IDENTIFICATION OF GAPS IN EXISTING STRATEGIES AND DIRECTIVES IMPLEMENTATION ON OPERATIONAL LEVEL

WORK PACKAGE T4 - JOINT STRATEGY DEFINING POTENTIAL COMMITMENTS IN IMPROVEMENT OF PLANNING PROCESS CONSIDERING CC

ACTIVITY T4.1 STRATEGY DEVELOPMENT

DELIVERABLE D.T4.1.1

Lead Institution	Warsaw University of Life Sciences – SGGW (PP4)
Lead Author/s	**Louis Courseau, Damian Bojanowski**
Version	V-04
Date last release	**07-11-2021**

List of contributors

Review Working Group:

- Warsaw University of Life Sciences – SGGW (PP4): Ignacy Kardel, Tomasz Okruszko, Tomasz Stańczyk with external experts: Louis Courseau, Damian Bojanowski
- University of Ljubljana (PP1-LP): Anja Torkar, Barbara Čenčur Curk, Uroš Lesjak, Primož Banovec
- INFRASTRUKTUR & UMWELT Professor und Böhm (PP3): Anna Goris, Peter Heiland, Stefanie Weiner
- Euro-Mediterranean Center on Climate Change Foundation (PP5), CMCC: Guido Rianna, Dr. Silvia Torresan,
- University of Natural Resources and Life Sciences, Vienna, BOKU (PP6): Roland Koeck, Prof. Eduard Hochbichler
- Federal Research and Training Centre for Forests, Natural Hazards and Landscape (PP7): Chakraborty Debojyoti
- Global Water Partnership Central and Eastern Europe, GWP CEE (PP8) Anna Smetanova
- Middle Tisza District Water Directorate, MTDWD (PP9): Dr. János Fehér
- Po river district Authority (PP10): Betrice Bertolo
- Institute of Meteorology and Water Management - National Research Institute, IMGW-PIB (PP11): Mariusz Adynkiewicz-Piragas

Table of Contents

List of annexes

- Annex 1 - Review form template - MS Excel file
- Annex 2 - Detailed references for grey and scientific literature reviewed in chapter 3.1 - MS Excel file

List of abbreviations

AHP	Analytic hierarchy process
BMP	Best Management Practices
BWT	Bathing Water Directive
CC-ARP-CE	Integrated toolbox for Climate Change Adaptation and Risk Prevention in Central Europe
CC	Climate change
CE	Central Europe
C3S	Copernicus Climate Change Service
DSS	Decision Support System
DST	Decision Support Tool
DTP	Danube Transnational Programme
DWD	Drink Water Directive
EQSD	Environmental Quality Standards Directive
FD	Floods Directive
FRMP	Flood Risk Management Plan
GIS	Geographic Information System
GWD	Groundwater Directive
IED, ex. IPPC	Industrial Emissions Directive
NSWRM	Natural Small Water Retention Measures
ND	Nitrate Directive
PSD	Priority Substances Directive
RBMP	River Basin Management Plan
SDG	Sustainable Development Goals
UWWTD	Urban Waste-water Treatment Directive
WISE	Water information system for Europe
WFD	Water Framework Directive

Introduction

One of the main objectives of the TEACHER-CE project is to develop an integrated and joint strategy for improvement of existing water management practices (implementation of EU water legislation) taking into consideration knowledge gained from previous projects. Strategy will be released for promoting and stimulating adoption of TEACHER-CE Toolbox (CC-ARP-CE) for efficient decision making in water management planning.

In order to achieve this objective, it is first necessary to identify the gaps in existing strategies, policy documents and directives implementation at the operational level.

For this purpose, a multi-perspective approach was applied, which combines an identification of gaps:

- at the level of European Union water legislation in order to identify potential policy gaps that may explain difficulties at the local level (see chap. 1.1);
- at the level of countries from a formal perspective through the RBMP and FRMP assessment reports (see chap. 1.2);
- at the local, regional, river basin and national level in the frame of a scope review of policy documents (see Section 2);
- from a horizontal perspective with review of grey and scientific literature and previously funded projects (see Section 3).

1. Meta-analysis of EU legislation & directives implementation

1.1. Identification of intrinsic gaps in the EU water legislation

The TEACHER-CE project does not aim to assess the EU water legislation. Moreover, this was done by the EU Commission in the frame of the fitness check process in 2019[1]. It assesses whether the EU water directives (Water Framework Directive (WFD), the Environmental Quality Standards Directive (EQSD), the Groundwater Directive (GWD) and the Floods Directive (FD)) were fit for purpose by examining their performance against five criteria set out in the EU Commission's Better Regulation agenda: effectiveness, efficiency, coherence, relevance and EU added value.

Nevertheless, it should be verified whether in the framework of this fitness check, gaps have been identified in the field of adaptation to climate change. These gaps at the EU legislation level could indeed explain difficulties encountered at the local level in implementing these directives.

The Fitness Check[2] point out that the climate change is not explicitly mentioned in the WFD and daughter directives (GWD and EQSD) and that the WFD give a less prominent place to the issue of water quantity.

1 The results of the fitness check are available on the web site of the European Union Commission: https://ec.europa.eu/environment/water/fitness_check_of_the_eu_water_legislation/index_en.htm

2 Commission Staff Working Document Fitness Check of the Water Framework Directive, Groundwater Directive, Environmental Quality Standards Directive and Floods Directive (European Commission, 2019), p. 162, available on European Union Commission web site:

Nevertheless, it adds that this aspect of the WFD does not seem to diminish significantly the potential of the legislation to address the impacts of climate change on water management. This can be explained by:

- the need to identify all 'significant pressures' affecting water bodies (see Section 2.2 on Article 5 WFD/pressures and impacts analysis). This identification of pressures provides the framework for Member States to incorporate the expected impacts of climate change (both on quantity and quality);
- the cyclical nature of the implementation that enable to updated scientific and technical knowledge into the planning process;
- Guidance Document No 24 provides support for incorporating climate change projections into the second and third planning cycles and more specifically into the assessment of pressures and impacts, monitoring and establishment of measures;
- the intrinsic characteristic of the WFD. The Fitness Check finds that *"the Water Framework Directive is sufficiently prescriptive with regard to the pressures to be addressed, and yet flexible enough to reinforce its implementation as necessary with regard to emerging challenges not mentioned in the Directive such as climate change, water scarcity […]"*.

On a more technical level, the Fitness Check points out the difficulties of the valuation of the benefits that can be attributed to the WFD, because measures included in the RBMP may be multifunctional and have multiple benefits that contribute to the objectives of several policies. For example, restoration of rivers contributes to flood prevention, climate adaptation and biodiversity conservation.

Unlike the WFD, the FD does have an explicit requirement for Member States to take into account the likely impact of climate change on the occurrence of floods (Article 14(3)) from the second planning cycle. The difficulties may arise from the fact that the Flood Directive does not mention the EU's green infrastructure strategy, nor the EU adaptation strategy. However, the Fitness Check highlights that these strategies are continuously promoted in the Commission's work with the Member States[3]. As 26 member states have indicated that their plan includes nature-based solutions or a subset of these, the results of this approach seem rather encouraging.

Directives are suitable for adaptation to climate change, with some scope for improvement. The room for improvement is therefore not to be found in the directives themself, but mainly in their implementation (eg.: by speeding up implementation, integrating environmental objectives into sectoral policies, etc.). These conclusions are shared by the results of the public consultation on the question of coherence between the Directives covered by this fitness check and other sectoral policies. According to these results, 54% of respondents find the EU water legislation fully coherent or partly coherent with the climate change adaptation and mitigation policy[4].

https://ec.europa.eu/environment/water/fitness_check_of_the_eu_water_legislation/documents/Water%20Fitness%20Check%20-%20SWD(2019)439%20-%20web.pdf

3 Commission Staff Working Document Fitness Check of the Water Framework Directive, Groundwater Directive, Environmental Quality Standards Directive and Floods Directive (European Commission, 2019), p. 163, available on European Union Commission web site: https://ec.europa.eu/environment/water/fitness_check_of_the_eu_water_legislation/documents/Water%20Fitness%20Check%20-%20SWD(2019)439%20-%20web.pdf

4 Results of the public consultation on the question of coherence between the Directives covered by this fitness check and sectoral policies (Source: Trinomics and Wood, 2019) reported in the figure 21, p. 92 of the Commission Staff Working Document Fitness Check of the Water Framework Directive, Groundwater Directive, Environmental Quality Standards Directive and Floods Directive (European Commission, 2019) available on European Union Commission web site: https://ec.europa.eu/environment/water/fitness_check_of_the_eu_water_legislation/documents/Water%20Fitness%20Check%20-%20SWD(2019)439%20-%20web.pdf

1.2. Identifying gaps in the strategic documents: the assessment report of the River Basin Management Plans (RBMP) and Flood Risk Management Plan (FRMP) as a point of entry

In accordance with Article 18 of the Water Framework Directive and Article 16 of the Floods Directive, the European Commission shall publish a report on the implementation of these Directives by Member States. The report includes a country-specific assessment for EU Member States River Basin Management Plans (RBMP) and Flood Risk Management Plan (FRMP)[5], presenting also suggestions for improvement of future plans. Among other issues these reports include an assessment of the consideration of the climate change. It should be noted that the requirements for adaptation to climate change are more stringent and explicit in the Floods Directive than in the Water Framework Directive.

The purpose of this chapter is to review the gaps and good practices identified by these assessment reports in the field of taking climate change into account. It should be emphasized that the evaluation of these plans is above all carried out under a formal prism, that of the implementation of these two above-mentioned directives. However, they offer a good entry point to identify gaps and good practice. The analysis covers the 9 countries of the Interreg Central Europe: Slovenia, Germany, Poland, Italy, Austria, Slovakia, Hungary, Czech Republic and Croatia. In addition, three others countries outside of the Interreg Central Europe were considered in the analysis with a view to a potential transferability of the present methodologies to other EU regions. Cyprus, Portugal and Finland were chosen due to their geographic distance from the Interreg Central Europe region and the difference in latitudes between them and also analysed on the basis of the implementation reports[5].

The review of these reports (meta-review) was organized into two levels:

- the strategic level, where the planning decision is taken and the objectives set;
- the operational level, where the measures are prepared.

The strategical level

The most common gap is the lack of drought management plans or specific sub-plans addressing climate change, in case countries have been reported as sensitive to these events or changes. The reports recall that although there is no legal obligation to prepare these plans, many Member States have prepared them to deal with droughts or the effects of climate change.

