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ADAPTATION TO CLIMATE CHANGE

Assessing climate change risks and vulnerabilities (climate risk assessment)

A DIY Manual

Version 1, November 2023

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Disclaimer

1. INTRODUCTION

This guide explains how to carry out a climate risk assessment, which will underpin the development of your regional climate adaptation plan or strategy.

The guide was developed by the Implementation Platform of the EU Mission on Adaptation to Climate Change (MIP4Adapt)[1] and can be shared publicly. It is also provided as an Excel workbook with functioning templates that you can use to perform your climate risk assessment. You can download this workbook directly via this link without requiring login details.

Slow-onset changes (e.g., in mean temperature, mean precipitation, sea-level rise) and extreme weather-related events (e.g., drought, flood, heatwave) can result in climate-related hazards. Within your regional or local authority, these hazards may have negative (and positive) impacts on:

- People
- Ecosystems and species
- Economic, social, and cultural assets, and
- Services.

Assessing the risks (and opportunities) of such impacts will provide a sound basis for identifying and prioritizing what actions need to be taken to adapt to climate change.

This guide describes the core elements of a climate risk assessment, in accordance with the Intergovernmental Panel on Climate Change. If your time and resources do not allow you to undertake a full climate risk assessment, shortcuts are provided. The level of detail with which you undertake the assessment and what further tools you may wish to use beyond the key ones mentioned here will depend on your available resources and the issues that must be addressed.

[1] For further information see https://climate-adapt.eea.europa.eu/en/mission/the-mission/about-mip4adapt

2. DEFINITIONS

Climate risks (and opportunities) result from four different factors (see Figure 1):

Figure 1: Definition of risk based on IPCC AR6

The IPCC Sixth Assessment Report (AR6) provides standard definitions of each of these factors:

Vulnerability is the tendency of people, ecosystems and species, economic, social and cultural assets, and services to be affected by climate-related hazards. It is a product of:

- **Sensitivity,** which is the degree to which people, ecosystems and species, economic, social and cultural assets, and services are affected, either negatively or positively, by climate variability or change. They may be affected directly (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirectly (e.g., damage caused by an increase in the frequency of coastal flooding due to sea-level rise or from the responses to climate-related hazards of other people, ecosystems and species, economic, social and cultural assets, and services within your regional or local authority or beyond its boundaries, for example, regarding transboundary water catchments).

- **Adaptive capacity,** which is the ability to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.

Hazards are associated with extreme weather-related events or slow-onset climate changes and may cause negative or positive impacts to people, ecosystems and species, economic, social and cultural assets, and services.

Exposure refers to the presence of people, ecosystems and species, economic, social and cultural assets, and services in places and settings that could be affected, e.g., on floodplains.

Responses can reduce or increase risks (and opportunities) by affecting each of the other factors. The process of climate risk assessment considers indirect sensitivities to climate-related hazards

resulting from the responses of other people, ecosystems and species, economic, social and cultural assets, and services.

Adaptation is the process of adjustment to actual or expected climate-related hazards and their effects. It reduces risks by reducing vulnerabilities and/or exposure to hazards (and increases opportunities by increasing vulnerabilities and/or exposure to hazards). Your regional or local authority's own responses to climate risks and opportunities will be the adaptation actions that you subsequently identify, prioritize and implement.

3. HOW TO CARRY OUT YOUR CLIMATE RISK ASSESSMENT

Using the terms detailed above and interacting them sequentially in accordance with the IPCC's definitions, as illustrated in the flow diagram in Figure 2, provides the basis for a simple, stepwise approach for you to assess your climate risks (and opportunities). The approach is summarised immediately below and guidance is then provided on how you can carry out each action. You may also wish to refer to ISO 14092, which provides requirements and guidance on adaptation planning for local governments and communities.

3.1 Summary

Action 1. Preparing the ground: Before beginning your climate risk assessment, consider its scope in relation to your regional or local authority's powers, methodological approach and its alignment with existing risk management processes, and how you will involve stakeholders to ensure your assessment's relevance, importance and legitimacy.

Action 2. Assessing climate vulnerabilities: Identify and rate adaptive capacity of people, ecosystems, assets, and services and their (direct and indirect) sensitivities to climate-related hazards. Combining the ratings of sensitivities and adaptive capacities will then provide ratings of vulnerabilities.

Action 3. Identifying future scenarios: Choose future scenarios to understand the extent to which climate-related hazards may change. It is important to select more than one scenario to take account of uncertainties.

