




Tackling Climate Change in Agriculture

**Approaches to Climate Change Adaptation and Climate Smart
Agriculture in Southern Africa**

Training Manual for the Climate Proofing Tool

A practice-oriented training based on the OECD Policy Guidance, adopted to climate smart
agriculture in southern Africa



The initial training course and associated materials are based on the OECD Policy Guidance “Integrating Climate Change Adaptation into Development Co-operation”, published in May 2009. They were generously funded by the **German Federal Ministry for Economic Cooperation and Development (BMZ) and developed by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH** in coordination with OECD and a broad range of reviewers from development agencies, NGOs and research institutions from around the world. The authors gratefully acknowledge the valuable feedback contributed by reviewers and training participants.

The original training material was published by

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

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This publication has been produced and financed by
the German Federal Ministry for Economic
Cooperation and Development (BMZ):

On behalf of

BMZ



Federal Ministry
for Economic Cooperation
and Development



Training Manual for the Climate Proofing Tool

This climate proofing tool is part of the training package on *Tackling Climate Change in Agriculture: Approaches to climate change adaptation and climate smart agriculture in southern Africa*. It is based on the *Integrating Climate Change Adaptation into Development Co-operation Climate Proofing Tool* initially developed by the Organisation for Economic Cooperation and Development (OECD) and GIZ in 2009. This climate proofing tool expands the original tool towards a stronger focus on climate change adaptation in agriculture in southern Africa and places more emphasis on knowledge co-generation with respect to the specific case study system at hand. It has been adapted to southern Africa by the SADC Adaptation to Climate Change in Rural Areas in Southern Africa (ACCRA) Programme. ACCRA has been established by the German Government through the Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Southern African Development Community (SADC), funded by the Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (BMZ). The programme is implemented by the Centre for Coordination of Agricultural Research & Development for Southern Africa (CCARDESA).

The training package combines a range of different technical/topical modules with this climate proofing tool and its practical application within specified case studies. This climate proofing tool forms an integral part of the training package.

The climate proofing tool consists of a series of steps which will be implemented in small groups, who will work together throughout the training course. Each group will focus on a particular case study or system of interest – an agricultural system or value chain.

The climate proofing steps include:

1. Assessing the current and future climate risks
2. Identifying adaptation options
3. Selecting adaptation measures

Pre-defined case studies form the basis of applying the climate proofing tool. The selection of the case studies will have been done in advance by the programme implementing the training or by the participants themselves, or both. The case studies have been prepared with details on existing climate conditions, systems characterisation including biophysical, as well as socio-economic aspects.



This training manual will guide you through all steps (modules A-C) of climate proofing an agricultural system of interest. **All modules follow the same sequence**, including the following crucial elements:

1. The **introduction**, given by the trainer, provides the necessary theoretical background and introduces participants to the case work.
2. The **case work** gives participants the opportunity to work through the different aspects linked to climate change adaptation in agriculture in a systematic manner. Participants assume the roles of “case work experts” in charge of the specific module’s task.
3. The “case work experts” **summarise and present their results** in the plenary. This is the opportunity to share experiences and for mutual learning. Trainers offer alternatives and corrections when necessary. This is also the opportunity to co-generate new knowledge about the specific case, its vulnerabilities and its adaptation options, which will all be documented.
4. In a final **reflection**, the participants reassume their own real-life position. They reflect on their experiences and link them to their own work in order to make the newly gained knowledge more applicable. Trainers support through guiding questions.

Box 1: Guidance for effective group work

- Given the limited time, try to balance effectiveness and efficiency: select one **facilitator**, one **time keeper**, one **note taker**, and one **presenter** who will explain the group’s work in plenary – tasks can rotate between the different steps.
- Take your time to read the task description and see if everybody in the group is on board. Ask, if things are unclear.
- The working groups work independently, and trainers can be asked for advice at any time.
- Do not stress yourself to produce “perfect results”, there is probably no “one and only right solution”. Take the time to get into the step-wise approach to this complex topic, “digest” the different inputs offered and add by sharing your experiences in your work group.
- Matrixes are to be worked through horizontally



Module A: Assess the Risk

Learning objectives

- Analyse the current risks and additional challenges caused by climate change in a defined agricultural system of interest
- Identify and handle the different factors contributing to “risk” in a system: sensitivity, adaptive capacity, basic vulnerability, hazard, exposure, and potential impacts
- Define the need for action according to the projected risk (the probability of climate hazards and the extent of damage) in the system

Orientation

Module A is divided into two parts:

- **Part 1** is a preparatory step for the in-depth assessment in the second part. Part 1 considers the **current situation** in the defined agricultural system of interest: inventory of actors and their responsibilities and other key elements of the system.
- **Part 2** deals with the **future** under the projected changing climate. You will analyse the hazard and the exposure, the vulnerability and the potential impacts induced by climate change in the agricultural system and evaluate the risk/the necessity to act.

