Vipava River Basin Adaptation Plan

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Part I

BeWater
Society Adapting to Global Change

Vipava River Basin Adaptation Plan

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Preface

Climate change projections for the Mediterranean region estimate an increase in water scarcity and drought episodes, as well as more frequent floods and other extreme weather events . There is a high likelihood that these events will evoke substantial socio-economic losses and negative environmental impacts if no action is taken to support territories' adaptation efforts. Furthermore, changes in population and land use, such as urban expansion or the abandonment or intensification of agriculture, also affect the response of territories to these events. In this context, sustainable water management strategies are urgently needed as they will enhance the resilience of socio-ecological systems, referring both to society and the environment.

Current water management practices focus on the river basin level as the natural geographical and hydrological unit. Resilient water management strategies focusing on the river basin can respond to pressures within this unit in an appropriate way, while trying to minimize disruptions to the socio-ecological systems.

'Making Society an Active Participant in Water Adaptation to Global Change' (BeWater) is an EU-funded project which responds to the above challenges by promoting dialogue and collaboration between science and society for sustainable water management and adaptation to the impacts of global change. The BeWater project, taking place from 2013 to 2017, focuses on the design of adaptive water management approaches at a river basin scale in the Mediterranean region. More specifically, the project aimed to develop a river basin adaptation plan for each of four pilot case studies, namely for the Tordera (Spain), Pedieos (Cyprus), Rmel (Tunisia) and Vipava (Slovenia) River Basins. These basins are representative of various Mediterranean conditions with regards to climate, topography, environment, socio-economic and political conditions, land use and water demands.

The adaptation plans were developed in a collaborative process according to a common methodology developed within BeWater, and utilising existing information on the local dynamics of global change. Over the course of the three and a half-year project, the subsequent plan and the plans of the other three pilot cases were co-produced by experts and stakeholders in the respective river basins as well as with scientists and experts from within the BeWater consortium, with guidance from the project's advisory board.

The four river basin adaptation plans (RBAPs) aim at fostering adaptation to global change within the four basins, and serve as a reference for other basins within the Mediterranean region and beyond, that wish to increase their resilience and undertake such a participatory development process. To facilitate the transferability potential, the BeWater project is also producing a handbook presenting lessons learned from throughout the development process.

The present plan is a document designed by the Slovene partners and stakeholders. It outlines the adaptation action for the Vipava river basin.

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Executive Summary

Within the BeWater project (funded by the European Union through the 7th Framework Programme), a River Basin Adaptation Plan was developed for the Vipava river basin to integrate global changes in river basin management. The plan is a guiding document for stakeholders in water use sectors and affiliated policy areas acting in the river basin. The specific aim of this river basin adaptation plan is to increase the resilience of the social and ecological system of the Vipava river basin and to facilitate a proactive response to emerging global changes and related challenges. Therefore, the objective of the adaptation plan is the delineation of water management options that aim to implement sustainable water management in the Vipava river basin for the period until 2030.

In the Vipava river basin, citizens have little awareness of the challenges that they and the environment are facing due to global changes. To start the awareness raising process, stakeholders from the Vipava river basin determined appropriate strategies for management of the Vipava river basin guided by local and international experts. The plan is thus the result of a bottom-up approach in which researchers interacted with stakeholders to identify how pressures from climate change, land use, and elsewhere could be tackled best. During the development process 114 stakeholders provided concrete input regarding the process of formulating and evaluating water management options, as well as identification of adaptation strategies in several stages of a participatory process that included (a) three professionally facilitated workshops, (b) follow-up interviews, (c) individual and group sessions, and (d) an additional open consultation.

Based on stakeholder knowledge and scientific information, three water-related challenges and 20 water management options that would tackle these challenges and support the adaptation process were identified. The majority of options (16) were identified to cope with the challenge of water availability during droughts in the growing season (challenge A), followed by 13 options coping with the appropriate water quality (challenge C). Half of the options (ten out of 20) were identified to address the challenge of reducing flood risks (challenge B); however several options are addressing more than one challenge. To maximise the synergistic benefits among the individual options and to increase their effectiveness, seven different complementary sector-based bundles of options were defined. Within the bundles, stakeholders indicated also the optimal timing for implementing the options over the short, medium and long-term.

According to stakeholders' preferences, implementation-oriented factors such as multi-criteria analysis, the implementation of options regarding the challenges, feasibility, acceptability, and policy synergies, five water management options were assigned the highest priority for the implementation process: a) *Establishment of an inter-municipal expert working group*, b) *An awareness campaign for the local public*, c) *Construction of water reservoirs*, d) *An awareness campaign for water management experts*, and e) *Improving the financing system for water infrastructure*. These options should therefore be highlighted when considering adaptation actions in the Vipava river basin. The majority of recommended options represent a soft approach to adaptation, which achieved the highest preference of stakeholders, having low implementation and operational costs and the best outcome for all three identified challenges of the Vipava river basin. Although the option *Construction of water reservoirs* has the best evaluation outcome for the two identified challenges of the Vipava river basin, the option is a technical solution (grey approach to adaptation) with high implementation costs. As such it is also involved with low feasibility or even conflicts with the objectives of Water Framework Directive.

To assure the successful implementation of individual water management options or bundles of options, the development and execution of a monitoring plan including sound indicators is crucial.

Hence the alignment of existing monitoring plans with the objective to monitor the implementation of water management options should be considered.

Povzetek

V okviru projekta BeWater (ki ga financira Evropska unija v okviru 7. okvirnega programa) je bil razvit načrt prilagajanja porečja reke Vipave z namenom vključitve globalnih sprememb pri upravljanju porečij. Načrt je ključni dokument namenjen zainteresiranim deležnikom na strani uporabnikov vode in povezanih področij politike, ki delujejo v porečju reke Vipave. Poseben cilj tega načrta je povečanje prilagodljivosti socialnega in ekološkega sistema porečja reke Vipave ter omogočanje proaktivnega odziva na nastajajoče globalne spremembe in s tem povezane izzive. Med drugim je cilj načrta prilagajanja predstavitev možnosti upravljanja voda, ki so namenjene izvajanju trajnostnega upravljanja voda v porečju reke Vipave za obdobje do leta 2030.

V porečju reke Vipave se prebivalci premalo zavedajo izzivov globalnih sprememb, s katerimi se soočajo tako oni sami kot njihovo okolje. Da bi pospešili proces ozaveščanja, so zainteresirani lokalni deležniki s pomočjo domačih in tujih strokovnjakov določili ustrezne strategije za upravljanje porečja reke Vipave. Načrt prilagajanja je torej rezultat pristopa od spodaj navzgor, v katerem so raziskovalci sodelovali z zainteresiranimi deležniki, da bi skupaj ugotovili, kako bi na najboljši način reševali pritiske zaradi podnebnih sprememb, rabe zemljišč in ostalih dejavnikov. Tekom postopka je skupno 114 deležnikov podalo konkretne prispevke k procesu oblikovanja in vrednotenja možnosti upravljanja voda, kot tudi k opredelitvi strategij prilagajanja na različne načine in v več korakih, vključno z: (a) tremi strokovno vodenimi delavnicami, (b) naknadnimi intervjuji, (c) individualnimi in skupinskimi sestanki ter (d) dodatnim javnim posvetom.

Temelječ na poznavanju problematike s strani zainteresiranih deležnikov ter znanstvenih dognanj so bili prepoznani trije glavni izzivi in 20 možnosti upravljanja voda, ki bi reševale te izzive in podpirale proces prilagajanja. Večina možnosti (16) je bilo prepoznanih na področju spopadanja z izzivom razpoložljivosti vode med sušnimi obdobji v rastni dobi (izziv A), ki mu sledi 13 možnosti spopadanja z ustrezno kakovostjo vode (izziv C). Polovica možnosti (10 od 20) je bilo opredeljenih na področju zmanjševanja poplavne ogroženosti (izziv B). Vsekakor pa več možnosti obravnava več kot en izziv. Z namenom povečanja skupnih koristi posameznih možnosti upravljanja in povečanja njihove učinkovitosti, je bilo opredeljenih sedem različnih sektorskih svežnjev. V okviru teh svežnjev so zainteresirani deležniki nakazali tudi optimalni časovni okvir za izvedbo posameznih možnosti v kratkoročnem, srednjeročnem in dolgoročnem časovnem obdobju.

Glede na večjo naklonjenost deležnikov in dejavnikov glede uvajanja možnosti kot so npr. analiza več meril, učinek možnosti na prepoznane izzive, izvedljivost, sprejemljivost in sinergije politik, je bilo petim možnosti upravljanja voda dodeljena najvišja prioriteta pri samem postopku uvedbe in sicer: a) *Oblikovanje medobčinske strokovne delovne skupine za porečje reke Vipave*, b) *Kampanja ozaveščanja lokalne javnosti*, c) *Izgradnja vodnih zadrževalnikov*, d) *Kampanja ozaveščanja o trajnostnem upravljanju voda, namenjena strokovnjakom s področja upravljanja površinskih voda* in e) *Izboljšanje sistema financiranja vodne infrastrukture*. Posledično je potrebno poudariti te možnosti pri obravnavi ukrepov prilagajanja v porečju reke Vipave. Večina priporočenih možnosti predstavlja mehak pristop k prilagajanju, katerim so zainteresirani deležniki dali najvišjo prioriteto, povzročajo nizke stroške uvedbe in obratovanja in imajo najboljši izid za vse tri prepoznane izzive porečja reke Vipave. Čeprav je možnost gradnje vodnih zadrževalnikov dosegla najboljši ocenjeni rezultat za dva ugotovljena izziva, pa ta možnost predstavlja tehnično rešitev (sivi pristop k prilagajanju) z visokimi stroški izvedbe. Kot taka, je tudi slabše izvedljiva ali celo v nasprotju s cilji okvirne Vodne direktive.

Za zagotovitev uspešnega izvajanja posameznih možnosti upravljanja voda ali svežnjev možnosti, je ključnega pomena razvoj in izvedba načrta spremljanja ter vključitev smiselnih kazalnikov. Zato je treba razmisliti o uskladitvi obstoječih načrtov spremljanja s ciljem spremljanja izvajanja možnosti upravljanja voda.

Glossary of key terms

- **Acceptability (as criteria for water management options) -** an option is considered as acceptable if there is not significant reason a priori for actors in the basin to reject the option, e.g. because of its design [1]
- **Adaptation pathway -** portrays a sequence of actions and their implementation prioritisation over the short, medium and long-term, with regards to achieving a set of pre-specified objectives under uncertain changing conditions [2]
- **Adaptive management -** an approach to reduce ecological uncertainty and increase resilience by emphasising that management regimes should be regularly adjusted to changes in the ecological system being managed and to managers' evolving understanding of this system
- **Bottom-up approach -** entails the participation of local actors in decision-making about the selection of the priorities and actions to be pursued in their local area; the approach can interact and be combined with top-down approaches from national and/or regional authorities in order to achieve better overall results [3]
- **Challenge -** something that by its nature or character serves as a call to a special effort; the RBAP focuses on the challenges related to the impacts of global change in the river basin - now and in the years to come
- **Climate change -** any long-term change in climate over time, whether due to natural processes or as a result of human activity [4]
- **Climate change adaptation -** appropriate action to prevent or minimise the damage that climate change impacts can cause, or taking advantage of opportunities that may arise due to climate change [5]
- **Climate change scenario -** the difference between a climate scenario (i.e. a plausible and often simplified representation of the future climate) and the current climate [6]
- **Co-benefits (as criteria for water management options) –** options are considered to have co-benefits when their combined implementation amplifies the total impact-related benefits, as compared to the benefits which would arise from implementing each option individually
- **Environmental flow regime** - describes the amount of water that is needed by the river ecosystem to sustain its natural functioning
- **Extreme weather event** - an average of a number of weather events over a certain period of time, an average which is itself extreme (e.g. rainfall over a season) [7]
- **Feasibility (as criteria for water management options) -** an option is considered as feasible if physical, technical, regulatory or organizational obstacles are not existing or can be easily overcome during option's implementation [1]
- **Flexibility (as criteria for water management options) -** an option is considered flexible when it can be adjusted/ complemented or reversed when it turns out to be inadequate or inappropriate in practice [1]
- **Fuzzy cognitive map -** a tool to graphically represent the knowledge about or the perception of a given system; can be converted into simple mathematical models to run simulations and calculate outcomes of possible scenarios to facilitate the discussion and exploration of complex issues [8]
- **Global change** - changes in the global environment that may alter the capacity of the Earth to sustain life, encompassing climate change as well as other critical drivers of environmental

change that may interact with climate change, such as land use change, population trends, the alteration of the water cycle and changes in ecosystem functionality [9]

- **Good status (of a water body)** – a term to describe a condition under which water bodies have the biological and chemical characteristics expected under sustainable conditions [10]
- **Governance -** the way rules, norms and actions are produced, sustained, regulated and held accountable; it refers to the processes of interaction and decision-making among the actors involved in a collective problem that lead to the creation, reinforcement, or reproduction of social norms and institutions [11]
- **Green measures -** ecosystem-based approaches that are using green infrastructure to address three identified challenges. Four options in the RBAP fit in green measures category
- **Grey measures –** measures related to the tehnological and engeniring solutions that include improvements in water availability, water quality or flood risk reduction. Seven options in Vipava River Basin Adaptation Plan fit in grey measures category
- **(Invasive) alien species –** plants, animals, pathogens and other organisms that are non-native to an ecosystem, and which may cause economic or environmental harm or adversely affect human health [12]
- **Impact assessment –** a method to identify the environmental, social and economic impacts of an action or project prior to decision-making
- **Implementation barrier or opportunity -** elements deriving from the implementation context influencing the foreseen or ideal development of an action
- **Integrated River Basin Management -** Integrated river basin management (IRBM) is the process of coordinating conservation, management and development of water, land and related resources across sectors within a given river basin, in order to maximise the economic and social benefits derived from water resources in an equitable manner while preserving and, where necessary, restoring freshwater ecosystems
- **Karst -** a special type of landscape formed by the dissolution of soluble rocks, including limestone, dolomite and gypsum; it is characterised by underground drainage systems with sinkholes and caves; Karst regions contain aquifers that are capable of providing large supplies of water [13]; subterranean drainage may limit surface water with few to no rivers or lakes
- **Knowledge transfer –** the process of engaging with researchers, decision-makers or the community and decision-makers to generate, acquire, apply and make accessible the knowledge necessary to successfully develop and enhance evidence-based initiatives which enhance human, material, social and/or environmental wellbeing [14]
- **Meander -** a bend in a watercourse or river formed by erosion on the outer banks due to the flow of moving water and resulting in a winding watercourse; when a meander gets cut off from the main stream, an oxbow lake forms
- **Multi-criteria analysis -** a tool for supporting complex decision-making situations with multiple and often conflicting objectives (e.g. economic, ecological and social) that stakeholder groups and/or decision-makers value differently [15]
- **Mutual learning -** a learning process experienced and shared by different actors developed through direct interactions; the process is conducive to adaptive water management and includes the exchange of information on technical features of river basin management, scientific findings, as well as political aspects, so as to arrive at a shared understanding of issues and possible solutions
- **Oxbow lake -** a crescent shaped body of water lying alongside a winding river; formed when a wide meander from the main stem of a river is cut off [16]
- **Participatory co-creation -** an approach which integrates all stakeholders in the entire design process of an action, i.e. problem definition, solution generation, evaluation of proposed

solutions during development, and implementation of solutions, to help ensure the result meets user needs and increase acceptability

- **Policy framework -** a broad set of laws, regulations, or processes that structure political, social, cultural or economic activities in a society; these policies form an interacting web and therewith impact the functioning of exiting policies as well as new policy developments and policy amendments [17]
- **Pressure -** anthropogenic factors inducing environmental change (impacts), including for example the release of substances (emissions), physical and biological agents, the use of resources and the use of land by human activities [18]
- **Resilience -** the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change [19]
- **River basin -** the area of land from which all surface water runs off through a sequence of streams, rivers and, possibly, lakes into the sea at a single river mouth, estuary or delta; it is a natural geographical and hydrological unit that is used e.g. by the European legislation to manage a single drainage area [20]
- **River Basin Adaptation Plan -** management plans containing a series of basin-specific options for enhancing the resilience of the basin's water resources as well as societal resilience in the face of global change. They include an analysis of the options' implementation over time and present a range of further aspects relating to these options, such as implementation opportunities and co-benefits between the options.
- **River Basin Management Plan -** document including the objectives for a given river basin district and the programme of actions required to meet these objectives; the aim is to protect, improve and sustainably use the water environment; these plans are a requirement of the European Water Framework Directive
- **River Basin District** - the area of land and sea, made up of one or more neighbouring river basins together with their associated groundwaters and coastal waters [21]
- **Robustness (as criteria for water management options) -** an option is considered robust to uncertainties if it can maintain its effectiveness under different climatic and socio**-**economic development scenarios [1]
- **Sediment management -** organized and coordinated actions to reduce the impact of human activities or natural changes on the quantity and quality conditions of solid material that is or can be transported by or deposited from the river's water [22]
- **Shelterbelts -** a row of trees planted across the direction of wind to deflect and reduce wind speed without causing turbulence; generally, provide protection from desiccating winds to the extent of 5 to 10 times their height on windward side and up to 30 times on leeward side, thus reducing evaporation losses and wind erosion [23]
- **Socio-ecological system –** consists of 'a bio-geophysical' unit and its associated social actors and institutions; delimited by spatial or functional boundaries surrounding particular ecosystems and their problem context [24]
- **Soft measures –** measures related to governance changes and are including policy approaches, raising awareness, monitoring systems and other "soft" approaches. Nine water management options in the river basin adaptation plan fit in green measures category
- **Stakeholder** - any person, group or organisation with an interest or "stake" in an issue, either because they will be affected or because they may have some influence on its outcome; the term is usually reserved for well-organised and active groups and organisations, thus making a distinction from the general public
- **Water management option –** activity developed within the scope of the BeWater project which aims to impact the interactions between water uses and the water body; can be characterised

as nature-based approaches (enhancing natural regulation of ecosystem functionality), soft approaches (acting on management or policy norms and regulations) or technical approaches (developed through engineering)

