STRATEGY IMPLEMENTATION

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

ACTIVITY T4.2 STRATEGY IMPLEMENTATION

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DELIVERABLE D.T4.2.1 - STRATEGY FOR INTEGRATED AND PARTICIPATORY WATER AND LAND USE MANAGEMENT CONSIDERING CLIMATE CHANGE

DELIVERABLE D.T4.2.2 - LINKING TEACHER-CE PROJECT WITH KEY STAKEHOLDERS - FORUM FOR INTEGRATED WATER MANAGEMENT

DELIVERABLE D.T4.2.3 - SET-UP OF FOLLOW-UP ACTIVITIES

Note: given the high level of interactions between the different deliverables, it was decided to merge the D.T4.2.1 - D.T4.2.3 deliverables into a single document to facilitate its understanding.

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List of abbreviations

CC-ARP-CE	Integrated toolbox for Climate Change Adaptation and Risk Prevention in Central Europe
CC	Climate change
CE	Central Europe
DWD	Drink Water Directive
EQSD	Environmental Quality Standards Directive
EU	European Union
FD	Floods Directive
FHRM	Flood Hazard and Risk Map
FRMP	Flood Risk Management Plan
GIS	Geographic Information System
GWD	Groundwater Directive
IPCC	Intergovernmental Panel on Climate Change
PFRA	Preliminary Flood Risk Assessment
RBMP	River Basin Management Plan
WFD	Water Framework Directive

1 Introduction

One among 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.

By integrated strategy, we mean a strategy that covers all the fields of actions related to water management in the context of climate change (horizontal integration) but also a strategy that is part of EU, national and regional policies (vertical integration).

By joint strategy, we mean a strategy built on the implementation experiences from all Pilot Areas (PA) of the TEACHER-CE projects and the results of the forum with local key stakeholders.

As a first step to build the above-mentioned strategy, the deliverable D.T4.1.2 presents a coherent vision for involved Pilot Areas (local level), regions and/or countries for improvement of existing strategies considering lessons learned from T3.2 and the T.4.1.1 of the TEACHER-CE project and recommendations developed in cross-fertilized projects. The main outcome was the definition of five main visions, which can be also understood as general recommendations:

- integrating assumptions of national/regional documents into the planning process;
- mainstreaming the climate change effects into the planning process;
- maximizing of cross-sectoral benefits;
- privileging the implementation of natural-based solutions, implementing sustainable land use;
- involving stakeholders.

On this basis, the presented deliverable aims to identify measures to be taken to better integrate CC-aspects in water management and so to get a better implementation of WFD, FD, DWD, RBMP on the local level using TEACHER-CE Toolbox CC-ARP-CE. This was done by presenting case studies about already implemented good practices or implementation possibilities of the TEACHER-CE Toolbox (CC-ARP-CE) and recommendations (D.T4.2.1). Forums has then been organized in Pilot Areas to check the implementation, or the applicability to implement the Toolbox and the recommendations described in the factsheets (D.T4.2.2).

Finally, in the framework of the D.T4.2.3 future directions, challenges and potential opportunities for further joint actions has been assessed on 3 levels: operational (further implementation of the Toolbox), national and EU.

2 How to integrate CC-aspects in water management, how to integrate developed toolbox and strategies: applied methodology and workflow

2.1 The factsheet

A factsheet template has been defined to collect information in a structured way on the most relevant fields of actions for each Pilot Area. It enables to illustrate already implemented good practices or implementation possibilities of the TEACHER-CE Toolbox (CC-ARP-CE) as well as recommendations from the D.T4.1.2 deliverables. For these purposes, factsheets present information about:

- Pilot Area name;
- Field of Action covered by the factsheet;
- Definition of the issue;
- Existing important policy documents related to the field of action, their gaps and recommendations for improvement;
- Measures (implemented or implementable);
- Potential synergies with other fields of actions.

The case studies presented in the factsheets cover all the fields of actions analyzed in the framework of the TEACHER-CE project (see Fig.1).

Pilot Area / Field od action	Slovenia	Germany	Poland	Poland	Italy	Austria	Austria	Hungary	Czech Rep.
	Kamniška Bistrica	Upper Lusatia	Kamienna	Nysa Łużycka	Enza	Vienna Water Drinking Water Sources	Waidhofen/ Ybbs Drinking Water Sources	Nagykunsagi	Podyjí National Park
Fluvial flood risk management	*	*		*	*				*
Pluvial flood risk management		*	*						
Groundwater management							*		
Drinking water supply management	*					**	*		*
Irrigation water management								*	
Water scarcity and drought management		*		*	*			*	
Management of water-dependent ecosystems			*						

Fig. 1 Repartition of factsheets among PA and fields of actions

2.2 Stakeholder forum organisation

Key stakeholders relevant to each PA were contacted at the beginning of the year 2022. A participatory meeting, in particular cases of pandemic-based unavailability substituted by interview (further forum) was organized in each PA were organized in the framework of the deliverable D.T4.2.2. The forums aim to check the implementation, or the applicability to implement the Toolbox and the recommendations described in the factsheets. By key stakeholders, we mean the representant of organisation potentially in charge of the implementation of the toolbox and the recommendations to improve existing policy documents. The agenda of the meeting covered several points related to strategies and implementation:

- presentation of the of TEACHER-CE Toolbox (CC-ARP-CE) and discussion of its applicability and ways to implement the toolbox;
- presentation of the factsheets (D.T.4.2.1) related to the PA and discussion on how to improve policies at the local level;
- discussion to collect ideas on toolbox, methods recommendations for the next steps - new tools/methods, and integration to broader policy context.

Additionally, list of key questions was presented. It helped in conducting the meetings in a coherent way, and gather information related to the strategy development and setting up following activities (D.T.4.2.3). There were four major questions:

- Are the proposed recommendations for the identified planning documents/strategies implementable?
- What key messages / recommendations could be applied for similar planning documents/strategies?
- Do participants see additional needs for synergies in the development of planning documents/strategies?
- How long should the time interval of the CC projection be and how the strategies should be updated?

Beyond this general guideline each organizer of the forum was free to adapt its content to the profile of the participants or the characteristics of the PA.

2.2.1 Key stakeholders

List of relevant stakeholders of each PA, who attended the forum is provided in Table 1.

Table 1. List of key relevant stakeholders for each PA

PA		Country	Key stakeholders relevant for PA	Strategy for FoA	Organizer
1	Kamniška Bistrica RB	SL	Municipality of Kamnik: - Department of Spatial Planning - Department of Development and Investment - Service for the implementation of cohesion projects - Department of Economic Activities, Public Utilities and Finances - Civil Protection	Drinking water supply management, Fluvial flood risk management	PP1
2	**Upper Lusatia RB**	DE	By sector: water management, flood and heavy rain risk management, drought management, water sensitive urban development and climate change By region: Baden-Württemberg, North-Rhine Westphalia, Saxony	Climate sensitive urban water management/urban development	PP3
3	Kamienna RB	PL	- City Hall of Starachowice - PGW Wody Polskie – Water Supervision in Skarżysko-Kamienna	Management of water-dependent ecosystems, Pluvial flood	PP4
4	**Lusatian Neisse**	PL	- Instytut Rozwoju Terytorialnego - Państwowe Gospodarstwo Leśne Nadleśnictwo Wymiarki - PGW Wody Polskie Nadzór Wodny w Zgorzelcu - PGW Wody Polskie RZGW Wrocław - PGW Wody Polskie Zarząd Zlewni Zgorzelec -WIOŚ Wrocław Delegatura w Jeleniej Górze - Fundacja Natura Polska - Fundacja Eko Region	Water Scarcity and Drought risk (management), Fluvial flood risk management	PP11
5	**Enza RB**	IT	ADBPO IDECO Arpae SIMC	Water Scarcity and Drought management, Fluvial flood risk management	PP5

PA		Country	Key stakeholders relevant for PA	Strategy for FoA	Organizer
			Arpae - Climate Obseratory Comune di Monchio delle Corti		
6	**Vienna**	AU	- BMLRT - Federal Ministry - Vienna Water, City of Vienna - Forest Department, City of Vienna	Drinking Water Supply management (forest ecosystems, alpine pastures)	PP6, PP7
7	**Waidhofen an der Ybbs**	AU	- BMLRT - Federal Ministry - Vienna Water, City of Vienna - Forest Department, City of Vienna	Drinking Water Supply Management (CC adaptability, ground water wells)	PP6, PP7
8	**Nagykunság RB**	HU	- regional municipality - MÖSZE Ltd. (leading regional irrigational company)	Water Scarcity and Drought (management)	PP9
9	**Podyjí National Park**	CZ	- Department of Water Management and Environmental Modelling - Global Change Research Institute - Czech Academy of Science	Drinking-Water Supply, Fluvial flood risk	PP12

3 The measures to be taken and recommendations to be applied to better integrate CC aspects in water management on the local level

3.1 Improvement of policy documents in Pilot Area Kamniška Bistrica River Basin

The selected pilot area Kamniška Bistrica River basin is located in the northern part of Slovenia. The Kamniška Bistrica River is the largest Slovenian torrential river, which originates in the mountainous region of the Kamnik Alps and flows through the town of Kamnik into the lowlands. It faces many issues regarding water management in a broader sense. The main issues are presented in the following stories, separately for two main fields of actions.

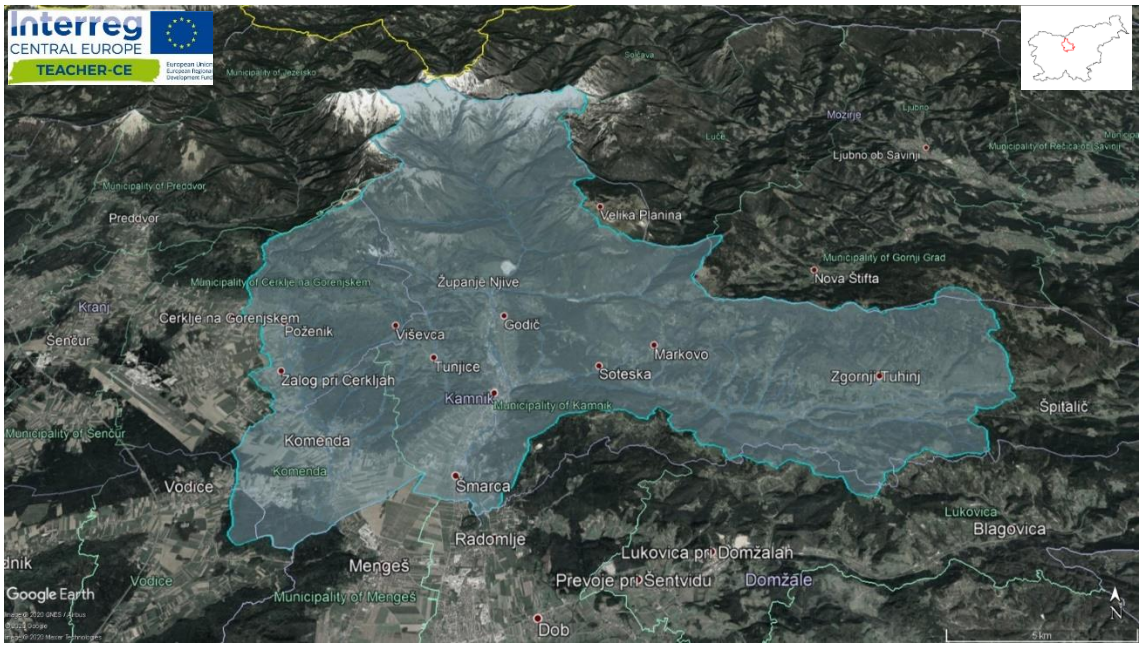

Fig. 2 Pilot area Kamniška Bistrica river basin

Pilot Area	PA1 Kamniška Bistrica River Basin
Field of Action	Drinking water supply management
Definition of the issue	The Kamniška Bistrica is the largest Slovenian torrential river, which originates in the mountainous area Kamnik Alps with peaks over 2000 m high and flows through the town of Kamnik to the lowlands. The Kamniška Bistrica River supplies the Iverje drinking water source, which is the main source of drinking water in the area. The upper course of the Kamniška Bistrica has a very good ecological status. The chemical status of the Kamniška Bistrica is very good. More than half of the area is covered by forest and is under Natura2000 protection. Annual precipitation in the PA Kamniška Bistrica is close to the Slovenian average (about 1600 mm/year) but can vary considerably locally due

	to the altitude. Droughts occur frequently in the summer months, especially during longer periods without rainfall. Droughts affect vegetation and crops, but do not represent a problem for water supply. Although a large part of the settlements is connected to a sewage system and a central WWTP, the water in the lower parts of the catchment is occasionally polluted, especially during the summer months when the main channel is almost dry and the water temperature rises. The vulnerability of groundwater in the Slovenian pilot area is mainly determined by the activities in the surrounding mountains. Other sources of water pollution are sewage overflows during flood events. The main concern are the springs in the Kamniška Bistrica valley that supply the Iverje drinking water source, which provides drinking water to approximately 20,000 inhabitants of the Kamnik and Komenda municipalities. It is the main source of drinking water for public water supply and is located in the northern part of PA and had the largest drinking water protection zone (DWPZ). The maximum allowable annual water withdrawal is 3 784 000 m3. The pumping wells are located near the Kamniška Bistrica River, and the pumped water comes from the infiltration of the river water through the gravely sandy banks. An alternative source of water for the main water supply system is Pod Skalco, with a maximum allowable annual water withdrawal of 1 078 000 m3. Currently, only half of this is pumped in Iverje and quantity does not present a problem. The Iverje well field is in an alluvial plain near the river, so there is a strong interaction between the surface and groundwater. The vulnerability of groundwater in the Slovenian pilot area is threatened by pollution, caused mainly by the activities in Velika and Mala Planina and in the surrounding mountains. High sensitivity of aquatic systems to any pollution occurring in the headwaters of the streams were identified. Analyses show a high proportion of faecal and domestic sewage from huts, mountain lodges and other facilities on the plateau which appear relatively quickly in smaller springs on the plateau and in larger springs below. Other sources of pollution are due to works in the riverbed (e.g., high turbidity due to work in the riverbed).
Existing important policy documents (1), Their gaps (2) and Recommendations for improvement (3)	(1) Decree on drinking water supply - Uredba o oskrbi s pitno vodo (Uradni list RS, št. 88/12)). Drinking water sources are divided into two categories: Water sources for private (local) use and water sources managed by public utilities and serving public water supply. The use of water sources is determined by a water right that defines how much water may be used. (2) On the territory of PA Kamniška Bistrica there are 11 allocated water rights for drinking water sources for private use. These water sources do not require drinking water protection zones and are not regularly tested for their water quality. (3) The quality and quantity of water used from the water sources should be controlled so that they are within the limits set by Water right. (1) Slovenian Water Act - Zakon o vodah (Uradni list RS, št. 67/02, 2/04 – ZZdrI-A, 41/04 – ZVO-1, 57/08, 57/12, 100/13, 40/14, 56/15 in 65/20))

	(2) Within the PA Kamniška Bistrica there are 54 water sources used for public drinking water supply, where Iverje is the most upper water source and there are no alternative water sources. For this sources Drinking Water Protection Zones are mandatory. (3) Rules for the definition of DWPZs should be updated at the national level (Rules on the criteria for the designation of a water protection zone - Pravilnik o kriterijih za določitev vodovarstvenega območja (Uradni list RS, št. 64/04, 5/06, 58/11 in 15/16)). (1) The Nature Conservation Act (Official Gazette of the Republic of Slovenia, nos. 96/04 – official consolidated text, 61/06 – ZDru-1, 8/10 – ZSKZ-B and 46/14; hereinafter referred to as 'ZON') establishes a comprehensive nature conservation system with the aim to protect valuable natural features and preserve biodiversity. (2) The area is located within the Natura 2000 sites and is obliged to protect special areas but for this area no supervision or regulation is organized. High sensitivity of aquatic systems to any pollution occurring in the headwaters of the streams were identified. The vulnerability of the groundwater on the Slovenian pilot area is determined mainly by the activities that take place in Velika and Mala Planina and the surrounding mountains. (3) An agreement to regulate the facilities and activities on Velika, Mala planina and the surrounding mountains is crucial for improving water protection; this includes the regulation of proper wastewater treatment and supervision of the protected area. (1) Kamnik Municipality development plan (2) Climate changes regarding fluvial flood risk are not covered Plan should include measures and limitations regarding climate changes effects regarding fluvial flood risk (1) Slovenia 's long - term climate strategy until 2050 (2) Covers only climatic aspects regarding Drinking water supply management/ (1) Strategy of spatial development of Slovenia 2050 (2) Fluvial flood risk management is not covered in a satisfactory amount (3) Broaden its scope
Measures	The Slovenian Water Act, especially the part on the drinking water protection zone's (DWPZ) in Slovenia, needs to be updated at the national level. Drinking water production is relatively shallow and depends heavily on riverbed works and the quality of the Kamniška Bistrica River. Deeper wells and the use of the aquifer with karst fractures would be better (some studies have already been carried out). An agreement to regulate the facilities and activities on Velika, Mala planina and the surrounding mountains is crucial for improving water protection; this includes the regulation of proper wastewater treatment.

Potential synergies	In PA Kamniška Bistrica, the management of drinking water supply is related or affected by most of the fields of actions. The biggest impact is seen by Fluvial and Pluvial flood risk management. In order to effectively manage the problems related to surface water and groundwater, cross-sectoral cooperation between these three areas is required.

