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 1

MOUNTAIN FOREST AND GRASSLAND SITES

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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 1: Mountain forest and grassland sites

In mountain forests and grassland sites best management practices for land use and drinking water management differ from those in plain sites. Therefore, this was selected as separate Pilot Action Cluster. In mountainous areas drinking water sources are mainly originated from groundwater (fractured and karst aquifers).

Within the Pilot Action Cluster 1 (PAC1) two Pilot Actions from Austria were assigned:

- PA1.1: Catchment area of the Vienna Water Supply, and
- PA1.2: Catchment area of Waidhofen/Ybbs.

For selected BMPs in the particular Pilot Actions, implementation possibilities were assessed. 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 1.

2. Solutions for case specific adaptation of best management practices

There are many best management practices for drinking water protection and flood protection, which already exist, 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, persuasive efforts 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.

In PA1.1, catchment area of Vienna Water Supply, the major gaps identified were (A) erosion dynamics (open soils without vegetation cover) around water troughs for cattle, (B) grazing of cattle in or close to dolines and sinkholes and (C) unwanted grazing patterns of cattle. As gap (D) the missing knowledge about spatial and temporal patterns of infiltration and surface flow was identified.

The related BMPs to balance the unwanted situation were defined with (A) Placing of water troughs for cattle more frequently, avoiding concentrations of cattle / Concrete basements for the troughs and their surroundings, (B) Fencing of dolines and sinkholes in order to keep cattle in

distance from those karstic features and (C) Grazing management for cattle on alpine pastures. As BMP (D) hydrological modelling with KAMPUS was carried out in order to gain data about surface flow and infiltration patterns. The implementation of those crucial BMPs is essential and will be tracked through the staff of Vienna Water.

In PA1.2, catchment area of Waidhofen/Ybbs the most important gaps identified are (A) continued application of the clear-cut technique, (B) high ungulate densities which are causing browsing damages, (C) extensive construction of forest roads, (D) conifer plantations on sites where deciduous trees should dominate, (E) cutting of old, huge and stable tree individuals and (F) reduced groundwater recharge due to dolomite quarries.

The selected most important BMPs in PA1.2 are (A) Avoidance of the clear-cut technique, (B) Establishment of Forest Ecologically Sustainable Wild Ungulate Densities, (C) Limitation of forest road constructions, (D) Tree Species Diversity According to the Natural Forest Community and (E) Foster old, huge and vital tree individuals. Within the context of hydrological modelling the need for (F) Continuous monitoring of relevant hydrological data and hydrological modelling was identified.

Detailed solutions for case specific adaptation of best management practices are presented in Table 2., 3., 4.

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

Actual management practice (GAP)	Proposed BMP	Proposed solutions and recommendations			Remaining issues to be solved
		Adaptation of existing land use management practices towards the purpose of drinking water protection	Adaptation of existing flood/drought management practices with regard to drinking water protection	Adaptation of policy guidelines	
Continued application of the clear-cut technique	Avoidance of the clear-cut technique	Application of continuous cover forestry systems and all related BMPs, strategies and measures.	Application of continuous cover forestry systems and all related BMPs, strategies and measures.	Prohibition of clear-cut applications within DWPZ.	The avoidance of the clear-cut technique has to be applied within all DWPZ in Austria, what will be a challenge in many cases.
Unnaturally elevated wild ungulate densities as result of trophy-hunting activities and resulting browsing and bark-stripping damages	Forest Ecologically Sustainable Wild Ungulate Densities	Regulation of the wild ungulate densities to a forest ecologically sustainable level, hence providing vital regeneration dynamics of all tree species.	Regulation of the wild ungulate densities to a forest ecologically sustainable level, hence providing vital regeneration dynamics of all tree species.	Clear compliance to the regional Hunting Acts (provincial legislation) in all Austrian forest areas.	The regional and provincial forest authorities have to be forced to act according to the Provincial Hunting Acts.
Extensive construction of forest roads	Limitation of forest roads	Application of skyline-cranes or other techniques for timber-yield.	Construction of forest roads only exceptionally if necessary for forest stabilisation.	Clear guidelines for forest management within DWPZ.	Limitation of forest road constructions within DWPZ will cause resistance of some forest owners.
Creation of conifer plantations, even within deciduous forest communities	Tree Species Diversity According to the Natural Forest Community	Man-made plantations with non-natural tree species should be transformed gradually to stands dominated by native	Man-made plantations with non-natural tree species should be transformed gradually to stands dominated by	The guidelines for DWPZ should define the creation of natural and stable forest stands with native tree species as necessary management	For DWPZ outside the PROLINE-CE project space it will be a challenge to establish the optimal native tree species set for each forest site.

		species. In Austria the project-DWPZ are represented through the Forest Hydrotope Map, defining the optimal tree species set for each forest site.	native species. In Austria the project-DWPZ are represented through the Forest Hydrotope Map, defining the optimal tree species set for each forest site.	practice.	
Cutting of old, huge and vital tree individuals	Foster old, huge and vital tree individuals	Old, huge and vital trees provide a substantial contribution to forest stand stability. Hence, they have to be selected and protected, so that they can provide their services as long as possible.	Old, huge and vital trees provide a substantial contribution to forest stand stability. Hence, they have to be selected and protected, so that they can provide their services as long as possible.	Forest Policy in Austria should develop more awareness towards the need to protect old growth forests and tree species.	The protection of old growth trees and forests in Austria is in general lacking, it has to be improved.