Not taking into account the national climate change adaptation strategy or the lack of coherence between the strategy and the plans is one of the other significant gaps identified in the framework of the assessment of RBMP and FRMP. Even if the strategy has been mentioned in the plans, it may be also not always clear how climate change is taken into consideration in the plans.

These gaps in themselves define the good practices to be adopted:

- whether droughts have been reported as relevant for the country, preparing a sub-plan on water scarcity and droughts or / and addressing change climate should be considered (gap for 5/9 countries or 6/12 considering countries outside the Interreg Central Europe region);
- the conclusions of the national climate change adaptation strategy must be integrated into the plans to maintain a common thread and consistency (no clear coordination for 5/9 countries or 6/12);

5 The fifth Water Framework Directive Implementation Report – assessment of the second River Basin Management Plans and the first Floods Directive Implementation Report – assessment of the first Flood Risk Management Plans (2019) are available on European Union Commission web site: https://ec.europa.eu/environment/water/water-framework/impl_reports.htm

- climate change should be considered when setting objectives, for instance by recalculating extreme events probability (gap for 3/9 countries or 4/12);
- the plans should clearly explain how climate change is taken into consideration in the plans or how it may affect the occurrence of extreme events (gap for 6/9 countries or 7/12).

The operational level

At the operational level, the assessment reports have pointed out:

- the lack of adaptation measures (2/9 countries or 2/12 considering countries outside the Interreg Central Europe region);
- the non-consideration of climate change in the design of measures (3/9 countries or 4/12).

The reports also present their recommendations and often identify good practices. According to this information, consideration of climate change should take place for:

- increasing knowledge, for instance by monitoring change at reference sites, detecting climate change signals, or commissioning studies about linking climate modelling to flood risk management;
- checking the effectiveness of measures and assessing direct and indirect climate pressures (selection of robust measures);
- assessing the contribution of measure groups to climate change adaptation;
- the maximisation of cross-sectoral benefits / minimisation of negative effects across sectors. For instance, the reports point out the possible synergies between operational objectives: climate change adaptation measures may also tackle hydromorphological pressures, abstractions and hydrological alterations or address significant pressures related to agricultural diffuse pollution;
- forecasting the economics of water supply and demand;
- designing measures, for instance by:
    - linking climate modelling to flood risk management,
    - adding safety margins in order to cope with potential impact of climate change (e.g.: to the dyke height, for building codes).

These identified gaps and recommendations come from the evaluation of two types of plans (RBMP and FRMP), but may be potentially valid for other areas. In this perspective, the Table 1 presents an assessment of the applicability of the recommendations in the fields of action covered by the TEACHER-CE project.

Table 1. Assessment of the applicability of the recommendations in the fields of action covered by the TEACHER-CE project

Recommendations	Fluvial flood risk management	Pluvial flood risk management	Groundwater management	Drinking water supply management	Irrigation water management	Water Scarcity and Drought risk management	Management of water-dependent ecosystems
Strategical level							
Preparing a sub-plan on water scarcity and droughts	-	-	+	+	+	++	+
The conclusions of the national climate change adaptation strategy must be integrated into the plan	++	++	++	++	++	++	++
Climate change should be considered when setting objectives	++	++	++	++	++	++	++
The plans should clearly explain how climate change is taken into consideration	++	++	++	++	++	++	++
Operational level							
Implementing CC adaptation measure	++	++	++	++	++	++	++
increasing knowledge	++	++	++	++	++	++	++
Selecting of robust measures	++	++	++	++	++	++	++
assessing the contribution of measure groups to CC adaptation	++	++	++	++	++	++	++
the maximisation of cross-sectoral benefits	++	++	++	++	++	++	++
forecasting the economics of water supply and demand	-	-	++	++	++	+	+
Considering CC for the design of measures	++	++	++	++	++	++	++

Explanation:

++	*applicable*
+	*partly applicable*
-	*not applicable*

The transferability of the identification of gaps

It should be noted that most of the gaps identified in the 9 countries of the Interreg Central Europe region were also present in the 3 countries outside of it. In addition, no other gaps were identified from the analysis of the RBMP and FRMP assessment reports of Portugal, Cyprus and Finland. This suggests that the findings of this document are potentially transferable to other regions of the EU.

2. The scope review of strategic documents

2.1. Methodology

2.1.1. Overall approach

The primary objective of the deliverable is to identify gaps present in the strategic documents. To meet this objective, a scope review was carried out by all members of the working group covering all the countries involved in the project. For the sake of objectivity, this review is framed by a form comprising 100 questions divided into 7 sections:

- SECTION A - General information about the document
- SECTION B - Description of the climate change issue
- SECTION C - Effect of the CC on the measures / assumptions of the document
- SECTION D - Impact assessment of measures / assumptions of the document in the field of CC
- SECTION E - Adaptation to CC
- SECTION F - Which TEACHER's tools are suitable to improve this document?
- SECTION G - Which other tools are suitable to improve this document?

The section A allows to classify the different documents according to their type, their field of action, date of publication and geographic level (e.g.: local, regional, national).

Sections B - E correspond to different issues of the climate change in the context of water management policy document (see Figure 1). The data collected by the questionnaire of each these sections are the basis for calculating the CC robustness score (see chapter 2.1.3) and subsequently, for the identification of gaps.

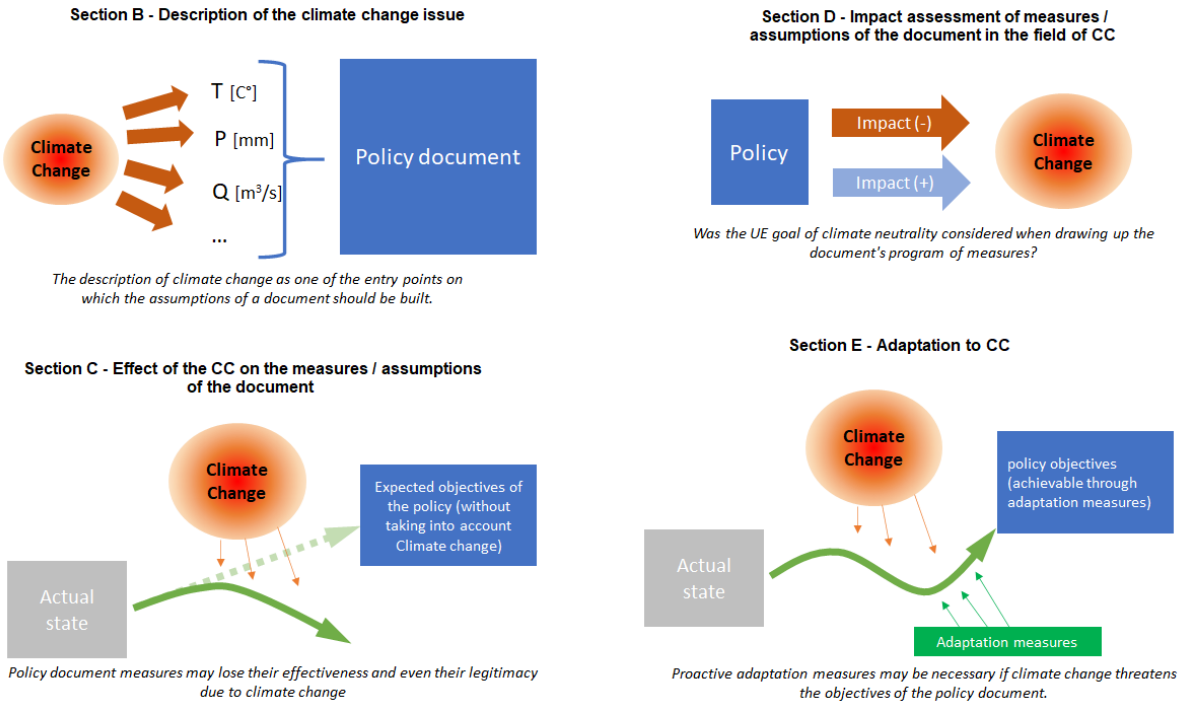

Figure 1: Illustration of the issues covered by the sections B, C, D and E of the review form

It should be noted that these issues are closely linked to each other:

- the quality of the description of climate change will influence the credibility and legitimacy of the document as well as the need or not to apply adaptation measures;
- the dialogue between the impact assessment and the policy document may lead to choices of measures that emit less CO_2 or recommend adaptation measures;
- understanding the impact of climate change on the objectives of the document will trigger the need for adaptation measures. Conversely, the use of adaptation measures can allow the objectives of the document to be adjusted;
- sections B and D are interlinked with each other since they share the same state of play (see Figure 2).

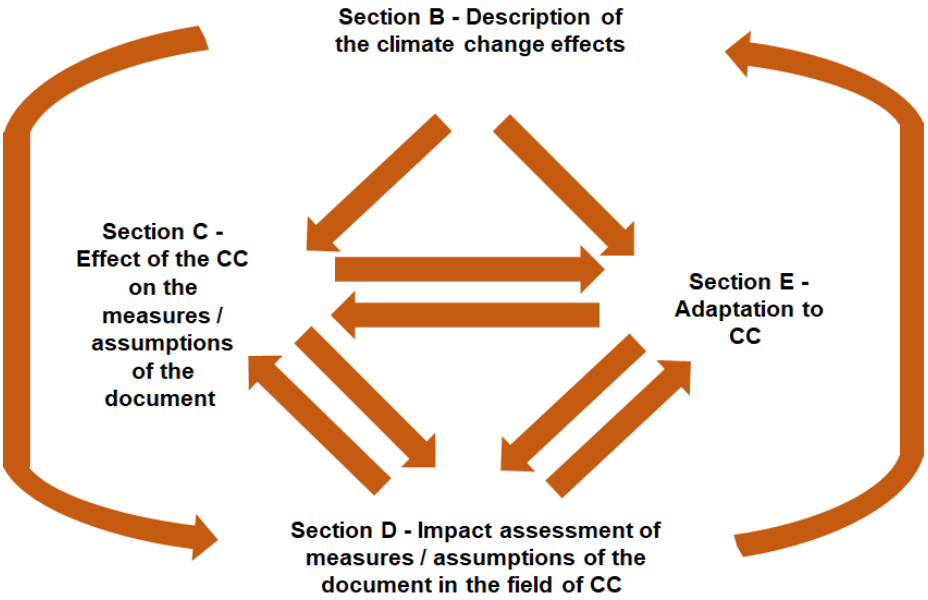

Figure 2. The relationships between issues covered by the sections B, C, D and E

Section F collects information on the potential utility of TEACHER-CE's tools in the context of the document being reviewed. This will allow to link the identified gaps with tools of capitalized projects. Section G has a similar purpose, but with tools outside the TEACHER-CE's project.