Assess the Risk – Part 1: The Current Situation

- Use **Matrix 1** to guide your work.
- Read the available materials regarding the case study, i.e. your system of interest.
- Discuss within your group the system of interest and what exactly you intend to focus on for this exercise. Appreciate the diversity of perspectives, expertise and experience in your group. You need to specify your system of interest – you can do this at different levels, e.g. a single crop system, an ecosystem, a region. Note down the selected system and the development objective within the system in **column A** (e.g. *rice/wheat rotation in the central plain. Development goal: Increase and diversify production and rural incomes*).
- In **column B**, list the key actors of the system of interest (*relevant ministries, consumers etc.*). Also, explore their roles and responsibilities. Please limit the list of actors to five key actors.
- Explore in **column C** further key elements of the system such as social, technical or natural components (e.g. *culture, equipment, institutions*) and give an estimate of their actual status quo on the tendencies, positive and negative.
- Use Matrix 1 to document your findings and discussions.



Matrix 1: Evaluate the current situation

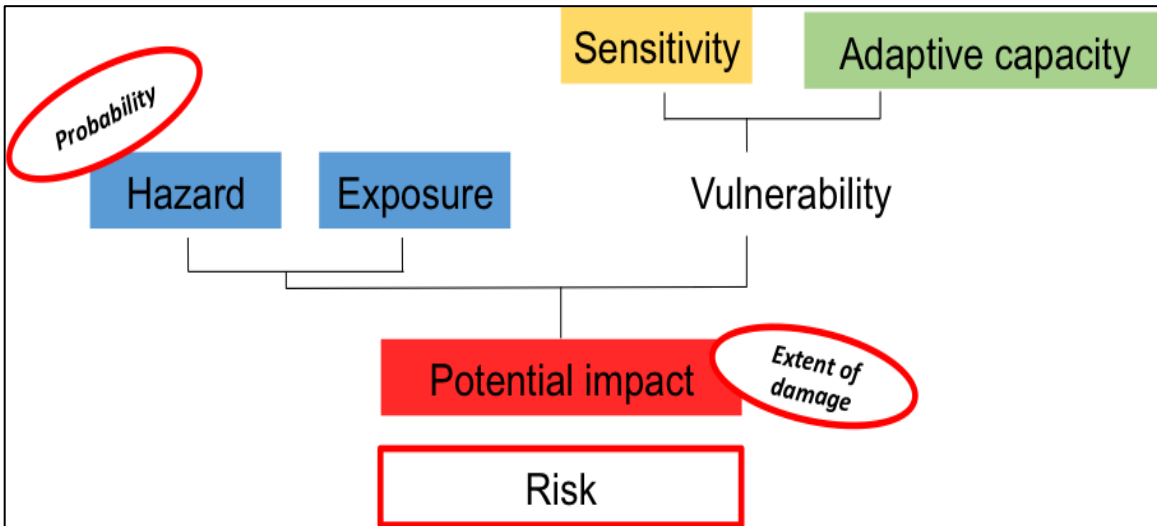
A System of interest and development goal	B Key actors: roles and responsibilities	C Further key elements of the system: status quo and tendencies
<i>System of interest: Rice/wheat rotation in central plain.</i> <i>Development goal: Increase and diversify production and rural incomes</i>	<ul style="list-style-type: none">• <i>Extension services: provision of information, support of farmers</i>• <i>NGO XY: advise for crop varieties</i>• <i>....</i>	<ul style="list-style-type: none">• <i>Farmers are open towards new technical measures</i>• <i>Limited climate data in several regions</i>• <i>...</i>



Assess the Risk - Part 2: The Future

Part 2 works through the components of risk of the system in the future: hazard, exposure, vulnerability, and potential impact. Information from part 1 supports this assessment.

