REPORT ON EXPERIENCES WITH PREPARATION OF THE CONCEPT PLANS

D. T2.3.2

Version 4

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WP	**WP2 Effectiveness of the Natural Small Water Retention Measure**
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Participating partners	all
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1. Introduction

„The report will summarise experiences from the preparation of the concept plans and will describe the approach used to prepare it. It will be a part of the Manual (O.T2.1)." (Application form).

Within the FramWat project the Concept plans aim to give information on the best possible locations and type of measures for a given river basin, together with their estimated cumulative effect for natural and small water retention. They were prepared using the GIS Tool (O.T1.1) and selected models, as well as utilizing the inputs from the national trainings (O.T2.2)'.

In the frame of the FramWat project Concept plans were prepared for six different river basins, namely Aist of Austria, Bednja of Croatia, Nagykunsági of Hungary, Kamienna of Poland, Slovakian part of Slaná/Sajó and Kaminška Bistrica of Slovenia, in order to determine the appropriate measures and locations for small water retention in the pilot catchments.

The main objectives of the Concept Plan are:

- to explain in a transparent way how data analysis was performed, presented in context and how the evaluation of stakeholder preferences and expert knowledge led to choosing design principles;
- to show how the design and location of selected N(S)WRMs respond to the opportunities and constraints identified by the analysis;
- to explain and justify the setting of N(S)WRMs;
- to demonstrate a genuine response to context instead of using predetermined design solutions.

This deliverable provides an assessment of the 6 river basin's Concept Plans.

2. Characteristics of the pilot areas

The selected pilot areas

Six catchments from 6 Central European countries were selected as pilot areas (Table 1) for the FramWat Project. All 6 pilot catchments have several water management issues in terms of both surface water quality and quantity, that make them as appropriate pilot areas for testing natural small water retention measures (NSWRMs). The selections were based on landscape features and relevant ecosystem services as innovative solutions.

Country	Catchment	Why it was chosen?
Austria	Aist	Topographic characteristic and siltation, flood management
Croatia	Bednja	Torrents forming after intensive rainfall events, sediment issues
Hungary	Nagykunsági	Pluvial flood, drought and water quality problems
Poland	Kamienna	Ecological status and flood, drought and water quality problems
Slovakia	Slaná/Sajó	Significant flood risk
Slovenia	Kamniška Bistrica	Diverse character (from wooded subalpine hills to lowland plains), flood risk

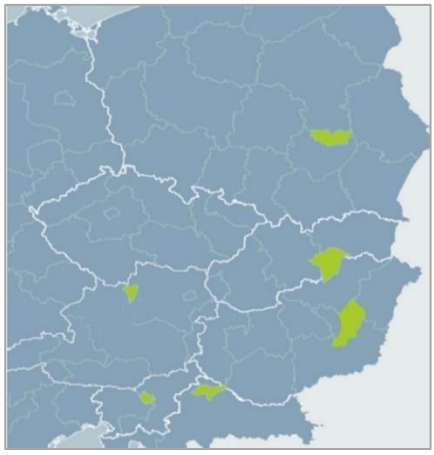

Table 1. Pilot areas of the FramWat Project

Characterization of the pilot area

The most important characteristics of the pilot areas are summarized in Table 2 below.

The area, geographical features, water resources, climatic conditions and land use (including urbanization) characteristics of the selected pilot areas are quite heterogenic, which are helpful for studying the use of different NSWRM(s) in various conditions as well as testing decision support tools (FroGis).

The most important general features (natural conditions) are:

- The pilot catchments belong to two main river basins. 5 pilot areas are located in the Danube River Basin and 1 pilot area is within the Vistula River Basin;
- 3 of the pilot catchments have an area in the range of 500-600 km^2, while the size of the other 3 catchments is between 2 000 and 3 500 km^2;
- One of the pilot catchments is mostly arable land with artificially managed lowland river/canal system controlling inland excess water and supplying irrigation demands (Nagykunsági), while the other 5 pilot areas have natural runoff characteristics generated from forested, low hills to lowlands with intensive agricultural uses;
- The most important general water management issues are the flooding and high nutrients/phytobenthos among components of ecological status.

Characteristic	Unit	Aist (Austria)	Bednja (Croatia)	Nagykunsági (Hungary)	Kamienna (Poland)	Slána/Sajó (Slovakia)	Kamniška bistrica (Slovenia)
Character of catchment		central uplands (low mountain ranges with plateaus, gorges)	lowland 30% low hills 70%	lowland	lowland/piedmont	plains / higher highlands	Upper part: highland, wooded, Middle and lower part: lowland;
Catchment area (main river)	km²	647 *(Danube River)*	616 *(Drava River)*	2965 *(Tisza River)*	2020 *(Vistula River)*	3217 *(Tisza River)*	539 *(Sava River)*
Average flow low/avg/high	m³/s	5.1/6.4/7.8	0.8/7/77	0/20/30	2.9/8.3/40	19,355 (avg)	2.2/7.9/67.2
Extreme flow low/high	m³/s	0.44/336.6	0.003/179	0/44	0.07/113	2,426/470	0.9/282
Annual precipitation low/avg/high	mm	726/835/993	481/931/1312	382,9/513,4/929,5	420/640/920	568/823/1215	998/1383/1851
Annual air temperature min/avg/max	°C	5.4/7.1/9.5	10.4 (avg)	-24,8/10,7/40,8	3/6/12	3/7/10	9/11/13
Agricultural area	%	48.9	30	73	49	40.02	34.5
Urban area	%	3.9	2	5	6.4	3.08	8.2
Forest area	%	46.8	49	5	44.2	56.78	54.1
Open water area	%	0.01	0.1	1	0.4	0.12	0.4
Flooded area (1/100 years)	km²	1.9	37.7	430,5 (excess water)	55.6	63	39.2
Artificial drainage area	km²	0	0	2300	59.2	0	0
Ecological status not good/bad	waterbody		3/2 (of 6)	5/21	2/11	8 generally medium/bad	Moderate (4/5) to very good (1/5)
Climate change * Summer temperature [oC]/ precipitation [%]		1.5/5	2/15	2/10	1.5/5	1.5/5	1.5/5
Major problems to achieve good ecological status		Phytobenthos, Macrozoobenthos, NO3, o-P,DOC	Phytobenthos, Macrophytes, Macrozoobenthos, Total N and Total P	Biology, hydromorphology	Phytobenthos, Macrophytes, NH4, PO4, Norganic	Phytobenthos, Macrophytes, NH4, PO4, Norganic	Hydromorphological alteration

Remark: the data provided for average and extreme flows, annual precipitation and air temperature is originating from different multiannual statistics of various timescales for each pilot area, for details see the original Concept Plans of the pilot catchments.

Table 2. Characteristics of the 6 pilot catchments

2.1 Aist pilot catchment

The Aist Basin was chosen by WasserCluster Lunz –Biologische Station GmbH (PP9) as a pilot catchment because the existing topographical characteristics as well as the prevailing problems, pressures and water management measures that make the basin an appropriate case study region for a NSWRM approach. In the region of the basin all river catchments share one common problem: siltation (fine sediment accumulation in the riverbeds) from granite weathering and erosion, causing ecological problems in rivers (habitat degradation) as well as problems of water and flood management (riverbed rising). One main concern is the degradation and disappearance of suitable habitat for the Natura 2000 target species freshwater pearl mussel.

