PROLINE-CE

WORKPACKAGE T2, ACTIVITY T2.3

OUTLINING OF LESSONS LEARNT AND RESULTING RECOMMENDATIONS

D.T2.3.4 STRATEGIC IDENTIFICATION OF NEEDS FOR ACTION FOR CLUSTERS

PILOT ACTION CLUSTER 3

SPECIAL SITES (RIPARIAN STRIPS)

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1. Introduction

Review of main land use conflicts and Best Management Practices (BMPs) for drinking water protection and protection against floods on Pilot Action level has already been done in Pilot Action BMPs reports, which were a basis for *D.T2.1.2 Transnational case review of best management practices in pilot actions*. Implementation and testing of BMPs in Pilot Action are described in *D.T2.2.2 Partner-specific Pilot Action documentation report*. Evaluation of actual implementation and thematic interpretation of tested management practices as well as their acceptance among stakeholders and experts is described in *D.T2.3.1 Evaluation reports for each pilot action*.

Pilot actions and pilot sites respectively were classified into three clusters (Table 1) concerning the geographic specification and natural site characteristics (aquifer type) and main land use:

Pilot Action Cluster 1: Mountain forest and grassland sites,

Pilot Action Cluster 2: Plain agriculture/ grassland/ wetland sites and

Pilot Action Cluster 3: Special sites (riparian strips).

Table 1: Pilot Actions and Pilot Sites respectively, classified into three clusters according to land uses and geographic scope.

PILOT ACTION CLUSTER 1 (PAC1) Mountain forest and grassland sites	PILOT ACTION CLUSTER 2 (PAC2) Plain agriculture/ grassland/ wetland sites	PILOT ACTION CLUSTER 3 (PAC3) Special sites (riparian strips)
PA1.1 Catchment area of the Vienna Water Supply, AT1 Drinking water source: Karst aquifer	PA2.1 Well field Dravlje valley in Ljubljana, SI Drinking water source: Porous aquifer	PA3.1 Po river basin, IT Drinking water source: Bank filtration
PA1.2 Catchment area of Waidhofen/Ybbs, AT2 Drinking water source: Fractured aquifer	PA2.2 Water reservoir Kozłowa Góra, PL Drinking water source: Surface water	PA3.2 Along Danube Bend, HU2 Drinking water source: Bank filtration
	PA2.3 Tisza catchment area, HU1 Drinking water source: Surface water	
	P2.4 Groundwater protection in karst area, HR 2.4.1 - South Dalmatia: Prud, Klokun and Mandina spring 2.4.2- Imotsko polje springs) Drinking water source: Karst aquifer	
	PA2.5 Neufahrn bei Freising, DE Drinking water source: Porous aquifer	

1.1. Pilot Action Cluster 3: Special sites (riparian strips)

Into the Pilot Action Cluster 3 (PAC3) two Pilot Actions were assigned:

- PA3.1: Po river basin and
- PA3.2: Along Danube Bend.

Both Pilot Actions are riparian sites (Table 1). The Po river basin District is Italy's largest plan and the economically most developed part of the country. It plays a critical role for Italian agriculture, industry, and energy production. The main objective in PA3.1 is to improve protection of drinking water resources in terms of quality, quantity and flooding process, even considering climate change impacts and land uses changes. The pilot area 3.2 is located in the northern part of Central Hungary. It includes the municipality Budapest, the Szentendre Island, in north of it, and the Csepel Island, in south of the capital. On these islands are located the two most important bank-filtered drinking water resources of Hungary. The main objective in PA3.2 is therefore principally the protection of the bank-filtered drinking water resources, especially in terms of water quality.

The main land use conflicts for both PAs stem from agriculture and settlements, in PA3.1 also from traffic infrastructure. Both PAs face drought problems. In the Po delta area in PA3.1 water quality issues are present due to salt water intrusion. Furthermore, in PA3.1 drier and more humid areas will be defined. Drinking water source in PA3.2 is bank filtration. In details, in PA3.1, pressures on water resources in terms of water demand, mainly generated from the heavy exploitation of the water system, represent the main issue related to the water availability. Furthermore, direct and indirect impacts of floods on drinking water resources and on water distribution plans and the assessment of the potential impacts of climate change on water demand are also identified as pilot action's gaps.

