Interreg CENTRAL EUROPE
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European Regional Development Fund

TEACHER-CE

JOINT EFFORTS TO INCREASE WATER MANAGEMENT ADAPTATION TO CLIMATE CHANGES IN CENTRAL EUROPE

A synergy of selected previously funded projects



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TAKING COOPERATION FORWARD

Imprint

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1. INTRODUCTION

The consequences of climate change (CC) are already visible in Central Europe and require better coordination of the management of water-related risks. The project TEACHER-CE (Joint efforts to increase water management adaptation to climate changes in Central Europe) addresses this need by integrating and harmonizing the results of previously funded projects focusing on water resources management and protection through sustainable land-use management, including CC adaptation and water-related risks, such as floods and heavy rain, drought and water scarcity. The main challenges in adapting water management to CC have already been addressed in previously funded projects: reducing risks of heavy rainfall (RAINMAN), flood protection (Danube Floodplain, FRAMWAT) and mitigation of droughts (DRIDANUBE) through integrative water resources management and appropriate land use management (PROLINE-CE, FRAMWAT, FAiRWAY) and adaptation of forest management practices to CC (SUSTREE).

The partnership consists of 12 project partners from 8 countries (Slovenia, Germany, Austria, Poland, Italy, Slovakia, Czech Republic and Hungary) with different expertise in water management, environment, forestry, agriculture, climate change and spatial planning. Within the project TEACHER-CE the partnership focused on the development of an integrated TEACHER-CE Toolbox. This is an online platform that provides national and local communities with useful information for the integrated consideration of different fields of action in water management affected by climate change.

The final objective of the project TEACHER-CE is to develop an integrated and joint strategy to promote and stimulate the adoption of this innovative TEACHER-CE Toolbox for efficient use by decision makers in the field of water management planning. Given the uncertainties of the future climate, the aim will be to maximize the use of the Toolbox to effectively and robustly integrate climate change adaptation into sectoral plans such as flood, river basin and drought management plans, as well as regional or local spatial plans.

2. THE WAY TOWARDS TOOLBOX DEVELOPMENT

Climate change has various effects on water management and related sectors. The risks of heavy rain events and flooding are increasing. At the same time, the risk of extreme dry periods is increasing, affecting the groundwater availability and quality. Often the events coincide, as for example, extreme thunderstorms can also occur during drought periods, resulting in extreme heavy rain and flooding. The combination of extremes causes problems for all types of land-use and infrastructures, such as urban areas and green spaces, water related ecosystems, drinking water supplies, urban water management (sewage systems) as well as agriculture and forestry. Even though experts can now demonstrate impacts and adaptation strategies and measures are known, knowledge transfer into practice and into other related sectors as well as knowledge-based decision-making with regard to climate-safe water management and urban planning is still limited. This is where the idea of the TEACHER-CE Toolbox and decision support system started.

2.1 Aim of the TEACHER-CE Toolbox

The goal of the project TEACHER-CE was to develop an integrated Toolbox focusing on climate-proof management of water related issues that builds on already established tools in this context. The Toolbox was developed to make municipalities and regions in Central Europe (CE) more resilient to extreme weather events (including climate change) and to avoid negative impacts on ecosystems and land use.

2.2 Established tools: building blocks for the TEACHER-CE Toolbox

Why should a project reinvent the wheel? Or in this case: TEACHER-CE should build on existing knowledge and tools, analyse them and compile them into a more advanced toolbox. Several previous projects have developed (transferable) tools for municipalities as well as regional and national authorities to better manage the impacts of climate change and weather extremes such as heavy rain, droughts and floods and to make different types of land use more sustainable. These projects used different approaches and methods to integrate and implement their results. They provided best practice solutions for different geographical and regional settings and for different specific extreme events and fields of action. The purpose of these tools ranges from guidance documents to intraoperative applications (decision support tools).

A total of 23 projects and their approaches and results were evaluated by the TEACHER-CE experts, focusing on four “Interreg CE projects”: RAINMAN, PROLINE-CE, FRAMWAT and SUSTREE. Synergies were also built with other selected projects from CE, H2020, DTP, Copernicus Climate Change Service (C3S), and others. The aim was to identify the best available building blocks for a comprehensive Toolbox, develop synergies between them and thus provide the basis for the conception of the TEACHER-CE Toolbox. Individual results and identified adaptation measures from the projects are included in the Toolbox and the Toolbox measures database.

2.3 Toolbox concept for integration of tools

The partnership focused on evaluating selected instruments and tools for adapting water management tasks to climate change. The main focus was on identifying potentials and starting points for integrating the functions of the tools into the TEACHER-CE developments. The aim was to cover a wide range of aspects with the new Toolbox. The evaluation of the existing approaches was therefore based on criteria in which the projects each focused on selected aspects and the combination should cover as many different aspects as possible:

- Impacts of climate change addressed: e.g. river flooding, heavy rain events, droughts, impacts on water supply, agriculture and forestry.
- Targeted sectors: e.g. water management, forestry, agriculture, urban planning
- Target group levels and expert level: local actors, regional actors, policy and decision makers
- Focus of the tool: e.g. hazard and risk assessment, risk mitigation measures, CC impacts/climate proofing, prioritisation/decision support, practical (step by step) guidelines
- Spatial application area, characteristics: e.g. urban/built environment, rural/forest areas, water environment, low land, river valleys, rural/agricultural areas, rural/natural environment, not spatially fixed (e.g. social), mountainous areas
- Spatial scope: e.g. local/municipal level, regional level, river basin level
- Technical outline/aspects of the tool: e.g. web-application/online-info, decision support tool, maps viewer, climate modelling features
- Stakeholder interaction: e.g. information of stakeholders, exchange, training/capacity building
- Link to EU legislation: Water framework directive, floods directive, drinking water directive.

The tools were examined for their climate robustness. This involved the question of whether and how uncertainties related to climate change scenarios are taken into account in the tools. In addition, a scoping study on the impacts of climate change on water management components was conducted based on existing studies and findings. The study provided an important knowledge base for the specification of the climate change assessment functions that are part of the TEACHER-CE Toolbox.