Table 3: Solutions for case specific adaptation of best management practices, hydrological modelling with regard to forests, dolomite quarries and alpine pastures.

Actual management practice (GAP)	Proposed BMP	Proposed solutions and recommendations			Remaining issues to be solved
		Adaptation of existing land use management practices towards the purpose of drinking water protection	Adaptation of existing flood/drought management practices with regard to drinking water protection	Adaptation of policy guidelines	
Dolomite quarries are causing a decrease in groundwater recharge	Continuous monitoring of relevant hydrological data and hydrological modelling	Using hydrological modelling to continuously evaluate the changes of spring discharge due to extending of quarry areas in the pilot area helps to support future decision-making.	Using hydrological modelling to continuously evaluate the changes of spring discharge due to extending of quarry areas in the pilot area helps to support future decision-making.	No policy guidelines have to be adapted for this BMP.	Monitoring has to be continued over time.
Infiltration and surface flow affecting spring quality are not known	Surface flow – spring dynamic Zeller Staritzen	Through applying a rainfall/run-off model based on observed and defined processes as well as measured and mapped parameters the surface run-off and infiltration will be determined.	Through applying a rainfall/run-off model based on observed and defined processes as well as measured and mapped parameters the surface run-off and infiltration will be determined – relevant also for flood/drought protection.	No policy guidelines have to be adapted for this BMP.	Modelling should be extended to other areas of the karstic DWPZ.

Table 4: Solutions for case specific adaptation of best management practices, Alpine Pastures.

Actual management practice (GAP)	Proposed BMP	Proposed solutions and recommendations			Remaining issues to be solved
		Adaptation of existing land use management practices towards the purpose of drinking water protection	Adaptation of existing flood/drought management practices with regard to drinking water protection	Adaptation of policy guidelines	
Erosion processes around water troughs for cattle due to open soils without vegetation cover, as well as washing out faeces	Placing of water troughs for cattle more frequently, avoiding concentrations of cattle / Concrete basements for the troughs and their surroundings	In order to avoid the creation of erosion dynamics and concentrations of faeces, more troughs should be provided and distributed strategically over the whole alpine pasture. Construction of concrete basements for the troughs as erosion prevention.	In order to avoid the creation of erosion dynamics, more troughs should be provided and distributed strategically over the whole alpine pasture. Construction of concrete basements for the troughs as erosion prevention.	No policy guidelines have to be adapted for this BMP.	Water trough spacing, and construction of concrete basements could be difficult on some alpine pastures.
Grazing of cattle in or close to dolines and sinkholes	Fencing of dolines and sinkholes in order to keep cattle in distance from those karstic features	At active pastures the karstic features dolines and sinkholes have to be fenced out in order to minimize the risk of source water contamination with faeces stemming from cattle or other grazing livestock.	No relevance for flood/drought management.	No policy guidelines have to be adapted for this BMP.	Fences around dolines and sinkholes have to be maintained continuously for providing sustained functionality.
Unwanted grazing patterns of cattle	Grazing management for	Grazing management requires strategic planning,	Grazing management requires strategic	No policy guidelines have to be adapted for this BMP.	The challenge of this BMP is the necessity of a strategic planning

	cattle on alpine pastures	the placing of fences and the punctual change of the grazing cattle from one to the next fenced part of the alpine pasture. It helps to avoid erosion processes.	planning, the placing of fences and the punctual change of the grazing cattle from one to the next fenced part of the alpine pasture. It helps to avoid erosion processes.		process which requires detailed knowledge about the pasture quality on the alpine pasture and the consequent implementation through the strategic placing and spacing of fences. To achieve this, training of the alpine staff and persuasive efforts will be necessary.

3. Conclusions

The strategic implementation of Best Practices (BMPs) within the pilot actions of PAC1 has to be seen very specific for each of them. The strategic identification of needs for action hence was established specifically for each pilot action.

PA1.1 – DWPZ Vienna Water – Zeller Staritzen and Hochschwab

All issues related to alpine pastures are of great importance for the overall drinking water protection policy and actuation within the drinking water protection zone (DWPZ) of Vienna Water. Hence information about basic interdependencies within the context of alpine pastures is relevant for the key stakeholder, the staff of Vienna Water. Only if information of the staff is given on a high level, guidelines for the alpine pastures can be set up and the compliance to them can be claimed.

In the course of stakeholder information days both staff from Vienna Water and from the alpine pasture farmers were informed about essential dynamics and interdependencies of alpine pastures. The presentation was given through scientific experts.

The major Best Practices for alpine pastures were presented. Those cover the application of management practices to avoid (A) erosion dynamics (open soils without vegetation cover) around water troughs for cattle, (B) grazing of cattle in or close to dolines and sinkholes and (C) unwanted grazing patterns of cattle. Those were identified as major gaps within the DWPZ.