Further issues in the Aist catchment are: hydro-morphological deficits due to river regulations and flood protection measures, and poor ecological status in several

VISION: The vision for the Aist pilot catchment is to improve sustainably the sediment balance of the catchment by implementing a set of appropriate NSWRM. The NSWRM approach will contribute to a restored and enhanced ecological situation that provides ideal habitat conditions for the freshwater pearl mussel leading to a growing and healthy population. The NSWRM approach will become an important part of the water management planning strategy and will generally help to advance water quality (nutrients) and water quantity (flooding) issues of the catchments

It is a representative catchment of the Austrian part of the Central Uplands ecoregion (low mountain ranges with plateaus and gorges), a region that geologically belongs to the Bohemian Massif (Variscan orogeny, 370-290 million years) with the prevailing bedrock granite and gneiss. Within this region all river catchments share one common problem: siltation from granite weathering and erosion, causing ecological problems in rivers (habitat degradation) as well as problems for water and flood management (riverbed rising). NSWRM can help mitigate the existing problems in the catchment and improve conditions related to the aspects of water quality, sediment balance, nutrient cycle and habitat diversity.

Activities to improve the situation in the catchment are already included in various strategic national planning documents, based on the Water Framework Directive, e.g. action plans within the National Water Management Plan (NGP, 1st 2009, 2nd 2015) and the National Flood Risk Management Plan (HRMP 2015).

The main tributaries in the Aist catchment are the Feldaist, draining the northwestern area, and the Waldaist, draining the northeastern part of the catchment. In the Waldaist area forestry and extensive pastures are dominating, while the Feldaist area is characterized by intensive agricultural practices. In summary, there is a north to south and an east to west gradient regarding land use intensity and population density.

Land use within the Aist catchment is dominated by agriculture (48,9%) and forestry (46,8%), urban areas are very limited (3,9%). Regarding forestry a differentiation must

be made between planted forests (mainly spruce monocultures) and natural forest (mixed conifer and broadleaf forest) as these two types have very different effects on the water and sediment balance in the catchment. A GIS estimation shows that planted forests (mostly spruce monoculture) occupy 80% of the forested area, with the remaining 20% left to semi-natural, broad-leaved forest.

The most relevant protected area within the Aist catchment is the Natura 2000 site called "Waldaist, Naarn" This Flora, Fauna, Habitat (FFH) area is dominated by the valleys of the rivers Waldaist and Naarn, which are largely preserved in a natural condition, but locally also affected by small power plant constructions. In addition to man-initiated spruce cultures there are also numerous natural mixed forest types, e.g. alluvial forests with alder and ash in the valley floors. In the widening sections, small-scale cultivated landscapes with extensive meadows have been preserved. Of particular importance is the occurrence of the freshwater pearl mussel.

2.2 Bednja pilot catchment

The Bednja river basin was chosen by Croatian Waters (PP7) because of problems caused by torrents forming after intensive rainfall, causing the movement and transport of significant sediment quantities into the lowland parts of the watercourse. It is common that torrents are accompanied by landslides. In the basin there are 6 water bodies from which 2 have bad status, 3 moderate and 1 water body has good ecological status (National RBMP 2016-2021). Phytobenthos, Macrophytes, Macrozoobenthos, Total N and Total P are the major problems in

VISION: The vision for the pilot catchment is to use appropriate N(S)WRM-s to reduce and solve the problems caused by torrents forming after intensive rainfall, causing the movement and transport of significant sediment quantities into the lowland parts of the watercourse. Additional vison is, that through structural measures related to watercourses flood risk is reduced and the ecological status of

Bednja is the longest river that flows through Croatia and it is a tributary of the Drava River. The river spring is located near Trakošćan in the Maceljsko gorje hill in Hrvatsko zagorje. It flows through the settlements of Bednja, Lepoglava, Ivanec, Beletinec, Novi Marof, Varaždinske Toplice, and Ludbreg, and flows into the Drava at Mali Bukovec near Ludbreg. It forms a northern natural border separating Mt Kalnik from the Topličko gorje hill in the west and from the Drava plain in the east.

Bednja catchment has an area of approximatelly 616 km^2 and is composed of about 30% low hills with the rest 70% being lowland. Bednja river has an average flow of 7 m^3/s with extreme flow going up to 179 m^3/s with an annual precipitation averaging 931 mm/year and annual average air temperature of 10.4 ^0C. Based on flood modelling scenarios a 100 year return period flood would inundate around 37,7 km^2.

The basin area is largely unurbanised, with vegetation cover made of forests (49 %), orchards and vineyards (app. 21 %), and agricultural land (30 %). The population mostly lives in villages and deals with traditional farming on small, fragmented plots lying on hill slopes, which is highly unfavourable from the aspect of exposure of the surface soil layer to erosion.

The most important road in the basin is a section of motorway cutting the basin into two parts slightly further downstream of the natural borderline between the upland and lowland parts of the basin. Its major part was built on an embankment with several culverts causing obstacles for the flow of high waters of Bednja and its tributaries.

According to Natura 2000, in the Bednja basin there are 14 sites important for the conservation of endangered species and a total of 12 sites with different levels of protection: 1 regional park, 3 nature monuments, 1 significant landscape, 1 park forest and 6 monuments of park architecture.

2.3 Nagykunsági pilot catchment

The Nagykunsági basin was chosen by Middle Tisza District Water Directorate (PP5) because the basin and its water systems are regularly affected by floods, inland excess water and droughts even within the same year.

Most of the water bodies in the sub-basin have bad or moderate ecological status except the Nagykunsági irrigation system. Water quality problems occures mainly in drainage canal system.

VISION: The vision for the pilot catchment to use appropriate N(S)WRM-s, other structural and non-strucutral measures to reduce drought, pluvial flood, heavy rainfall and water quality problems in sustainable and socially acceptable way.

The pilot area is located in the middle of the Hungarian Great Plain. The area is predominantly flat and the rivers shaped its topography. The eastern border of the pilot area is the Hortobágy-Berettyó River and the Tiszafüred main irrigation canal, and the southern border of the area is the Hármas-Körös River. The catchment is characterized by low elevation (79-100 m a.s.l. Baltic).

The Middle Tisza District, where Nagykunsági pilot catchment is located has always been characterized by extreme weather conditions. The rainy weather is often followed by long lasting dry, warm periods that can cause water quantity and quality issues and extreme water management situations.

Due to many external pressures, e.g. land use changes, climate change and hydromorphological alterations the frequency of floods increases and the flood levels rise, which can cause increasing flood risk as well as damages. Therefore, two emergency flood reservoirs were built with a total capacity of 196 million m^3 named Nagykunsági and Tiszaroffi on the pilot catchment. These reservoirs can effectively reduce the flood peaks in river Tisza River to aid flood protection works in extreme situations.