- **Water scarcity –** a lack of sufficient available or safe water resources to meet water needs within a region; this can involve water stress, water shortage or deficits, and water crisis as a result of climate change, increased pollution, or increased human demand and overuse of water [25]
- **Watershed -** the area of land that catches rain and snow and drains or seeps into a marsh, stream, river, lake or groundwater; this area is typically smaller than a river basin, meaning that several watersheds may comprise a single river basin [26]

List of acronyms

ARSO	Agencija Republike Slovenije za okolje (Slovenian Environmental Agency)
CAP	Common Agricultural Policy
CS	Case Study
DRSV	Direkcija Republike Slovenije za vode (Slovenian Water Agency)
EIA	Environmental Impact Assessment supported by Environmental Protection Act (Official Gazette of RS, no. 39/06 - consolidated text, 49/06 - ZMetD 66/06 - dec. U.S. 33/07 - ZPNačrt, 57/08 - ZFO-1A, 70/08, 108/09, 108/09 - ZPNačrt-A, 48/12, 57/12, 92/13 and 56/15) and with Decree on the activities (interventions) for which an environmental impact assessment is mandatory (Official Gazette of RS, no. 51/41)
FCM	Fuzzy Cognitive Map
FFP	Fisheries and Farming Management Plan
FRMP	Flood Risk Management Plan 2015-2021 (FRMP) and Programme of Measures (in preparation)
GeoZS	Geological Survey of Slovenia, Ljubljana
HQ	The higherst discharge observed – extreme; an example of HQ 50 - the flood extent is given for return period of 50 years, extreme weather event
IzVRS	Inštitut za vode Republike Slovenije (Instutute for Water of the Republic of Slovenia)
MCA	Multi-criteria Analysis
MKGP	Ministrstvo za kmetijstvo, gozdarstvo in prehrano (Ministry of Agriculture, Forestry and Food)
MOP	Ministrstvo za okolje in prostor (Ministry of the Environment and Spatial Planning)
PMFIWRS	Programme for the Management of Fish in Inland Waters of the Republic of Slovenia
RB	River Basin
RBAP	River Basin Adaptation Plan
RBMP	River Basin Management Plan for period 2015 - 2021 (slo: “NUV II” implementation of the WFD) – in preparation
RDP	Rural Development Programme
SEA	Strategic Environmental Assessment also known as comprehensive environmental impact assessment supported by Environmental Protection Act (Official Gazette of RS, no. 39/06 - consolidated text, 49/06 - ZMetD 66/06 - dec. U.S. 33/07 - ZPNačrt, 57/08 - ZFO-1A, 70/08, 108/09, 108/09 - ZPNačrt-A, 48/12, 57/12, 92/13 and 56/15) and with Decree laying down the content of environmental report and on detailed procedure for the assessment of the effects on certain plans and programmes on the environment (Official Gazette of RS, no. 73/05)

WFD	Water Framework Directive; Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy
WMO	Water Management Option
WWTP	Wastewater Treatment Plant

PART 1

2.1 Introduction

2.1.1 Introduction

The Vipava river basin is a part of the Soča river basin and belongs to the Adriatic sea basin district. The climate of the Vipava river basin is a sub-Mediterranean type, with mild winters and hot summers. The Vipava river basin is constantly influenced by a warm and humid southwestern wind and by the cold and gusty northeastern bora wind, especially in the cold half of the year. According to the trends in the discharges for the Vipava river basin, a decrease in low and mean annual discharge has been observed [27]. Climate change projections show an increase in average annual temperatures and decrease in precipitation. Hence, an additional decrease in low and mean discharges are expected with high probability.

The Vipava river basin as well as other river basins in Slovenia are managed at the national level with the River Basin Management Plan (2009 - 2015) [28] and its Program of Measures in force [29], according to the Water Framework Directive [21]. Nevertheless, the Program of Measures is addressing adaptation to climate change at too general and declarative level so as to support the development of concrete water management strategies and actions. These strategies and actions are needed to increase the resilience of the socio-ecological system of river basins.

Beside the River Basin Management Plan, there are also other sectoral strategic plans related to water management, like for example the flood risk management plan, Natura 2000 Management Programme, and other sectoral documents in agriculture and forestry. As such, these plans should be harmonized with the River Basin Management Plan. Therefore, in the process of developing the Vipava river basin adaptation plan, existing water related sectoral strategic plans must be considered in order to help all the river basin authorities and other relevant actors develop adaptive and harmonized strategies, plans and actions.

To maximise the effectiveness of these sectoral strategies, regional and local characteristics must be considered and local communities must be engaged in developing these strategies. Profund participatory approaches are often missing in policy making (e.g. for designing river basin management plans). Furthermore, many institutions act behind closed doors, making it impossible for the local society (e.g. via NGOs) to participate and discuss already in the early phases of planning and designing of measures.

To begin the integration of global change in the river basin's management at the local level, innovative bottom-up approaches have been tested. By promoting an iterative dialogue and mutually educational collaboration processes between science and society, the process of river basin adaptation plan (RBAP) development is moving away from expert-dominated adaptation planning towards a process that will support the co-design of adaptation responses by stakeholders and scientists. The specific aim of this river basin adaptation plan is to increase the resilience of social and ecological systems linked to the Vipava river basin and to allow a proactive response to emerging global changes and related challenges. There are many initiatives across the world that have started to integrate global change in water management planning at multiple levels. Nevertheless few attempts have been made to integrate global change in river basin management as proposed by the present document.

Text box 1: Definition of RBAP

The BeWater River Basin Adaptation Plan (RBAP) is a management plan containing a series of basin-specific options for increasing the resilience of the basin's water resources as well as societal resilience in the face of global change. It includes an analysis of the options' implementation over time and presents a range of further aspects relating to these options, such as implementation opportunities and co-benefits between the options.

2.1.2 Objectives and vision

Future climate change projections for the Euro-Mediterranean region estimate an increase in water scarcity and droughts, causing substantial socio-economic losses and environmental impacts. Foreseen global change and recognized existing conflicts among water-related objectives (e.g. improving flood/erosion risk protection, optimizing water use, improving ecological status) are a challenge for developing an integrated and sustainable water management.

The vision for the river basin adaptation plan is to strenghten the resilience of the river basin against the impacts of global changes and to better manage conflicts between sectors. In accordance with the so-called Integrated River Basin Management [30], a long-term inter-sectoral cooperation at the river basin level must be established. Such cooperation can provide a framework for harmonized and feasible strategic planning not only at the national level but also regional and local levels. Long-term inter-sectoral cooperation on adaptation should also:

- assure participation of all river basin authorities and other relevant actors on the basis of equal inter-sectoral partnership;
- assure good knowledge of the socio-ecological systems in and around the basin, especially through iterative dialogue and mutual learning processes between scientific disciplines and society;
- develop all relevant documents (e.g. policies, strategies, projects) in an integrated manner;
- incorporate communities and stakeholder participation into the planning and management processes;
- improve awareness and shared responsibility;
- establish a system to assess whether or not the river basin is being managed sustainably.

In order to make adaptation strategies credible, informed and achievable, they need to be developed in close and continuous consultation with a diversity of stakeholders, sectors and policy areas in the river basin. Within such a long-term cooperation framework, global change impacts can be managed in a more efficient and sustainable way together with prioritizing concrete adaptation actions that can give inter-sectoral synergic benefits.

According to the statement above, the main objectives for the Vipava River Basin Adaptation Plan are:

- to raise public awareness on the importance of sustainable water management, considering the expected impacts of global change at the river basin scale;
- to promote the importance of the involvement of the local stakeholders from various disciplines and levels of practical involvement;

- to identify current water uses, related problems, and potential solutions through the involvement of the communities within the Vipava river basin;
- to prepare, analyse and assess adaptation options which can increase the capacity of the Vipava river basin to adapt to the impacts of global change and other pressures on water resources;
- to support sustainable water management in the long-term by providing recommendations for strengthening the resilience of the river basin's society to global change and improving governance for adaptation.

To address these objectives, the Vipava River Basin Adaptation Plan was developed through an iterative process of mutual learning, participatory techniques, and a bottom-up approach to ensure that stakeholders play an active role in developing appropriate strategies for the management of the Vipava river basin. During this process a total number of 114 stakeholders participated in workshops, consultations, and interviews to express their interest in and views on managing water-related challenges in the Vipava river basin. The participatory workshops led to the identification of three water-related challenges and 20 water management options that would tackle these challenges and support the adaptation process.

2.1.3 Overview of content

Following the introductory section, chapter 2.2 presents details on current and possible future state development of the main socio-ecological systems (land, climate and water, biodiversity, and people) in the Vipava river basin and the context for policy context. The main challenges identified throughout the participatory approach are included in this chapter. Chapter 2.3 provides a short overview of the methods used to identify, formulate and evaluate water management options with a graphical component, a list of water management options and a more detailed description of the river basin adaptation plan planning process with information on the stakeholder engagement process. Chapter 2.4 presents the adaptation actions prepared for the Vipava river basin in a form of seven sector specific bundles together with monitoring and evaluation. Chapter 2.5 concludes with the recommendations for policy/decision makers on priority water management options. Part 2 of the river basin adaptation plan includes a detailed description of the 20 Water Management Options. Engagement and dissemination activities taking place in the Vipava river basin are presented in Annexes I and II.

2.2 Vipava River Basin

After a short introduction to the Vipava river basin, this chapter provides an overview of the current state and expected future state of Vipava's land use and industry activity, climate and water, people, and water uses. The expected future state or so called dynamics are presented mainly for the climate of the Vipava river basin and for resulting water availability. This chapter also includes an overview of the main flood areas in the Vipava river basin that were identified in the transposition of the Floods Directive [31] into Slovenian legislation. In addition, relevant legislation and policies are listed and described. This chapter concludes with an overview of the main challenges identified for tackling global change in the Vipava river basin.

2.2.1 Current status and dynamics

2.2.1.1 Geography and geology

The Vipava river basin is located in south-west Slovenia covering an area of 589 km2. The upper part of the Vipava river basin includes the Vipava River spring and the catchment area of its main tributaries Močilnik, Bela, Hubelj, and Lokavšček. The lower part of the Vipava river basin starts where the Branica River flows into the Vipava River and it includes the Vipava River and the catchment area of its main tributaries Lijak, Vrtojbica, and Branica (see Figure 1). Just after the Vrtojbica River flows into the Vipava River (near the town Miren), the Italian state border forms a virtual boundary around the Vipava river basin. Soon after the state border the Vipava River flows into the Soča River.

Geologically, the Vipava Valley is composed of tertiary and quaternary alluvial sediments where the soil is quite fertile. The mountain range that envelops the valley in the north is a massive Mesozoic limestone accretion, covered by a thin and unstable layer of flysch. For this reason, landslides are common on the steep slopes during heavy rainfall events. The elevated but much lower plateau to the south is largely of more or less pure limestone from the Mesozoic era [32]. Both limestone plateaus lack surface water and all the water sinks into ground creeks and canyons, only to emerge again just above the impermeable valley bottom.

In general, water management in such karstic regions is difficult, as the groundwater behaves similar to surface water streams and may be affected by sources of pollution that are distant and difficult to locate. Moreover, the water's self-purification capabilities in comparison to non-karstic regions are extremely limited due to the lack of proper natural filters (e.g. lush vegetation, a thick layer of soil, layers of sand and gravel underneath, etc.).

Due to the fact that the Vipava river basin hinterland is sparsely populated and with the exception of a small number of pastures (the Trnovo Forest and the Nanos and Hrušica Plateaus), the waters in the surrounding karstic regions of the Vipava river basin do not experience large-scale pressure. However, a noticeable number of vineyards in the karst region could to some extent exert environmental pressure.

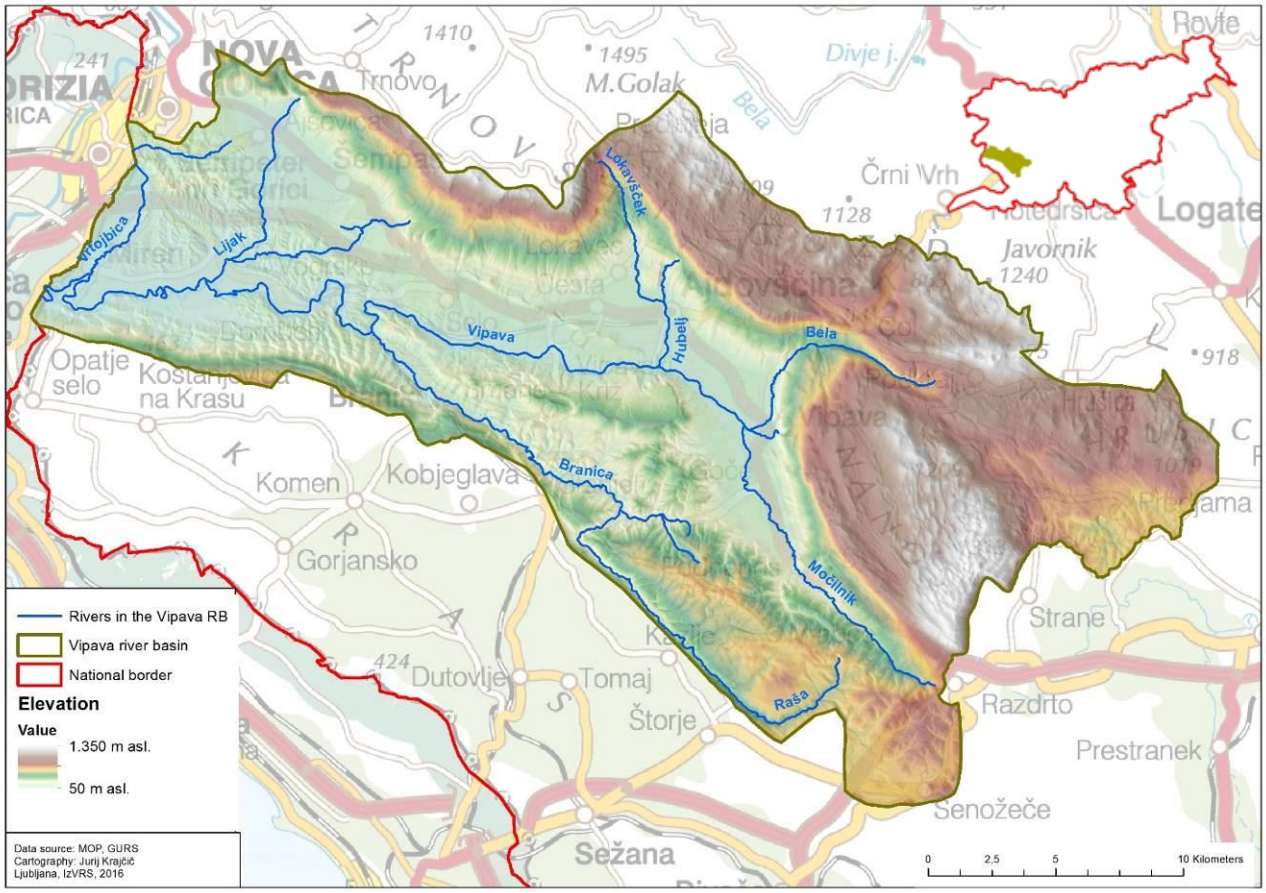


Figure 1: *Overview of the Vipava River Basin with its main watercourses and elevation, and its location within Slovenia*

2.3.1.1. Land use [33] and industrial activity

A large part of the Vipava river basin is covered by forest (61%), mostly on the slopes and higher altitudes around the main valley, and in the north and south periphery of the lower part of the basin. The second main land use in the Vipava river basin is agriculture (33%), mostly in the flatland around the Vipava River and its tributaries.

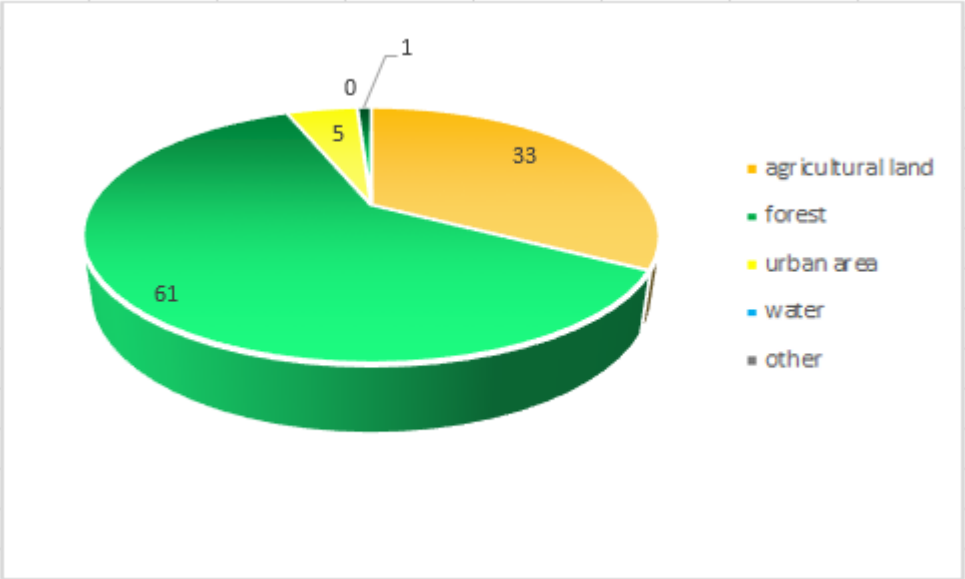


Figure 2: *Percentage of land use in the Vipava River Basin*

A comparison between land use in 2002 and 2015 shows noticeable changes. In this time, 2.1% of the river basin area were transformed from arable land to grassland and urban area and 3.5% of the area that formaly was geassland developed into forest and shrubland [33] [34]. Due to the specific geology and morphology of the area, the Vipava RB has a large number of nature conservation areas (e.g. valuable natural features, protected areas), protected at the national level by the Nature Conservation Act [35].

