



**BINGO**  
a better future under  
CLIMATE CHANGE

**BRINGING INNOVATION TO ONGOING  
WATER MANAGEMENT**

**D5.7**

**Prioritisation between long list of  
adaptation measures (process/method)**

**May 2019**

[www.projectbingo.eu](http://www.projectbingo.eu)



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Horizon 2020 Societal challenge 5:  
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## BINGO

### Bringing INnovation to onGOing water management – a better future under climate change

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Not applicable

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**Short Summary (<250 words)**

This document provides a practical guideline to collecting and analysing measures for adaptation to climate change. This approach has been developed for and applied in project BINGO. This guideline aims to make the approach accessible and applicable to other cases as well.

**Evidence of accomplishment**

Report

D5.7. Prioritisation between long list of adaptation measures (process/method)



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## **1. INTRODUCTION**

One of the goals of the BINGO project is to select and analyse adaptation measures as part of an adaptation strategy. In previous research projects (such as PREPARED and CARPATHIAN CC) numerous adaptation measures have been identified that deal with different aspects of climate changes, such as floods and droughts. In BINGO, we have applied a stepwise approach to prioritize between these and other measures, using different approaches to elicit stakeholder knowledge and expert analysis. This allowed the different research sites in BINGO to select suitable adaptation measures, supported by stakeholders and grounded in research and effective on a broad range of socio-economic criteria.

In this guideline, the stepwise approach is laid out that was followed in the BINGO project to select and analyse adaptation measures.

The approach relies on active participation of stakeholders. In BINGO this was organized through Communities of Practice (CoPs) that functioned as a platform for much of the work in this guideline. Apart from stakeholder involvement, also expert knowledge and data and knowledge from outside the project has been used. The initial long list of measures was based on the results of previous (European) projects and for the different analyses (Social Justice Analysis, Governance Analysis, Multi Criteria Analysis) expert from inside or outside the CoPs were consulted.

Within the BINGO, the approach was set up by a core team of the associated work package (WP5), but the local execution of the activities were coordinated by the local research partners and the end users involved in the project.

For the six research sites in BINGO, this approach has resulted in the selection and analysis of the following measures:

**Table 1: Adaptation measures per research site**

Research Site	Increased precipitation	Decreased precipitation
Germany, Wuppertal	Alignment protection	Substitution with alternative water sources or water saving
	Technical protection measures for property	Transition between reservoir catchments
	Retention basin	Reduction of low water elevation
The Netherlands, Veluwe		Agricultural water restrictions
		Artificial retention
		Land use change
Portugal, Tagus		Waterproofing of irrigation channels
		Construction of intermediate reservoirs
		Change open channels into pressurised pipes
		Upgrade of irrigation equipment
		Install agro-meteorological monitoring system
Cyprus, Troodos		Connection to desalinated supply
		Groundwater recharge systems
		Treated sewage water for irrigation
		Irrigation scheduling technologies
Norway, Bergen	Safe flood ways	
	Public involvement	
	Sewer separation	
	Sustainable Urban Drainage Systems	
Spain, Badalona	Early warning system	
	Increase of inlet, drainage and retention capacity	
	Sustainable Urban Drainage Systems	

This guideline is aimed at supporting other sites to use this approach as well. It is aimed at all actors responsible for or involved in adaptation to climate change. In the following chapter, the stepwise approach will be explained in more detail.



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## 2. STEPWISE APPROACH

This chapter elaborates on the different steps in this approach, with an explanation of how these steps were followed in BINGO, some examples and remarks on how they can be replicated. The steps were the following:



Create portfolio of potential adaptation measures



Select relevant measures based on risk analysis and stakeholder preferences



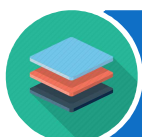
Multi-Criteria-Analysis (1): Develop a set of socio economic indicators to score the selected measures



Multi-Criteria-Analysis (2): Score selected measures on socio economic criteria

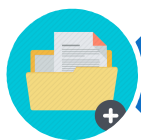


Analyse adaptation measures on social justice



Analyse adaptation measures for governance needs using the three-layer-framework

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## Create portfolio of potential adaptation measures

In this step, two approaches were taken to collect potential adaptation measures (1) a desk study of previous climate research and (2) consultation of stakeholders involved in the local Communities of Practice (CoPs). In the past decade, a number of research projects have been undertaken in identifying adaptation measures for extreme weather events, such as PREPARED and CARPATHIAN CC. These have been made available in databases and/or reports and address a broad range of issues relating to either decreased or increased precipitation. The WP5 core team, consisting of IWW, InterSus and KWR have made a first selection of these measures, based on their relevance for the issues studied in BINGO at the different research site.

