from qualitative and descriptive to quantitative and prognostic.
3. **Testing the method**, which involved model validation, sensitivity testing and uncertainty analysis to ensure the credibility of the tools applied in the assessment.
4. **Development of the scenarios**, requiring first, the projection of conditions expected to exist over the study period in the absence of climate change, and second, the projection of conditions associated with possible future changes in climate.
5. **Assessment of potential impacts**, which involves estimating, for the sectors and regions of interest, the differences in environmental and socioeconomic conditions projected to occur with and without climate change.
6. **Assessment of autonomous adjustments**, which implies the analysis of responses to climate change that generally occur in an automatic or unconscious (spontaneous) manner.
7. **Evaluation of adaptation strategies**, involving the analysis of different means of reducing damage costs through exogenous or planned adaptation, requiring deliberate policy decisions.

Vulnerability/risk assessments in Europe

Risk / vulnerability assessments in Europe (1):

- **Risk or vulnerability assessments are available for 22 countries across Europe.**
  - *Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Lithuania, Malta, the Netherlands, Norway, Portugal, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom.*

- **Diverse methods are reported for the conduct of risk or vulnerability assessments.**
  - **Austria:** *an extensive literature review was conducted prior to the assessment to collect readily available information on observed impacts, exposure, sensitivity, and impacts. Qualitative vulnerability assessments were then carried out on the basis of the collected information.*
  - **Germany***: a multi-method approach was developed, including the use of literature review, climate-impact models from different sources, indicators derived from impact models and expert judgement, quantitative and qualitative socio-economic scenarios and normative decisions made by experts from federal agencies.*
  - **Denmark:** *a dialogue-based approach was developed, involving the private sector and industry. This ensured a forward-looking input and ownership of the climate change adaptation efforts, which, along with other initiatives undertaken, strengthened the vulnerability assessment.*

Risk / vulnerability assessments in Europe (2):

Table 2.5 Overview of methods used in risk or vulnerability assessments (Question 18; 28 responding countries)

Methodological approach used in risk or vulnerability assessments	Example countries
Review of literature/existing databases	AT, BE, BG, CH, CY, CZ, DE, ES, FI, FR, HU, IT, LT, NL, PT, RO, SI, UK
Interviews/surveys	BE, CH, CY, NL, UK
Expert judgement/appraisal	BG, CH, CY, CZ, DE, FI, FR, HU, IE, IT, LI, LT, LV, NL, PT, RO, SE, SI, SK, TR, UK
Stakeholder engagement/consultation/advisory committee	BG, ES, IE, NL, PT, SE, UK
Workshops/seminars	BG, CH, ES, NL, SE, UK
Qualitative assessment	AT, CH, NL, NO, SK
Quantitative assessment	CH
Modelling	BE, BG, CH, CY, CZ, DE, FR, IE (incl. sensitivity analysis), LV, PT, RO, SE, SK, UK (sensitivity analysis)
Scenario analysis	BG, CH, DE, ES, FR, NL, PT, SE, SK, UK
Indicators/indexes	CH, DE, SE, SK
Monetisation exercise (market prices, non-market values, informed judgement)	CH, UK
Mapping exercise	UK
Multi-criteria scoring system	UK
Application/further development of existing frameworks	UK

UK example:

Risk assessments in support of adaptation action

- The Climate Change Act 2008 presents a framework for a long-term response to climate change in UK and formulates climate change mitigation and adaptation laws in the country. It requires:
  - the production of a UK–wide Climate Change Risk Assessment (CCRA) every five years,
  - the development of national adaptation programmes based on the results of the former.

- first British CCRA Evidence (2012): a detailed analysis of potential impacts, risks and opportunities that might emerge in UK as a result of climate change both in and across a set of 11 sectors. Also, it provides an estimation of monetary values for certain risks when available data allowed.

- The overall approach is based on the UK Climate Impacts Programme Risk and Uncertainty Framework.

- A wide range of quantitative, semi-quantitative and qualitative methods (e.g. literature reviews, workshops, interviews, expert opinion, analysis of historical data, modelling, mapping exercises, application and further development of frameworks, multi-criteria scoring and metrics) were used at different stages of the assessment.

- This approach allowed for optimum use of the existing knowledge and human resources. At the same time, it supported identification of the areas that require more attention (Defra, 2012b), and the type of new knowledge that needs to be generated.

- Evidence from the first CCRA was used as the base for the development of the British National Adaptation Programme (2013–2018).

From

1) ADAPTATION SUPPORT TOOL (Climate-ADAPT)

2) EU Guidelines on developing adaptation strategies

Step 2. Assessing risks and vulnerabilities to climate change (1)

- **Step 2.a. Analyse how past weather events have affected your country**
  - Considering past weather events will help to gain a better understanding of how a country might be affected by climate change impacts in the longer term.
  - It can help to determine a country's sensitivity to current weather and thus, provide significant insight for adaptation needs.
  - Relevant existing work, such as national risk assessments14, which many Member States have already carried out, can provide an excellent starting point for answering these questions.
  - Information can be obtained from national Met Offices.
  - Additional workshops with affected stakeholders might help get to insight from practitioners.
- **Step 2.b. Undertake a climate change risks and vulnerability assessment**
  - As a first step, available information for your country's future threats (e.g. sectoral vulnerability assessments) and opportunities should be collected and analysed.
  - If the available information base is not sufficient for elaborating adaptation responses, additional assessments might need to be carried out. Various approaches for risk assessments are available, e.g. from the UK17 and Germany.

