Conducting Vulnerability Assessment

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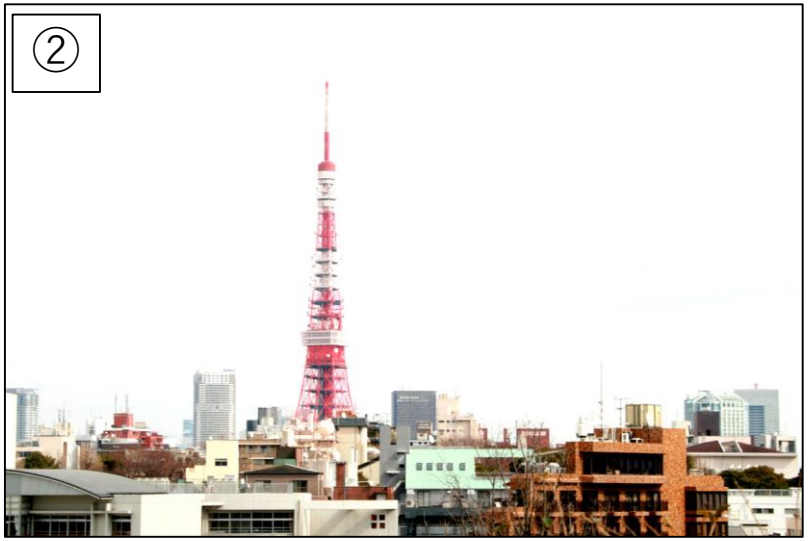
Morning Quiz ① : Which is the highest tower in Japan?

①

②



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④

Morning Quiz ① : Which is the most highest tower in Japan?

Morning Quiz ① : Which is the most highest tower in Japan?

Morning Quiz ② : What is this sport and who is he?

Morning Quiz ② : What is this sport and who is he?

Please think.

Morning Quiz ② : What is this sport and who is he?

Contents

1. What is “Vulnerability”?

2. How to conduct Vulnerability Assessment

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Contents

What is “Vulnerability”?

- The Definition of “Vulnerability”

“Vulnerability to climate change describes the degree to which a system – an ecosystem, an economic system or a social system – is endangered by climate changes” (German Environment Agency,2017).

German Environment Agency (2017), Guidelines for Climate Impact and Vulnerability Assessments : https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/guidelines_for_climate_impact_and_vulnerability_assessments.pdf

1 . What is “Vulnerability”? : Video

- Animation :
  What is vulnerability and
  how do we adapt to climate change? (3:42)

  (giz, Deutsche Gesellschaft fur International Zusammenarbeit(GIZ) GmbH)

  https://www.youtube.com/watch?v=gRnvx75D0W8

The definition of Vulnerability

- There are several definition of Vulnerability.

NO	Word	Definition
1	Vulnerability	"Vulnerability should be recognized as a key indicator of the seriousness of environmental problems such as global warning." (Adger et al., 2001)
2	Vulnerability	"[...] 'vulnerability' to the natural phenomenon must be present for an event to constitute a natural disaster. Vulnerability is defined as a condition resulting from physical, social, economic, and environmental factors or processes, which increases the susceptibility of a community to the impact of a hazard." (ADRC, 2005)
3	Vulnerability	"If risk is one side of the coin, its other side is vulnerability, which we may loosely define as potential for losses or other adverse impacts. People, buildings, ecosystems or human activities threatened with disaster are vulnerable. [...] Essentially, vulnerability refers to the potential for casualty, destruction, damage, disruption or other form of loss with respect to a particular element. Risk combines this with the probable size of impact to be expected from a known magnitude of hazard. [...] Many authors [...] have confused vulnerability with exposure: in reality they are two complementary components of risk." (Alexander, 2000)
4	Vulnerability	"The insecurity of the well-being of individuals, households or communities in the face of a changing environment." (Adger, W. Neil and Kelly, P. Mimura, N. Ahmad, Q. K. and Burton, I., 2001)
5	Vulnerability	"Summarizing livelihood and environmental literature: vulnerability is the exposure of individuals or groups to livelihood stress as a result of environmental change."(Alwang et al., 2001)
6	Vulnerability	"The characteristics of a person or a group in terms of their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard. It involves a combination of factors that determine the degree to which someone's life and livelihood is put at risk by a discrete or identifiable event in nature or society. [...] Vulnerability concept consists of two opposing forces: On one hand, the processes that cause vulnerability that can be observed; on the other hand, the physical exposure to hazards (earthquakes, storms, floods, etc.). Vulnerability develops then from underlying reasons in the economic, demographic and political spheres into insecure conditions (fragile physical environment, instable local economy, vulnerable groups, lack of state or private precautions) through the so-called dynamic processes (e.g., lack of local institutions, under-developed markets, population growth, and urbanization)." (Blaikie et al., 1994)
7	Vulnerability	"Vulnerability concerns the complex social, economic, and political considerations in which peoples' everyday lives are embedded and that structure the choices and options they have in the face of environmental hazards. The most vulnerable are typically those with the fewest choices, those whose lives are constrained, for example, by discrimination, political powerlessness, physical disability, lack of education and employment, illness, the absence of legal rights, and other historically grounded practices of domination and marginalization."(Bolin and Stanford, 1998)

Terms of Vulnerability is not easily defined in an exhaustive way (United Nations University, 2006).

What definition should we use here?

United Nations University (2006), Components of Risk –A Comparative Glossary- : http://collections.unu.edu/eserv/UNU:1869/pdf4042.pdf

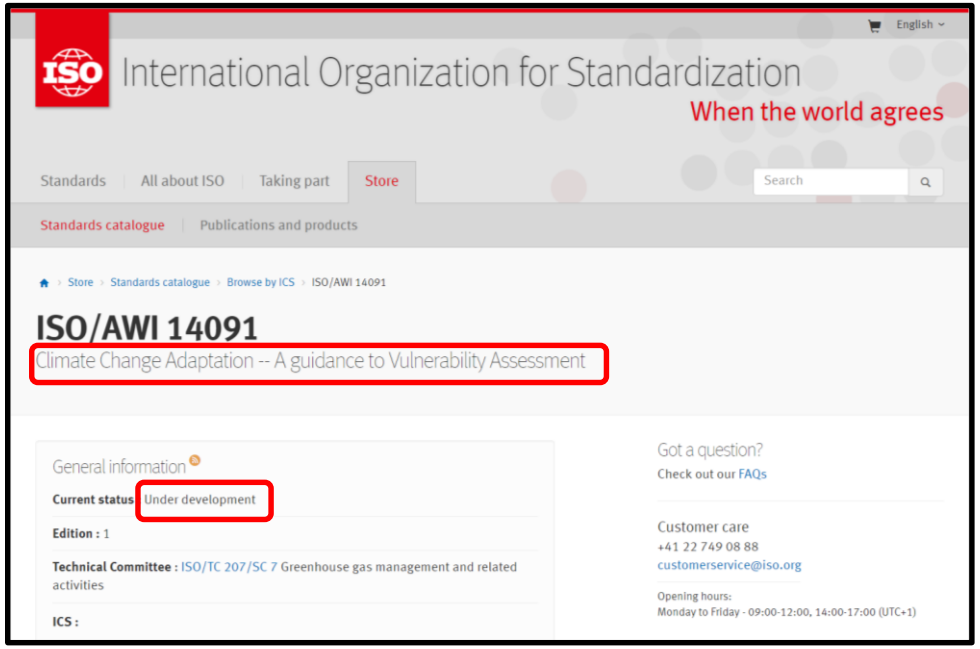
ISO of Vulnerability Assessment

- ISO of Vulnerability Assessment is now being developed.

There is now no unified "Vulnerability Assessment" as the situation of the definition of Vulnerability.

However, ISO standard of Vulnerability Assessment "A guidance to Vulnerability Assessment" is now being developed. This project is being lead by Germany.

This guidance may be a standard for "Vulnerability Assessment" in the future.



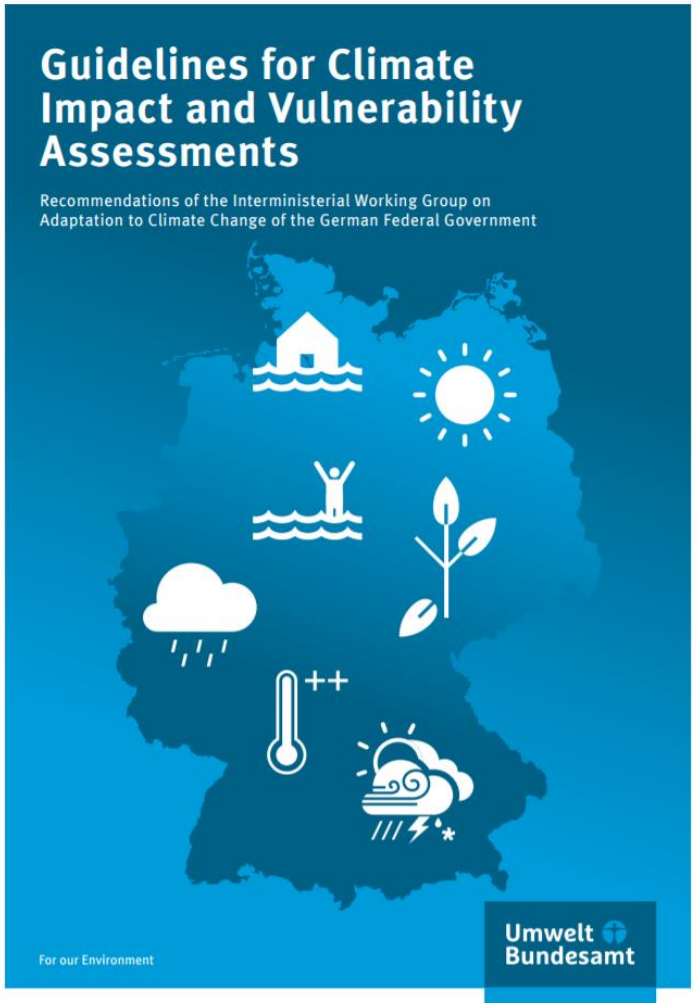
https://www.iso.org/standard/68508.html

German Guideline

- Guidelines for Climate Impact and Vulnerability Assessments

The ISO standard mentioned above is based on a guideline “Guidelines for Climate Impact and Vulnerability Assessments”.

So, today I ‘d like to explain “Vulnerability Assessment” with the scheme of this guidance.



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What is “Vulnerability”?

- We will use the definition of “Vulnerability” as below.

“Vulnerability to climate change describes the degree to which a system – an ecosystem, an economic system or a social system – is endangered by climate changes” (German Environment Agency,2017).

