Climate impact assessment Guidance: Adaptation

**Version 1.1**

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Jeroen Oomkens1, Eva Keller2

1 Oomkens Consultancy, WesselIlckenstraat 18, 1311RH Almere, Netherlands

2 Climate-KIC, Hochstrasse 60, 8044 Zurich, Switzerland

**www.**[**climate-kic.org**](http://www.eit.europa.eu)

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# 1. Introduction

The climate impact assessment guidance for adaptation is a technical document for Climate-KIC project proponents to assist in the narrative of climate relevance of the adaptation to climate change proposition. It informs Climate-KIC project proponents to consider the adaptation to climate change contribution and relevance. In addition, the guidance pursues uniform climate impact results to all types of adaptation project.

To increase resilience and adaptive capacity to climate change, qualitative and quantitative aspects are considered in this guidance document. Climatological data, scientific papers or conducted field experiments are valid quantitative information to support the climate relevance narrative.

For completing the climate impact assessment, the template in ANNEX I should be applied. In ANNEX II, two case studies illustrate how this guidance is used to assess the potential climate impact of the Climate-KIC adaptation project.

The climate impact assessment guidance draws upon existing frameworks and lessons learned from partners and scientific literature as well as other internationally accepted methodologies.

# 2. Key concepts

The following set of definitions1 and concepts are key to understanding and participating in the discourse of adaptation to climate change. Application of the definitions and concepts can be found within two case studies of ANNEX II.

## 2.1 Definitions

Adaptation

In human systems, adaptation means 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, where human intervention may facilitate adjustment to expected climate.

Adaptive capacity

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.

Resilience

The ability of a system 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.

Vulnerability

The susceptibility of a system to be adversely affected by climate change.

## 2.2 Key concepts

Baseline scenario

The baseline scenario describes what would happen if the project would not be implemented. To assess the potential climate impact, Climate-KIC projects are compared to a certain baseline. The baseline scenario might be a ‘current baseline, in which case it represents an observable, present-day scenario. It might also be a historical baseline, which consists of historical observations and data, excluding the project scenario.

Project boundary

It describes the extent of the designated area of Climate-KIC project implementation in both spatial and temporal variables, as well as the pertaining climatological conditions. The project boundary is a description of the selected area, within which the Climate-KIC project is planned to be implemented. It resides within the system boundary (see Figure 1).

Project scenario

The project scenario describes what will occur when the proposed Climate-KIC project is implemented within the project boundaries. The result of implementation of the project scenario is the adaptation to the baseline scenario with the potential climate impact.

Process indicators

Climate-KIC projects depend on process indicators that reflect the process of adaptation to climate change when the project is implemented. Process indicators are specific, measurable, achievable, relevant and time-bound (SMART)[[1]](#footnote-1) and must define the fundamental processes of adaptation, both qualitative and quantitative of the project.

Outcome indicators

Climate-KIC projects seek a uniform outcome that align with sustaining and improving resilience of society. Therefore, the project outcome indicator reflects the anticipated adaptation to climate change result, the potential climate impact. Climate-KIC has defined the following outcome indicators:

1. Loss of lives that are prevented (%)
2. Assets protected (€)

Spatial variables

Spatial variables describe the spatial frame within which the Climate-KIC project is planned to be implemented. Climate impact is spatial variable and determines the project’s adaptation on scale. While extreme events have impact on local and regional scale, similarly slow trends, like gradual temperature increase, have impact from local to global scale.

Temporal variables

Temporal variables describe the time over which the adaptation to climate change through the Climate-KIC project implementation is taking place and is assessed. It considers the effects of climate change on different time-scales, like the exacerbating effects of extreme events as well as the slow-increase of global temperature rise. In addition, the project type is a determinant for the period, since solution projects offer typically a long-term climate impact, while enabling projects are more variable in terms of temporal scale.

System boundary

It describes the full extent of the area in similar spatial and temporal variables as well as the pertaining climatological conditions as defined in the project boundaries. The system boundary provides an outlook of the potential area in which the proposed Climate-KIC project can be adopted (see Figure 1).



Figure 1: Relationship between system boundary and project boundary.

Potential climate impact

Within the scope of this guidance, the potential climate impact describes the benefit of the proposed Climate-KIC project estimated in process indicators and outcome indicators. For Climate-KIC, the potential climate impact is the result of the comparison between the process indicators of the baseline scenario and the project scenario. The anticipated climate impact is successively expressed as an outcome indicator when a plausible relationship with the process indicator is presented. For Climate-KIC, the anticipated potential climate impact is expressed in:

1. Loss of lives that are prevented (%)
2. Assets protected (€)



Figure 2. Benefits from the implementation of a proposed adaptation solution

## 2.3 Project types

All Climate-KIC projects seek to develop and implement processes, technologies, services and tools that can be taken to the market by significantly improving the resilience to climate change impacts. Climate-KIC distinct two type of projects, and when applying this guidance, make sure you first identify which type of project it fits into.

Enabling the transition project (Enabling project)

Projects that enable transition to adaptation are intangible and do not physically maintain or increase adaptive capacity and resilience. However, when implemented it will ensure the adoption of solution.

|  |  |
| --- | --- |
| **Project** | **Outcomes** |
| Climate Data Factory (CDF)[Click here](http://www.climate-kic.org/case-studies/distributing-user-friendly-climate-projections-data-to-facilitate-adaptation-strategies/) | Climate services that facilitate and catalyze the diffusion of climate data to society. This will help reduce time to action for climate change adaptation. E.g., prior identification of flood prone areas by real-time monitoring the water saturation (%, saturation) within dykes to accelerate the deployment of mobile emergency dams in the earliest stage to reduce monetary loses (€) and potentially increases the % of loss of lives that are prevented. |
| Extreme Events for Energy Providers (E3P)[Click here](http://www.climate-kic.org/case-studies/climate-adaptation-strategies-in-the-energy-sector-as-a-response-to-extreme-weather-events/) | Utilizing climate change projections to assist energy providers to future proof their energy provisioning. E.g., smart grids (%, connected) offer decentralized energy in industry and reduces monetary loses (€) when centralized energy supply is interrupted by extreme events.  |
| Additional examples of these types of projects can be found on the Climate-KIC webpage: <http://www.climate-kic.org/projects/> |

Exploiting the Innovation Opportunity project (Solution project)

These types of projects develop concrete innovative solutions for climate change adaptation such as: technologies and products that lead to direct physical and tangible effects that increase adaptive capacity and resilience when implemented.