The review sheet includes multiple choice questions, which allows quantitative statistical processing, but also open text fields to complete the response and allow a more qualitative study of the responses.

2.1.2. The definition of gaps

In the context of this review, a gap is defined as the distance between the methodological assumptions applied for the preparation of the document and the good practices in the field of climate change management. In other words, if the document is compliant with the best practices, then no gap will be identified. So as a preliminary step before looking for gaps, good practices were identified on the basis of the review of assessment reports of the River Basin Management Plans (RBMP) and Flood Risk Management Plan (FRMP) (see chapter 1.2), Guidance Document No 24 - River Basin Management in a changing climate, and expert judgment.

The level of compliance is assessed by the document reviewer using the review sheet, whose questions address the various aspects of these good practices.

The identified gaps may then take the form of lack of:

- taking into account the relevant climate change indicators;
- indication of measures concerning adaptation to CC (CCA) and/or counteracting effects of CC (CCE);
- climate proofing test;
- appropriate tools to improve the decision-making process, i.e., problem; definition, matching of potential place and type of measures, assessment of effectiveness, consultations;
- other concerning planning in the context of CC.

The following tables (Table 2-5) show the correspondences between the questions of the scope review sheet and the potential gaps, which can be identified from these questions at the evaluation stage (see chapter 2.1.3).

Table 2. Relation between the questions of the review sheet for the section B - Description of the climate change issue and potential gaps associated with them

Question number*	Question of the sheet review	Gap code	Potential gaps name
19	Did the information of the CC model was downscaled?	B1	non-optimal geographic scale
20	Have the projections of the CC model been transferred / downscaled to the basic planning units of document for operational purpose?		
21	How long does the reference period last? (The reference period is the period from which the model projections are compared)	B2	non-optimal time scale
22	Is the timeframe of the CC prevision adequate to the document perspectives?		
23	Please provide information and if it is possible link to the CC model use for the CC projections	not applicable	not applicable
What meteorological parameters are taken into account in the description of CC?			
24	Air temperature?	B3	weak meteorological description
25	Precipitation?		
26	Wind speed?		
27	Snow?		
28	Solar radiation?		
29	Evapotranspiration?		
30	Other?		
What hydrological parameters are taken into account in the description of CC?			
31	River/lake water level?	B4	weak hydrological description
32	River flow?		
33	Run off?		
34	Water quality?		
35	Other?		
36	The projection for these hydrological parameters are based on hydrological modelling or/and historical trend analysis or/and expert judgment?		
What hydrological parameters are taken into account in the description of CC?			
37	Groundwater level?	B5	weak hydrogeological description
38	Groundwater quality?		
39	Soil water capacity?		
40	Other?		
41	The projection for these hydrological parameters are based on hydrological modelling or/and historical trend analysis or/and expert judgment?		
42	Are the CC projections taken into account in forecasting the economics of water uses	B6	no water use forecast

* Questions nr 1 – 18 make it possible to characterised the documents (name, administrative level, fields of action covered, etc…).

Table 3. Relation between the questions of the review sheet for the section C - Effect of the CC on the measures/ assumptions of the document - and potential gaps associated with them

Question number	Question of the sheet review	Gap code	Potential gaps name
43	Was the document drawn up taking into account the climate change? Do the assumptions of the document take into account the impact of climate change?	C1	No consideration of CC effects in the document assumptions
44	Is every measure of the document subjected to a CC resilience (climate proofing) test?	C2	No CC- resilience test of measures
45	Have the measures passed a climate proofing test at the design stage?	C3	No CC climate proofing test at the design stage of the measures

Table 4. Relation between the questions of the review sheet for the section D - Impact assessment of measures/assumptions of the document in the field of CC - and potential gaps associated with them

Question number	Question of the sheet review	Gap code	Potential gaps name
46	Does the document properly analyse the negative impact of its measures /assumption on emission of greenhouse gases?	D1	Weak assessment of the document on emission of greenhouse gases
47	Does the document properly analyse the positive impact of its measures /assumption on emission of greenhouse gases?		
48	Does the document properly analyse the positive impact of its measures /assumption on adaptation to the CC? (e.g.: increase retention)?	D2	Weak assessment of the document on adaptation to the CC
49	Does the document properly analyse the negative impact of its measures /assumption on adaptation to the CC? (e.g.: decrease infiltration capacity)		
50	Does been considered the cumulative effect of all measures on the CC (e.g.: greenhouse emissions balance at the document implementation level) ?	D1	Weak assessment of the document on emission of greenhouse gases

Table 5. Relation between the questions of the review sheet for the section E – Adaptation to the CC - and gaps associated with them

Question number	Question of the sheet review	Gap code	Potential gaps name
51	Does the document include CC effect counteracting measures/assumption in the field of natural water retention?	E1	No natural water retention adaptation measures
52	Does the document include CC effect counteracting measures/assumption in the field of technical water retention?[6]	E2	No technical water retention adaptation measures
53	Does the document include CC effect counteracting measures/assumption in the field of planning/governance/awareness?	E3	No measure in the field of planning/governance/awaren ess
54	Was the need to implement adaptive measures consulted with neighbouring countries?	E4	No consultation with neighbouring countries for implementing of adaption measures
Does the document include CC effect counteracting measures in the next field of action?			
55	Fluvial flood risk (management)	E5	Poor adaptation to fluvial flood risk
56	Pluvial flood risk (management)	E6	Poor adaptation to pluvial flood risk
57	Groundwater management	E7	Poor adaptation to groundwater management
58	Drinking water supply (management)	E8	Poor adaptation of drinking water supply
59	Irrigation water (management)	E9	Poor adaptation of irrigation water
60	Water Scarcity and Drought risk (management)	E10	Poor adaptation to water Scarcity and drought risk
61	Management of water-dependent ecosystems	E11	Poor adaptation of water-dependent ecosystems
62	Other fields	considered at the level of the section	
63	Has the effectiveness of these measures been evaluated? If so, please explain how in the "detailed answer" column.	E12	No evaluation of effectiveness of the adaptation measure

2.1.3. The evaluation of policy documents

The possible answers to the questions in the sheet review are mainly coded in the form of ordinal data ("Yes", "Rather yes", "Rather not", "No", "not applicable") which makes it possible to graduate the level of compliance for each question (see Table 6). Then the points are summed at the level of each gap formulated in the Tables 2-5 or section to define the distance to the good practices for each issue of climate change management.

[6] Technical measures should not necessarily be considered as a gap given the capacities offered by green infrastructures.

Table 6. Number of points according to the options for the section C – D of the sheet review

Options	Number of points awarded / maximum number of points
Yes	3/3
Rather yes	2/3
Rather not	1/3
No	0/3
not applicable	-/- (question not taken into account)[7]

Section B is an exception to this scoring system. The questions in this section essentially require binary answers without the need to graduate a degree of agreement: does the description of climate change take this parameter into account, yes or no? The weight of the ratings of each question varies from one parameter to another depending on their potential influence on the assumptions of the document.

The obtained number of points (or its sum, e.g., at the level of the section) is then divided by the maximum of points. The result is called the **robustness score**.

It should be remembered that this score is not intended to judge or evaluate the policy documents individually. It is the aggregation of the scores of all the documents examined that makes it possible to identify the aspects of climate change management with the greatest margins for improvement. The statistics aggregated at the question level allow us to understand the nature of the gaps.

In the methodology adopted, the Joint Strategy must then focus on these gaps, in particular by presenting the TEACHER tools as a means of addressing them.

2.1.4. The selection of policy documents

The document review aimed to cover a large spectre of policy documents, which may reflect the diversity of:

- administrative/spatial levels:
  - local,
  - regional,
  - national,
  - subbasin/basin;
- document types:
  - environmental strategy,
  - climate strategy,
  - other strategy,
  - river basin management plan,
  - flood risk management plan,
  - drought management plan,

7 For the River Basin Management Plan and Flood Risk Management Plan: in order to reduce the variations linked to the subjectivity of the reviewers, and given that the questionnaire was designed and built in particular on the good practices presented in the EU CIS Guidance no. 24 (see chap...), the choice of the option "not Applicable" resulted in a score of zero, and not, as for the other documents, an outing the question during the scoring. However, this principle does not apply to the section D (because the impact assessment was not always available during the evaluation of the document), nor to the questions 52 and 54 – 62 of the section E because the scoring of these questions depends on the international character or not of the basin or the FoA of the document.

- other plan in the field of water management (i.e., Water maintenance plans, National program of municipal wastewater treatment),
- national spatial development plan/strategy,
- regional spatial development plan/strategy,
- local spatial development plan/strategy,
- local plan of Adaptation to Climate Change,
- regional plan of adaptation to Climate Change,
- national plan of adaptation to Climate Change;

- fields of action:
  - fluvial flood risk (management),
  - pluvial flood risk (management),
  - groundwater management,
  - drinking water supply (management),
  - irrigation water (management),
  - water scarcity and drought risk (management),
  - management of water-dependent ecosystems.

Subsequent levels of the hierarchy in the same administrative unit (preferably from a pilot action area) were privileged in the choice of documents for a better understanding of horizontal translatability of the assumptions between documents (e.g.: regional CCA plan -> regional spatial strategy -> regional spatial plan).

2.1.5. Workflow of the review of the policy documents

The review of policy document was carried out by members of the Review Group from individual countries. The Table 7Table 7 describes the workflow of the reviewing process.

Table 7. Workflow of the reviewing process

Reviewers' tasks	
1) Preparation	1) finding the document by an expert
	2) adding it to the database
	3) copying a blank form sheet in Excel
2) Form filling	1) reading the document's table of contents
	2) quick (cursory) overview of the entire document
	3) searching for text fragments (using keywords) relevant to the questions in the form or indicating measures for improvement in CCA
	4) In-depth reading of selected text fragments
	5) marking important (related to the answer) passages in a PDF file
	6) translation of the passage to English
	7) filling in the next row in the form (including pasting the translated quote)
3) Sending results to the WP leader	1) completed form & record in database
	2) suggestions for improving the review methodology (optional)

2.2. Results of the scope review

During the task, 110 policy documents containing aspects of water management were analyzed. Documents came from 7 countries. Each document was assessed using the review sheet described in Chapter 2.1. The following table presents an overview of the documents selected by the reviewers. Documents came from various fields related to water management and climate change issues. In total, 15 types of documents were analyzed.