Action 4. Assessing future potential climate-related impacts: Identify and rate the exposure to future climate-related hazards for each scenario. Combining the ratings of vulnerabilities and exposure will then provide ratings of potential climate-related impacts.

Action 5. Assessing climate risks (and opportunities): Rate the likelihood of future potential climate-related impacts. Combining them with the ratings of their magnitude will then determine high climate risks and opportunities on which to focus when you subsequently identify adaptation options.

Action 6. Communicating uncertainties: Consider and communicate uncertainties related to data and knowledge used to determine the sensitivities, adaptive capacities, future scenarios,

exposure to climate-related hazards, the likelihood of climate-related impacts, and the timing and spatial distribution of climate risks (and opportunities).

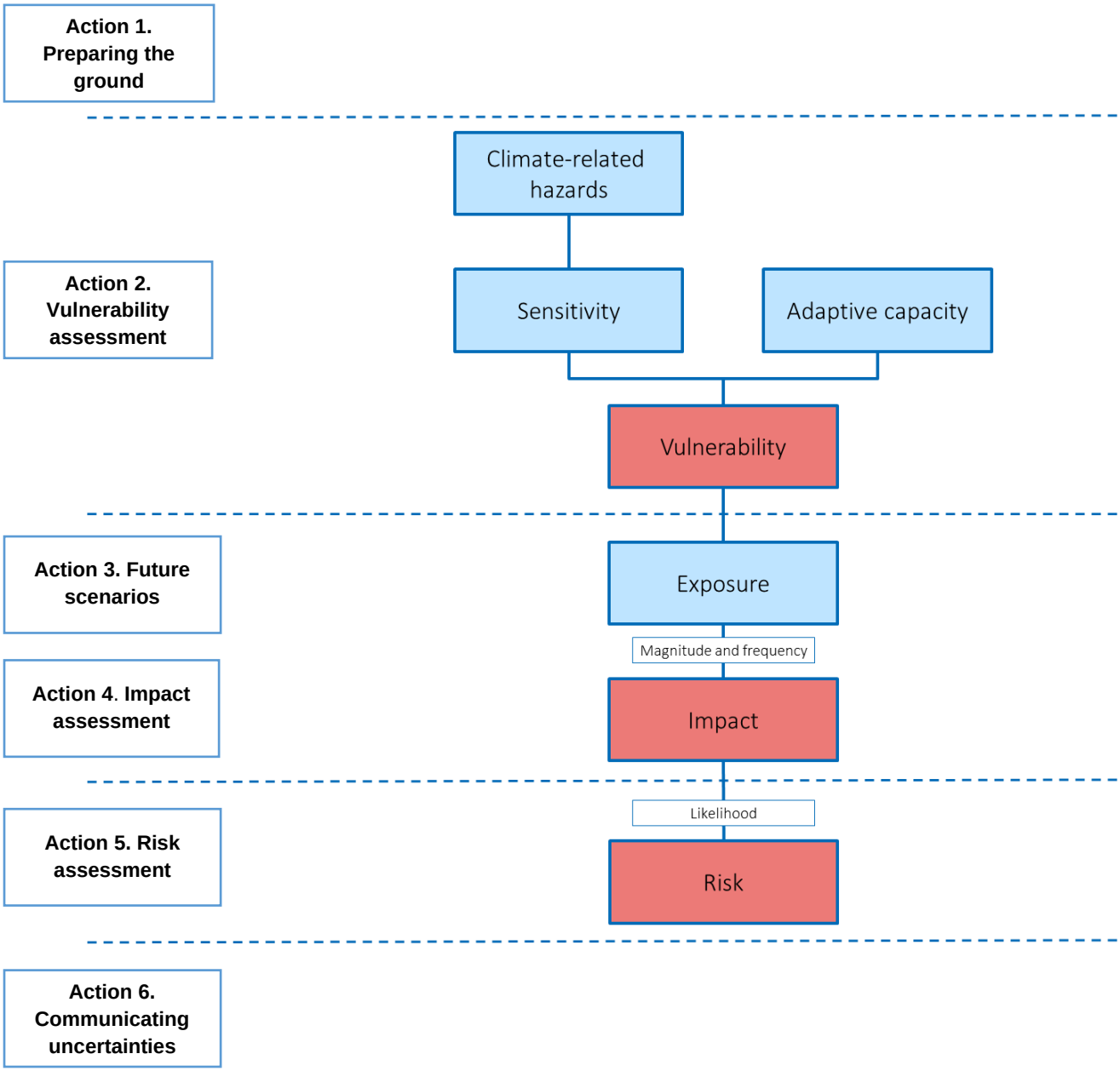

Figure 2: Towards a climate risk assessment

3.2 Action 1: Preparing the ground for climate risk assessment

Before starting your climate risk assessment, you should consider:

1. The scope of your assessment
2. Your methodological approach
3. The involvement of stakeholders and citizens**.**

The scope of your assessment. You should identify which are the people, ecosystems and species, economic, social and cultural assets, and services that you need to assess in relation to

your regional or local authority's powers, leaving the remainder to be assessed at other levels of governance (e.g., nationally).