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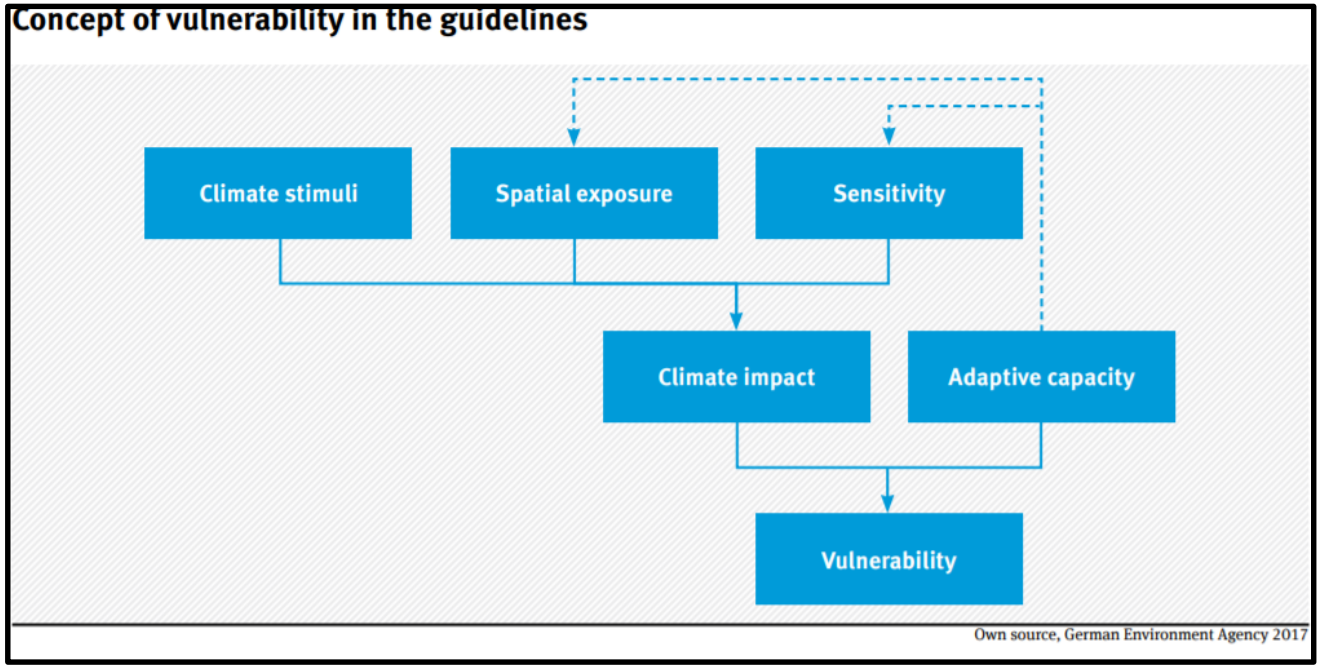
The Concept of “Vulnerability”

The Concept of the German guidance

Vulnerability is composed of elements.
The elements are Climate Impact and Adaptive Capacity.

Climate Impact is also composed of Climate Stimuli, Spatial Exposure, and Sensitivity.



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The Element of Vulnerability

- The Element of Vulnerability in the German guidance

Climate Impact: Climate impact describes the observed or potential impact of the climate stimuli on the system taking into account the corresponding sensitivity and spatial exposure.

Adaptive Capacity: Adaptive capacity comprises the possibilities for a system to adapt to climate change in the future through additional measures and to reduce potential losses or exploit opportunities.

German Environment Agency (2017), Guidelines for Climate Impact and Vulnerability Assessments : https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/guidelines_for_climate_impact_and_vulnerability_assessments.pdf

The Element of Vulnerability

- The Element of Vulnerability in the German guidance

Climate Stimuli: Climate Stimuli are described by climate parameters that are relevant for a climate impact such as temperature, precipitation, wind, etc.

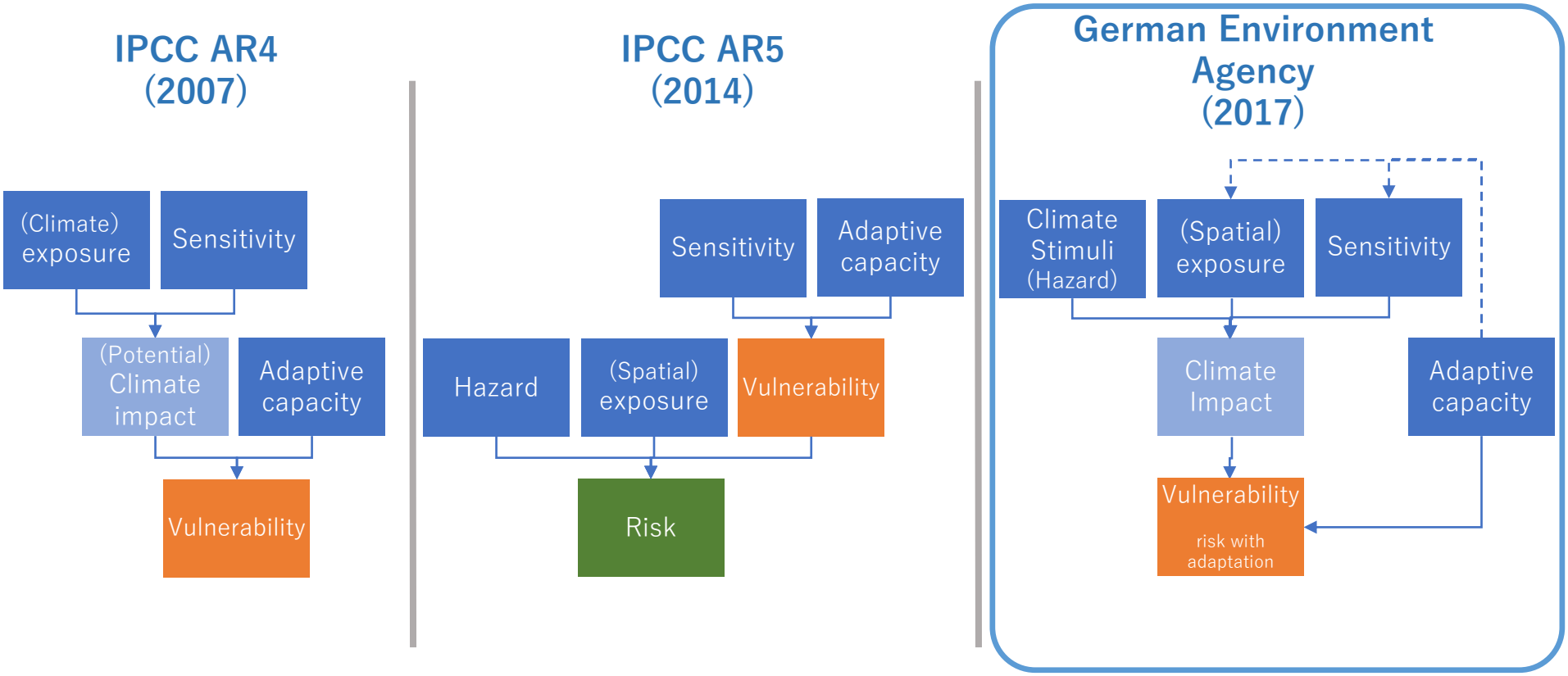
Spatial Exposure: Spatial exposure describes the presence of a system potentially affected by climate stimuli in an investigation area (e. g. types of land use).

Sensitivity: Sensitivity (susceptibility or fragility) describes the extent to which a system (e. g. economic sector, population group, ecosystem) reacts to climate stimuli given the properties of the system.

German Environment Agency (2017), Guidelines for Climate Impact and Vulnerability Assessments : https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/guidelines_for_climate_impact_and_vulnerability_assessments.pdf

Comparison of the Concept of Vulnerability

- AR4, AR5, German guidance



We can see the difference of definition of Vulnerability and also can see the similarity of the final output.

German Environment Agency (2017), Guidelines for Climate Impact and Vulnerability Assessments : https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/guidelines_for_climate_impact_and_vulnerability_assessments.pdf

Contents

Working step 1 Plan and prepare the assessment

Plan and Prepare the assessment

The type of assessment to be carried out and the steps required must be defined depending on the issue to be investigated. The following should be considered as early as the planning of an assessment:

- what is the purpose of the assessment,
- what knowledge and which results are needed for this purpose,
- what data and results are already available,
- who is legitimized to make normative evaluations,
- which political stakeholders can promote the acceptance and use of the results,
- which experts from responsible institutions should represent the decision-making level
- who are the target audience of the results.

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Working step 1 Plan and prepare the assessment

- Plan and Prepare the assessment

  - Involving experts from responsible institutions
  - Specifying the methodological framework and key terms
  - Specifying scenarios for climate stimuli, spatial exposure and sensitivity

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Involving experts from responsible institutions

- Experts from several institutions are essential.

Experts from responsible institutions are needed and they are usually representatives of authorities or ministries. They act as the decision-making level for normative decisions and provide technical support to the working level.

If possible, experts from responsible institutions should be involved at the working level and most importantly at decision-making level of vulnerability and climate impact assessments because value decisions must be made and participation implies that decision makers identify better with the assessment and derive actions.

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Involving experts from responsible institutions

KEY RECOMMENDATIONS

1. Climate impacts and vulnerabilities should be assessed and evaluated together with a group of representatives from authorities or ministries. Their expertise should cover the scope of the investigation and, if possible, they should be authorized for normative decisions, for example by being delegated from their responsible ministries. For majority decisions, a transparent mode should be devised in advance to account for the distribution of the participants among the action fields investigated.

2. All normative processes should be decided by the decision makers and must be documented transparently.

3. Good cooperation and division of labor between the working level and the decision-making level is essential. The working level should prepare the basis for decision making and prepare and carry out the assessment. The decision-making level has the responsibility to decide on the basic approach and take normative decisions. In addition, additional experts should be involved as required.

4. Collaboration requires sufficient resources from all involved stakeholders.

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Specifying the methodological framework and key terms

Specifying the framework and terms

The concept of vulnerability and the key terms

The concept of vulnerability and the key terms must be specified at the beginning of a vulnerability assessment. This will ensure that they are applicable to the issues in the assessment and the participants share a common understanding.

Specification of investigation periods

Since individual climate parameters show great variability on a decadic scale, climate projections should in principle be assessed for a longer period (cf. Linke et al. 2015). Periods considered for possible climate changes should, as a rule, be at least 30 years.

Specifying the area of investigation and spatial resolution

The area investigated depends on the purpose and objective of the investigation. Spatial resolution of the assessment also depends on this, but it is also influenced by available data, in particular climate and socio-economic scenarios (see Section 3.1.3). Grids, natural areas or administrative units usually serve as spatial resolution.

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Specifying the methodological framework and key terms

KEY RECOMMENDATIONS

1. The purpose of climate impact or vulnerability assessment must be taken into account when designing and selecting the methods because the desired result and possible evaluation schemes depend on it.

2. There are several concepts of vulnerability. When starting a climate impact or vulnerability assessment, it must be decided which concept to follow. It is recommended to use the further developed concept of vulnerability for the time being.

3. At the beginning of the assessment the key terms climate stimuli, sensitivity, spatial exposure, climate impact, adaptive capacity and vulnerability must be defined as unambiguously as possible to be able to apply them for empiric research.

4. The area of investigation, spatial resolution and the periods of investigation should be specified with a view to the aim of assessment. An outlook for the near future (i.e. 2021–2050 or 2031–2060) is appropriate for policy recommendations. The distant future (2071–2100) should also be included for long-term developments and planning. Optionally, present (1981–2010) can be considered.