Pilot Area	PA1 Kamniška Bistrica River Basin
Field of Action	Fluvial flood risk management
Definition of the issue	The Kamniška Bistrica is the largest Slovenian torrential river, which originates in the mountainous area Kamnik Alps with peaks over 2000 m high and flows through the town of Kamnik into the lowlands. In the downstream, flat part of PA, the Kamniška Bistrica River is heavily regulated for its hydropower potential and for flood protection. This part of the catchment area is covered with a dense network of artificial channels that is used to supply water for the operation of water and sawmills. Today, they are mainly used to supply small hydropower plants. There are three main water bodies in the catchment area of PA: Kamniška Bistrica, Pšata, and Nevljica with the length of 38, 36, and 19 km, respectively. All surface waters in PA have a nivo-pluvial regime with typically two peak discharge periods, the first occurring in late autumn-early summer and the second in autumn. The prevailing type of flooding is flash flooding. According to official data, there are currently four (4) gauging stations (GS) located on the PA. The Pšata and Kamniška Bistrica gauging stations are located on the most upper course of the river and therefore have limited calibration and validation usability. A major cause of frequent and catastrophic flooding is heavy rainfall, especially in late autumn. The main problem is flooding in urban areas and areas of economic interest. General rainfall patterns are known for the PA and surrounding areas, but can vary widely locally due to high elevation.
Existing important policy documents (1), Their gaps (2) and Recommendations for improvement (3)	(1) National program for environmental protection (NPVO) (2) Not always possible to satisfactory implement broader scale policy at a municipal level. Lack of detailed approach targeted at local level (3) Needed better connection to existing municipality development plans (1) Comprehensive national energy and climate plan of the Republic of Slovenia (NEPN) (2) Does not cover all basic issues from a fluvial risk management perspective (3) Broaden the scope of NEPN so it covers more relevant issues regarding fluvial risk management

	(1) Strategy of spatial development of Slovenia 2050 (2) Fluvial flood risk management is not covered in a satisfactory amount (3) Broaden its scope (1) Slovenia 's long - term climate strategy until 2050 (2) Covers only climatic aspects regarding fluvial risk management (3) n/a (1) Water management plan for the Adriatic region 2016-2021 (2) The document is only conceptually made, hence no detailed measures regarding fluvial risk are proposed (3) Document should introduce more profound measures proposals (1) Kamnik Municipality development plan (2) Climate changes regarding fluvial flood risk are not covered (3) Plan should include measures and limitations regarding climate changes effects regarding fluvial flood risk
Measures	Detailed measures regarding fluvial flood risk are usually covered in detail in design phase of project documentation. Policy documents include only general recommendations/possibilities/limitations regarding measures. Based on experience and analyses so far, the most appropriate measures in the Kamniška Bistrica PA are a combination of • general technical river training • water detention • walls and dams for the protection of areas at high risk
Potential synergies	In PA Kamniška Bistrica, fluvial flood risk management is related or affected by most of the fields of actions. The biggest mutual impact is seen with Drinking water supply management and Pluvial flood risk management. To effectively cope with surface flow and groundwater related issues, cross-sectoral joint between the three is needed.

3.2 Improvement of policy documents in Pilot Area UPPER LUSATIA

The area of Upper Lusatia spans a huge part of Eastern Germany – it covers an area from the southern borders of Brandenburg to the whole eastern part of Saxony almost to its federal capital Dresden (about 4500 km²). The spatial focus for the pilot action area was the County of Görlitz.

Fig. 3 County of Görlitz

The thematic focus in the pilot area was on the effects of rising temperatures and droughts as well as on heavy rain. The increasing weather extremes affect water balance and water quality. Impacts of climate change will be especially addressed in the blue highlighted fields of water management, see Fig. 4.

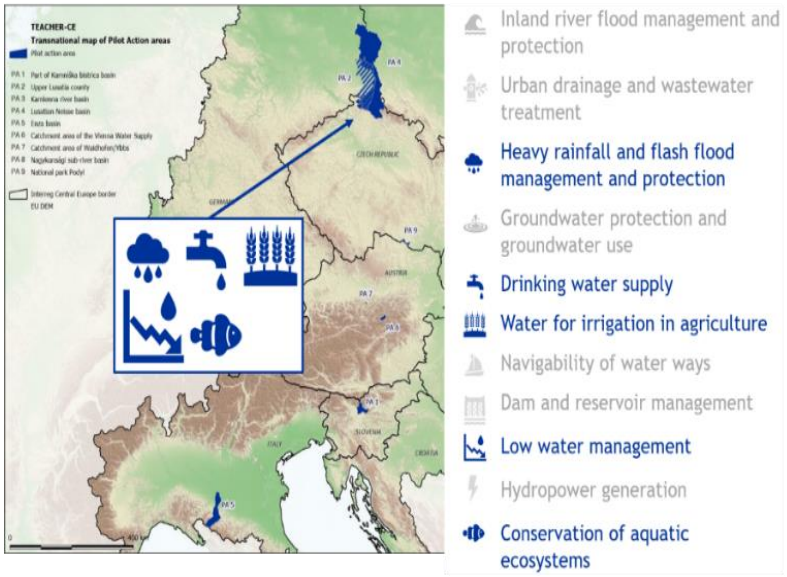

Fig. 4 Thematic focus in the pilot area

Pilot Area	PA2 Upper Lusatia River Basin
Field of Action	Climate sensitive urban water management/urban development
Definition of the issue	The main issue in the pilot area is the adaptation to extreme events: the region Upper Lusatia and within this the cities of Görlitz and Zittau suffer of increasing heavy rain events with urban flooding and damages and increasing drought that causes loss of vegetation and increasing heat islands in the urban areas. Thus, the main scope of the exemplary application of the TEACHER-CE tools in the PA was on the adaptation of urban planning to the water-related impacts of climate change in the region. Exemplary local and regional effects of CC-change were analysed, and vulnerability assessments were conducted, adaptation strategies and adaptation measures were identified and all findings were discussed with local and regional stakeholders. The adaptation effects and synergies of different urban development scenarios in urban quarters were evaluated for water management and urban heat islands. As specifically focused example, urban development concepts for certain exemplarily selected quarters in the city of Zittau were analysed regarding CC-impacts (especially flooding, heavy rain risk, droughts, and urban heat islands). For this quarter, adaptation measures were developed and tested by local microclimatic modelling. Especially the impacts of water sensitive urban development measures, like green-blue retention areas, green roofs and green facades, infiltration facilities and specific tree infiltrators etc. were analysed. The overall objective was to identify the chances and the limits of cc-change adapted, water-sensitive urban development (sponge city). Within the described context, one objective was, beside the CC-change adaptation itself and the texting of the TEACHER-CE toolbox, to analyse the existing policies for urban development regarding the objective of integration of CC-change aspects in urban development and water management in urban areas as well as the integration and coordination of all relevant aspects.
Existing important policy documents (1), Their gaps (2) and Recommendations for improvement (3)	(1) Spatial regional and local development policies and acts that regulate the spatial planning policies (2) All spatial planning policy documents require to consider environmental impacts of the plans on the environment and vice versa of the environment (including impacts of climate change like flood risk or local climatic conditions) on the healthy living conditions within the plan area. This is a request of the planning acts. The problem is in case of urban planning, that often no sufficient and planning oriented information on local climate change impacts are available. In the PA the exemplary focus was on heat island effects and interdependencies between urban heat and urban water resource management (rainwater storage, local infiltration and evaporation). Without the detailed information

	and assessments in the individually adequate scale and level of detail of the specific plans, no integration of these effects is possible in the urban planning approach. Existing administrative structure makes cooperation difficult; late participation in the planning process cause a reduction of opportunities for water-sensitive urban development. (3) The main improvement must come from the integration of different disciplinary policies rather than from the one policy. However, the planning policies should have obligation for the integrative approach on urban planning and urban water management from an early strategic planning phase on. In detail planning policies should require obligatory • development of integrated planning processes; • optimisation of administrative structures, clearly define decision-making competencies • agreements on interdisciplinary urban strategies • overall urban strategy for water-sensitive urban development • integration of decentralised rainwater management into the planning process at an early stage (concerns, among other things, the allocation of land).
Measures	The federal spatial planning act and according urban planning policies should get additions that rule the process of early integration of climate change impacts and climate change adaptation in urban planning processes. The regulations should specify that without proper climate change impact assessments (climate proofing) no urban planning document is to be approved. The climate change impact assessments (climate proofing procedures) as obligatory and integral part of urban planning procedures should integrate flood risk, heavy rain risk, drought risk and risks of urban heat for human health and biodiversity.
Potential synergies	Synergies will tackle all activities in the implementation of the European Water Framework Directive (River Basin Management Planning) and of the European Floods Directive (Flood Risk Management Planning). The integration of RBMP and FRMP in urban development strategies and urban planning is an essential part of climate proofing. At the same time integration should lead to a comprehensive climate proofing instead of separated approaches for FRM, RBM and urban water management.

3.3 Improvement of policy documents in Pilot Area Kamienna

Kamienna is the highland river located in central Poland. Its length is approximately 157 km and its catchment is approximately 2020 km^2. Average flow in the river at the mouth is 8,4 m^3/s. The main land use types in the catchments area are the agricultural (47%) and forest or seminatural areas (43%). The Kamienna River catchment is inhabited by approximately 280 000 people. From the point of view of climate change the **most critical issues are pluvial and fluvial flood, bad ecological status of surface water and agricultural drought**.

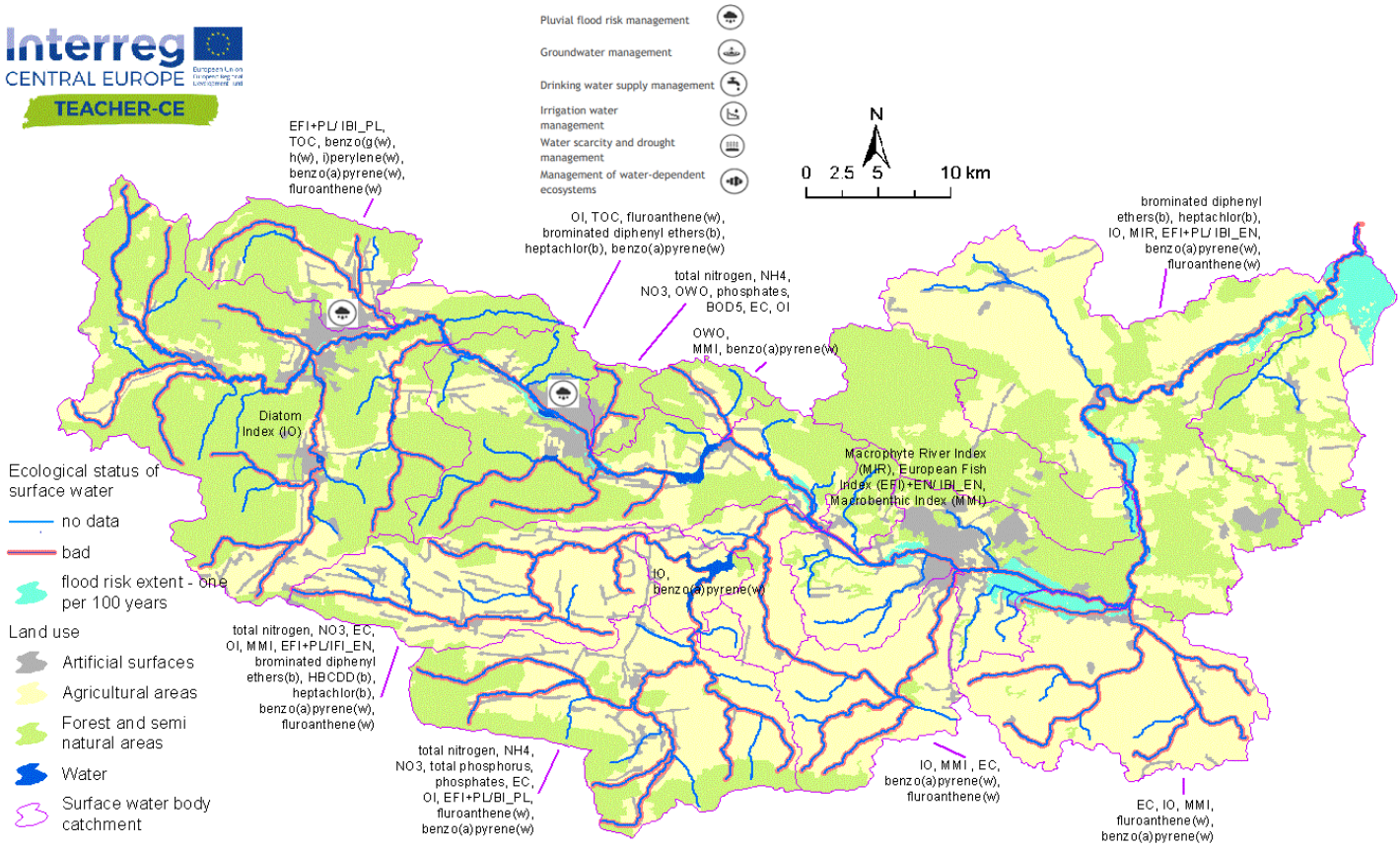

Fig. 5 Location of the main issues in the Kamienna River catchment area in view of land use

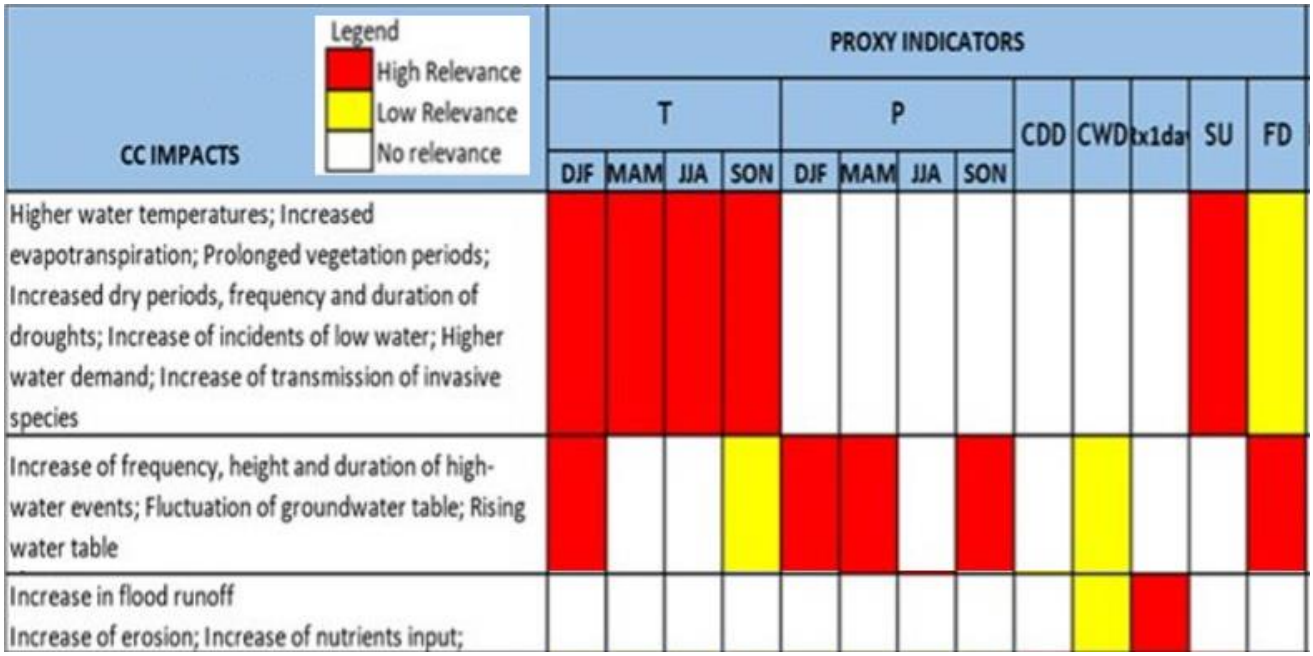

Fig. 6 Relationship between CC indicators and their impact for the Kamienna River catchment

Pilot Area	PA3 Kamienna River Basin
Field of Action	Management of water-dependent ecosystems
Definition of the issue	The Kamienna river catchment area contains catchments of 25 water bodies (14 according to draft 2nd update of polish RBMPs) mostly of natural character and typology of carbonate highland stream. The area of surface waters is approximately 1000 ha (including streams and rivers) with 2 reservoirs bigger than 50 ha. Status of water bodies is mostly bad. The most identified pressures are diffuse pressures on trophic state (agricultural loses, atmospheric deposition) and municipal point sources (WWTPs). Pressures on chemical state are originated mostly from low emissions zones (Benzopyrene, Fluoranthene). The climate changes in Kamienna River catchment may have an effect on flood protection levels, high water levels due to elevated river levels, water quality of streams (receiving waters), urban drainage, agricultural land and soil, infiltration capacity, water quality, groundwater recharge and water table – increase, need for irrigation, available water for irrigation, soil water conditions, water availability and quality of streams, reaching the objectives of WFD.
Existing important policy documents (1), Their gaps (2) and	(1) Environmental Protection Programs (local – municipal level) (2) Environmental Protection Programs will soon lose their validity or already has been expired or the perspective for which they are binding is ending. 2nd update of River Basin Management Plans introduces new arrangements for assessing the condition of the water environment, pressures

Recommendations for improvement (3)	and introduce new activities and measures that could be transferred to the findings of new, updated programs. (3) The environmental protection programs should be updated with taking into account new arrangements and River Basin Management Plans. The strategy and framework for these updates may be initiated and introduced in voivodeship level (see the general vision "integrating assumptions of national/regional documents into the planning process"). (1) Local spatial development plans (2) These documents do not take into account pro-environmental development and do not designate places that could become buffer zones in terms of water retention and nutrients. This problem may intensify with climate change and the increased erosion process associated with it. (3) Local spatial development plans should take into account not only functional and aesthetic considerations, but also the potential impact on reducing the pressures identified by water management plans or other analyses (see the general vision "integrating assumptions of national/regional documents into the planning process"). They could have been updated or re-established to develop new buffering zones in wetlands and river valleys to improve retention possibilities (see the general vision "Privileging the implementation of nature-based solutions, implementing sustainable land use"). (1) Local Low Emission Reduction Program (2) These documents have similar timework as Environmental Protection Programs, which mean that they have already expired or have become obsolete. These documents are aiming to reduce low emission which is significant source of pollution which are harming air and water environment (f.e. benzopyrene). (3) Documents should be revised and level of implementation of their objectives should be assessed. When needed, documents should be updated. (1) Local wastewater management plans (2) Information on the number of inhabitants not connected to the sewage systems is not reliable. (3) Information on the number of inhabitants not connected to the sewage system should be obtained to efficiently asses the need for development of wastewater management systems.
Measures	• Review documents at the national, regional and local level set to implement catalogues of measures which are either obligatory or voluntary. The catalogues of measures are focused on the whole area of water management issues, however to correctly address the CC related issues some of them are some of them are more effective than others. • Taking into account CC related issues the main measures which could be implemented considering local authorities are related with hydromorphology according to its wide synergies (see next chapter),

	wastewater management and retention, especially including small retention and restoration of natural or seminatural wetlands. • In current RBMP's programme of measures there is 160 measures planned for Kamienna River catchment (excluding country-wide measures). These measures are focused on: wastewater management, hydromorphology, agricultural surface runoff and industry. The administrative units responsible for its implementation during 2016-2021 cycle were: local administrative units, environmental inspection and water management authorities. • Draft 2nd update of RBMP's programme of measures introduces 67 measures for Kamienna River catchment. They are related with wastewater management, hydromorphology, agricultural surface runoff, industry, protection areas and retention. These measures are planned to counteract identified pressures. Their implementation is planned to take place during 2022-2027 water cycle and there is predicted that these measures are sufficient to reach and maintain good environmental status of water bodies located on the area of tis catchment. • For the better implementation of measures there are tools available for use in discussed Field of Action. For example, FRAMWAT tool is responding for lack of a non-commercial web-based platform to support the planning process in a comprehensive manner and lack of GIS methodologies/tools indicating potential needs and possibilities of development based on multi-criteria analysis taking into account environmental conditions. It is possible to implement in Field of Action: "Management of water-dependent ecosystems", but also for "Fluvial flood risk management" or "Water Scarcity and Drought risk (management)". FRAMWAT supports the idea for using the landscape features to help solving environmental problems in water bodies in a sustainable way. • The TEACHER-CE Tools can provide interface to follow up the up-to-date of each document. For example, the set of Environmental Protection Programmes and other documents such as Local Spatial Development Plans could be implemented to the repository. The users could compare compliance and time perspective of the documents between each municipality or district. It might result in punctuality in updating documents and intercalibration of measures. TEACHER-CE Tools could also allow users to provide input to be implemented in each document in updating process in pre-consultatuion phase of its develompent.
Potential synergies	• The potential synergies between the Field of Action: "Management of water-dependent ecosystems" and FoAs: " Water Scarcity and Drought risk (management)" and "Pluvial/Fluvial flood risk (management)" results from cumulative character of planned or implemented measures. For example, measures activities consisting in renaturalisation of water bodies results not only in improvement of ecological status but also in for example improvement of natural retention. Restoration of wetlands and other water dependent ecosystems also increases the retention capacity of

	natural areas and increases the availability of water resources at the catchment scale. • The phenomena of “reversed synergy” may be crucial to be considered in planning and implementing actions in every Field of Action: i.e., some technical actions aimed at counteracting the effects of drought or floods may contribute to reducing the ability of aquatic ecosystems to achieve or maintain good ecological status, therefore it is important that activities in these field of action take into account environmental objectives. The potential profit resulting from actions consisting in adaptation to climate change in the area of drought and flood effects may be offset by losses in another field of action. This "reverse synergy" may apply to any Field of Action pair, but “Management of water-dependent ecosystems” seems to be the most vulnerable to it.