|  |  |
| --- | --- |
| **Project** | **Outcomes** |
| Introduction of salt tolerant crop | An increase of resilience in food security by replacing traditional crops with salt tolerant crops. E.g., total area (m2, agricultural field) cultivated with salt tolerant crops to increase yield and therefore ensures income generated (€) and the % of loss of lives that are prevented. |
| Prediction on ECOsystem Services(PRECOS)[Click here](http://www.climate-kic.org/case-studies/an-integrated-approach-for-preserving-natural-resources/) | To help local stakeholders to preserve natural resources, land, water and minimize their exposure to risk. E.g., the monitoring of soil evaporation rates (%, soil moisture) ensures, with appropriate irrigation in place, in times of severe droughts a sustainable crop yield and therefore ensures income generated (€).  |
| Blue Green Dream (BGD)[Click here](http://www.climate-kic.org/case-studies/using-water-and-vegetation-together-to-make-our-cities-more-liveable/) | The restoration and redevelopment of integrated ‘blue’ and ‘green’ infrastructure reduces the climate change impact. E.g., the installation of a blue roof on a business center mitigates flooding (m3, water storage) in the area which reduces monetary loses (€), and in times of drought it provides additional cooling (€, assets protected). |
| Additional examples of these types of projects can be found on the Climate-KIC webpage: <http://www.climate-kic.org/projects/> |

# 3. Climate impact assessment: adaptation

This chapter describes in more detail how the various steps of the climate impact assessment: adaptation have to be carried out for Climate-KIC projects. In ANNEX II, you can find two case studies following the stepwise climate impact assessment. The climate impact assessment has to be carried out by using the corresponding template in ANNEX I.

The following figure describes the stepwise approach:

Figure 1: Stepwise approach of the climate impact assessment: adaptation.

## 3.1 Step 1 – Describe your project’s climate impact story

The climate impact adaptation story describes in simple terms how the proposed Climate-KIC project is expected to build resilience in human and physical systems, by discussing how it contributes to maintaining or increasing the adaptive capacity and reducing vulnerability. The story must discuss why the proposed project is relevant, i.e. to what extent is the proposed project aligned with the priorities of the stakeholders. The story should provide a brief overview of the aim of the project as well as its climate relevance, a short summary of the outcomes from the following step-wise assessment.

**The climate impact story should include the following aspects:**

* Description of the specific climate change challenge the project tackles (e.g. vulnerability of human or natural systems of the climate change impact)
* Description of the baseline scenario (What would happen in the area of the project’s focus in absence of the proposed project)
* Description in very clear terms of what the proposed project sets out to achieve and how it is expected to build resilience in human or physical systems to the impact of climate change by discussing how it contributes to maintaining or increasing the adaptive capacity and reducing vulnerability. E.g., discuss how your project would help meet an EU country (ies) adaptation policy objectives. This demonstrates the proposing is relevant, EU institutions have already established that such is the case)

In order to demonstrate relevance and evidence of the climate impact story, third party documentation shall be used, which may include:

* Reports from independent institutions that are responsible for formulating adaptation policies
* Reports from private sectors, financial institutions, pension funds, etc.
* Peer reviewed literature
* Government data

## 3.2 Step 2 - Define the scope of your project

The project’s scope definition is necessary to successfully complete the climate impact assessment.

Project boundary

Within the proposed Climate-KIC project’s scope, it is important to define the project boundary by asking where and in what timeframe the project will be deployed. The project boundary describes the by climate change affected area within which the project solution is planned to be implemented. The project boundary focusses on the smallest spatial scale possible, and is typically detailed in its description due to the locality of the Climate-KIC project.

The project boundary has to be defined considering spatial and temporal variables of the project. It helps, when defining the project boundary, to ask the following questions:

|  |  |  |  |
| --- | --- | --- | --- |
| **SPATIAL****VARIABLES**  | *Where takes the adaptation place?*  | **URBAN AREAS** | Adaptation in urban areas is often subject to complex types of adaptation measures. An emphasis on prevention and risk reduction is the main task for decision makers to ensure public safety. Initiatives and regulations often follow a top-down sequence based on available local information. |
| **RURAL AREAS** | Although adaptation to climate change in rural areas have a similar emphasis on prevention and risk reduction, less complex types of adaptation may apply. In contrast to urban areas, the development of specific knowledge in rural-areas is regional, and the adoption for policy is bottom-up.  |
| **INDUSTRY** | Impact of climate change on industry is highly significant because of its economic impact. In addition, similar complex types of adaptation measures are apparent for urban areas. The spatial scale may be local, up to international. |
| **INFRASTRUCTURE** | The impact of climate change on infrastructure is similar to industry and urban areas. Infrastructure is in contrast to industry, part of the public domain and under government control. Therefore, policy and regulations dictate the strategy for adaptation to climate change measures. |
| **TEMPORAL VARIABLES** | *What is the expected timeframe for the adaptation to take effect?* | **0-5** | Depending on the type of adaptation to climate change measure, impacts have various timespans. Measures that reduce risks in regard to extreme events that may occur ones every 30 years, are ineffective for long periods of time. This holds also true for certain enabler projects, where actual effects can be measured ones implemented and solutions become effective.  |
| **5-10** |
| **10-20** |
| **20+** |

## 3.3 Step 3 – Define the baseline scenario

The project proponent must describe in both quantitative and qualitative terms the baseline scenario that is expected to exist in the absence of the proposed project. In establishing a baseline scenario for an adaptation solution or enabler, it is important for Climate-KIC to challenge assumptions about prevailing conditions and what these mean for the project objectives. It also implies a broader range of process indicators to determine the baseline scenario, which capture changes in environmental and socio-economic conditions, which may later become pertinent.

Baseline scenario description

The baseline scenario describes what would happen if the project outcome were not implemented and against which the potential climate impact is measured. The baseline scenario might be a ‘current baseline, in which case it represents an observable, present-day scenario. It might also be a historical baseline, which consists of historical observations and data, excluding the project scenario. Third party documentation shall be provided by the project proponent to support the chosen baseline scenario and its description. Project proponents may refer to the two following *approaches* to defining a baseline scenario, but may to resort to others as long as the assumptions that underpin them are clearly described:

1. ***Simplified and conservative baseline scenario approach***

In the simplified approach, the baseline builds upon quantitative historical data where climate change does not exist. This is only acceptable in cases where evidence from reputed resources other than the project proponent exist, that suggests that historical variability is likely to be exacerbated by climate change. Alternatively, baseline scenarios developed from climate predictions made by reputable third parties also suffice.

1. ***Baseline scenarios developed by host country authorities addressing adaptation to climate change***

In such cases the project proponent may refer to the baseline scenarios described in National Adaptation Plans (NAPs) for example. Selecting such baseline scenario has the advantage that alignment with the national adaptation strategy results in reduced risk that the baseline scenario may not be correct.

NOTE: Project proponents are encouraged however to put forward alternative approaches to determine the baseline scenario.

Choice of process indicators

To assess the potential climate impact of the proposed Climate-KIC project, project specific process indicators must be defined. The composition of process indicators offers a measure in quantitative and qualitative terms of the adaptation to climate change. A process indicator derives from a measureable physical process that reflects the adaptation capacity of the system (environment, economy or society). Since an adaptation to climate change solution result in numerous impacts, it is to be advised to use multiple process indicators. Make sure that they reflect the core of the project’s baseline scenario, project scenario and must successively derive into an outcome indicator described in step 5, e.g. the reduction of flood prone areas (m2) result in in the reduction of monetary loses (€) due to reduced damage.