At the same time, the first workshops at the six research sites were being planned, providing the opportunity to connect with local stakeholders about what risks they perceive and what adaptation measures are already being planned or considered for the future. Both approaches resulted in a long list of measures based on previous research and input from local stakeholders. This selection (about 10-15 measures per research site) was compiled as an online Portfolio of Adaptation Measures and shared with all research sites. The Portfolio of Adaptation is now available as an online tool, which is accessible to anyone who is interested in adaptation measures to extreme weather events.

The body of work on adaptation measures is steadily growing, so replicating this step in the future requires exploring a broad range of databases. When collecting adaptation measures, it is advisable to have a good idea of what are the anticipated risks, who is the risk owner and what the adaptation objectives are. Also, it is recommended to collect different kind of measures for the same adaptation objective. In the BINGO Portfolio, we distinguish informational measures (such as raising awareness for behavioural change), financial measures (such as insurance and subsidies), regulatory measures (such as standards and legal bans) and infrastructural measures (technical and bio-physical changes).

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## Select relevant measures based on risk analysis and governance aspects

At this point in the project, a first assessment of potential risks at the research site was made and discussed with local stakeholders. Based on this first risk assessment local stakeholders could make a first selection of adaptation measure from the longlist provided by the project team and/or the measures that were developed locally. This first selection of measures was done by focussing on some of the governance aspects related to the measures: (1) responsibility for implementation, (2) participation/division of roles, (3) availability of necessary resources; (4) potential challenges. In CoP meetings at the six research sites, these issues were discussed for the different measures and a selection was made either through scoring or through voting.

In this step, it is important to involve local stakeholders that will play a role in deciding on or implementing the measures. The stakeholders need to be aware of the potential risks of climate change and have knowledge of the governance aspects of the different measures. A workshop or meeting with room for open discussing is the most suitable form for this step.

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## Multi-Criteria-Analysis (1): Develop a set of socio economic criteria to score the selected measures

In this step, preparations are made to perform a Multi-Criteria-Analysis (MCA) on the selected adaptation measures. A Multi-Criteria-Analysis is a method to evaluate options (such as measures) using a broad range of indicators, related to socio-economic or other (e.g. environmental) factors. In this way, the wider socio-economic effects and side effects of adaptation measures can be assessed to a broader extent than looking at costs and the direct effect on risk reduction.

A Multi-Criteria-Analysis can also be used to analyse effects that are difficult to quantify (e.g. acceptability or environmental side effects). Hence, it can be used as a "flanking analysis" to a quantitative Cost-Benefit-Analysis/economic analysis (as it was done in some research sites in the BINGO project), widening the focus, and/or in cases where data availability is seriously limited.

To perform a Multi-Criteria-Analysis, a set of indicators/criteria must be selected to score the measures against. Which indicators/criteria are most suitable is very dependent on local circumstances, therefore this step can best be performed at the level of the research site, involving local stakeholders. The group of local stakeholders could consist of governmental organizations, NGOs, affected inhabitants and entrepreneurs or any other party that might be affected by the risks or the implementation of one of the potential adaptation measures. In the case of BINGO, the CoPs were used as a platform.

Some examples of indicators/criteria which were used in various BINGO research sites are:

- Effects on groundwater dependant terrestrial nature in the area
- Effects on aquatic nature
- Effects on drinking water provision
- Social acceptability and conflicting interests
- Effect on risk on fires and erosion
- Cultural history
- Tourism and recreation
- Effect on CO2 emissions and storage

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- Effect on public health (fine dust, bugs)
- New economic potential on agriculture and forestry
- Effect on ecosystem services provision
- Technical feasibility/knowledge requirement
- Justice and ethics (fair allocation and pricing of water/affordability)
- Flexibility of the measure
- Effects on labour

After the indicators/criteria have been selected, they can be weighted by the stakeholders according to their relative importance. This can be done by having the stakeholders assign a number to each criterion (e.g. 0-2) and take the average score as the weight. A criterion with a higher weighting is considered more important by the stakeholders and will have a bigger influence on the overall outcome of the Multi-Criteria-Analysis.