In PA3.2, water quality damage due to chemical contamination is the most relevant issue because the bank-filtered water and the extraction wells are mostly situated near to agricultural and urban areas. In this case, agricultural pollution, lack of sanitary coverage in urban areas and indirect impacts of floods on bank-filtered wells are identified as principal pilot action's gaps.

The comparison of the gaps and related BMPs in PA3.1 and PA3.2 allows stating that regarding the Italian case study (PA3.1), more attention is required for the management of the **drinking water supply,** even considering the **climate change** effects on water resources, whilst the **drinking water quality** protection is the major challenger in the Hungarian case study (PA3.2). Furthermore, **direct and indirect impacts of floods** need to be better investigated in both pilot actions, in order to improve the management and to enhance the protection of the water resource in terms of both quality and quantity.

In this report strategic identification of needs for action for implementation of best management practices for drinking water protection are presented for Pilot Action Cluster 3.

2. Solutions for case specific adaptation of best management practices

Within the PROLINE-CE Project, the whole water governance process has been investigated for each PA. Taking into account the specific and local characteristics of the PAs, relevant gaps have been identified and BMPs have been selected among all the practices reviewed for each PA.

There are many best management practices for drinking water protection and flood protection, which already exists but often there are problems with actual implementation of these BMPs.

On the Pilot Action level, some BMPs were already implemented in the frame of T2 activities. On the other hand, some BMPs are very complex and require system change or even policy change, which are long lasting procedures. For such BMPs possibilities of implementation have to be assessed and implementation strategies have to be determined. Implementation of BMPs may require:

- adaptation of existing land use management practices with the purpose of drinking water protection,
- adaptation of existing flood/drought management practices with relation to drinking water protection,
- adaptation of policy guidelines.

Specifically, in **PA3.1** the following gaps have been identified: i) **Pressures on water resources management; ii) Flood impact not fully implemented and considered; iii) Climate change impacts on drinking water resources.** In order to cope with these gaps, the following BMPs have been selected:

- The Drought Steering Committee and the Drought Early Warning System (DEWS)
- The Flood Forecast Centre and the Flood Early Warning System (FEWS)
- Analysis of the impacts of climate changes on drinking water resources.

In the Pilot Action 3.1, selected BMPs mainly concerned the following topics:

- water resources modelling systems and operational tools;
- water and land management participation instrument, also at operational level;
- tools and issues concerning impact assessment of projected climate change on good water availability, droughts and floods.

These BMPs are already implemented even if some further improvements are still needed in order to:

- empower, maintain and integrate modelling system;
- increase accessibility and availability of information;

- further develop stakeholders and experts engagement and involvement;
- improve the understanding of the impacts of climate change and land uses changes on ecosystem services provision.

In details, concerning the first BMP (the Drought Steering Committee and DEWS), actions not yet implemented are related to the following issues:

- give more decisional power to the Permanent Observatory on Water Uses;
- increase weather, ice/snow cover, ground water and water allocation demand information;
- fix water scarcity thresholds;
- increase water resources awareness.

Concerning the second BMP (the Flood Forecast Centre and FEWS), actions not yet implemented are related to the following issues:

- promote synergic approaches between Disaster Risk Reduction and Climate Change Adaptation;
- add other weather, ice/snow cover, ground water information;
- support vulnerability and exposure evaluation;
- increase flood awareness.

Concerning the analysis of the third BMP, related to the assess of the climate change impacts of on drinking water, the procedure proposed for completing the not implemented actions includes:

- the development of some scenarios corresponding to the management options such as the change in land use, crop types, water consumption for irrigation and urban;
- the implementation of these scenarios in the InVEST model;
- the evaluation the effectiveness of these scenarios to propose the best options and management actions.

In the case of **PA3.2**, the following gaps have been identified: **i) Agricultural groundwater pollution; ii) Lack of sanitary coverage; iii) Flood protection protocol on bank-filtered wells operations during high water and flood events.** In order to cope with these gaps, the following BMPs have been selected:

- Participation in Agro Environment Program;
- Municipal sewage disinfection;
- Ensure the drinking water supply during high water or flood.