Figure 3: Relationship between the process indicator and outcome indicator

## 3.4 Step 4 – Define the project scenario

Project scenario description

The project scenario describes what will occur when the Climate-KIC project is deployed within the project boundary defined in step 2. The project proponent shall describe the implemented solution of the project scenario supported by process indicator to substantiate the narrative. In terms of an enabler solution (e.g. a decision-making tool), this would include a project scenario that describes the early adoption of measures to address the effects of extreme events. The result of this decision-taking tool is the implementation of a physical and tangible adaptation to climate change solution, e.g. the reduction of flooded area in m2.

Choice of process indicators

In this step, the selected process indicators from the baseline scenario must be adopted to the project scenario. It is important to adopt the same process indicators as defined in step 3. Whereas the project’s process indicator in step 3 defines the in-situ baseline scenario, the process indicator in step 4 describes the project scenario and thus the situation where the proposed Climate-KIC project is implemented.

## 3.5 Step 5 – Determine the potential climate impact

For the purposes of this guidance, the potential climate impact of the proposed Climate-KIC adaptation project is the result of the comparison between the baseline and project scenario. Since Climate-KIC projects seek a uniform outcome that aligns with sustaining and improving resilience of society, a plausible relationship is evident between the result of the comparison of process indicators and outcome indicator.

This outcome and plausible relationship is described in a narrative and successively the selected outcome indicator(s) expresses the overall potential climate impact of the Climate-KIC project in a uniform unit.

First, the process indicators defined for baseline and project scenario has to be compared. The result gives a first indication of the potential climate impact and serves as a base for the following transition to the outcome indicators. The comparison of process indicators should reflect the project’s adaptation to climate change in clear terms.

In a second step, the relationship between the process indicators and the outcome indicators has to be descibed. The project’s performance must be described as one or both designated outcome indicators. It is important to substantiate the relationship between the process and outcome indicator as well as the decision of outcome indicator in the narrative.

For Climate-KIC, the project’s potential climate impact is expressed in:

1. Loss of lives that are prevented (%)
2. Assets protected (€)

For the first outcome indicator, a narrative description of the relationship between the process indicator and the outcome indicator is expected. For the second outcome indicator, a quantitative result is expected.

System boundary

The area within which the Climate-KIC project is expected to be adopted on a larger scale has to be described. The system boundary describes the full extent of the area of adoption, considering similar spatial and temporal terms, as well as pertaining climatological conditions as defined in the project boundaries. The difference between the selected project boundary and potential system boundary offer alignment with Climate-KIC’s inquiry for projects that cater upscale potential. To do so, project proponent should identify other locations within the region, country or even globally, facing similar climatological conditions in similar spatial and temporal conditions as in the project scenario where the Climate-KIC project additionally can be implemented

## Final Remarks

Please ensure you are using the template (see ANNEX I) for completing the climate impact assessment.

## Further Information and Support

For further support or any further questions, please contact the Climate Accounting team of Climate-KIC via [climate.accounting@climate-kic.org](http:///h)

# ANNEX

# Annex I: Template

Climate impact assessment template: Adaptation

**Version 1.1**

Project Name:

Submitted by:

Date:

Step 1 - Describe your project’s climate impact story

*Please convey the climate impact story of your project using a maximum of 2’500 characters, with spaces.*

|  |
| --- |
| … |

Step 2 - Define the scope of your project

**Spatial variables**

*Describe where the project is planned to be implemented.*

|  |
| --- |
| … |

**Temporal variables**

|  |
| --- |
| … |

*Describe the expected time over which* *the adaptation is taking place.*

**Describe the project boundaries**

*Describe in a narrative the boundaries of the project area affected by climate change.*

|  |
| --- |
| ... |

Step 3 - Define the baseline scenario

**Describe the baseline scenario**

*Describe in both quantitative and qualitative terms the baseline scenario that is expected to exist in the absence of the proposed project solutions.*

|  |
| --- |
| … |

**Define the process indicators**

*Define relevant process indicators for your project. Please include to each indicator a description, where it derived from, to what system it pertains, whether it is quantitative or qualitative, the unit it is expressed in, and a number to measure against.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PROCESS INDICATOR** | **SYSTEM** | **QUANTITATIVE****or****QUALITATIVE** | **UNIT** | **STEP 3:**BASELINE SCENARIO |
| **INDICATOR** | **Environmental****Economic****Social** |  |  |  |
| DESCRIPTION |
| *Derived from:*  |

Step 4 - Define the project scenario

**Describe the project scenario**

|  |
| --- |
| … |

*Describe in both quantitative and qualitative terms what will occur when the proposed adaptation solution is deployed within the project boundary.*

**Define the process indicators**

*Apply the process indicators defined for the Baseline scenario (Step 3) to the project scenario.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PROCESS INDICATOR** | **SYSTEM** | **QUANTITATIVE****or****QUALITATIVE** | **UNIT** | **STEP 4:**PROJECT SCENARIO |
| **INDICATOR** | **Environmental****Economic****Social** |  |  |  |
| DESCRIPTION |
| *Derived from:*  |

Step 5 - Potential climate impact

**Process indicators**

*Compare the process indicators of the baseline and project scenario and explain the results.*

|  |
| --- |
| … |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **PROCESS INDICATOR** | **SYSTEM** | **QUANTITATIVE****or****QUALITATIVE** | **UNIT** | **STEP 3:**BASELINE SCENARIO | **STEP 4:**PROJECT SCENARIO | IMPACT |
| **INDICATOR** | **Environmental****Economic****Social** |  |  |  |  | ▲▼▲▼ |
| *DESCRIPTION* |

**Outcome indicators**

***Loss of lives that are prevented (%)***

*Provide a narrative description of the relationship between the process indicator and this outcome indicator.*

|  |
| --- |
| … |

***Assets protected (€)***

*Provide a description of the relationship between the process indicator and this outcome indicator including a quantitative result.*

|  |
| --- |
| … |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **OUTCOME INDICATOR** | **SYSTEM** | **QUANTITATIVE****or****QUALITATIVE** | **UNIT** | IMPACT | **CLIMATE IMPACT**  |
| **INDICATOR** | **Environmental****Economic****Social** |  |  |  |  |
| *DESCRIPTION* |

**System boundary**

*Define the system boundary to provide an outlook for the potential uptake of the proposed adaptation solutions, other than within the project boundary.*

|  |
| --- |
| … |

# ANNEX II: Case studies

Climate impact assessment: Adaptation

**Version 1.1**

Project Name: Introduction of participatory water management in urban areas

Submitted by:

Date:

Step 1 - Describe your project’s climate impact story

|  |
| --- |
| The current water management system needs to be improved. This not only requires a broader collaboration between the affected stakeholders but also a higher degree of information exchange. In the field of participatory water management sharing responsibilities and mutual dependency between stakeholders may contribute to explore new ways of collecting and distributing information. The environmental effects of climate change in the City of Rotterdam has, in retrospect, been moderate. Although in recent years, intensified precipitation in excess of 7–8 mm h−1, caused serious stress in several locations in 7 different neighborhoods, with a total surface area of 7ha. The sewage system exceeds its discharge capacity.Accurate climatological data (obtained from: KNMI) about extreme weather are readily available for the City of Rotterdam of the last 30 years. The sewage system is currently 20 years old, and in terms of coping capacity, adequate for a 1/100-year extreme event. For the next 20 years it is to be expected that minor maintenance or replacement is required if climate change does not further intensify. However, the current maximum discharge of the sewage system cannot cope with the forecasted intensification of extreme weather events. Novel governance will enable collaboration between professionals and non-professionals to provide a solid knowledge base for the adoption of adaptation to climate change solutions. Implementing novel governance will ensure the uptake of knowledge by local urban stakeholders to address the current challenges of extreme events and slow change in climatic conditions. The results of participatory monitoring of engaged stakeholders will provide specific local data on discharge rates and infiltration capacity within the area. This information combined with the embedded governance structure; ensure a robust initiative for new urban spatial planning. An increase in resilience of the environmental, social, economic and governance system is to be expected as a result of this project. In environmental terms more green areas will result in an increase of permeable area. The reduction of water disturbance will positively contribute to the well-being of the stakeholders. The economic impact is significant as well since insurance claims will reduce. In addition, the collaboration between the local government and stakeholders gained trust.Gaitan, S., Veldhuis, J. T., Spekkers, M., & Giesen, N. V. D. (2012, November). Urban vulnerability to pluvial flooding: complaints location on overland flow routes. In *Proceedings of the 2nd European Conference on Flood Risk Management FLOODrisk* (pp. 338-339).Arts, B., & Goverde, H. (2006). The governance capacity of (new) policy arrangements: A reflexive approach. In Institutional dynamics in environmental governance (pp. 69-92). Springer Margerum, R. D., & Robinson, C. J. (2015). Collaborative partnerships and the challenges for sustainable water management. Current Opinion in Environmental Sustainability, 12, 53-58.Lu, P., & Stead, D. (2013). Understanding the notion of resilience in spatial planning: A case study of Rotterdam, The Netherlands. Cities, 35, 200-212.Ten Veldhuis, J. A. E. (2014). Rotterdam and surroundings hit by extreme rainfall, October 2013. *Druppel; magazine of the Student Society of Water Management of the TU Delft, 24.2014*. |

*Please convey the climate impact story of your project using a maximum of 2’500 characters, with spaces.*

Step 2 - Define the scope of your project

**Spatial variables**

*Describe where the project is planned to be implemented.*

|  |
| --- |
| Within 7 neighborhoods (7ha) in the City of Rotterdam, Netherlands |

**Temporal variables**

*Describe the expected time over which* *the adaptation is taking place.*

|  |
| --- |
| Short term policy measures: 0-5 years, Long term solutions: 0 – 20 years |

**Describe the project boundaries**

*Describe in a narrative the boundaries of the project area affected by climate change.*

|  |
| --- |
| The affected areas within the city are local on single city block scale (1ha), but despite their locality multiple areas within the city face similar challenges. The current sewage is adequate for a 1/100-year intense rainfall event. However, on average once every 5-year heavy local rainfall will result in immediate overload of the sewage system. This is inheriting to the sewage network, which is designed with nodes. A node is like an intersection. This type of design in combination with increased heavy rainfall forecasts will result in flooded streets, homes and industry. And although these heavy rainfalls pose a minor threat to the society, the economic impact is severe. By engaging stakeholder participation and successively enabling participatory monitoring, valuable environmental information can be shared amongst professional and non-professional stakeholders which may catalyse both short (0-5 y.) and long (0-20 y.) term solutions that may counter future flooding’s. E.g. a short term solution may comprise subsidies for long term solutions like green or blue roofs. Stakeholder incentives like greening gardens are also considered.Ten Veldhuis, J. A. E. (2014). Rotterdam and surroundings hit by extreme rainfall, October 2013. *Druppel; magazine of the Student Society of Water Management of the TU Delft, 24.2014*. |

Step 3 - Define the baseline scenario

**Describe the baseline scenario**

|  |
| --- |
| Accurate climatological data from local, regional and national sources about extreme weather are readily available for the city for the last 30 years. The sewage system is currently 20 years in place, and in terms of coping capacity, adequate for a 1/100-year extreme event. For the next 20 years it is to be expected that minor maintenance or replacement is required IF climate change does not further intensify. The current maximum discharge of the sewage system is 150l/s/ha and depended on the type of spatial planning e.g. domestic, park, city centre or industry. Preliminary GIS analysis on the inclination and total amount of hard surface versus permeable surface is calculated to map the potential drainage capacity. Furthermore, the distribution of insurance claims, complaints and experienced disturbance are mapped. This enabled professional stakeholders to determine 7 hot spots that are prone to flooding.Gaitan, S., Veldhuis, J. T., Spekkers, M., & Giesen, N. V. D. (2012, November). Urban vulnerability to pluvial flooding: complaints location on overland flow routes. In *Proceedings of the 2nd European Conference on Flood Risk Management FLOODrisk* (pp. 338-339). |

*Describe in both quantitative and qualitative terms the baseline scenario that is expected to exist in the absence of the proposed project solutions.*

**Define the process indicators**

*Define relevant process indicators for your project. Please include to each indicator a description,* *where it derived from, to what system it pertains, whether it is quantitative or qualitative, the unit it is expressed in, and a number to measure against.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PROCESS INDICATOR** | **SYSTEM** | **QUANTITATIVE****or****QUALITATIVE** | **UNIT** | **STEP 3:**BASELINE |
| **PERMEABLE SURFACE** | **Environmental** | QUANTITATIVE | **M2** | 5 x105  |
| NOTE: Total permeable surface within the area |
| *Derived from: Conducted GIS analysis, and local government information* |
| **HOT SPOTS** | **Environmental** | QUANTITATIVE | **(#)** | 7 |
| *NOTE:* Areas where the threshold of 150l/s/ha is exceeded within 60 minutes |
| *Derived from: Conducted GIS analysis, and local government data, insurance company data* |
| **SOCIAL DISTURBANCE** | **Social** | QUANTITATIVE | **(#)** | 1’500 |
| NOTE: Affected people by flooding |
| *Derived from: local government information* |
| **INSURANCE CLAIMS** | **Economic** | QUANTITATIVE | **(€)** | 1,2x107 |
| NOTE: Damages reported at insurance companies per hot spot |
| *Derived from: Insurance Company data* |

Step 4 - Define the project scenario

**Describe the project scenario**

|  |
| --- |
| Non-governmental stakeholders collaborate to increase the amount of permeable area by sacrificing each a minimum of 2 m2 within their garden if that space is available. Additionally, the city investigated in which areas more green is possible. This result in a significant increase of permeable area and a permanent adaptation solution for 2 identified hot spots, which reduced the number of affected people by 600. Other hot spots experience the positive effects as well; however, the results border the set criteria of 60 minutes. The economic impact result in a decrease of 3 million Euros in insurance claims.Spekkers, M. H., Clemens, F. H. L. R., & ten Veldhuis, J. A. E. (2015). On the occurrence of rainstorm damage based on home insurance and weather data. Natural Hazards and Earth System Sciences, 15(2), 261-272. |