Using these building blocks from the assessed projects and tools the TEACHER-CE partnership elaborated a concept integrating these different tools into one Toolbox, to activate synergies between the tools in the context of climate adaptation and to tailor the Toolbox to the needs of potential users. The Toolbox was designed to meet the defined objective, but at the same time to be user-friendly and operational.

Figure 1: Logo of the CC-ARP-CE (TEACHER-CE) Toolbox: Integrated toolbox for Climate Change Adaptation and Risk Prevention in Central Europe

Based on the selected four projects that are "capitalized" in the TEACHER-CE project, the Toolbox will support users in particular in:

- manage the effects of heavy rainfall and floods;
- exploit small water retention measures
- protect drinking water through sustainable land use
- and properly manage forests under climate change

These findings from the assessment of existing tools and available toolboxes were integrated into the CC-ARP-CE Toolbox.

Building on the tools from the existing projects, TEACHER-CE developed a decision support tool to support Climate Change Adaptation and Risk Prevention in Central Europe (CC-ARP-CE) in the water management sector. All these aspects are included in the logo of the CC-ARP-CE Toolbox (Figure 1): vertical blue lines sand for rainfall (heavy rain), inclined yellow lines are presenting sun (rising temperature), blue curls are presenting water (runoff and floods) and brown horizontal lines for soil (drought) and all these elements are affected by climate change.

2.4 Approach

How to create a user-friendly tool that is useful for experts and the general public at the same time? Of course, a user experience design is especially important. Therefore, our approach to designing the Toolbox was well thought out (Figure 2). The users should be able to contribute their ideas/problems and with the help of our tool better understand the problem by getting information about the expected changes due to climate change and proposed measures on how to address the issue. Also, the user can collect more information by searching the existing national and EU tools for water management.

The aim of the TEACHER-CE Toolbox is also to stimulate the exchange of different views and visions on water development in specific catchments with different stakeholders and to support the learning process together with the participatory process already foreseen in the WFD (Water Framework Directive). Some of the tools that exist at national level are official tools that provide information on water bodies and in particular their status (according to EU WFD), information on flood hazards and programs to implement flood risk reduction measures (EU Floods Directive, EU FD). It is therefore well embedded in the context of existing WFD and FD processes, while trying to avoid overlaps with existing tools.

The TEACHER-CE approach focuses on water issues and contributes to the improvement and implementation of EU WFD, FD, GWD (Groundwater Directive), DWD (Drinking Water Directive) and SDG6 through:

- developing the TEACHER-CE Toolbox and recommendations taking into account climate change (CC);

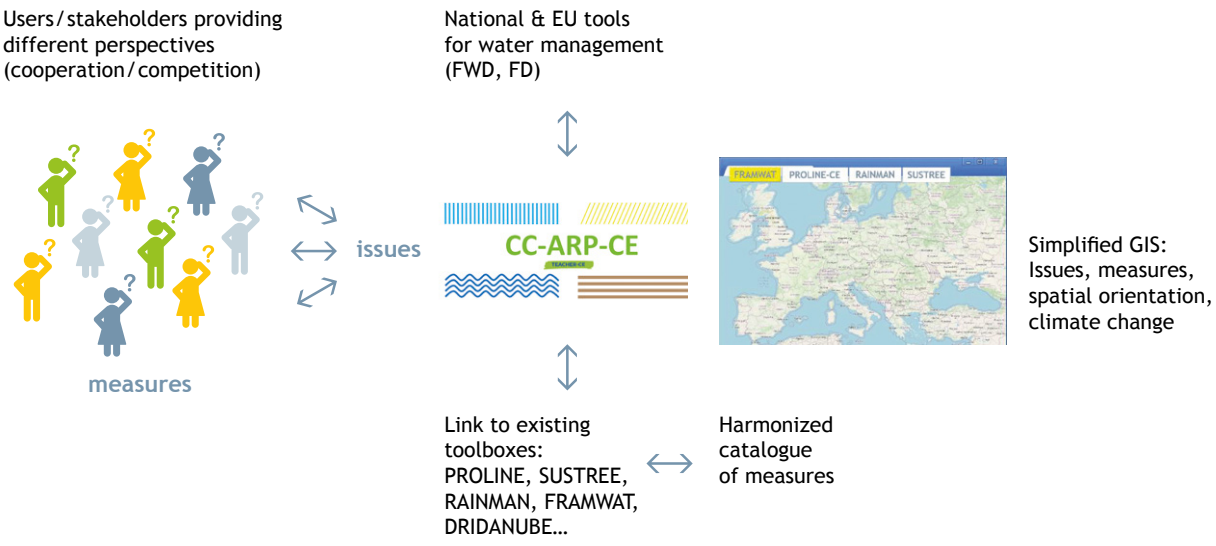


Figure 2: Conceptual scheme of the Toolbox

- promoting policy recommendations to stakeholders not previously addressed;
- linking the CC adaptation and risk prevention toolbox with other tools from the broad fields of action in integrative and participatory water and land use management.

The aim of TEACHER-CE Toolbox is also to have a specific role as a central online platform to support stakeholders with the integrated consideration of different fields of action of the water management sector that are affected by climate change. The potential water related issues are categorized according to the relevant field of action. Due to the broad scope of the term “water management”, which includes many different fields of action at all administrative levels affecting both water quantity and water quality and a variety of management tasks of freshwater and other water bodies (e.g. waste water) in different geographical settings (e.g. rivers, lakes, seas), the scope was narrowed down to the main objectives of the TEACHER-CE Toolbox in order to achieve a targeted input.

Seven fields of action of the water management sector were identified that are relevant for TEACHER-CE:

- 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

The identified issue is shown on the map with the icon of the corresponding Field of action and coloured according to the respective category (forestry, general water management, agriculture, wetland, river training and erosion control structures and urban) as shown in Figure 3.