In the Pilot Action 3.2, selected BMPs mainly concerned the following topics:

- the application of proper agricultural practices;
- improvement of sewage systems;
- management of the high-water levels and floods

In this case, both BMPs have been considered specifically for protecting and reducing the contamination of drinking water resources in the area. The implementation of the proposed BMPs is partially underway. Since a significant proportion of the pilot area is under agricultural management, proper practices are essential in ensuring the safety of underlying and downstream water resources. Many of these practices have already been implemented and better management practices are being used by farmers, particularly in highly sensitive areas. However, the high investment cost of farming equipment – especially considering precision agriculture – often proves to be a limiting factor in the application of the best available methods. Besides agriculture, the most typical polluting source in the area is municipal wastewater and, for this reason, improvement of sewage systems is continuously ongoing in the region depending on available funding. Last, high water levels and floods can cause problems at certain wells by either flooding the well or polluting its source water.

In Table 2 solutions for case specific adaptation of best management practices in pilot actions are presented. Gaps and BMPs are ordered following the classification suggested in the report D.T2.2.3, in which BMPs are classified according their influence and relevance on drinking water on their relevance on the drinking water damage mitigation (in terms of quality, quantity and flood impacts). Specifically, the following three groups are proposed:

Group 1 - Water Quality, which includes the following GAPs identified in PA3.2: “Agricultural groundwater pollution” and “Lack of sanitary coverage”;

Group 2 - Water Quantity, which includes the following GAPs identified in PA3.1: “Pressures on water resources management”; “Climate change impacts on drinking water resources”;

Group 3 - Flood protection, which includes the following GAPs identified in PA3.1 and PA3.2: “Flood impact not fully implemented and considered” (PA3.1); “Flood protection protocol on bank-filtered wells operations during high water and flood events” (PA3.2).

Climate change can affect both the quality and the quantity of the drinking water resources and it can also influence the flood events, in terms of frequency and intensity. Nevertheless, this gap (and the related BMP) has been included in the Group 2 (water quantity) because of the relevant impacts it can have on drought events. Climate change has been selected as gap only in the case of PA3.1, being this area particularly sensitive to the expected climate variations.

Table 2: Solutions for case specific adaptation of best management practices.

GROUP 1 Actual management practice (GAP)	Proposed BMP	Proposed solutions and recommendations			Remaining issues to be solved
		Adaptation of existing land use management practices	Adaptation of existing flood/drought management practices	Adaptation of policy guidelines	
Agricultural groundwater pollution	Participation in Agro Environment Program	Existing practices can generally be adapted to employ better methods.	There were no clear recommendations.	The availability of subsidies act as a main driver for the implementation of such practices. Guidelines can be adapted to not only prohibit certain practices in sensitive areas but also to better encourage sound practices beyond the required minimum.	-
Lack of sanitary coverage	Municipal sewage disinfection	Not applicable	Not applicable	There are already relevant existing policy guidelines.	-
GROUP 2 **Actual management practice (GAP)**	**Proposed BMP**	**Proposed solutions and recommendations**			**Remaining issues to be solved**
		Adaptation of existing land use management practices	**Adaptation of existing flood/drought management practices**	**Adaptation of policy guidelines**	
Pressures on water resources management	The Drought Observatory/ Steering	Improvement of knowledge on links between land use and	Increase the use and sharing of drought early warning system among	Improvement of potential synergies among stakeholders on water	- Empower modelling system; - increase accessibility and availability of information;