The most important agricultural products in the valley are fruits (especially peaches) and grapes for wine production. Other important agricultural products are early vegetables (lettuce, potato, cabbage, carrot, onion, garlic, and strawberries) due to favorable climate conditions and a vegetation period that is significantly longer compared to the continental parts of Slovenia [36].

Besides agriculture, industry is also an important sector in the Vipava RB (31% of the total GDP in the Goriška region). Industry is present in all major cities of the Vipava Valley (e.g. Ajdovščina, Vipava, Šempeter, Nova Gorica), although it is more condensed in the lower part of the basin. The town of Ajdovščina developed along the Hubelj watercourse (see Figure 1). In Ajdovščina, there are two important food processing factories. Other important industrial sectors in the valley are electronics, construction, and transport services. The number of newly established micro-, small-, and medium-sized companies during the past decade is increasing as people are developing new income opportunities, following the abandonment of agricultural activities and decreasing employment opportunities in large industry complexes.

With its rich natural and cultural heritage, the Vipava Valley (especially in the upper part) has great potential for developing ecotourism. Besides beautiful landscape, the Vipava wine road is a good starting point for countryside ecotourism. The importance of tourism for the local economy has been increasing. The number of visitors is rising every year, reaching 176,000 in 2014, the main attractions being the landscape, wine tasting, and gastronomy [36].

2.2.1.2 Climate and water

Being open to the west towards the Adriatic Sea, the Vipava river basin is subject to a strong Mediterranean climate interplaying with continental climate conditions. The sub-Mediterranean climate is moderated by occasional influxes of continental air masses from the north-east across the mountain barrier. Summers are hot and dry with occasional droughts, while winters tend to be mild and rainy with frequent bora winds, a prominent local wind which is dry, cold, and often comes in gusts with well over 100 km/h and can occasionally exceed 200 km/h, causing damage to crops and buildings, and causing problems in traffic. The section most affected by bora wind is usually the upper part of the Vipava Valley, stretching from Ajdovščina to Podnanos.

The bottom of the valley rarely sees freezing temperatures and snow is a rare occurrence as well. The average annual temperature for the reference period 1981 – 2010 at the bottom of the valley is 12-13 °C. The hottest month is July with an average temperature (1981 – 2010) of 22 °C, and the coldest month is January with an average of 3 °C. Temperatures drop with altitude; at the annual level, they are 2 °C lower on the Karst plateau and 6 °C lower in the highlands of the Trnovo Forest mountain range. The average annual precipitation in the upper part of the Vipava Valley is around 2,000 mm per year, and in the lower part and the Vipava Hills around 1,500 mm per year. For example, Figure 3 shows average monthly air temperature and precipitation for the reference period 1981 – 2010 for Bilje Meteorological Station, located at the bottom of the valley in the north-west of the basin [37].

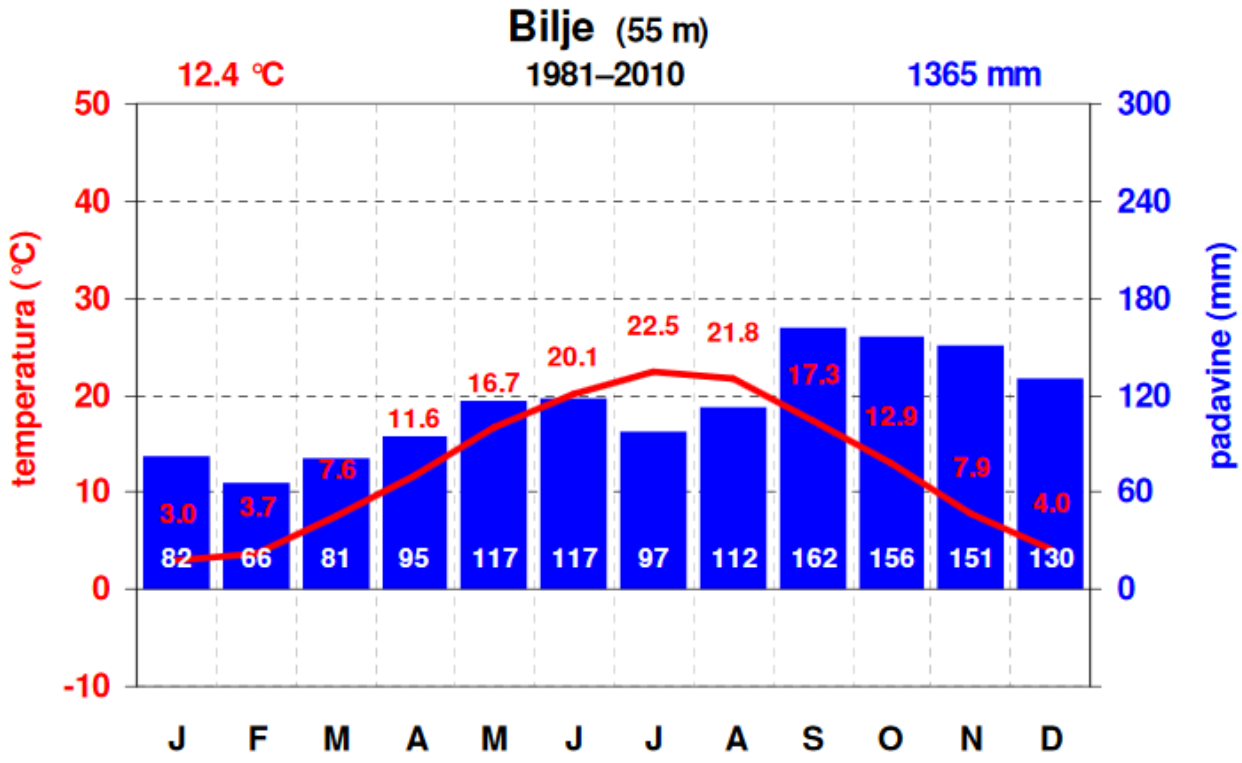


Figure 3: *Diagram for the Bilje Meteorological Station, located in north-west of the Vipava river basin, with average monthly air temperature (red numbers) and precipitation (blue numbers) for the reference period of 1981-2010*

The main water body, the Vipava River, with a length of 47 km and a mean yearly discharge of 17.3 m3/s (the 1971 – 2000 period), has a pluvial or pluvio-nival flow regime. From its right river

bank it is fed by several tributaries with strong karstic springs (e.g. Lijak, Hubelj), which are fed from the wet Trnovo Forest mountain range. The Vipava River has a short but noticeable low flow in late winter due to snowfall in the mountains, a long and persistent low flow during the summer, and two high flows, one in early spring and one in late autumn. Low-scale floods are frequent in the lower part of the valley during late autumn and larger-scale floods occur every couple of years [38].

According to national legislation by the rules on determing and classification for water bodies [39] the Vipava river basin comprises three surface water-bodies (Hubelj, Vipava Brje – Miren, and the Vipava povirje – Brje) and one heavily modified water-body (zadrževalnik Vogršček) according to the EU Water Frame Directive [21].

According to data from the river basin management plan (2015 – 2021) of Slovenia (in preparation) [27], the chemical status of surface waters in the basin is good, whereas the ecological status or ecological potential of the Vipava River is moderate in the lower part and good in the upper part. Ecological conditions of the lower part of the Vipava River are deteriorated due to high levels of nutrients and presence of specific pollutants. The chemical status of three groundwater bodies in the Vipava river basin (Obala in Kras z Brkini, Kraška Ljubljanica, and Goriška Brda in Trnovsko Banjška planota) is good [40]. However, the chemical status of groundwater aquifer system “Vrtojbensko polje” is questionable due to high levels of nitrates [41], which was confirmed also by the ASTIS project [42]. In addition to nitrates, the project’s results also showed increased levels of specific pollutants such as chlorides and sulphates which are of anthropogenic origin in the groundwater aquifer system “Vrtojbensko polje”.

For the implementation of the Floods Directive [31], a total of 56 potentially significant flood risks areas were demarcated in 2012 across Slovenia with regard to human health, environment, cultural heritage, and economic activity [43]. In the Vipava river basin there are five such areas (see Figure 4). According to the preliminary hazard indication map, there is the likelihood of very rare floods1 (estimated in the Vipava river basin in total area of 19.21 km2 (3.3% of the total river basin area) (see Figure 4).

[1] HQ 50 and more means the highest discharge observed – the flood extent is given for return period of 50 years, for extreme weather event [43].

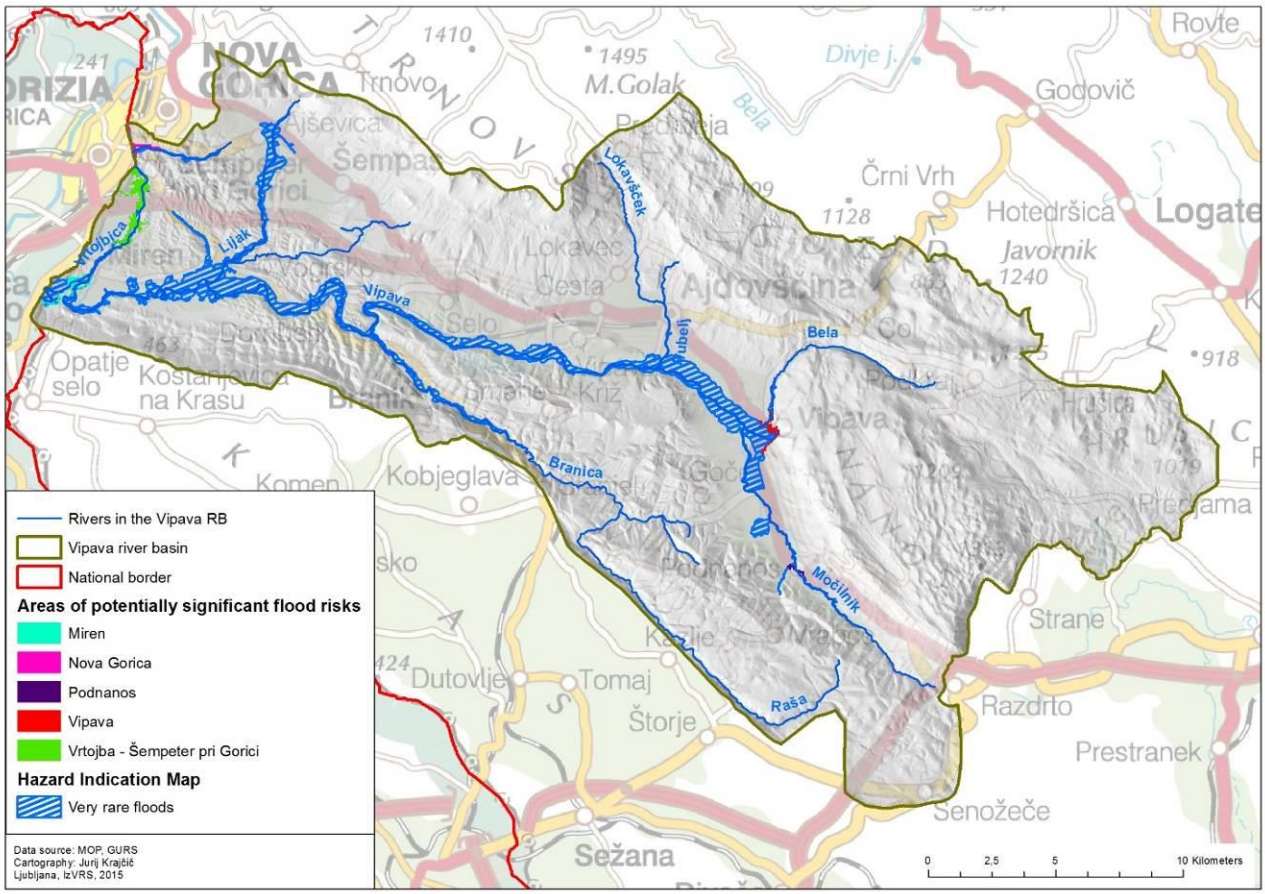


Figure 4: *Areas of potentially significant flood risks and very rare floods (HQ50 and more, marked in blue) in the Vipava River Basin*

The Vipava river basin is one of the areas most profoundly influenced by human activity in Slovenia. The upper stream of the Vipava River and its tributaries were technically regulated in the past because of floods and to increase the area of arable land. With regulation of the Vipava River, flood protection in the upper part of the basin has improved. However due to a quicker run-off towards the lower part of the basin, floods have become more frequent [45] and several catastrophic floods occurred in past years which resulted from changes in the precipitation regime, one of the consequences of climate change. There is one large Vogršček water reservoir, built on a rather weak watercourse with the same name. The total designed volume (both lower and upper reservoir) of Vogršček is 8.5 million m3 of water. Vogršček has been designed to provide water for the irrigation of the lower Vipava Valley, amounting 84.5% of the total usable volume (6.8 million m3). 15.5% of the total usable volume is intended to prevent hydropeaking and flooding during high flows [46]. Although planned (Republic Green plan, 1970-1980) not all the corresponding irrigation systems were constructed. Today's capacity of Vogršček is only 1.8 million m3 per year, which corresponds to possible irrigation of 1,400 ha of agricultural land. Due to Vogršček's sub-optimal functioning (leakage of the barrier, low water level resulting in low pressure for optimal irrigation) only approximately 1.3 million m3 of water per year (1,000 ha of agricultural land) is used for irrigation.

Slovenia is one of the eight Member States that have failed to comply with their obligations under the Urban Waste Water Treatment Directive [47]. The main reason is that municipal wastewater treatment in the basin is not sufficient, which is reflected in poorer ecological status, especially during extreme low flows. Buildings in most of the smaller settlements still have (permeable) septic tanks instead of sewerage systems or small wastewater treatment plants. However, two municipal

wastewater treatment plants (WWTP) with total capacity of 56,500 population equivalents together with sewerage systems were constructed most recently in the basin (1) WWTP Vipava in the upper part of the basin and (2) WWTP Nova Gorica (Vrtojba) in the lower part of the basin. Surface water quality is expected to improve. Nevertheless, more WWTPs are needed in the basin, mostly on a smaller scale.

2.2.1.3 People and water uses

Urbanisation in the Vipava river basin is moderate. There is only one town, Ajdovščina, with more than 5,000 residents. The population density is quite high at the bottom of the valley and lower on the slopes that enclose the valley. The area of the Vipava river basin is divided among eleven municipalities with a total of 172 settlements [48] and a population of approximately 52,000 inhabitants. Three of the municipalities, Vipava, Renče – Vogrsko, and Šempeter – Vrtojba, are located entirely in the area of the Vipava river basin, while most of them are located partly in the Vipava river basin and partly in other river basins (Ajdovščina, Nova Gorica, Miren – Kostanjevica, Postojna, Divača, Sežana, Komen, and Idrija).

Data from water balance in the 1971–2000 period show that the overall water supply is relatively stable and secure. However, there are shortages of surface water during the summer months. Occasional droughts result in damage on crops and in yield loss, but underground aquifers, which make up the vast majority of potable water resources, are rarely notably affected [49].

The total annual runoff of the basin is approximately 545 million m3. Regarding authorized water withdrawals (or abstractions) we distinguish between two terms:

1) water use that describes the total amount of water withdrawn from its source to be used. Uses of surface water include small hydropower plants, aquaculture, fisheries, saw/mill, water used by technological plants, and individual water supply [50].

2) water consumption as the portion of water use that is not returned to the original water source after being withdrawn [51]. In 2013, the total granted water consumption from surface waters through granted water permits amounted around 33.5 million m3, around 6% of all water available from surface waters. Almost all of this quantity was allocated to irrigation (and mostly from the Vipava River).

Drinking water for households is provided by mandatory municipal public utility services (Komunala Nova Gorica d.d. in municipalities Nova Gorica, Šempeter-Vrtojba, Miren-Kostanjevica and Renče-Vogrsko and Komunalno stanovanjska družba d. o. o. Ajdovščina in municipalities Vipava and Ajdovščina) and is obtained from springs (e.g. Hubelj). The total granted withdrawal in the Vipava river basin in 2013 amounted around 6.2 million m3 through water permits. Additional 0.08 million m3 were allocated to individual water supplies. The two uses combined presents more than 99% of all water consumption from springs. An additional granted amount of 3.9 million m3 was allocated to aquaculture [51].

Water use from groundwater sources others than springs is low. In 2013 only 7,000 m3 of withdrawal was granted through water permits for individual water supplies, and additional 64,000 m3 for technological purposes. There were no concessions awarded for use of ground water in 2013 [51].

The importance of hydropower is small. There are nine small hydropower plants in the basin; most of them are on the Vipava River [51].

2.2.1.4 Climate change and expected impacts

In Slovenia, temperature measurements clearly show that the climate is warming [52]. According to the analysis presented by dr. Kajfež-Bogataj in 2005, “in the period 1951-2000, the average annual air temperature increased by 1.1 °C, and during the last 30 years, warming exceeded the limit of 1.5 °C” [53]. Analysis of water balances in Slovenia for the period 1971–2000 [54] show changes in precipitation levels in the last few years, with an increasingly pronounced autumn peak of precipitation and decreased amounts in other seasons. On average, snow cover has become rarer and the snow line has been occurring on higher altitudes, decreasing the amount of water to be retained until spring. Thus, low flows or occasional water shortages in surface waters to the start of the vegetative season have become more common, jeopardising crop yields. Even though the annual precipitation levels do not show any trend, it tends to be ever less equally distributed throughout the year; winters have been getting wetter and summers drier [38] [55] [56]. Evaporation is increasing in comparison to the 1961-1990 period [54]. As a consequence, water flow regimes are changing, with diminishing differences in river water flow regime at regional levels. Water flow trends are generally declining. A comparison of water balance elements in the period from 1971–2000 with those in the 1961–1990 period [54] also indicates an increase in evaporation and a reduction in surface water runoff. The above-listed climate changes on a regional level have not yet caused water shortages in the short term at the regional level, the risks of water provision are increasing locally. Namely, in the last years the Vipava river basin has been experiencing persistent extreme low-flow events during the summer months as well as relatively short but extreme peak discharges during heavy rainfall, causing sometimes devastating torrential floods [38] [56].