Pilot Area	PA3 Kamienna River Basin
Field of Action	Pluvial flood
Definition of the issue	The analysis of daily rainfall occurring in the last decade in Starachowice, a city located in the central part of the Kamienna river catchment area (SPA3), showed that heavy rains occurred there very often in the last decade. High sums and rainfall intensities came from local storm cells, the formation of which is stimulated by the height of the terrain (highlands at the foot of the mountains), and condensation nuclei related to emissions from residential, industrial and communication areas. The maximum daily rainfall in the analyzed period in Starachowice was 103 mm and occurred during a rainfall lasting only two hours on 31 May 2016, which led to flooding of buildings and key communication routes of the city. High variation in the height of the terrain favours the occurrence of intense local precipitation (not always recorded by meteorological stations). Large slopes of the terrain generate rapid surface runoff from the slopes of the hills through the built-up slopes and the bottom of the Kamienna river valley, flooding the buildings and infrastructure. The existing rainwater sewage system in cities is not able to drain water from extreme rainfall in a short time, because it was not designed for such large flows, and in many places it is overloaded as a result of connecting new buildings to developing urban areas. Locating some of the buildings in depressions of the land and on local runoff routes increases material losses.
Existing important policy documents (1), Their gaps (2) and	(1) A key document in the aspect of spatial planning is the Study of the conditions and directions of spatial development of the city of Starachowice. It is a strategic document whose task is to comprehensively (holistically) describe and diagnose the current state of development, its conditions and to define general future directions of development of individual parts of the city.

Recommendations for improvement (3)	(2) The current study does not fully address CC issues and uses a limited set of sustainable rainwater management measures. (3) It is desirable to update and extend the analyses contained in the Study by carrying out an Ecophysiographic Study and additional thematic studies on the functioning of the rainwater sewage system and the hydrographic network, as well as increasing the emphasis on rainwater retention. (1) Spatial development plans for the commune of Starachowice (2) The climatic changes related to the risk of rainfall floods have not been taken into account. Older plans do not require any rainwater retention within the property boundaries. (3) The plans should include measures and limitations on the effects of climate change in relation to the risk of rainfall floods, e.g. indicators of the permissible degree of impermeability of the area, orders for retention of surface run-off at the site of its origin. Currently, the City of Starachowice is developing (1) the "City adaptation plan to climate change", which is an opportunity to (3) complete the analyses of the characteristics of the predicted climate changes, identify areas of sensitivity, indicate the necessary adaptation measures and give them greater priority.
Measures	Effective counteracting the above-mentioned negative phenomena requires coordinated actions at all stages of city space planning and development, including: 1) pre-planning analyses, 2) land use planning, 3) designing specific solutions taking into account the conditions of a given place (terrain, surface, type and location of pavement impermeable and built-up, soil properties), 4) construction and maintenance. The issues of sustainable rainwater management should be included in the development plans for new areas (so far undeveloped), modernization of already developed areas and revitalization of post-industrial areas. Recommended planning path facilitating rational management of rainwater: 1. Carrying out analyses to identify particularly sensitive areas having a significant impact on the hydrological functioning of the landscape; 2. Covering the above-mentioned protection of areas against buildings, covering with impermeable surfaces or drainage and preserving them as the so-called green infrastructure. 3. Determination of the principles of development of the remaining areas, which would allow the preservation of important hydrological functions of the landscape, and preparation of detailed plans for this purpose; 4. Reserving space in the plan for retention solutions and infrastructure enabling their water supply (pipes, ditches, open channels); 5. Water run-off route planning to maintain the desired water transport time and flow control according to the amount of rainfall. TEACHER-CE tools useful for creating updates of planning documents as well as for the implementation of their provisions:

	1. Climate change indicators as a source of data to describe the predicted CCs in the prepared adaptation plan. 2. Catalog of measures and previous projects: especially Rainman and Framwat, with numerous tools such as "identification of surface runoff paths", “green roofs and green facades”, “infiltration facilities”, “Avoidance of building in hazard zones”. 3. General recommendations of TEACHER's Join Strategy as a reference level for the development of the CC Adaptation Plan, and in the case of policy documents in the field of spatial planning, also specific recommendations of this strategy
Potential synergies	1) with FoA Management of water-dependent ecosystems by improving the quality of rainwater discharged into rivers, 2) with FoA Water scarcity and drought risk (management)" by retaining rainwater, enhancing infiltration and supply of groundwater resources 3) with FoA Fluvial flood risk (management) by retaining rainwater in the catchment area and relieving watercourses during heavy rains.

3.4 Improvement of policy documents in Pilot Area Lusatian Neisse

The area of the Lusatian Neisse river basin is 4 398,6 km^2. The area of Lusatian Neisse river basin is located in Central Europe, within the border of three countries: Poland (52,5% of the catchment territory),Germany (33%) and the Czech Republic (14,5%).

The area of Lusatian Neisse river basin is characterized by significant variability in terms of altitude, relief and land use. The southern part of the catchment is located in a mountainous area i.e. Western Sudetes and their foreland (app. 40% area of the catchment), while the northern part lies in lowlands i.e. Central European Lowlands (app. 60% area of the catchment). Total hypsometric differentiation of the catchment varies from 100 m a.s.l. in the north to over 1000 m a.s.l. in the south. Forests cover approx. 43.5% of the Lusatian Neisse catchment area, and the agricultural land covers approx. 45%, urban areas (approx. 5%). In the catchment there are also large-scale anthropogenically transformed areas, i.e. large-area lignite pits.

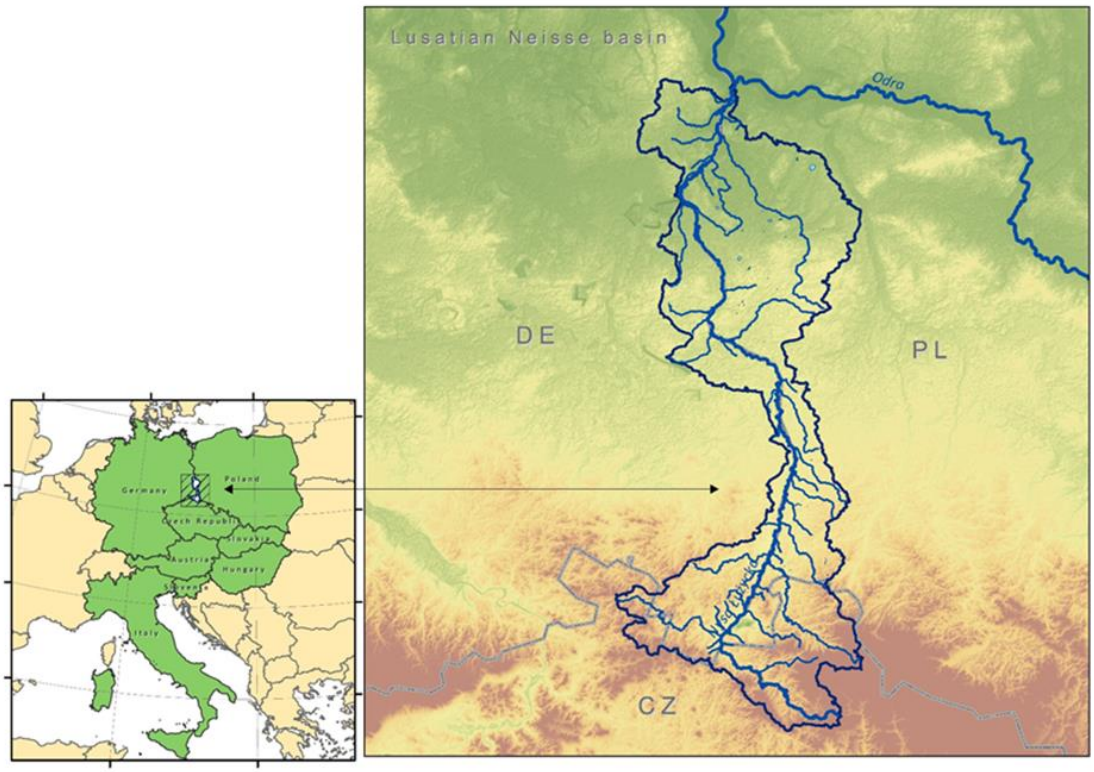

Fig. 7 The pilot area of the Lusatian Neisse river basin

Pilot Area	PA4 Lusatian Neisse
Field of Action	Water Scarcity and Drought risk (management)
Definition of the issue	Climate conditions of the pilot region of the Lusatian Neisse river basin are typical for moderate latitudes. Circulation conditions are usually related to western advection of marine polar air masses that are predominant in this part of Europe. The local climate conditions can be also modified by hypsometric and morphologic variability (terrain relief). In the lowlands, mean annual air temperature varies within 8-9°C. In the higher altitudes of the region, it decreases with an average rate of 0,55-0,60°C per 100 m. July is the warmest month while the lowest air temperature is observed in January. Precipitation is characterized by very high temporal and spatial variability. The highest average annual precipitation totals, approx. 750-800 mm, occur in the highest part of the Lusatian Neisse river basin, such as the southern and south-eastern part of the Western Sudetes Foothills (Bogatynia, Bierna). The lowest precipitation totals (approx. 570 mm) occur in the northern part of the region, representing mainly by lowlands. The precipitation totals are characterized by a high range of changes in individual years. In the last decades, the highest annual totals occurred in 2010, reaching over 150% of the climatic norm. The most dry ones were: 1982 (60-52% of norm) and 2003 (60% of norm). In the pilot area, days with heavy precipitation (≥ 10 mm per day) occur on average 14-18 days annually. Drought is a natural phenomenon that occurs in the Central Europe, along with flood, is one of the most severe natural phenomena impacting the society, environment and the economy. Drought is an irregular phenomenon, the short-time drought (1-3 months) events occurs the most frequently, however long-term (6 months and longer) drought also can be observed. In 1981-2019, basing on drought index, i.e. Standardized Precipitation Index (SPI), 14 years were categorized as dry. The years of: 1982, 2003 and 2018 were classified as extremely dry (SPI≤ -2,0). Recently, long-lasting and severe droughts in the Lusatian Neisse catchment occurred in the years of: 2015, and 2018-2019. Meteorological conditions, i.e., rainfall deficit, anomaly high air temperature and high insolation, contributed to the development of droughts. Meteorological conditions in winter seasons have also influence on development of drought. Higher air temperature (if compared to the mean value), lack of snow cover and higher evaporation affect the reconstruction of the water supply in the soil. Therefore, especially in 2018, after warm and dry winter of 2017/2018, at the beginning of the growing season, conditions were favourable for the development of drought. As a result, meteorological drought in 2018 already occurred in spring. In the following months, meteorological drought became more intensive. The drought index of SPI showed the conditions of strong and locally even extreme drought. In autumn 2018, the drought became less intensive. However, in 2019 drought condition still lasted. Wet winter months (December 2018 and January 2019) did not compensate such a large water deficit. Therefore, a combination of shortage of precipitation and sustained above-average temperatures (including heat waves) contributed for the occurrence of another drought

	event in 2019. In the Lusatian Neisse river basin, low-flow periods occurred from May 2018 to the middle of December 2018 and from June 2019 to November or even December 2019. They were still observed in the beginning of 2020. Climate change projections indicate that there may occur a direct threat to ensuring the quantity of water of appropriate quality at a given place and time. A prolonged drought may reduce the level of surface or ground water, which may lead to a reduction in the use of water, access to water services or the possibility of agricultural or forestry production. The projected increase in temperatures for the entire territory of Poland and the change in the structure and amount of annual precipitation totals for individual regions constitute a serious hazard of drought development, the effects of which will be intensified by the low potential of water retention in the catchment area.
Existing important policy documents (1), Their gaps (2) and Recommendations for improvement (3)	The national strategies pointed out the individual areas prone to droughts together with the identification of actions aimed at reducing its effects. Increasing the potential conditions for water retention by keeping it in a biotic and abiotic environment is an optimal adaptation measure to the effects of climate change, limiting the effects of drought. The use of various forms of retention, including artificial and natural (implemented through measures aimed at the protection of water resources by restoring or maintaining natural ecosystems), will significantly contribute to reducing the sensitivity of the environment, society and economy to the effects of climate change. Moreover, the national strategies pointed out that under high climate uncertainty conditions, rational use of water resources will allow to meet the water needs of all users. In Poland, according to Water Law prevention against droughts is a task of local and national authorities and the Polish Waters National Water Management Holding (PGW WP). The prevention against drought impact is run accordingly to the Drought Effects Counteracting Plan (DECP) in a river basin. (1) Drought Effects Counteracting Plan (DECP), Plan Przeciwdziałania Skutkom Suszy (2) Good/strong points: An important element of DECP is the catalogue of measures. It is a set of measures for limiting and preventing the effects of drought. Measures included in the catalogue are addressed to various groups of users and various sectors of the economy (agriculture, energy, industry, forestry), as well as various areas (urban, forest). As part of the DECP based on climate change scenarios, trends in changes of the level of atmospheric drought hazard were determined. The results of the analysis of climate change scenarios confirm the need of measures implementation in the field of reducing the impact of drought in Poland in future climatic conditions. (3) n/a (1) Assumptions for the Program for counteracting water scarcity for the years 2021-2027 with a perspective until 2030 (Założenia do Programu

	przeciwdziałania niedoborowi wody na lata 2021–2027 z perspektywą do roku 2030) (2) The aspect of climate change is described generally (3) Broaden the aspect of climate change impact relate to quality and quantity of water resources based on climate scenarios (1) Strategy plan for adaptation for the sectors and areas sensitive to climate changes by 2020 with a perspective until 2030 (Strategiczny plan adaptacji dla sektorów i obszarów wrażliwych na zmiany klimatu do roku 2020) (2) Assessment of effectiveness of the adaptation measures (3) n/a (1) Development Strategy for the Lower Silesia Voivodeship 2030 (2) The operational goal of protection against natural disasters has been identified as a priority for only one functional area in the Lower Silesia Voivodeship (3) Protection against natural disasters should be identified as priority protection for the entire area, especially in aspect of climate change The local authorities have developed plans and strategies at the commune (gmina) or district (powiat) level. The most of the local documents in the case of Water Scarcity and Drought risk introduce the following activities: increasing water retention, activities to maximize the savings of water resources for industrial and consumption purposes, rationalization of the management of surface and groundwater resources. Currently, most of the local documents identified climate changes as one of the threat that result in increasing the occurrence of weather anomalies (heat weaves, droughts, floods etc.) Therefore, most of the activities against drought are included in the operational objective: Environmental protection and adaptation to climate change. (1) Strategy for development of the commune of Pieńsk for 2021-2025 (Strategia Rozwoju Gminy Pieńsk na lata 2021-2025) (2) Impact of climate change and adaptation measures mentioned only in general aspect (3) Broaden adaptation measures at local level (1) Program of environment protection for the municipality of Zgorzelec for 2017–2020 with the perspective till 2024 (Program ochrony środowiska dla miasta Zgorzelec na lata 2017–2020 z perspektywą do roku 2024) (2) Impact of climate change and adaptation measures mentioned only in general aspect (3) Broaden adaptation measures at local level
Measures	The measures mainly concern the increase in the retention capacity of the catchment area and implementation of small water retention facilities, as well

	as reducing the sealed areas and increasing area of green infrastructure. Examples of measures for PA Lusatian Neisse catchment: • construction of water retention facilities • protection and preservation of existing meadows and pastures • implementation and restoration of small retention and micro retention facilities in forest areas • implementation and restoration of small retention and micro retention facilities in agricultural areas • promoting and implementing agrotechnical measures which increase soil retention • creation and restoration of mid-field, roadside and water-bearing trees • shifts to less water-demanding crops and cropping systems • creation and maintenance of “blue-green” retention areas in urban areas • • infiltrating pavements/permeable surfaces
Potential synergies	The potential synergies between the Field of Action “Water Scarcity and Drought risk (management)” with FoAs: "Management of water-dependent ecosystems” and “Pluvial/Fluvial flood risk (management)” results from cumulative character of planned or implemented measures. For example, implementation of the measures concerning the restoration of small retention and increasing retention in forest and agricultural areas result in protection against the impact of drought as well as in the improvement of ecological status of water bodies and protection against pluvial flood. Increase in the retention capacity of natural areas (wetlands, forests etc.) have the impact on rising availability of water resources at the catchment scale. In addition, appropriate maintenance or modernization of water drainage devices (ditches) enables the control of water outflow, its slowing down in dry periods (preventing drought) and water retention in periods of intense rainfall (reducing the risk of flooding).

Pilot Area	PA4 Lusatian Neisse
Field of Action	Fluvial flood risk management
Definition of the issue	Due to geographical variability and location within temperate climate zone, the region is prone to pluvial flood occurrence, resulting mainly from intensive precipitations during the warm season. As a result, the region has been frequently affected by pluvial flood occurrence. This concerns especially the areas located in the mountains or mountain foreland. A disastrous event that occurred in August 2010 caused several deaths, numerous damages in urban areas and negatively affected ecosystems, agriculture and forest areas.