Table 8. List of policy documents reviewed for the analysis

Type of documents	Country (anonymized)							Total
	A	B	C	D	E	F	G	
Climate strategy			2		2	1	1	6
Drought management plan			1	1	1		1	4
Environmental Strategy	5		1		4	2	4	16
Flood risk management plan	1	1	2	4	1	1		10
Local plan of Adaptation to Climate Change		1		1	3			5
Local spatial development plan/strategy					1	1		2
National plan of adaptation to Climate Change		2		1		1		4
National spatial development plan/strategy		1	2	1		1		5
Other document			1	3				4
Other plan in the field of water management			2	2	3		1	8
Other strategy		1	2		2		12	17
Regional plan of adaptation to Climate Change		2		2				4
Regional spatial development plan/strategy	4	2	2	2	5			15
River basin management plan		1	3	2	1	2	1	10
Total	10	12	18	19	23	9	20	**110**

In their spatial scope, the documents covered various levels of detail: from national, through regional, to local. Evaluation of each spatial level was discussed as this division is not compatible with the administrative division of all countries, but it was finally assumed that local level is municipality – related region and regional level is every unit that is wider than municipality, but do not cover national level.

The reviewed covered 52 national documents, 29 regional and 20 local. Documents were evaluated in connection with Field of Action (described in chapter 1.2). The reason of that was to identify possible gaps connected with scope of the document as well as spatial scale of the document. This aimed to evaluate vertical translatability of wide-scope policy documents to arrangements of specific low-level plans and programs. The documents were also evaluated in each category such as RBMPS, Spatial development plans etc. to compare and identify gaps in each type.

Each section, as described in chapter 2.2.1 aimed to evaluate specific issues related to climate change:

- Section B score - Description of the climate change issue;
- Section C score -Effect of the CC on the measures/ assumptions of the document;
- Section D score -Impact assessment of measures/assumptions of the document in the field of CC;
- Section E score - Adaptation to CC.

According to the methodology of the review each answer scored a certain number of points in each section. It should be one more time noted, that the purpose of such quantification was not to hierarchize documents from the best to the least in terms of addressing climate change issues, but to assess the emphasis on a specific aspect of climate change in each document. It was assumed that documents which do not address certain matter score 0 point in given section while the document with widely described and addressed issue will score a large number of points. Then, the issues which caused the difference could be identified as gaps in the context of addressing climate changes.

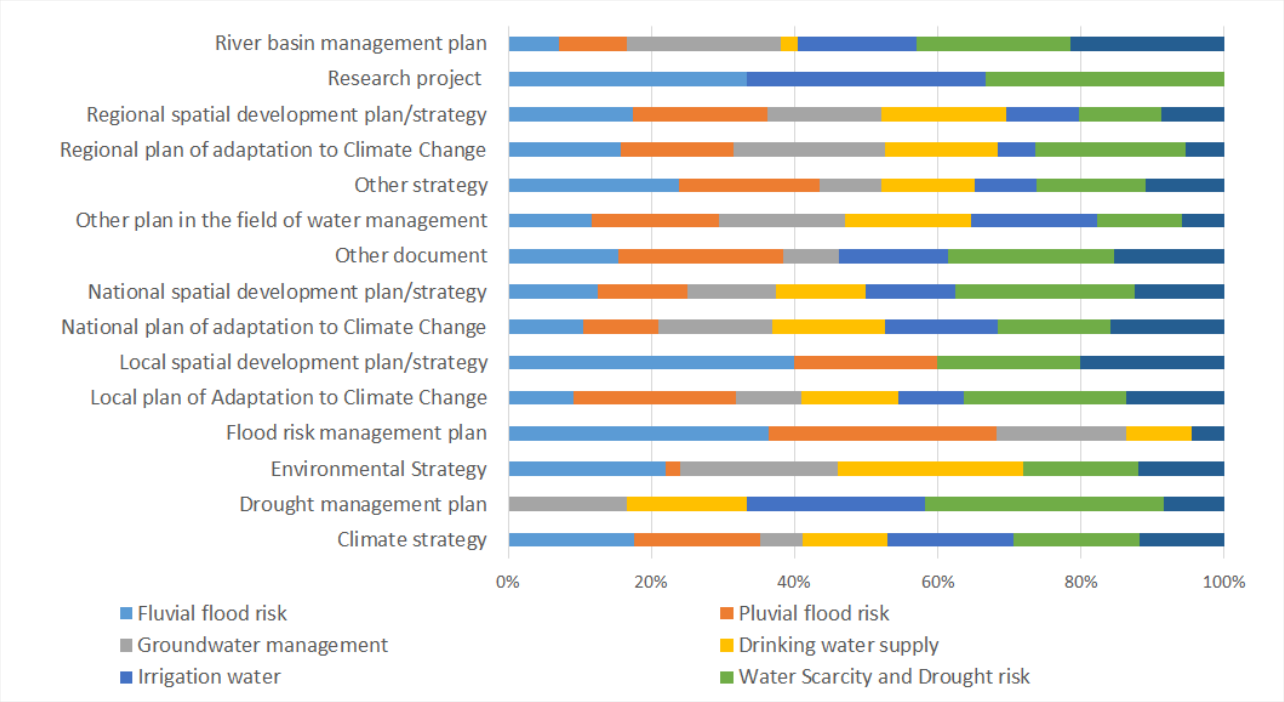

Figure 3. Classification of the documents to each Field of Action

The chart presents the field of actions to which the documents were classified. Documents such as river basin management plans and climate strategies covered many fields of actions, mainly due to regulations and extensive thematic issues. Documents such as local spatial development plans did not cover such a wide thematic spectrum.

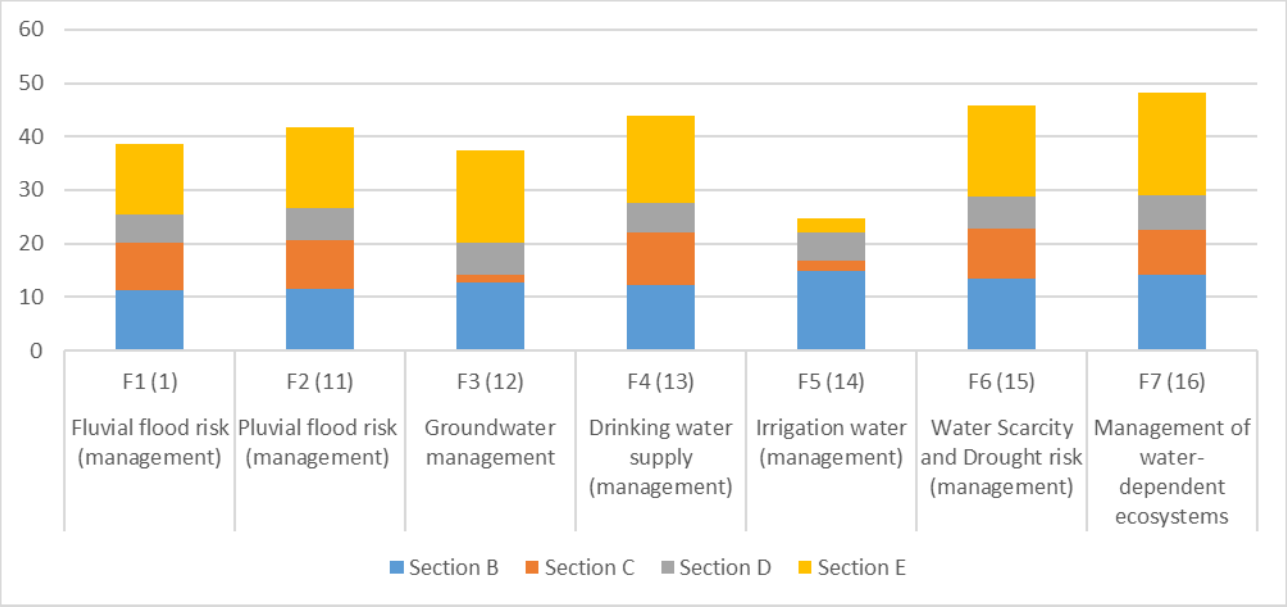

Figure 4. Average points scored in each Field of Action

The graph shows how the individual fields of actions were assessed in each of the assessed sections. It can be seen that the results of section E, which dealt with adaptation to climate change, were higher in fields associated with meteorological or hydrological events than fields related to strictly human functional activities (e.g.: irrigation).

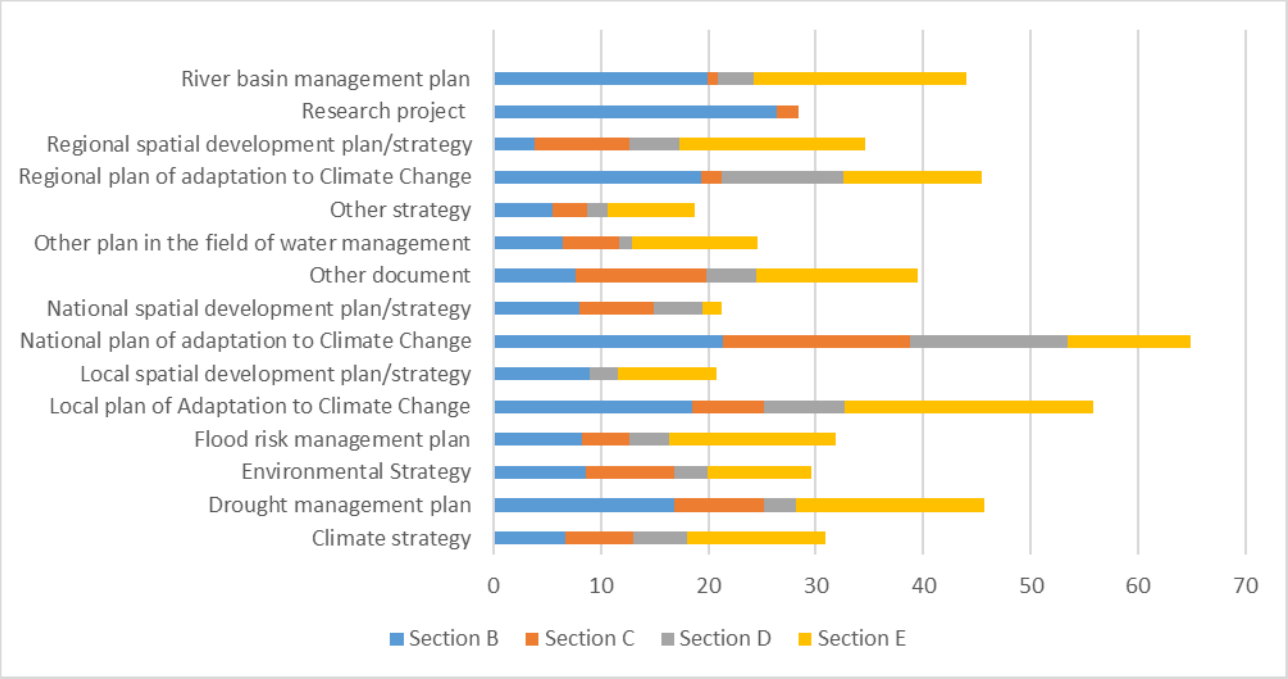

Figure 5. Points scored in each type of the document

The chart shows how the various types of documents were assessed. Water management plans (e.g.: drought management plans and river basin management plans) as well as documents whom the thematic is directly related to the issue of climate change are characterized by a high score. The results were aggregated into the four sections of the sheet review (Sections B – E).