## Multi-Criteria-Analysis (2): Score selected measures on socio-economic criteria

In this step, the selected measures are scored against each of the indicators/criteria. For this, in BINGO a scale ranging from 1 (low/negative effect) to 5 (high/positive effect) was used, but other scales (e.g. 1 to 3) are also applicable.

The scoring itself should be integrated into the general stakeholder participation strategy, in the case of BINGO the CoP, and general participation methods can be used (e.g. scorecards, white boards and stickers etc.). Hence, resources needed should not be significantly increased over what is generally required for a consistent stakeholder participation strategy.

The score that each measure is assigned for each indicator/criterion is multiplied with the MCA factor according to the weighting of the criteria (if any was done), giving each measure a final "MCA score", resulting in a new ranking. An example for a final scoring and ranking is depicted in Table X below.

**Table 2: Example of MCA scoring**

Indicator/criteria	Weighting Factor	Measure 1: Original score	Measure 1: Adapted score
Effects on groundwater dependent terrestrial nature in the Veluwe	1.6	4	6.4
Effects on aquatic nature	1.6	5	8
Effects on drinking water	1.6	2	3.2
Social acceptability and conflicting interests	1.4	1	1.4
Effects on agriculture	1.2	2	2.4
Effect on risk of fires and erosion	1.2	1*	1.2*
Cultural history	1.2	4	4.8
Tourism and recreation	1	4	4
Effect on CO <sub>2</sub> emissions and storage	1	1	1
Effect on public health (fine dust, bugs)	1	2	2
New economic potential for agriculture and forestry	1	1	1
Effect on ecosystem services provision	1	4	4
Effect on urban areas	1	1	1
Judicial implementation hurdles, incl. N2000 and WFD	0.8	1	0.8
Technical feasibility/knowledge requirement	0.8	4	3.2
Justice and ethics (fair allocation and pricing of water/affordability)	0.8	1	0.8
Flexibility of the measure	0.8	3	2.4
Effects on labor	0.6	3	1.8
Time horizon (short or long term)	0.6	5	3
<b>TOTAL</b>			<b>52.4</b>

The final scores should then be discussed with the stakeholder group, and/or analysed by experts, considering other factors, such as costs and effects. As such, the MCA can shed light onto some formerly underrepresented aspects of a measure, or provide decision support in case measures are equally effective/costly, as a "second criterion".



## Analyse selected measures on social justice

Social justice is considered an increasingly important topic in climate change adaptation. Therefore, to support decision making on adaptation it is important to take this issue in account. In the social justice analysis, the focus lies on the distribution of costs/negative impacts and benefits of the adaptation measures on different actors or groups in society. Social justice can be analysed by answering the following questions for each adaptation measure.

### Analysis of social justice

1. How are costs for the implementation and upkeep of this measure shared between parties?
2. Does the adaptation measure incur any negative side-effects (indirect/social costs)? If so, what kind of effects?
  - a. If yes: To what extent and how are these side-effects mitigated, and by whom (who is paying for the mitigation)?
  - b. If no: Who will carry the burden of the negative side-effects?
3. Which actor(s) will directly benefit from this measure, e.g. in terms of economic revenue, or access to products or services created by the measure? Or does the measure benefit the general public?
4. Does the adaptation measure incur any positive side-effects (additional social benefits)? If so, what kind of effects?
5. Which actor(s) will enjoy these indirect benefits?
6. Considering the answers to the questions above, which equity principles do you recognize in these distributions?
7. To what extent and in what way does the adaptation measures reduce or strengthen existing social (in)equalities?

**Figure 1: Social Justice Questionnaire**

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These questions are grounded in three principles of social justice:

1. The deontological principle is based on Kant's notion that people are rational and act intentional, and can therefore be held responsible for their choices and actions. The "polluter pays" principle is an example of this principle.
2. The solidarity principle aims to neutralize "involuntarily inequalities" between people. Distributions follow Rawls' "maximin" principle which involves maximizing the well-being of those who are worst-off.
3. The egalitarian principle is based on Mill's and Bentham's utilitarian "greatest happiness principle". Distributions aim to maximize the positive effects and minimize the negative effects for society as a whole.

The results from this analysis show not only what the broader socio-economic effects of an adaptation measure are, but also how these effects are distributed over different groups in society. This can be useful when adaptation strategies need to be linked to other policy issues, such as ensuring fairness or reducing inequalities in society (particularly those caused by climate change).