Pluvial flood is a typical form of excess water causing damages in a flat country and a yearly occuring phenomenon in the closed lowland catchment area of Nagykunsági. More than half of the pilot area is threatened by excess water inundation. In periods of extensive rainfall and snow melting, large areas used to be flooded which caused major economic and environmental problems annually. The excess water hazard is mainly moderate or strong in the pilot area.

The pilot area belongs to the very heavy drought zone (see details in the Concept Plan). There were numerous years when water scarcity was recorded in recent decades (1997, 2002, 2003, 2011, 2012).

The proportion of the agricultural land within the pilot basin is the largest in Hungary as well as in the Tisza sub-basin, but from agro-ecological point of view this land use is considered to have the most unfavourable structure. Large portion of the basin is arable land used dominantly for grain production, while intensive cultures (such as vegetables, fruits, etc.) have low proportion. A significant part of the agricultural area consists of arable land (74 %), while the share of the garden, fruit and grapes represent less than 0.1 %. The peculiarities of this river basin are the relative importance of fishponds. The proportion of forest areas does not reach 5 %.

There are a few, quite small Natura 2000 bird protection areas, mainly along the bordering main river courses and some fragmented nature conservation areas.

2.4 Kamienna pilot catchment

The Kamienna Basin was chosen by Warsaw University of Life Sciences (LP) due to the fact that it has a bad ecological status and all problems (i.e. flood, drought, water quality) occur within its area.

The floods occur practically along the entire length of the Kamienna River, omitting its source section. The greatest threat concerns agricultural lands located in the lower part of the basin. The urban areas are slightly threatened.

The greatest problems are caused by agricultural drought in the north-eastern part of the Wolanka catchment, while in the lower and middle sections of the Kamienna River and in all sub-catchments with an agricultural land use.

Bad ecological status occurs in 80% of the assessed JCWP (Surface Water Bodies) and covers the middle and lower section of the Kamienna River and southern tributaries from agricultural catchments. The main cause of its poor condition are the biological indicators such as phytobenthos, phytoplankton and macrophytes. The single exceedances relate to the following substances: Benzo (a) pyrene, Benzo (b) fluoranthene, Bezo (g, h, i) perylene, BOD5, Total suspended sediment, PO4, Total P

VISION: The vision for the pilot catchment is to use appropriate N(S)WRM-s measures to reduce agriculture drought and pollution by reducing the evapotranspiration rate, slowing down surface runoff in particular from drained areas. In addition, through structural measures related to watercourses, stubs, floodplains and forests – envisioning the reduction of flood risk and improving the

The Kamienna pilot catchment is located in south-central Poland, in the area of the Polish Upland, in the water region of Central Vistula. The main river in the basin is the Kamienna River, a left-bank tributary of the Vistula. The source of the river is located at the boarder of the Masovian and Świętokrzyskie provinces close to Borki village (Chlewiska municipality, Szydłowiec County). The river is 156 km long and runs from west to east and the catchment area is 2 020 km^2. The main tributuaries of Kamienna are: Świślina, Kobylanka, Młynówka, Wolanka, Modła. The catchment covers both

upland and lowland areas, the highest point has a height of 609.60 m above sea level, while the lowest is located at 126.40 m above sea level.

The mean annual temperature and precipitation of the area is similar to the country mean. Water balance for Kamienna River basin is similar to the national average - in the dominating part of the catchment, the annual evaporation rate is comparable to the annual rainfall and in a small part there is a prevalence of precipitation over evaporation.

Agricultural areas hold the dominant land use form of the catchment area; they constitute more than half of the catchment area. About 30% are forests, including mixed forests (6.8%), deciduous forests (6.3%), coniferous forests (5.9) and forest complexes with shrub vegetation (10.6%). Anthropogenic areas stretching along the Kamienna river account for approximately 15.6% of the catchment area, Featured water areas are mainly Wióry and Brody Iłececkie reservoirs.

The areas with different forms of nature conservation often overlap partially with each other, but in total about 70% of the catchment area is protected. According to the information provided by the General Directorate for Environmental Protection, in the analyzed area there can be found the following forms of nature protection: national parks; nature reserves; landscape parks; protected landscape areas; Natura 2000 areas; nature monuments; documentation stands; ecological land; natural and landscape complexes and species protection of plants, animals and fungi. The areas of cities: Ostrowiec Świętokrzyski, Starachowice and Skarżysko-Kamienna, as well as the south-eastern part of the basin don't include any protected areas.

By 2050, climate change in this region will cause (source of project Chase-PL, compared to 1971-2000, RCP 8.5) an increase in average air temperature (1.3^{o}C) and precipitation (6%) as well as low (30%) and high flows (18%). This will increase flood risk and surface runoff, especially in winter (90%) and summer (43%).

2.5 Blh pilot catchment (Slana)

The Slana Basin was chosen by Slovak Water Enterprise (PP3) because it is affected by floods, there have been identified 31 geographical areas with significant flood risk which are connected with 8 water bodies.

The most important impacts on water bodies' status are change of biotopes due to hydromorphological changes, organic pollution, contamination due to priority and relevant substances and eutrophication due to nutrient pollution. There are localities suitable for water retention, 4 water bodies have been determined to be affected by significant disruption of lateral connectivity and for 6 water bodies the potential of reconnection was identified.

VISION: The vision for the pilot catchment is to use appropriate N(S)WRM-s measures to reduce agriculture drought and pollution by reducing the evapotranspiration rate, slowing down surface runoff in particular from drained areas. In addition, through structural measures related to watercourses, floodplains and forests – envisioning the reduction of flood risk and improving the ecological status of water.

The pilot catchment has a fan-shaped river network with surface of plains to higher highlands dissection. The size of the catchment is approximately 270 km^2.

Pre-dominating land use types within the Blh sub-catchment are forestry (53,76%) and agriculture (43,00%), urban areas are very limited (2,80%).

In the Blh sub-catchment there are quite a lot of existing flood protection measures and water reservoir to manage water flows during dry periods, but also a lot of flood protection measures as e. g. dry polders planned with the aim to mitigate flood impacts.

In the Blh sub-catchment there are declared also nature protection areas. There of depending on water were identified based on data in River Basin Management Plan II (RBMP II), management of these areas officially reported to RBMP II is also substantial part of Action Plans on wetlands management. In the catchment there are also very small wetlands of local importance not officially reported by national nature protection authority to the RBMP II, these are identified based on communication with local nature protection authorities.

2.6 Kamniška Bistrica pilot catchment

The Kamniška Bistrica River catchment was chosen by the University of Ljubljana (PP8) as a pilot catchment because of its diverse character, ranging from wooded subalpine hills to lowland plains, which are highly urbanized.

The main problem within the catchment is the relatively frequent flooding. There are also some moderate hydro-morphological alternations due to river regulation. As for water quality, Kamniska Bistrica River has moderate to very good ecological

VISION: A vision for the pilot area is to use dispersed N(S)WRM-s at specific sites (flow control and flow improving measures, flood plain restauration and afforestation measures) as flood protection mechanism on a river basin scale and at the same foster other issues not directly included in the flood risk management such as climate change adaptation.