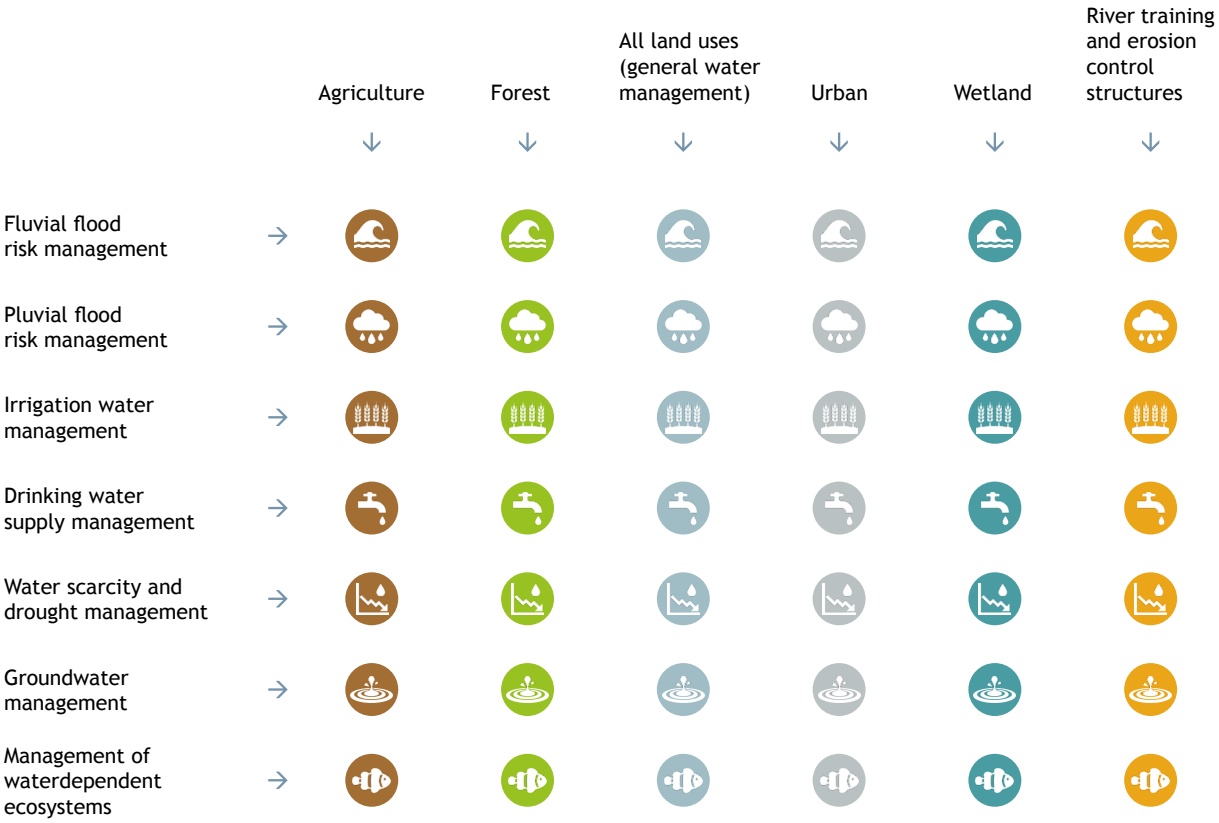


Figure 3: Icons representing identified issues according to the relevant Field of Action and Category

3. CC-ARP-CE TOOLBOX

The Toolbox was developed as an online platform and validated through pilot actions. The aim is to support stakeholders of water management in integrated strategies and actions to adapt to climate change and prevention/reduction of the associated risks. We have identified the need and positioning of the Toolbox in the area where it can help to integrate cross-use strategies for specific catchments (i.e. size of the TEACHER-CE pilot actions) where the interests of different user groups meet and face the challenges related to the climate change adaptation process in the water management sector.

In order to link several sectors involved in the decision-making process at the level of sub-basins and catchments that are close to the municipalities in a longer-term strategic vision (e.g.: potential drinking water source), the idea of capitalising the aforementioned tools is to:

- make the tools "climate proof" and applicable in a climate change perspective and
- integrate the tools into a comprehensive Toolbox to address interacting water-related issues affecting CE (Central Europe).

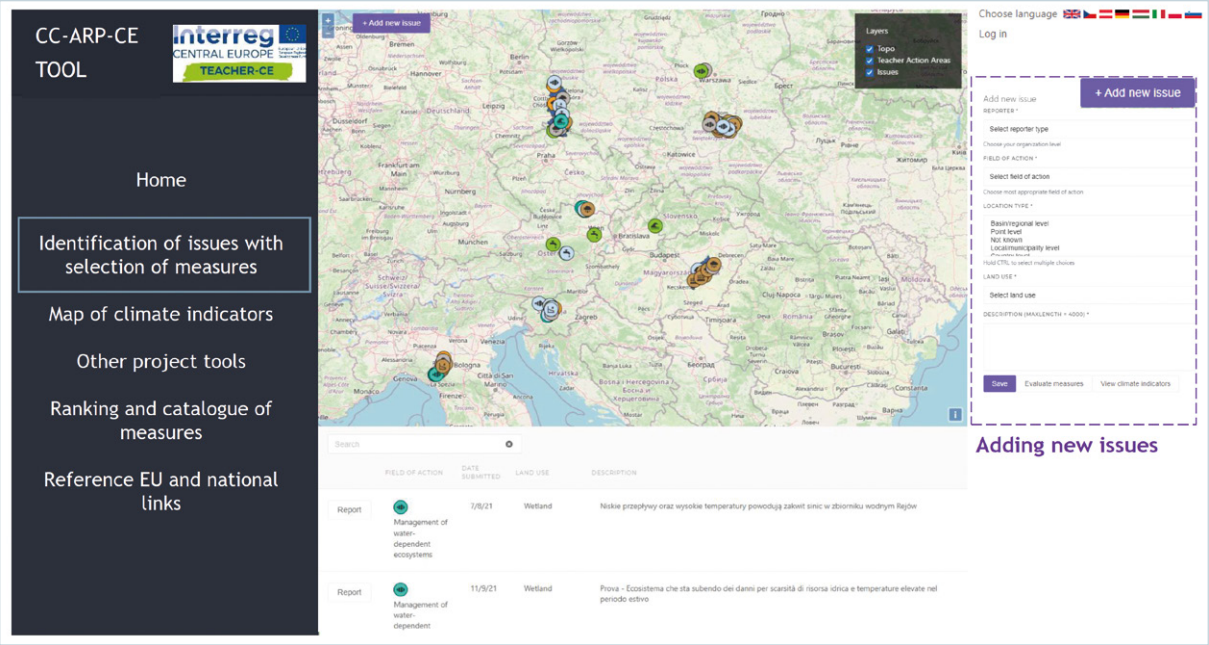
The Toolbox includes a web map service that provides spatial orientation between all identified issues in water management, provides information on climate change scenarios with key indicators, allows navigation through EU and national data portals, provides links to tools developed in past EU projects and provides an integrated comprehensive catalogue of measures. The tool is designed with easy to use options for basic use and a wider audience. However, it also includes advanced features for expert use that increase the complexity of the tool and require background data. All these functions are included in the Toolbox as 5 features:

1. Identification of Issues with selection of measures
2. Map of Climate Indicators
3. Other Project Tools
4. Ranking and Catalogue of measures
5. Reference EU and National links

3.1 Identification of Issues

The respective feature of the CC-ARP-CE focuses on identifying potential water related issues such as floods, heavy rains and droughts and links them to measures to prevent flood and drought risks, adapt to climate change and protect water resources through sustainable land-use management. It aims to identify potential climate impacts on water availability and quality that could affect surface and groundwater. Users can insert identified issues (related to climate change impacts) in the water management sector into the CC-ARP-CE Toolbox. Issues are documented in the Toolbox using the GIS function and locating the issues at a specific point on the map. For each issue it is also possible to connect them to the relevant field of action, land use and administrative level. Based on this information, the Toolbox proposes a set of measures applicable to this specific issue – the user has the possibility to make an individual selection from of this set of measures.

The tool helps the user define the issue, allows comparison with similar issues in other countries, checks the proposed measures, and provides expected variations in different climate indicators, proxies for water-related issues, under two-time horizons and concentration scenarios for a selected area. The proposed measures help to improve the capacity of local and regional stakeholders to adapt to various impacts, with a focus on climate-proof water management.



The issues are displayed on the map and are listed in a table below the map. The issue is presented with the icon relevant to the Field of action and the colour represents the category indicated in the legend (forestry, general water management, and more).

The user can also comment an issue suggested by other users, by selecting an issue and clicking: comment an issue (button below the issue description). This comment will be displayed in the report for that specific issue.

3.2 Map of Climate Indicators

The Toolbox CC-ARP-CE provides information on expected variations in climate indicators potentially due to climate change. Climate indicators are used as proxies for impacts that could affect water management in Central Europe. Fifty-three indicators were selected taking into account the requirements of the project partners and stakeholders, which were collected via a web survey or during the stakeholder workshops in autumn 2020.

The indicators are computed exploiting 19 climate simulation chains included in the EURO-CORDEX multi-model ensemble, in which dynamic downscaling is performed using Regional Climate Models (RCM) with a horizontal resolution of about 12 km (0.11°).

For each climate indicator, two Representative Concentration Pathway RCPs (the midway RCP4.5 and the more extreme RCP8.5) and a time horizon (2021–2050 versus 1971–2000 or 2071–2100 versus 1971–2000) are provided. Values can be visualized as median value of the anomalies aggregated at the NUTS level (level 3 for all the countries except Germany for which level 2 is used). The map shows the climate indicators at the NUTS level, but for advanced users, downloading the EUROCORDEX grid point level of indicators will be optional upon request to the administrator.

The climate indicators refer to measures through Fields of actions.

3.3 Other Project Tools

The Toolbox focuses on the integration of the results and tools developed in the selected Interreg Central Europe (CE) projects and other EU projects. The selected results of the individual projects that have been integrated into the TEACHER-CE Toolbox are briefly presented on the Other project tools page.

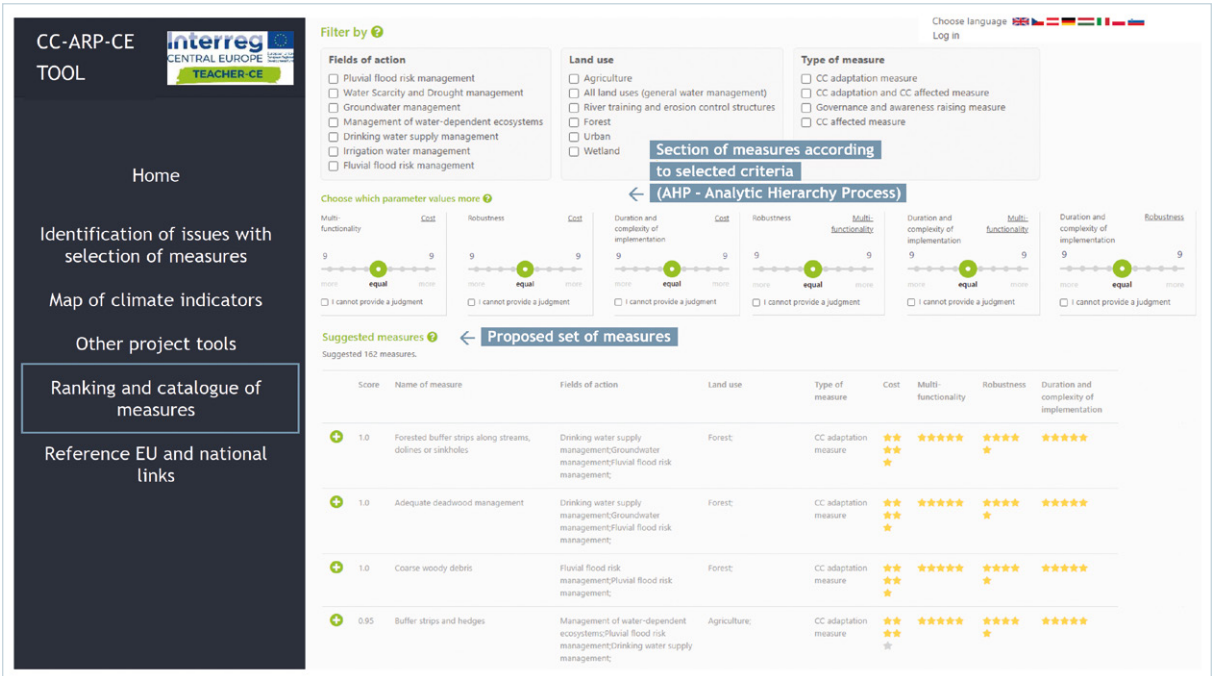
The core of the catalogue of measures is formed by the specific outcomes of four projects (FRAMWAT, PROLINE-CE, RAINMAN and SUSTREE) whose results are directly exploited. In addition, the Toolbox CC-ARP-CE and its catalogue of measures integrate the catalogues of measures and the tools from other EU projects, some of which are also described on this page. The presentation of the four main projects includes a link to the tool, a link to the website of the main project and a short description of the tool.