Your methodological approach. This should include its consistency with your other existing risk management processes and with your national climate risk assessment[2]. Taking a sectoral approach to your assessment of relevant people, ecosystems and species, economic, social and cultural assets will make it easier to use and build upon information in your national climate risk assessment, which will include some or all of the following sectors:

- Agriculture
- Biodiversity
- Buildings
- Business and industry
- Coastal areas
- Cultural heritage
- Disaster Risk Reduction
- Energy
- Financial
- Forestry
- Health
- Information and communication technologies
- Land use planning
- Marine and Fisheries
- Mountain areas
- Tourism
- Transport
- Urban
- Water management

A good risk assessment will enable you to identify and prioritise what adaptation actions need to be taken within your regional or local authority. As such, it may substantially reduce the future costs of damage that could arise. We, therefore, strongly recommend that you invest sufficient resources in the assessment.

Appoint a project team or working group to plan and implement the climate risk assessment and involve individuals with decision-making authority from your local administration. As climate risks (and opportunities) are wide-ranging, the team should also be able to call upon and facilitate inputs from relevant stakeholders with expert knowledge of the people, ecosystems and species, economic, social and cultural assets, and services that may be at risk.

[2] Go to https://climate-adapt.eea.europa.eu/en/countries-regions/countries and then select your country from the dropdown list to go directly to the country's page. Then click on a tab on the left called "Assessment" and the relevant information will be shown. Please note that the format and the content of the assessments varies widely and not all countries have reported all the assessments carried out.

The involvement of stakeholders and citizens to ensure its relevance, credibility and legitimacy (see Citizen Engagement DIY manual). You should engage a wide range of expert stakeholders within and across sectors and consider how to involve citizens more generally in your climate risk assessment, as outlined in the Citizen Engagement DIY Manual.

3.3 Action 2: Assessing climate vulnerabilities

To identify climate vulnerabilities, consider the extent to which people, ecosystems and species, economic, social and cultural assets, and services are sensitive to climate-related hazards (including extreme weather-related events and slow-onset climate changes) and have related adaptive capacities.

Check your Country Profile on Climate-ADAPT and the Mission Portal's Adaptation Dashboard to identify those **climate-related hazards** worthy of consideration. Your Country Profile lists "Observed climate hazards" and "Key future climate hazards" that are considered acute (i.e., extreme weather-related events) or chronic (i.e., slow-onset climate changes) at the national level. The Mission Portal's Adaptation Dashboard may identify other hazards specific to your region. At this point in the process, you do not need to consider the magnitude or frequency of these hazards, you should simply consider:

- The degree to which people, ecosystems and species, assets, and services are **sensitive** to variability or change in each hazard; and
- The **adaptive capacity** of those people, ecosystems and species, assets, and services, i.e., their ability to face hazards, cope with their consequences and recover after they occurred.

Referring to documented information (scientific studies) will help you in this phase. This information that you found can be supplemented by expert stakeholders' knowledge and potentially by citizens engagement. Some data on past impacts and, more specifically, on vulnerability (regarding sensitivity and adaptive capacity) may be available from the Mission Portal's Adaptation Dashboard.

It is important that you consider both direct and indirect sensitivities to climate-related hazards (see definitions).

Rate sensitivity and adaptive capacity

If time and resources allow:

1. Identify and rate (e.g., on a scale from 0 to 5) how people, ecosystems and species, economic, social, and cultural assets and services are sensitive to each climate-related hazard.

2. Identify and rate adaptive capacity (e.g., on a scale from 0 to 5) of the people, ecosystems and species, and services. Adaptive capacity may relate to organisational capabilities, technical and financial capacities of a region, and the ability of managed and natural ecosystems to adapt, as described in Annex G of ISO 14091.