Kamniška Bistrica is a glacial valley, which starts in the gorges in the Kamniško-Savinjske Alps. The river of the same name springs at an altitude of 587 m. The upper part of the valley, which ends at the confluence of the Kamniška Bistrica and Korošica, is U-shaped, and the lower part is in the form of a letter V. The valley here already passes into characteristics of river valley and opens to the Kamniško-Bistriško field. Upper part of the Kamniška Bistrica valley is mostly highland on limestone and dolomite, covered with forest and sparsely populated, while middle and lower parts are lowland on quaternary alluvial sediments and are highly urbanized and intensively agricultural. Kamniška Bistrica flows into Sava River at an altitude of 266 m.

Upper part of the Kamniška Bistrica valley is mostly highland covered with forest. Middle and lower parts are highly urbanized lowland with intensive agricultural (app. 25 %) and a strongly branched network of watercourses. On the quaternary alluvial sediments fertile soils were developed. Urban areas are concentrated among watercourses and therefore threatened by floods.

Kamniška Bistrica catchment is rich in protected areas. In the upper part of the catchment Natura 2000 area is present, and there are a lot of natural values in the entire

basin. In its middle and lower part, Kamniška Bistrica River is highly regulated due to its hydropower potential and as protection against floods. This part of the catchment is covered with a dense network of artificial channels that used to supply water for the operation of water- and sawmills. Today, they are mainly used for supplying small hydropower plants.

Although a large part of the settlements is connected to a sewage system and central WWTP, water in lower parts of the catchment is occasionally polluted, especially in summer months when the main channel is almost dry and the water temperature rises. Other sources of water pollution are sewage overflows during flood events.

Kamniška Bistrica catchment is rich in protected areas. In the upper part of the catchment Natura 2000 area is present, and there are a lot of natural values in the entire basin.

Ecosystem services of the pilot catchments

Based on Haines-Young, R. and M.B. Potschin (2018): Common International Classification of Ecosystem Services (CICES) V5.1and Guidance on the Application of the Revised Structure.

Integrating the ecosystem services framework into the study of natural small water retention measures is very beneficial as NSWRMs provide water management solutions by using not only the physical characteristics of the landscape but also the services of ecosystems inhabit the area. On the other hand, by implementing NSWRMs we not only use various ecosystem services but can change (limit or enhance) the quality of the same or any other ecosystem services too. Thus, it is necessary to list, analyse and - if possible - map the relevant (used) and most important (impacted) ecosystem services on the pilot catchments.

The pilot catchments provide various ecosystem services listed by CICES:

- biotic and abiotic provisioning services in the divisions Biomass and Water,
- biotic and abiotic regulation and maintenance services in the divisions. Regulation of physical, chemical, biological condition and Transformation of biochemical or physical inputs to ecosystems, as well as
- cultural ecosystem services in the divisions Direct, in-situ and outdoor interactions with natural physical systems that depend on presence/do not require presence in the environmental setting.

The most important ecosystem services of the pilot catchments, according to Common International Classification of Ecosystem Services (CICES) classification are listed in Table 3.

For further information on the characteristics, problems, water management issues, and ecosystem services, please read the individual Concept Plans of each pilot catchment.

ECOSYSTEM SERVICES			**PILOT CATCHMENTS**					
Section	**Division**	**Group**	Aist (Austria)	Bednja (Croatia)	Nagykunsági (Hungary)	Kamienna (Poland)	Blh (Slovakia)	Kamniška bistrica (Slovenia)
Provisioning	Nutrition	Cultivated crops	+	+	+	+		
		Wild plants, algae and their outputs					+	
		Wild plants, algae and their outputs					+	
		Reared animals	+	+	+	+		
	Water	Surface water used for nutrition, material (irrigation)			+		+	
		Surface water used for drinking with minor or no treatments						+
		Groundwater used for nutrition, material (drinking water, irrigation)	+	+	+	+		
	Energy	Biomass (production from grassland)				+		+
		Biomass (production from forest)					+	
		Biomass-based energy sources (Fuel wood)	+					+
Regulation & Maintenance	Transformation of biochemical or physical inputs to ecosystems (Mediation of waste, toxics and other nuisances)	Filtration of surface water by ecosystems	+	+		+		+
		CO2 sequestration by forest and bogs	+	+		+		+
	Transformation of biochemical or physical inputs to ecosystems (Mediation of flows)	Mass flows (Protection against avalanches, mudslides and	+	+				+

		rock falls)						
	Regulation of physical, chemical, biological conditions, processes	Lifecycle maintenance, habitat and gene pool protection	+		+	+	+	+
		Regulation of baseline flow and extreme events	+	+	+	+	+	
		Erosion control	+	+	+	+	+	
		Water conditions	+	+	+	+	+	+
		Soil formation and composition	+	+	+	+	+	+
		Air quality regulation	+	+	+	+	+	+
		Climate regulation	+	+	+	+	+	+
	Other type	Pollination	+	+	+	+	+	+
Cultural	Direct, in-situ and outdoor physical and intellectual interactions with biota, ecosystems, and land-/seascapes that depends on presence in the environmental setting	Outdoor recreation activities	+		+	+	+	+
		Intellectual and representational interactions			+		+	
	Spiritual, symbolic and other interactions with biota, ecosystems, and landscape	Spiritual and/or symbolic interactions					+	

Table 3. Ecosystem services of the pilot catchment's ecosystems

3. Valorisation: a multi-criteria analysis

The aim of the valorisation analysis is to identify areas with different needs for retention in the catchment for different goals, such as: drought mitigation, flood control, water quality improvement, enhancing nutrient re-circulation and sediment balance.

In the frame of the valorisation method, the FroGIS tool was developed to create a map for valorisation of small retention needs, which should streamline the N(S)WRM location planning process.

The spatial unit of valorisation method (SPU) and the indicators used in the assessment were chosen individually by the partners for their pilot river basins taking into account the characteristics of the basins.

Table 4 summarizes the initial conditions and goals for the valorisation on the 6 pilot catchments.

River basin	Catchment size (km^2)	Valorisation goals	Number of SPU	Number of indicators
Aist	647	Sediment	21 sub-basins	13
Bednja	616	General, Flood, Drought, Water quality, Sediment transport	101	8
Kamienna	2 020	General, Flood, Drought, Water quality	187	19
Kamniška Bistrica	539	Flood	91	19
Nagykunsági	2 965	General, Flood, Drought, Water quality	28 sub-basins	20
Blh river	3 217	Flood	40	10

Table 4. Comparison of FroGIS data

In the elaboration of the 6 Concept, plans FroGis supported efficiently the planning process of N(S)WRM, identifying areas for water retention and for prioritization on the river basins.

Detailed information on valorisation as well as user and pre-defined indicators were presented in Deliverable DT1.3.1 Report from pilot action - testing the prototype of the FroGis tool in the river basins.