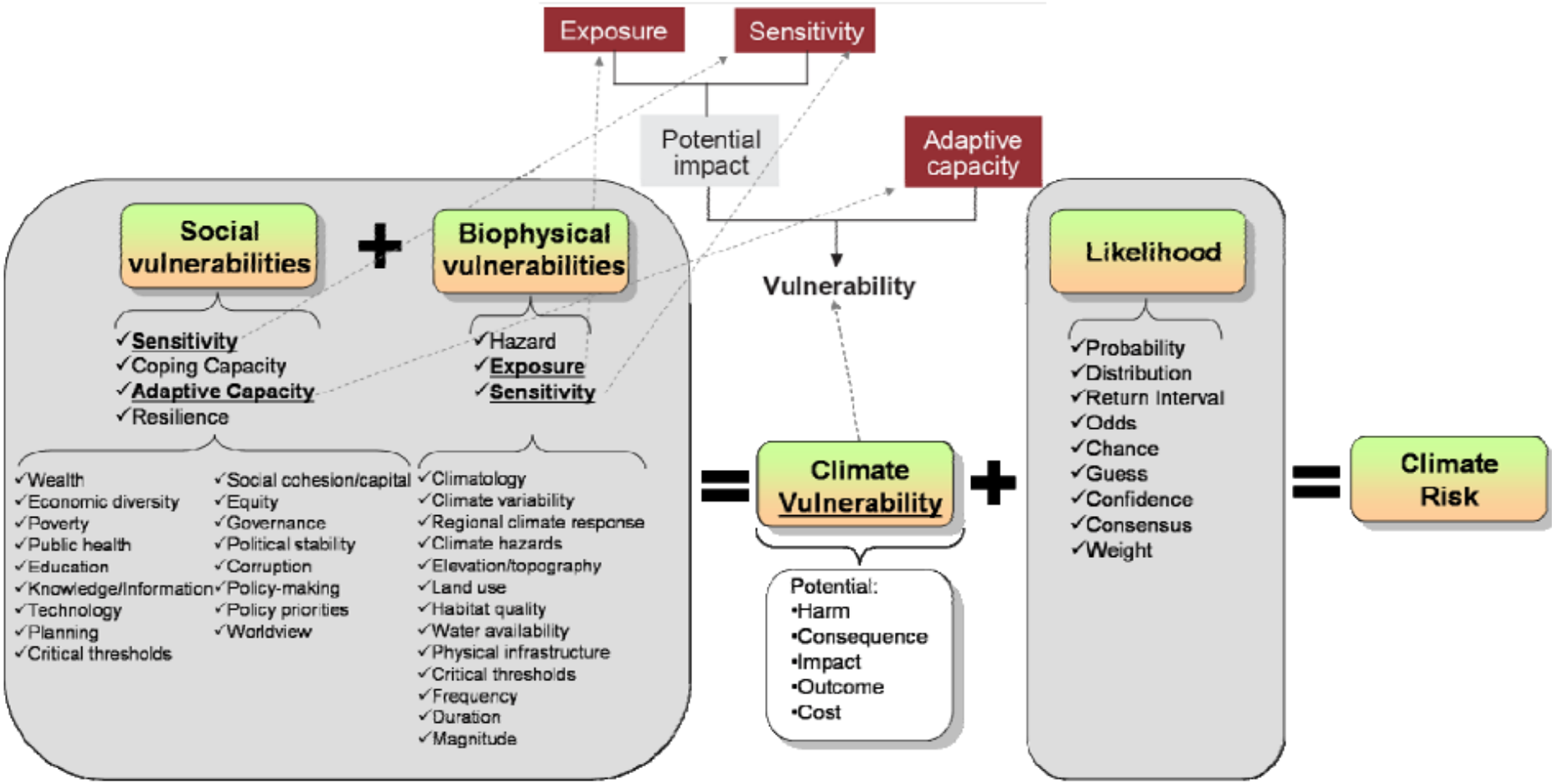
Step 2. Assessing risks and vulnerabilities to climate change (2)

- **Step 2.c. Take trans-boundary issues into account**

- **Step 2.d. Develop an approach for addressing knowledge gaps and for dealing with uncertainties**
  - The quality of the information and the existing knowledge gaps need to be made explicit. Research, social learning, exchange of good practice and stakeholder cooperation can help reduce the lack of knowledge (e.g. regarding plausible climate change impacts).
  - When future society and environment might undergo rapid and unexpected change, the future does not appear to be predictable through simple extrapolation of historical trends.
  - It is important that the development of an adaptation policy does not assume a single future. It is crucial to identify, prepare for, and practice actions under several future scenarios

CLIMATE-ADAPT:
http://climate-adapt.eea.europa.eu/web/guest/uncertainty-guidance-ai

Combining concepts of climate vulnerability with those of climate risk.



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