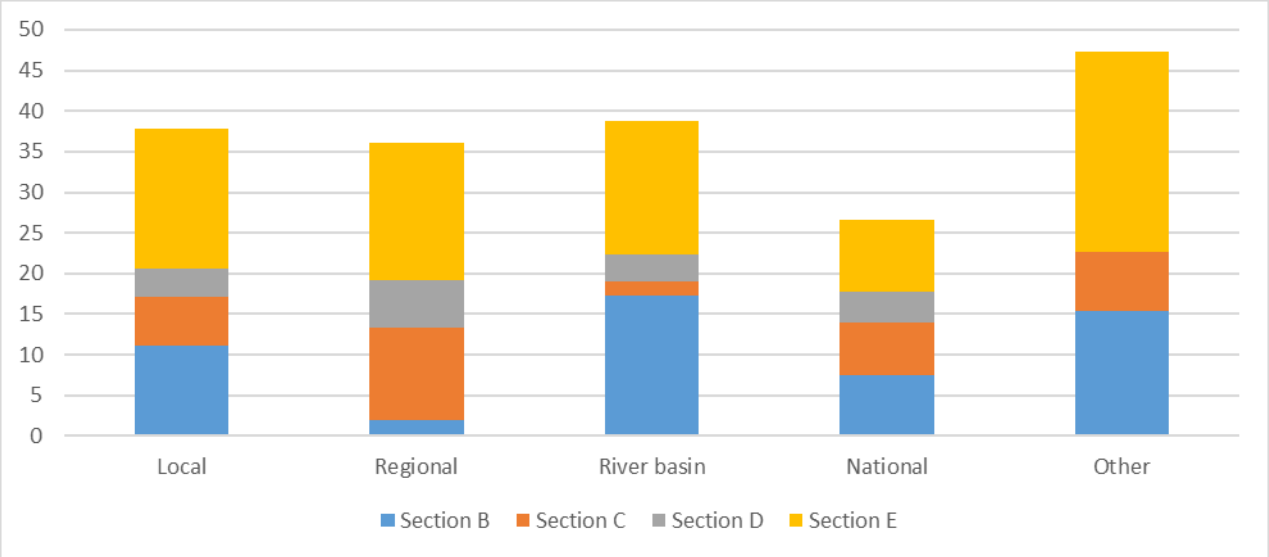

Figure 6. Scores according to spatial scale of documents

The chart shows how documents were assessed in terms of their spatial scale: national documents scored lower than documents with a smaller spatial scale.

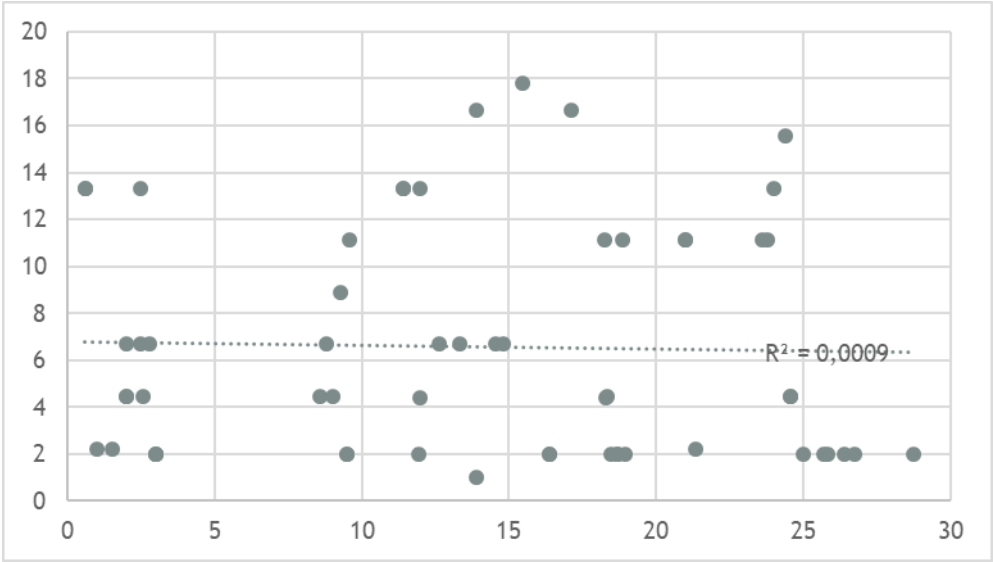

Figure 7. Section B and section C score relation

The correlation between the results of section B and section C, expected at the beginning of the analyzes, was not confirmed during the analysis. The 0 point values for each section have been excluded from the chart.

2.3. Gaps identification of policy documents

2.3.1. Gaps identification based on the CC robustness score (quantitative analysis)

Following the evaluation of the document, a score of robustness to climate change is calculated (see 2.1.2). For the present section of the document, the score is expressed as a percentage of the maximum score achievable by the analyzed documents, i.e. excluding the questions considered as not applicable by the reviewer. A 100% score means a full compliance with the good practices, and so the lower the robustness score, the more substantial the gap. The robustness scores have been averaged for all the documents at the level of potentials gaps according to the Tables 2-5 and for the different spatial scopes: local, regional, river basin and national.

We make the assumption that an issue with a score under 66% should be considered as a gap, as it corresponds to a score under the "rather yes" option. In order to facilitate the reading of the results, potential gaps have been classified with a five-level scale according to their prevalence in the reviewed documents (Table 9).

Table 9. Classification of a potential gap according to the robustness score

CC robustness score (expressed as a percentage of the maximum score)	Qualification of the prevalence of the gap
>= 66 %	No gap
65 % - 50%	Uncommon gap
49% -33%	Quite prevalent gap
32 % - 17%	Very prevalent gap
>17 %	Quasi omnipresent gap

The following tables (Tables 10–13) present the robustness score of the potential gaps, as well as the class assigned to them according to the Table 9, and therefore, their designation or not as a gap.

Table 10. Gaps identification for the section B - Description of the climate change issue and potential gaps associated with them

Gap code	Potential gaps	Robustness score - general [%]	Robustness score - local level [%]	Robustness score - regional level [%]	Robustness score - river basin level [%]	Robustness score - national level [%]
B1	non-optimal geographic scale	41%	33%	44%	33%	44
B2	non-optimal time scale	64%	70%	82%	32%	82
B3	weak meteorological description	48%	56%	52%	38%	52
B4	weak hydrological description	34%	30%	31%	42%	31
B5	weak hydrogeological description	24%	18%	20%	30%	20
B6	no water use forecast	23%	17%	25%	17%	25

Colour explanation: in accordance with Table 9

Table 11. Relation between the questions of the review sheet for the section C - Effect of the CC on the measures/ assumptions of the document - and potential gaps associated with them

Gap code	Potential gaps	Robustness score - general [%]	Robustness score - local level [%]	Robustness score - regional level [%]	Robustness score - river basin level [%]	Robustness score - national level [%]
C1	No consideration of CC effects in the document assumptions	68%	50%	66%	73%	66
C2	No CC- resilience test of measures	46%	2%	45%	47%	45
C3	No CC climate proofing test at the design stage of the measures	28%	4%	32%	20%	32

Colour explanation: in accordance with Table 9

Table 12. Relation between the questions of the review sheet for the section D - Impact assessment of measures/assumptions of the document in the field of CC - and potential gaps associated with them

Gap code	Potential gaps	Robustness score - general [%]	Robustness score - local level [%]	Robustness score - regional level [%]	Robustness score - river basin level [%]	Robustness score - national level [%]
D1	Weak assessment of the document on emission of greenhouse gases	16%	14%	21%	4%	21
D2	Weak assessment of the document on adaptation to the CC	27%	23%	33%	10%	33

Colour explanation: in accordance with Table 9

Table 13. Relation between the questions of the review sheet for the section E - Adaptation to CC - and potential gaps associated with them

Gap code	Potential gaps	Robustness score - general [%]	Robustness score - local level [%]	Robustness score - regional level [%]	Robustness score - river basin level [%]	Robustness score - national level [%]
E1	No natural water retention adaptation measures	69%	46%	79%	43%	79%
E2	No technical water retention adaptation measure	54%	52%	59%	43%	59%
E3	No measure in the field of planning/governance/awareness	75%	56%	75%	77%	75%
E4	No consultation with neighbouring countries in the field of adaption measures	34%	19%	38%	17%	38%
E5	Poor adaptation to fluvial flood risk	57%	63%	51%	79%	51%
E6	Poor adaptation to pluvial flood risk	57%	71%	50%	79%	50%
E7	Poor adaptation of groundwater management	62%	52%	52%	100%	52%
E8	Poor adaptation of drinking water supply	57%	53%	57%	57%	57%
E9	Poor adaptation of irrigation water	73%	67%	61%	100%	61%
E10	Poor adaptation to water Scarcity and drought risk	76%	77%	71%	86%	71%
E11	Poor adaptation of water-dependent ecosystems	79%	88%	71%	100%	71%
E12	No evaluation of effectiveness of the adaptation measure	22%	16%	20%	27%	20%

Colour explanation: in accordance with Table 9

Identified gaps and key observations

Based on the general results, the exercise made it possible to identify **1 omnipresent gap and 5 very prevalent gaps:**