3. Combine the resultant ratings of sensitivities and adaptive capacities to provide ratings of climate vulnerabilities, for example, through use of a vulnerability matrix (see Figure 3). Appendix 1 provides an example of a simple table format for recording your climate vulnerability assessment. Note that, to be able to combine sensitivities (hazard-dependent) with adaptive capacities (hazard-independent), you need to enter some adaptive capacity values several times, in the table.

Adaptive capacity	High (5)	1	2	2	3	3
	Medium-high (4)	2	2	3	3	4
	Medium (3)	2	3	3	4	4
	Low-medium (2)	3	3	4	4	5
	Low (1)	3	4	4	5	5
Vulnerability matrix		Low (1)	Low-medium (2)	Medium (3)	Medium-high (4)	High (5)
		Sensitvity				

Figure 3: Vulnerability Matrix example

If you do not have the time and resources to undertake a complete vulnerability assessment, you may prefer simply to identify and rate climate vulnerabilities, rather than determine them from their component sensitivities and adaptive capacities. However, do bear in mind that taking this shortcut means that the assessment will be far less informative when subsequently seeking to identify and select adaptation options.

3.4 Action 3: Identifying future scenarios

Next, you need to choose the future scenarios that you will use to determine the extent to which climate-related hazards are projected to change according to potential different futures. This will then allow you to determine the extent to which the climate vulnerabilities that you have identified in Action 2 could be exposed to the future climate-related hazards.

The IPCC AR6 considers five possible future scenarios (Shared Socioeconomic Pathways (SSPs))[3]. The Coordinated Regional Climate Downscaling Experiment (CORDEX) has also produced climate data at a finer resolution. All these climate projection data are available from Copernicus. It is recommended that you liaise with your national meteorological

[2] IPCC AR6 considers five Shared Socioeconomic Pathways (SSPs), which explore possible futures, based on integrated assessment models (IAMs) of socioeconomic trends and associated climate, modelled by the World Climate Research Programme in CMIP5 and CMIP6. The IPCC previously only considered Representative Concentration Pathways (RCPs) of greenhouse gas emissions and associated climate, modelled by CMIP5.

services[4] to identify those climate projections that you should use for your assessment[5]. For consistency, it may make most sense to use the same projections used by your national adaptation strategy or plan.

It is important that your risk assessment takes account of uncertainties by considering future projections of climate-related hazards associated with **more than one scenario**. However, time and resources are unlikely to allow you to consider more than two scenarios.

The IPCC AR6 does not estimate the relative likelihood of each SSP scenario. However, if you are using the SSPs, it makes sense to select SSP2-4.5 (the "middle of the road" scenario with estimated global warming of 2.1 to 3.7 °C by 2081-2100), as it was identified in 2020 as the most likely by a commentary published in Nature (generally considered to be the world's leading multidisciplinary science journal). As a precaution, you may also wish to select SSP5-8.5 (the "fossil-fuelled development" pathway with estimated global warming of 3.3 to 5.7 °C by 2081-2100), as a subsequent paper demonstrated that RCP8.5 (which corresponds to SSP5-8.5) is the closest match with our current emissions trajectory. Alternatively, you may also wish to consider SSP1-2.6 (the "sustainability - taking the green road" scenario with estimated global warming of 1.3 to 2.4 °C by 2081-2100), which is in line with the demands of the Paris Agreement.

You should identify near-term (2021-2040) as well as medium-term (2041-2060) and/or long-term (2081-2100) scenarios, as compared to a baseline (e.g., 1981-2010). Data that enable the identification of potential climate-related impacts in the near future rather than the distant future are often more important for making climate adaptation decisions, particularly regarding extreme weather-related events. However, for some vulnerabilities, understanding how they may be exposed to climate-related hazards in the distant future may also be important, e.g., for coastal areas in relation to gradual sea-level rise or for trees which take a long time to grow and deliver benefits.

Appendix 2 provides an example of a simple table format for recording a summary of your future scenarios.

3.5 Action 4: Assessing future potential climate-related impacts

Next, you should identify and rate the magnitude of potential climate-related impacts by rating the **exposure to each relevant future climate-related hazard** (e.g., on a scale from

[4] Go to https://climate-adapt.eea.europa.eu/en/countries-regions/countries and then select your country from the dropdown list to go directly to the country's page. Then click on a tab on the right called "Contact". The relevant contact details of the services will be shown if your country has reported them.

[5] While you may be attracted to use downscaled model outputs, you should bear in mind that downscaling increases rather than decreases uncertainties, so may lead to decisions that are not robust to the full set of plausible climate futures.