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Specifying scenarios for climate stimuli, spatial exposure and sensitivity

Determination of climate stimuli, spatial exposure and sensitivity

Determination of climate stimuli, spatial exposure and sensitivity requires climate and possibly biophysical and socio-economic data for the periods of investigation.

Comparing the reference period to present or future can then show potential changes. Measured data from past and present are often available. However, the description of future climate stimuli, spatial exposure and sensitivities should be based on scenarios or projections, provided that they are available or can be determined.

Priority should be given to those climate, spatial or sensitivity parameters that are relevant to the observed or projected climate impacts.

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Specifying scenarios for climate stimuli, spatial exposure and sensitivity

- Determination of climate stimuli, spatial exposure and sensitivity

Climate Projections

Future climate is usually investigated by a model chain comprising first an emission or concentration scenario, second a global climate model and third at least one regional climate model. Currently, the generally acknowledged state of the art is to work with what is referred to as an ensemble of climate projections. They are based on different combinations of global and regional climate models and help describe the range of uncertainties in the anticipated climate changes.

Before a decision is taken, it should be checked what conditions the climate projections must satisfy to meet the requirements of the selected climate parameters and climate impact models.

Time series e. g. for hydrological modelling that include consistent parameters such as daily temperature and precipitation values are necessary. However, they are not easy to provide because of bias minimization often needed for climate projections and the ensemble approach. In any case, the model ensemble should cover the entire area of investigation and consist of a sufficient number of model runs in order to assess climate variability and be based on a previously specified emission or concentration scenario.

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Specifying scenarios for climate stimuli, spatial exposure and sensitivity

- Determination of climate stimuli, spatial exposure and sensitivity

Sensitivity scenarios and scenarios for spatial exposure

Sensitivity and spatial exposure also should, where possible, be based on scenarios that are consistent with climate projections in terms of time. Some of the socio-economic or biophysical parameters such as population or tree species composition can be quantitatively projected for near future (up to 2030). Since spatial exposure is closely linked to the development of (socio-economic) sensitivity, joint sensitivity and spatial scenarios should be developed. Existing uncertainties can be taken into account by using at least two sensitivity and spatial scenarios.

Scenario combinations

Climate projections and scenarios for sensitivity and spatial exposure must be combined for the assessment of climate impacts. Scenario combinations should be used to show the range of possible developments of climate impacts. These should cover the spectrum of the combination of change. It is worth considering cross-combining socio-economic and climate scenarios (strong weak and vice versa), in order, for example, to identify whether climate impacts are driven more by climate or socio-economic change.

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Working step 2 Step-by-step execution

- Step-by-step execution

  - Developing impact chains
  - Operationalizing selected sectoral climate impacts
  - Evaluating and aggregating climate impacts
  - Evaluating adaptive capacity
  - Evaluating vulnerability

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Developing Impact Chains

Impact Chains

In order to assess the cause-effect interlinkage between climate stimuli and possible climate impacts, it is recommended to create so-called impact chains for each action field. Impact chains help understand, systematize and prioritize which factors influence the impacts of climate extremes and climate change on a system. Both direct climate impacts on biophysical and socio-economic (sectoral) systems and indirect climate impacts can be considered.

For example, direct biophysical impacts include the development of floods as a result of heavy precipitation in certain catchment areas. Socio-economic impacts include for instance heat stress on human health. Indirect climate impacts include the impacts of changes in flood frequencies on sensitive systems such as humans or material goods.

The impact chains clarify which climate parameters influence and therefore provide the basic framework for the vulnerability assessment. In addition, they serve as an important communication tool that helps stakeholders involved agree on what needs to be assessed and which climate and socio-economic or biophysical parameters play a role. This makes it easier to derive targeted adaptation measures following the vulnerability assessment.

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Developing Impact Chains

- Impact Chains

Selecting climate impacts

It is recommended to first develop simple impact chains for all climate impacts at the working level, together with the involved experts from responsible institutions. These should be based on existing (literature) knowledge. This should be done regardless whether these impacts can be represented with models, indicators or expert knowledge.

If more possible climate change impacts were identified by impact chain than can be investigated within the framework of the assessment, the decision-making level needs to subsequently select the climate impacts that appear particularly relevant for the respective assessment and its purpose.

The advantage of this approach is that technical and regional or local conditions can be taken into consideration, which ultimately increases the acceptance of the assessment results. The more concrete the purpose has been defined, the more clearly the selection criteria can be identified.

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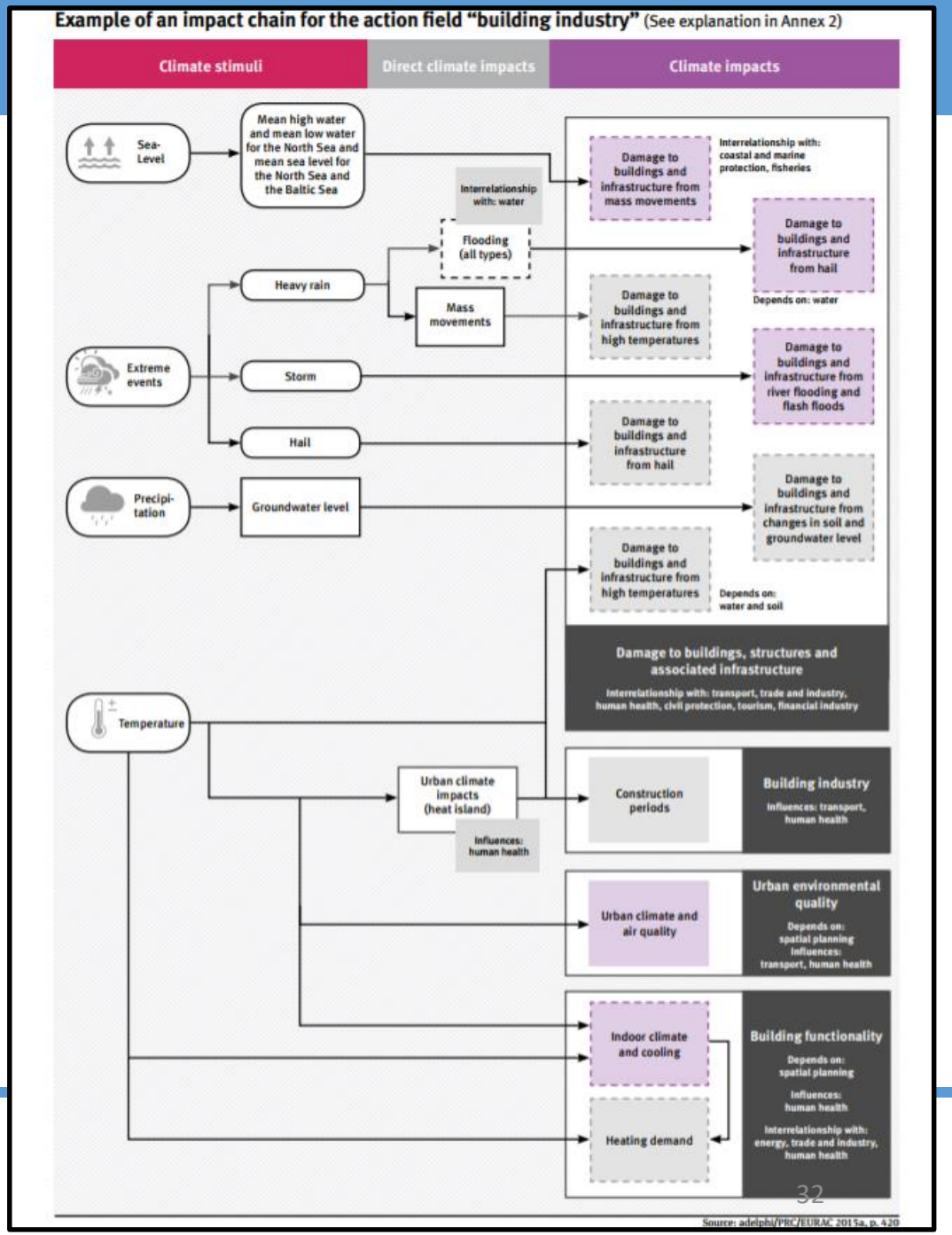
Developing Impact Chains

- Example of an impact chain for the action field "building industry" in Germany
  - ➢ Climate Stimuli
  - ➢ Direct climate impacts
  - ➢ Climate impacts