Graph 1: Components of risk



Your tasks

- Review [Graph 1](#) above (and glossary) to ensure that you have in mind the different terms and their connections.
- Continue to use [Matrix 2](#) to guide your work.
- In **column D**, identify the key climate related **hazards** (observed & projected) of concern e.g. *changing precipitation patterns, extreme temperatures* etc. to which the agricultural system might be exposed to. If possible, also note the frequency to which the system might get exposed to these climate signals (e.g. occasionally, once in ten years).
- In **column E**, consider if and how the system of interest's actors and assets are **sensitive** to climate hazards (D). Think of ecological, social, economic and other types of sensitivities. Relate your assessment to the conditions and trends of the system of interest. Examples of sensitivity factors are, for example: *water needs for plants, length of growing season, local housing materials for livestock*. Take into consideration the actual situation and the tendencies in the system (part 1).
- In **column F**, elaborate the system's current adaptive capacity, e.g. *access to reliable seasonal weather forecasts, existence of an early storm warning system or research*



results on drought-tolerant crops. Focus on how the existing adaptive capacity provides opportunities. Consider what is the current adaptive capacity of institutions to support climate adaptation. Are national or local governments and organisations supporting planned adaptation?

- In **column G**, brainstorm regarding the potential impacts of the climate hazards on the agricultural system of interest.
 - First brainstorm the potential impacts to the **biophysical** part of the system by considering the hazard (column D) in combination with the vulnerability factors (column E and F). Example: *prolonged dry periods endanger a sufficient recharge of groundwater on which the agriculture production is depending on*
 - Then brainstorm **socio-economic** impacts in **column H**, resulting from the biophysical impacts, e.g. *reduced production and yield and thus loss of income*. You may also want to consider positive impacts.
- In **column I** assess the probability of the hazard and the extent for every potential biophysical and socio-economic impact. Discuss column I using the following questions by looking at each identified impacts in columns G and H:
 - How relevant is the potential impact to the development objective?
 - How likely is the impacts' occurrence?
 - What is the extent of expected damage?
 - Assess the level of risk (low, medium, high) of each impact using Figure 2. Combine the likelihood of each biophysical impact with the severity of its socio-economic impact. Identify which risks are most urgent to address by looking at their level of risk. This will give you the fields requiring action.
- Use Matrix 2 to document your findings and discussions.

Figure 2: Risk Rating Matrix

		IMPACT (extent of damage)		
		Low	Medium	High
	RATING			
PROBABILITY (of hazard)	High	Medium	Medium	High
	Medium	Low	Medium	Medium
	Low	Low	Low	Medium



Matrix 2: Assess risk and define need for action

System of interest	D Climate hazard the system might be exposed to	Basic vulnerability		Potential impacts		I Risk rating
		E Sensitivity	F Current adaptive Capacity	G Biophysical	H Socio-economic	
<i>Rice/wheat rotation in central plain</i>	<p><i>Observed:</i></p> <ul style="list-style-type: none"> • <i>Seasonal rain pattern becomes erratic</i> • <i>Heavy precipitation in short time periods</i> <p><i>Projected:</i></p> <ul style="list-style-type: none"> • <i>Slight increase of annual precipitation</i> • <i>Dry spells</i> 	<ul style="list-style-type: none"> • <i>Limited water resources (seasonal precipitation, almost the whole area is under irrigation)</i> • <i>Seed varieties commonly used are sensitive even to small temperature changes</i> • <i>Dependency of rural communities on employment in agriculture</i> 	<ul style="list-style-type: none"> • <i>Ability of farmers to access forecasts and adjust cropping calendar accordingly</i> • <i>Growing service sector in the country offers other employment opportunities (alternative income)</i> 	<ul style="list-style-type: none"> • <i>Plant sterility with temperature increase</i> • <i>Decreasing yields</i> • <i>Erosion</i> 	<ul style="list-style-type: none"> • <i>Loss of income</i> • <i>Adverse effects on food security</i> 	<i>High: high damage if less production: food security issues and loss of GDP</i>



Module B: Identify Adaptation Options

Learning objectives

- *Learn about different categories of adaptation in agriculture (policy, technical measures, capacity development, and research).*
- *Learn about different starting points for adaptation (1) reduce exposure, reduce sensitivity, increase adaptive capacity – all of them leading to reduced risk and (2) enhance opportunities from climate change.*
- *Understand that adaptation includes “no-regret options” as well as options that require doing things differently.*

Orientation

- After you evaluated the risk and identified the fields of action (Module A), your task is now to ask yourselves “Which adaptation options could be useful to reduce the specific climate change-induced risk?”
- At this stage, it is important to brainstorm as broad as possible to generate new ideas, learning from experiences and being innovative and creative.