3.4 Ranking and catalogue of measures

The core of the TEACHER-CE Toolbox CC-ARP-CE is an integrated comprehensive catalogue of measures, gathered from all directly exploited projects and some other linked EU projects.

The results of selected projects have been reviewed and harmonised by our expert group in order to create synergies and include measures that meet the objectives of TEACHER-CE. The result of this approach is the harmonised catalogue of measures, which has been evaluated according to the ranking of selected criteria. The measures can be filtered by category (fields of action, land use, type of measures) and assessed with the Analytical Hierarchical Process (AHP) to select measures according to criteria with pairwise comparison. The selected criteria are listed below:

- cost – defined in terms of the relevance of economic constraints to the selection of measures. All aspects "from cradle to grave" should be considered. Rating: the cheaper the BMP (Best Management Practice), the higher the associated rate.
- multi-functionality – meaning the ability to provide other functions for which the BMP is not specifically designed. Rating: the larger/higher the suite of services provided, the higher the associated rate.
- robustness – refers to the ability of BMPs to cope with external constraints that were not planned for or were subject to uncertainty during the design phase (e.g., climate change or land use change in surrounding areas). Rating: the more robust the BMPs, the higher the associated rate
- duration & complexity of implementation – can be seen as a barrier to realisation. Duration is the time it takes to implement BMPs and until a measure is effective and should include all aspects of the first implementation. Rating: The shorter and simpler the implementation process, the higher the rate.



An additional filtering category was added according to CC adaptation measure, CC affected measure, CC adaptation and CC affected measure, Governance and awareness raising measure:

- CC adaptation measures are measures to prepare and adapt to both the current impacts of climate change and the projected impacts in the future.
- CC affected measures are measures whose effectiveness could be limited by the climate change.
- Governance and awareness raising measures are general measures important to the water management sector connected to governance and for raising awareness.

3.5 Reference EU and National links

Navigating the universe of pre-existing tools in the field of water management is challenging. Therefore, we have collected the existing national links to different tools (data portals and GIS tools) that are closely related to the implementation of EU legislation:

- Water Framework Directive (WFD),
- Floods Directive (FD),
- Urban Waste-water Treatment Directive (UWWTD),
- Nitrate Directive (ND),
- Drinking Water Directive (DWD),
- Bathing Water Directive (BWT),
- Industrial Emissions Directive (IED, ex. IPPC),
- Priority Substances Directive (PSD).

The Water navigation node provides a transparent overview of existing national and EU tools accessible through the Toolbox CC-ARP-CE. The links are categorized according to their content and structured into Fields of actions.

The CC-ARP-CE Toolbox can be found at: http://teacher.apps.vokas.si

4. TESTING OF THE TOOLBOX AND IMPLEMENTATION

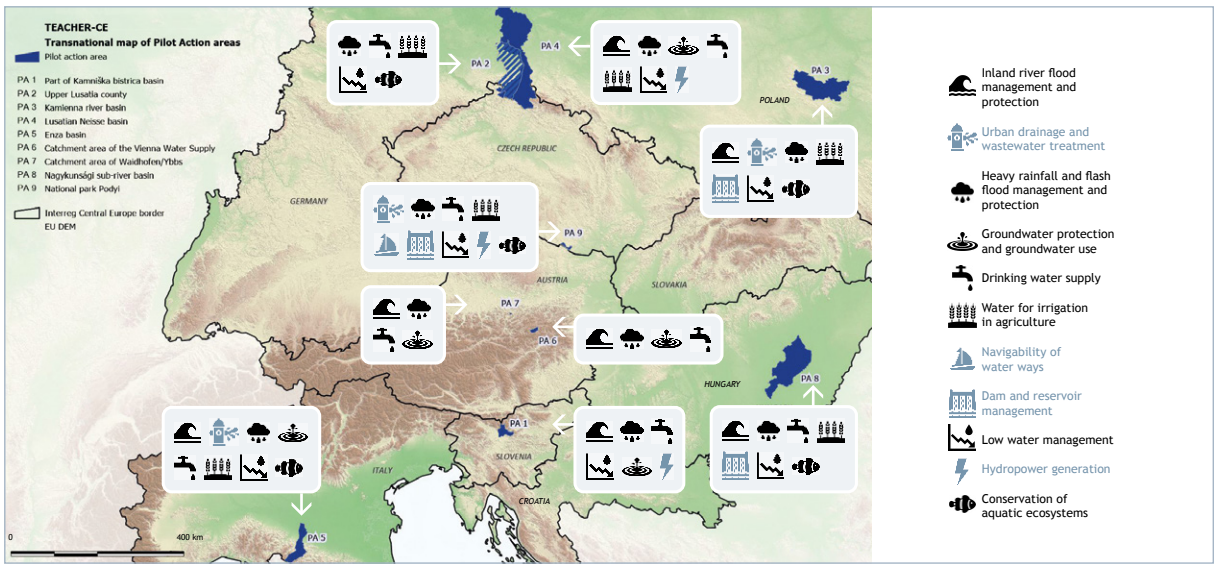
What is a Pilot Action?

The Pilot Action (PA) is a method we use to test and improve our CC-ARP-CE Toolbox. This means that after the first development phase of the Toolbox its functionality and usability was tested for issues in specific regions, called Pilot Action Areas. We have nine pilot actions in eight countries that have different starting points, problems, and stakeholders with different needs and concerns.

These pilot actions were set up in previously funded projects. This means, that project partners (PPs) responsible for each PA were already familiar with the key issues in the area and know what specific topics can be focused on when testing the Toolbox. These topics included flood prevention, drought mitigation, drinking water protection, and adaption to climate change. Project partners focused on the topics relevant for their PAs, but extended their efforts to combine measures to address additional challenges, which had not been addressed in previous projects.