In most cases it will not be easy to quantify or evaluate the impacts of a measure with regard to social justice in one unambiguous way that all stakeholders would agree to. Thus, instead of evaluating the measure with a final conclusion if the measure is a "fair" measure, the answers of the questions rather informing the reader about the expected social impacts without a final judgement of the measure.

Summarized, the answers given to the questionnaire allow a comprehensive description of the "pro's" and "con's" of the adaptation measures with regard to social justice putting the reader in the position to come to an individual conclusion of the measure's social justice.



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## Analyse selected measures on governance needs

This step focusses on the governance needs of the adaptation measures. With "governance needs" the governance requirements that need to be met to be able to implement the measure are meant, such as knowledge requirements, administrative requirements and legal-operational requirements. The governance analysis is based on the three layer framework which has been developed by the Water Governance Council to assess the policy and governance situation in light of climate change adaptation.



**Figure 2: The Three Layer Framework**

The Three layer framework has been operationalised by the project partners in a questionnaire.

### Analysis of governance needs

#### Knowledge requirements

1. What knowledge is required to develop and implement the measure? What level and detail of information about the addressed risk is needed to effectively implement the measure? What types of knowledge and skills are needed to develop and/or implement the measure (e.g. about the water system, the agricultural cycle, consumer behaviour, process management)?
2. To what extent are the knowledge requirements met at the research site?

#### Responsibility structure

1. Which (constellation of) actor(s) should be involved in the development and implementation of the adaptation measure?
2. Are the necessary actors currently involved sufficiently?
3. What requirements are placed on coordination between actors, levels and sectors?
4. Are these requirements met at the research site?

#### Administrative resources

5. Which administrative resources are needed to implement the measure? For example, staff, administrative (e.g. accounting or monitoring) capacities, regulatory (e.g. independent standard-setting or adjusting) capacities, technical expertise, knowledge infrastructure, etc.
6. Are these administrative resources available at the research site?

#### Relevant EU legislation, policy and directives

7. What EU directives and regulations influence the governance of this measure?

#### Legal-operational requirements

8. Does the measure require setting legal standards (e.g. technological process-requirements, output standards) or the use of certain types of rights (i.e. land-use or taxation rights)?
9. Are these legal-operational requirements met at the research site?

#### Financial requirements

10. What types of costs are involved with the implementation and operation of the adaptation measure?
11. How can these financial means be generated; which sources can be used, which actor(s) should pay?
12. Are the necessary financial resources available at the research site?

#### Culture and ethics

13. Which cultural or ethical issues either support or obstruct the implementation of the adaptation measure?

#### Public accountability, communication, and participation

14. Which public accountability requirements are there for the adaptation measure?
15. Are there specific transparency requirements?
16. What requirements does this place on communication of responsible actors and agencies, and public participation?
17. Are these requirements sufficiently met at the research site?

Figure 3: Governance analysis questionnaire

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The questionnaires can be filled in by a research partner or in a collaborative effort of the relevant stakeholders.

The analysis on governance needs gives a broad overview of what is necessary in terms over governance to successfully implement the adaptation measure. A conclusion can be that all necessary actors are involved, but public support is lacking. Or that all required knowledge is available, but finances are difficult to organize. This can provide important building blocks for developing an implementation pathway for adaptation measures.

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### 3. CONCLUSION

The process as outlined above is a valuable contribution to strategy development and decision making on climate change adaptation. The selection and analysis of adaptation measures should take place after a risk analysis has been conducted and the strategic objectives for adaptation have been formulated. The Multi Criteria Analysis provides an assessment of the effectiveness of the measure in terms of risk reduction and thus the extent to which the strategic objective can be achieved with the measure. Moreover, since the broader focus on socio-economic effects and social justice, the Multi Criteria Analysis also places the measures in broader strategic perspective beyond the scope of adaptation to climate change. For example, a measure like Sustainable Urban Drainage Systems is not only successful in reducing flood risks, but also contributes to health, air quality, urban cooling and bio-diversity and can contribute to strategic goals on these topics as well.

When it comes to the actual implementation of the measures, the governance analysis provides insight into a broad range of requirements and the extent to which they are being met at the site. From this, recommendations can be formulated, for example on how to implement the measure, which actors to involve, how to communicate about the measure and how to obtain political support. This contributes to the development of an implementation pathway for adaptation to climate change.