Short summary of the results of valorisation method used for different purposes, evaluation experiences:

3.1 Aist river basin

The assessment focused on erosion and sediment accumulation issues that cause ecological problems: habitat deterioration (key species: fresh water pearl mussel) and hydraulic problems (flood control and protection) raising riverbeds causing decreased flow capacities within the river channels.

Three different valorisation maps were produced:
- sediments generation,
- sediments transport off-stream,
- sediment transport in stream.

3 additional user defined indicators were used in the process.

3.2 Bednja river basin

Valorisation maps were created for general, flood, drought and water quality purposes.
Based on assessment experiences for general and flood mitigation purposes natural breaks gives better results. However, for drought and water quality proper valorization results are obtained with Equal method.

Weighting has very little influence on the final results. In the assessment, only flood data was available for comparison.

3.3 Kamienna river basin

The valorisation assassement focused on general, flood, drought, water quality purposes in 187 SPUs.

The GIS Tool analysis has been carried out using natural breaks for indicators classification to 5 classes. Indicators have been aggregated without weights (all weights were set equal to 1, i.e. all indicators have the same relative importance).

3.4 Kamniška Bistrica river basin

Using FroGis tool, valorisation maps were created for flood defence purpose.

The best results were obtained from equal width method of division into classes. However, valorisation map indicates high need for water retention on steep upstream slopes (SPU 12 and 36) where measures are not feasible; map by division into classes by natural breaks eliminates SPU 12 from areas with high need for water retention, which is correct. None of the methods shows SPU 79 as area with high need for water retention even though three water retention basins were planned. Division in natural breaks with variable weight shows greater potential for water retention in the western part of the catchment, which coincidences with planned measures.

3.5 Nagykunsági river basin

FroGis tool was used to create valorisation maps for general, flood, drought, water quality need of retention.

As a result of the tests, it was found that the best results were obtained from the natural breaks and equal width method of division into classes.

The division into 5 classes seems to be most suitable for the final classification map. The required data for evaluation and calculations are easily available. However, pre-processing calculation for valorisation method needs careful work.

Depending on the division method, the results may be very different from each other for the same valorisation purpose.

Comparing FroGis results with planned actions: The planned measures are strongly influenced by the impact area of the built irrigation system in this catchment. Development needs are influenced by other external reasons: e.g.: agricultural needs. The program provides flexible design by changing the indicators and their weight values.
It is not possible to evaluate the FroGis results without field knowledge.

3.6 Blh river basin

The 26 sub-catchments were subdivided into 40 more precise units based on Digital Elevation Model (DEM) the natural hydrological condition. As the biggest problems in the Blh sub-catchment are caused by floods, the valorisation calculations were run for flood goal.

Detailed information on the valorisation, as well as user and pre-defined indicators were presented in Deliverable DT1.3.1 Report from pilot action - testing the prototype of the FroGis tool in the river basins.

FroGis program is available to support planning process of N(S)WRM, identifying areas for water retention, for prioritization on river basins.

4. Defining variants, selecting the final version

Following the valorisation process based on the results of FroGis tool, the variants of N(S)WRM had to be defined including stakeholder's preferences, as well. The selected variants will be analysed later by Static tool and/or Dynamic models based on the features of the pilot catchment.

The applicable measures for the pilot river basins are selected from the Annex 1 of the Report D.T2.1.1 (Review of the existing parameters for evaluation of effectiveness of N(S)WRM.

The basis of the measures in FramWat project is the Catalogue of Natural Water Retention Measures (NWRM), which was developed by a previous EU project, and the results can be found at the official website of that project (http://nwrm.eu/measures-catalogue).

That project gathered information on NWRM at EU level, covering a wide range of actions and land use types.

Main sectors of NWRM:

- Agriculture,
- Forestry,
- Hydro-morphology,
- Urban. (Not relevant in FramWat project)

In FramWat project the NWR measures were complemented with other relevant technical measures regarding:

- Drainage area and,
- Hydro technical structures.

Considering these measure, two types of variants were elaborated in the frame of concept plans:

- **Expert variant** (Created by experts having experiences in the field of water management, protection of water resources, aquatic ecosystems and water dependent ecosystems, as well as agriculture and forestry)
- **Local preferences variant** (Created by relevant stakeholders, such as local authorities, local communities, NGOs)

In this part of the project planning process the main task was to select and place the appropriate measures and combinations of measures for further examinations.

The selected variants will be analysed later by Static tool and/or Dynamic models, based on the features of the pilot catchment.

The static tool and the dynamic models are two complementary approaches:

- The static tool relies on simple datasets and on expert opinion and useful to assess the effectiveness of large sets of NSWRMs over broad spatial ranges;
- The investigation of the effects of the implementation of NSWRMs using dynamic models requires more effort, and those models are more suited for a targeted approach.

4.1 Aist pilot catchment

Regarding sediment problems three variants were examined; 1.) Baseline Scenario (Based on Model information), 2.) Threshold Variant, and 3.) Expert Variant. Agricultural measures to reduce sediment generation, as well as measures to improve sediment in-stream and off-stream transport were planned in the pilot catchment.

Planned measures were examined with SWAT for hydrology and sediment; Hec-RAS for the whole river network, Siltation risk model; Habitat model for Freshwater Pearl Mussel (FPM).

Already existing measures as well as planned measures had to be taken into account in the future measures variant definitions. Existing measures that affect the sediment aspect in the catchment:

- cross sectional modifications to reduce sediment transport during periods with high flows (hydro-morphological modifications);
- sediment retention ponds off stream (artificial floodplains).

Further measures can be planned based on the valorisation results and on static and dynamic modelling results.

Variants to be assessed

With the help of the models three variants were analysed:

1. *Baseline Scenario*

The baseline scenario includes the following information: location of sediment hotspots by SWAT; siltation risk by Hec-RAS; potential sites available for FPM by Habitat model. It is important to notice that a hypothetical variant based on the stakeholders' planned measures in the area can still be considered as part of the baseline scenario because the planned measures are so small that a change at the catchment scale is not visible. No measure tested by dynamic tools.

2. *Threshold Variant*

Sediment pond measures (simultaneously increase water retention and trap sediments): the aim is to assess threshold effects - critical threshold (volume, area coverage) that leads to a change in the river habitat - in the implementation of certain NSWRM. Assessed by SWAT.

3. *Expert Variant*

Based on habitat and sediment hotspots in the baseline scenario and on threshold effects determined in variant 1 and 2, a set of NSWRMs is proposed. The EU inventory will be filtered based on SWAT feasibility and on on-site feasibility. Single measure effects and combined effects are investigated.

These variants were chosen because:

- there is no strategic plan yet on how to develop water retention with the help of NSWRM at catchment scale;
- implementation and planning of NSWRM at the moment happens at local scale only;
- potential effects of measure combinations at catchment scale on sediment input, transport, and on habitat availability are of special interest for regional water and nature protection authorities.

Combining the information available on NSWRMs, expert opinions and local stakeholder knowledge, a set of measures was proposed and the potential spatial siting was discussed based on the results of the valorisation and the baseline scenario from the dynamic models. The selected measures were allocated to specific SPUs (among 21 SPUs) based on the results of the valorisation method.