	Therefore, this phenomenon can have influence on multiple sectors in the region. Most of the area of the region is covered by agriculture land and forests which makes these sectors noticeably vulnerable to floods. Furthermore, there are numerous hydropower plants and water withdrawal bodies located on the Lusatian Neisse River. Potential occurrence of pluvial flood can seriously disturb the operation of such institutions. There are also municipal areas located along the Lusatian Neisse River which, in case of flood event, can be seriously affected in terms of the human safety and losses in infrastructure. Research on climate changes indicated significant changes in some climate variables, including intensive precipitations. In some regions, the frequency of intensive precipitations can noticeably increase which can contribute to further intensification of flood risk in the considered region. This concerns especially the upper part of the River, where the potential for disastrous flood occurrence is the highest. Changes in precipitation regime can also modify other aspects, such as groundwater, drinking water supply, local water management, etc.
Existing important policy documents (1), Their gaps (2) and Recommendations for improvement (3)	(1) National Plan for Energy and Climate for 2021-2030 (Krajowy Plan na rzecz Energii i Klimatu na lata 2021-2030) (2) The document does not include the aspect of the intensity of climate changes and their projections (3) Considering climate projections would enable development of more appropriate adaptation measures related to climate changes, i.e. for the purposes of fluvial floods. (1) Strategy plan for adaptation for the sectors and areas sensitive to climate changes by 2020 with a perspective until 2030 (Strategiczny plan adaptacji dla sektorów i obszarów wrażliwych na zmiany klimatu do roku 2020) (2) The aspect of fluvial flood risk management is described generally (3) Broaden the range of flood risk management related to fluvial floods (1) Development Strategy for the Lower Silesia Voivodeship 2030 (Strategia Rozwoju Województwa Dolnośląskiego 2030) (2) The document do not concern the problem of the relationship between climate changes and fluvial flood risk management (3) Detailed description related to the dependence of fluvial flood risk and climate change is needed (1) Strategy for development of the commune of Pieńsk for 2021-2025 (Strategia Rozwoju Gminy Pieńsk na lata 2021-2025) (2) Climate change aspects are mentioned only generally; fluvial flood risk management is not considered in the appropriate level (3) Include analysis related to observed and projected climate changes in the commune; improvement in fluvial flood risk management analysis

	(1) Program of environment protection for the municipality of Zgorzelec for 2017–2020 with the perspective till 2024 (Program ochrony środowiska dla miasta Zgorzelec na lata 2017–2020 z perspektywą do roku 2024) (2) Climate projections in the context of fluvial flood risk management are not included Consider climate projections in the context of their impact on likelihood of fluvial flood occurrence and risk assessment.
Measures	The documents that concern directly or indirectly fluvial flood risk management do not consider the entire spectrum of climate changes, including climate scenarios. Such detailed analysis could be an important basis for multiple measures which could be implemented to these documents. Regarding the issues mentioned above, risk area, mapping and designation could be carried out with a consideration of climate projections analysis. The analysis would be also useful in the context of the implementation of the plans related to fluvial retention areas and technical retention. Considering such characteristics while local land use planning or granting building permit provisions could improve the level of flood risk assessment in the region. Besides, inter-communal cooperation between the communes located in the basin could enable a common development of strategies related to fluvial flood risk management with a consideration of climate change aspect.
Potential synergies	The measures concerning fluvial floods are often related to other fields of actions related to water management and ecological state. The measures can positively affect water availability for the inhabitants and industry, as well as the structure of water treatment. Considering the problem of projected spectrum of climate changes, the measures will help improve the other fields of actions (i.e. technical retention and appropriate land use will positively affect pluvial flood issues, while raising awareness can contribute to the more effective use of drinking water resources). The measures also are in synergy with higher-level strategic documents (such as Strategy plan for adaptation for the sectors and areas sensitive to climate changes by 2020 with a perspective until 2030) in the context of prevention against forecasted climate changes and their effects.

3.5 Improvement of policy documents in Pilot Area Enza River Basin

The Enza River is a right tributary of the Po River which originates in the province of Massa Carrara, Comano Municipality (Tuscany), between the Giogo Pass (1.262 m a.s.l.) and Mount Palerà (1.425 m a.s.l.) and crosses Emilia-Romagna region from the Apennines, the mountains that border the hydrographic basin of the Po River to the South. The total area of the basin is 890 km^2, of these 583 (65% of the total area) are made up of hilly and mountainous territory, and 307 (35% of the total area) of plain territory.

Different types of protected areas are present in the basin, ranging from a national park along the Apennines to the EU Natura2000 sites, to the regional protection areas that safeguard small "Ecological rebalancing areas" and/or landscapes.

The Enza hydrographic basin can be considered as a rural territory placed between the two cities of Reggio Emilia and Parma.

Beside forage, agricultural production is important for cereals, vegetables, and beetroot.

In the low plain area, together with agricultural productions, many industrial activities are established, mostly related to food-production and manufacture.

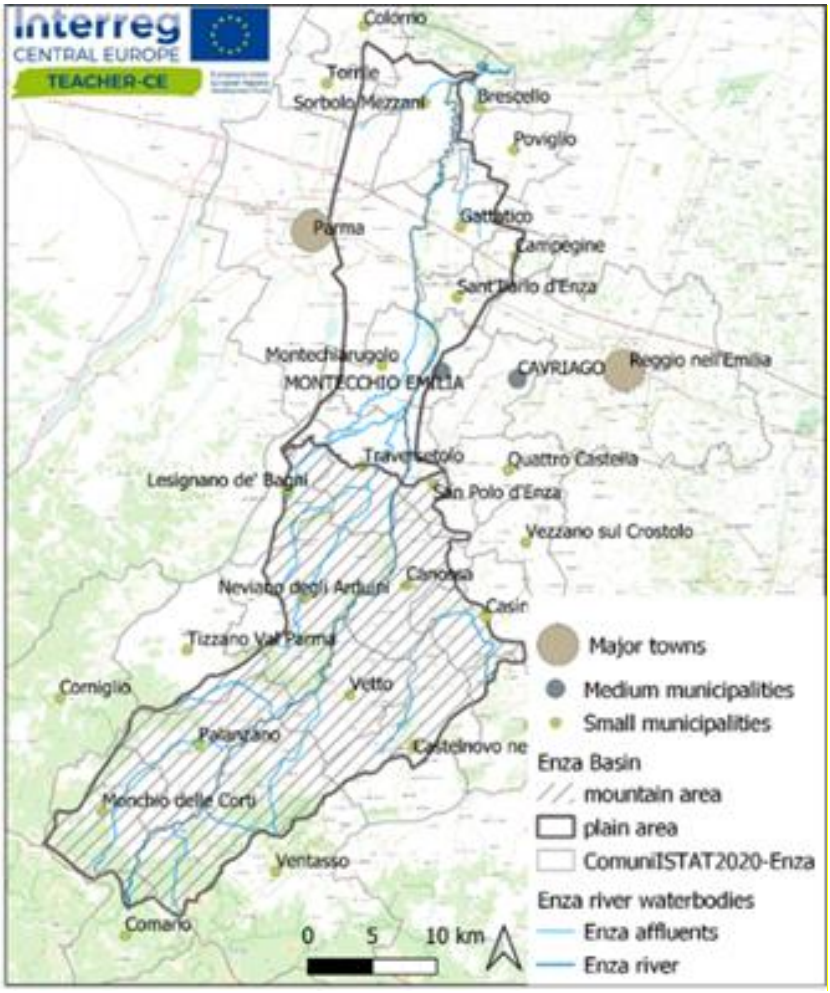

Fig. 8 The Pilot Area Enza River Basin

Pilot Area	PA5 Enza River Basin
Field of Action	Water Scarcity and Drought management
Definition of the issue	One of the most important economic features of the Enza basin lies in its agricultural activities, with the production of Parmigiano Reggiano playing the major role. This product relies on permanent pastures that are surface irrigated, thus increasing agriculture water demand. The agricultural system is mainly fed by the Enza River through the Enza Channel, partially by groundwater, and in part, in the downstream territories, is fed by the Po River. Aquifers belonging to the Enza alluvial fan are mainly fed from the river itself, and from direct infiltration of precipitation in the recharge area. Under such constraints, conflicts for the use of the water resources (industrial, civil, agriculture purposes) can arise. They could play a significant role in special way in dry seasons or during droughts. These last ones are expected to increase in frequency under the combined impacts, due to the climate change, of temperature increases and more seasonally varying cumulative precipitations.
Existing important policy documents (1), their gaps (2) and recommendations for improvement (3)	(1) Overarching and wide area references: a. Piano di Gestione del distretto idrografico di fiume Po (PdG Po) b. Piano di Gestione del Rischio Alluvione (PGRA) (1) At regional scale there are: c. Piano di Tutela Acque (PTA) e Piano Territoriale Regionale (PTR) d. Piano territoriale paesistico regionale e. Piano energetico regionale (Per) 2030 (e Piano triennale di attuazione 2017-2019) f. Programma di Sviluppo Rurale (Psr) 2014-2020 dell'Emilia-Romagna g. ZSC IT4030013 – Fiume Enza dalla Mora a Compiano h. ZSC-ZPS IT4030023 – Fontanili di Gattatico e Fiume Enza i. LIFE13 NAT/IT/001129 (LIFEBarbie) j. Strategia per il Cambiamento Climatico in Regione Emilia-Romagna (1) References on a local scale: k. Piano Territoriale di Coordinamento Provinciale (P.T.C.P.) della Provincia di Parma l. Piano Territoriale di Coordinamento Provinciale (P.T.C.P.) della Provincia di Reggio Emilia m. Piano di conservazione delle risorse idriche e piano di gestione della siccità e della scarsità Idrica del Consorzio di Bonifica dell'Emilia Centrale

	(2) Due to the size of the reference territory and the high number of contents, it may happen that there is not always congruence between the Po RBMP and the plans and programs at national and smaller scale. Climate change impacts are causing increased frequency of extreme events (e.g. high temperatures, heavy rainfall, long periods without precipitations), and in summer drought events are more and more common. (3) Due to the characteristics of the basin and the main activities, an improvement in the efficiency of water use and a more rational usage of the available water resources are necessary, also considering the climate change impacts. As regards the agriculture and silviculture sector, which comprises also the remediation and irrigation sections, and is important for the Po River District, it is necessary to underline that the recovery of the environmental quality of the territory and of the water bodies can also have some drawbacks with the undeniable benefits it creates. In fact, this restoration can potentially contribute to create good opportunities because of the rural development policy implementation, but it can also bring a lower water resources availability for agricultural purposes, especially for the ones demanding more water.
Measures	Measures in place related to the water resources management are both organisational and structural. At national level a modelling system (www.irriframe.it) has been developed to support farmers in improving the irrigation techniques through the continuous update of meteorological data, coupled with detailed data on type of soils and water demands of different crops. Outputs of this model help farmers in identifying the exact amount of water needed and the best moment to irrigate. Water demands for irrigation are nearly completely managed by Irrigation and reclamation waterboards, that organize shifts in irrigation, based on farmers demands and on the characteristics of the irrigation channels network, that optimises the use of water resources even through re-use from upstream to downstream. Where possible, irrigation systems have been moved to more water saving ones, but there is still much discussion about irrigation techniques for permanent pastures supporting the production of Parmigiano Reggiano cheese. From the structural point of view, projects are already available to maintain and upgrade existing weirs on the Enza River to create small and temporary reservoirs able to support irrigation in dry periods. A higher attention and a better monitoring of the actuation and efficiency of the measures already in place to deal with the problem of nitrates contained in zootechnical origin water, as required by the PdG-Po regulation, may affect the development of the agricultural sector reducing the number of the animals and/or limiting the utilization of animal waste in agriculture when not properly treated. A more rational usage of the available water resources, also considering the climate change effects already taking place, through a stricter control and an increased regulation of water uses as a function of the criticality levels at a

	district (salt intrusion and water crisis) and regional/local scale, will improve the efficiency of water uses themselves. As a consequence, this rational water resources usage could lead to a higher water availability, not only for agriculture, but also for manufacture, and particularly for hydroelectric production. Finally, a better maintenance and use of the territory and the water bodies can bring a positive impact on the natural environment. For example, the PdG-Po regulation discourages soil sealing and the alteration of the natural hydromorphology of water bodies. A better management of conflicts for the water resources could exploit CC-ARP-CE permitting an effective sharing of needs and remarks from the stakeholders and local communities impacted by the same issue or living in the same area. Climate indicators can support a proper evaluation on how the issue could be exacerbated in a climate change perspective. Several measures in the catalogue are expected to handle drought issue taking into account also concurrent dynamics (impact of heavy rainfall events, pluvial/fluvial flooding); finally, small water retention basins can support the management of both the issues associated to low/high water levels.
Potential synergies	In this area, water scarcity and drought management are related to most of the fields of action. Besides, in relation to the main economic source, a relevant impact derives from the irrigation water management. Similarly, synergies effects may be related to groundwater management and to the management of water dependent ecosystems.

Pilot Area	PA5 Enza River Basin
Field of Action	Fluvial flood risk management
Definition of the issue	During the year there is a marked variability of hydrological conditions: in fact, periods characterized by rainfall equal to double or half of the average precipitation value often occur. Another characteristic of the basin is the concentration of inflows in short-term events: for example, in the extreme weather event happened in December 2017, almost 1/6 of the average total annual precipitation fell in just 48 hours. This flood event occurred concurrently with more extensive hydrological weather phenomena, developed from the 10th to the 12th of December, which have affected the western and central basins of the Emilia-Romagna region, causing considerable damages.
Existing important policy documents (1), Their gaps (2) and Recommendations for improvement (3)	(1) Flood risk management plan and Flood and landslide risk management master plan (2) possible conflicts of planning and programming tools determined by the remarkable consistency of references considered in this territorial context. An aspect closely linked to what has just been said concerns the fact that there is not always clarity on the functions covered by the two plans and this could generate confusion in managing the planning aspects, for example inherently

	to the delimitation of flood hazard maps. Finally, another critical aspect concerns the fact that climate change scenarios are not considered by these plans, especially in anticipation of the fact that an outflows concentration is expected in shorter time intervals, with consequent floods of greater severity. (3) the most important reference for fluvial floods risk management is the Po River Flood risk management plan. The Flood risk management plan (Piano di Gestione Rischio Alluvioni - PGRA) is the operational tool required by Directive 2007/60/EC, to reduce floods negative impacts on human health, territory, assets, environment, cultural heritage, and economic and social activities. Because of its features, the PGRA is a strategic plan by which the District goals for flood safety are set through structural and non-structural measures, defined on the basis of hazard and risk mapping, so that its targets can be achieved within a medium timeframe (the plan is updated every 6 years). The PGRA focuses on the areas of greatest risk (APSFR), sharing with the PAI the contents related to flood danger and risk management in a coordinated and synergistic way. It is an articulated and complex plan covering all the aspects of risk management (prevention, protection, preparation, post-event evaluation and reconstruction), to which public and private entities are called to pay attention and take part to. The main goals of the Flood risk management plan are: to promote the development of technical and scientific knowledge appropriate to the management of floods and the dissemination of adequate basic training for both decision-makers and citizens, in order to allow the implementation of good defence practices; to ensure surveillance, maintenance, integration and adaptation of existing active and passive flood defence systems; to monitor the exposed assets in areas subjected to floods, even for rare scenarios, and to promote the reduction of economic vulnerability of the territory as well as of the individual assets; to provide, where possible, the maintenance and/or restoration of floodplains, as privileged areas for floods expansion and at the same time for the conservation, protection and restoration of ecosystems; to promote sustainable land use practices, improving water retention capacity as well as the controlled flooding of predefined areas in case of flood phenomena.
Measures	The WFD requires the consideration of climate change impacts to be part of the review and update of both the PdGPo and the PGRA. For this reason, the effects of possible change scenarios in the regime of precipitation and temperature as a consequence of most accredited CO2 emission scenarios proposed by the scientific community, were considered. However, it has been highlighted that the safety of a consistent dataset, even at a European level, which does not allow to identify a trend with regard to intense flood events especially, and it is currently difficult to quantify the contribution of the increase in intense precipitation compared to that observed by land use changes and more specifically resulting from changes in the morphological structure of watercourses and their defensive systems, as well as the reduction of flood expansion and lamination areas. It has been represented how the current trends and the possible future variations of the flood regime require paying special attention to their effects. In particular, attention was paid to those types of floods triggered by intense

	and concentrated events (flash floods, pluvial floods), certainly more sensitive to the effects of the climate change and which in mountain basins can also give rise to highly critical debris flow phenomena (debris flow). Some first assessments were also produced on some watercourses with hydro and hydraulic simulations projected to 2100 and on the RCP 4.5 scenario, estimating in both intense rainfall and flood flows an increase between 20% and 30%. Starting from these considerations, the activities of the second planning cycle were defined and launched by defining the methodologies to include the hydrological data of recent events in the probabilistic analysis and to include the more quantitative projections of the hydrological magnitudes in the probabilistic analysis themselves. The tools included in CC-ARP-CE can effectively support the management of the issue. Climate indicators can provide further details about the expected trends, the uncertainties associated to the projections under different time horizons and scenarios of climate altering gases concentration. The guidelines developed in RAINMAN Project represent a valuable tool to support the management of heavy rainfall events during all the stages of risk management process, from prevention to restoration
Potential synergies	In the Enza fluvial basin, the fluvial flood risk management is related to pluvial flood risk management and affects irrigation water management. Therefore, for a correct management it is fundamental to compare this FoAs. Finally, the strong variations in precipitation regime induces, at the same time, more frequent and impacting drought and flood conditions. Under such assumptions, it is important to design win-win measures.

3.6 Improvement of forest ecosystem adaptability towards climate change in Pilot Action "Vienna Water Drinking Water Sources"

The Zeller Staritzen is situated in the Styrian Salza valley, which is part of the forest growth district 4.2 (Eastern part of the Northern Alps of Austria). Also the Central Mount Hochschwab is ranging from the Salza valley to the respective summit areas. The Zeller Staritzen area is marked with a black line (Fig. 9).

Zeller Staritzen is ranging from 677 m ASL (close to Weichselboden in the Salza valley) up to the summit "Zinken" (1619 m ASL). The main part of Zeller Staritzen is forested, the second most important area is covered with alpine pastures. There occur also rock areas in the steep karstic alpine terrain. The Styrian villages Wegscheid, Gusswerk and Weichselboden are situated already outside the PA but mark the surroundings of PA6. The total area of PA6 is 41.6 km2.