Specific information for Module 2

- Your task, after having identified the need for action, is to ask: “What could be done to respond to the challenges in order to be able to meet the development objective(s)?”
- At this point it is important to think as broadly as possible to come up with new ideas. The exercise is therefore conducted via brainstorming¹. Think of measures to reduce sensitivity and increase adaptive capacity.

¹This means that for the time being all ideas that you can come up with are welcome. No idea should be criticised; limiting factors will be reflected during the analysis in the next step.



- **Matrix 3** helps organise your work.

Your task

- Use **Matrix 3** to guide your work.
- In **column K** you find a selection of impacts you have rated as “high risk” from Matrix 2, columns G and H.
- In **column L**, brainstorm as many adaptation options as possible per “high risk” impact to reduce the risk of climate change.
 - Add adaptation options from policy, capacity development, technical or research that may be necessary to make up a comprehensive adaptation strategy that suits your development objective in the specific system of interest (see Box 2).
- In **column M** note main actors whose contributions are necessary for implementing the adaptation options.
- Use Matrix 3 to document your findings and discussions.

Box 2: Types of adaptation options:

Generally, adaptation aims to reduce or prevent the negative impacts or to benefit from opportunities of climate change. For your work, please consider the following approaches:

- **Reduce exposure** towards climate hazards
- **Reduce the sensitivity** of the system of interest
- **Enhance the adaptive capacity** of the considered system

This can be done through taking options in the domain of:

- **Policy and framework conditions**
- **Enhancement of capacities**
- **Technical measures**
- **Research**



Matrix 3: Develop adaptation options

System of interest	K Selected impacts of "high" risk	L Adaptation options	M Relevant actors / stakeholders
<p><i>Rice/wheat rotation in central plain</i></p> <p><i>Development goal: Increase and diversify production and rural incomes</i></p>	<ul style="list-style-type: none"> • <i>Plant sterility with temperature increase</i> • <i>Decreasing yields</i> • <i>Loss of income</i> • <i>Adverse effects on food security</i> 	<ul style="list-style-type: none"> • <i>Use adapted seed varieties</i> • <i>Inform farmers on water-saving (irrigation) techniques</i> • <i>Introduce agroforestry</i> • <i>...</i> 	<ul style="list-style-type: none"> • <i>Ministry of Agriculture</i> • <i>Regional environmental authorities</i> • <i>Local NGOs</i> • <i>...</i>



Module C: Select Adaptation Measures

Learning objectives

- Understand that strategic priority setting supports effectiveness.
- Learn how to select appropriate criteria.
- Run a multi-criteria analysis to evaluate adaptation options
- Learn about the potential for mitigation co-benefits through adaptation measures
- Understand the synergies and trade-offs between different criteria
- Come up with a set of deliberately chosen adaptation measures.

Orientation

- **Module C** is the third step of the systematic adaptation assessment.
- It asks: “Which adaptations options should be prioritized in order to ensure effective adaptation despite limited resources and/or limited climate information?”
- It encourages strategic thinking and the capacity to run a transparent and systematic selection process in order to create acceptability among stakeholder groups.
- It encourages thinking about the synergies and trade-offs between competing objectives (e.g. of adaptation and mitigation).

Your task

- Use **Matrix 4** to guide your work.
- Transfer the identified adaptation options from **column L Module B**.
- In **columns N, O, P and Q**.
 - Agree on the selection criteria (e.g. see **Box 2**).
 - Discuss each option using the criteria and score them by using 1 to 5. Advice: Evaluate all criteria in the same way: 5 being positive in terms of implementation (BUT: for the cost criteria, you must weight it inverse: high costs = 1, low costs = 5). Otherwise, it will not be possible to calculate the overall score.
- In **column R** do the overall score (per option).
 - If too many options (of the same cluster) have similar evaluations, try to be more specific by introducing another criterion or weighting the criteria.
- In the last column, evaluate the **mitigation potential** of each adaptation option. If the option is a *sink* for Greenhouse gases (GHG), rate it as positive +. Example: tree planting. If the option is a *source* for GHG, rate it negative: -. Example: diesel generators for water pumps. If the option is *neither a sink nor a source* for GHG, rate it as neutral: 0. Example: use adapted seed varieties.