Climate change projections for Slovenia published by the Slovenian Environment Agency in 2008 [57] suggest that the average annual temperature in the Vipava Valley could increase by around 1.3 °C under the scenario A1B (Special Report on Emissions Scenarios (SRES)) by 2030 (see Figure 5 also for other scenarios). It should be noted that this increase differs between various models used to make these projections. The biggest positive trend in temperature is seen during the summer months [58]. The increase in temperature is accompanied by a reduction of precipitation in the summer and increases in the winter. Under the scenario A1B approximately a 2% rise in precipitation for winter months and a 4% reduction for summer months until 2030 is projected (see Figure 5) [58]. Moreover, summer precipitation tends to decrease with shorter but more intense rainfall with storms and torrential downpours, causing rapid surface run off of precipitation water with little infiltration into the soil.

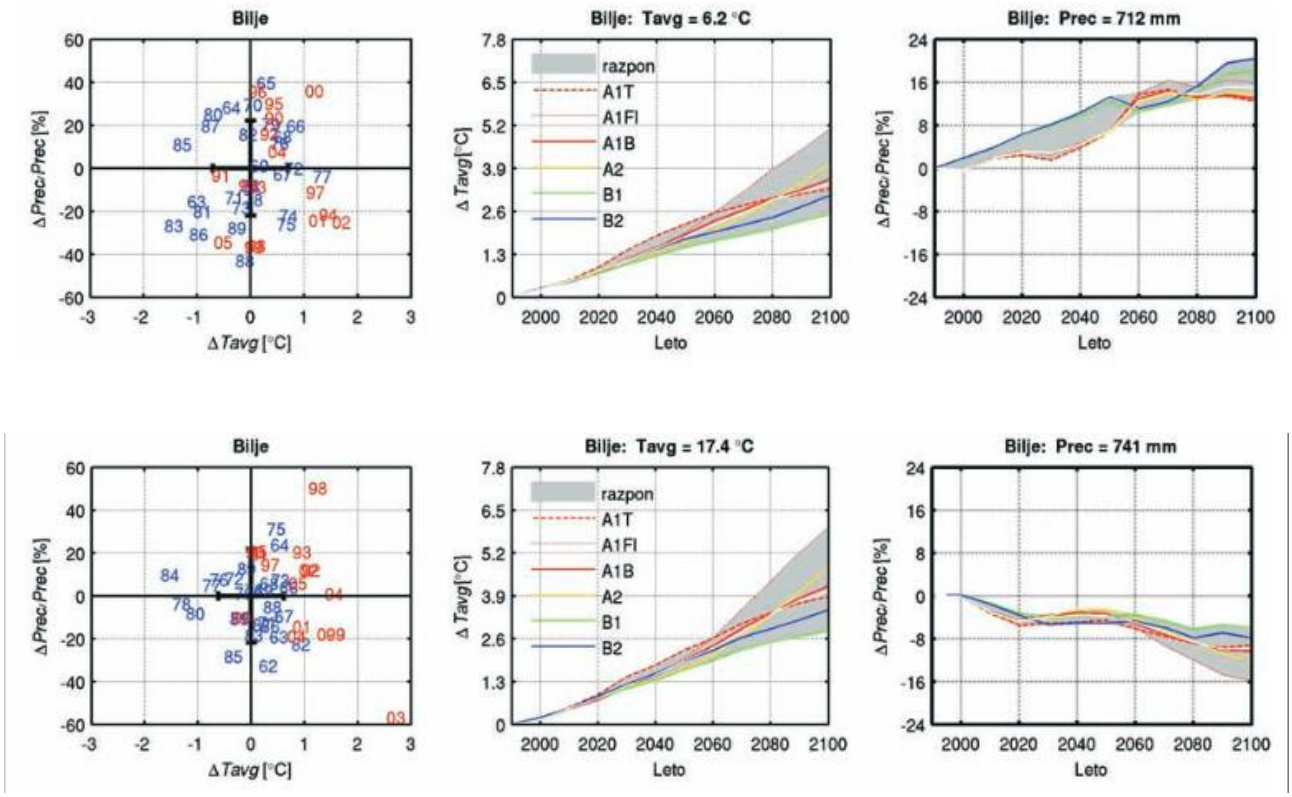


Figure 5: *Distribution of years in the period 1961-2005 according to the variations in average air temperatures (Tavg) and precipitation (Prec), in the cold (October-March) and warm (April-September) halves of the year. Cold half of year is shown above and warm half of year is shown below.*

Average in the 1961-1990 period for Bilje Meteorological Station (located 7 km south from Nova Gorica) together with the indicative projections of changes in air temperature (Tavg: middle) and precipitation (Prec: right) through the end of the 21st century, according to different scenarios of greenhouse gas emissions (SRES A1B, A1T, A1FI, A2, B1, B2).

2.2.2 Policy Context

The existing policy framework is an important starting point for river basin adaptation planning. It directs the actors' existing efforts in solving the issues at stake by complying with set objectives. Hence, the existing policies can present synergies for the implementation of further actions that are aligned with the policies' objectives and support the implementation of proposed adaptation options. This support can be based on regulatory, financial, or information-based mechanisms and instruments. Identified opportunities and barriers for the implementation of individual adaptation options prepared for the Vipava River Basin Adaptation Plan are outlined in chapter 2.4 and Part 2.

The main water management policy in the EU is the Water Framework Directive [21]. The Republic of Slovenia has completely integrated the Water Framework Directive into national legislation through the Waters Act [59]. Besides the Water Framework Directive, other directives such as the Bathing Water Directive [60], Floods Directive [31], and Marine Strategy Framework Directive [61] have been transposed in the national Waters Act [59].

Ministrstvo za okolje in prostor (The Slovenian Ministry of the Environment and Spatial Planning) is the country's main institution in water management and is responsible for preparing and implementing environmental policies and legislation. This Ministry is responsible for implementing the Water Framework Directive and preparing the river basin management plan. Adopted in 2011, the river basin management plan (2009–2015) [28] together with the programme of measures [29] is a national strategic planning document for water management. The river basin management plan specifies the mechanisms for carrying out policies by which the good status of water bodies will be achieved. Based on the determination of characteristics and status of river basin districts, and on management objectives in water protection, water management and water use are defined. In Slovenia there are two basin districts: the Danube basin district and the Adriatic sea basin district. The Vipava river basin as part of the Soča river basin belongs to the Adriatic sea basin district [28].

There are four institutions affiliated to the Ministrstvo za okolje in prostor [62]; the Direkcija za vode Republike Slovenije (Slovenian Water Agency), the Agencija Republike Slovenije za okolje (Slovenian Environmental Agency), the Geološki zavod Slovenije (Geological Survey of Slovenia) and the Inštitut za vode Republike Slovenije (Institute for Water of the Republic of Slovenia) that was in charge of the development of this plan. The Direkcija za vode Republike Slovenije and the Agencija Republike Slovenije za okolje are actively involved in drafting the next river basin management plan for the period 2016-2021 by providing the requisite expert bases. The Geološki zavod Slovenije provides support in data analysis and expert knowledge on groundwater. The Inštitut za vode Republike Slovenije is preparing methodologies related to the development of a river basin management plan. A new river basin management plan for the period 2016-2021 is in preparation and is planned to be finished and adopted in 2016.

The Direkcija za vode Republike Slovenije performs administrative, expert and developmental tasks in water management, in accordance with the regulations governing water. It performs tasks as a spatial planning authority in water management, as a consent authority, and other tasks within the context of spatial planning procedures, building construction, and environmental impact and other assessments. The Direkcija za vode Republike Slovenije, together with a concessionaire selected on the basis of a public tender, provides the water management public service. The Agencija Republike Slovenije za okolje conducts expert, analytical, regulatory, and administrative tasks related to the environment at the national level, except for tasks that are in the responsibility of the Direkcija za vode Republike Slovenije.

The Ministrstvo za okolje in prostor is responsible also for the preparation and implementation of flood risk management plan 2015-2021 (in preparation) [63]. The Flood risk management plan is a separate document from the river basin management plan and is expected to be adopted in 2016.

Apart from the Waters Act, other policies are related for water management.

The Decree on the protection of waters against pollution caused by nitrates from agricultural sources [64], which is an executive act of the Environmental Protection Act [65], and in accordance with EU Nitrates Directive [66]. It sets threshold values for nitrogen input from agricultural sources into agricultural soils and includes measures to reduce and prevent water pollution caused by nitrates from agricultural sources. In accordance with the Nitrates Directive [66], the entire territory of the Republic of Slovenia is designated as a Nitrate Vulnerable Zone.

The Decree on groundwater status [67], is another executive act of Environmental Protection Act, and is in accordance with EU Groundwater Directive [68]. It sets among other parameters the chemical and quantitative status and groundwater quality standards.

The operational program of discharge and municipal wastewater treatment for the period 2005-2017 [69] was prepared in accordance with Urban Waste Water Treatment Directive [47]. The Direkcija za vode Republike Slovenije is currently preparing a new operational programme.

Another important plan, affecting management also in the Vipava river basin, is the Natura 2000 Management programme for Slovenia for the period 2015-2020 [70], adopted in April 2015 and prepared by the Ministrstvo za okolje in prostor. Expert input was provided by the Zavod za varstvo narave Republike Slovenije (Institute for Nature Conservation of the Republic of Slovenia). The Natura 2000 Management programme is important for water management as many species and habitats are dependent on water. The framework for this programme is made up by the Birds Directive [71] and Habitats Directive [72], which are transposed in the national Nature Conservation Act [34].

Since 2008 the Slovenian agriculture and forestry strategy of adaptation to climate change and its implementation document (Action plan, 2011) [73] have been in force. Primarily it is focusing on building capacity to manage the adaptation of agriculture and forestry, education, raising awareness, consulting to farmers, and the maintenance and acquisition of new knowledge on adapting to climate changes. The strategy outlines, technological measures to reduce the vulnerability of agricultural production to drought (2008) and to reduce the impact of drought in cultivation of maize. It contains a map of agricultural land (cultivation of maize) in risk of drought, that was prepared in 2014. Nevertheless, an overall national strategy including all sectors and policies is still missing. The current practice in the occurrence of drought as a natural disaster is mainly targeted at mitigating the impacts (economic loss/economic drought). To overcome this gap, Slovenia prepared in 2014 a draft assessment of climate change risks and opportunities as a basis for the climate change adaptation action plan. This assessment will, based on climate scenarios, serve as a basic document for drafting action plans (period 2020 - 2030) and guidelines for administrators involved in water management at local, regional, and national levels.

Besides the Ministrstvo za okolje in prostor also the Ministrstvo za kmetijstvo, gozdarstvo in prehrano (the Slovenian Ministry of Agriculture, Forestry and Food of the Republic of Slovenia) is relevant for water management. The Ministrstvo za kmetijstvo, gozdarstvo in prehrano performs inter alia tasks in the areas of agriculture, rural development, plant protection, forestry, hunting and fisheries. The Ministrstvo za kmetijstvo, gozdarstvo in prehrano is also responsible for the implementation of the EU common agricultural policy. The current rural development programme 2014-2020 focuses on two main areas: i) improvement of biodiversity, and ii) improvement of water status and soil quality [74].

The Ministrstvo za kmetijstvo, gozdarstvo in prehrano has on the basis of the Freshwater Fisheries Act [75] adopted the programme for the management of fish in inland waters of the Republic of Slovenia in 2015 [76]. This programme is the basis for the fisheries and farming management plans [77], which are prepared by the Zavod za ribištvo Republike Slovenije (the Fisheries Research Institute of Slovenia) with the help of local fishing clubs. The fisheries and farming management plans, still in preparation, form the basis for the annual programs [78]. Expert bases for the programme for the management of fish in inland waters of the Republic of Slovenia are provided by the Zavod za ribištvo Republike Slovenije.

Representatives of the Ministrstvo za okolje in prostor, the Agencija Republike Slovenije za okolje and the Ministrstvo za kmetijstvo, gozdarstvo in prehrano have been directly or indirectly involved in the preparation of the Vipava river basin adaptation plan by providing relevant information on water use conflicts and the desired state for the Vipava river basin. Policy-makers within the Ministrstvo za okolje in prostor and the Ministrstvo za kmetijstvo, gozdarstvo in prehrano have also provided information on the current situation of adaptation to global change at national and river

basin level. They also provided their experience with public participation in the design of policies and potential conflicts that may appear.

2.2.3 Main Challenges

The challenges identified by stakeholders during the first stakeholder workshop were analysed and consolidated by the BeWater project team into three overarching challenges that the Vipava river basin is facing: (a) Water availability during droughts in growing season, (b) Flood risk reduction, (c) Appropriate water quality.

➢ Challenge A: Water availability during droughts in the growing season

The main challenge indicated by stakeholders is water availability in irrigation networks and rivers during drought occurrences, especially in the growing season. In the Vipava river basin meteorological, agrometeorological and hydrological droughts are present, each having a specific impact on the environment. The adverse climate conditions (higher temperatures and reduction of precipitation in in the warmer part of the year) will aggravate risks of water shortage in the future even more.

When droughts occur, a variety of activities, sectors (water users) and ecosystems can be severely impacted by water shortage, especially agriculture. When farmers can no longer use water to irrigate their crops from the two main water sources, the Vipava River and Vogršček water reservoir, they potentially use potable water, which can cause some problems with the drinking water supply, especially in the summer months. Furthermore, when droughts occur, they can also cause damages to water distribution systems infrastructure – damaged, broken water pipes, causing unavailability of drinking water in some areas of the Vipava river basin.

Although the water demand for households is expected to stay at approximately the same level, water demand for agriculture, especially irrigation, is expected to rise in the years to come because of expected drier summers and due to plans encouraging irrigation and consequently decreasing the vulnerability of crops to droughts [79].

The main reasons why water is unavailable during droughts in growing season are listed below:

I. Droughts have been always present in the Vipava river basin in the past. Due to the impacts of climate changes they have been occurring more frequently in the last few years, thus affecting larger areas. Beside climate changes, the changed water cycle in the river basin is also a result of extensive regulations of watercourses (Vipava, Hubelj, Lijak) in 1980s and earlier, and amelioration works that drain excess water the from soil. The consequences are more rapid surface water runoff from the basin, increased flow velocity, the decreased retention functions of the riverbed and soil, and reduced water infiltration, causing a lower groundwater level.

II. Although several water reservoirs and irrigation systems were planned to be constructed in the Vipava Valley (e.g. Branica, Pasji rep, Močilnik, Malenšček-Kamenski potok, Vrtovinšček, Lokavšček, Košivec) in the 70s, due to a program to increase the level of self-sufficiency in food (called Republic Green plan, 1970-1980) only the Vogršček water reservoir with corresponding irrigation systems for the lower part of the valley were actually constructed. The reasons were the changed priorities of the Republic of Slovenia and thus the available funds at that time were transferred into the construction of highways. After that, several plans of different water reservoirs were discussed, but not yet realized.

III. The Vogršček water reservoir was a major intervention in the valley's water cycle, yet with undesirable results, attracting political and professional criticism for many years. The main problem is unclarified ownership of the reservoir and its infrastructure between government and the private sector, which, in the past 20 years, has resulted in poor management, improper functioning, lack of operation and maintenance funding. The result is (for details see sub-chapter 2.2.1.2) lower capacity compared to planned volume for irrigation. Together with illegal connections to irrigation system there is less water available for proper management of the irrigation system. According to stakeholders there are many challenges that need attention regarding Vogršček among which the most important are (a) better understanding of the system functioning, (b) more transparent functioning of the system (with no illegal connections), (c) better cooperation among users (16 irrigation communities), (d) organization of optimal irrigation (irrigation time plan), and (e) technological renovation and modernization of the reservoir and connected irrigation systems.

IV. The Vipava River, as the only water source for irrigation in the upper Vipava river basin, is dependent on rainfall (flow is directly dependent on the precipitation regime in the catchment area). In dry periods, when water is needed for agriculture, there are restrictions for water abstraction from the river due to maintenance of the ecological flow (Water Framework Directive). Nevertheless, illegal water abstraction from the Vipava River occurs even during low flows, thus exacerbating the negative impacts of drought on aquatic, riparian, and wetland ecosystems (reduced water flow, flow cessation, eventually complete desiccation; resulting in not achieving good ecological status of surface waters according to Water Framework Directive). Already, some experts have claimed that the irrigation needs in the Vipava Valley are greater than the available water quantities and other water sources besides the Vogršček water reservoir would be needed.

In the framework of the Republic Green plan (1970-1980), shelterbelts (wind barriers) were planted to minimize the impact of wind on agriculture by reducing evaporation and the impact of summer winds on soils (drying, loss of water in soil). Due to the illegal removal of already planted shelterbelts by farmers (lack of awareness) and improper agricultural practice, the deflationary effects of the bora wind are even stronger, especially in winter.

➢ Challenge B: Flood risk reduction

Floods have always occurred in the Vipava river basin and pose a bigger problem in the lower part of the river basin. Due to impacts of global change, changes in the river regime as a result of regulations of the watercourses in 1980s and building of settlements too close to the watercourses (deprivation of riparian area), severe floods are occurring more frequently and at a larger scale. Trapped and rigidly regulated watercourses (concrete banks) in the upper valley lack the needed space (floodplains) and the ability to reduce the flow velocity; hence water rapidly drains downstream causing severe floods in the lower valley.

One of the main challenges identified by stakeholders regarding flood risk management is the lack of competences between local and national authorities mostly due to unclear legislation. Most problematic are smaller watercourses not recorded in the water cadaster or the water cadaster is not properly managed at all. Additionally, municipal spatial planning and its effect on flood occurrence must be mentioned in any discussion of flood risks in the Vipava river basin. In the Vipava river basin there are eleven municipalities, but not all of them are affected by floods. Each municipality manages its own area without considering the impacts of their measures upstream or/and downstream of the watercourses and thus increasing flood risks outside their area.