*Describe in both quantitative and qualitative terms what will occur when the proposed adaptation solution is deployed within the project boundary.*

**Define the process indicators**

*Apply the process indicators defined for the Baseline scenario (Step 3) to the project scenario.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PROCESS INDICATOR** | **SYSTEM** | **QUANTITATIVE****or****QUALITATIVE** | **UNIT** | **STEP 4:**PROJECT SCENARIO |
| **PERMEABLE SURFACE** | **Environmental** | QUANTITATIVE | **M2** |  7.5x107 |
| NOTE: Total permeable surface within the area |
| *Derived from: Conducted GIS analysis, and local government information* |
| **HOT SPOTS** | **Environmental** | QUANTITATIVE | **(#)** |  2 |
| *NOTE:* Areas where the threshold of 150l/s/ha is exceeded within 60 minutes |
| *Derived from: Conducted GIS analysis, and local government data, insurance company data* |
| **SOCIAL DISTURBANCE** | **Social** | QUANTITATIVE | **(#)** | 600 |
| NOTE: Affected people by flooding |
| *Derived from: local government information* |
| **INSURANCE CLAIMS** | **Economic** | QUANTITATIVE | **(€)** | 3,0x106 |
| NOTE: Damages reported at insurance companies per hot spot |
| *Derived from: Insurance Company data* |

Step 5 - Potential climate impact

**Process indicators**

*Compare the process indicators of the baseline and project scenario and explain the results.*

|  |
| --- |
| The process indicators reflect the climate impact which are described by the permeable area that is increased as result of the stakeholder participation. The increase of surface area reduces stress on the sewage system, because more water is absorbed in the soil. The adoption of more green space resulted in the alleviation of stress on the sewage system of all hot spots, although 2 areas are no considered climate change proof. This results in a decrease of insurance claims.  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **PROCESS INDICATOR** | **SYSTEM** | **QUANTITATIVE****or****QUALITATIVE** | **UNIT** | **STEP 3:**BASELINE SCENARIO | **STEP 4:**PROJECT SCENARIO | IMPACT |
| **PERMEABLE AREA** | **Environmental** | QUANTITATIVE | **M2** | 5x106  | 7,5x107 | ▲2,5x101 |
| *NOTE: Size of permeable surface (city total)* |
| **HOT SPOTS** | **Environmental** | QUANTITATIVE | **(#)** | 7 | 2 | ▼5 |
| *NOTE: Areas where the threshold of 150l/s/ha is exceeded in 60 minutes.* |
| **DISTURBANCE** | **Social** | QUANTITATIVE | **(#)** | 1.500 | 600 | ▼900 |
| *NOTE: Number of affected people by flooding in their daily routine.* |
| **INSURANCE CLAIMS** | **Economic** | QUANTITATIVE | **(€)** | 1.2x107 | 3,0x106 | ▼2,8x101 |
| *NOTE: Accumulated damages reported at insurance companies for all hot spots* |

**Outcome indicators**

***Loss of lives that are prevented (%)***

*Provide a narrative description of the relationship between the process indicator and this outcome indicator.*

|  |
| --- |
| Not applicable |

***Loss of lives that are prevented (%)***

*Provide a description of the relationship between the process indicator and this outcome indicator including a quantitative result.*

|  |
| --- |
| The economic impact expressed as insurance claims is directly adopted as outcome indicator for this project. Damages avoided by the incentives derived from participatory water management will result in an annual reduction of costs for insurance companies. Insurance companies estimated that per local incident, the costs by reducing the amount of critical hot spots insurance claims also have significant impact at scale.Spekkers, M. H. (2014). Interactive comment on “On the occurrence of rainstorm damage based on home insurance and weather data” by MH Spekkers et al. |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **OUTCOME INDICATOR** | **SYSTEM** | **QUANTITATIVE****or****QUALITATIVE** | **UNIT** | IMPACT | **CLIMATE IMPACT**  |
| **INSURANCE CLAIMS** | **Economic** | QUANTITATIVE | **(€)** | 2,8x101 | ▼2,8x101 |
| *NOTE: Accumulated damages reported at insurance companies for all hot spots* |

**System boundary**

*Define the system boundary to provide an outlook for the potential uptake of the proposed adaptation solutions, other than within the project boundary.*

|  |
| --- |
| This project seeks solutions in terms of participatory water management within urban areas that are prone to flooding. Cities getting ever larger but often do not consider the effects exacerbating precipitation. It starts with the urgency of local governments within neighbourhoods for the awareness of the social disturbance and economic impact of flooding in urban areas. With this awareness in place, the adoption of blue and green solutions becomes significantly feasible. Large cities, like Rotterdam and Jakarta implemented large green and blue solution to alleviate the established water sewage infrastructure for extreme events. However, with the input of non-governmental stakeholders the adoption of solutions and successively climate impact is significantly improved. N.Ranger, A.Lopez (2011) The Role of Climate Change in Urban Flood Risk Management Today, Grantham Research Institute on Climate Change and the Environment, Centre for Climate Change Economics and PolicyBudiyono, Y., Aerts, J., Brinkman, J., Marfai, M. A., & Ward, P. (2015). Flood risk assessment for delta mega-cities: a case study of Jakarta. Natural hazards, 75(1), 389-413.Schewenius, M., McPhearson, T., & Elmqvist, T. (2014). Opportunities for increasing resilience and sustainability of urban social–ecological systems: insights from the URBES and the cities and biodiversity outlook projects. Ambio, 43(4), 434-444. |

Climate impact assessment: Adaptation

**Version 1.1**

Project Name: Introduction of salt tolerant crops

Submitted by:

Date:

Step 1 - Describe your project’s climate impact story

|  |
| --- |
| In a large region within Northern Spain with agricultural fields (100ha), the soil is slowly degrading because of longer periods of drought interchanging with intense periods of wet. The soil within this region is already saline and prone to accelerated salinization, and crops yields decrease as result. The climatic conditions are prevalent to this area, but are expected to exacerbate in the coming 20 years. During these periods of drought additional irrigation is needed to keep the soil moisture content up to the level that is acceptable for the crops to survive. And during the wet periods insufficient drainage is the main cause for water lodging. The slow trend of extending periods of drought and wet poses a threat to the region in terms of aquifer depletion and soil contamination that may irreversible change to a saline environment. This would imply that most of the farmers go out of business if no affordable measures are being taken to combat the impending change. The solution offered is introducing salt tolerant crops on several plots within the region where the necessity is most urgent. 6 farms volunteered to be part of the experiment of introducing salt tolerant crops. The introduction of this measure to the farmers will result in further degradation of the agricultural fields, and a transition to salt tolerant farming. An immediate increase in resilience of the social and economic system may be the result of this solution. Although the region is not under the authority of any nature conservation law, additional research is necessary to investigate the long term implication on the environmental system. The farmers are also aware that in case of failure of the experiment their agricultural field is irreversible changed to a saline regime. It is also unknown what the effect on the governance system may be, although suggestions are made towards the support and adoption these kinds of transitions in national adaptation plans.Wichelns, D., & Qadir, M. (2014). Achieving sustainable irrigation requires effective management of salts, soil salinity, and shallow groundwater. Agricultural Water Management |