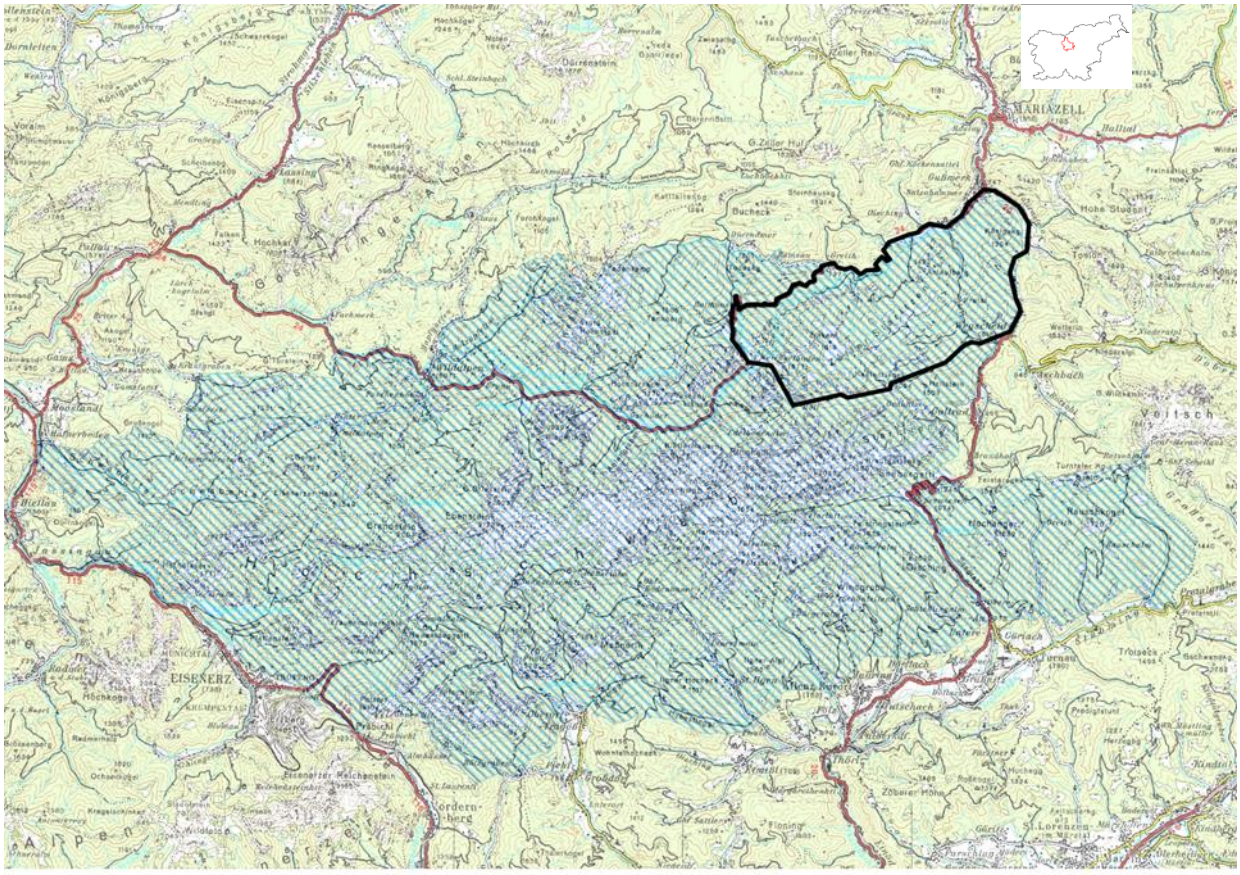

Fig. 9 Pilot Action 6, Vienna Water Drinking Water Sources - Zeller Staritzen

Pilot Area	PA6 Vienna Water Drinking Water Sources, Austria
Field of Action	Drinking Water Supply Management provided through management of water-protection forest ecosystems
Definition of the issue	Improvement of forest ecosystem adaptability towards climate change in Pilot Area "Vienna Water Drinking Water Sources" The Vienna Water Drinking Water Sources are characterized through the karstic alpine environment where the most part of the catchment area is covered by forests. The forest ecosystems play an important role for water protection, as their water protection functionality (WPF) supports and provides water supply security, e.g. to keep turbidity in the source waters below minimum concentrations. In order to keep WPF on the highest achievable level, tree species diversity according to the forest sites and natural regeneration dynamics have to be secured, especially for achieving adaptability of the forest ecosystems under the pressure of climate change. The "Forest Hydrotope Model" based on the Forest Site Mapping Survey of the water protection forest areas of the City of Vienna provides all information in order to reach this goal, both for actual climate and also for climate change conditions. Hence it is possible to deduce the tree species spectrum for each given forest site within the huge catchment area. In order to transform in some parts homogeneous conifer-plantations, regeneration dynamics of all desired tree species have to be facilitated. In order to reach this goal, various measures were and are applied in the Pilot Action.
Existing important policy documents (1), Their gaps (2) and Recommendations for improvement (3)	(1) Internal Guideline for Water Protection strategies (City of Vienna) (2) This Internal Guideline does not show any gaps. It is the definition of how to proceed in the field of water protection under climate changes. It encompasses Best Practices in various land-use types, above all in forest management. (3) The most important recommendation despite this fact is to keep the Internal Guideline for Water Protection strategies (City of Vienna) on the state of the art in terms of water protection, forest management and climate change data. This process is currently applied and has to be kept alive, also in future. This can be supported by the usage of the TEACHER-CE Toolbox CC-ARP-CE. (1) Forest Hydrotope Model (FoHyM) based on the Forest Site Mapping survey of the Water Protection Forests of the City of Vienna (2) There is no gap in the field of FoHyM, as this management tool is specifically tailored for the catchment areas of the City of Vienna. It covers tree species adaptation towards site condition and climate change. (3) The most important recommendation in the field of FoHyM is the process to keep the knowledge about this model and forest site types in PA6 alive, in order to secure it for future generations of foresters. (1) The Austrian Federal Forest Act

	(2) The Federal Forest Act actually defines all necessary frame conditions for forestry but does not refer to tree species diversity according site conditions and above all – it is not executed with regard to some essential parts. (3) Public awareness raising for the execution of essential paragraphs of the Austrian Forest Act. This process above all should encompass the execution of the paragraphs dealing with wild ungulate population densities, which could endanger forest ecosystem functions. This can be supported by the usage of the TEACHER-CE Toolbox CC-ARP-CE. (1) Regional Hunting Acts (Styria and Lower Austria) (2) The regional hunting acts actually define necessary frame conditions for the wide-spread trophy hunting activities in Austria, but in essence they are not executed. This is the major gap regarding these Acts. (3) Awareness raising with regard to the implementation of essential paragraphs of the Regional Hunting Acts. This would help to implement forest management adapted to site conditions and climate change. This can be supported by the usage of the TEACHER-CE Toolbox CC-ARP-CE.
Measures	• Orientation framework "Forest Hydrotope Model" and "Forest Site Mapping Survey" of the water protection forest ecosystems of the City of Vienna for the deduction of the Natural Forest Hydrotope Type on each given site within the catchment areas. This provides knowledge about the tree species spectrum available on each defined forest site. • Facilitation of natural regeneration dynamics in order to provide the full spectrum of possible tree species diversity, in order to reach adaptability under climate change • Continued adaptation of wild ungulate densities towards an forest ecologically sustainable level • Creation of "chaotic conditions" on the forest soils (intentionally placing of dead wood), which also facilitate natural regeneration dynamics through hindering browsing and fraying. • Information campaigns for foresters and hunters in order to keep their awareness level on the highest achievable level • Planting of "wild seedlings" in order to keep the autochthonous genetic pool and to increase regeneration numbers
Potential synergies	Groundwater Management Fluvial Flood Risk Management Pluvial Flood Risk Management

Pilot Area	PA6 Vienna Water Drinking Water Sources, Austria
Field of Action	Drinking Water Supply Management provided through management of alpine pasture areas with regard to water protection
Definition of the issue	Improvement of water supply security through implementation of Best Practices in Alpine Pasture Areas - Pilot Area "Vienna Water Drinking Water Sources" The Vienna Water Drinking Water Sources are characterized through the karstic alpine environment where the most part of the catchment area is covered by forests, but the highest parts of the catchment area are characterized through Alpine Pasture Areas, actually both active and abandoned ones. The land-use type alpine pastures involves above all cattle grazing during summer season at the highest elevations of Pilot Action 6 (PA6). As the karstic catchment area also involves typical features like dolines and swallow holes, direct connectivity between the landscape surface with the karstic aquifers is given, hence between cattle grazing areas (faeces on the soils) and the water resources for human use. This fact calls for the implementation of Best Practices in the field of land-use type alpine pastures. Vienna Water hence established both science-based research activities in PA6 in order to reach clarity about potential response strategies and also started communication and cooperation with the alpine pasture responsible persons. Through this twofold strategy it was possible to define an action plan with the overall purpose of the improvement of water protection and by the way of water supply security.
Existing important policy documents (1), Their gaps (2) and Recommendations for improvement (3)	(1) Internal Guideline for Water Protection strategies (City of Vienna) (2) This guideline does not show any gaps and also covers alpine pasture activities (3) Consequent implementation of the "Internal Guideline for Water Protection" with regard to the chapter "Alpine Pastures" (1) Alpine Grasslands Mapping survey data (carried out on demand of Vienna Water) (2) This management tool is specifically tailored for the catchment areas of the City of Vienna and has no gaps. (3) Public awareness raising for the execution of essential guidelines of the regional alpine pasture areas, which are based on the mapping survey. Keeping this knowledge base alive through transfer strategies. This can be supported by the usage of the TEACHER-CE Toolbox CC-ARP-CE. (1) The Austrian Federal Water Act (2) The Water Act actually defines all necessary frame conditions for water suppliers but does not refer specifically to alpine pasture activities and

	climate change, hence those are thematised in the "Internal Guideline for Water Protection Strategies". (3) Referring to the Water Act within the context of alpine pasture issues. Combining the knowledge base of the City of Vienna with specific focus on climate change and alpine pasture issues – with the legislative background of the Water Act. This can be supported by the usage of the TEACHER-CE Toolbox CC-ARP-CE. (1) Regional management guidelines for alpine pasture areas (2) The regional alpine pasture guidelines (organised on province-level) actually define necessary frame conditions for the - in Austria so far - still active alpine pasture areas and of course are an important tool in terms of communication tasks with farmers. But they do not thematise climate change and water resources protection. (3) The communication and cooperation strategy between Vienna Water and alpine pasture farmers has to be continued in order to ensure the integration of water protection and climate change issues in management concepts for this land-use type. This can be supported by the usage of the TEACHER-CE Toolbox CC-ARP-CE.
Measures	Implementation of Best Practices for active Alpine Pastures in PA6, which are clearly defined: • Fencing out of sinkholes and swallow wholes to keep cattle away • Distributing water troughs to avoid cattle concentrations • Alpine pasture strategies to keep the grassland quality on a high level • Avoiding additional deforestation of dwarf pine fields • Keeping the amount of cattle present on the alpine pasture area on an optimal level (not too many) • Information and communication strategy with alpine pasture farmers, through Vienna Water • Financing of key-measures like waste water solution technologies • Constant avoidance of manure distribution- Clear position to welcome the abandonment of alpine pasture areas within PA6, where subsequently natural vegetation like dwarf pine (Pinus mugo) can re-establish – this is the best solution for alpine pasture areas within PA6 Keeping the clear documentation (online documentation of the parameters) of water quality parameters of the tapped karstic springs also in future
Potential synergies	Groundwater Management

3.7 Improvement of policy documents in Pilot Area Waidhofen/Ybbs

The catchment area of the Waidhofen/Ybbs Water Supply, (Pilot Action 7 = PA 7) is characterized by steep karstic mountain ranges with forest ecosystems, grasslands, Dolomite stone quarries and urban areas (Fig. 1). The PA7 is situated in the North-Eastern Limestone Alps of Austria, in the Austrian province Lower Austria.

As most important economic factors of the region industry, forestry, drinking water supply, agriculture with alpine pastures and tourism have to be mentioned. The karstic alpine terrain of PA7 is situated in a rather dense populated region, industry is hence an important aspect of this area.

The water intake zone of Waidhofen/Ybbs was declared and decreed as water protection zone in 2018. The related aspects of all mentioned land-use types with regard to drinking water supply will be thematized.

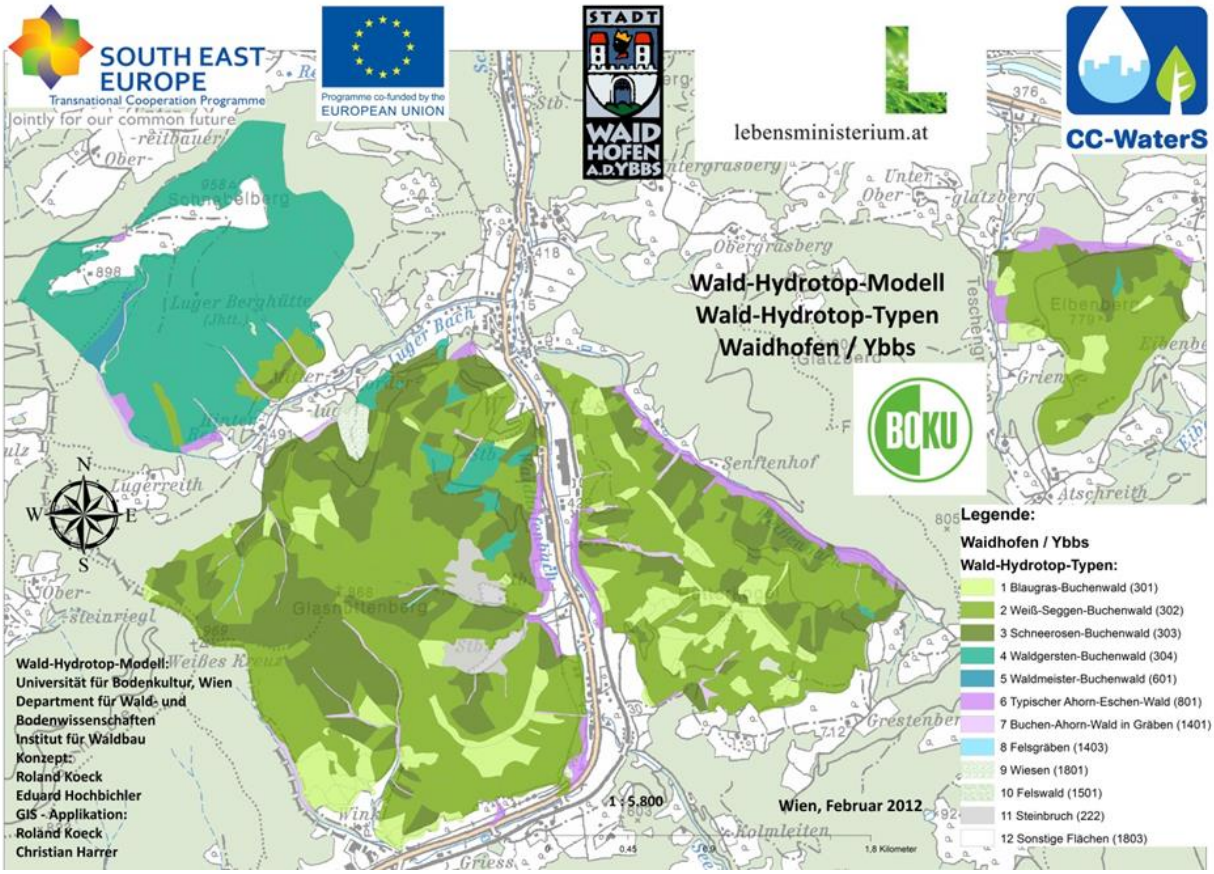

Fig. 10 Pilot Action 7, Waidhofen an der Ybbs Water Drinking Water Sources (Forest Hydrotope Map).

Pilot Area	PA7 Waidhofen an der Ybbs Drinking Water Sources, Austria
Field of Action	Drinking Water Supply Management provided through improvement of forest ecosystem adaptability towards climate change
Definition of the issue	Improvement of forest ecosystem adaptability towards climate change in Pilot Action 7 - "Waidhofen an der Ybbs Drinking Water Sources" The Waidhofen/Ybbs Drinking Water Sources are characterized through the karstic alpine environment where almost the whole part of the catchment area is covered by forests. The forest ecosystems play an important role for water protection, as their water protection functionality (WPF) supports and provides water supply security, e.g. to keep turbidity in the source waters below minimum concentrations. In order to keep WPF on the highest achievable level, tree species diversity according to the forest sites and natural regeneration dynamics have to be secured, especially for achieving adaptability of the forest ecosystems under the pressure of climate change. The "Forest Hydrotope Model" specifically elaborated for the City of Waidhofen / Ybbs provides all information in order to reach this goal, both for actual climate and also for climate change conditions. Hence it is possible to deduce the tree species spectrum for each given forest site within the huge catchment area. In order to transform in some parts homogeneous conifer-plantations, regeneration dynamics of all desired tree species have to be facilitated. To reach this goal, various measures were and are applied in the Pilot Action.
Existing important policy documents (1), Their gaps (2) and Recommendations for improvement (3)	(1) Guideline for Water Protection (City of Waidhofen / Ybbs) (2) This guideline does not show any gaps and motivates forest owners to apply Best Practices through a funding system. It was designed specifically for Waidhofen / Ybbs and its forest cover dominated drinking water protection zone, as output of several Interreg projects. (3) Consequent implementation of the "Guideline for Water Protection" of the City of Waidhofen / Ybbs. This process can be supported by the use of the TEACHER-CE toolbox CC-ARP-CE. (1) Forest Hydrotope Model (FoHyM) This management tool is specifically tailored for the catchment areas of the City of Waidhofen / Ybbs and has no gaps. (2) There is no gap in the field of FoHyM, as this management tool is specifically tailored for the catchment areas of the City of Waidhofen / Ybbs. It covers tree species adaptation towards site condition and climate change. (3) The most important recommendation in the field of FoHyM is the process to keep the knowledge about this model and forest site types in PA7 alive, in order to secure it for future generations of foresters. (1) The Austrian Federal Forest Act (2) The Federal Forest Act actually defines all necessary frame conditions for forestry but does not refer to tree species diversity according site

	conditions and above all – it is not executed with regard to some essential parts. (3) Public awareness raising for the execution of essential paragraphs of the Austrian Forest Act. This process above all should encompass the execution of the paragraphs dealing with wild ungulate population densities, which could endanger forest ecosystem functions, a fact which is also relevant in PA7. This process can be supported by the use of the TEACHER-CE toolbox CC-ARP-CE. (1) Regional Hunting Act (Lower Austria) (2) The regional hunting acts actually define necessary frame conditions for the wide-spread trophy hunting activities in Austria, but in essence they are not executed. This is the major gap regarding these Act of Lower Austria. (3) Awareness raising with regard to the implementation of essential paragraphs of the Regional Hunting Act. This would help to implement forest management adapted to site conditions and climate change. This process can be supported by the use of the TEACHER-CE toolbox CC-ARP-CE.
Measures	Extension of the "Guideline for Water Protection" to further forest owners through information campaigns Orientation framework "Forest Hydrotope Model" of the water protection forest ecosystems of the City of Waidhofen / Ybbs for the deduction of the Natural Forest Hydrotope Type on each given site within the catchment areas. This provides knowledge about the tree species spectrum available on each defined forest site. Facilitation of natural regeneration dynamics in order to provide the full spectrum of possible tree species diversity, in order to reach adaptability under climate change Continued adaptation of wild ungulate densities towards an forest ecologically sustainable level Creation of "chaotic conditions" on the forest soils (intentionally placing of dead wood), which also facilitate natural regeneration dynamics through hindering browsing and fraying activities of the ungulate species. Information campaigns for foresters and hunters in order to keep their awareness level on the highest achievable level Planting of "wild seedlings" in order to keep the autochthonous genetic pool and to increase regeneration numbers Knowledge and awareness raising through the use of the TEACHER-CE toolbox CC-ARP-CE.
Potential synergies	Groundwater Management Fluvial Flood Risk Management Pluvial Flood Risk Management