0 to 5) for each of the scenarios and timeframes. Exposure can be determined along a set of indicators[6].

You may wish to focus solely on rating the exposure of key vulnerabilities (e.g., those rated 3 to 5 in Action 2). You can then combine the ratings of **vulnerabilities** from Action 2 with the ratings of **exposure** to provide ratings of the **magnitude** of resultant potential **impacts**, for example through the use of an impact matrix (see Figure 4).

Exposure	High (5)	3	4	4	5	5
	Medium-high (4)	3	3	4	4	5
	Medium (3)	2	3	3	4	4
	Low-medium (2)	2	2	3	3	4
	Low (1)	1	2	2	3	3
Impact matrix		Low (1)	Low-medium (2)	Medium (3)	Medium-high (4)	High (5)
		Vulnerability				

Figure 4: Impact Matrix example

Appendix 3 provides an example of a simple table format for recording your assessment of future potential climate-related impacts. Where spatial data are available for the vulnerabilities and the future climate-related hazards to which they relate, you may wish to rate exposure by location through overlaying the two datasets if time and resources allow.

If you are using the SSPs scenarios, then a further sophistication that you can consider, if time and resources allow, is how projected socioeconomic changes (e.g., in population) alongside the climate projections could directly affect your ratings of:

- Future adaptive capacities and, thereby, vulnerabilities, and
- Exposure to climate-related hazards.

3.6 Action 5: Assessing climate risks (and opportunities)

You can then rate the **likelihood** of each of the future potential climate-related impacts (e.g., on a scale from 0 to 5) and combine them with the ratings of their **magnitude** identified in Action 4, to provide ratings of **risks** (and opportunities), for example, through use of a risk matrix (see Figure 5).

[6] A useful list of indicators can be found in table 4 of OECD Environment Working Papers No. 201: Monitoring exposure to climate-related hazards: Indicator methodology and key results, available under https://www.oecd-ilibrary.org/docserver/da074cb6-en.pdf?expires=1699702655&id=id&accname=guest&checksum=99ADEBF0F5649913896DA27F2F31FBC2

Likelihood	High (5)	3	4	4	5	5
	Medium-high (4)	3	3	4	4	5
	Medium (3)	2	3	3	4	4
	Low-medium (2)	2	2	3	3	4
	Low (1)	1	2	2	3	3
Risk matrix		Low (1)	Low-medium (2)	Medium (3)	Medium-high (4)	High (5)
		Impact				

Figure 5: Risk Matrix example

Appendix 3 provides an example of a simple table format for recording your assessment of climate risks.

If you do not have enough time and resources, you may wish to consider concluding the assessment at the end of Action 4, i.e., by identifying and rating the magnitude of potential impacts and not then considering their likelihood.

There are disadvantages in not rating risks (and opportunities), as it means when considering adaptation options that you cannot focus your attention so specifically on high risks (and opportunities). However, there are also advantages in not doing more than identifying and rating the magnitude of potential impacts, as it may encourage you to consider uncertainties when identifying and selecting adaptation options. It is important to appreciate that likelihood and uncertainty are two different things.

3.7 Action 6: Communicating uncertainties

When interpreting the results, you should consider and communicate uncertainties about the data and knowledge relating to each element of the assessment, i.e., the sensitivities and adaptive capacities and thereby vulnerabilities, the future scenarios regarding climate-related hazards and socioeconomic issues, the exposure to climate-related hazards, and the magnitude of potential climate-related impacts and their likelihood that results in risks (and opportunities). This should include uncertainties relating to the timing and spatial distribution of climate risks (and opportunities).

4. FURTHER INFORMATION

Further sources of information on climate risk assessments can be found:

- Your national climate vulnerability and risk assessment and the Green Deal Going Local Handbook can help inform your assessment. As there is no 'one-size-fits-all recipe' for local and regional implementation of the Green Deal, this Handbook provides a step-by-step guide. It is adapted to each local context (from urban to rural, mountain and coastal areas, among others). Creatively and interactively, it provides information on targeted financial and technical instruments based on geographical and institutional assets and vulnerabilities. It also provides best

practices that illustrate how local and regional policymakers can implement the adaptation objectives of the EU Green Deal.

- The Vulnerability Sourcebook provides guidelines for assessing domestic vulnerability across different sectors at the various administrative levels. It offers a practical and scientifically sound methodological approach to vulnerability assessments.