*Please convey the climate impact story of your project using a maximum of 2’500 characters, with spaces.*

Step 2 - Define the scope of your project

**Spatial variables**

*Describe where the project is planned to be implemented.*

|  |
| --- |
| 6 individual farms with a total area of 100ha within a region of Northern Spain |

**Temporal variables**

*Describe the expected time over which* *the adaptation is taking place.*

|  |
| --- |
| Boundary temporal extent: Long term 0 - 20+ years |

**Describe the project boundaries**

*Describe in a narrative the boundaries of the project area affected by climate change.*

|  |
| --- |
| The environmental, social and economic impact is significant in the most urgent areas with eutrophication. Six farms in a region of Northern Spain, are divided over 100ha of agricultural land, and are suffering significant loses in crop yield for the last 10 years. Their soil is degrading and their confidence for future business potential is diminishing. The farmers anticipate they go out of business within the next 5 years if no suitable alternative is presented. Furthermore, in this same region an area of 420 Km2 of agricultural land is potentially threatened by the same degradation within the next 20 years. http://esdac.jrc.ec.europa.eu/public_path/salinisation.pngFigure adopted from: http://esdac.jrc.ec.europa.eu/content/saline-and-sodic-soils-european-union |

Step 3 - Define the baseline scenario

**Describe the baseline scenario**

|  |
| --- |
| The baseline for this region is established on the trend of historical climatological data and crop yields (80.000 ~ 120.000 €/Yr.) per farm for the last 25 years. The environmental conditions (e.g. hydrology, soil, tillage and crop rotation) vary slightly within the region, but these slight variations are the root cause of failed yields. For example, assume that the irrigation needs are predicted to increase over coming years as a result of climate change, and that keeping the salinity in check is responsible for 60% of the water used for irrigation in the system boundary that has been defined and that it demands 80 Million m3/y. However, recent experience shows that during the dry season, pumping water for irrigation is banned partially over a certain number of months, reducing the amount of water that can be used for irrigation to 70 Million m3/y. To mitigate the effects of unavailable water and successively increasing salinization, valuable solutions may offer an answer to their challenges. However, their collaboration resulted into the introduction of salt tolerant crops, rather than investing in proven but very costly solutions to ‘save’ the combined 100ha of land. The numbers forwarded from research and the possible solutions to mitigate the circumstance resulted in low confidence of the 6 farmers.  |

*Describe in both quantitative and qualitative terms the baseline scenario that is expected to exist in the absence of the proposed project solutions.*

**Define the process indicators**

*Define relevant process indicators for your project. Please include to each indicator a description,* *where it derived from, to what system it pertains, whether it is quantitative or qualitative, the unit it is expressed in, and a number to measure against.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PROCESS INDICATOR** | **SYSTEM** | **QUANTITATIVE****or****QUALITATIVE** | **UNIT** | **STEP 3:**BASELINESCENARIO |
| **SALINIZED SOIL** | **Environmental** | QUANTITATIVE | **M2/Yr.** | 1,0x108  |
| NOTE: Salinization, thus soil degradation continues as result of this solution |
| *Derived from: Farmer data, Research institute data, EU data* |
| **CROP YIELD** | **Economic** | QUANTITATIVE | **€/Yr.** | 5,0x104 € |
| NOTE: Investing in salt tolerant crops demands market specification |
| *Derived from: Farmer data* |
| **BUSINESS OUTLOOK** | **Social** | QUALITATIVE | **1 to 5** | 1 |
| NOTE: Confidence in the opportunity in which land degradation is beneficial |
| *Derived from: Farmer data, Research data* |

Step 4 - Define the project scenario

**Describe the project scenario**

*Describe in both quantitative and qualitative terms what will occur when the proposed adaptation solution is deployed within the project boundary.*

|  |
| --- |
| The adoption of salt tolerant agriculture in the designated areas results improved food security as well as an increase of crop yield. The saline regime will remain and increase in salt concentration. For the farmers the option to grow salt tolerant crops is a positive development which results in a positive business outlook. |

**Define the process indicators**

*Apply the process indicators defined for the Baseline scenario (Step 3) to the project scenario.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PROCESS INDICATOR** | **SYSTEM** | **QUANTITATIVE****or****QUALITATIVE** | **UNIT** | **STEP 4:**PROJECTSCENARIO |
| **SALINIZED SOIL** | **Environmental** | QUANTITATIVE | **M2/Yr.** | 1,0x105 |
| NOTE: Salinization, thus soil degradation continues as result of this solution |
| *Derived from: Farmer data, Research institute data, EU data* |
| **CROP YIELD** | **Economic** | QUANTITATIVE | **€/Yr.** | 5,0x105 € |
| NOTE: Investing in salt tolerant crops demands market specification |
| *Derived from: Farmer data* |
| **BUSINESS OUTLOOK** | **Social** | QUALITATIVE | **1 to 5** | 4 |
| NOTE: Confidence in the opportunity in which land degradation is beneficial |
| *Derived from: Farmer data, Research data* |
| NOTE: Qualitative indicators are based on Likert scale observations, where 1 to 5 equals *very unsatisfied* to respectively *very satisfied*. |

Step 5 - Potential climate impact

**Process indicators**

*Compare the process indicators of the baseline and project scenario and explain the results.*

|  |
| --- |
| The economic impact expressed as crop yield is directly adopted as outcome indicator for this project. It should be noted that the salinization of soils progresses in the future. This is however, compared to traditional agriculture, regarded as a degradation process, which result in a decrease of resilience of the area. However, with the adoption of salt tolerant crops, the salinized soils offer an opportunity. Therefore, a potential environmental decrease in resilience is expected as outcome of project implementation, in contrast to the economic and social increase of resilience. |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **PROCESS INDICATOR** | **SYSTEM** | **QUANTITATIVE****or****QUALITATIVE** | **UNIT** | **STEP 3:**BASELINE SCENARIO | **STEP 4:**PROJECT SCENARIO | IMPACT |
| **SALINIZED SOIL** | **Environmental** | QUANTITATIVE | **M2/Yr.** | 1,0x108  |  1,0x105 | ▼ 1,01x103 |
| *NOTE: Salinization, thus soil ‘degradation’ continues as result of this solution.* |
| **CROP YIELD** | **Economic** | QUANTITATIVE | **€/ha/Yr.** | 5,0x104 |  5,0x105 | ▲ 1,0x101 |
| *NOTE: Result of investing in salt tolerant crops.* |
| **BUSINESS OUTLOOK** | **Social** | QUALITATIVE | **1 to 5** | 1 |  4 | ▲ 4 |
| *NOTE: Confidence in the opportunity in which land degradation is beneficial.* |