Also, further potential gaps (unwanted management practices) were presented, like the spraying of liquid manure on alpine pastures (what is forbidden), clearing of dwarf pine vegetation for pastures and subsequent milling of the upper soils, or the concentration of manure on parts of the pasture. All those practices should be avoided in future. The alpine pasture staff was convinced about the negative impacts of those unwanted management practices, which was a major step towards the implementation of Best Practices. The staff of Vienna Water was informed about the basic dynamics caused by such unwanted management practices (potential gaps) and hence possesses all necessary tools to contribute to the avoidance of them.

The most important Best Practices (BMPs) within the DWPZ were identified. Those are (A) Placing of water troughs for cattle more frequently, avoiding concentrations of cattle / Concrete basements for the troughs and their surroundings, (B) Fencing of dolines and sinkholes in order to keep cattle in distance from those karstic features and (C) Grazing management for cattle on alpine pastures. The implementation of those crucial BMPs is essential and will be tracked through the staff of Vienna Water.

Some of the BMPs are already implemented on the area of some alpine pastures within the DWPZ. The sustainable and continuous implementation of the BMPs for alpine pastures (mountain grasslands) within the whole DWPZ will be tracked in presence and future through Vienna Water staff. For this essential task in the field of source water protection the stakeholder training was essential.

The further focus within the Pilot Action 1.1 was put on surface flow modelling. This resulted in spatial and temporal patterns of surface runoff occurrence and frequency in the catchment at different events. This task required a detailed parameter set up process based on encompassing data acquisition and analysis as well as hydrogeological field mapping. The hydrological model applied in PROLINE-CE is the hydrological precipitation-discharge model KAMPUS. The further outcome of temporally and spatially resolved infiltration rates serves also as input into the 3-D Karst Model of Zeller Staritzen. This model will contribute to a further understanding of the karstic alpine water protection zone, especially the impact of surface runoff dynamics and precipitation infiltration on the spring water quality. The implementation of the model outcomes will be solely within the decision space of Vienna Water, the main stakeholder in PA1.1.

PA1.2 – DWPZ Waidhofen/Ybbs

Within PA1.2 the main activities were related to persuasive efforts for the main stakeholders, which are the local councillors of the municipal council. They were informed about the requirements of integral drinking source water protection within the forested watershed. The whole set of BMPs was presented and discussed. The most important BMPs were condensed into a "guideline for forest owners within the DWPZ" (drinking water protection zone) of Waidhofen/Ybbs. This "guideline" is written in German and is based on the BMP catalogue of PROLINE-CE. The purpose of this effort was the preparation of the municipal council meeting, where the guideline should be passed. The **resolution** of the "**G**uideline for securing the **W**ater **P**rotection functionality of the forest ecosystems within the DWPZ" (GWP) through the municipal council can be regarded as **milestone** towards the implementation of integral drinking source water protection and was accomplished in May 2018. This was the main test for the whole catalogue of BMPs assigned for PA1.2.

The selected most important BMPs in PA1.2 are (A) Avoidance of the clear-cut technique,
(B) Establishment of Forest Ecologically Sustainable Wild Ungulate Densities, (C) Limitation of forest road constructions, (D) Tree Species Diversity According to the Natural Forest Community and (E) Foster old, huge and vital tree individuals. Within the context of hydrological modelling the need for (F) Continuous monitoring of relevant hydrological data and hydrological modelling was identified.

For the strategic implementation of the whole BMP package, the set-up process of the GWP within the municipal council was essential.

Explanatory Abstract of GWP:

The structure of GWP encompasses a short description of the drinking water protection functionality of forest ecosystems. This is the introduction into the thematic field of drinking water supply security. The next section of GWP deals already with the explanation that only targeted silviculture with the overall purpose of drinking water protection can secure water supply security. Subsequently the most important Best Practices for forest management within

PA1.2 are described. Only if forest owners implement those Best Practices in their silvicultural practice they are allowed to receive payments form the water works of Waidhofen/Ybbs.

Contracts with the forest owners (on voluntary basis, each forest owner can decide whether this is an advantage) will regulate all monetary issues and the forest management rules which have to be followed in order to receive the payments on a yearly basis.

Hence GWP will form the basis for the implementation of the PES (payments for ecosystem services) scheme within PA1.2, when forest owners receive transfer payments if they apply BMPs relevant for the PA. Further talks with stakeholders will take place within this context. Also, the testing process of several BMPs together with related stakeholders will take place in near future.

GWP is now part of the strategic actuation of the water works of Waidhofen/Ybbs. It is part of their negotiation with forest owners within the DWPZ. Through this strategy drinking water supply security will be facilitated. Hence the implementation of whole set of BMPs for PA1.2 will be facilitated through GWP.

Pilot Action Cluster 1

Within Pilot Action Cluster 1 strategic identification of needs for action was carried out in both cases and implementation strategies were elaborated based on those insights. The sustainability of BMP implementation within the PA will depend on the continuation of efforts put on this thematic field. This will have to last far beyond project life-time.

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