- **Weak hydrogeological description (gap B5):** while surface waters and other common components of environment (mostly related with atmosphere – temperature, wind speed etc.) are often at least mentioned to be climate-change vulnerable, groundwater and its relation with climate change was often not identified or not mentioned. Even the drought related documents very often described decrease of water resources as an effect of human activity and its CC-related reasons were barely identified. Utilization of modeling to predict groundwater changes were not identified in any of analyzed documents,
- **No water uses forecast (Gap B6):** climate change can impact water resources but can also influence water use (e.g. increased abstractions for irrigation). The interactions between the uses of water, the resources and their evolutions because of climate change can however generate tensions and have a negative impact on the uses and their economy. The lack of water use forecast is however one of the most prevalent gaps,
- **No consideration of CC impact at the operational level (gaps C3 and E12):** even if the effects of CC seem to be taken into account in the general assumptions of the documents (no gap for C1, see table 11), this effort is not followed at the more operational level of the documents:
  - **No CC climate proofing test at the design stage of the measures (gap C3);**
  - **No evaluation of effectiveness of the adaptation measure (gap E12).**

  These gaps are particularly present at the local level, where these 2 above -mentioned gaps have been qualified as omnipresent gap, as well as the C2 gap (No CC – resilience test of measures).
- **Weak assessment of the document on emission of greenhouse gases or adaptation to the CC (gaps D1 and D2):** taking into account the EU goal of climate neutrality or the need to enhance adaptation to CC in the policy documents can still be subject to improvement at the step of impact assessment for instance by supporting expert judgment with data;

5 quite prevalent gaps:

- **None-optimal geographic scale (gap B1):** the resolution of the CC analysis is coarser than the basic planning unit[8] of the policy document. The coarser the resolution, the less precise the location of the most sensitive areas, and therefore the less optimal adaptation measures will be,
- **Weak meteorological description (gap b3):** many analysis in evaluated documents based on few indicators: mostly air temperature or surface water flow. The wide scope analysis with usage of many indicators to describe climate changes and predictions were used only in national level documents,
- **Weak hydrological description (B4):** despite the fact that the reviewed policy documents cover water-oriented fields of actions, the description of hydrological changes is quite limited,
- **No CC- resilience test of measures (gap C2):** it confirms the weak consideration of CC impact at the operational level,

8 The basic planning unit is the smallest administrative level or type of geographic area, for which the measures / assumptions in the document are designated / differentiated. In other words, it is the resolution of the document. E.g.: the basic planning unit of the River Basin Management Plan is the Water body

- **No consultation with neighbouring countries in the field of adaption measures (E4);**

and **7 uncommon gaps** related to the non-optimal time scale of the CC description (B2) and the presence of adaptation measures in the policy documents (gaps E2 and E5 - E8).

2.3.2. Overall gap identification from the scope review and conclusion

In addition to the quantitative analysis carried out on the basis of the robustness score of each potential gap, this section presents the results of the data analysis using an overall approach (i.e. behind the potential gaps-specific approach of the previous section). It allowed to identified these general gaps:

- the under-representation of documents focused to counteracting CC (e.g.: with greenhouse gases emission mitigation measures);
- the low optimization of the adaptation measures to CC.

In addition to these gaps, the exercise also highlighted the lack of erosion of the CC policy translatability.

Document CC orientation

Adopted methodology assumed that the documents could be assigned to each Field of Action with definition if any document contains assumptions or measures focused on CCA/CCE/Both in each Field of Action.

Performed analysis showed that there was no document which was oriented only on counteracting CC in particular Field of Action. Reviewed documents contained content related to counteracting CC only with connection with adaptation of them. Documents focused on adaptation to CC were in vast majority, however there was plenty of documents with combination of CCA/CCA.

The low optimization of the adaptation measures to CC

Among the 4 analyzed issues, the robustness score of section E - Adaptation to climate change - differs from the others by its high score: the documents analyzed contain measures for adaptation to climate change, or measures that can be classified as such. This can be explained by the fact that:

- measures that contribute to the objectives of water policies may be multifunctional and have multiple benefits, which the adaptation to the climate change;
- the measures address issues already present, of which climate change only increases the probability or the severity (e.g.: drought, flood).

In other word measures planned in documents were mainly aimed to face particular sectorial issue and not for counteracting climate changes or to adapt them just for themselves. These measures are thus partly uncorrelated with the predicted effects of climate change. There is therefore no statistical dependence between the robustness scores of sections B and E, despite the logical interdependencies between these sections: the more precise the description of the predicted effects of climate change, the more the authors of the document are able to propose pertinent adaptation measures. The fact that the measures depend on other policy without (fully) taking into account the prognosis of the CC assumes that they are at best not optimized, at worst not robust to CC.

Moreover, the weaker scores of the other sections seems to confirm the hypothesis that these adaptation measures are not fully optimized, e.g.:

- the description of climate change is only very rarely fully adapted to the geographic planning unit of the document;
- and is based in part only on expert judgment based on findings at the national level;

- the evaluation of the effectiveness of the adaptation measure is rarely fully carried out (see E12 gap).

No evidence of erosion of the CC policy translatability

The exercise does not reveal any evidence of a disintegration of CC policy assumptions during their translation to finer spatial scales (national -> regional -> local): the robustness score is not proportional to the size of the spatial scale. On the contrary, the reverse is observed: the national scale is characterized by the lowest scores, and the local by the highest. This may be explained by the intrinsic nature of the national documents and the structure of the review sheet these documents present general guidelines without the need to go into detail, which can result in a worse score according to the evaluation system of the review sheet. Even the analysis within the same country and/or the same kind of documents (e.g. national/regional/local spatial development plan) does not give clear conclusions.

3. Scope review of other documents

3.1. Grey and scientific literature

The literature review was divided into scientific and grey literature. The review of English-language scientific literature was carried out by PP4, while the review of grey and scientific literature in national language was conducted by members of the Review Group from individual countries. The idea of systematic literature review is based on the assumption that the best knowledge about the studied phenomenon can be obtained by analysing all research results, regardless of the place and form of publication.

Grey literature

The literature review was conducted with the use of internet search engines and an analysis of local magazines related to water management. Searches was performed across a suite of relevant organizational websites for management of water resources, small water retention measures and protection of water resources. Each potentially suitable website was also manually searched for relevant publications.

The information retrieval process was based on searching magazines in online databases and paper editions of journals based on the following keywords and their combinations: water management, adaptation to climate change, planning, policy, decision support system and cumulative effect. The grey literature searches were mainly in the 1st tier grey literature category: books, chapters in books, government reports, think tank publications as well as annual reports, newspaper articles.

Scientific literature

Review of the literature is based on comprehensive overview of the previously published works on a specific topic. In this case the review was focusing on climate-proof management of water resources, including floods/heavy rain/drought risk prevention, small water retention measures and protection of water resources through sustainable land-use management.

Specifically, search strategy aimed to collate all available, relevant research from traditional academic publications.

The comprehensive article searches were performed on the following databases:

Web of Science Core Collections, Scopus, Google Scholar and additionally: Directory of Open Access Journals, Electronic Theses Online Service.

The first step in the entire search process was searching for titles and abstracts. The following search string was used for this purpose:

Water management AND adaptation to climate change AND (Planning OR Policy OR Decision support System OR Cumulative effect).

These keywords and their combinations were used in search engines.

The searches in Web of Science Core Collections, Scopus and Google Scholar resulted in a total of 112 records. In the case of bases: Directory of Open Access Journals and Electronic Theses Online Service there were found 6 records related to keywords. In the next stage, carefully selected items were analysed based on abstracts and the most appropriate articles were selected for full text review and coding. A team of experts has selected which articles concern adaptation to climate changes or counteracting climate changes or both - when the documents is focused on both matters. Finally, 37 articles from the searched databases were selected and subjected to further analysis and coding.

Full text analysis and coding were performed based on the next characteristic:

- Field of Action
- Focus on CC
- Journal title
- Publisher of the journal
- ISSN of the journal
- Number of the issue of the journal
- Link to the article/paper
- Year of the publication
- Language of the publication
- Country of the journal
- Publication type
- Title of the publication
- Abstract
- Briefly what gaps it is referring to
- Broader what gaps it is referring to
- What tools it offers (link)
- Other comments

The following gaps and problems were found in the searched articles (the article number from the table below is given in brackets):

- A lack of expertise in dealing with climate challenges in an integrated manner, Insufficient human resources to develop and implement a comprehensive climate change adaptation strategy, Low budget and few opportunities to make large investments for climate change adaptation and mitigation, Limited benefit from climate-related research programs and funding, Less autonomy due to dependency on or limitations by upper governance levels (2).
- Functionalities and features limited to specific impacts or sectors such as wetland changes, coastal flooding and erosion; address problems at a coarse national/sub-continental scale, not useful to respond and manage risks locally; difficulties in answer effectively to a variety of important decision-making questions such as:
    - Which are the main regions or sectors more vulnerable to global climate change?
    - Which scenario is the least harmful for a target at risk?
    - Which adaptation actions can better contribute to risk reduction? (3)
- DSS tools intended merely as pieces of software can do very little and are also exposed to high risks of misuse (4).
- Lack of centrality/Lack of knowledge/Lack of time/Lack of money (6).
- The most widely recognized challenge is quantifying the impact of climate change on flood and drought risks, for only then can policy makers and individuals appropriately adjust their flood and drought projections and policy strategies. The challenges percolate to the EU policy level, where myriad EU directives, guidance documents, regulations, and other policy tools directly or indirectly target flood and drought risk policy in the agriculture and water sectors (13).
- It is assumed that in order to be fully efficient spatial planning and water management should be integrated. Future solutions should be integrated, multicriterial and strategic (9).