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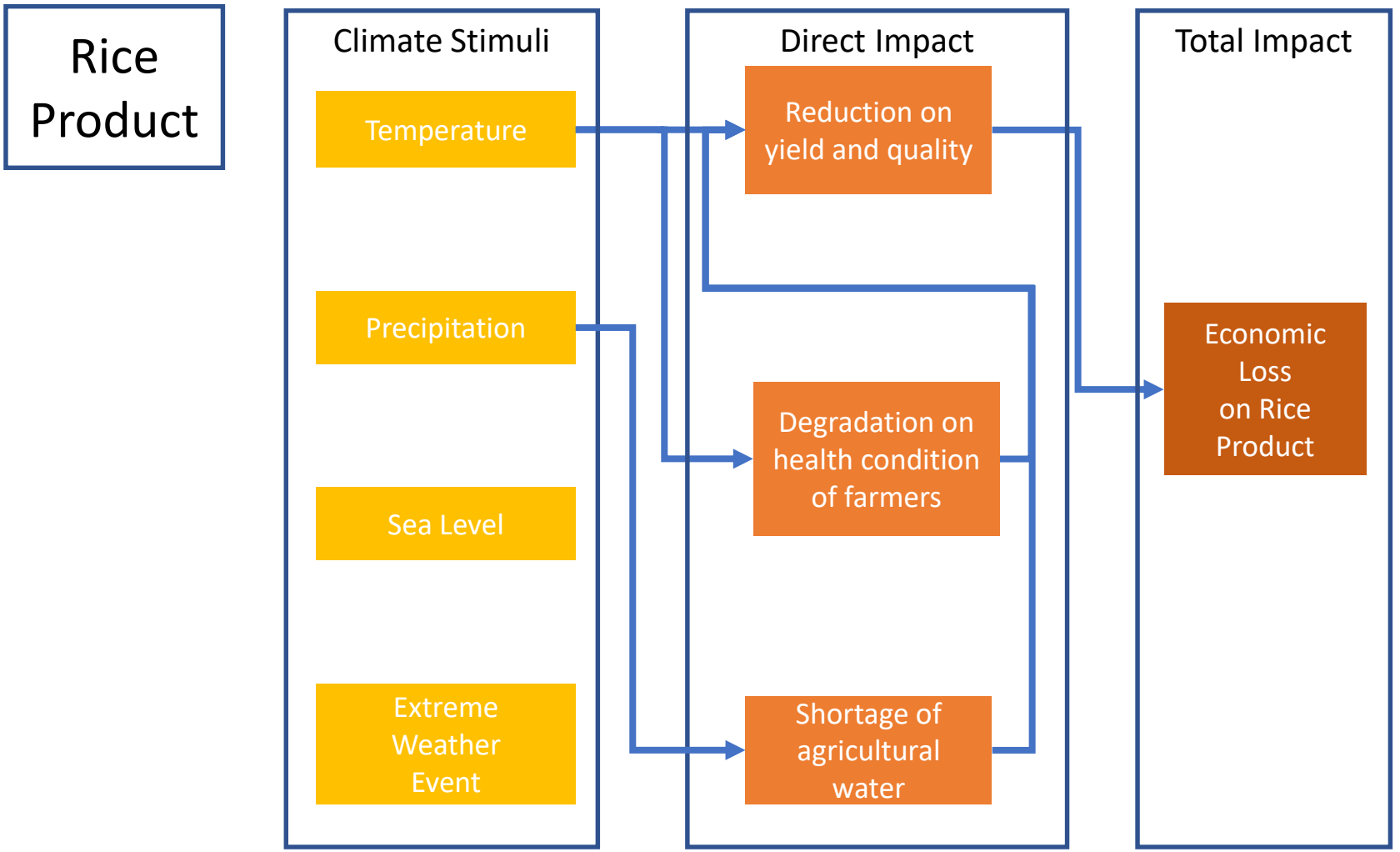
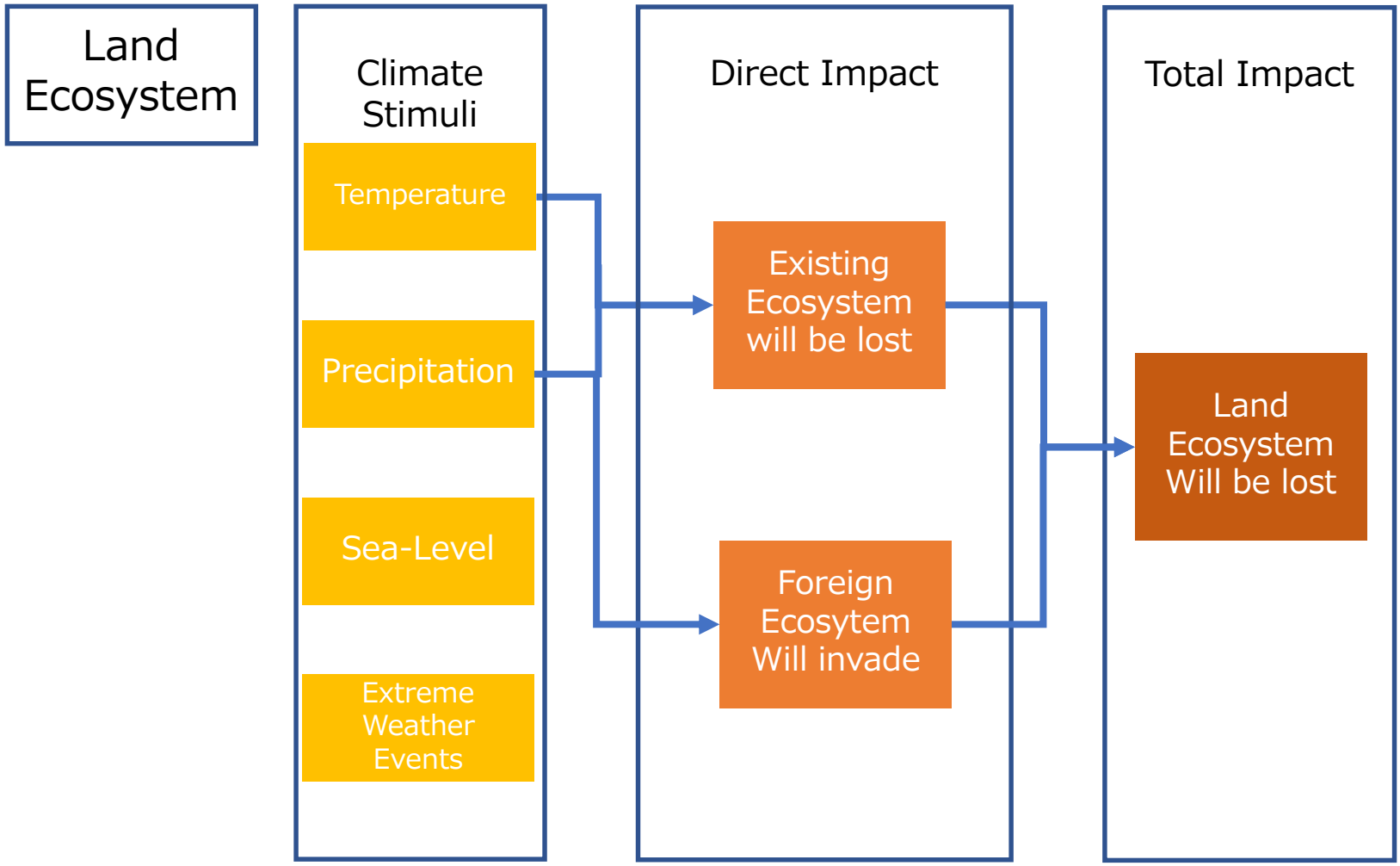
The our method of Assessment

- Example of an impact chain for Rice Product in Japan



Impact Chain in Biodiversity

- Example of an impact chain for Land Ecosystem in Japan



Operationalizing selected sectoral climate impacts

Operationalization paths for climate impacts

In order to operationalize the selected climate impacts relevant indicators should be discussed in expert workshops. In cooperation with the participating experts from responsible institutions, possibilities for operationalizing individual climate impacts should be identified and selected to create the basis for further evaluation steps.

This is particularly recommended when experts from responsible institutions have a specific technical or spatial relation to the selected climate impacts and/or when they hold adequate data that is necessary for the operationalization. However, the procedure of collecting indicators should be similar for the entire model area.

Furthermore, it is recommended to use clearly defined indicators for climate impacts. These can be quantitative (such as potential flooding areas as an indicator for the climate impact flooding), but also semi-quantitative or qualitative (for example, an estimation of energy availability).

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Operationalizing selected sectoral climate impacts

Operationalization paths for climate impacts

There are three basic methodological approaches (operationalization methods) for the assessment of future climate impacts:

1. Impact models

If impact models are available that represent the complex and often nonlinear interlinkages between climate parameters and sensitivity parameters the results of these models should be applied. When using models it is important to check the underlying assumptions and to verify whether they are consistent with the basic assumptions of the assessment regarding the time-related and spatial structures as well as the climate and socio-economic scenarios used.

2. Use of proxy indicators

If there are no suitable impact models, climate impacts should be parameterized using plausible data. This should be based on proxy indicators specified by experts for the core elements climate stimuli, spatial exposure and sensitivity.

The selection of the proxy indicators depends among others on the spatial resolution. For example “effect on the sewer system and wastewater treatment plants” combined the proxy indicators heavy rain and degree of soil sealing.

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Operationalizing selected sectoral climate impacts

Operationalization paths for climate impacts

There are three basic methodological approaches (operationalization methods) for the assessment of future climate impacts:

3. Expert knowledge

If causal relations cannot be fully or only partially quantified through the two approaches mentioned above, the strength of climate impacts can be evaluated using expert surveys.

These three recommendations on operationalization should help create a comprehensive, preferably quantitative conclusion on climate impacts and enable the comparison of different indicators. If the assessment pursues a different goal and aims for instance to identify single “hot spots” or detailed causal interlinkages, an alternative approach can be used: In these cases it is appropriate to first conduct expert surveys on all climate impacts but to quantify only those where more precise conclusions are needed. In particular at the local level, the procedure, which is predominantly based on expert surveys, can be more effective.

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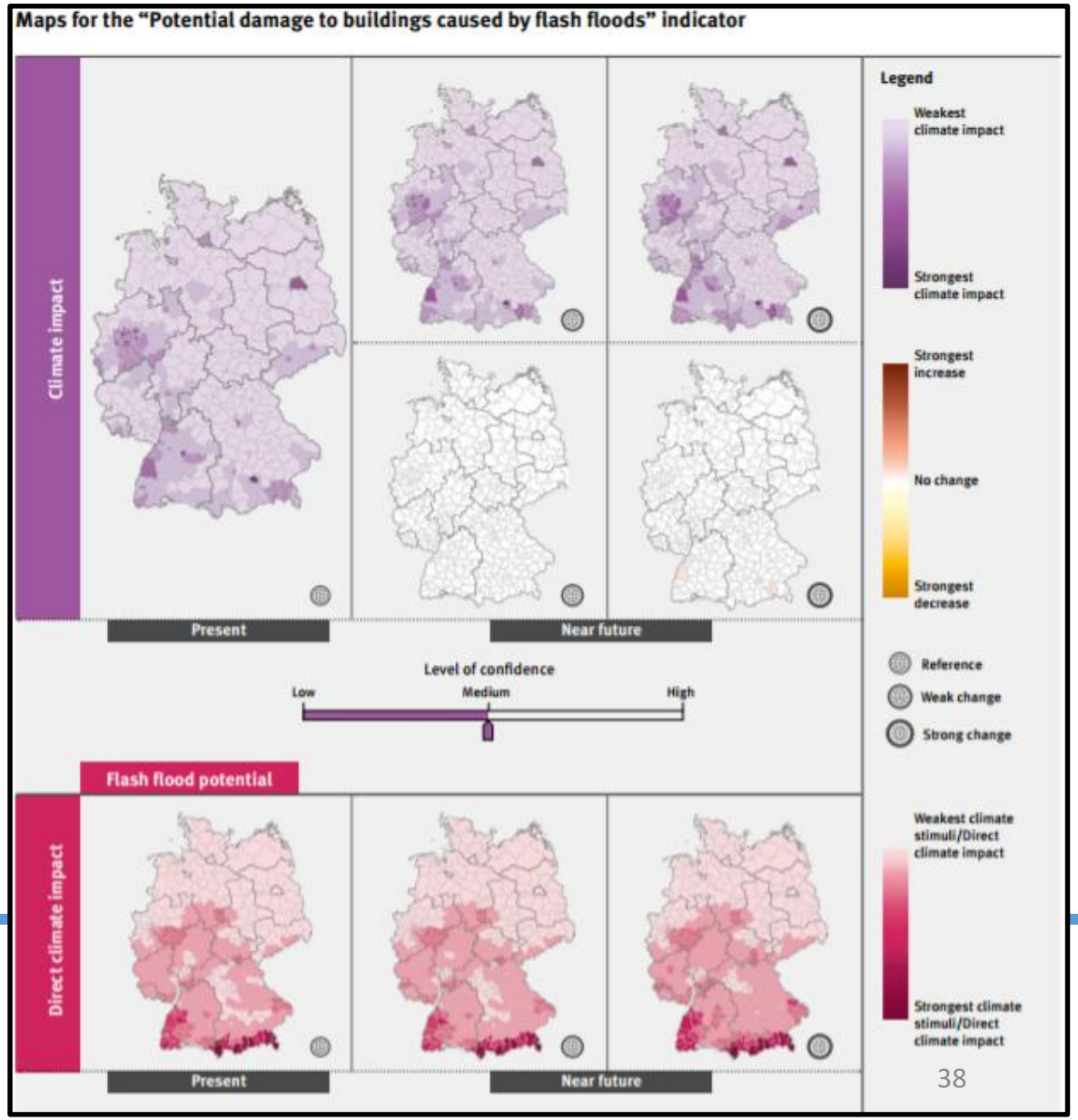
Operationalizing selected sectoral climate impacts

- Example of Climate Impacts :
Maps for the “Potential damage to buildings cause flash floods” indicators in German



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Operationalizing selected sectoral climate impacts

Verifying data availability

Data is the central issue of many quantitative assessments. Their availability or non-availability can be a limiting factor. Therefore, the following points should be considered:

- Nation- or state-wide data are necessary if the aim is to obtain comparable results for different climate impacts for the whole investigation area.
- For spatially specific results, data should be available at a uniform reference level (for example, districts) or able to be aggregated accordingly. Grid data (for example, climate data) can be applied to administrative spatial units. Vice versa, data for spatial units can also be converted into grid data.
- The data should be available at least for the reference period and the near future and ideally for the present and the distant future, should these be considered.
- If data gaps are identified at an early stage, it can be decided whether climate impacts can be quantified or should be estimated using qualitative surveys.
- The effort of the investigation work for the measurement of climate impacts depends more on the choice of indicators than on the chosen operationalization method.