**Outcome indicators**

***Loss of lives that are prevented (%)***

*Provide a narrative description of the relationship between the process indicator and this outcome indicator.*

|  |
| --- |
| Not applicable |

***Loss of lives that are prevented (%)***

*Provide a description of the relationship between the process indicator and this outcome indicator including a quantitative result.*

|  |
| --- |
| By accepting soil degradation and alternatively the application of salt tolerant crops, the environmental system is irreversible changed to a new resilient regime. In the perception of farmers that grow salt tolerant crops the soil is not degrading, the opposite holds true for farmers that are reliant on salt intolerant crops. Therefore, the outcome expressed in crop yield would result into € 1,0x101when the necessity for salt tolerant crops was immediate for the affected farmers. |

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| --- | --- | --- | --- | --- | --- |
| **OUTCOME INDICATOR** | **SYSTEM** | **QUANTITATIVE****or****QUALITATIVE** | **UNIT** | **IMPACT** | **CLIMATE IMPACT**  |
| **CROP YIELD** | **Economic** | QUANTITATIVE | **(€/Yr)** |  1,0x101 | ▲ 1,0x101 |
| *NOTE: Result of investing in salt tolerant crops.* |

**System boundary**

*Define the system boundary to provide an outlook for the potential uptake of the proposed adaptation solutions, other than within the project boundary.*

|  |
| --- |
| The adoption of salt tolerant agriculture determines an inevitable tipping point of the already salinized soils within the designated area. From this point onwards, only salt tolerant crops are suitable for agriculture on these fields, however, the soil eutrophication process will continue to exacerbate to the point no crop will survive. Unfortunately, this is not an isolated incident.**Extent of salt-affected soils**Several authors have attempted to estimate the extent of salt-affected soils in the last 30 years, for example: Using the FAO/UNESCO soil map of the world (1970-1980), FAO estimated that globally the total area of saline soils was 397 million ha and that of sodic soils 434 million ha. Of the then 230 million ha of irrigated land, 45 million ha (19.5 percent) were salt-affected soils; and of the almost 1 500 million ha of dryland agriculture, 32 million (2.1 percent) were salt-affected soils as indicated in the below table. Figures included arable and non-arable soils. |
| **Regions** | **Total area** | **Saline soils** | **%** | **Sodic soils** | **%** |
| Africa | 1899.1 | 38.7 | 2.0 | 33.5 | 1.8 |
| Asia and the pacific and Australia | 3107.2 | 195.1 | 6.3 | 248.6 | 8 |
| Europe | 2010.8 | 6.7 | 0.3 | 72.7 | 3.6 |
| Latin America | 2038.6 | 60.5 | 3.0 | 50.9 | 2.5 |
| Near East | 1801.9 | 91.5 | 5.1 | 14.1 | 0.8 |
| North America | 1923.7 | 4.6 | 0.2 | 14.5 | 0.8 |
| Total | 12781.3 | 397.1 | 3.1 | 434.3 | 3.4 |
| Oldeman, Hakkeling and Sombroek estimated in 1991 that the total area affected by waterlogging was over 10 million ha and that affected by salinity was over 76 million ha. They did not distinguish between irrigated and rainfed areas.Dregne et al estimated in 1991 that about 43 million ha of irrigated land in drylands were affected by various processes of degradation, mainly waterlogging, salinization and sodication. Umali estimated in 1993 that by that time 1-1.5 million ha were lost to salinization every year.Ghassemi et al estimated in 1995 that salinization of irrigated lands caused losses of annual income of about US$ 12 billion globallyNelson and Mareida estimated in 2001 that about 12 million ha of irrigated land may have gone out of production as a result of salinization.Data from FAO´s database Aquastat show that in some countries the area affected by salinity can be as high of 50% of the areas fully equipped for irrigationSome of these estimations are the result of expert judgment or the aggregation of statistics which have been collected by different methods, therefore they are difficult to compare. There is still the need for data on the rate of change in areas affected by salinization, sonication and waterlogging at regional and global level. |