Landslides, which occur everywhere in the Vipava Valley on a sloped terrain, have also an impact on floods occurrence although indirectly. The biggest and most dangerous areas for landslides occurrence are on the northern slope of the valley that descend from the Trnovo Forest (Trnovski gozd) into the valley. The landslides and also many other slope-movement phenomena originate in the current geological structure of the valley and in the formation of the terrain. However, most landslides are triggered by heavy rainfall.

Due to inappropriate spatial planning in the Vipava river basin, urbanisation of the valley slopes has increased the possibility of triggering landslides mostly due to the inappropriate regulation of storm water and hinterland water drainage. Also poor maintenance of the drainage system built more than 30 (or 50) years ago, like regulations of torrents and inadequate drainage of storm waters, contribute to triggering landslides more often. Landslides do not only threaten buildings and infrastructure, but also cause morphological changes of the terrain. Landslides often move large amounts of sediments, which does not only stay on the slopes, but also reach the fluvial network. Under extreme weather conditions, landslides may lead to torrential outbursts, debris flows or dam-break waves after a dam-breach of natural dams. As a result, floods of larger scope can occur.

➢ Challenge C: Appropriate water quality

The ecological status of the Vipava River is moderate due to high levels of nutrients and presence of specific pollutants (insufficient municipal wastewater treatment and agriculture).

One of the main reasons for the unsuitable water quality in the Vipava river basin is insufficient municipal wastewater treatment. To solve the current situation and most importantly due to compliance with legislative requirements, two waste water treatment plants (WWTPs) were constructed recently, in the upper valley WWTP Vipava (at the stage of trial operation) and in the lower valley WWTP Nova Gorica (Vrtojba). However, there is still unsolved problems of insufficient municipal wastewater treatment in small and dispersed settlements. This problem is evident in the catchment area of the Vogršček reservoir where monitoring of water quality confirmed presence of faecal coliforms [80]. The source of contamination are most probably septic tanks overflows in the catchment area. Since water in the Vogršček water reservoir occasionally contains too many coliforms, the use of water for irrigation purposes is limited. In the case of the Vogršček reservoir stakeholders have also highlighted the improper connection of the irrigation system to the floor outlet, resulting in (a) exceptionally cold water unsuitable for irrigation, and (b) water full of sediments unsuitable for irrigation (fruits like peaches and vegetables must be cleaned constantly) [81] [82]. These issues add to the challenge of water availability (challenge A).

When Vipava River and its tributaries (Lijak, Hubelj, etc.) were regulated and canalized in 1980s in order to increase area of arable land, the length of the Vipava River was shortened from 50 to 47.7 kilometres mostly due to the elimination of meanders. With regulations, many habitats for aquatic and riparian plants and animals disappear. The result is lower self-cleaning ability of watercourses resulting also in moderate ecological status.

In connection with the already mentioned excessive water abstraction from the Vipava River for irrigation, problems with maintaining ecologically acceptable flows and in this context achieving a good ecological status become an issue when droughts occur.

A pre-condition for water ecotourism development like natural bathing sites on the Vipava River is appropriate bathing water quality. With bathing waters on the Vipava River microbiologically unsuitable, the desired ecotourism cannot develop.

2.3 Participatory development of the River Basin Adaptation Plan

2.3.1 Development process

The development of the river basin adaptation plan for the Vipava river basin is the result of an intensive stakeholder engagement process. The participation and integration of a wide group of stakeholders from various sectors throughout the whole development process has had a crucial role in the identification and evaluation of water management options and all the necessary preparatory steps which took place in an iterative way.

Due to inherent project limitations [83] together with challenges with different levels of knowledge, and differing values, assumptions and terminologies among experts, scientists and stakeholders, a methodology for identification and selection of stakeholders was developed [83] with the help of the Stakeholder Integrated Research (STIR) approach [84]. As such a supporting management tool in the form of a stakeholder database was created [83] and used for the identification of all relevant stakeholders depending on the objective of the stakeholder engagement process.

A wide range of stakeholders were part of process, actively participated and provided concrete input to the identification, formulation and evaluation processes of water management options in several stages of the participatory co-creation process that included three professionally facilitated workshops, follow-up interviews, individual and group sessions, and an additional open consultation. Parallel to the stakeholder engagement, an awareness campaign in the form of tailor-made mobile exhibition took place in the Vipava river basin with the aim of raising social awareness and to encourage capacity building, empowerment, and social formation in water management challenges and adaptation (see Annex I and II for details). A detailed methodological overview with a graphical representation and detailed description is given in chapter 2.3.2.


Development of river basin
2014
January–March
April–June
1st general project meeting in Barcelona
Identification and mapping of river basin stakeholders and key actors
1st stakeholder workshop on identifying the current and desired status of the river basin
Review and analysis of river basin adaptation plans and strategies from around the world
2015
January–March
April–June
Stakeholder consultation on draft narratives and the basin's graphical representation (fuzzy cognitive map)
Finalisation of river basin narrative, fuzzy cognitive map, and main challenges
Formulation of water management options to tackle challenges
2nd stakeholder workshop on evaluating water management options
2016
January–March
April–June
Characterisation of policy and stakeholder basis of water management options
Assessment of water management option synergies and co-benefits
Design of draft bundles of water management options
3rd stakeholder workshop on desired content and implementation of the River Basin Adaptation Plan
Finalisation of adaptation pathways and bundles of water management options


adaptation plan
BeWater
Society Adapting to Global Change
July–September
October–December
Stakeholder interviews on the river basin context and challenges
2nd general project meeting in Nicosia
July–September
October–December
Finalisation of water management options
Impact assessment, multi-criteria analysis and economic assessment of water management options
Stakeholder consultation event to present and gather opinions on final water management options
3rd general project meeting in Barcelona
Finalisation of impact assessment, multi-criteria analysis and economic assessment
July–September
Completion of River Basin Adaptation Plan
Next steps
Development of policy recommendations to support river basin adaptation
Compilation of lessons learned during the River Basin Adaptation Plan development process
Local policy forum to present river basin adaptation plan and highlight potential paths forward
European policy workshop in Brussels to highlight BeWater outcomes and key messages for policy makers
River basin adaptation conference and final project meeting in Nova Gorica, Slovenia

2.3.2 Methodological steps followed


BeWater
Society Adapting to Global Change
EVALUATING OPTIONS
To evaluate the water management options, the stakeholders select the criteria on which the options will be evaluated, as well as the relative weight of each criterion. The information from the multi-criteria analysis is combined by scientific experts with the outcome of the options' impact assessment and results in the identification of options that have a desirable impact on the river basin, according to the local stakeholders.
Which options have desirable impacts on the river basin?
Assess the impacts of the options through the qualitative model
REVIEWING THE POLICY FRAMEWORK
Policies and programmes on the local, national and EU level can hinder or support the implementation of the options. Their potential role is determined by a scientific expert evaluation of whether the policy objectives, targets and timescales are in line with those of the options, what funding is available, and if eligibility or selection criteria create barriers to adopting the options.
How do the options fit within the relevant policy and decision-making frameworks?
Evaluate the options based on multiple decision criteria
IDENTIFYING POLICY ACTORS
As local stakeholders and policy actors will be directly involved in or affected by the implementation and maintenance of the options, their willingness and capabilities to support the implementation of the options are important to inform the selection and design of options. They are validated via interactive exercises with them.
How could stakeholders be involved in the implementation of the options?
Evaluate the role of existing policies in the implementation of the options
BUNDLING OPTIONS
Implementing multiple options together can result in different impacts than the individual options would produce on their own. These potential interactions are assessed using scientific expert judgment and validated via interactive exercises with the local stakeholders. Using these outcomes, previously determined basin challenges and main sectors affected by these challenges, the options are grouped into bundles.
Which synergies or conflicts arise between the options and how can they be grouped together?
Identify key stakeholders and their potential roles in implementing the options
DEVELOPING AN IMPLEMENTATION TIMELINE
The timeline for implementing each of the options within a bundle is based on their effectiveness over time, local stakeholder preferences and the policy framework. Developing the timeline for implementation takes into account factors such as feasibility, acceptability, Multi-Criteria Analysis results, costs, policy synergies. The initial scientific expert assessments were verified by the local stakeholders.
When should the options be implemented?
Assess co-benefits and conflicts arising between options in order to group them in bundles
FINALIZING THE ADAPTATION PLAN
Based on existing examples of adaptation plans in other river basins and an open dialogue between stakeholders and academics, the content and design most relevant to the local reality in the river basin are determined and integrated into a tailored river basin adaptation plan.
How can all this information be integrated and presented in the most effective way?
Assess the optimal timing for implementing the options
River Basin Adaptation Plan

The first step of the stakeholder engagement process was to identify relevant stakeholders in the Vipava river basin. With the selection criteria (e.g. gender, age, organizational affiliation and sector) stakeholders from national to local level, including civil society, scientists, public administrators (policy makers and implementers, institutional administrations and local governments), water sector actors (e.g. service providers) and other related sectors (e.g. agriculture, tourism, energy) were identified [83]. Afterwards, direct contact through e-mail, phone, and meetings was established.

Further information on the methodology and results introduced within this adaptation plan, as well as the BeWater project more generally, can be found on the project website (www.bewaterproject.eu).

Within the project three stakeholder workshops were organized. Objectives, outcomes, and other details are summarized in table 4.1.

Table 4.1: *Table of conducted workshops*

Date and title of workshop	No. of participants and sectors	Objectives	Outcomes
10th June, 2014 **1st Stakeholders Workshop**	32 a) water management, b) agriculture, c) public administration, d) infrastructure, e) energy, f) nature conservation, g) tourism, h) fishery, i) health, j) business and economy, k) civil society, l) municipalities.	a) Inform stakeholders about the BeWater objectives and expected results b) inform stakeholders on what is known about the current status of the Vipava river basin and expected impacts of global change c) gather information on stakeholder perspective of the issues and challenges in Vipava river basin in the medium-long term d) to clarify objectives (vision) for the Vipava river basin for 2030 e) to discuss on water management options aimed at achieving those objectives in the Vipava river basin by 2030	Three main challenges were identified: a) water availability during droughts in growing season; b) flood risk reduction; c) appropriate water quality.
27th May, 2015 **2nd Stakeholders Workshop**	12 a) agriculture, b) public administration, c) water management, d) municipalities.	a) To discuss the progress of the Bewater since the first workshop (June 2014); b) To collect stakeholders' comments on the formulated water management options based on the input of the first workshop; c) For stakeholders to evaluate the options through a social evaluation in a form of an on-the-spot multi-criteria analysis.	a) Selection of 13 criteria for assessing MCA; b) determination of relative importance of selected criteria; c) on-the-spot multi-criteria analysis was performed and results were discussed.
23th March, 2016 **3rd Stakeholders Workshop**	21 a) nature conservation, b) regional development, c) municipalities, d) education, e) agriculture, f) water management.	a) Identification of potential synergies and conflicts between water management options; b) Revision of prepared bundles by stakeholders; c) To discuss potential implementation barriers and opportunities.	a) Determination of synergies and conflicts between water management options; b) final selection of water management options in bundles; c) final timeline for implementing individual water management options.

At the first workshop experts provided participants information on the status of Vipava river basin and results of scientific research on the impacts of global change in the basin, with a 2030 horizon. Afterwards participants were asked to identify a medium-to-long term challenges for the Vipava river basin and their vision on its future status. In addition, participants proposed several preliminary options to address these challenges. Analysis of the first workshop showed some informational gaps, which were tackled by 14 additional interviews in October and November 2014 with policy representatives and key stakeholders that were not able to attend the first workshop. The objective of the interviews was to gain information about the current situation of adaptation in the region, personal experience with public participation in the design and especially the implementation of policies/natural resources management, and potential challenges that may appear.

The information collected on the current state and the future expectation regarding water management (according to the stakeholders) in the Vipava river basin was organized and synthesized by building a narrative of the Vipava river basin. This narrative was complemented with a graphical representation in the form of a fuzzy cognitive map (see [85] for details).

Text box 2: Description of the fuzzy cognitive mapping method

To evaluate the water management options against the three challenges expressed by the stakeholders, a method called Fuzzy Cognitive Mapping was applied. A Fuzzy Cognitive Map is a graphical representation of a system - in this case the Vipava river basin - where the components (factors) are represented as boxes and relationships as arrows. The arrows reflect the sign and strength of the relationships between the factors. The map is cognitive because it represents the dynamics in the system based on the understanding of individuals. Fuzzy cognitive maps allow all the information available on the basin to be organized in a clear way to illustrate the current status in the basin: main challenges at stake, drivers that influence them and their relationships in the system. The maps were constructed with inputs from stakeholders from different backgrounds. Besides clearly describing the river basin, the map was used to assess the impacts of the water management options on the river basin. In this way, the BeWater Project team was able to estimate of the impacts of the water management options and their effectiveness towards each of the three challenges.

The initial map prepared was consulted with the stakeholders (February 2015). Overall 19 stakeholders, also present at the first workshop or included in the additional interviews that followed, commented and suggested improvements of the map which resulted in factors and relationships being added or modified. After that a final map was produced (see Figure 5).

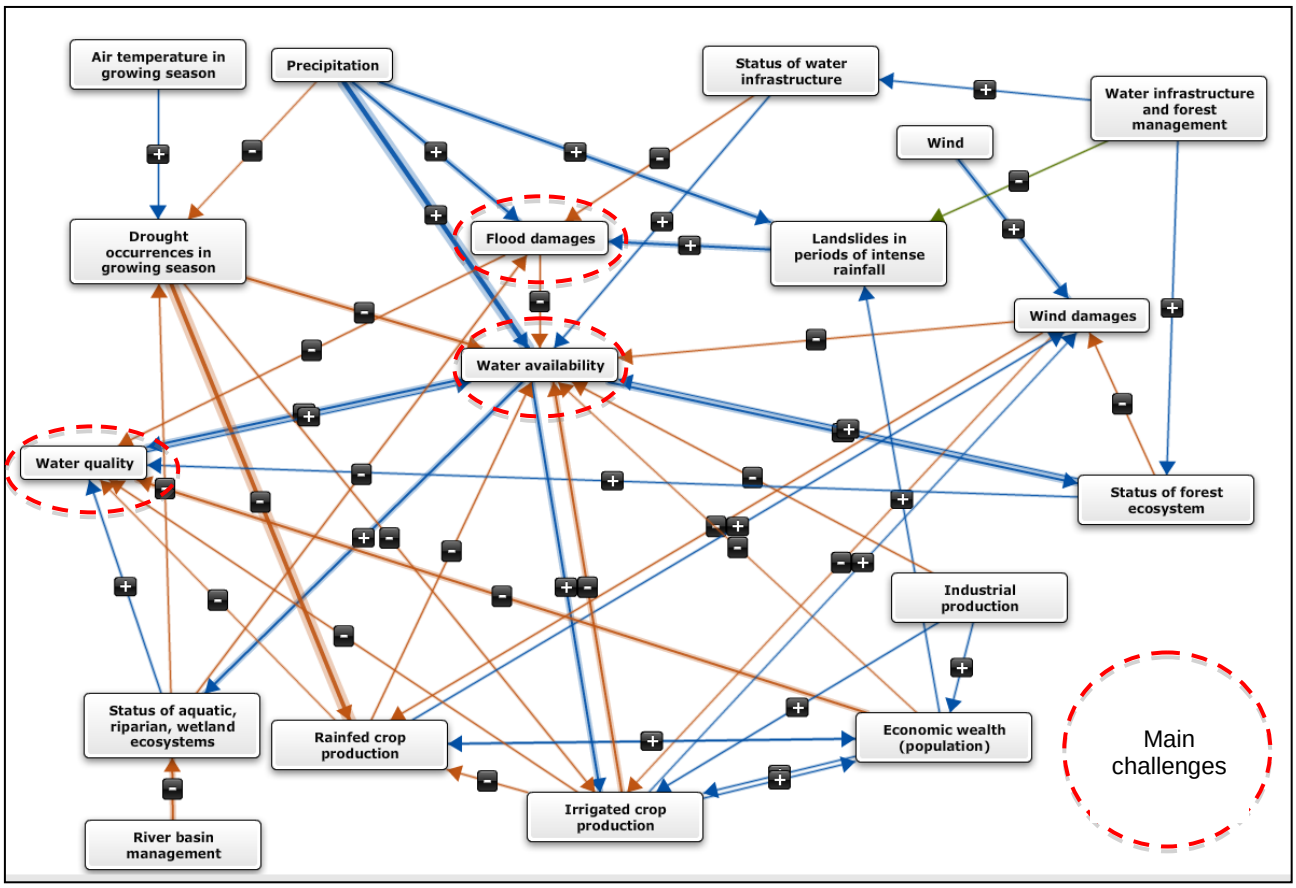


***Figure 5**: Fuzzy Cognitive Map of the Vipava river basin with identified three overarching challenges*

Next, water management options suggested by stakeholders during the first workshop were characterised using a fixed set of descriptors that mainly refer to the implementation of water management options (the parts of the RB, the sectors and land uses concerned, time frame, costs, type of approach, feasibility, acceptability, the relation to global change and to extreme weather events). This format allowed to cluster long list of options, based on the similarity of descriptors and challenges that they address in a refining process. By clustering water management options, based on the similarity of descriptors and challenges that they address and refining process, 21 options were developed to the point that allowed further analysis. A so-called impact analysis of individual options was conducted by experts using a fuzzy cognitive map (see Text box 2).

In the second workshop the 21 formulated water management options were presented to the participants. In order to evaluate and rank the formulated options from most to least preferred, participants selected 13 criteria and determined their relative importance by assigning points from one (1) to ten (10), with ten (10) representing the greatest importance and zero (0) if a criterion was not considered important. Once the stakeholders had selected and weighted the criteria, they were asked to review scoring functions for the criteria [83]. Afterwards an on-the-spot multi-criteria analysis was performed and discussed.