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Operationalizing selected sectoral climate impacts

Estimating the level of confidence

Both calculated results and those obtained from expert surveys are subject to uncertainties. It is recommended to estimate the confidence of the results of the climate impacts in order to facilitate the interpretation of the results. This should be done separately for the calculated climate impacts (operationalized via models or proxy indicators) and climate impacts operationalized via surveys.

It is recommended to evaluate the level of confidence for each indicator and each climate impact at least on a scale ranging from “low” to “medium” to “high”, or better still on a five-stage scale. A verbal conclusion should be drawn for climate impacts which have been investigated using several indicators.

Since the confidence assessment is in part subjective, it should be performed by the experts involved and experts from responsible institutions according to their technical competence.

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Evaluating and aggregating climate impacts

Evaluation approaches

It is important to clearly distinguish between the evaluation of the results and the technical analysis. The strength of a potential climate impact cannot be equated with its significance. While even small changes can be of great significance in some systems – for example certain ecosystems – other climate impacts that may be stronger can be more easily compensated.

The criteria and the scheme of the evaluation depend on the assessment's objective. If the aim is to prioritize the allocation of resources (including support for research) for climate change adaptation over the long-term, across large areas and taking into account the interlinkages among climate impacts, climate impacts or action fields should be considered in an integrated way.

Such an integrated evaluation can take place in various approaches:

1. Quantitatively using climate-specific benchmarks (threshold values),

2. Quantitatively using common reference quantities, for example through normalization or monetarization,

3. Qualitatively by experts based on comprehensive evaluation criteria, developed in agreement with the decision-making level.

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Evaluating and aggregating climate impacts

- Evaluation approaches

Determining evaluation criteria that are climate-impact specific and comprehensive usually represents a challenge. In order to merge single evaluations, one also needs a measure for the weighting of these evaluations.

Specific thresholds for determining when a climate impact becomes critical are difficult to establish, and many climate impacts cannot be quantified anyway. Therefore, a qualitative comprehensive evaluation often is the only way to draw comparative conclusions.

Even if climate impacts can be calculated using models or proxy indicators, uniform quantitative evaluation criteria such as monetarization are difficult to apply to all climate impacts. A whole series of normative assumptions are for instance needed in order to monetarize climate impacts on natural areas and ecosystems, for example spread of invasive species.

German Environment Agency (2017) : https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/guidelines_for_climate_impact_and_vulnerability_assessments.pdf

Evaluating and aggregating climate impacts

Aggregation

Aggregating the results of individual climate impacts is a useful way to draw cross-sectoral and summary conclusions. However, such an aggregation is only possible if the units of the data sets are compatible or if the data are dimensionless, which can be achieved e. g. by normalization. In order to be able to aggregate or blend the data in a spatially differentiated way, they must as a rule have a similar resolution and be available for the entire area.

German Environment Agency (2017) : https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/guidelines_for_climate_impact_and_vulnerability_assessments.pdf

Evaluating and aggregating climate impacts

- Example of Evaluation of Climate Impacts for the action field “building industry” in German

Evaluation of climate impacts for the action field “building industry”

Key climate stimuli:		Sea-level	Temperature	Heat	Extreme events
Key sensitivities:	Situation and condition of buildings and infrastructures, population density and proportion of elderly people				
Action-field-specific adaptive capacity:	Medium				

Climate impact	Climate stimuli	Significance			Confidence/ assessment method
Damage to buildings and infrastructure from storm surges	Sea-level rise, storm surges	Present			Low / Expert surveys
		Near future: Weak change	Near future: Strong change		
		Distant future: + to ++			
Damage to buildings and infrastructure from river flooding and flash floods	River flooding, flash floods	Present			Medium to high / Indicators
		Near future: Weak change	Near future: Strong change		
		Distant future: +			
Damage to buildings and infrastructure from strong wind	Strong wind	Present			Low / Indicators
		Near future: Weak change	Near future: Strong change		
		Distant future: ~			
Urban climate and air quality	Heat	Present			High / Indicators
		Near future: Weak change	Near future: Strong change		
		Distant future: ++			
Indoor climate and cooling	Heat	Present			Low to medium / Indicators
		Near future: Weak change	Near future: Strong change		
		Distant future: ++			

Significance of climate impact for Germany:
low medium high not evaluated

For the distant future the analysis only considers the trends of climate stimuli until the end of the century:
++ strong change + change ~ uncertain

Source: adelphi/PRC/EURAC 2015c, p. 37

German Environment Agency (2017) : https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/guidelines_for_climate_impact_and_vulnerability_assessments.pdf

Evaluating adaptive capacity

Adaptive Capacity

In addition to climate impacts, the adaptive capacity must also be evaluated in order to carry out a complete vulnerability assessment. For practical reasons, it is recommended to integrate the adaptive capacity as a status quo, i.e. its current condition, in the vulnerability assessment.

Adaptive capacity thus represents the currently identifiable scope of options for adapting to the expected climate change by means of additional measures. It is therefore not necessary to develop specific scenarios or to consider ways in which adaptive capacity could potentially change in future.

German Environment Agency (2017) : https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/guidelines_for_climate_impact_and_vulnerability_assessments.pdf

Evaluating vulnerability

- Combine the investigated climate impacts with the adaptive capacity to vulnerability

It is only possible and meaningful to quantitatively present the results on vulnerability if clearly defined and measurable parameters exist for both climate impacts and adaptive capacity. This is necessary, for example, to estimate the effect of adaptation measures on the vulnerability of systems, regardless of whether the measures are actually implemented or not.

However, it is difficult to combine the investigated climate impacts with the adaptive capacity to vulnerability in terms of methodology and content – especially if vulnerability is to be determined across action fields. One reason for this is the heterogeneous nature of the information (spatial, non-spatial, quantitative, qualitative). It is therefore recommended to estimate the vulnerability for individual action fields purely qualitatively using verbal descriptions or semi-quantitatively.

Regarding the spatial dimension of the climate impact, the indicators can also help determine, at least by verbal descriptions, how the vulnerabilities of individual regions differ.

German Environment Agency (2017) : https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/guidelines_for_climate_impact_and_vulnerability_assessments.pdf

Evaluating vulnerability

Evaluation of Vulnerability

The following should be considered when interpreting the vulnerability results:

If a system has a high adaptive capacity, it has relatively low vulnerability. However, this does not mean that there is no need for policy action and this circular reasoning should be avoided at all costs.

After all, the ability to adapt does not mean that this ability is also being used nor that necessary measures are being implemented. Thus, even systems with low vulnerability can still require incentives to implement adaptation measures.

In this respect, the results of the separate assessment and evaluation of climate impacts and adaptive capacity are often more important than combining them into a single vulnerability value.

In addition, it should be taken into account that the conclusions on the vulnerability of an action field is usually difficult to interpret since it strongly summarizes evaluations and insights of different quality.

German Environment Agency (2017) : https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/guidelines_for_climate_impact_and_vulnerability_assessments.pdf

Evaluating vulnerability

- Example of Crosstabulation for determining the vulnerability of an action field

Crosstabulation for determining the vulnerability of an action field

Action-field-specific adaptive capacity	Degree of threat: Low	Low to medium	Medium	Medium to high	High
Low	Low	Medium	Medium	Medium to high	High
Low to medium	Low	Low to medium	Medium	Medium to high	Medium to high
Medium	Low	Low to medium	Low to medium	Medium	Medium to high
Medium to high	Low	Low	Low to medium	Medium	Medium
High	Low	Low	Low	Low to medium	Medium

Source: adelphi/PRC/EURAC 2015a, p. 57

German Environment Agency (2017) : https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/guidelines_for_climate_impact_and_vulnerability_assessments.pdf

My image of Impact Assessment and Vulnerability Assessment

Impact Assessment

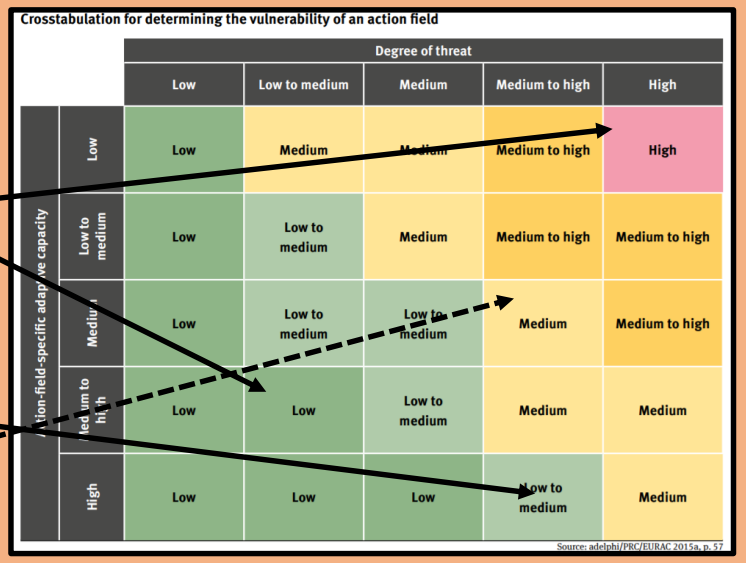
The future impact
in Building industry sector

The future impact
in Agriculture sector

The future impact
in Biodiversity sector

etc

Vulnerability Assessment



Crosstabulation for determining the vulnerability of an action field

Action-field-specific adaptive capacity	Degree of threat: Low	Low to medium	Medium	Medium to high	High
Low	Low	Medium	Medium	Medium to high	High
Low to medium	Low	Low to medium	Medium	Medium to high	Medium to high
Medium	Low	Low to medium	Low to medium	Medium	Medium to high
Medium to high	Low	Low	Low to medium	Medium	Medium
High	Low	Low	Low	Low to medium	Medium

Source: adelphi/PRC/EURAC 2015a, p. 57

In which sector should we conduct adaptation measures?