	Committee and Drought Early Warning System (DEWS)	water resources through: - Periodical updating of the assessment of land use impact on drinking water; - Increase of number, spatial/temporal detail and type of data about land use and environment representation.	stakeholders. Creation within the DEWS system of drought /water scarcity indicators and indices easier to understand for stakeholders. Investment in monitoring, simulation and analysis. Increase weather, ice/snow cover and ground water information. Operational platforms maintenance, education and training. Consider site specific drought impacts on drinking water. Fix water shortage/drought thresholds.	demand and land use. Give more decisional power to the Permanent Observatory on Water Uses.	- further develop stakeholders awareness and engagement; - assuring incentives and investments to prevent, mitigate and better manage water scarcity events; - improve dialogue and communication; - confirm and intensify already started activities and projects; - implement economic and environmental methodologies for water resource; - extend the number of stakeholders and stimulate attention to drinking water.
Climate change impacts on drinking water resources	Analysis of the impacts of climate changes on drinking water	The proposed solution is to carry out detailed studies about the potential impacts of climate changes and partly related land use	Investment in data collection, monitoring, model simulation and analysis, operational platform maintenance education and training.	Test the implementation of proposed solution by relevant stakeholder's communication in the decision-making process. Improving the decision-	- Regional and Urban Adaptation Plans should be performed; moreover, following EU Directive, the updates in Plans should explicitly account for CC issue (f.e. second implementation of

	resources	change. The main goal is to provide probabilistic evaluations of impacts on drinking water resources accounting for multiple constraints. Furthermore, it could increase the awareness of all the stakeholders about the topic.	Promote synergic approaches between Disaster Risk Reduction and Climate Change Adaptation communities by considering the cross-dependence between droughts and floods periods. The assessments could support systemic evaluations about the management of extreme events (flood and droughts) achieving solutions effective also for preserving drinking water resources. Moreover, the approaches are straightly exploitable also for other test cases.	making process increasing the awareness of all the stakeholders about the future challenges for effectively preserving drinking water resources.	actions required by flood Directive). - More quantitative evaluations could permit better driving decisions of Administrators also if carried out only on limited domains.
GROUP 3 **Actual management practice (GAP)**	**Proposed BMP**	**Proposed solutions and recommendations** **Adaptation of existing land use management practices**	**Adaptation of existing flood/drought management practices**	**Adaptation of policy guidelines**	**Remaining issues to be solved**

Flood impact not fully implemented and considered	The Flood Forecast Centre and Flood Early Warning System (FEWS)	Strengthening role and requirements of flood management system in relation to the operational needs in all phases of disaster management (forecast, preparation and response). Increase synergies among land use planning/management and emergency planning/management. Periodical updating of vulnerability and exposure evaluation.	Improvement of the monitoring and modelling system, also considering interactions with exposed elements and operational procedures. Investment in flood analysis, operational platform maintenance, education and training. Consider flood, drought and water management as a unique operational process. Make flood information more understandable to citizens. Consider flood impact on drinking water.	Integration in policy guidelines of the fundamental role of predictability, uncertainty and communication of extreme events in losses of lives and damages linked to heavy rain and floods, including losses in drinking water supply systems.	- Empower modelling system; - improve operational procedures and activities; considering the whole disaster cycle; - further develop citizen information and operation tools for alert dissemination; - assuring incentives and investments to prevent, mitigate and better manage floods; - confirm and intensify already started activities and projects; - implement impact based economic evaluations of flood management; - extend the number of stakeholders and stimulate attention to drinking water supply systems protection in case of floods.
Flood protection protocol on bank-filtered wells operations during high water and flood events	Ensure the drinking water supply during high water or flood	Not applicable	Management practices could be applied for better protection of the wells during floods.	There are no clear recommendations at present.	-

3. Conclusions

In the PROLINE-CE Project it has been possible to get a review of the main problems, pressures and gaps affecting the water resources. Furthermore, measures and practices for drinking water protection and land management have been also identified and tested in the PAs.

BMPs identified for the PAC3 include actions for the protection and management of drinking water resources in terms of quality and quantity accounting for, at the same time, the impacts of flooding events. In both PAs, selected BMPs have been implemented. Nevertheless, during the project progress emerged that operative actions are still needed as consequence of remaining gaps between the actual management practices and the revised BMPs.

Therefore, the aim of this report is to provide in a strategic form an outline of the needs for action in PAC3 (PA3.1 and PA3.2), which will serve as contribution to the Action Plan elaboration.