The measure testing is carried out with two steps.

- A broad screening with the static tool to identify areas/reaches with higher potential response to implementation;
- A focused testing with the dynamic model.

Summary of selected measures for further evaluation

Various NSWRM were chosen from the EU catalogue of Natural Water Retention Measures for the three overarching goals addressing the sediment aspect in the catchment for the expert variant. The rationale for the choice of the below listed measures are:

1. These measures can be modelled both with the static method and the dynamic modelling cascade, allowing a comparison of the results and a better estimation of the effectiveness of the implemented measures.
2. The feasibility of the measures implementation due to catchment characteristics and restraints and due to stakeholders' expectations and restrictions.

<u>Measures for "sediment generation" goal</u>

- WRAL - Water retention in agricultural lands through various best management practices,

Measures for "sediment in-stream transport" goal

- BPRC - Natural channels and best practices of river channels maintenance/ improvements,
- BPDA - Best practices on drained areas: small sediment retention ponds (located in-stream and off-stream)

Measures for "sediment off-stream transport" goal

- BPDA - Best practices on drained areas, small sediment retention ponds (located in-stream and off-stream)
- A02 - buffer strips and hedges: mainly between (or across) fields, also along water courses

or

- F01 – Forest riparian buffers: tree covered areas alongside streams

WORKFLOWS for siting of measures to be tested with the static tool and dynamic methods

Workflow of static tool

1. The SPUs showing class 5 and showing class 4 in the valorization process were chosen for the three different aspects of the sediment balance of the region.
2. The areas of maximum implementation for the intended measures were calculated in GIS for each SPU.
3. Intensity classes (high, medium, low) for the various measures implementations were chosen based on expert judgment and recommendations, and applied to the affected SPUs.
4. With the help of the Static Tool (Excel spreadsheet) the improvement values were calculated for the selected measures.
5. Partial results are presented for each SPU and each activity, summary results for the SPU, results related to the implementation of a specific type of activities in the catchment and the total result for the whole catchment (all SPUs).

Workflow of dynamic method

The dynamic models have been set up and used in the following steps listed below for 6 of the 21 SPUs (see also Fig 1):

1. SWAT, calibrated at daily time step for hydrology and at monthly time step for hydrology and sediment. The outputs from SWAT, i.e. the daily hydrograph for every sub-catchment and the monthly sediment loads were used in the following modelling steps;

2. Hec-RAS for the whole river network, calibrated for water level - for each of the 21 SPUs was used. (Flow percentiles obtained from the SWAT daily hydrograph were used to perform static flow profiles in order to assess local hydraulics.);
3. Siltation risk model (HecRAS hydraulic outputs were used as predictors to assess the siltation risk);
4. Habitat model for Freshwater Pearl Mussel (FPM) (HecRAS hydraulic outputs and riparian land use were used to assess the habitat abvailability for FPM).

The summary of the selected measures is available in Table5.

Remark:

Due to the limited experience of stakeholders with planning of NSWRMs in the catchment, the threshold variant was developed to be used as a first assessment of potential benefits. Based on the threshold variant, the stakeholders (regional nature protection, water management authorities, and the Natura 2000 site managers) provided information on the potential location of measures, that are not in the concept plan. The modelling of the measures implementation will be part of the action plan.

Experiences (by partner): The results from the baseline scenario of the dynamic modeling are matching the stakeholders' experiences with the catchment. The baseline scenario was useful for stakeholder discussion to develop the measures' variants.

4.2 Bednja pilot catchment

Two versions were assessed for flood mitigating purposes: Expert variant (water management filed) and Local preferences variant. The selected expert measures were examined with HEC-HMS, MIKE 21 models. The local preferences measures is examined with static tool.

Variants to be assessed

The expert variant

Expert measures are foreseen for flood defence in the Bednja basin, with proposed construction of three water retention basins. In addition to the retention basins, the existing dikes in the lower part of the basin should be relocated from the river.

According to the catalogue of measures and based on the basin analysis, the following basin-wide measures have been selected:

- T01 / T1 - polders, dry flood protection reservoirs, sediment trapping dams,

- T02 / T2 - widenning or removing of flood protection dikes.

These measures were tested both by static and dynamic tools.

The local preferences variant

The maintenance of forest areas in the steep upper parts of the Bednja basin has a large significance for erosion reduction, and consequently for reduced sediment transport downstream.

According to the catalogue of measures and based on the basin analysis, the following basin-wide measures have been selected:

- F02 - Maintenance of forest cover in headwater areas,
- N07 / ER - Reconnection of oxbow lakes and similar features.

These measures were tested by static tool.

WORKFLOWS for siting of measures to be tested with the static tool and dynamic methods

Workflow of static tool

In progress. No information is available

Workflow of dynamic method

For the purpose of assessing the hydrological contribution, a conceptual hydrological runoff model was developed using the HEC-HMS 4.0 software (Hydrologic Engineering Center - Hydrologic Modeling System). Model calibration and validation were done.

The 2D numerical model MIKE 21 (DHI) that uses available spatial data and synthetic water waves from each sub-basin which are the results of the hydrological model was selected for hydraulic analysis and modelling of flows in the Bednja basin. The hydraulic model was calibrated and validated based on the recorded water waves and recorded flood events.

The summary of the selected measures is available in Table5.

Remark: There is no detailed information provided in the Concept Plan of Bednja pilot catchment on (1) the involved sectors, workflow and distribution criteria for the expert variant and (2) the selection workflow for the local preferences variant. Assessment with static tool is in progress. Assessment with dynamic model is done.

4.3 Nagykunsági pilot catchment (Tisza river basin)

Two versions were assessed for flood mitigation purposes: Expert variant (water management filed) and Local preferences variant. The selected expert measures were

examined with HEC-HMS, MIKE 21 models. The local preferences measures were examined only with static tool.

Variants to be assessed

Expert variant

Sectors representing the experts for elaborating the expert version of measure combinations in the Middle-Tisza:

- Water management sector: MTDWD.
- Forestry: MTDWD.
- Agriculture: Hungarian Chamber of Agriculture

MTDWD experts preselected the appropriate measure combinations for Nagykunsági pilot catchment taking into account local conditions. This proposal was discussed with local experts having expertise on the pilot areas.

The choice of measures is very limited due to the characteristics of the river basin. About 72 % of the pilot area is arable land; therefore the agriculture type of measure group is of great importance.

The proposed measures are:

- A01 - Meadows and pastures
- A02 - Buffer strips and hedges
- A06 / WRAL - No till agriculture
- A07 / WRAL - Low till agriculture
- A08 / WRAL – Green cover
- A15 - Deep plowing or Deep ripping (removing the plow's sole)
- N02 - Wetland restoration and management
- N07 - Reconnection of oxbow lakes and similar features
- F01 - Forest riparian buffers
- D01 - Regulated outflow from drainage systems
- D02 - Water damming in ditches, wires with constant crest (valleys)
- D04 - Construction of micro reservoirs on ditches
- D07 - Construction of reservoirs on outflows from drainage systems
- D08 - Construction of small reservoirs on rivers (dammed reservoirs)

Local preferences variant

There were only few comments from local authorities, communities and NGO's to the Local Preferences version, therefore no separate version was created. There was only one measure that has been incorporated into the final set of measures:

- N02 - Wetland restoration and management

The summary of the selected measures is available in the Table5.