- Inundation and urban floods as a result of intense rainfall are the most common problems in cities. The reasons for the high sensitivity of the water management sector to climate change include the technical condition of the sewage and rainwater disposal infrastructure, in particular its failure to adapt to the increasing amount of rainfall and their intensity, deficiencies in flood protection, sealing the surface of cities, or a limited area of green areas. However, first of all, it is necessary to change the way of thinking towards recognizing rainwater and meltwater as a resource extremely valuable for the city and requiring appropriate management (23).
- Insufficiently developed monitoring network, Gaps in groundwater protection systems. The issues of sustainable use of groundwater, problems related to the legislative and financial tools of the state. The quality problems concern mainly the discharge of insufficiently treated municipal wastewater and sanitation of rural areas as well as littering the beds of rivers and streams (24).
- Too low a growth rate of investments in renewable energy sources (25).
- The issues of including adaptation to climate change in city programming documents, regardless of their size (7).
- Exhaustion of existing funding sources for environmental protection (25).
- The IPCC scenarios were not integrated (14-16).
- Monitoring data that may be insufficient or of poor quality (17).
- Unused potential of retention basins, lack of reserve water sources in smaller water supply systems; unstudied impacts of CC on water resources; big water losses within supply network; lack of necessary water polices (18)
- Lack of synergy of multiple sectors regarding drought management (19)
- Urban development is mainly directed by "capital" and does not follow recommendations of experts and/or publicly available flooding maps (20)
- Lack of interdisciplinary approach, conflict of interest, lack of sustainable development (27)
- Lack of preparedness to deal with CC issues (policies, measures) (29)
- Lack of non-structural measures in flood management (30)
- Not using the potential of solutions based on ecosystem services in protection of water source (quantitatively and qualitatively) (31)

The table below presents selected publications from all categories (technical/review/ newspaper/grey literature). Full bibliographic information is available in the references

Table 14. selected publications from all categories (technical/review/ newspaper/grey literature)

№	Publication type	Publication title in English
1	Technical	The use of 2D hydraulic modelling to verify the correctness of the axis of bridge pillars in relation to the flow direction
2	Review	Urban water management and climate change adaptation: A self-assessment study by seven midsize cities in the North Sea Region
3	Technical	DESYCO: A decision support system for the regional risk assessment of climate change impacts in coastal zones
4	Review	Decision Support for Mainstreaming Climate Change Adaptation in Water Resources Management
5	Technical	Development and application of a planning support system to assess strategies related to land and water resources for adaptation to climate change
6	Review	Decision support platforms for climate change adaptation: an overview and introduction
7	Review	Adaptation to climate change as a challenge for city development policy in the national and European context
8	Review	European water resource management systems - Estonia
9	Technical	Flood risk factors in suburban area in the context of climate change adaptation policies – case study of Wroclaw, Poland
10	Review	Engineering Methods of Forest Environment Protection against Meteorological Drought in Poland
11	Review	Integration of water management and land consolidation in rural areas to adapt to climate change: Experiences from Poland and the Netherlands
12	Review	Guidelines for the adaptation to floods in changing climate
13	Technical	Challenges for mainstreaming climate change into EU flood and drought policy: Water retention measures in the Warta River Basin, Poland
14	Technical	Soil Moisture and Soil Temperature Dynamics at the Tree Line of Mount Rax, 1999-2010
15	Technical	Landscape-Scale Forest Management in the Municipal Watersheds of Vienna, Austria and Seattle, USA: Commonalities Despite Disparate Ecology and History
16	Grey literature	Forest site mapping report, forest district Siebensee, forest administration Wildalpen.
17	Technical	Preparation of the basis for the Slovenian National Drought Management Action Plan
18	Grey literature	Measures to reduce the consequences of climate change - drinking water supply in Slovenia
19	Grey literature	Drought management in Slovenia
20	Newspaper	Floods in Slovenia: billions in damage, for which we are mostly to blame
21	Grey literature	Chemical status of groundwater in Slovenia
22	Grey literature	Wastewater management in Slovenia in the light of European legislation
23	Grey literature	Expert debate - "Let's feel the climate - adaptation in the city"
24	Grey literature	Main Groundwater Reservoirs in Poland
25	Grey literature	ECOLOGICAL REPORT of Bank of Environmental Protection
26	Grey literature	Wastewater management in Slovenia in the light of European legislation (2017)
27	Grey literature	Current problems of water management in Slovenia
28	Peer-rewieved	Assessment of achieving sustainable goals from the point of view of groundwater management and protection in Slovenia:
29	Peer-rewieved	Impacts of climate change on water quantities and sea flooding in Slovenian Istria
30	Peer-rewieved	Importance of non-construction measures for flood safety
31	Peer-rewieved	Ecosystem services of urban forests for backup water source
32	Peer-rewieved	Current problems of water management and management - some critical views

3.2. Cross-fertilized projects

Previous Interreg projects integrated into TEACHER-CE have attempted to address gaps and improve water management methods. These gaps were collected and connected with fields of actions.

The gap review was performed by the Partners who had previously been the leaders of these projects (Table 15). The gaps identified and addressed in these projects are shown in Table 16. Related fields of actions have been assigned to the individual gaps.

Table 15 Partners providing information about gaps identified by previous projects

Project	Responsible PP
RAINMAN	PP3
FRAMWAT	PP4
PROLINE-CE	PP1, PP5
SUSTREE	PP7
DTP CAMARO-D	PP6
H2020 FAiRWAY;	PP1
DRIDANUBE and DAREFFORT (DTP),	PP1
C3SDisaster Risk Reduction Sectoral Information System	PP5
C3S Soil Erosion Demo Case)	PP5

Table 16. The gaps identified and addressed in previous projects

Project	Gaps identified by the project	Field(s) of Action
FRAMWAT	1. Lack of a non-commercial web-based platform to support the NSWRM planning process in a comprehensive manner	• Water Scarcity and Drought risk (management) • Fluvial flood risk management • Management of water-dependent ecosystems • Groundwater management
	2.Lack of GIS methodologies/tools indicating potential needs and possibilities of NSWRM development based on multi-criteria analysis taking into account environmental conditions	
	3. Lack of simplified (static) methods/tools for assessing the cumulative effectiveness of NSWRM	
	4. Lack of instructions for the evaluation of the cumulative dynamic effectiveness of the planned NSWRM describing their implementation and evaluation in mathematical models	
	5. Lack of publicly available methods/tools facilitating the selection of NSWRM based on multi-criteria analysis	
	6. Lack of generally available guidelines for NSWRM cost evaluation	
	7. Lack of tools presenting legal requirements for the implementation of NSWRM	
RAINMAN (gaps identified before the start of the project)	1. Practice oriented guidance, experience and examples for an integrated heavy rain risk management are missing.	Pluvial flood risk (management)

Project	Gaps identified by the project	Field(s) of Action
	2. Despite numerous catastrophic heavy rain events in the past: neither sufficient capacities of public administrations, nor applicable tools are available. So far just isolated and specialised local experience on heavy rain risk management exists and needs to be combined to improve the situation in Europe.	
	3. Actors need better understanding and supporting tools for heavy rain risk management: “What exactly is the risk in this location?”, “How can we avoid or reduce the risk?” and “How can we motivate or force stakeholders to cooperate in risk mitigation?”	
	4. Flood risk management planning and respective tools focus on river flooding and do not consider heavy rain risks in practise. In theory different types of flood should be part of risk mapping and flood risk management plans. But due to missing practical methods and tools this is not implemented in most EU MS (see report EU-COM, WRc plc 3/2016).	
	5. Risk assessment and mapping: While for river flooding risk maps are available, a “heavy-rain-risk-assessment” or adequate maps do not exist everywhere.	
	6. Risk reduction measures: flood risk management is lacking of adequate measures regarding heavy rain events; options and implementation of heavy rain risk reduction measures (protection, warning, alarm, preparedness, retention) in most cities is limited; All target groups benefit from better knowledge & tools in this respect.	
	7. Pluvial flooding is influenced by a lack of retention of surface water before it enters (urban) areas. Natural retention has an important impact on the occurrence of pluvial floods.	
	8. Lack of risk communication strategies and information about existing risks and individual adaptation	
PROLINE-CE	1. Lack of adapted and target-oriented land-use activities concerning protection of water resources, balancing conflicts of land-use pressure on water and adaptation to climate change issues despite uncertain projections.	• Drinking water supply (management) • Water Scarcity and Drought risk (management), • Groundwater management • Fluvial flood risk (management)
	2. Lack of extended and systematized reviews about Best Management Practices already elaborated but not yet successfully applied in CE domain	
	3. Lack of guidelines and recommendations for the implementation of sustainable land use and flood/drought management	

Project	Gaps identified by the project	Field(s) of Action
	4. Lack of publicly available methods/tools facilitating the selection of Best Management Practices supporting water protection in Central Europe based on multi-criteria analysis	
	5 Limited knowledge about delivered ecosystem services regarding water in CE and the ways for their economic quantification	
	6. lack of sufficient legislative basis for integrated land-use and water management practices –to develop integrated efficient land-use management practices regarding optimisation of the use of capacities and resources	
	7. need of national capacity building and transnational stakeholder dialogue (local authorities, interested communities, end users etc.) in order to reach a common approach towards sustainable transnational land-use and water management	
SUSTREE	1. lack of harmonized access to data on vulnerability of forests to climate change	• Water Scarcity and Drought risk (management) • Management of water-dependent ecosystems • Drinking water supply (management)
	2. lack of common management system for trade and utilization of Forest reproductive materials such as seeds across and between Central European Countries	
	3. lack of freely available web-based decision support system for advising stakeholder on vulnerability of forests, species choice and choice of adapted planting material	
DRIDANUBE (DTP)	1. Drought was not considered as an issue of high priority in the region	Water Scarcity and Drought risk (management)
	2. Drought monitoring: - untimely delivery - cross-border inconsistencies - lack of integration of risk and impact data	
	3. Drought management in the region is weak, in a reactive mode, cooperation between key actors is missing and formal legislation mostly does not exist	
	4. Drought Impacts and risk assessment: - no systematic collection of drought impacts - lack and incomparable drought risk assessment methodologies - despite the impacts on the economy and welfare of people, mainly in agriculture, drought is still not considered an issue of high priority	
	5. Drought Management: - reactive, dealing mainly with losses and damages - cooperation between key actors is missing - formal legislation does not exist	

Project	Gaps identified by the project	Field(s) of Action
DTP CAMARO-D	1. Insufficient monitoring and data to quantify the environmental impacts of activities	all
	2. Qualified human resources are limited and current employees are fully occupied with their daily obligations	
	3. Dissemination of positive environmental actions to the general public is lagging behind (PR know-how is missing)	
	4. The most important barrier towards better environmental conservation is increased administration	
C3SDisaster Risk Reduction Sectoral Information System	1. Limited information for the recent decades about the characterization of precipitation regimes over Europe in special way in terms of extreme events	• Pluvial flood risk (management), • Fluvial flood risk (management)
	2. Limited availability of datasets for recent decades to be post processed by Expert Users about the characterization of precipitation regimes (in special way, for extreme events)	
	3. Limited understanding about how the most reliable gridded datasets (e.g., E-OBS, reanalysis ERA5) can provide information about extreme precipitation events	
	4. Lack of information about expected flooded areas and associated economic damages for European cities highly vulnerable to pluvial flooding, highly asked to support policy and decision makers	
	5. Lack of catalogues about the main events occurred during the most recent decades in terms of magnitude, affected area and empirical damages	
	6. Lack of a clear evaluation about how the ECMWF reanalysis ERA5 and its downscaling at very high resolution can reproduce the patterns for heavy rainfall is highly asked by the Users	
C3S Soil Erosion Demo Case)	1. Lack of knowledge about how the gridded datasets freely available on Climate Data Store can support the evaluation of soil erosion over Italy	Other (precipitation-induced soil erosion)
	2. Limited information about the expected changes and the related uncertainties in rainfall erosivity and then in soil loss under the potential effect of climate change	
	3. Lack of Decision Support Tools to clearly assess how variations in land use or management practices can influence soil loss at large scales (e.g. NUTS levels) also taking into account expected variations under climate change	
	4. Lack of Information about expected changes in rainfall indicators assumed as proxies for soil erosion supporting policy and decision makers	

An analysis of 8 previously funded projects included in TEACHER was carried out. a total of 44 gaps related to all FoA were distinguished. The thematic scope of gaps is very wide.