How was the Toolbox tested in the Pilot Actions?

In a first phase the beta-version of the Toolbox was tested by the project partners. In each PA the responsible partners, together with the Associated Partners (ASPs) and Focus Groups of key stakeholders, tested the Toolbox. These groups entered their issues from the pilot action area into the Toolbox and evaluated the results based on their expert knowledge and familiarity with implementation options of the suggested measures. The focus lay on their specific issues related to the TEACHER-CE Fields of Action: Fluvial Flood Risk (Management), Pluvial Flood Risk (Management), Ground Water Management, Drinking Water Supply (Management), Irrigation Water (Management), Water Scarcity & Drought (Management), and Management of Water-Dependent Ecosystems.Input from this testing was used to improve the Toolbox, which was then presented to the stakeholders in each Pilot Action at a training workshop. This step was important to see how well CC-ARP-CE Toolbox is fitted to the real-life needs of users, such as municipalities, water-providers or urban planners, and to improve it even further.



Fields of Action per Pilot Action

PA1: floods in Kamnik, Slovenia; Photo: Kamnik info

PA2: Flooded street, Germany; Photo: Mana2014/pixabay

PA3: Kamienna river, Poland; Photo: SGGW-WULS

PA4: Aerial photo of the Lusatian Neisse, Poland; Photo: IMGW-PIB

Where was the Toolbox tested?

PA1: Kamniška Bistrica river basin, Slovenia

The Kamniška Bistrica River is the largest Slovenian torrential river, which originates in the mountainous region of the Kamnik Alps with peaks over 2,000 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. The main problems are related to pluvial and fluvial flood risk, and concerns about the drinking water supply.

PA2: County of Görlitz and the City of Zittau, Germany

The county of Görlitz is located in the very eastern part of Germany, belongs to the German federal state of Saxony and is part of the three-country triangle Germany-Poland-Czech Republic. The county is characterized by agricultural land use and has an area of 2,111 km² with about 250,000 inhabitants. The largest cities are Görlitz with 56,000 inhabitants and Zittau with 26,000 inhabitants. The thematic focus in the pilot area lies especially on the effects of rising temperatures and droughts as well as on heavy rain. The increasing weather extremes affect water balance and water quality.

PA3: Kamienna river basin, Poland

The Kamienna river is a left tributary of the Vistula River (the biggest river in Poland) located in south-central Poland. The basin covers an area of 2,020 km². It consists of highland part in the west and south-west and a lowland part in the east. The dominant land use is agricultural which covers more than half of the catchment area; about 30% of the area is covered by forest. The activities in the catchment area focus mainly on mitigation of pluvial and fluvial floods, drought and water quality.

PA4: Lusatian Neisse river basin, Poland

The Lusatian Neisse river basin with an area of 4,400 km² is located on the border of three countries, namely Poland, Germany and Czech Republic. The total length of the river Lusatian Neisse is 248 km. Most of the length of the river is the state border between Poland and Germany. The region Lusatian Neisse river basin is characterized by significant variability in terms of altitude, relief and land use. The southern part of the basin is located in a mountainous area (Western Sudetes and their foreland), while the lowlands form the northern part. Activities focus mainly on risk reduction measures concerning low and high-water conditions – pluvial and fluvial flood risk and water scarcity and drought.

PA5: Enza river catchment, Italy; Photo: Beatrice Bertolo

PA6: Mount Schneealpe, Water protection zone of Vienna, Austria; Photo: H. Siegel

PA7: Schnabelberg at Waidhofen/Ybbs; Photo: Roland Köck

PA8: Drone photo of the Nagykunsági Irrigation Canal, Hungary; Photo: Middle Tisza District Water Directorate

PA5: Enza River basin, Italy

The Enza River is situated in the Po hydrographic basin in northern Italy. The basin is closed by the Apennine Range to the south, with peaks higher than or close to 2000 m asl, while the average altitude at its confluence with the Po river is 20 m asl. The Enza river is about 112 km long and the total area of the basin is 890 km^2. Rural areas in the plain part of the basin are mainly occupied by permanent pastures and horticultural crops, and industrial production in the agrifood sector is pretty important, since the Enza basin belongs to the Parmigiano Reggiano production area. Activities focus on fluvial flood risk reduction, water scarcity and drought and irrigation water management.

PA6: Vienna Water drinking water sources, Austria

The catchment area for the water supply of the City of Vienna spreads over 1,000 km^2. A small part of it, Zeller Staritzen, was selected as pilot action. Various springs and groundwater resources are situated in the Northeastern Limestone Alps of Austria. The raw water is transported via two spring water mains to the City of Vienna. The main issues in the Water Protection Zone of the City of Vienna are alpine pastures and water protection forest ecosystems. Activities are all dedicated to the protection of the water resources for drinking water supply and groundwater management.

PA7: Waidhofen/Ybbs drinking water sources, Austria

The catchment area of the Waidhofen/Ybbs Water Supply is characterized by steep karstic mountain ranges with forest ecosystems, grasslands, Dolomite stone quarries and urban areas. It 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. As in the other Austrian pilot action, activities are all dedicated to the protection of the water resources for drinking water supply and groundwater management.