Text box 3: Description of multi-criteria analysis

Water management options have quite different characteristics and impacts on the water basin and local communities. Selecting the specific options that should be included in the river basin adaptation plan is a complex endeavour. To support this process, a participatory multi-criteria analysis was conducted. During a workshop, stakeholders were asked to select the evaluation criteria to decide how well options perform, as well as the importance of each of these criteria in relation to each other. Criteria referred to both the design of the water management options and their expected impacts on the river basin, as estimated with the fuzzy cognitive map. The scores and weights of the criteria given by the stakeholders were combined with the characterization of the water management option and the outcomes of the impact assessment to evaluate the water management options prepared by experts and the research team. The evaluation results are presented on a scale of 0-100 with a 0 indicating the least preferred evaluation outcome and a value of 100 as the most preferred evaluation outcome.

After performing the analysis, the outcomes of the multicriteria analysis were discussed, allowing for the integration of participants' perspectives for interpreting the final prioritization of options. The main comments of the stakeholders were that some individual water management options were ranked as high or low, depending on which of the three challenges they address. Experts reviewed all the comments carefully and where needed changes in impact assessment were made. As for the comments on the list of water management options, participants expressed some doubts about one particular option, which was later deleted, and a list of 20 water management options remained. The overall results of the multi-criteria analysis are shown in the figure below. For each option, evaluation results are presented as described in the description of Multi-criteria Analysis (see Text box 3).

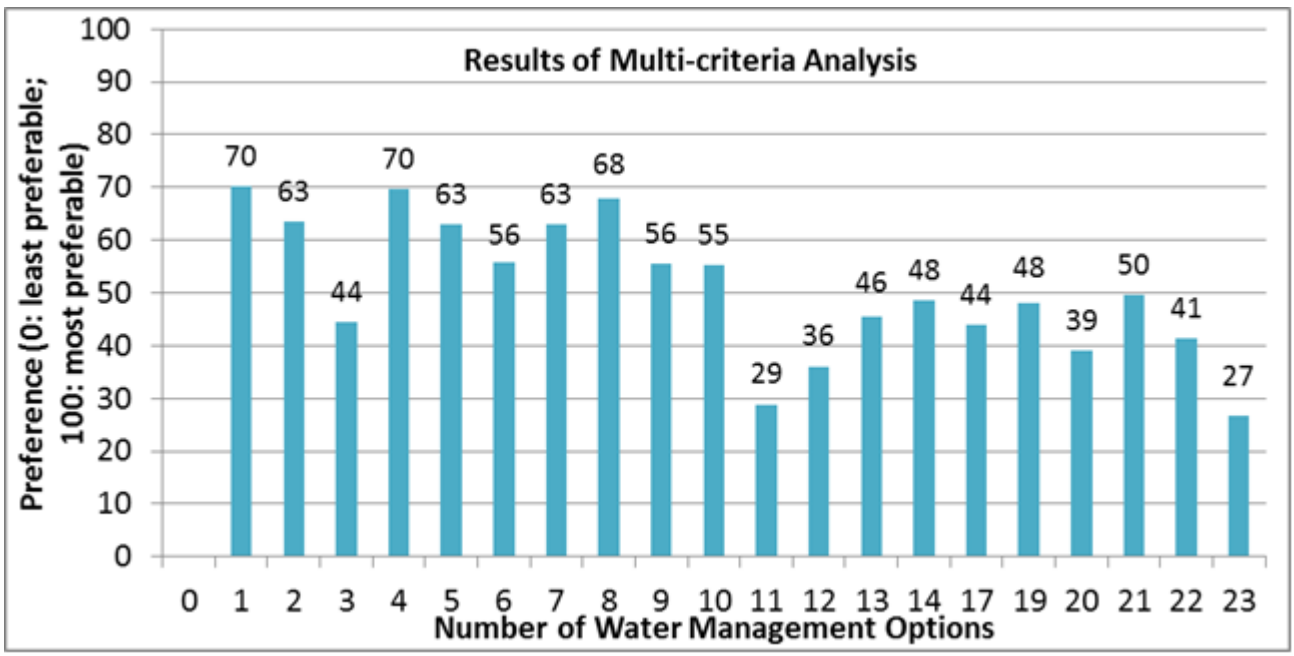


Figure 6*: Results of Multi-criteria analysis based on criteria (and their changes) derived from the Fuzzy Cognitive Map and the impact assessment. Numbers refer to the water management options in Table 4.2*

In the process of characterisation of water management options, a more detailed description on the steps or actions was developed by experts. This was the basis for an economic analysis or so called cost assessment from the beginning of their implementation plan (2018) towards 2030, i.e. a 13-year time horizon, which was the same for all water management options and could correspond to the project's objectives. The information on steps and costs for each water management option can be found in Part 2. The results of this assessment are considered to be indicative only, because a detailed assessment for 20 options was not feasible with the given project resources. Hence, the results of the cost assessment must be interpreted with care. A more detailed assessment of costs and benefits is recommended before these options could be implemented.

The objectives of the open stakeholder consultation (October 2015) was to present the latest version of the water management options; to receive feedback and collect input for further substance to options with an eye on validation and implementation, to sequence options (in the years from 2018 to 2030), and to disseminate current outcomes of the BeWater project. There were 16 participants actively attending the event, representing public administration, forestry, nature conservation, industry, and agriculture. The participants suggested some improvements for implementations steps that were considered in the descriptions of the water management options and additional or different implementation bodies. Some participants have already indicated various combinations of options. At the end, participants had the opportunity to indicate a timeline for the implementation of the individual water management options.

Afterwards, experts identified potential co-benefits between the individual options. Co-benefits were identified if the combined implementation of options amplified the total impact-related benefits, compared to the benefits gained from implementing each option individually. Based on the co-benefits, seven bundles were formulated. With the help of a methodology developed among the experts, optimal timing for implementing individual water management options within each bundle was prepared. The so called ‘‘adaptation pathway’’ is a combination of options and their implementation prioritisation over the short, medium, and long-term, with regards to achieving a set of pre-specified objectives under uncertain changing conditions [86]. The ‘‘adaptation pathway’’ takes into account factors like policy synergies, co-benefits or conflicts between the options, acceptability, feasibility, results from multi-criteria analysis (second workshop), and associated costs (see Table 4.2).

In the third workshop participants identified potential synergies and conflicts between the water management options that were combined by experts into seven sector- or challenge-specific bundles. Bundles contain individual interlinked options each other with the “adaptation pathways”. Participants also commented on prepared bundles of water management options and the proposed implementation timeline of individual options within the bundles. The aim was to increase the effectiveness of implementing bundles of options compared to implementing individual water management options. All suggestions given by participants that showed no discrepancy with the results of experts were taken into account in the subsequent steps. If the comparison showed a two- or more-degree difference (e.g. low conflict vs. low co-benefit or high conflict vs. no interlinkage), this was counted as a discrepancy and hence a detailed revision followed. For the final results please see Chapter 2.4. Comments given on the content of the water management options (e.g. suggesting improvements toward better definition of the options) were not taken into account if there was a possibility of altering the results of the analysis conducted in previous steps.

With the help of stakeholders thoughts and ideas on the desired content and implementation of the adaptation plan for the Vipava river basin were gathered. There were some suggestions to include new water management options as well as to amend the content of existing options to an extent that would alter the social and economic assessment done in previous steps. Such comments could not be added at this stage of the project but are mentioned in chapter 2.3.3. Relevant

comments given to the content of the River Basin Adaptation Plan are already incorporated in the structure of this document. Suggestions on stakeholder interest in taking forward water management options or even the individual bundles given by participants are included in chapter 2.4.3.

2.3.3 Further considerations

As described above in chapter 2.3, the formulation and detailed analysis of the options consisted of a particular set of steps based on the participatory approach. After the formulation of options, their detailed description allowed for the social and economic assessment. The final list of options was presented to the broader public (October 2015) and additionally to the Agencija Republike Slovenije za okolje (Slovenian Environmental Agency) at an informal meeting in Nova Gorica in January 2016. In March 2016 also the third workshop followed based on the final list of options. As some new stakeholders attended the events and the meeting, some new insights were shared with the experts. Due to the methodology prepared within the BeWater project, new ideas like for e.g. the extension of the options or adding new options, that could alter the results of previous analysis, could not be integrated in the Vipava River Basin Adaptation Plan. Therefore we mention the main ideas or new options within this chapter and give the base for improvements of the content of the River Basin Adaptation Plan in the near future.

Although it was pointed out at the first workshop (June 2014) that there were no problems with drinking water supply, one of the stakeholders participating the third workshop pointed out the problem of using drinking water also for irrigation and for technological purposes. This becomes an issue mostly during drier periods (summer) when the water consumption is at highest and people use drinking water also for other uses (irrigation, watering the garden, washing the car, etc.). This issue should be addressed in a way that basic supply should not be threatened by means of prohibiting the use of drinking water for irrigation. Also water saving techniques could be applied at the household level (e.g. turn off the tap when brushing teeth, invest in water-efficient household products, …) and in industry (e.g. closed water circuit). By doing so, the economical efficiency of the operation of the Ultraviolet Water Purification Plant at the Hubelj water spring would increased.

Regarding flood risk reduction the main comment was that integrated options for reducing floods are missing. At the first workshop the preparation of a harmonised flood risk study was proposed, and would contain a number of measures to govern the long-term flood protection for the whole Vipava river basin, not just its parts. Due to limited resources (lack of detailed data) it was not possible to develop this proposal to such an extent that the social and economic analysis could be possible. Still, as mentioned in chapter 2.2.2, the Ministrstvo za okolje in prostor (Ministry of the Environment and Spatial Planning) is preparing flood risk management plan 2015-2021 (in preparation) [63] and programme of measures that will include also Vipava river basin where problems of floods were recognized also at the national level. The flood risk management plan is expected to be adopted in 2016. Within the draft flood risk management plan five areas with significant impact of floods have been identified in the Vipava river basin (see Chapter 2.1.2). In 2014, already three of five flood hazard maps and flood risk maps have been prepared for the Vipava river basin [87].

2.4 Adaptation actions

2.4.1 Adaptation actions

Table 4.2 below lists 20 water management options (WMOs) developed for the Vipava river basin and presents a selection of additional information associated with each option. While the options are grouped together in bundles in chapter 2.4 according to their synergistic interactions with one another and the common objective they contribute to, this table provides an overview of information that is specific to individual options in the columns. This information can be used by decision-makers when determining which single option(s) would be most appropriate to achieve their targeted objectives.

More specifically, table 4.2 associates each option with one or more of the challenges identified for the Vipava basin (see also Chapter 2.2.3) and a score from the multi-criteria analysis. This score is based on the characterization of the option, the result of an assessment of the option's impact when applied in the river basin, and stakeholder evaluations ('weights') of the importance of the various possibilities for option features and impacts. A higher score from the multi-criteria analysis (ranging from 0 to 100) represents a stronger overall performance in coparison with alternative options in view of the criteria important to local stakeholders (see Text box 3 for more information about the multi-criteria analysis).

Each option is further characterized by a set of additional implementation-oriented factors, such as its feasibility, acceptability, and policy synergies. These factors help to determine whether there will be barriers to the option's implementation or, conversely, if there may already be elements in place that facilitate its implementation. Costs represent an indicative estimate of the full cost of implementing the water management option and can be used to determine which options fall within a given allocated budget. The co-benefit gives the score of combined implementation of options amplifies the total impact-related benefits, as compared to the benefits which would arise from implementing each option individually. Finally, the priority associated with each option is a combination of how an option performs according to stakeholder preferences and implementation-oriented factors evaluated through expert opinion.

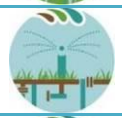
The information presented below also enables stakeholders to compare the various options and identify individual ones that fulfill desired expectations, such as selecting an option which addresses a specific challenge within certain cost limitations, while meeting an individual criterion such as having high "acceptability". Based on the value of each criteria:

- The majority of options (16) were identified to cope with the challenge of water availability during droughts in the growing season (challenge A), followed by 13 options coping with the appropriate water quality (challenge C). Half of the options (ten out of 20) were identified to cope with the challenge of reducing flood risks (challenge B); however several options are addressing more than one challenge.
- Option 1, 4, and 8 performed particularly well in the multi-criteria analysis and are therefore presented mostly with high priorities. Nevertheless, option 8 is involved with high costs and low feasibility and is therefore presented with medium priority.
- Option 11 and 23 performed relatively poor in the multi-criteria analysis and are therefore presented with low or medium priorities. Both options are involved with high costs and low co-benefit with other options.

A detailed description of all 20 options is provided in the Part 2 of the document.

Table 4.2: *Overview of the identified water management options for Vipava river basin*

#		Name of Water Management Option	Challenges (A-Water availability during droughts in growing season; B-Flood risk reduction; C-Appropriate water quality)	MCA results (0: least preferable; 100: most preferable)	Feasibility (0: serious obstacles, 1: no major obstacles, 2: minor obstacles)	Acceptability (1<: low, 1: medium, >1: high)	Policy synergies (0: none, 1: medium, 2: high)	Costs (€: low (<200,000 eur), €€: medium (200,000-1,000,000 eur), €€€: high >1,000,000 eur))*	Co-benefit (>1: high, 1: medium, <1: none or conflicts)	Phasing Priority level
1		Establish an inter-municipal expert working group for the Vipava river basin	A, B, C	70	1	2	2	€	1.29	High
2		Awareness campaign focused on educating experts involved in surface water management for sustainable water management	A, B, C	63	1	2	2	€€	1.40	High
3		Awareness campaign focused on optimizing water use for farmers, for proper irrigation and minimize impacts on water quality through proper agricultural practices	A, C	44	1	2	2	€€	1.30	High
4		Awareness campaign for local public on impact of their activities on the river	A, B, C	70	1	2	2	€	1.50	High
5		Improve the financing system for water infrastructure	A, B	63	1	1	2	€	1.67	High
6		Upgrade and update the existing network for monitoring the status of water environment	A, B, C	56	1	1.5	2	€€	0.77	High
7		Setting up monitoring to reduce pressures on aquatic ecosystems resulting from water abstraction and water storage	A, C	63	1	1	2	€	1.11	High
8		Construction of water reservoirs on the watercourses in the upper part of the river basin	A, B	68	0	1	1	€€€	0.73	Medium

#		Name of Water Management Option	Challenges (A-Water availability during droughts in growing season; B-Flood risk reduction; C-Appropriate water quality)	MCA results (0: least preferable; 100: most preferable)	Feasibility (0: serious obstacles, 1: no major obstacles, 2: minor obstacles)	Acceptability (1<: low, 1: medium, >1: high)	Policy synergies (0: none, 1: medium, 2: high)	Costs (€: low (<200,000 eur), €€: medium (200,000-1,000,000 eur), €€€: high >1,000,000 eur))*	Co-benefit (>1: high, 1: medium, <1: none or conflicts)	Phasing Priority level
9		Construction of dry reservoirs	B	56	1	1	1	€€€	1.60	High
10		Reconstruction of existing water reservoir Vogršček	A	55	1	1.5	2	€€€	1.22	High
11		Development of new irrigation systems	A	29	0	1	1	€€€	0.45	Low
12		Reconstruction of existing irrigation system	A	36	1	2	2	€€€	0.50	High
13		Restoration of Vipava river and its tributaries	A, B, C	46	1	1	2	€€€	0.82	High
14		Restoration of old meanders and oxbows of Vipava river and its tributaries	A, B, C	48	1	2	2	€€€	0.67	Medium
17		Reconstruction of stabilizing and transverse constructions from natural stone in the smaller tributaries of Vipava river	B	44	2	2	2	€	0.67	High
19		Improving the system of payment for water used for irrigation	A, C	48	1	1	1	€	1.17	High
20		Preservation of existing and introduction of new shelterbelts	A, C	39	1	2	2	€€€	1.14	High

#	Name of Water Management Option	Challenges (A-Water availability during droughts in growing season; B-Flood risk reduction; C-Appropriate water quality)	MCA results (0: least preferable; 100: most preferable)	Feasibility (0: serious obstacles, 1: no major obstacles, 2: minor obstacles)	Acceptability (1<: low, 1: medium, >1: high)	Policy synergies (0: none, 1: medium, 2: high)	Costs (€: low (<200,000 eur), €€: medium (200,000-1,000,000 eur), €€€: high >1,000,000 eur))*	Co-benefit (>1: high, 1: medium, <1: none or conflicts)	Phasing Priority level
21	 Removal of invasive non-native species	C	50	1	1.5	1	€	1.20	High
22	 Construction of municipal wastewater treatment plants and sewage systems	C	41	1	2	2	€€€	1.33	High
23	 The cultivation of crops that are resistant to climate changes (drought, pests and diseases)	A, C	27	2	0.5	2	€€€	0.13	Medium

*Remarks: €: low costs mean under EUR 200,000.00, €€: medium costs mean between EUR 200,000.00 and EUR 1,000,000.00, €€€: high costs mean above EUR 1,000,000.00.

2.4.2 Political context

All 20 options were cross-checked with five relevant sectoral programmes related to water management in Table 4.3. Some programmes are already adopted and some are still in preparation. Among the sectoral programmes, drafts of river basin management plans for the Danube and the Adriatic Sea Basins (2015 – 2021) [29] and a flood risk management plan [63] are still in preparation. It is expected that both key plans, prepared by the Ministrstvo za okolje in prostor (Ministry of the Environment and Spatial Planning) will be adopted by Vlada Republike Slovenije (The Government of the Republic of Slovenia) by the end of 2016. The Natura 2000 Management Programme [70] and Programme for the Management of Fish in Inland Waters of the Republic of Slovenia (Inland Fisheries Programme) [76] were adopted in 2015 for the periods until 2020 and 2021, respectively. A Draft Plan for Development of Irrigation until 2020 (Irrigation Plan) [79] is still considered among the sectors.