Considering the PA3.1, the roadmap proposed for completing the actions not yet implemented includes: improvement of operational procedures and activities, further development of citizen information, assurance of incentives and investments to prevent, mitigate and better manage water shortage events, droughts and floods. In details, concerning BMP Drought Steering Committee and DEWS, main activities include: increase in decisional power of the Permanent Observatory, increase in the availability of information on weather, ice/snow cover, ground water, identify and fix thresholds for the water scarcity alert. Concerning BMP related to the impact of flood events (Flood Forecast Centre for the Po River and FEWS), further activities include: the extension of the flood management system to other sectors (CC, drinking water, and sediment cycle), the addition of information about the weather, ice/snow cover, ground water, and the increase in vulnerability and exposure evaluation. In order to perform these activities, it results necessary: i) empowering of the modelling systems; ii) increasing in accessibility and availability of information; iii) further developing citizen information and operation tools for alert dissemination.

Considering the BMP related to the analysis of climate changes impacts on drinking water resources, the main activities are related to: i) the assessment of the expected changes in weather forcing; ii) the evaluation of the variations in LULC through an ensemble approach (taking into account variations in socio-economic, demographic and climate conditions); iii) the projection of climate change and land-use change impacts on drinking water resources. Furthermore, activities related to this BMP include the development of a regional and urban adaptation plan that, following EU Directive, should explicitly account for CC issue.

As emerged during the partner's meeting, stakeholders have a strong interest in the identified BMPs, especially in relation with flood and drought modelling (FEWS and DEWS). They are very interested in the possible application of these systems in the operational daily management, whilst the climate change simulated scenarios could be useful to address water safety plans, strategic planning and investment options on the management of new supply resources.

In the case of PA3.2, the identified BMPs mainly account for the protection of the water quality because of the drinking water extraction wells are mostly situated near to agricultural and urban areas. The implementation of the proposed BMPs is partially underway. Better management practices are being used by farmers, particularly in highly sensitive areas and the availability of subsidies act as a main driver for the implementation of such practices. Wastewater treatment is also being improved in the region. Considering the gap related to the drinking water management and water supply during flood events, the protection of wells during high water or flood events is only a problem in a few specific cases and as such are mostly dealt with on a case-by case basis. Nevertheless, such changes in flood levels might increase the risk of such events and therefore they should not be neglected in the region. The remaining issues for the proposed BMPs account for the increase in education and awareness of farmers about the available agricultural methods.

In conclusion, the testing of the selected BMPs in PAC3 highlights the importance of actions focused on flood prediction, timing uncertainty assessment and early warning systems (observation networks, models operational procedures, hazard, exposure and vulnerability assessment, and communication tools). Furthermore, another relevant point is the need of the increasing in community awareness and preparedness about water resources issue, in order to cope with drought and flood events, which could be also enhanced by climate change. It results also fundamental assuring incentives and investments to prevent, mitigate and better manage drinking water resources. Finally, the activities carried out in PROLINE-CE project highlighted the importance of communication, dissemination and stakeholder involvement in all the operative phases of the management.

4. References

PROLINE-CE WORKPACKAGE T2, ACTIVITY T2.1 REPORTS:

- D.T2.1.2 Best management practices report. PILOT ACTION: PA3.1 Po River Basin
- D.T2.1.2 Best management practices report. PILOT ACTION: PA3.2 Along Danube bend

PROLINE-CE WORKPACKAGE T2, ACTIVITY T2.2 REPORTS:

- D.T2.2.2 Partner-specific pilot action documentations. PILOT ACTION: PA3.1 Po River Basin
- D.T2.2.2 Partner-specific pilot action documentations. PILOT ACTION: PA3.2 Along Danube bend
- D.T2.2.3 Pilot action cluster report: PILOT ACTION CLUSTER 3 SPECIAL SITES (Riparian Strips)

PROLINE-CE WORKPACKAGE T2, ACTIVITY T2.3 REPORTS:

- D.T2.3.1 Evaluation reports for each pilot action. PILOT ACTION: PA3.1 Po River Basin
- D.T2.3.1 Evaluation reports for each pilot action. PILOT ACTION: PA3.2 Along Danube bend