Working step 3 Communicating and using results

Communicating and using results

Firstly, it is important to clarify from the very beginning who will be the target group of the assessment and its results. The presentation of results should be oriented at this target group.

Sufficient resources for communication measures must be calculated in terms of finances and time, particularly if the results, at least in part, should be communicated to the public. This requires a suitable, generally comprehensible language and representation. In addition – and this must also be calculated in advance – data records could be edited by science journalists in a way that they can be presented online for a broader public.

The technical documentation of the assessment in a final report should include not only the results, but also the methodology including all assumptions and normative decisions.

This makes it easier to interpret the results and to compare them between assessments. Furthermore, uniform evaluation and formulation rules particularly contribute to greater transparency of the results.

German Environment Agency (2017) : https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/guidelines_for_climate_impact_and_vulnerability_assessments.pdf

Working step 3 Communicating and using results

KEY RECOMMENDATION

1. Every climate impact and vulnerability assessment should declare its purpose and target audience because this determines many of the normative decisions made in the assessment and evaluation.

2. It should always be indicated which data, models and scenarios the assessment of climate impacts or vulnerability is based on. It is also particularly important to note the period for which the conclusions are made and the reference year to which the estimates of the changes apply.

3. It is recommended to name all participating experts from responsible institutions, survey partners and other experts.

4. There are various ways to graphically map the results of climate impact and vulnerability assessments. Map-based representations are recommended for spatial assessments. Climate impact maps can be interpreted more easily if the climate, spatial exposure and sensitivity parameters included in the assessment are also mapped. The spatial resolution of the data must be taken into account for map representations.

5. The way in which quality assurance was carried out should be made clear for each assessment, for example, whether and in what form a review process took place.

German Environment Agency (2017) : https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/guidelines_for_climate_impact_and_vulnerability_assessments.pdf

Contents

Japan's Case : Assessment in Japan

【Significance】 Very High / Not "Very High" / —: N/A(currently cannot be assessed)
【Confidence】 High / Medium / Low / —: N/A(currently cannot be assessed)
【Urgency】 High / Medium / Low / —: N/A(currently cannot be assessed)

Chapter	Section	Sectors	Significance	Urgency	Confidence
Agriculture, Forest/ Forestry, Fisheries	Agriculture	Paddy field rice	Very High	Very High	High
		Fruit trees	Very High	Very High	High
		Barley/Wheat, Soybean, Feed crops..	Very High	Medium	Medium
		Vegetables	—	Medium	Medium
		Livestock Farming	Very High	Medium	Medium
		Plant Pests, Weeds	Very High	Very High	High
		Water, Land and Agricultural Infrastructure	Very High	Very High	Medium
	Forest Forestry	Sediment, Landslide..	Very High	Very High	Medium
		Storm surges Tidal waves	Very High	Very High	High
		Coastal Erosion	Very High	Medium	Medium
		Water supply (Surface water)	Very High	Very High	Medium
		Timber production (e.g. Plantations)	Very High	Very High	Low
		Planted forests	Very High	Medium	Medium
		Natural forests/ Secondary forests	Very High	Medium	High
		Non-wood forest products (e.g. Mushrooms)	Very High	Very High	Low
	Fisheries	Migratory fish stocks (Ecology of fishes..)	Very High	Very High	Medium
		Marine ecosystems	Very High	Medium	Low
		Coastal ecosystems	Very High	Very High	Medium
		Propagation and Aquaculture..	Very High	Very High	Low
		Freshwater ecosystems	Very High	Medium	Low
		Sea-level rise	Very High	Medium	High
		Storm surges, Tidal waves	Very High	Very High	High
		Coastal Erosion	Very High	Medium	Medium
	Others	Risk of Mortality	Very High	Very High	High
		Heat stroke	Very High	Very High	High
		Damage from Wildlife	Very High	Very High	—
		Shifts in Distribution and Populations	Very High	Very High	High
Water environment, Water resources	Water environment	Lakes/Marshes, Dams(Reservoir)	Very High	Medium	Medium
		Rivers	Not "Very High"	Low	Low
		Coastal areas & Closed sea areas	Not "Very High"	Medium	Low
Water environment, Water resources	Water resources	Water supply (Surface water)	Very High	Very High	Medium
		Water supply (Groundwater)	Not "Very High"	Medium	Low
		Water demand	Not "Very High"	Medium	Medium
Natural Ecosystems * Only Described "assessment for Ecosystems"	Terrestrial ecosystems	Alpine / Subalpine zone	Very High	Very High	Medium
		Natural forests/ Secondary forests	Very High	Medium	High
		Countryside-landscape (Satochi-Satoyama)	Not "Very High"	Medium	Low
		Planted forests	Very High	Medium	Medium
		Damage from Wildlife	Very High	Very High	—
	Freshwater ecosystems	Material Balance	Very High	Medium	Medium
		Lakes / Marshes	Very High	Medium	Low
		Rivers	Very High	Medium	Low
		Marshlands	Very High	Medium	Low
	Coastal ecosystems	Subtropics	Very High	Very High	Medium
		Temperate / Subarctic	Very High	Very High	Medium
	Marine ecosystems	Marine ecosystems	Very High	Medium	Low
	Phenology	Phenology	Not "Very High"	Very High	High
	Shifts in Distribution and Populations	Native species	Very High	Very High	High
		Alien species	Very High	Very High	Medium
Natural disasters, Coastal areas	Water-related disasters	Floods	Very High	Very High	High
		Inland waters	Very High	Very High	Medium
		Storm surges, Tidal waves	Very High	Very High	High
	Storm surges, Tidal waves	Sea-level rise	Very High	Medium	High
		Storm surges, Tidal waves	Very High	Very High	High
		Coastal Erosion	Very High	Medium	Medium
	Sediment-related disasters	Sediment, Landslide..	Very High	Very High	Medium
	Others	Strong wind..	Very High	Medium	Medium
Human health	Heat stress	Risk of Mortality	Very High	Very High	High
		Heat stroke	Very High	Very High	High
	Infection	Vectorborne diseases	Very High	Medium	Medium
		Water- and food-borne diseases	—	—	Low
		Other infectious diseases	—	—	—
	Others	Combined impacts (warming and air pollution)	—	Medium	Medium
		Impacts on vulnerable populations	—	Very High	Low
		Health impacts without leading to clinical symptoms	—	Low	Low
Industrial / Economic activities	Industrial / Economic activities	Manufacture	Not "Very High"	Low	Low
		Energy Demand and Supply	Not "Very High"	Low	Medium
		Commerce	—	—	Low
		Construction	—	—	—
		Medical	—	—	—
	Finance, Insurance	Finance, Insurance	Very High	Medium	Medium
	Tourism	Tourism	Very High	Medium	High
	Others	Other impacts (e.g. Overseas impact)	—	—	Low
Life of Citizenry, Urban Life	Urban Infrastructure, Lifeline	Water supply, Transportation..	Very High	Very High	Low
	Life with sense of culture & history	Phenology	Not "Very High"	Very High	High
		Traditional events / Local industry	—	Very High	Low
	Others	Impact on life due to Heat stress	Very High	Very High	High

Japan's Case : Assessment in Japan

【Significance】 Very High / Not "Very High" / —: N/A(currently cannot be assessed)
【Confidence】 High / Medium / Low / —: N/A(currently cannot be assessed)
【Urgency】 High / Medium / Low / —: N/A(currently cannot be assessed)

Chapter	Section	Sectors	Significance	Urgency	Confidence
Agriculture, Forest/ Forestry, Fisheries	Agriculture	Paddy field rice			
		Fruit trees			
		Barley/Wheat, Soybean, Feed crops..			
		Vegetables	—		
		Livestock Farming			
		Plant Pests, Weeds			
		Water, Land and Agricultural Infrastructure			
	Forest Forestry	Sediment, Landslide..			
		Storm surges Tidal waves			
		Coastal Erosion			
		Water supply (Surface water)			
		Timber production (e.g. Plantations)			
		Others			
		Heat stroke			
		Damage from Wildlife			—
		Shifts in Distribution and Populations			
Water environment, Water resources	Water environment	Lakes/Marshes, Dams(Reservoir)			
		Rivers			
		Coastal areas & Closed sea areas			

Chapter	Section	Sectors	Significance	Urgency	Confidence
Water environment, Water resources	Water resources	Water supply (Surface water)			
		Water supply (Groundwater)			
		Water demand			
Natural Ecosystems ＊Only Described "assessment for Ecosystems"	Terrestrial ecosystems	Alpine / Subalpine zone			
		Natural forests/ Secondary forests			
		Countryside-landscape (Satochi-Satoyama)			
		Planted forests			
		Damage from Wildlife			—
		Material Balance			
	Freshwater ecosyst	Lakes / Marshes			
		Rivers			
		surges, Tidal waves			
		Storm surges, Tidal waves			
		Coastal Erosion			
	Sediment-related disasters	Sediment, Landslide..			
	Others	Strong wind..			

Chapter	Section	Sectors	Significance	Urgency	Confidence
Human health	Heat stress	Risk of Mortality			
		Heat stroke			
	Infection	Vectorborne diseases			
		Water- and food-borne diseases	—	—	
		Other infectious diseases	—	—	—
	Others	Combined impacts (warming and air pollution)	—		
		Impacts on vulnerable populations	—		
		Health impacts without leading to clinical symptoms	—		
Industrial / Economic activities	Industrial / Economic activities	Manufacture			
		Energy Demand and Supply			
	Others	Impact on life due to Heat stress			

The Vulnerability Assessment in Japan has been conducted by several experts to identify which sector is vulnerable with the following point of view.

Significance：Which sector will have significant impact?
Urgency：In which sector will the impact happen urgently?
Confidence：In which sector will the possibility of impact be high?