Remark: There is no detailed information provided in the Concept Plan of Nagykunsági pilot catchment on (1) the workflow for the expert variant and on (2) the selection workflow for the local preferences variant.

4.4 Kamienna pilot catchment

Expert and local preferences variants were created aiming the mitigation of flood, drought and water quality problems.

The choice of measures is very limited due to the characteristics of the river basin. About 49 % of the pilot area is arable land and 44% forest. Therefore agriculture, drainage area and forest type of measure groups are of great importance.

Variants to be assessed

Expert variant

Experts preselected the appropriate measure combinations for Kamienna pilot catchment, taking into account the local conditions.

The proposed measures are:

- A02 - Buffer strips and hedges
- A03 / WRAL - Crop rotation
- A08 / WRAL - Green cover (WRAL)
- F01 - Forest riparian buffers
- F03 - Afforestation of reservoir catchments
- N02 / ER- Wetland restoration and management
- N03 / ER - Floodplain restoration and management
- N07 / ER - Reconnection of oxbow lakes and similar features
- D01 / BPDA - Regulated outflow from drainage systems
- D04 / BPDA - Construction of micro reservoirs on ditches
- T01 / T1 - Polders, dry flood protection reservoirs, sediment trapping dams
- T02 / T2 - Widening or removing of flood protection dikes
- T03 / T3 - Construction of small reservoirs on rivers (dammed reservoirs)

Local preferences variant

For elaboration of the measures list stakeholders from local communities, local authorities, organizations and agencies were contacted and invited to the first meeting. Only a few proposals were received that were already considered in the project.

On the National training in May 2019, 25 people participated (included 9 WULS-SGGW representatives and the remaining number consisted of representatives of the Regional Water Management Authority in Warsaw (RWMA) as well as local Town Councils, Forest District Administration, Chamber of Agriculture, Catchment Management and Water Supervision Bodies). New natural type of measure was suggested by an NGO, that was added to the measure list.

Proposed actions are:

- Regulated outflow from drainage systems (D01 / BPDA)
- Dike removal (T02 / T2)
- Construction of a new reservoir (T03 / T3)
- Reconstruction of historical factory system driven by water (Staszic channel and reservoir)

- Reconstruction of reservoirs (T03 / T3)
- Using the natural process of river bed infiltration
- Increasing in-channel flood retention
- Increasing water retention in oxbow lakes (Floodplain restoration and management) (N03 / ER)
- Construction of a dry reservoir
- Conversion of arable land to meadows and pastures (A08 / WRAl)

The summary of the selected measures is available in the Table5.

Remark: There is no detailed information provided in the Concept Plan of Kamienne pilot catchment on (1) workflow and distribution criteria for the expert variant and (2) the selection workflow for the local preferences variant.

Experiences (by partner):

- According to the majority of participants the initial valorisation of the region is needed.
- From the perspective of the region (Southern and Central Europe) there should be a coherent message to managers of structural programs regarding matters related to water management.
- At present the voice of experts is missing.
- Discussions among specialists from various fields are important.

4.5 Blh (Slaná/Sajó) pilot catchment

Expert and Local preferences variants were developed for flood mitigation purpose where two planned measures are additional (not in the catalogue of N(S)WRM).

Variants to be assessed

Expert variant

The expert variant was proposed based on measures already mentioned in the strategic documents, such as River Basin Management Plan of Slovakia 2015 - 2021 and Flood Risk Management Plan of Slaná River Basin 2021, as well as utilizing consultations with State Nature Conservancy as authority for management of protected areas, and on experiences of local Water Management Authority. Spatial extent and localization of some measures were identified through GIS analyses done over the available spatial data.

The proposed measures are:

- A04 - Strip cropping along contours
- D01 - Regulated outflow from drainage systems
- N02 - Wetland restoration and management
- N03 - Floodplain restoration and management
- T1 - Polders, dry flood protection reservoirs, sediment trapping dams
- D03 - Active water management on a drainage system (river valleys)
- T - Removal of sediments and / or bank vegetation
- T - Adjustment of watercourse.

There were also technical measures proposed to be kept, which did not belong to natural small water retention measures, but their effect is necessary to keep. From these types of potential measures different combinations should be designed which will be further tested through Static method on effectiveness assessment and/or through Dynamic modelling.

Local preferences variant

The local preferences variant was proposed based on communication with different types of local stakeholders. For that purpose a web-application was developed using all input data.

- A04 - Strip cropping along contours
- D01 - Regulated outflow from drainage systems
- N02 - Wetland restoration and management
- N03 - Floodplain restoration and management

From types of potential measures which are proposed by local stakeholders, different combinations should be designed which will be further tested through Static method on effectiveness assessment and/or through Dynamic modelling.

The summary of the selected measures is available in the Table5.

Remark: There is no detailed information provided in the Concept Plan of Blh pilot catchment on (1) workflow and distribution criteria for the expert variant and (2) the selection workflow for the local preferences variant.

4.6 Kamniska Bistrica pilot catchment

Three variants of measures were developed for the river basin: stakeholder measures, local authorities' measures and expert knowledge measures. The latter considered both stakeholder and local authority measures, and those chosen measures were later on evaluated with the use of static and/or dynamic tools. The main goal of those selected measures is flood risk mitigation. For the planning process the National Flood Risk Management Plan and River Basin Management Plan for the Danube RBD were also used.

Kamniska Bistrica lies in Danube river basin district. Development of RBMPs and FRMPs under Directive 2000/60/EC are elements of integrated river basin management. strategic documents, such as

- River Basin Management Plan for the Danube RBD (Danube RBMP 2016-2021);
- Flood Risk Management Plan (FRMP 2017-2021).

These plans were reviewed in order to identify already planned SWRM in the Kamniska Bistrica catchment.

Variants to be assessed

Expert variant

Expert knowledge list of SWRM is based on the understanding of the catchment and how SWRMs affect it. The proposed measures are:

- Peak flow control structures (dam - retention /i.e. reservoir/, river regulation);
- Afforestation (erosion control measures /i.e. afforestation/, flood diversion canals /restoration of natural infiltration to ground water/);
- Flood plain restoration and management (protected flood retention area /"natural"/);
- Basins and ponds/wetlands (ponds, wetlands, earth fill removal, complex measures);
- Elimination of riverbank protection (widening of river canal, removal of illegal interventions, other)

will be re-evaluated with the use of static and/or dynamic tool.

Local preferences variant

The main concern of stakeholders regarding NSWRM is their placement in environment due to geographical conditions and different interests. Water retention needs were confirmed where SWRM are already planned. Stakeholders identified potential locations for NSWRM.