PA8: Nagykunsági sub-river basin, Hungary

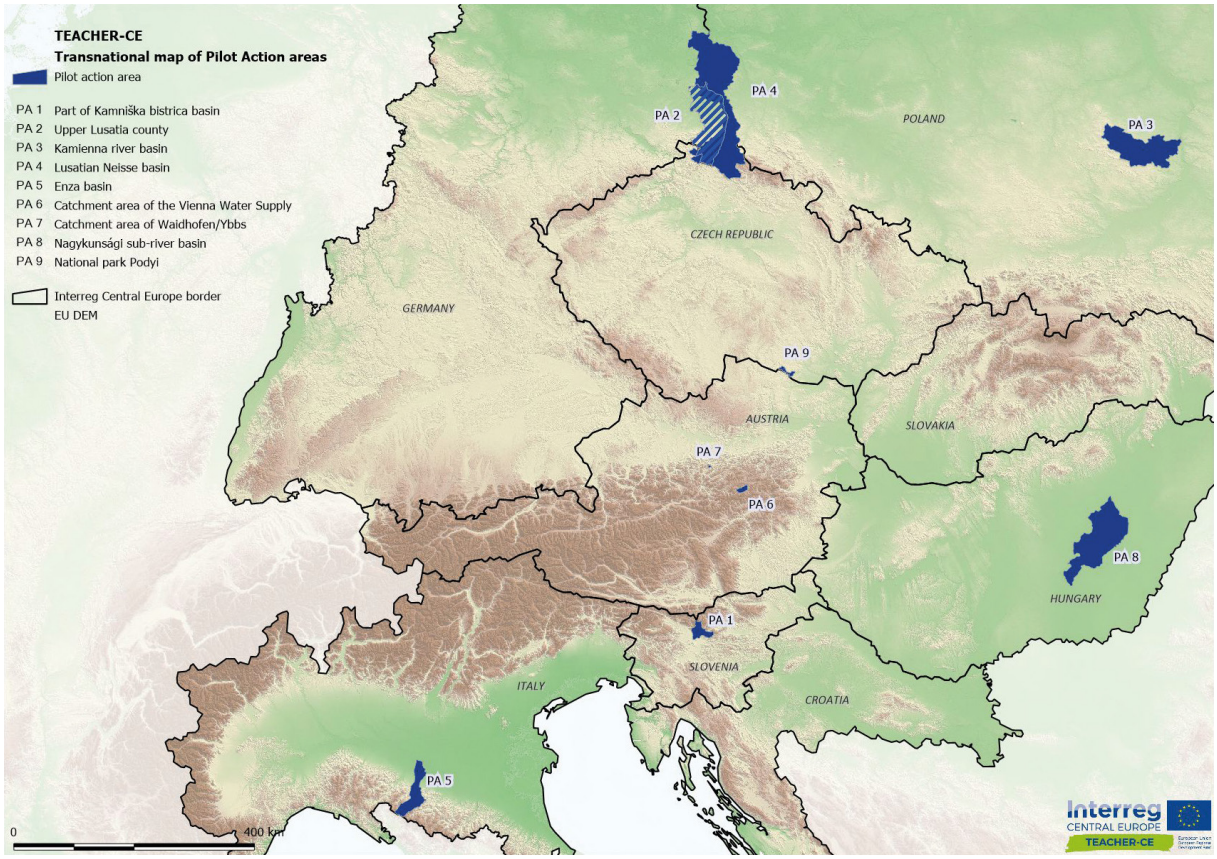
The pilot area is located in the heart of the Hungarian Great Plain. The area is almost plain, the topography was shaped by rivers. The summer heavy rains are becoming more and more frequent, causing floods and serious problems to settlements that do not have sufficient drainage capacities and in the flat-land regions the excess waters cause several problems and damages mainly in the agricultural areas having basin-bottom character of Carpathian basin. On the other hand the Hungarian Great Plain is vastly

PA9: Podyjí National Park, Czech Republic; Photo: vovanovaque.com/czechia/national-park-podyji.html

threatened by droughts, and water scarcity during long lasting dry and hot periods. Therefore, activities mainly focus on pluvial flood risk and irrigation water management.

PA9: Podyjí National Park, Czech Republic

The park is located in the south of the Czech Republic, and is part of the Dyje river basin. In most of its territory, 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 6,276 ha among which 2,822 ha are protected zones. The park is mostly covered by forest; a small part is agriculture area, and fishponds, which are an important feature to alleviate the negative impact of drought events. Regularly, floods damage valuable features of the park such as pond dikes and footbridges. Activities focus on drinking water supply, groundwater management and fluvial flood risk management.



Transnational map of pilot action areas

5. JOINT STRATEGY FOR FUTURE WATER MANAGEMENT

Derived from the previous results of the TEACHER-CE project an integrated and joint strategy for improvement of existing water management practices (implementation of EU water legislation) was developed taking into consideration also the knowledge gained from previous projects. The Strategy will be released for promoting and stimulating adoption of TEACHER-CE Toolbox (CC-ARP-CE) for efficient decision making in water management planning.

In order to achieve this objective, it was necessary to identify the gaps in existing strategies, policy documents and directives implementation at the operational level. For this purpose, a multi-perspective approach was applied, which combines an identification of gaps:

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

Major effort was made for local, regional, river basin and national level analysis of policy documents. A review group formed by representatives of all project partners analysed over 100 policy documents containing strategies related to water management and adaptation to climate change. These documents include: river basin management plans, flood risk management plans, climate, environmental and spatial strategies and plans. The collected knowledge made it possible to recognise the scope of existing strategies and identify gaps in them that reduce their effectiveness in the implementation of climate proof, sustainable water management. Most of the analysed strategies need to be supplemented with the characteristics of predicted climate changes, additional measures and methods of increasing resistance to drought or floods while reducing greenhouse gas emissions.

The TEACHER-CE project responds to the needs of supplementing and improving existing strategies and policy documents by providing a wide range of tools – from describing climate change, through diagnosing current and future problems, to delivering carefully selected adaptation measures included in the catalogue and capitalized projects. Proposed vision of strategies improvement consists of 4 general recommendations:

1) Integrate assumptions of national/regional documents into the planning process

Addressing problems at a coarse national/sub-continental scale may be not the appropriate scale to respond and manage risks locally. Nevertheless, local policy documents should consider the objectives of the national/regional ones to achieve synergy with them and, in case of RBMP and FRMP, be consistent at the watershed level.

2) Integrate the climate change effects into the planning process

Climate change effects should be considered when setting objectives of the policy document. 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 also recommended to take into account IPCC scenarios as a reference data.

3) Maximize cross-sectoral benefits

To achieve these objectives, local planning actors should apply integrated, multi-criteria and strategic solutions. Thus, an interdisciplinary approach should be favoured. Maximizing cross-sectoral benefits will de facto promote green infrastructure and nature-based solutions.

4) Privilege the implementation of nature-based solutions, implementing sustainable land use

Local planning actors consider and promote the potential of solutions based on ecosystem services for the protection of water source (quantitatively and qualitatively) or the adaptation to climate change.