Contents

1. What is “Vulnerability”?

2. How to conduct Vulnerability Assessment

3. Japan’s case

4. Sensitivity and Adaptive Capacity Assessment

Sensitivity and Adaptive Capacity Assessment

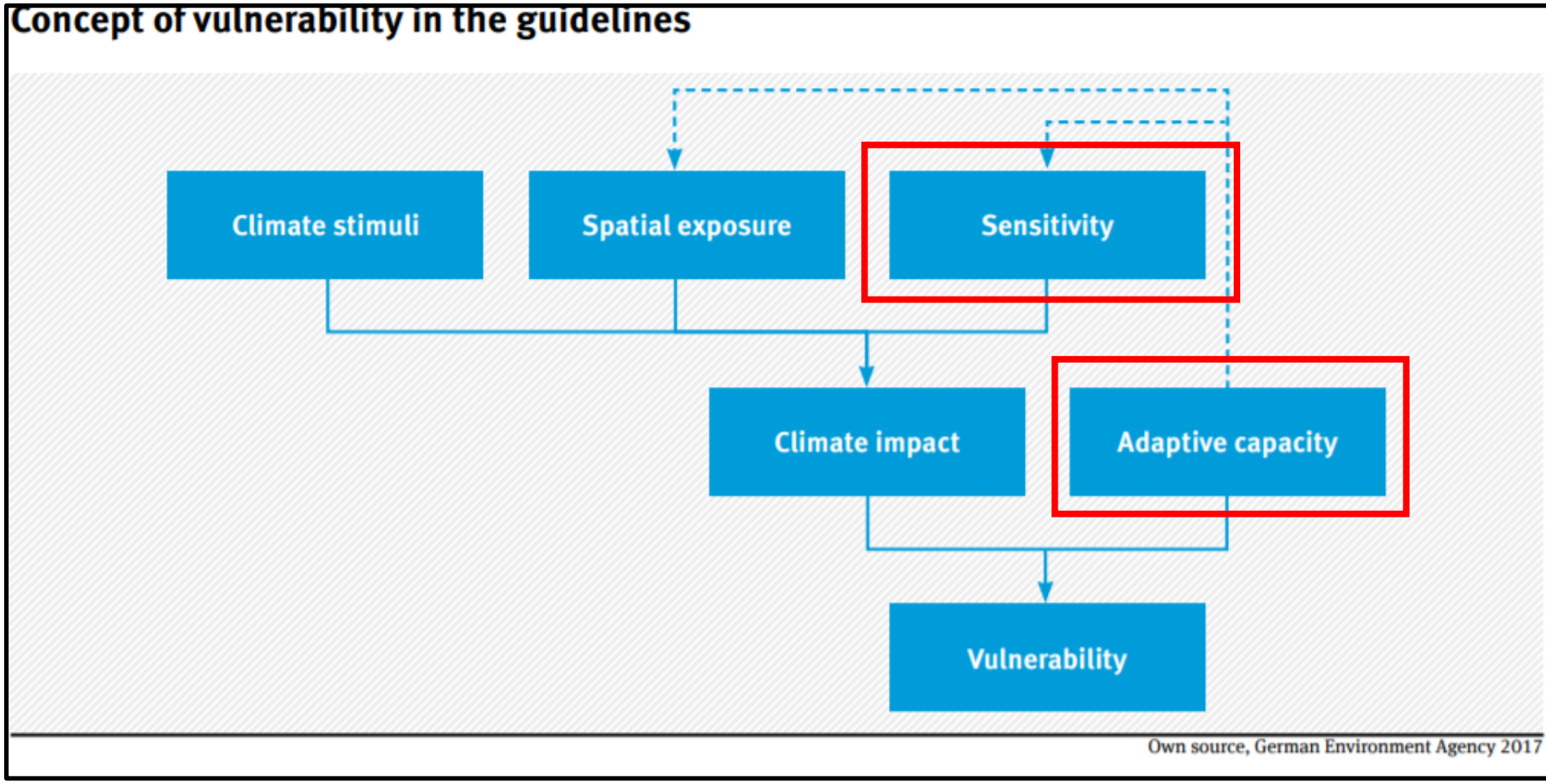
- It is needed to develop a method to assess Sensitivity and Adaptive Capacity

Many research projects have been conducted, and knowledge regarding to Vulnerability(Risk of with adaptation) and adaptation measures have been accumulated in Japan.

Although those knowledge are created by experts on several sectors as the result of the latest scientific findings, it is said the problem is that those research projects mainly have focused on “Climate Stimuli” and “Exposure”, and that “Sensitivity” and “Adaptive Capacity” have not been taken into account sufficiently.

Therefore, it is needed to develop a method to assess those elements of Vulnerability more specifically.

Sensitivity and Adaptive Capacity Assessment

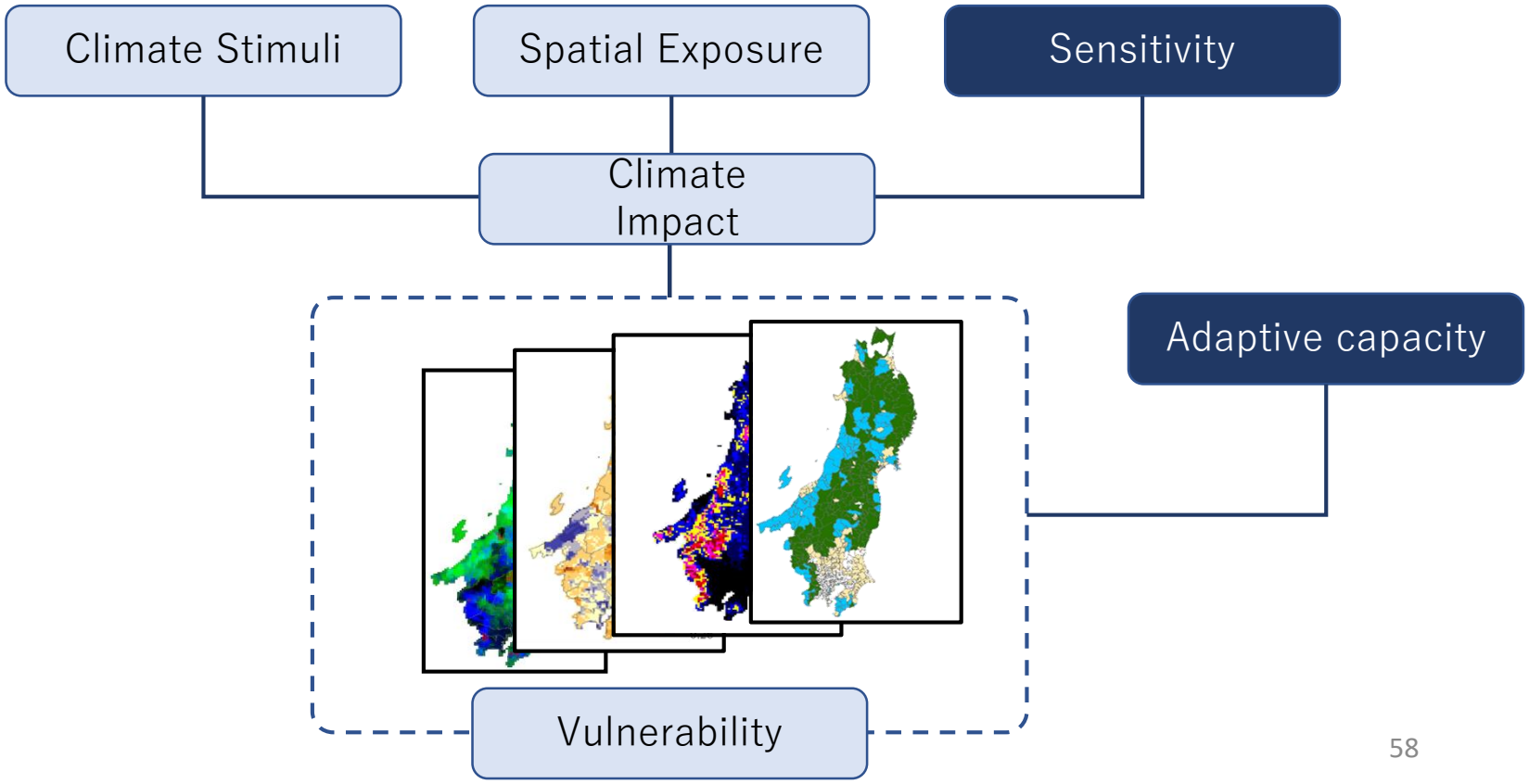


German Environment Agency (2017), Guidelines for Climate Impact and Vulnerability Assessments : https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/guidelines_for_climate_impact_and_vulnerability_assessments.pdf

Sensitivity and Adaptive Capacity Assessment

- It is needed to develop a method to assess Sensitivity and Adaptive Capacity

We are now developing the method to assess Sensitivity and Adaptive Capacity to support the existing assessment method of Vulnerability.



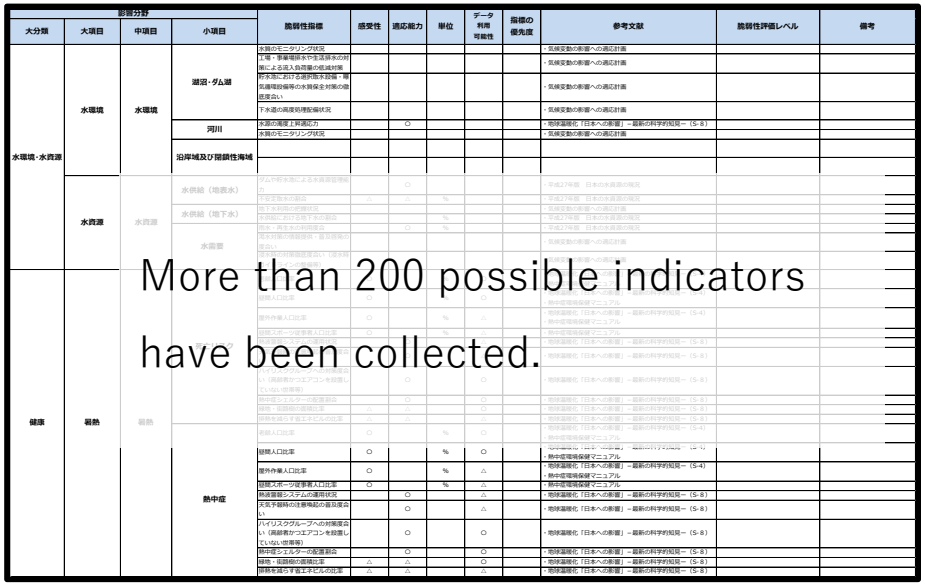
Identification of Indicators

- This study had two approach for identification of Sensitivity and Adaptive Capacity indicators.

Firstly, this study has conducted literature research about vulnerability in Japan and all over the world broadly and collected the indicators suggested in those research, and more than 200 indicators have been collected.

Approach 1

Literature Research



The our method of Assessment

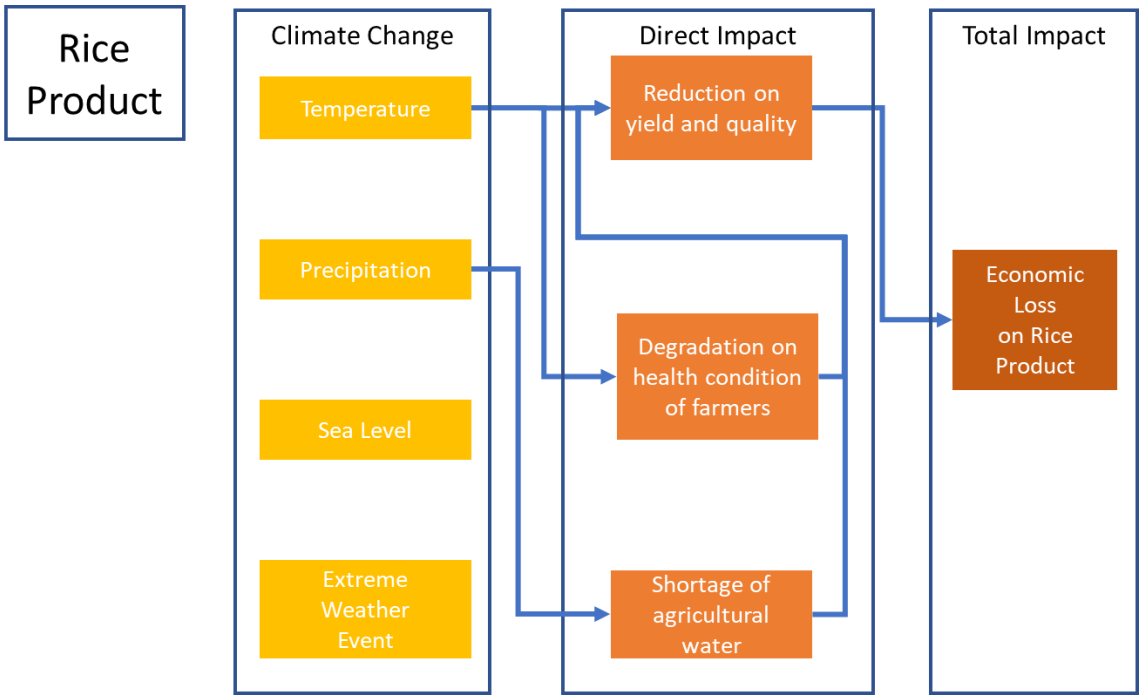
- This study had two approach for identification of Sensitivity and Adaptive Capacity indicators.