Pilot Area	PA7 Waidhofen an der Ybbs Drinking Water Sources, Austria
Field of Action	Drinking Water Supply Management - water supply security provided through the provision of new source waters (groundwater wells)
Definition of the issue	Improvement of water supply security under climate change through integration of new groundwater wells in Pilot Area "Waidhofen/Ybbs Drinking Water Sources" The Waidhofen/Ybbs Drinking Water Sources are characterized through the karstic alpine environment where almost the whole part of the catchment area is covered by forests. The water resources are actually provided through karstic springs, which are currently piped towards the supply facilities of the City and surrounding villages. In order to reach a higher level of water supply security, additional groundwater wells are integrated into the existing supply system. This because under current climatic conditions dry spells occur frequently and additionally further villages in the surroundings of Waidhofen / Ybbs have to be supplied by the Water Works of the city. The whole situation calls for a better balanced supply system. In order to meet potential higher water supply demands, an additional groundwater well is constructed, which improves the water supply security in terms of available source water quantity. The groundwater source is monitored hydrologically and it is the defined purpose of the municipal water works, to only use a defined proportion through the well in order to keep the groundwater level in stable conditions (avoiding over-use of the groundwater resources).
Existing important policy documents (1), Their gaps (2) and Recommendations for improvement (3)	(1) The Austrian Federal Water Act (2) The Water Act actually defines all necessary frame conditions for water suppliers but does not refer specifically to climate change. (3) Referring to the Water Act within the context of the integration of the new groundwater well. Combining the knowledge base of the TEACHER-CE Toolbox CC-ARP-CE – with the legislative background of the Water Act.
Measures	Hydrological documentation of the groundwater resources in the area of the groundwater well Monitoring of the precipitation amounts in the area Documentation of the evolvement of the groundwater level in order to avoid over-use Construction of the groundwater well, integration of all necessary measures to secure water supply security
Potential synergies	Groundwater Management

3.8 Improvement of policy documents in Pilot Area Nagykunsági, Field of Action: Water Scarcity and Drought (management),

The Pilot Area called Nagykunság River Basin, is located in the Hungarian Great Plain.

The River Basin located in the driest part of the country, where the pluvial flood risk and sensitivity is also high because of the surface relief and soil condition. The biggest challenge is to cope with water scarcity and extreme rainy periods, which was taken into account as the most severe effect of the climate change.

The catchment of the Nagykunsági River Basin was chosen for the Pilot Area in the Teacher-CE project which is focusing on the Climate Change (CC) issues in the Central Europe.

The presented issue in the field of "Water Scarcity and Drought (management)" is one of the biggest problems expected in the PA.

As a result of the extreme weather conditions caused by climate change, the periods of low precipitation are longer, and the average temperature can reach higher values, hence the issues of this field of action are especially important in the river basin, which is mainly arable area.

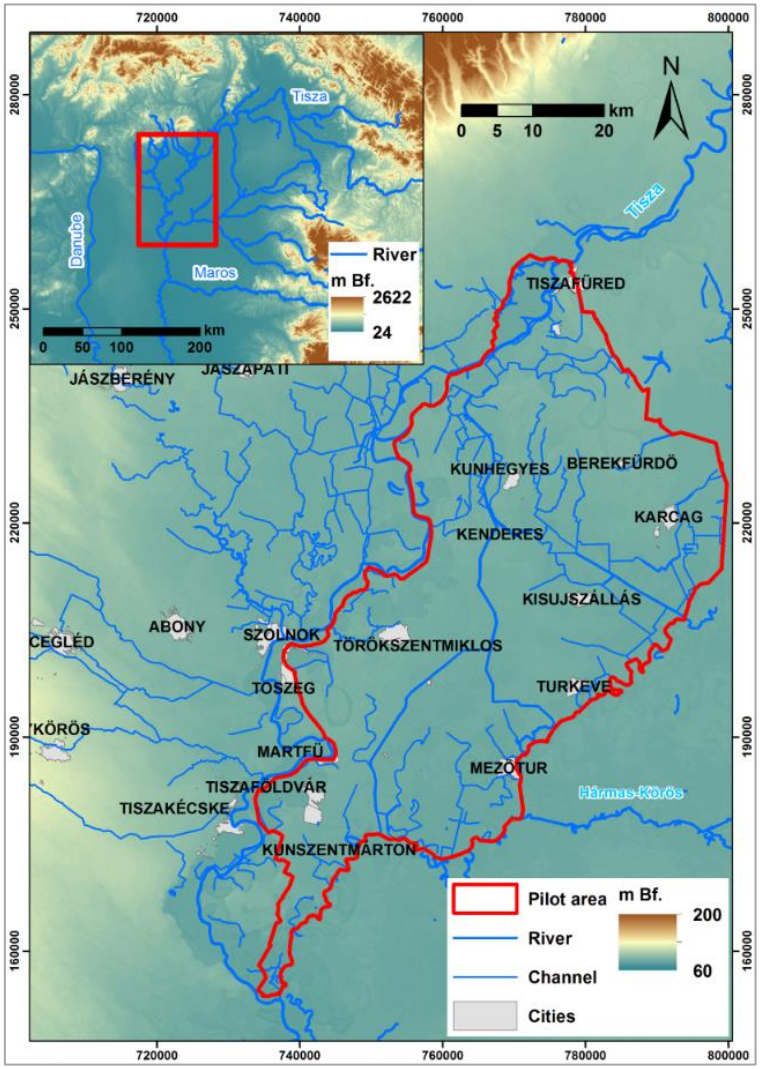

Fig. 11 The Pilot Area called Nagykunság River Basin

Pilot Area	PA8 Nagykunság River Basin
Field of Action	Water Scarcity and Drought (management)
Definition of the issue	The River Basin is a flat lowland polder surrounded by flood dikes, crossed by well-built drainage and irrigation systems. The water flow in the basin is artificially modified and controlled. The flood situations in the rivers depend on the impacts of the upper river catchment. There are well-built flood defence systems, dikes and two reservoirs in the basin. The pilot area is part of the Tisza-Körös Valley Water Management System (TKVWMS), which belongs to the Middle Tisza District Water Directorate (MTDWD) operational area. The size of the pilot area is 2950.9 km2 which is bordered by the Tisza River from the west, and by the Lake Tisza from the north. The eastern border is the Hortobágy-Berettyó River and the Tiszafüredi main irrigation canal, and the southern border of the area is the Hármas-Körös River. The Nagykunsági Basin is one of the sub-basins of the Tisza River. Most of the water bodies in the sub-basin are in poor ecological status, and effected regularly by floods, droughts, and water quality problems, which can occur almost every year. These issues are partially included in the strategic planning documents prepared for the area, such as: River Basin Management Plan; Flood Risk Management Plan, Drought Impact Mitigation Plan, and Irrigation Development Strategy Plan. The vast majority of the 2 965 km^2 sized catchment is agriculturally used (73%). The maximum inundated area by excess water was 430,5 km^2, the annual average precipitation: 513,4 mm, the status of water bodies is mostly poor (good:5, poor: 21). TEACHER-CE toolbox provides data for 54 indices that can be used to describe climate change. These are historical data and the results of forecasts are based on numerical modelling in two variants of rising CO2 concertation: optimistic (smaller changes) and pessimistic (bigger changes). The quantitative results and related statistical values are in general shown as comprehensive data tables while expected anomalies are in general provided in the form of easily interpretable maps. Mean temperature of the warmest quarter of the year shows rising up to 1,45°C in the Pilot area according to the CC indicators (mid- way scenario, 2021-2050), however the worst case predict 4,35 °C. The already high risks of drought will continue to rise in any case, so planning of measures to mitigate these risks is essential.
Existing important policy documents (1), Their gaps (2) and	(1) Ministry of Agriculture Decree No. 10/2015. (III. 13.) on the rules of the requisition of the subsidy which is beneficial to the reachable agricultural practices at the aspect of climate and environment, as well as the conditions

Recommendations for improvement (3)	on to keep the arable, the permanent grassland and the land which covered by permanent crops suitable for cultivation or grazing. (2) Despite the regulation, it is not visible that the cultivation structures, and land use adapted to environmental conditions would increase in the pilot area. (3) Develop an effective support system to disseminate environmentally beneficial practices. In addition to rethinking the financial support system, Decision Support System for Planning of Natural (Small) Water Retention Measures developed within the FramWat project can be used for this purpose. (1) The water scarcity activity has been included in the water damage protection legislation as modification of the legislation. (Ministry of Transport, Communications and Water Decree No. 10/1997.KHVM legistlation) (2) The effects of climate change are difficult to predict, not only should water shortages be expected in areas that are currently water-scarce, but even the runoff of our large rivers could decline drastically during periods of drought. The water scarcity activity depends on water sources of the rivers may lead to an unsustainable defense techniques. This problem also threatens the sustainability of the results of ongoing large-scale irrigation development investments. (3) Increased consideration of climate adaptation measures, using for example Teacher project Toolbox for Identification of issues with selection of measures.
Measures	Increasing the proportion of water retention measures is a key part of national water strategies and is supported by the relevant regulatory environment. However, the use of previously planned and significant water retention storage options on rivers with significant runoff is still not included in the long-term plans. In lowland river basins in terms of improving the water balance, the use of top soil layer as a reservoir space in the river basin is more effective, than other surface retention. Therefore during the colletion of possible measures in the pilot area mainly land use and cultivation change type were chosen in agricultural area (proportion of agricultural land 74%). In addition, traditional storage measures for water management have been incorporated, taking advantage of existing canal network and other storage options. Measures to improve the water balance in the catchment area also have a beneficial effect on the inland excess and local flood situation.
Potential synergies	The synergies between the Field of Action: " Water Scarcity and Drought risk (management)” and FoAs: " Management of water dependent ecosystems” and

	"Pluvial/Fluvial flood risk (management)" exists varying degrees due to the nature of the planned measures. Improving water retention capacity of the river basin has an impact on the flood situation, improves soil water management, increases the available irrigation water supply, and beneficial for water dependent ecosystems. The measures proposed in the Pilot area have an impact on the FoA's by making optimal use of the existing water resources and improving the water retention conditions.

3.9 Improvement of policy documents in Pilot Area Podyjí National Park

The Podyjí national park is located in the south of the Czech Republic and is part of the Dyje river basin. In most of its territory (34 km of the river), the Dyje forms the state border between the Czech Republic and Austria; the park lies only on its left bank. The total area of the Podyjí National Park is 6276 ha, among which 2822 ha are protected zones. The park is represented by 84 % forest cover, 9% agriculture area, 42km of the Dyje river, and 21 fishponds. The NP's average annual temperature is around 8-9°C in the western and eastern parts. Total precipitation in the Vranov region is close to 600 mm, and 530 mm in Znojmo. The valley's bottom temperatures can be up to 1–3°C lower than its upper edges.

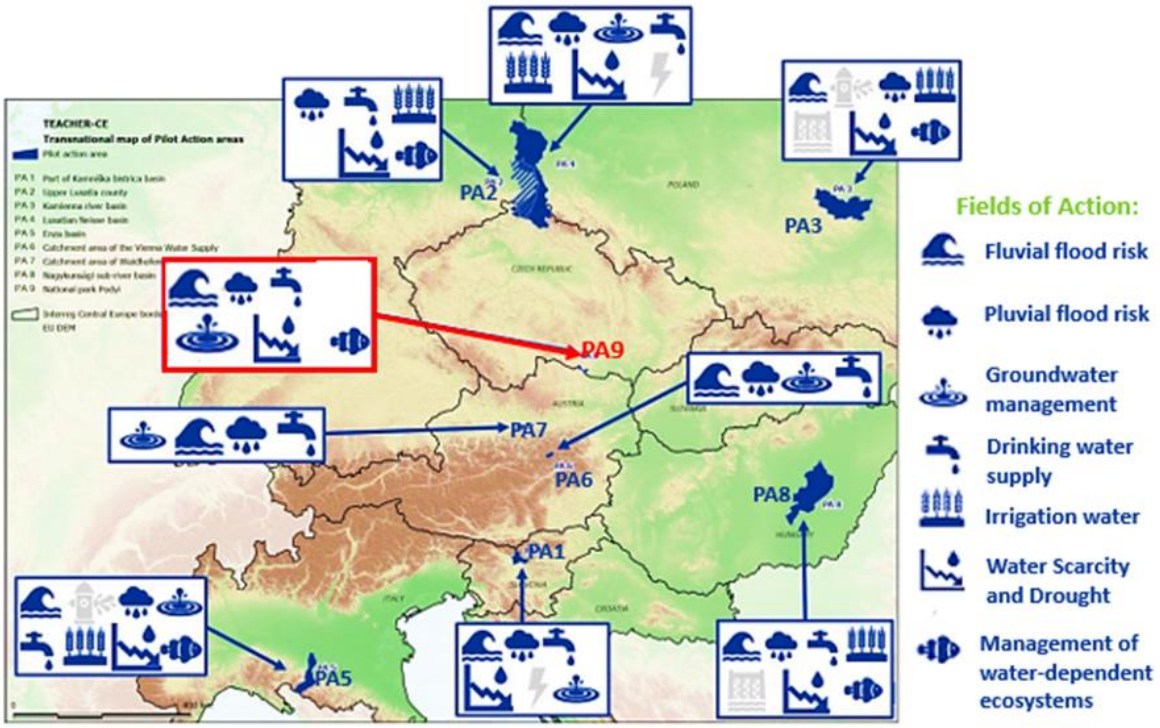

Fig. 12 Map of the TEACHER-CE project pilot actions. The Podyjí national park pilot action, in the Czech Republic, is marqued in red

Pilot Area	Podyjí National Park
Field of Action	Drinking-Water Supply
Definition of the issue	Approximately 40 springs and wells were found in the Podyjí National Park regarding the drinking water supply. Some springs near the hiking trails have been adapted for visitors to the park. Water quality is regularly monitored here. Unfortunately, anthropogenic nitrogenous and biocidal pollution is threatening all the drinking water sources in the park, and only 20% of the springs and wells regularly meet the drinking water limits.  https://www.nppodyji.cz/studanky
Existing important policy documents (1), Their gaps (2) and Recommendations for improvement (3)	(1) Team of authors (2020). Report on the quality of drinking water in the Czech Republic for 2020. Státní zdravotní ústav. (2) The document provides an annual evaluation of the water quality in the Czech Republic. It does not link water quality under the influence of climate change and associated events (extreme weather events, drought, etc.). (3) Water quality could be statistically linked to multiple explanatory factors. Measures should be provided to improve the clean water supply in the Czech Republic. (1) Team of authors (2015). National adaptation action plan on climate change. Implementation document adaptation strategy in the conditions of the Czech Republic. Ministry of Environment of the Czech Republic. (2) The influence of climate change on water quality is limited to drought events with limited quantification of the actual effects.

	(3) The document should provide more detailed predictions on climate change effects on drinking quality supply, considering extreme events. (1) Team of authors (2020). Flood risk management plan for the Danube basin. Ministry of the Agriculture and Ministry of the Environment of the Czech Republic. (2) While the document links the effect of climate change to the probability of flood risk, it does not explicitly relate that to the drinking water supply. (3) The document should provide additional information (water quality impact of flood events).
Measures	The policy documents reviewed here often discuss possible measures to deal with drinking water supply issues. However, the measures mentioned are only briefly described and do not necessarily take climate change into consideration. It is our opinion that using a tool like the comprehensive list of measures developed during the TEACHER-CE project would benefit stakeholders during the decision-making process.
Potential synergies	The CC-ARP-CE toolbox developed during the TEACHER-CE project is not only focused on drinking water supply but also on six other water related field of actions. Some measures can be beneficial for more than one field of action allowing a synergetic implementation of measures.

Pilot Area	Podyjí National Park
Field of Action	Fluvial flood risk
Definition of the issue	Regarding the fluvial flood risk, the winter flood regime dominates the Dyje and its tributaries, mainly caused by melting snow in the Bohemian-Moravian Highlands and parts of the Dyje river basin in Austria (e.g., spring flood 2006). The summer flood of the regional type in August 2002 and the flood from torrential rains in June 2006 can be considered less frequent. Regularly, floods damage valuable features of the park such as pond dikes and footbridges. The ponds are artificially created tanks, which were created mainly for fish farming. However, they also have a number of other functions. They create picturesque landscape images, and if they have developed coastal and wetland vegetation, they are attractive for a large number of diverse species of plants and animals. They also compensate for temperature fluctuations in the surroundings. Also, ponds are an important feature to alleviate the negative impact of drought events.  https://www.nase-voda.cz/np-podyji-znate-take-podyjske-rybniky /
Existing important policy documents (1), Their gaps (2) and Recommendations for improvement (3)	(1) Team of authors (2020). Documentation of areas with a significant flood risk (DOSVPR DP Dyje). Povodí Moravy. (2) The document includes limited measures related to the influence of floods on natural protection areas. The resolution is too large, the examples are not sufficiently detailed for the pilot action area, and the impact of climate change is not discussed. (3) The document is at the regional level, and more details should be provided on a local scale. In the process of implementing the document, the

	Toolbox could be used for communication between park managers and water managers regarding identified problems or action planning (1) Team of authors (2015). National adaptation action plan on climate change. Implementation document adaptation strategy in the conditions of the Czech Republic. Ministry of Environment of the Czech Republic. (2) The influence of climate change on flood distribution is generally unknown in the Czech Republic, with low accuracy of computer model predictions. (3) The document is at the state level, and more details and recommendations should be provided on a local scale.
Measures	Some of the policy documents reviewed here are discussing possible measures to deal with fluvial flood issues at the regional and national level only. They also do not all include the impact of climate change. It is our opinion that using the CC-ARP-CE toolbox would help stakeholders find measures at the local level as well as information regarding climate change.
Potential synergies	The CC-ARP-CE toolbox developed during the TEACHER-CE project is not only focused on the fluvial flood risk management but also on six other water-related field of actions. Some measures can be beneficial for more than one field of action allowing a synergetic implementation of measures. Additionally, measures are classified for different scales levels enabling more adequate measures selections.