- Together discuss the results using a “bird’s eye view”, e.g.
 - Do the selected adaptation measures address the key risks?
 - Will they be effective to attain the development objective in the chosen system?
Is something missing?
 - What could be useful arguments to convince the officials of taking up these activities?
 - Which activities could be a useful entry point when dealing with reluctant stakeholders?
- Use Matrix 4 to document your findings and discussions.

Box 2: Criteria for selecting adaptation measures

The OECD Guidance recommends the following key criteria:

- **Effectiveness:** describes the extent to which the adaptation option reduces vulnerability and provides other benefits. Think of effectiveness of the adaptation option under different scenarios.
- **Costs:** describes relative costs of an adaptation option. Think of investment costs as well as costs over time, such as operation and maintenance costs, reconstruction costs, etc. Think of economic and non-economic costs. Think of costs of avoided damage.
- **Feasibility:** answers whether the necessary legal, administrative, financial, technical, etc. resources exist. Adaptations that can be implemented under the current operational framework will usually be favored.

Further criteria may include, depending on the context, e.g. political and social acceptance, urgency, potential for mitigation co-benefits, relative speed of implementation or benefits, “no regrets” potential, alignment with funding requirements or other eligibility criteria, alignment with policy priorities, etc.

Other relevant questions are “What happens if you don’t take a specific action?”; “If the adaptation measure is already being implemented, would it need additional funding to improve or to do more of the same?”

HINT: Rate all criteria the same way: 5 being positive in terms of implementation (e.g. high costs would be 1). Otherwise, you will face difficulties in calculating an overall score.



Matrix 4: Select adaptation measures based on criteria

L Adaptation options	N Criterion 1 Effectiveness	O Criterion 2 Costs	P Criterion 3 Feasibility	Q Criterion 4	R Overall evaluation	Mitigation potential (- / o / +)
<ul style="list-style-type: none"> • Use adapted seed varieties 	5	2 <i>(quite costly, also implementation costs must be considered)</i>	4 <i>(technology exists, quite feasible under current conditions)</i>	<i>If “no regret”: 5</i>	16/20	0 <i>(is neither a source nor a sink for GHG)</i>



Glossary

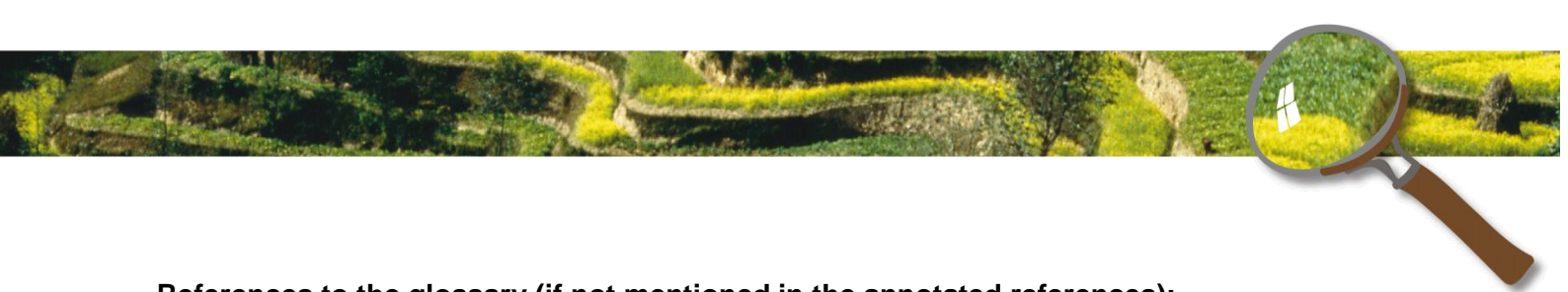
<p>Adaptation</p>	<p>In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate. (IPCC SREX report 2012)</p> <p>In order to distinguish ‘adaptation’ from to ‘regular development activities’, the OECD Guidance describes a continuum of four different levels of activities from development to climate change adaptation (reference to WRI 2007):</p> <ol style="list-style-type: none"> 1 Activities that increase human development and address drivers of vulnerability, e.g. gender initiatives, livelihood enhancement efforts. 2 Activities that build response capacity, often in directly affected sectors, e.g. natural resource management, weather monitoring. 3 Activities that aim at managing climate risks, mostly through strategic use of climate information, e.g. disaster response planning, drought resistant crops. 4 Activities that confront climate change by addressing concrete impacts, e.g. relocation of communities in response to sea-level rise.
<p>Adaptation of ecosystems</p>	<p>Adapting ecosystems and ecosystem management to climate change in order to maintain their services which can become necessary in order to sustain ecosystem services under the pressure of a changing climate.</p>
<p>Adaptive Capacity</p>	<p>The IPCC SREX report defines adaptive as the combination of the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities.(IPCC SREX report 2012)</p>
<p>Biodiversity</p>	<p>The variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part. This includes diversity within species (genetic diversity), between species and of ecosystems, with corresponding elements, functions and structures. The different levels and aspects of biodiversity directly and indirectly contribute to ecosystem goods and services (CBD 1992).</p>
<p>Climate</p>	<p>The weather averaged over a long period of time, typically 30 years or more (IPCC 2001).</p>
<p>Climate Change</p>	<p>A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. (UNFCCC)</p>