# Annex III: Information and Tools to undertake the adaptation to climate change assessment steps

|  |  |  |  |
| --- | --- | --- | --- |
| **YEAR** | **TITLE**  | **REFERENCE** | **LINKS** |
| **2013** | Guidance on assessing vulnerability, impacts and adaptation  | UNEP PROVIA (2013) (VIA) | [Click here](http://static.weadapt.org/knowledge-base/files/1300/52865896ab2a4provia-guidance-nov2013-low-res.pdf) |
| **2013** | Framework for guiding monitoring and evaluation of climate adaptation policies and projects. | van de Sandt, Kaj; Klostermann, Judith; van Minnen, Jelle; Pieterse, Nico; van Bree, Leendert (2013): | [Click here](http://promise.klimaatvoorruimte.nl/pro1/publications/show_publication.asp?documentid=8515&GUID=2fecb99c-acb6-430f-aea2-60efa3f00f0e) |
| **2013** | How to Track Adaptation to Climate Change: A Typology of Approaches for National-Level Application | James D. Ford , Lea Berrang-Ford , Alex Lesnikowski, Magda Barrera and S. Jody Heymann (2013) | [Click here](http://www.ecologyandsociety.org/issues/responses.php/5732) |
| **2012** | Framework and guideline for project/programme evaluations,  | Adaptation Fund (AF) (2012) | [Click here](https://www.adaptation-fund.org/sites/default/files/Evaluation_framework.pdf) |
| **2012** | Adaptation Measures in the EU: Policies, Costs, and Economic Assessment. “Climate Proofing” of key EU policies.  | Altvater, S. et al. (2012), | [Click here](http://ftp.zew.de/pub/zew-docs/gutachten/ClimateProofing2012.pdf) |
| **2012** | Adapting to Climate Change: Assessing the World Bank Group Experience Phase III | IEG (2102) | [Click here](http://ieg.worldbankgroup.org/Data/reports/cc3_full_eval_0.pdf) |
| **2012** | Tracking Adaptation and Measuring Development (TAMD) framework | IIED (2012), | [Click here](http://pubs.iied.org/pdfs/17143IIED.pdf) |
| **2012** | Monitoring and Evaluation for Adaptation: Lessons from Development Cooperation Agencies | Lamhauge, N. et al. (2012), OECD Environment Working Paper No. 38, OECD. | [Click here](http://dx.doi.org/10.1787/5kg20mj6c2bw-en) |
| **2012** | Review of international experience in adaptation indicators.  | AEA (2012), AEA/R/ED 57591 Issue Number 3. | [Click here](http://hmccc.s3.amazonaws.com/ASC/2012%20report/AEA%20Global%20adaptation%20indicators%20review%20-%20final.pdf) |
| **2012** | Adaptation made to measure | BMZ (2012) | [Click here](https://login.mailingwork.de/-link2/1593/985/71/188/4/ca5f9/2fNaHlCCz8/0) |
| **2012** | Participatory Monitoring, Evaluation, Reflection and Learning for Community-based Adaptation: A Manual for Local Practitioners.  | Ayers, J., Anderson, S., Pradhan, S. and Rossing, T. (2012). CARE International and International Institute for Environment and Development. | [Click here](http://www.careclimatechange.org/files/adaptation/CARE_PMERL_Manual_2012.pdf) |
| **2012** | Local government response to the impacts of climate change: An evaluation of local climate adaptation plans.  | Baker, I./Peterson, A,/Brown, G./McAlpine, C. (2012), Landscape and Urban Planning 107, 127– 136 | [Click here](http://www.sciencedirect.com/science/article/pii/S0169204612001594) |
| **2011** | Adapting to climate change in the UK, measuring progress,  | Adaptation sub-committee (2011). ASC Progress Report 2011. | [Click here](http://archive.theccc.org.uk/aws2/ASC%202nd%20Report/ASC%20Adaptation%20Report%20Interactive_3b.pdf) |
| **2011** | Tracking progress for effective action: A framework for monitoring and evaluating adaptation to climate change.  | Sanahuja, Haris E. (2011) GEF Climate-Eval Community of Practice | [Click here](http://www.climate-eval.org/sites/default/files/studies/Climate-Eval%20Framework%20for%20Monitoring%20and%20Evaluation%20of%20Adaptation%20to%20Climate%20Change.pdf) |
| **2011** | Making Adaptation Count: Concepts and Options for Monitoring and Evaluation of Climate Change Adaptation.  | Spearman, H./McGray, M. (2011), | [Click here](http://pdf.wri.org/making_adaptation_count.pdf) |
| **2011** | Learning to ADAPT: Monitoring and evaluation approaches in climate change adaptation and disaster risk reduction – challenges, gaps, and ways forward  | Villanueva, P. S. (2011). (SCR Discussion Paper 9). Gland, Switzerland: IUCN. | [Click here](http://community.eldis.org/.59d49a16/Learning-to-ADAPT.pdf) |
| **2011** | Climate Adaptation – modelling water scenarios and sectorial impacts  | Flörke, M. et al. (2011), (ClimWatAdapt) | [Click here](http://climwatadapt.eu/sites/default/files/ClimWatAdapt_final_report.pdf) |
| **2010** | Establishment of an Indicator Concept for the German Strategy on Adaptation to Climate Change | Umweltbundesamt (UBA) (2010), | [Click here](http://www.umweltbundesamt.de/en/publikationen/establishment-of-an-indicator-concept-for-german) |
| **2010** | Synthesis Report on Efforts Undertaken to Monitor and Evaluate the Implementation of Adaptation Projects, Policies and Programmes and the Costs and Effectiveness of Completed Projects, Policies and Programmes, and Views on Lessons Learned, Good Practices, Gaps and Needs.  | UNFCCC (2010). FCCC/SBSTA/2010/5. United Nations Framework Convention on Climate Change, Bonn, Germany. | [Click here](http://unfccc.int/resource/docs/2010/sbsta/eng/05.pdf) |
| **2010** | Urban Regions: Vulnerabilities, Vulnerability Assessments by Indicators and Adaptation Options for Climate Change Impacts.  | Schauser et al. (2010), ETC/ACC Technical Paper 2010/12. | [Click here](http://acm.eionet.europa.eu/reports/docs/ETCACC_TP_2010_12_Urban_CC_%20Vuln_Adapt.pdf) |
| **2010** | Mainstreaming Adaptation to Climate Change in Agriculture and Natural Resources Management Projects.  | World Bank (2010). Guidance note 8. | [Click here](http://siteresources.worldbank.org/EXTTOOLKIT3/Resources/3646250-1250715327143/GN8.pdf) |
| **2010** | Towards a characterisation of adaptive capacity: a framework for analysing adaptive capacity at the local level.  | Jones, L. et al (2010), ODI Background Notes. | [Click here](http://www.odi.org.uk/publications/5177-adaptive-capacity-framework-local-level-climate) |
| **2010** | Participatory Tool on Climate and Disaster Risks. Integrating Climate Change and Disaster Risk Reduction into Community-level Development Projects,  | Keller, M. (2010), | [Click here](http://www.adaptationlearning.net/sites/default/files/CliDR%20Eng_Vers5_0.pdf) |
| **2010** | Participatory Tools and Techniques for Assessing Climate Change Impacts and Exploring Adaptation Options; Tool 10: Coping and Adaptation Strategies Assessment,  | Regmi, B.R. et al. (2010), | [Click here](http://www.forestrynepal.org/images/publications/Final%20CC-Tools.pdf) |
| **2009** | Development of Adaptation Indicators.  | Harley/van Minnen (2009), ETC/ACC Technical Paper 2009/6. | [Click here](http://acm.eionet.europa.eu/docs/ETCACC_TP_2009_6_Adaptation_Indicators.pdf) |
| **2009** | Evaluation of the Implementation of Finland’s National Strategy for Adaptation to Climate Change. Helsinki, Ministry of Agriculture and Forestry.  | Ministry of Agriculture and Forestry (2009) | [Click here](http://www.mmm.fi/attachments/mmm/julkaisut/julkaisusarja/2009/5IEsngZYQ/Adaptation_Strategy_evaluation.p) |
| **2009** | Bellagio Framework for Adaptation - Assessment and Prioritization, | WRI (2009) | [Click here](http://pdf.wri.org/working_papers/bellagio_framework_for_adaptation.pdf) |
| **2008** | Climate change vulnerability and adaptation indicators.  | Harley, M. et al. (2008), ETC/ACC Technical Paper 2008/9. | [Click here](http://www.seachangecop.org/sites/default/files/documents/2008%2012%20ETC%20-%20Climate%20change%20vulnerability%20and%20adaptation%20indicators.pdf) |
| **2008** | Evaluating adaptation to climate change from a development perspective | IDS (2008) International Development studies - | [Click here](http://www.ids.ac.uk/project/evaluating-adaptation-to-climate-change-from-a-development-perspective) |
| **2007** | Monitoring Framework for Climate Change Adaptation | UNDP  | [Click here](http://www.un.org/esa/sustdev/natlinfo/indicators/15Oct_2008/presentations_pdf/Bo%20Lim.pdf) |
| **2007** | Framework of Milestones and Indicators for Community-Based Adaptation | CARE  | [Click here](http://www.careclimatechange.org/tk/integration/en/quick_links/tools/monitoring_evaluation.html) |
| **2004** | UK Climate Change Impacts Programme | Defra | <http://www.ukcip.org.uk/>  |

1. S.M.A.R.T. Specific, Measurable, Achievable, Relevant, Time-bound Doran, G. T. (1981) “There’s a S.M.A.R.T. way to write management’s goals and objectives”, Management Review, Vol. 70, Issue 11, p35-36, 2p. [↑](#footnote-ref-1)