4 Proposals for improving policies related to CC integration in water management at the local level - outcomes from Forums

Within the framework of the deliverable D.T.4.2.2 each partner reviewed the TEACHER strategy together with key stakeholders in PA in order to formulate the next steps - how to integrate developed toolbox and strategies into local to national process.

4.1 Main agreements about the toolbox implementation

In general, the interest was expressed to pursue the use of the toolbox and its science-based enhancement. Moreover, it was advocated to link the toolbox to nationally relevant tools. Forums participants consider that the Toolbox contributes to a better adaptation to CC of issues related to water management aspects, as it makes possible to:

- analyse the water-related issues in a given area
- identify the mitigation measures,
- raise discussion and dialogue between the different parties involved and share best practices from different places (also different countries) with similar problems and issues,
- use it by bodies dealing with scientifical work or for educational purposes.

Some participants (Italia, Poland) agreed that Toolbox can be used as an additional tool to realize their duties (e.g.: every day operations, repairing planning documents, implementing measures from RBMP). Others (Germany, Austria, Hungary) are planning further actions to disseminate the implementation of the Toolbox (e.g.: presentation at strategy meeting, further discussion about how the toolbox can be connected with "official" governmental platforms). The table nr 2 recalls the main characteristics of the TEACHER-CE Toolbox CE-ARP-CE.

Table 2 . Description of the TEACHER-CE Toolbox CE-ARP-CE

Link	https://teacher.apps.vokas.si/home
Home	the tool and the contents of the other sub-pages are briefly described.
Identification of issue with selection of measures and measures	Presented as a map in which it is possible to insert new issues, each of these issues is represented by an icon representing the Field of action and the Land Use affected by the issue
Map of climate indicators	Maps of climate indicators, for the area of the Interreg Central Europe program, for two different time horizons (2021-2050 and 2071-2100) and two representative concentration pathways (RCP 4.5 and RCP 8.5)
Other project tools	This page links to the tools of previously funded EU connected projects
Ranking and catalogue of measures	The 161 measures provided by the Toolbox are listed and it is possible to filter them on the basis of user needs
Reference EU and national links	Reports reference to EU and national GIS tool and data portals

4.2 The proposals for improving policies related to local level

In this section, the strategies and proposals for improving policies related to local level are summarized. The main ideas developed by key stakeholders are mostly specific to country situation (see country specific recommendations), however some of them may be generalized for all strategies. After discussions with stakeholders and between the TEACHER consortium members we have chosen eight of them:

1. Science-based strategies: Develop science-based strategies, and aligning measures proposed within them with strategic adaptation goals. More clarity is needed on how specific measures fulfil the goals, and how to implement them on specific site within the strategy.
2. Multi-sector approaches: Multisector functionality and benefits should be highlighted in sectoral strategies
3. Legislative perspective: Aligning of the differing and contradicting legislations. Linking local to regional strategies, including the clear responsibilities to develop and implement them. Enable bottom-up decision making system on water resources in some countries.
4. Funding implementation – implementation on local level should be substantially funded due to lacking resources in municipalities budgets.
5. Measuring implementation success: For implementing strategies, provide simple measurable (preferably non-site specific) indices to measure the policy contribution to relevant national or international commitments. Monitoring (see section “Adaptability of strategies on changing conditions”) is further tool for measuring success.

6. Measures for integrating planning efforts: Evaluate possible linkages of climate adaptation with climate mitigation measures and focusing on measurable multiple benefits of the common measures.
7. Adaptability of strategies on changing conditions: Harmonisation and homogenisation of data, including future projections and modelling. Homogenisation of the reference range and methods would also be useful. Novel approaches to monitoring and continuous monitoring networks should support implementation of strategies. Closing data gaps, such as missing soil properties and forest vegetation mapping.
8. Capacity building and guidance on strategy development and implementation on local level: Capacity building on national and regional strategies to local level, and providing staff, who can implement it. Guidance on level of risk which should be considered in shaping adaptation strategies. Awareness of future possible unavailability of water and means to avoid potential conflicts should be increased among the decision makers, and all types of water users.

4.2.1 Country specific recommendations

At the country level, the forums have identified the following recommendations:

- **Slovenia (PA1):** Municipal reconstruction programmes are weakly funded and poorly organised and do not perform all necessary maintenance works. The municipalities cannot afford to finance critical sites, despite the public interest. Therefore, the main higher-level policy strategy should be to finance critical sites of river maintenance, financial and capacity building and protecting areas with economic interests in Slovenia. Furthermore, the old municipal ordinance for drinking water protection was not in line with the Rules on criteria for the designation of a water protection area (Uradni list RS, št. 64/04, 5/06, 58/11 in 15/16), so the aligning of the legislation should be the priority.
- **Germany (PA2)**: Despite scientific background for strategies and strategic aims are both available, the gap between goals and measures exists. More clarity is needed on how specific measures fulfil the goals, and how to implement them on specific site.
- **Poland: (PA3 and PA4)**: There is no obligation to develop a strategy of the development of the commune, and there is a urgent need to link scientific-based results to the plans/strategies. The priorities for implementation of strategies are: (i) involvement of interested groups and built upon natural environment by implementing sustainable land use; (ii) linking local strategies with to the national/regional documents to the planning process, (iii) implement climate change adaptation to the main planning process and to maximize inter-sectoral benefits.
- **Italy (PA5):** Policy makers experience difficulties to insert adaptation measures into planning, linked to the gap between adaptation and mitigation measures. Contrary to adaptation, which clear CO_2 equivalence index, effects of adaptation are site-specific and difficult to assess.
- Procedures and guidelines for data harmonisation are being developed, yet not finalised, while comparison and homogenization of data, difficult even for future projections. Homogenisation of the reference range and methods would also be useful. Hydrological monitoring, and the definition of procedures and guidelines to enable the comparison and homogenization of data are needed. There are difficulties in developing planning tools at municipality level, due to the lack of employees in the technical offices, and the lack of information and coordination at local level in the implementation national strategies.

- **Austria (PP6 ad PP7)**: The uppermost strategic recommendation is to facilitate a nation-wide forest soil and forest vegetation mapping survey for all Austrian forest areas, with respect of CC effects on species diversity, and their water-related ecosystem functions.
- **Hungary (PA8):** Bottom-up decision making system would be more beneficiary than top-down in terms of water management. The awareness among decision makers and water users should increase, including accepting unavailability of water
- **Czech Republic (PA9):** Climate change adaptation should be objectives of a policy document clearly explaining how climate change is taken into consideration, and which IPCC scenarios are used as a reference data. Furthermore, clear definition of aims and time periods to achieve them is needed. Stakeholder communication should be improved in cross-sectoral expert communication. Guidance on which level of risk should be used in planning.

5 Key messages from the case studies and Forums

5.1 General recommendations / visions for climate change adaptation strategies

The D.T4.1.2 has led to the identification of five general recommendations / main visions for climate change adaptation strategies:

1. integrating assumptions of national/regional documents into the planning process;
2. mainstreaming the climate change effects into the planning process;
3. maximizing of cross-sectoral benefits;
4. privileging the implementation of natural-based solutions, implementing sustainable land use;
5. involving stakeholders.

On the basis of the factsheets and the findings of the Forums (see Chapter 3 and 0), **key messages** have been identified to detail the implementation of these recommendations. Therefore, key messages should be considered as overall objectives, that should be considered in relevant policies for the Improvement of adaptation to impacts of climate change in water management projects and spatial planning projects. The outcomes from the Forums also contributed to updating the general recommendations: some proposals from Key Stakeholders point out a new issue, that was not previously identified: **developing a science-based and data-driven strategy and implementation (as a general recommendation nr 6)**.

5.2 General recommendation no. 1 - Integrating assumptions of national/regional documents into the planning process

Description of the recommendation:	Addressing problems at a coarse national/EU scale aims at setting the strategic framework, but is not appropriate to respond and manage risks locally. Nevertheless, local policy documents should consider the objectives of the national/ regional strategic documents to achieve synergies with them and, in case of RBMP and FRMP, be consistent on the river basin level.

Key message 1.1: Using the potential of local spatial development plans

National or regional policy documents may define measures addressing agriculture or industrial pressures on water quality or increasing water retention, but these measures are not always possible to implement at the local level. **Therefore, the most important municipal tool that can reduce these pressures or increase retention are local spatial development plans.** Their findings should take into account not only functional and aesthetic considerations, but also the potential impact on reducing the pressures identified by water management plans or other analyses. For example local spatial development plans could have been updated or re-established to develop new buffering zones in wetlands and river valleys to improve nutriment or water retention possibilities (see the factsheet 3.3 Improvement of policy documents in Pilot Area KamiennaIntroduction). In urban area they could also define multifunctional land uses, e.g. traffic and parking areas suitable for collection, storage and drainage of water (see the factsheet 3.2 Improvement of policy documents in Pilot Area UPPER LUSATIA). The Forums point out the lack of knowledge in many

municipalities about the possibilities of linking municipal planning with adaptation measures (see the DE Forum report- annex 1).

!!! *The ranking and catalogue of measures of the CC-ARP-CE Tool provides examples of measures that may be included in local spatial development plans.*

Key message 1.2: Prioritizing the implementation of measures from RBMP and FRMP in local policy documents

Local policy documents should consider the objectives of RBMP and FRMP to achieve synergy with them and be consistent at the watershed level. The factsheet 3.8 Improvement of policy documents in Pilot Area Nagykunsági, Field of Action: Water Scarcity and Drought (management), illustrates this key message: the main issues in the field of "Pluvial/Fluvial flood risk" are the increasing frequency of extreme hydrometeorological events, such as extreme heavy rainfalls, and snowmelt caused by sudden warming. Managing the growing risk requires proper preparation and planning. In EU Flood risk management is carried out in accordance with the EU Flood Directive. As part of this, design flood levels as well as measures are constantly reviewed on river basin/ national level. For this reason, the local level should prioritize and implement flood risk management measures in accordance with the EU Floods Directive/Flood Risk Management Plan (FRMP) to achieve equal safety and equal economic risks.

5.3 General recommendation no. 2 - Mainstreaming the climate change adaptation into the planning

Description of the recommendation:	Climate change effects should be considered when setting objectives for all relevant planning and policy documents. This exercise of integration should be transparent: the policy document should clearly explain how climate change is taken into consideration. To describe climate change, it is recommended to consider different reliable and updated projections as a reference.

Key message 2.1: Water management and planning must be better integrated from the beginning of planning processes

The relevance of this message is all the more true in the urban environment: urban water management and urban planning must be better integrated from the beginning of planning processes on regarding the retention, storage, re-use and infiltration of rainwater, to improve:

- flood protection (for CC-induced increasing flood events);
- protection from storm water (heavy rain events);
- water scarcity in CC-induced dry periods;
- heat island effects due to cooling by evaporating water;

- urban green/urban nature which depends on sufficient water availability for growing, maintenance (in effects on cooling: evaporation, shadow).

Urban planning policies and water management policies have to set the overall objectives for development projects to create the urban space as sponge city: more space for retention areas, multifunctional uses to combine urban functions retention/storage capacities, unsealing of public and private space, disconnection of sealed areas from drainage systems, infiltration areas etc. (see the factsheet 3.2 Improvement of policy documents in Pilot Area UPPER LUSATIA).

!!! The D.T4.1.2 deliverable propose a step-by-step guideline (operational recommendations) that aims to integrate the dynamics of the effects of climate change in the planning process of policy documents associated - directly or indirectly - with water management.

Key message 2.2: Providing more detailed predictions on climate change effects on water uses, considering extreme events

The D.T4.1.1 and D.T4.1.2 deliverables have identified the lack of water use forecast as a very prevalent gap in policy documents. The factsheet 3.9 Improvement of policy documents in Pilot Area Podyjí National Park illustrates an element of this problem: in the analysed policy documents the influence of climate change on water quality is limited to drought events with limited quantification of the actual effects. The policy documents should provide more detailed predictions on climate change effects on drinking water quality supply, taking into consideration extreme events (e.g.: including water quality impact of flood events).

!!! Identifying the impacts of climate change on the water use, considering the interactions between fields of actions is one of the task from the guideline of the D.T4.1.2 deliverable.

5.4 General recommendation no. 3 - Maximizing cross-sectoral benefits

Description of the recommendation:	To maximize cross-sectoral benefits, local planning actors should apply integrated, multi-criteria and systematic solutions. Thus, an interdisciplinary approach should be followed. Maximizing cross-sectoral benefits will de facto promote combined green-blue infrastructure and nature-based solutions.

Key message 3.1: Identifying of connections between fields of actions to maximize the cross-sectoral benefits

The potential synergies between the Field of Action “Water Scarcity and Drought risk (management)” with FoAs: "Management of water-dependent ecosystems” and “Pluvial/Fluvial flood risk (management)” results from cumulative character of planned or implemented measures. For example, implementation of the measures concerning the restoration of small retention and increasing retention in forest and agricultural

areas result in protection against the impact of drought as well as in the improvement of ecological status of water bodies and protection against pluvial flood. Increase in the retention capacity of natural areas (wetlands, forests etc.) have the impact on rising availability of water resources at the catchment scale. In addition, appropriate maintenance or modernization of water drainage devices (ditches) enables the control of water outflow, its slowing down in dry periods (preventing drought) and water retention in periods of intense rainfall (reducing the risk of flooding) (see the factsheet 3.4 Improvement of policy documents in Pilot Area Lusatian Neisse).

!!! The ranking and catalogue of measures of the CC-ARP-CE Tool provides a prioritisation system with 4 criteria, one of which is precisely the multifunctionality of the measures.

Key message 3.2: Broaden the scope of CC adaptation documents to cover relevant issues

CC adaptation documents should cover all relevant issues related to impacts of climate change in water management projects, e.g.: broaden the aspect of climate change impact related to quality and quantity of water resources based on climate scenarios (see the factsheet 3.4 Improvement of policy documents in Pilot Area Lusatian Neisse), or broaden CC adaptation policy to fluvial risk management (see the factsheet 3.1 Improvement of policy documents in Pilot Area Kamniška Bistrica River Basin).

This interdisciplinary approach is essential to identify connections among fields of actions, understand their interdependencies and so maximize the cross-sectoral benefits. In practice, interdisciplinary tasks are challenging to implement, as they may not fit to the daily work structure of local stakeholders (see DE Forum report – Annex 1).

!!! Identifying of connections between fields of action to understand the interdependencies and maximize the cross-sectoral benefits is one of the task from the guideline of the D.T4.1.2 deliverable

Key message 3.3: Improving the efficiency of water uses for the goods of all sectors by regulation/controls

A rational water resources usage could lead to a high-water availability for agriculture, manufacture, and so can bring a positive impact on the natural environment (see the factsheet 3.5 Improvement of policy documents in Pilot Area Enza River Basin). Policy documents should include joint objectives for the regional management of water conflicts in drought periods, for human health, public water supply and public functions like firefighting, priorities for the functions of the ecosystems, lower priorities for individual water users etc. (see the factsheet 3.2 Improvement of policy documents in Pilot Area UPPER LUSATIA)

5.5 General recommendation no. 4 - Privileging the implementation of nature-based solutions, implementing sustainable land use

Description of the recommendation:	Local planning actors should consider and promote the potential of ecosystem-based solutions for the protection of water resources (quantitatively and qualitatively) and the adaptation to climate change.

Key message 4.1: Improving water retention capacity of the river basin

Improving water retention capacity of the river basin has an impact on the flood situation, improves soil water management, increases the available irrigation water supply, and is beneficial for water dependent ecosystems (see factsheet 3.8 Improvement of policy documents in Pilot Area Nagykunsági, Field of Action: Water Scarcity and Drought (management),). Another example may be the PA Lusatian Neisse (see the factsheet 3.4 Improvement of policy documents in Pilot Area Lusatian Neisse), where a large range of water retention measures have been recommended:

- construction of water retention facilities
- protection and preservation of existing meadows and pastures
- implementation and restoration of small retention and micro retention facilities in forest areas
- implementation and restoration of small retention and micro retention facilities in agricultural areas
- promoting and implementing agrotechnical measures which increase soil retention
- creation and restoration of mid-field, roadside and water-bearing trees
- shifts to less water-demanding crops and cropping systems
- creation and maintenance of “blue-green” retention areas in urban areas
- infiltrating pavements/permeable surfaces.

!!! *The catalogue of measures of the CC-ARP-CE Tool propose a large range of measures to improve water retention capacity of the river basin with nature-based solutions.*

Key message 4.2: Implementing and maintaining sustainable land use

The case study presented in the factsheets 3.6 Improvement of forest ecosystem adaptability towards climate change in Pilot Action “Vienna Water Drinking Water Sources” and 3.7 Improvement of policy documents in Pilot Area Waidhofen/Ybbs illustrate the important role of the forest in ensuring the protection of drinking water resources. It also shows that a long-term water protection objective is ensured by securing the natural regeneration dynamics of the forest despite the conditions of climate change.

!!! The catalogue of measures of the CC-ARP-CE Tool propose a large range of measures related to land use as a CC adaptation solution.

5.6 General recommendation no. 5 – Involving stakeholders

Description of the recommendation:	The involvement of stakeholders in the planning process ensures a reliable and improved acceptability of the adaptation measures, and so a better implementation of the policy documents, including straight forward climate change adaptation goals. Their involvement is over all needed at the step of assessing and approving adaptation options.

Key message 5.1: Raising awareness among the inhabitants or stakeholders to ensure a wise use of water resources, increase acceptance

Raising the political leaders' awareness about the opportunities and synergies of adaptation measures on all levels is still necessary to enhance integration into strategies. Additionally, obstacles that stand in the way of implementation on the local level need to be communicated openly (see the factsheet 3.2 Improvement of policy documents in Pilot Area UPPER LUSATIA).

Raising public awareness or keeping this knowledge base alive through transfer strategies is also a necessary task for the execution of essential guidelines or regulations (see factsheet 3.7 Improvement of policy documents in Pilot Area Waidhofen/Ybbs).

!!! The map of climate indicators within the TEACHER-CE Toolbox CC-ARP-CE may be a good starting point to illustrate the CC impacts. Cross-fertilized projects, e.g. RAINMAN provides an online knowledge platform, which offers good practice examples and guidance on (1) assessment and mapping, (2) a catalogue of risk reduction measures with additional detailed information on retention, prevention, spatial planning, early warning and emergency response and (3) risk communication.