Participating municipalities identified problems and proposed SWRM measures in the catchment. The identified measures are:

- new dam and dam heightening
- new levee
- stream regulation
- erosion control measures
- flood diversion
- bed-load trap cleaning and new bed-load trap.

The summary of the selected measures is available in Table5.

Remark: there is no detailed information provided in the Concept Plan of Kamniska Bistrica pilot catchment on (1) the involved sectors, workflow and distribution criteria for the expert variant and on (2) the selection workflow for the local preferences variant.

The measures are not indicated according to the catalogue of measures.

Experiences (by partner): Beside flow control and conveyance improving measures, several different types of other measures have been planned, some of them even outside of the NSWRM catalogue, such as flood plain restoration, afforestation, basins and ponds, complex measures etc.

(NWRM/NSWRM)			Aist (Austria)			Bednja (Croatia)			Nagykunsági (Hungary)			Kamienna (Poland)		Blh (Slána/Sajó) (Slovakia)		Kamniska Bistrica (Slovenia)	
Code	**Sector**	**Measures type**	**E/LP Vs**	**Static tool**	**Dynamic tool**	**E/LP Vs**	**Static tool**	**Dynamic tool**	**E/LP Vs**	**Static tool**	**Dynamic tool**	**Static tool**	**Dynamic tool**	**Static tool**	**Dynamic tool**	**Static tool**	**Dynamic tool**
A01	Agriculture	Meadows and pastures							**E**	**+**	**---**						
A02		Buffer strips and hedges	**E**	**+**	HEC-RAS, SWAT, SR*, Habitat				**E**	**+**	**---**	**E****					
A03		Crop rotation										**E****					
A04		Strip cropping along contoures												**E** and **LP** **			
A06		No till agriculture	**E**	**+** (WRAL)					**E**	**+** (WRAL)	**---**						
A07		Low till agriculture	**E**						**E**		**---**						
A08		Green cover	**E**						**E**		**---**	**E** and **LP** **					
A15		Deep plowing or Deep ripping							**E**	**+**	HEC-RAS 1D						
N02	Hydro-morphology	Wetland restoration and management							**LP**	**+**	HEC-RAS 1D			**E** and **LP** **		**E** **	
N03		Floodplain restoration and management										**E** and **LP** **		**E** and **LP** **		**E** **	
N07		Reconnection of oxbow lakes and similar features				**LP**	**+**	**---**	**E**	**+**	HEC-RAS 1D						
F01	Forestry	Forest riparian buffers	**E**	**+**	HEC-RAS, SWAT, SR*, Habitat				**E**	**+**	**---**	**E****					
F02		Maintenance of forest cover in headwater areas				**LP**	**+**	**---**									
F03		Afforestation of reservoir catchments										**E****				**E** **	
D01	Drainage area	Regulated outflow from drainage systems	**E**	**+** (BPDA)					**E**	**+** (BPDA)	HEC-RAS 1D	**E** and **LP** **		**E** and **LP** **			
D02		Water damming in ditches, wires with constant crest (valleys)	***E***						**E**		HEC-RAS 1D						

(NWRM/NSWRM)			Aist (Austria)			Bednja (Croatia)			Nagykunsági (Hungary)			Kamienna (Poland)		Blh (Slána/Sajó) (Slovakia)		Kamniska Bistrica (Slovenia)	
Code	**Sector**	**Measures type**	**E/LP Vs**	**Static tool**	**Dynamic tool**	**E/LP Vs**	**Static tool**	**Dynamic tool**	**E/LP Vs**	**Static tool**	**Dynamic tool**	**Static tool**	**Dynamic tool**	**Static tool**	**Dynamic tool**	**Static tool**	**Dynamic tool**
D03		Active water management on a drainage system (river valleys)	**E**						**E**		HEC-RAS 1D			**E****			
D04		Construction of micro reservoirs on ditches	**E**						**E**		HEC-RAS 1D	**E****					
D07		Construction of reservoirs on outflows from drainage systems	**E**						**E**		HEC-RAS 1D						
D08		Construction of small reservoirs on rivers (dammed reservoirs)	**E**		HEC-RAS, SWAT, SR*, Habitat				**E**		---						-
T01	Hydrotechnical structures	Polders, dry flood protection reservoirs, sediment trapping dams	**E**	**+**	HEC-RAS, SWAT, SR*, Habitat	**E**	**+**	HEC-HMS, MIKE 21				**E****		**E** and **LP** **			
T02		Widenning or removing of flood protection dikes				**E**	**+**	HEC-HMS, MIKE 21				**E** and **LP** **				**LP** **	
T03		Construction of small reservoirs on rivers (dammed reservoirs)										**E** and **LP** **				**E** **	
T	BRPC	Natural channels and best practices of river channels maintenance/ improvements	**E**	**+**	HEC-RAS, SWAT, SR*, Habitat												
T	Additional measures in FramWat Project	Increasing in-channel flood retention										**LP****				**E** and **LP** **	
T		Using the natural process of river bed infiltration										**LP****				**E** **	
T		Removal of sediments and / *or bank vegetation*												**E****			
T		Adjustment of watercourse River regulation												**E****		**E** and **LP** **	
D		Ponds														**E** **	
-		Water quality improvement							**E**	---	HEC-RAS 1D						

E: *Expert variant*, LP: *Local preferences variant*, E and LP**: *the Expert and Local preference variants will be assessed by Static and Dynamic tools during the elaboration of the Action Plan*
+ : *Static or Dynamic tool was applied* ---: *Static or dynamic tool will be applied according to the planned progress (in the Action Plan) – in case of Nagykunsági pilot as well,* ,SR*: *Siltation Risk model*

Table 5. Summary of selected N(S)WRTM and applied assessment

5. Summary of experiences and lessons learnt

It can be concluded that the development of the Concept Plans and the development of the variants should not be uniform completely. These depend on the catchments' characters, the major problems and water management issues of the catchments, thus the assessment approach should have its own features.

Lessons learnt:

- The elaborated Concept Plan method is suitable to assist the planners to provide information for the decision makers on the best possible locations and type of measures for a given river basin, together with their estimated cumulative effect for natural and small water retention.
- Choosing variant(s) and measures from N(S)WRMs' list, placing the appropriate measure(s) and findings of the assessment tools are the main features of the Concept plans.
- In the process of creating a plan, an important element is the awareness of climate change and adaptation to it through appropriate selection of measures.
- It is not possible to indicate the exact location for all measures, but it is worth suggesting to the stakeholders / decision makers through a valorisation map and consultation/workshops/ web-tools / guideline which types of measure are recommended for them (Kamienna).
- Cooperation among all potentially involved parties – stakeholders, experts and officials proved to be very beneficial. It has also proven that contribution from a party that is familiar with local conditions, whether it be weather, topographic, socio-economic etc, is invaluable (Kamniška Bistrica).
- FroGis program is available to support planning process of N(S)WRM, identifying areas for water retention, for prioritisation on river basins. Howewer, field knowledge and expert involvement is essential for the selection and placement of the water retention measures.
- Other measure(s) than listed in the catalogue of N(S)WRMs can be applied, the catalogue can also be supplemented.