As expected, more than half of the options show synergies with the objectives of draft river basin management plan or even overlap with some of the proposed measures [29]. There are also two options (no. 8 and 11) in conflict with the objectives of draft river basin management plan. Reasons behind such conflicts are due to differing views of the stakeholders and opinions on how best to adapt to the impacts of global change. As mentioned already in chapter 2.1, existing conflicts among water related objectives (e.g. improving flood/erosion risk protection, optimizing water use, improving ecological status) have been recognized. These conflicts pose a challenge for development of an integrated and sustainable water management.

If options already show synergies with the objectives of cross-checked sectoral plans, support for the actual implementation exists. This support can be based on regulatory, financial, or information-based mechanisms and instruments. For options lacking such synergies, more effort and additional support from relevant actors would be needed.

Table 4.3: *Cross check of the identified water management options for Vipava River Basin with relevant sectoral programmes*

No.	Short name of water management options (WMO)	Draft river basin management plan	Draft flood risk management plan	The Natura 2000 Management Programme	Inland Fisheries Programme	Irrigation plan
WMO 1	Establish an inter-municipal expert working group	**1**	**0**	**0**	**0**	**1**
WMO 2	Awareness campaign for water management experts	**1**	**0**	**0**	**0**	**0**
WMO 3	Awareness campaign for farmers	**1**	**0**	**1**	**0**	**0**
WMO 4	Awareness campaign for local public	**1**	**0**	**1**	**0**	**0**
WMO 5	Improve the financing system for water infrastructure	**1**	**1**	**0**	**0**	**0**
WMO 6	Upgrade and update the monitoring network	**1**	**0**	**1**	**0**	**0**
WMO 7	Setting up monitoring for water abstractions	**1**	**0**	**0**	**0**	**0**
WMO 8	Construction of water reservoirs	**-1**	**1**	**1**	**0**	**1**
WMO 9	Construction of dry reservoirs	**0**	**1**	**0**	**0**	**0**
WMO 10	Reconstruction of water reservoir Vogršček	**0**	**1**	**1**	**0**	**1**
WMO 11	New irrigation systems	**-1**	**0**	**0**	**0**	**1**
WMO 12	Reconstruction of existing irrigation system	**0**	**0**	**0**	**0**	**1**
WMO 13	Restoration of Vipava river and its tributaries	**1**	**1**	**1**	**1**	**0**
WMO 14	Restoration of Vipava river and its tributaries	**1**	**1**	**1**	**0**	**0**

No.	Short name of water management options (WMO)	Draft river basin management plan	Draft flood risk management plan	The Natura 2000 Management Programme	Inland Fisheries Programme	Irrigation plan
WMO 17	Reconstruction of stabilizing and transverse constructions	**0**	**1**	**1**	**0**	**0**
WMO 19	Improve the system of payment for water use	**1**	**0**	**0**	**0**	**0**
WMO 20	Preservation and introduction of shelterbelts	**0**	**0**	**1**	**0**	**0**
WMO 21	Removal of invasive non-native species	**1**	**0**	**1**	**1**	**0**
WMO 22	Construction of municipal wastewater treatment plants	**0**	**0**	**0**	**0**	**0**
WMO 23	Cultivation of climate change resistant crops	**0**	**1**	**1**	**0**	**0**

Legend:

1	**synergy with sectoral plan**
-1	**conflict with sectoral plan**
0	**no synergy with sectoral plan**

2.4.3 Presentation of bundle factsheets

The aim of the bundling of the individual options was to increase the effectiveness of implementing bundles of options compared to implementing individual options. Namely, the evidence from studies of adaptation to past and current climate variability indicates that adaptation measures are rarely adopted singly [88]. Instead, bundles of adaptation options are adopted together, in an attempt to address the multiple impacts of global change on the socio-ecological systems of the river basin. Although many of the options could be implemented individually to achieve the addressed objectives, some of the options are missing complementary options to give the desired results. This was also noticed by stakeholders within the participatory process. However, not all adaptation options are necessarily compatible with one another [88].

The identified adaptation options for the Vipava River Basin Adaptation Plan were bundled with one another based on: 1) options addressing water management relevant sectors (water management, agriculture, tourism and nature conservation) and 2) their co-benefits and conflicts. Experts assessed the impact of different combinations of adaptation options in relation to the implementation of individual options. Based on this co-benefits analysis, groups of adaptation options with high or low co-benefits were grouped together.

Implementation timeline of the bundled adaptation options was assessed, based on their effectiveness over time and local preferences. This assessment aimed to identify when each option would best be implemented within each bundle.

For individual water management options, information about synergies with other policies and suggestions on stakeholder involvement was specified in Part 2.

The seven bundles, developed within this process, address sectors that were recognized by experts and stakeholders as relevant for the uptake in the adaptation plan:

1. Organisation of Sustainable Water Management
2. Implementation of Sustainable Water Management
3. Flood Risk Reduction
4. Improving Conditions for Agriculture Taking Climate Change Impacts into Account
5. Adaptation of Agriculture to Climate Change Impacts
6. Development of Sustainable Tourism
7. Implementation of Nature Protection Management

Factsheets of the bundles of adaptation options are presented below and provide summarised information for each bundle, including:

- the focus of the bundle
- the proposed combination of adaptation options per bundle
- the “adaptation pathway”, representing the implementation of the options in short-term (2018), mid-term (2021), and long-term (2025), and
- the way forward, i.e., implementation avenues.

2.4.3.1 Organisation of sustainable water management

Focus of the bundle

Organisation of sustainable water management is the precondition for implementation phase of sustainable water management. This bundle aims to prepare currently missing integrated plans that are applicable for an individual river basin. Spatial planning and raising awareness among water management experts are crucial options for the preparation of those plans. Other options provide needed information about the scope and intensity for water management options that are directly addressing implementation phase of sustainable water management. The bundle addresses all three identified challenges: water availability, flood risk reduction, and appropriate water quality.

Proposed combination of options

Context		
Water management options included in this bundle have in common that they all aim to establish the organization of sustainable water management at the river basin level. The water management options present all co-benefits, with the WMO 1 to 5 and WMO 6 and 7 scored with high co-benefit and others as low co-benefit. The WMOs 1, 5, 6, and 7 are providing information for preparation of integrated plans at the river basin level. Hence spatial planning, improvement of expert knowledge, financing of options and monitoring of water status and water abstractions are covered.		
Water Management Options		
1	Establish an intermunicipal expert working group	The task of the inter-municipal working group is to direct spatial planning considering water management in the river basin. Representatives of each local authority with external help of requisite expert knowledge will be included in working group. The position would last through the financial cycle of river basin management plan.
2	Awareness campaign for water management experts	The objective of the awareness campaign for water management experts in the first place is to educate them on impacts of their work on hydromorphological pressures. The second objective is to educate them about more sustainable techniques in designing interventions on watercourses. The last objective is to collect existing good practices with suggestions for improvements and a complementing database of good practices.
5	Improve the financing system for water infrastructure	The objective is to determinate a contribution key and to set legal bases for the eligible use of funds for financing water infrastructure. The objective is also to improve system of financing water infrastructure in a way so as to help achieve the objectives of sustainable water management and of the river basin management plan.
6	Upgrade and update the monitoring network	The objective is to review all of existing monitoring stations and their status and in the second phase to upgrade the network system with new stations where needed.
7	Setting up monitoring for water abstractions	The objective is to verify existing water rights in Vipava river basin and to verify actual water consumption. This is precondition for monitoring illegal water abstractions.

'adaptation pathway'

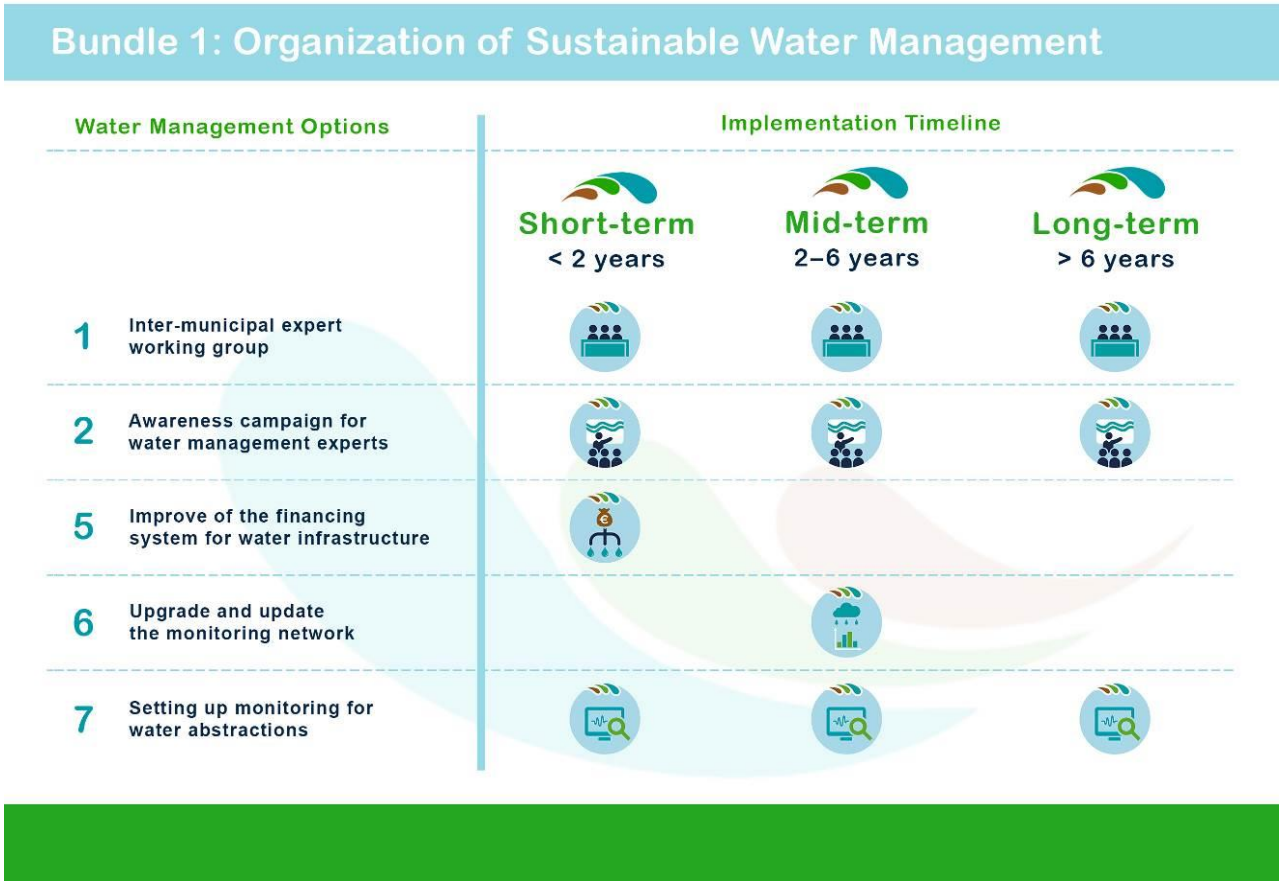
With the creation of an inter-municipal expert working group (WMO 1), the much needed cooperation between municipalities and experts and the main objectives are first set. Together with WMO 2, an awareness campaign focused on educating experts, and WMO 5, the improvement of the financing system, they should be implemented first, in the first year (short term). Despite minor barriers due to limited financial capacities or the varying levels of acceptability according to stakeholders, they show many policy synergies. They form the basis for the organisation of an integrated and sustainable water management plan addressing the whole Vipava river basin.

For monitoring of actual water consumption at holders of water rights (WMO 7) minor barriers due to possible restriction of water use and medium acceptability by stakeholders exist. Still due to the lowest costs, this option (WMO 7) should be implemented next, especially during a period of low natural flows, and repeated every 5 years.

When the facts regarding water consumption are identified, the upgrade of the existing monitoring network (WMO 6) should be implemented in the mid-term due to limited financial capacities. With both options (WMO 7 and 6), more representative data can help to better understand the current situation in the Vipava River Basin as the basis for improvement of river basin management.

The upgrade and update of the existing monitoring network for assessing the status of the water environment (WMO 6)

should be implemented after WMO 5. WMO 5, the improvement of the financing system, will make the implementation of the rather costly option WMO 6 feasible, as it reduces the highest implementation barrier, the costs of WMO6. Therefore, the acceptability of WMO 6 for stakeholders will probably improve over time, once the funding sources are secured.



Way forward/implementation avenues

The bundle is showing an overall policy synergy with draft river basin management plan. There are also some synergies with the Natura 2000 management programme [70] and also the flood risk management plan [63]. The resolution on the national environmental action programme (2005–2012) [89], and others (e.g.: local self-government act [90]) allow for the establishment of groups of stakeholders (WMO 1) to help achieve the objectives of the regional development programme of Northern Primorska (Goriška development region) 2014-2020 [91] in planning a comprehensive spatial development of the region.

Many of the water management options included in the bundle could be funded through different financial mechanisms such as Horizon 2020, The INTERREG MED Programme 2014-2020, depending on the priorities and challenges they address.

The main identified actors that need to be involved in the implementation of this bundle can be divided into national and local actors. National actors that are most important for this bundle are the Ministrstvo za okolje in prostor (Ministry of the Environment and Spatial Planning) with its bodies, especially the Direkcija Republike Slovenije za vode (Slovenian Water Agency) and the Agencija Republike Slovenije za okolje (Slovenian Environmental Agency). At the local level active involvement of municipalities together with regional development agencies and users of water infrastructure must be assured.

During the third workshop (March, 2016) the municipalities, the Water Management Company with state concession to provide the water management public service, and the health sector through the Nacionalni laboratorij za zdravje, okolje in hrano (National Laboratory of Health, Environment and Food) and Nacionalni inštitut za javno zdravje (National institute of public health) indicated their willingness to take up the bundle or individual water management options with differing roles in the implementation process.

2.4.3.2 Implementation of sustainable water management

Focus of the bundle

In the past, the water management sector had the main objective to provide flood safety of people and their property. After the adoption of the Water Framework Directive in 2006 the component of ecological status was legally included in water management. The bundle addresses the physical part of sustainable water management. Each individual water management option included has beside the regulatory part, also the part which addresses the ecological status of water management. The bundle addresses all three identified challenges: water availability, flood risk reduction, and appropriate water quality.

Proposed combination of options

Context		
Water management options included in this bundle present concrete options where actual improvements of water management status can be made. The majority of options are complement with each other and have scored co-benefit, only a few scored no interlinkage and few scored low conflict. Pairs WMO 13 and 17 and WMO 14 and 17 have scored as low conflict due to possible prevention of sediment transport as a crucial element of natural hydromorphology		
Water Management Options		
13	Restoration of Vipava river and its tributaries	The objective is to establish the original state of the Vipava river and its tributaries with removal of transversal and longitudinal protection objects. It proposes 16 potential locations for the restoration of the Vipava river and seven locations of its tributaries in total length of 21,926 m.
14	Restoration of old meanders and oxbows	The objective is to establish the original state of old meanders and oxbows with restoration of the former connection of the main watercourse with its old meander and oxbow. It proposes restoration of old meanders on nine potential locations in total length of 2,721 m.
17	Reconstruction of stabilizing and transverse constructions	The objective is to locate existing transversal and stabilizing construction in the tributaries of Vipava river and set a priority for their reconstruction. Their function is to stabilize the water bed and prevent erosion. Reconstruction is conceived with the use of all known sustainable techniques.
20	Preservation and introduction of shelterbelts	The objective is to preserve existing and introduce new shelterbelts. Implementation of shelterbelts includes trees seedlings (four seedlings per meter of approx. 50 cm high), with their marking and protection with poles.
22	Construction of municipal wastewater treatment plants	Agglomerations under 2,000 population equivalent (PE) – overall 21,225.44 PE is without the existing public sewage system, 21.137,05 PE is without the existing WWTP. Agglomerations above 2,000 PE – overall 4,767.36 PE is without the existing public sewage system, 5,207.80 PE is without existing WWTP.