Climate Variability	The variations in the mean state and other statistics (e.g., standard deviations, the occurrence of extremes) of the climate on all spatial and temporal scales beyond that of individual weather events. Examples of climate variability include interannual El Niño and La Niña events that occur every two to seven years and influence weather patterns over vast regions of the globe (IPCC 2011).
Climate Proofing	Methodological approach aimed at incorporating issues of climate change into development planning at national, sectoral, local and project level. The approach can be applied in the planning phase or when revising plans. Properly implemented, it makes a given plan or investment more “climate-proof” (adapted from GTZ 2010).
Ecosystem-based Adaptation	The use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change. As one of the possible elements of an overall adaptation strategy, ecosystem-based adaptation uses the sustainable management, conservation, and restoration of ecosystems to provide services that enable people to adapt to the impacts of climate change. (CBD, IUCN 2010).
Ecosystem	A community of plants, animals and smaller organisms that live, feed, reproduce and interact in the same area or environment (IUCN 2010). It is a dynamic complex of animals, plants and microorganisms and their non-living environment interacting as a functional unit, and depending on one another. If one part is damaged it can have an impact on the whole system. Humans are an integral part of ecosystems. Ecosystems can be terrestrial or marine, inland or coastal, rural or urban. They can also vary in scale from global to local. Examples of ecosystems include forests, wetlands, open ocean, coastal, coral reefs, inland water, drylands, desert, cultivated (e.g. cropland or pasture) and urban ecosystems.
Ecosystem services	The goods and services provided by the environment that benefit and sustain the well-being of people. These services come from natural (e.g. tropical forests) and modified ecosystems (e.g. agricultural landscapes). While there is no single, agreed method of categorizing all ecosystem services, the Millennium Ecosystem Assessment (MEA) framework of provisioning, regulating, supporting and cultural services is widely accepted and seen as a useful starting point.
Exposure (to climate hazards)	The presence (location) of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected. (IPCC SREX report 2012)
Impact (CC)	Effects on natural and human systems. The IPCC AR5 further elaborates: Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. Impacts are also referred to as consequences and outcomes. The impacts of climate change on geophysical systems, including floods, droughts, and sea level rise, are a subset of impacts called physical impacts



Hazard	The potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources. (IPCC SREX report 2012)
Mitigation co-benefit	The potential of an adaptation measure to also have positive benefits for mitigation by reducing greenhouse gas emissions.
No regret option	Adaptation actions that benefit development and are justified regardless of climate change.
Resilience	The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions. (IPCC SREX report 2012)
Sensitivity	The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise). (IPCC 2014)
System of interest	The 'system of interest' is the unit you chose to assess with respect to your question. You may determine your system of interest at different levels, e.g. a single crop system, an ecosystem, a region – depending on the objective of your analysis. (Imagine looking at your house from different angles.) Elsewhere, you may find 'system of interest' called 'exposure unit'.
Vulnerability	The propensity or predisposition to be adversely affected. (IPCC SREX report 2012). Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (IPCC 2014).
Weather	The atmospheric conditions at a particular place in terms of air temperature, pressure, humidity, wind speed, and rainfall. Weather is what is happening now or is likely to happen in the very near future. You can observe the weather by looking outside to see if it is raining, windy, sunny, or cloudy. You can tell how hot or cold it is by looking at a thermometer.



References to the glossary (if not mentioned in the annotated references):

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