Secondly, this study have identified specific indicators with Impact chain from the indicators collected by the previous approach.

After identifying indicators, this study continued to improve the logic by analysis of the data availability, statistics analysis, and expert judge.

Approach 2

Impact Chain



The Identified Indicators

- We've identified indicators of Sensitivity and Adaptive Capacity in the sector of rice cultivation as a case-study.

We've identified several indicators as below, for example the rate of the high temperature-tolerant bleed of rice cropped.

Impact	Direct Impact	Exposure	Vulnerability	Vulnerability Indicators	Priority (Example)
Economic loss on rice product	Reduction on yield and quality	Rice itself	Sensitivity	Parcentage of area which cropped by the rice of high-temperature-tolerant	100
			Adaptive Capasity	Condition of recognision by rice farmers on impact of climate change and adaptation measures	–
				Condition of development about the rice with high-temperature-tolerant	50
				Condition of implementation of adaptation measures	50
	Degradation on health condition of farmers	Farmers of rice	Sensitivity	Percentage of aged person in rice farmers	100
				Mutual condition of farmers	50
			Adaptive Capasity	Condition of recognition on countermeasures on heat-related illness for rice farmers	–
				Condition of implementation of adaptation measures on heat-related illness for rice farmers	50
	Shortage of agricultural water	Agricultural water of rice	Sensitivity	Percentage of water for rice product on all agricultural water	50
			Adaptive Capasity	Condition of recognision by rice farmers on impact of climate change and adaptation measures	–
				Condition of development about efficient management method of agricultural water	50
				Condition of implementation of adaptation measures on efficient management method of agricultural water	50

Vulnerability Assessment

分野	農業、森林・林業、水産業														
小項目	水稲														
分類におけるメカニズム	確信度高い														
指標の性格	外力指標	曝露指標	脆弱性指標												
指標	2081～2100年の平均コメ収量における現在との変化率／地球温暖化「日本への影響」(S-4)より	水稲の農業産出額（1,000万円）／市町村別農業産出額(推計)(農林水産省)より	水稲作付面積に占める高温耐性品種作付面積の割合	水稲農家における温暖化やその対策についての認知状況	高温耐性品種開発に取り組む研究機関の有無	地域における適応策（水管理以外）実施に関する記録の有無	農家の高齢化比率	ソーシャル・キャピタル 統合指数	水稲作従事者の暑熱対策についての認知状況	地域において行われる熱中症対策の取組みの有無	水使用量に占める農業用水の割合	水稲農家における温暖化やその対策についての認知状況（再掲）	農業用水関係事業の都道府県別予算額（百万円）	地域における適応策（水管理対策）実施に関する記録の有無	脆弱性評価（脆弱順位10位以内の項目の数）
脆弱性評価レベル（or有無）	（あり）	（あり）	◎	×	○	◎	○	○	×	◎	○	×	○	◎	
指標の単位	都道府県単位	市町村単位	都道府県単位	データなし	都道府県単位	都道府県単位	都道府県単位	都道府県単位	データなし	都道府県単位	地域区分単位	データなし	都道府県単位	都道府県単位	
指標の傾向	減少であれば外力を受けやすい	大きいほど曝露大	小さいほど脆弱	小さいほど脆弱	小さいほど脆弱	小さいほど脆弱	大きいほど脆弱	小さいほど脆弱	小さいほど脆弱	小さいほど脆弱	大きいほど脆弱	小さいほど脆弱	小さいほど脆弱	小さいほど脆弱	
北															5
青															3
岩															5
宮															4
秋															3
山															3
福															3
茨															2
栃															2
群															6
埼															4
千															3
東															6
神															6
新															2
富															2
石															1
福															4
山梨県	減少	536	0%		1	0	50.0%	23.3%		28	75.7%		651	0	3
長野県	変化なし	4,233	0%		1	0	50.2%	25.1%		2	54.1%		480	0	3
岐阜県	減少	2,021	13.3%		1	2	48.5%	22.7%		18	54.1%		150	0	2
静岡県	減少	1,832	0%		1	0	50.2%	23.2%		1	54.1%		2,344	0	4
愛知県	減少	2,542	0%		1	0	50.1%	19.7%		26	54.1%		4,146	0	4
三重県	増加	2,358	0%		1	0	47.2%	21.6%		8	54.1%		770	0	3
滋賀県	変化なし	3,192	0%		1	2	41.3%	22%		7	66.9%		2,700	1	1
京都府	減少	1,589	12.2%		2	1	48.2%	20.3%		8	66.9%		0	0	2
大阪府	減少	756	0%		0	0	49.1%	18.6%		20	43.4%		0	0	6
兵庫県	減少	4,328	0%		1	0	47.7%	20%		15	43.4%		2,200	0	4
奈良県	減少	893	10.3%		0	0	47.0%	20.7%		16	66.9%		257	0	3
和歌山県	減少	760	25.4%		1	1	50.6%	20.4%		8	43.4%		3,230	0	2

Finally, this study synthesized indicators identified and conducted the assessment of regional vulnerability.

Vulnerability Assessment

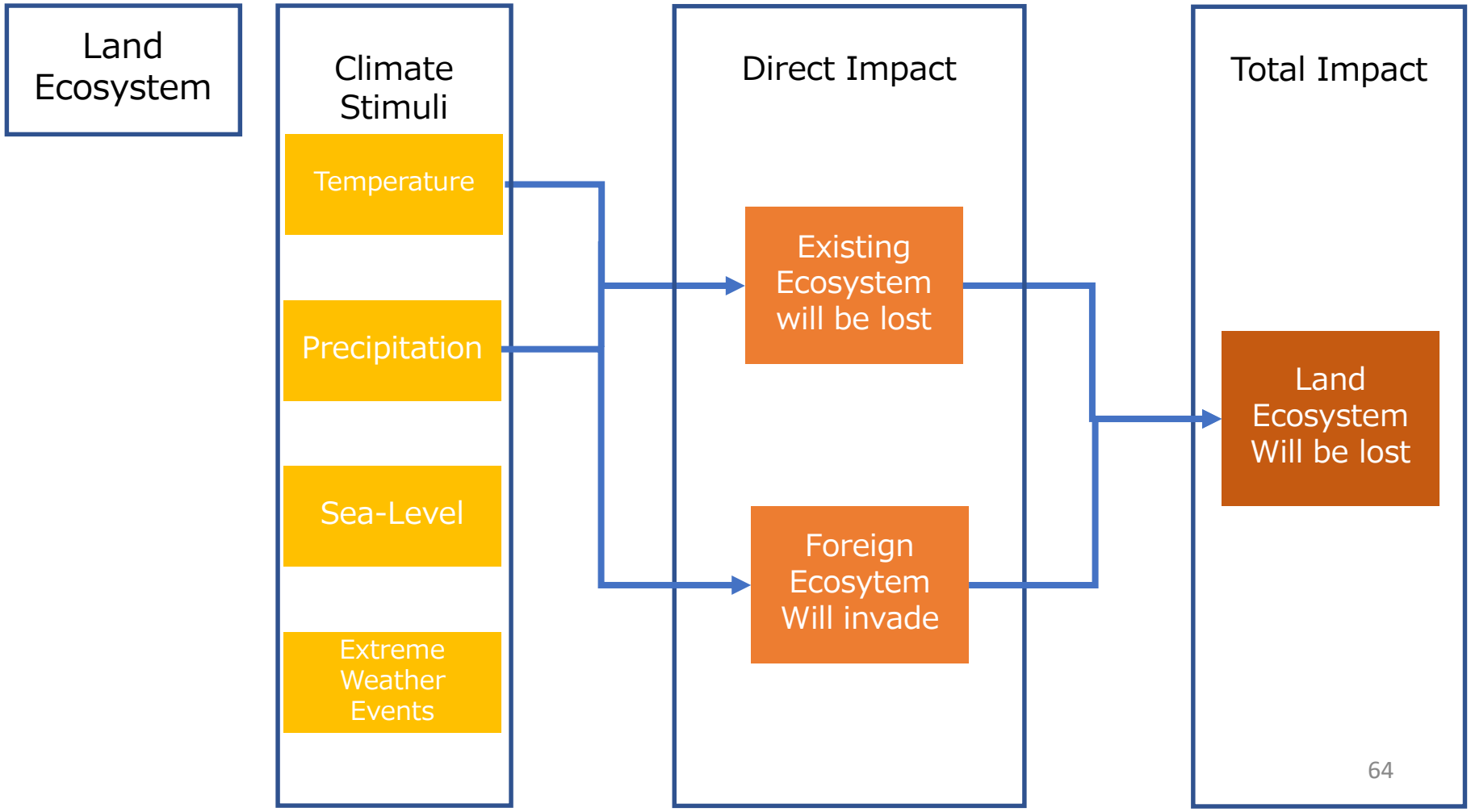
- As the result, this study found out that specific regions in the middle of Japan were relatively vulnerable.

Area		Climate Stimuli	Spatial Exposure (Million Yen)	Sensitivity, Adaptive Capacity
Gunma	10	Down	1,350	6
Saitama	11	Down	3,538	4
Sizuoka	22	Down	1,832	4
Aichi	23	Down	2,542	4
Hiroshima	34	Down	2,239	4
Tokushima	36	Down	1,059	4
Chiba	12	Down	5,668	3
Hyougo	28	Down	4,328	3
Tottori	31	Down	1,209	3
Okayama	33	Down	2,939	3
Yamaguchi	35	Down	2,020	3
Kagawa	37	Down	1,008	3
Kumamoto	43	Down	3,609	3
Gifu	21	Down	2,021	2
Kyoto	26	Down	1,589	2
Fukuoka	40	Down	3,701	2
Saga	41	Down	2,488	2
Ehime	38	Down	1,355	1

Impact Chain in Biodiversity

- A Case-study of Impact chain in the sector of Land Ecosystem.

  We are planning to conduct Vulnerability Assessment in the sector of Land Ecosystem as a next case-study.



End

Thank you very much for your attention