Key message 5.2: Enhancing cooperating with stakeholders

To reduce consequences of climate change impacts policies and strategies for the management of water need to be developed in close cooperation of all relevant groups and stakeholders. For example in the PA Kamniška Bistrica, the management of drinking water supply is related or affected by most of the fields of actions. The biggest impact is seen by Fluvial and Pluvial flood risk management. In order to effectively face the problems related to surface water and groundwater, cross-sectoral cooperation between these three areas is required (see the factsheet 3.1 Improvement of policy documents in Pilot Area Kamniška Bistrica River Basin). The factsheet 3.6 Improvement of forest ecosystem adaptability towards climate change in Pilot Action "Vienna Water Drinking Water Sources" underlines also that the communication and cooperation strategy between Vienna Water and alpine pasture farmers has to be continued in order to ensure the integration of water protection and climate change issues in management concepts for this land-use type.

!!! Setting up consultative and participatory mechanisms to enable multi-stakeholder engagement in the adaptation process and a continuous communication process for the engagement of the different target audiences, is one of the task from the guideline of the D.T4.1.2 deliverable.

Key message 5.3: Privileging a bottom-up decision-making system

The recommendation nr 1 should not be a justification to apply a top-down decision-making system. The bottom-up system is more recommended in terms of water management (see the Hungarian Forum report – Annex 1).

5.7 General recommendation no. 6 – Developing a science-based and data-driven strategy and implementation

Description of the recommendation:	The strategy should be based on strong scientific reference and reliable data. The implementation of the measures from the strategy should be monitored, as well as their contribution to relevant national or international commitments.

Key message 6.1: Developing science-based strategies

Develop science-based strategies, and aligning measures proposed within them with strategic adaptation goals. This exercise should be transparent: the policy document should clearly explain how climate change is taken into consideration (see the Czech Forum report – Annex 1). More clarity is needed on how specific measures fulfil the goals, and how to implement them on specific site within the strategy. Closing data gaps, such as missing soil properties and forest vegetation mapping (see the Austrian Forum report – Annex 1).

!!! The map of climate indicators within the TEACHER-CE Toolbox CC-ARP-CE may be a good starting point to develop a science-based strategy.

Key message 6.2: Monitoring implementation progress, contributions and changing conditions

For implementing strategies, provide simple measurable (preferably non-site specific) indices to measure the policy contribution to relevant national or international commitments. Novel approaches to monitoring and continuous monitoring networks should support implementation of strategies, including harmonisation and homogenisation of data, future projections and modelling (see the Chapter 0).

!!! Identifying indicators to evaluate the achievement of the objectives is one of the task from the guideline of the D.T4.1.2 deliverable

6 Set-up of follow-up activities

6.1 Operational level: ideas for the futher development of the Toolbox

The following main proposals identified during the Forums may be synthetized as following:

- adding reference sites as examples of best practices and reference contacts;
- making a more synthetic and sharable version of the catalogue of measures;
- developing methods of modelling extreme hydrological phenomena and the effect of measures;
- contributing to cross-sector collaboration (data connectivity between municipal and national levels, see the Slovenia (PA1) specific proposal);
- considering the hydropower potential of the basin and so changing the name of one category of ”land use” to: "River training, erosion control and energy production structures”;
- adding an “*open to a general public*” section in the tool “*Identification of issue with selection of measures and measures*” for training activities.

The Forum also enable to identify country specific next steps:

Slovenia (PA1): An application for data connectivity between municipal and national levels contributing to cross-sector collaboration and efficiency is needed. The benefits of such an application would be very high - both the multi-layered data and the benefits to individuals, as society is accustomed to studying documents on its own, if available, and easily cross-referencing information with experts. Better organisation of river channel monitoring should be prepared. Monitoring of river channels could be done through the use of drones that would send images or video to the application

Germany (PA2): Discussion how such a platform like the toolbox can be connected with “official” governmental platforms or information campaigns is following.

Poland: (PA3 and PA4): Toolbox can be used as an additional tool in their everyday operations. This can be focused on decision support issues and contribute to the improvement of adaptation process related to water management aspects. Furthermore, the information about the climate indices and projections can be used by the bodies dealing with scientifical work. The aspect of educational purposes was also emphasized.

Italy (PA5): (i) providing strong reference to regulatory instruments and measures, (ii) promoting the efficiency of water use through regulations and controls, (iii) broadening the scope of CC adaptation documents to cover relevant issues, (iv) Improving water retention capacity" has an important relevance for the agricultural sector, and (v) integrating risk management

Austria (PP6 ad PP7): The next steps for the Toolbox implementation are the fulfilment of a CC-ARP-CE presentation at the water protection strategy meeting of the City of Vienna (MA31 & MA49), which will be carried out by PP6. This meeting could take place between May and September 2022. It will support and facilitate the CC-ARP-CE implementation.

Hungary (PA8): Stakeholders agreed on taking part in disseminating the results of TEACHER-CE.

Czech Republic (PA9): Following improvement of the toolbox would be beneficial: (i) combine the map of climate indicator with hydrological and soil models. (ii) modelling of effect of the measure.

6.2 National level –Following-up from main significant water management issues identified in the river basins

The overview of the significant water management issues identified in the river basin is prepared during the process of water cycle which is based on the development and update of river basin management plans. It addresses the problems identified in the water management field in the context of implementation of river basin management plans. The preparation of this document includes the process of publishing it and making available for comments which allows the society to make an input to the water policy in each country. The formula of preparation of an overview depends on country approach to preparation of the policy documents and of course on identified issues. In Europe, the most significant issues are insufficient achievement of environmental objectives (good water status), staff shortages, legal, organizational and social aspects and modifications of water bodies.

The term used in TEACHER-CE project deliverables to identify issues related to the climate change aspects in water management defined as "gaps" is similar to the meaning of issues in the context of Water Framework Directive. However, when the significant issues are related in wide context of water management of each country, the term "gap" refers to lack of knowledge, lack of tools and measures or insufficient description of climate change related issues.

The following section contain the summary of cross-references between TEACHER-CE WP4 +results and issues addressed in overviews of the significant water management issues prepared by UE countries as well as the summary of issues which are not connected and/or should be included in future projects.

6.2.1 Main significant water management issues linked, or partly linked with the TEACHER-CE tools and recommendations

Slovenia (PA1)

- An application for data connectivity between the municipal and national levels is urgently needed and would contribute to cross-sector collaboration and efficiency. The important addition to the application should be **descriptions of the issues with photos**. Since a photo contains valuable information about the state (flood, pollution, etc), this type of system is necessary. Such application could be a documentation of the realistic situation in the field.
- CC-ARP-CE toolbox should contain measures for all fields of action and land uses with focus on climate change impacts. For instance, The **Catalogue of measure** contains only some measures for water-dependent ecosystems and nature-based solution, therefore such measures have to be added.
- To make the toolbox more user-friendly and easier to use, **climate change indicators** should be divided into groups, e.g. temperature and participation.
- A specific task was the development of an improved platform for communication between stakeholders about the proposed measures. To improve the **Comments section**, it should be set

up as a **forum** where the author of the report would be notified by email when someone commented on the issues.

- The Catalogue of measures contains many measures on different fields of action. The focus group members should be given the opportunity to select their own **list of measures** and that the list can also be exportable.

Poland (PA3 & PA4)

- Influence of emissions from agricultural areas on the condition of water

  The agricultural emissions to water are one of the most significant sources of nutrient emissions in Poland. The lack of sufficient regional and local measures aimed to reduce its impact on water was conformed during the review of documents under the WP4. Teacher tools could improve the communication between local agricultural stakeholders (i.e. farmers) and water authorities to identify agricultural hot spots and implementation of measures aimed to reduce its input but also to face other issues related for example with drought and/or flood risk.

- Impact of municipal emissions on water status, including protection against sewage from households, recreational areas and landfills and/or industrial emissions on the condition of water

  Municipal emissions are also significant source of emissions to water, not only in the terms of nutrients but also other organic and inorganic pollution and hazardous substances. Gaps consisting in insufficient knowledge of population not connected to WWTPs and the need for improvement of reduction coefficients from WWTPs were identified in the WP4. Teacher Tools could improve to identify this kind of problems in the Pilot Areas.

- The influence of atmospheric deposition on the state of water

  Atmospheric deposition was identified as significant source of chemical pollution in the Pilot Area of Kamienna. The need for improving local and regional documents aimed to reduce low emission influence on water were identified in WP4.

- Morphological changes of surface waters, Influence of hydromorphological changes on the condition of water

  Morphological changes were identified as issue related with various Field of Action. The influence of modification of water bodies influences ecological capacity of water ecosystems, drought and flood risk and climate change vulnerability.

- The impact of the insufficient potential of natural retention and restoration of rivers resulting in the necessity to implement technical methods of protection against flooding on the state of waters

  Restoration of natural wetland ecosystems were identified under the WP4 as a measure aimed in facing climate changes and increase of retention capacity and ecosystem restoration. It consists the various of Field of Actions.

- The impact of climate change on the condition of water and protection against drought

  This issue, addressed in Polish overview of the significant water management issues (2020) was the main subject of whole TEACHER-CE project. All gaps, recommendation on its improvement and measures to mitigate them were connected with measures and Tools developed under the project.

Italy (PA5)

- The main criticalities, as arisen by the Management Plan of Po River Basin District, concern chemical and nutrient pollution, water abstractions and induced shortage, foreign species, hydro morphological alterations. High emphasis is given in the Toolbox to the criticalities related to water shortage in terms of proxies regulating the drought hazard (e.g. Standardized Precipitation Index, Hydroclimatic Budget), but limited information are given in terms of water abstractions: for example, the expected variations induced by climate change in crops requirement and civil/industrial uses.
- In highly urbanized contexts (e.g. Northern Italy), indeed, the analysis should consider the anthropic forcing to provide reliable estimations. The other topics are partly considered in Best Management Practices, but they are not explicitly covered by the main Fields of Actions; in this regard, it should be taken into account that, for these topics, weather forcing play a minor role, then the potential variations induced by climate change are very limited while the anthropic action is predominant. Specifically, hydro morphological alterations affecting a large part of the Po River Basin should be taken into account to mitigate their impact on quality and availability of water resources.

Austria (PA6 & PA7)

- Influence of climate change on forest ecosystems in the drinking water protection watersheds

  The main task for all ASP in Austria's project partnership was the adaptation of the forest ecosystems which provide water regulation as ecosystem service. This task was covered very well, as the ASP have the Forest Hydrotope Model within their watersheds and TEACHER-CE provides with the catalogue of measures a fitting tool for confronting this challenge.

- Impact of faeces of cattle and sheep on alpine pasture areas:

  This issue was thematised in PA6 and the discussions with farmers are ongoing. The project provided a very well fitting frame for keeping this theme alive and adding some important new strategies for solving this main challenge in alpine pasture areas.

- The need to integrate new water sources

  The need to integrate new water sources for securing a safe drinking water supply under climate change was thematised in PA7, the related tasks were described in TEACHER-CE deliverables.

- Ongoing training of people working in the water management sector

  During the TEACHER-CE project the training issue for people working in the sector was emerging as important facet. During the focus group meetings it was possible to tackle this issue and provide knowledge transfer and facilitation of fitting concepts and strategies.

6.2.2 Main significant water management issues not addressed by TEACHER-CE tools and recommendations: what should be done in the next projects?

Slovenia (PA1)

- CC-ARP-CE toolbox should be extended with adding CC adaptation measures on other weather-related hazards, e.g.: impacts of wildfires, water scarcity, sea floods and ecosystem functions for flood protection (e.g. natural based solutions), etc.
- Provision of high-quality drinking water will be one of the biggest challenges in the future. The protection of drinking water resources in connection with land-use management and flood/drought protection considering climate change is an environmental challenge that is common to all countries in CE and has a specific transboundary and transnational relevance. A **sustainable spatial planning** considering climate change is thus strongly required for drinking water protection and management.
- **Wildfires** can compromise water quality both during active burning and for months and years after the fire has been contained or extinguished. Burned watersheds are prone to increased flooding and erosion, which can negatively affect water-supply reservoirs, water quality, and drinking-water treatment processes.
- **Seafloods**: Climate change is an aggravating factor, triggering changes in precipitation and weather patterns, and sea level rises. Several phenomena, such as coastal erosion, storms at sea, and high tides and winds pushing tides into the land, heighten the risk of flooding in coastal areas.

Poland (PA3 & PA4)

- Issues of the urban rainwater drainage networks management

  Proper management of the storm water drainage network in the city requires in-depth knowledge of its hydraulic operation. The issues of the functioning of the underground infrastructure went beyond the subject of TEACHER-CE, therefore it is advisable to develop in future projects tools supporting the management of urban rainwater drainage networks and enabling modelling of its operation in extreme rainfall conditions, tools supporting the design of retention devices in built-up areas with large land slopes.
- Legal, organizational and social aspects

  This issue is not addressed in TEACHER-CE WP4 Tools however it was addressed in conclusions from review. The efficient communication between policy/decision makers, stakeholder and the society should effect with better implementation of international and national legal arrangements at regional and local levels. It is crucial to have up-to-date programmes and documents which results from knowledge of a higher-level documents at operational level and to implement task scalable to lower levels.
- Economic and financial aspects

  These aspects are realised numerous times in the context of implementing measures and preparing documents at regional and local levels. Accessible and purposeful funds should be addressed and the source of funding should be indicated at higher level possible to ensure that implementation of measures will be possible.

Austria (PA6 & PA7)

> Detailed ecosystem integration

The Austrian PAs have the Forest Hydrotope Model as tool for identifying issues in forest ecosystems. In further projects this tool could be made available to further project partners.

> Legal issues in Austria

The sometimes weak implementation of Federal Acts has to be thematised in next projects, as this represents a crucial obstacle for the implementation of climate change adaptation strategies.

6.3 EU level – Potential following-up from the EU water directives fitness check

D.T4.1.1 deliverable identified the gaps in existing strategies, policy documents and directives implementation. The identification of potential policy gaps at the level of the European Union water legislation was realized by a review of findings from the fitness check processed in 2019[1] by the EU Commission. This chapter takes up the findings of the D.T4.1.1 Deliverable by putting them into perspective with the results of the D.T4.2.1 deliverable but also relies on a new review of the fitness check.

The fitness check 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.

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. 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. 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;

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

- Guidance Document No 24 "River Basin Management in a Changing Climate"[3] 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, renaturation of rivers contributes to flood prevention, climate adaptation and biodiversity conservation. The challenge of the valuation of multiple benefits is closely related to the recommendation "*Maximizing cross-sectoral benefits*" from the D.T4.2.1 deliverable: without a reliable evaluation of the benefits, the maximization of cross-benefits is more difficult to argue and implement. This aspect should be consider as an axis of development in furthers projects.

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[4]. 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. Continuing the implementation of green infrastructures should then be consider as an axis of development in furthers projects. It would be the deepening of the recommendation "*privileging the implementation of natural-based solutions, implementing sustainable land use*" from the D.T4.2.1 deliverable.

In addition to the challenges outlined above the Fitness check point out the followings lessons learned for future follow-up:

- assessing the effectiveness of the measures being put into operation, and whether they are sufficient to achieve the objectives;
- identifying and apply innovative technology aiding the cause of the WFD can also play a role in advancing towards the 2027 deadline;
- ensuring a balanced and coherent approach to the sometimes competing uses of water by different sectors (especially in the context of the climate change). This aspect is closely related to the Key message "*Improving the efficiency of water uses for the goods of all sectors*

3 Guidance document No. 24 River Basin Management in a Changing Climate, Common Implementation Strategy For The Water Framework Directive (2000/60/EC) available on CIRCABC web site: https://circabc.europa.eu/sd/a/a88369ef-df4d-43b1-8c8c-306ac7c2d6e1/Guidance%20document%20n%2024%20-%20River%20Basin%20Management%20in%20a%20Changing%20Climate_FINAL.pdf

4 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

by regulation/controls" of the recommendation "*Maximizing cross-sectoral benefits*" from the D.T4.2.1 deliverable;

- considering how further integration of the Directives with other policy areas can best be advanced in a mutually supportive way.

7 Conclusions

This report identified measures, which should be taken to better integrate CC-aspects in water management. It should improve implementation process of WFD, FD, DWD, RBMP at the local level by using TEACHER-CE Toolbox CC-ARP-CE.

Firstly, case studies for each Pilot Area were prepared in a form of factsheet (see Chapter 3). The role of each case study was to identify documents that may be improved by implementing TEACHER-CE Toolbox CC-ARP-CE or recommendations worked out during the TEACHER project. The propositions were then discussed within Forums to connect the key stakeholders to the project outcomes, mainly the strategy vision developed in D.T.4.1.2. Stakeholders' forum organized in all Pilot Actions, brought the following ***key proposals for improving policies related to CC integration in water management at the local level***:

1. Developing science-based strategies, and aligning measures proposed within them with strategic adaptation goals.
2. Assuring multisector functionality and benefits should be highlighted in sectoral strategies
3. Aligning different and contradicting legislations.
4. Funding local level implementation beyond the little resources in municipalities budgets.
5. Measuring implementation success and providing indices to do so.
6. Integrating planning efforts for adaptation and mitigation at local level.
7. Harmonising data, monitoring and adapting strategies to changing conditions.
8. Building and guiding capacities at local level to prepare and implement the needed strategies.

Interest was expressed to pursue the use of the toolbox and its science-based enhancements and to advocate its linking to nationally relevant tools. Country specific, next steps were also listed.

Based on the factsheets and the forums the following key messages have been identified:

1. Using the potential of local spatial development plans;
2. Prioritizing the implementation of flood risk management measures in accordance with the EU Floods Directive to achieve equal safety and equal economic risks;
3. Water management and planning must be better integrated from begin of planning processes;
4. Providing more detailed predictions on climate change effects on water uses, considering extreme events;
5. Identifying connections between fields of actions to maximize the cross-sectoral benefits;
6. Broadening the scope of CC adaptation documents to cover relevant;
7. Improving the efficiency of water uses for the goods of all sectors by regulation/controls;
8. Improving water retention capacity of the river basin;
9. Implementing sustainable land use;
10. Raising awareness among the inhabitants or stakeholders to ensure a wise use of water resources, increase acceptance;
11. Enhancing cooperating with stakeholders;
12. Developing a Science-based strategies;

13. Monitoring implementation progress, contributions and changing conditions.

These key messages advanced recommendations and visions (D.T.4.1.2) and advance it by providing operational details for further practical implementation

In order to draw the further perspectives for the next projects, a review of follow-up activities has been done by the review working group:

- at the operational level about the further development of the toolbox on the basis of the outcomes from the forums;
- at the national level, based on the significant issues according to the WFD;

The identification of follow-up activities was complemented by a review at the EU level, based on the fitness check processed in 2019 by the EU Commission.

Further improvement of the legislation, including sustainable spatial planning and regulation of competing water uses has been identified as one of the key directions for better implementation of climate change adaptation strategies. Applying innovative technologies and ecosystem integration processes to achieve the WFD objectives and improve the CC adaptation abilities may be also a way for further development. Work on CC adaptation measures on other weather-related hazards, e.g.: impacts of wildfires, water scarcity, sea floods, urban rainwater drainage issues and ecosystem functions for flood protection were also mentioned as possible follow-up activities.