The gaps listed in the table are associated with multiple fields of action (Figure 8), with the most numerous being the gaps in the scope of Water Scarcity and Drought risk (management) and Fluvial flood risk management.

The least numerous were gaps related to the risk of erosion. However, it should be noted that erosion issues were the subject of only one project.

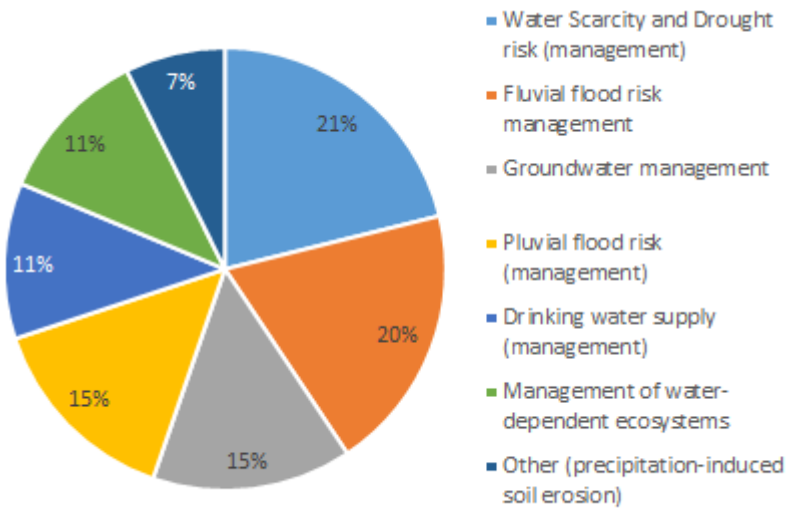

Figure 8. Share of gaps associated with each Field of Action

3.3. Other projects

A review of other water management projects was carried out in order to in the proposal (not finished projects) or in the final report analysis important gaps and proposals to solve them. The collection of this data will allow to expand the number of activities, tools or methodologies to support the CCA or CCE process through inclusion in the Toolbox or guidelines for strategy development. In order to select projects, first a review of existing databases was performed. Then the project description and a list of its results were read (if possible). The selected projects containing CCA or CCE related tasks were analysed in detail and the identified shortcomings and proposed methods for their solution were described.

For projects from Interreg programmes and project databases were searched:

https://www.interregeurope.eu/projects/

https://www.interreg-central.eu/Content.Node/projects/projects.html

Projects related to selected water issues and those with a reference to climate change planning/adaptation in the main description were searched.

For projects from the Life programme, the search engine was used:

https://webgate.ec.europa.eu/life/publicWebsite/search/advanced

Water issues were selected, with conditions on planning/adaptation to climate change.

Then, from the pre-selected ones, each in turn was substantively analysed by accessing the project website or available online studies. The final reports and tools (if any) and their conclusions were searched.

As a result of the work, 57 documents were analysed, of which 15 was analysed in detail. The selected shortcomings are summarised in the table below.

Table 17. Selected projects addressing climate change impacts on water management

Project name	Theme	Duration	Programme	Focus on CC	Useful knowledge for TEACHER strategies
HydroSense	Water availability, irrigation	2010-2012	Life	CCA	The HydroSense project applied precision agriculture methods to achieve the integrated crop management of combined inputs in three pilot cotton fields in the Pinios watershed, in order to reduce irrigation and the use of chemicals (fertilisers, herbicides and pesticides). The project results present methods to save water during these crops and can be used to adapt to climate change (droughts).
FIGARO	Water availability, irrigation	2012-2016	EU FP7-KBBE - Specific Programme "Cooperation": Food, Agriculture and Biotechnology	CCA	The FIGARO irrigation decision-support platform is designed to allow growers to easily harness the power of cutting-edge irrigation technology and agronomic knowledge to optimize the use of water and can be used as an adaptation to climate change. http://www.figaro-irrigation.net/outputs/the-figaro-platform/en/
REFRESH	Climate change impact and adaptation	2010-2014	European Union Seventh Framework Programme	CCA	Review of published climate change adaptation and mitigation measures related with water. pgs 115-118 http://www.refresh.ucl.ac.uk/webfm_send/1470 article http://www.refresh.ucl.ac.uk/node/288
WETwin	IWRM, wetland management	2008-2011	7th Framework Programme of the European Union	Both	Guidance for the application of Vulnerability Assessment and MultiCriteria Decision Analysis in integrated wetland management http://www.wetwin.eu/downloads/D9-1.pdf. The guidance is focused on adaptation to Climate Changes and to counteracting Climate Changes
EU NWRM Initative	Natural Small Water Retention Measures	2013 - 2014	DG ENV	CCA	Guideline for support NWRM http://nwrm.eu/guide-pl/files/assets/basic-html/index.html#1. The guideline can be used in planning NSWRM for climate change adaptation as drought and floods.
NAIAD	Flood and draught	2016-2019	Horizon 2020	CCA	NBS guideline/tool: http://naiad2020.eu/about-the-e-guide/nbs-solution-guide/. The guideline can be used in planning NSB for climate change adaptation as drought and floods.
MARS project	water management	-2018	7th Framework Programme of the European Union	CCA	Recommendations document provides information and highlights relevant outcomes of the MARS project aiming to inform River Basin Managers http://mars-project.eu/index.php/results.html. The recommendations can be used for catchment management in climate change adaptation.
DANUBE FLOODPLAIN	water management and flood risk prevention	2018-2020	INTERREG DANUBLE	CCA	A manual, strategy and roadmap for floodplain restoration and protection in the Danube River Basin, which may be useful in planning projects to reduce the risk of pluvial and fluvial floods in the Danube River Basin. Reports on possible restoration approaches for each type of water work: http://www.interreg-danube.eu/uploads/media/approved_project_output/0001/39/8f96d99be7c3935cf1ba78cb72c35d1f56b72913.pdf
BEGIN	green infrastructure, flood risk	2016-2022	Interreg	CCA	Guidelines for Blue and Green Infrastructure in cities as climate change adaptation measures. https://vb.northsearegion.eu/public/files/repository/20200610145644_20200525142712_BEGIN-PolicyBrief-Final-2020.pdf
LIFE WATERCOOL	water management	2019-2023	LIFE	CCA	Project will develop: Green solutions catalogue comprising bioclimatic technologies and solutions for sustainable urban development; Manual of technologies and bioclimatic solutions for sustainable urbanism, focused on the healthy street concept for quick replication and transference;
WIZ	drinking water	2010-2013	LIFE	CCA	The on-line platform of WIZ has been developed and tested and is now active with its two services, WIZ4ALL and WIZ4PLANNERS (no link)
GISBLOOM	water management	2010-2013	LIFE	CCA	Project created models and interactive map services designed for the participatory monitoring and

Project name	Theme	Duration	Programme	Focus on CC	Useful knowledge for TEACHER strategies
					management of eutrophication and algal blooms in river basins, lakes and coastal areas https://www.jarviwiki.fi/wiki/Etusivu
OPTAIN	water management	2020-2025	Horizon 2020	CCA	Project (ongoing) will quantitatively assess the effectiveness of NSWRM under current and future climate assuming a discrete set of actor-based scenarios for each case study (14 pcs). This will be done by integrated process-based environmental modelling combined with conceptual socio-economic assessments at the field and catchment scale. Then will couple the process-based and conceptual models to a multi-objective evolutionary algorithm to identify optimal trade-off implementation schemes for NSWRM, including their combination and allocation within the catchment. The results will be post-processed using adequate machine learning and visualisation techniques to derive generic patterns and relationships among trade-off solutions and to enable actors to elaborate preferred solutions according to their own preferences.

4. Conclusions

The exercise has led to the identification of about 90 gaps:

- 0 gap at the level of European Union water legislation in order to identify potential policy gaps that may explain difficulties at the local level (see chap. 1.1);
- 11 gaps at the level of countries from a formal perspective through the RBMP and FRMP assessment reports (see chap. 1.2);
- 16 gaps at the local, regional, river basin and national level in the frame of a scope review of policy documents (see Section 2);
- 64 gaps from the review of grey and scientific literature and previously funded projects (see Section 3).

As part of the next deliverable (D.T.4.1.2), an in-depth analysis will make it possible to identify the tools developed within the framework of TEACHER-CE, which can address these gaps, whether via the Toolbox (CC-ARP-CE) and the cross-fertilized projects.

The Joint Strategy itself (deliverable D.T.4.2.1) should also be constructed keeping in mind these gaps, because they correspond to the room of improvement of the existing policy documents. The review form template and its integrated evaluation system developed within the framework of this deliverable (Annex nr 1) can thus be used by local key actors to evaluate their own policy document.

5. References to chapter 1

> Commission Staff Working Document Fitness Check of the Water Framework Directive, Groundwater Directive, Environmental Quality Standards Directive and Floods Directive (European Commission, 2019), available on European Union Commission web site: https://ec.europa.eu/environment/water/fitness_check_of_the_eu_water_legislation/documents/Water%20Fitness%20Check%20-%20SWD(2019)439%20-%20web.pdf

> The fifth Water Framework Directive Implementation Report – assessment of the second River Basin Management Plans and the first Floods Directive Implementation Report – assessment of the first Flood Risk Management Plans (2019), available on European Union Commission web site: https://ec.europa.eu/environment/water/water-framework/impl_reports.htm

> Results of the public consultation on the question of coherence between the Directives covered by this fitness check and sectoral policies (Source: Trinomics and Wood, 2019) reported in the figure 21, p. 92 of the Commission Staff Working Document Fitness Check of the Water Framework Directive, Groundwater Directive, Environmental Quality Standards Directive and Floods Directive (European Commission, 2019) available on European Union Commission web site: https://ec.europa.eu/environment/water/fitness_check_of_the_eu_water_legislation/documents/Water%20Fitness%20Check%20-%20SWD(2019)439%20-%20web.pdf