- The European Climate Adaptation Platform Climate-ADAPT and the JRC Risk Data Hub (a GIS web platform of European wide risk data and methodologies for Disaster Risk Assessment) are rich sources of scientific evidence.

- The EEA Member Country Profiles provide a good overview of approaches implemented in each Member State. The European Climate Data Explorer and the Mission Portal's Adaptation Dashboard give information on indicators of observed and projected climate change, and on current and future climate-related hazards

5. APPENDIX 1: AN EXAMPLE OF A SIMPLE TABLE FOR RECORDING YOUR CLIMATE VULNERABILITY ASSESSMENT (ACTION 2)

Full guidance document is also provided as an Excel workbook with functioning templates that you can use to perform your climate risk assessment. This document can be found here.

Sector	Receptor	Hazard	Sensitivity	Sensitivity rating (e.g., 1-5)	Organisational capability	Technical capacity	Financial capacity	Ecosystem capacity	Adaptive capacity rating (e.g., 1-5)	Vulnerability rating (e.g., 1-5)
Name of sector	List of people, ecosystems and species, economic, social and cultural assets, and services	List of all relevant climate-related hazards (including extreme events)	Qualitative description of each receptor's sensitivity to each hazard		Qualitative description of each of these components of adaptive capacity of each receptor					Determined for each receptor in relation to each relevant hazard by combining the ratings of sensitivity and adaptive capacity, e.g., using a vulnerability matrix
Once you have completed your climate vulnerability assessment, copy the content of the first three columns to the first three columns of the table for your assessment of future potential climate-related impacts and climate risks (Appendix 3)										Once completed, copy to your table for assessment of future impacts and climate risks (Appendix 3)

6. APPENDIX 2: AN EXAMPLE OF A SIMPLE TABLE FOR RECORDING A SUMMARY OF YOUR FUTURE SCENARIOS (ACTION 3)

Full guidance document is also provided as an Excel workbook with functioning templates that you can use to perform your climate risk assessment. This document can be found here.

Hazard	Unit of measurement	Near term (2021-2040)		Medium term (2041-2060)		Long term (2081-2100)	
		Scenario 1 (e.g., SSP2-4.5)	*Scenario 2 (e.g., SSP5-8.5)*	*Scenario 1 (e.g., SSP2-4.5)*	*Scenario 2 (e.g., SSP5-8.5)*	*Scenario 1 (e.g., SSP2-4.5)*	*Scenario 2 (e.g., SSP5-8.5)*
Slow onset changes							
e.g., Mean temperature change	*Average annual air temperature (°C)*	*18*	*20*				
e.g., Relative sea-level rise	*Change in sea level compared to a baseline period of 1981-2010 (metres)*	+0.03	+0.05				
Extreme events							
e.g., Extreme heat	*Maximum monthly air temperature (°Cs)*	*28*	*32*				
e.g., Heavy precipitation	*Number of days annually with precipitation over 50mm*	*10*	*15*				

7. APPENDIX 3: AN EXAMPLE OF A SIMPLE TABLE FOR RECORDING YOUR ASSESSMENT OF FUTURE POTENTIAL CLIMATE-RELATED IMPACTS (ACTION 4) AND CLIMATE RISKS (ACTION 5)

Full guidance document is also provided as an Excel workbook with functioning templates that you can use to perform your climate risk assessment. This document can be found here.

Sector	Receptor	Hazard	Vulnerability rating (e.g., 1-5)	Location of receptor	Location of hazard	Exposure	Exposure rating (e.g., 1-5)	Impact rating (e.g., 1-5)	Likelihood rating (e.g., 1-5)	Risk rating (e.g., 1-5)
Name of sector	List of people, ecosystems and species, economic, social and cultural assets, and services	List of all relevant climate-related hazards (including extreme events)	Determined for each receptor in relation to each relevant hazard by combining the ratings of sensitivity and adaptive capacity, e.g., using a vulnerability matrix	Qualitative description of the location of the receptor	Qualitative description of the location of the relevant hazard	Qualitative description of the exposure of the receptor to the hazard, given the degree of coincidence in their locations		Determined for each receptor regarding each relevant hazard by combining vulnerability and exposure ratings, e.g., by using an impact matrix		Determined for each receptor in relation to each relevant hazard by combining the ratings of impact and likelihood, e.g., by using a risk matrix
Copy the contents for these first three columns from your table used for your climate vulnerability assessment (Appendix 1)			Copy from the final column of your table used for your climate vulnerability assessment (Appendix 1)		Columns to be repeated and completed for each scenario and timescale					

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