5) Involve stakeholders

The involvement of stakeholders in the planning process ensures a better acceptability of the adaptation measures, and so a better implementation of the policy documents. Their involvement is over all needed at the step of assessing and approving adaptation options.

More detailed recommendations, in the form of a step-by-step guideline, were prepared for operational level of water management planning:

Step #0 – Preparation – engaging stakeholders and other audiences

- Obtaining political support for adaptation
- Setting up consultative and participatory mechanisms to enable:
  - the multi-stakeholder engagement in the adaptation process,
  - a continuous communication process for the engagement of the different target audiences,
- Assigning roles and responsibilities of the "core adaptation team" responsible of the review of the strategy wit**hin** the administration, setting up institutional cooperation,
- Identifying and securing human, technical and financial resources

Step #1 – Identification and prioritisation of relevant fields of action in the local context

- Identifying which fields of action are considered as a relevant local issue
- Prioritising identified fields of action

Step #2- Climate change description: state of play and projections

- Recognizing past and present climate impacts (overview of past climate and extreme weather events, their consequences and existing response actions is in place)
- Describing the climate changes projection at the local scale:
  - in the atmospheric medium;
  - in the hydrological medium;
  - in the hydrogeological medium;
  - in the frequency of extreme meteorological events.

Step #3 – State of play of the different fields of actions and objectives

- Describing the state of play of the different fields of actions
- Describing the objectives of the different fields of actions
- Setting up a schedule to reach the objectives (the time perspective of the reviewed document).
- Using GIS methodologies/tools indicating potential needs (vulnerabilities) and possibilities (capacities) of NSWRM (Natural Small Water Retention Measures) development based on multi-criteria analysis taking into account environmental conditions

Step #4 – Assessing the Climate Change risks associated with objectives – Integration of the Step #2 with the Step #3

- Preparing the assessment by determining the impact of the climate changes on the fields of action objectives defined in the reviewed document, by:
  - identifying connections between fields of action to understand the interdependencies and maximize the cross-sectoral benefits at the step #5
  - identifying the impacts of climate change on the water use, considering the interactions between fields of actions
  - checking the robustness of the measures planned in the reviewed documents or its assumptions (climate change resilience test)
- Assessing the climate change risk by developing an impact chain by identifying and organizing its 3 components:
  - the hazards (e.g.: too high temperatures) on the basis #2
  - the vulnerabilities (e.g.: unfavourable soil conditions) – on the basis of the step #3
  - the exposures (e.g.: high proportion of agriculture in the local economy) on the basis #3

Step #5 – Identification and selection of adaptation measures

- Defining the operational priorities, e.g.: how much your objectives are time bounded? What is the affordability of the actors? E.g.: the ranking and catalogue of measures of the CC-ARP-CE Tool provides a prioritisation system with 4 criteria:
  - cost;
  - duration and complexity of implementation;
  - robustness;
  - multi-functionality
- Involving stakeholders in the development of the prioritization/selection system for adaptation measures or in the process of weighting criteria
- Using decision Support Tool (DST) developed for supporting the implementation of innovative Best Management Practices (BMPs)
- Completing the analysis by discussing with stakeholders about the best way to address vulnerabilities.

Step #6 – preparation of the implementation of the reviewed document and the monitoring of its objectives, assessment of impact

- Consulting stakeholders and ensuring their approval and support for the chosen set of measures
- Consulting with neighbouring countries in the field of adaption measures (if applicable)
- Identifying indicators to evaluate the achievement of the objectives
- Assessing the document on emission of greenhouse gases or adaptation to the climate change at the step of impact assessment, supporting expert judgment with data

Operational recommendations aim to integrate the dynamics of the effects of climate change in the planning process of policy documents associated – directly or indirectly – with water management. In other words, they try to ensure that the document's objectives are met despite the climate risk. The guideline mainly refers to the CC-ARP-CE Toolbox and the cross-fertilized projects and takes into account the assumptions of the European Climate Adaptation Platform “Climate-ADAPT”.

6. PARTNERSHIP

6.1 Project partners

Slovenia
- University of Ljubljana – Lead Partner

Austria
- University of Natural Resources and Life Sciences, Vienna
- Federal Research and Training Centre for Forests, Natural Hazards and Landscape

Czech Republic
- Czech University of Life Sciences, Prague

Germany
- Saxon State Office for Environment, Agriculture and Geology (since 01.01.2021 Associated Partner)
- Infrastruktur & Umwelt Professor Böhm und Partner

Hungary
- Middle Tisza District Water Directorate

Italy
- Euro-Mediterranean Center on Climate Change Foundation
- Po river district Authority

Poland
- Warsaw University of Life Sciences
- Institute of Meteorology and Water Management – National Research Institute

Slovakia
- Global Water Partnership Central and Eastern Europe

6.2 Associated Partners

Slovenia
- The Municipality of Kamnik
- Association of Municipalities and Towns of Slovenia
- Public Utility, JP VOKA SNAGA

Austria
- Municipality of the City of Vienna, MA31 – Vienna Water
- Municipality of Waidhofen/Ybbs
- Federal Ministry of Sustainability and Tourism, Forest Department

Czech Republic
- The Forests of the Czech Republic, State Enterprise
- The Forest Management Institute

Germany
- City of Görlitz
- City of Zittau
- County Görlitz

Hungary
- General Directorate of Water Management
- Blue Planet Foundation

Italy
- Programme for the Endorsement of Forest Certification schemes Italia (PEFC ITALIA)

Poland
- Institute of Territorial Development
- State Water Holding Polish Waters, Regional Water Management Board in Warsaw
- Kampinos National Park

Slovakia
- Slovak Environment Agency

TEACHER-CE & THE CENTRAL EUROPE PROGRAMME

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Priority 3.1 To improve integrated environmental management capacities for the protection and sustainable use of natural heritage and resources.

The CENTRAL EUROPE Programme is a European Union funding programme that encourages cooperation in Central Europe. With 246 million Euro co-financing it supports institutions to work together beyond borders to improve cities and regions in Austria, Croatia, Czech Republic, Germany, Hungary, Italy, Poland, Slovakia and Slovenia.

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