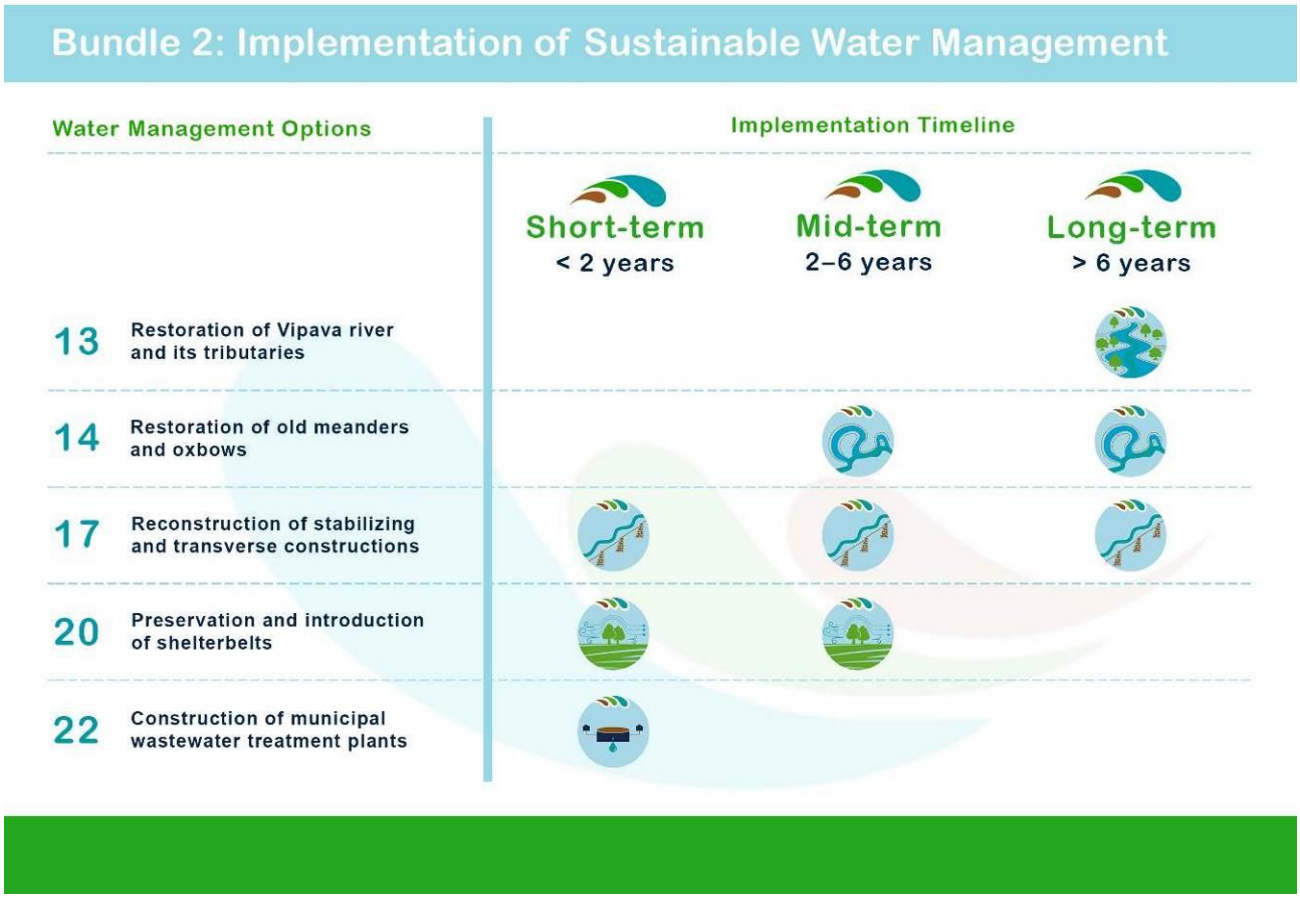
'adaptation pathway'

The reconstruction of stabilizing and transverse constructions in the Vipava's tributaries (WMO 17) and construction of missing sewage and municipal wastewater treatment plants across the river basin (WMO 22) should be implemented or be begun in the first year, respectively. Although there are barriers due to high costs, constructing sewage and municipal wastewater treatment plants across the river basin (WMO 22) shows high policy synergies. WMO 22 can reduce water pollution (organic, nutrients, pathogens) and result in better water quality. At the same time (in parallel), reconstruction of stabilizing and transverse constructions in the Vipava's tributaries (WMO 17) should be implemented. WMO 17, concentrated to specific areas in Vipava river basin, result in low costs, with no major barriers for implementation and showing many policy synergies. As maintenance works must be continuously conducted, the phasing is adapted accordingly.

With minor barriers due to low awareness of farmers, and also limited financial capacities, the option of preserving existing and introducing new shelterbelts (WMO 20) should be implemented next. As more time is needed for trees to function as shelter and wind breakers, the option should be implemented in first potential location (proposal of four potential locations is prepared, see description of WMO in Part 2) in the second year, followed by the third, fourth, and fifth year for the remaining three proposed locations.

Minor barriers due to high costs and varying acceptability of stakeholders also accompany next two proposed options, restoration of old meanders and oxbows (WMO 14) and restoration of Vipava river and its tributaries (WMO 13).

Although in low conflict with WMO 17, as sediment transport is prevented downstream, both options show low co-benefits with WMO 20, as shelterbelts can be also part of riparian vegetation. They would improve the ecosystem services of the river and riparian zones (including sediment and nutrient filtering, water storage, bank stabilization, and provision of habitat for biodiversity).



Way forward/implementation avenues

Options no. 13 and 14 showing synergies with the river basin management plan [29], flood risk management plan [63] and the Natura 2000 management programme [70]. Option no. 13 shows synergies with the programme for the management of fish in inland waters [76]. Option no. 20 shows synergies with the Natura 2000 management programme [70]. Construction of municipal wastewater treatment plants (WMO 22) follows the requirements of the operational program of discharge and municipal wastewater treatment [69].

Option no. 17 could be financed through the Vodni sklad (Water fund). Other options could be covered through other mechanisms such as INTERREG MED Programme 2014-2020, funding via the Common Agricultural Policy, European Regional Development Fund, and the Cohesion Fund.

The main actor identified for the implementation of this bundle is the Ministrstvo za okolje in prostor (Ministry of the Environment and Spatial Planning) and its bodies the Direkcija Republike Slovenije za vode (Slovenian Water Agency) and the Agencija Republike Slovenije za okolje (Slovenian Environmental Agency). Beside options directly connected to the water sector there is option no. 20, where the Ministrstvo za kmetijstvo gozdarstvo in prehrano (Ministry of Agriculture, Forestry and Food) and the Zavod za gozdove Slovenije (Slovenia forest service) should actively cooperate and support its implementation. As in practice municipalities play a main role in implementation of option no. 22.

During the third workshop (March, 2016) the municipalities, the water management company, the Služba vlade RS za razvoj in evropsko kohezijsko politico (Government office for development and European cohesion policy), and the health sector representatives the Nacionalni laboratorij za zdravje, okolje in hrano (National Laboratory of Health, Environment and Food) and the Nacionalni inštitut za javno zdravje (National institute of public health) indicated their willingness to take up the bundle or individual water management options with differing roles in the implementation process.

2.4.3.3 Flood Risk Reduction

Focus of the bundle

With settlement expansion (urbanization) and the need for increasing farmland in the past took Vipava river and its tributaries the needed space that was used as natural inundation area. In the lower parts of Vipava river basin there are flood areas practically all through the valley. The bundle includes water management options addressing flood protection and so coinciding with a challenge of flood risk reduction. This bundle works in a curative way of past interventions and in preventive way to avoid new mistakes.

Proposed combination of options

Context		
Water management options included in this bundle have the objective of reducing flood risks and the majority of them are complementary with each other and have a scored co-benefit. Due to the high number of WMOs included it is undersandable that not all included WMOs have a scored co-benefit. Low conflicts are shown for pairs WMO 8 and 13, WMO 8 and 14, WMO 13 and 17, and WMO 14 and 17. The reason for this is that WMOs 8 and 17 can have a negative effect on the ecological state of water. This is in contradiction to the objectives of WMOs 13 and 14 of restoring natural hydromorphology. Ten pairs out of 45 combinations of water management options have scored no interlinkage as no co-benefit or conflict was assessed between them.		
Water Management Options		
1	Establish an intermunicipal expert working group	The task of the inter-municipal working group is to direct spatial planning, considering water management in the river basin. Representatives of each local authority with external help of requisite expert knowledge will be included in working group. The position would last through the financial cycle of river basin management plan.
2	Awareness campaign for water management experts	The objective of the awareness campaign for water management experts in the first place is to educate them on the impacts of their work on hydromorphological pressures. The second objective is to educate them about more sustainable techniques in designing interventions on watercourses. The last objective is to collect existing good practices with suggestions for improvements and a complementing database of good practices.
5	Improve the financing system for water infrastructure	The objective is to determinate the contribution key and to set legal bases for the eligible use of funds for financing water infrastructure. The objective is also to improve the system of financing water infrastructure in a way so as to help achieve the objectives of sustainable water management and of the river basin management plan.
6	Upgrade and update the monitoring network	The objective is to review all of existing monitoring stations and their status and in the second phase to upgrade the network system with new stations where needed.
8	Construction of water reservoirs	The objective is to construct water reservoirs that are already part of the "Development Plan for Irrigation till 2020". There are planned four new water reservoirs in the Vipava river basin: • Košivec – in municipality Ajdovščina, volume 1.176 million m^3 • Vrnivec – in municipality Ajdovščina, volume 1 million m^3 • Svinjšček – in municipality Ajdovščina, volume 1 million m^3 • Pasji rep – in municipality Vipava, volume 2.5 million m^3
9	Construction of dry reservoirs	The objective is to identify areas that require increased protection against floods and identify potential locations for building dry reservoirs.
10	Reconstruction of water reservoir Vogršček	The objective is to reconstruct the Vogršček water reservoir. The "Reconstruction of the Vogršček Barrier" is already planned and now documentation is being prepared.

13	Restoration of Vipava river and its tributaries	The objective is to establish original state of the Vipava river and its tributaries with removal of transversal and longitudinal protection objects. It proposes 16 potential locations for restoration of Vipava river and seven locations of its tributaries in total length of 21,926 m.
14	Restoration of old meanders and oxbows	The objective is to establish the original state of old meanders and oxbows with the restoration of the former connection of the main watercourse with its old meander and oxbow. It proposes restoration of old meanders in nine potential locations in a total length of 2,721 m.
17	Reconstruction of stabilizing and transverse constructions	The objective is to locate existing transversal and stabilizing construction in the tributaries of Vipava river and set the priority for the reconstruction. Their function is to stabilize water bed and prevent eroison. Reconstruction is conceived with the use of all known sustainable techniques.

'adaptation pathway'

With the creation of an inter-municipal expert working group (WMO 1), the much needed cooperation between municipalities and experts is set first. Together with options no. 5, the improvement of the financing system, and 2, the *awareness campaign focused on educating experts, they should be implemented first, in the first year (short term). Despite minor barriers due to varying levels of acceptability among stakeholders, they show many policy synergies. WMO 5, improving the financing system, will make the implementation of the rather costly options (WMO 6, 8, 9, 10, 13, and 14) more feasible.*

Despite minor barriers due to high costs, reconstruction of the existing Vogršček water reservoir (WMO 10) as such is already envisaged by the Ministrstvo za okolje in prostor (Ministry of the Environment and Spatial Planning) and is consequently in the short term (in first two years' time).

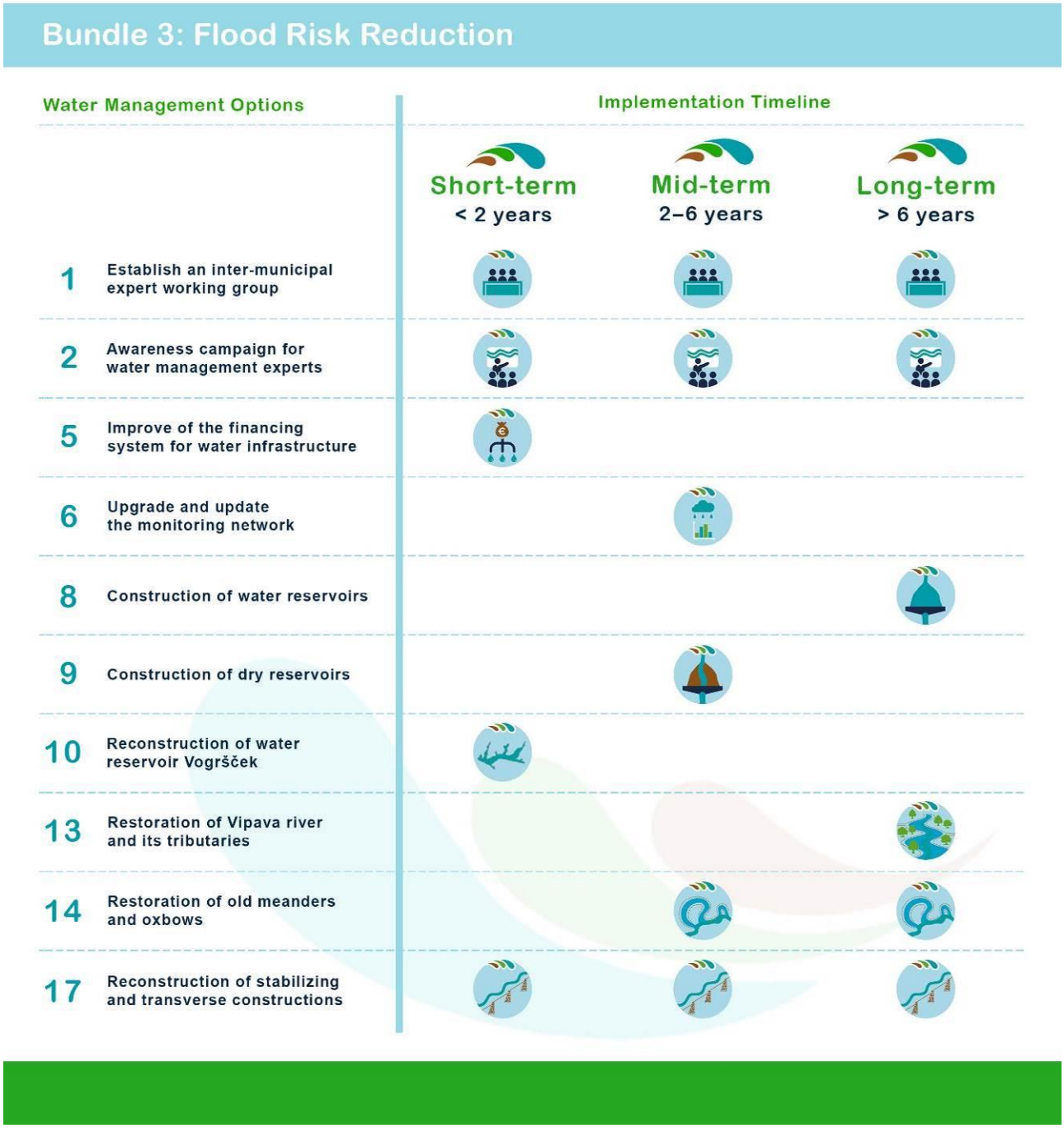
WMO 10 is followed by the reconstruction of stabilizing and transverse constructions in the Vipava's tributaries (WMO 17), which must be continuously maintained. WMO 17, concentrated on specific areas in the Vipava river basin, results in low costs, no major barriers for implementation, and the potential for many policy synergies. This option shows also high co-benefits with WMO 2 (considering more sustainable techniques).

The upgrade and update of the existing monitoring network for assessing the status of the water environment (WMO 6) should be implemented after WMO 5, but not necessarily after WMO 10 and 17. Namely, WMO 5, as written above, will make the implementation of the rather costly option WMO 6 feasible, as it reduces the highest implementation barrier, the costs of WMO 6. Therefore, the acceptability of stakeholders for WMO 6 could probably improve over time, once the funding sources are secured.

The option WMO 14 (restoration of old meanders and oxbows) should be implemented before WMO 13 (restoration of the Vipava river and its tributaries) due to higher acceptability among stakeholders. Both of the options would be implemented gradually, starting with WMO 14 in the third year and continuing with the implementation, when, later, WMO 13 would be put into motion. Both options show high co-benefits, improving the status of water and riparian ecosystems in larger scale.

Dry reservoirs (WMO 9), if backed up with the analysis, could be implemented in a later stage. If the rates of changes (flood events) increase and the Flood risk management plan recognizes the need for the implementation of such reservoirs, then option 9 could be brought forward. If the rates of changes are slower, then the implementation can be delayed or even abandoned. This option shows low co-benefits with WMO 1 and high co-benefits with WMO 2, as with proper planning and the use of more sustainable techniques considering water management in the project design possible negative impacts on the environment and society can be minimized.

Multifunctional water reservoirs (WMO 8) can only in a small part help reduce floods downstream and are so placed at the very end of the option list. Although many synergies with policy objectives do exist, major barriers due to high implementation costs and varying acceptability of stakeholders have been identified. This option, like WMO 9, shows co-benefits with WMO 1 and 2 for the same reasons, but shows conflicts with WMO 13 and 14 as water reservoirs on watercourses will affect structural water quality.



Way forward/implementation avenues

Options show synergies with the river basin management plan, except water management options 9, 10, and 17, where there is no connection with sectoral plans. WMO 8 is in conflict with the river basin management plan [29] due to the measure of restricting the granting of water rights that poses a precondition for the construction of water reservoirs. The flood risk management plan [63] has synergies with most water management options, but with WMO 1, 2, 6 no connection has been detected. Except for WMOs 1, 2, and 5, where no connection detected, other options are in synergy with the Natura 2000 Management Plan [70]. WMO 13 is in synergy with the programme for the management of fish in inland waters [76]. WMOs 1, 8, and 10 are in synergy with the national irrigation strategy in preparation [79]. The spatial plan of municipality ajdovščina and its amendments [92], together with draft spatial plan of the municipality of Ajdovščina (June 2014), plans for two water reservoirs, Košivec and Vrnivec (WMO 8). WMO 8 is also supported by the development programme of Northern Primorska (Gorizia development regions) 2014-2020 [91] within the measure A2P1, which plans a selection of the optimal project solutions of flood safety measures, which will allow multipurpose use and integration of financial resources across sectors and, consequently, best solutions from a technical, environmental, and economic point of view.

Funding of water infrastructure could be provided by the Water fund. Other water management options could be financed through other mechanisms, such as development programme of Northern Primorska [91], Horizon 2020, INTERREG MED Programme 2014-2020, CAP/European Agricultural Fund for Rural Development (EAFRD), European Regional

Development Fund (ERDF) and Cohesion Fund.

Identified main actor for the implementation of this bundle is the Ministrstvo za okolje in prostor and its bodies, mainly the Direkcija Republike Slovenije za vode and the Agencija Republike Slovenije za. The Inštitut za vode Republike Slovenije and the Zavod Republike Slovenije za varstvo narave could be involved in the options of restoration (WMO 13, WMO 14) and reconstruction of objects on watercourses (WMO 17). Reconstructing and building new water reservoirs is an area where the Ministrstvo za kmetijstvo, gozdarstvo in prehrano and the Ministrstvo za should actively cooperate and support implementation. An important actor for the implementation of WMO 5 is the ministry responsible for finances. At the local level municipalities and regional development agencies could contribute to the success of this bundle.

During the third workshop (March, 2016) the municipalities, the water management company, the Služba vlade za razvoj in evropsko kohezijsko politiko, and health sector representatives the Nacionalni laboratorij za zdravje, okolje in hrano, and the Nacionalni inštitut za javno zdravje indicated their willingness to take up the bundle or individual water management options with differing roles in the implementation process.

2.4.3.4 Improving conditions for agriculture taking climate change impacts into account

Focus of the bundle

Agricultural land makes up 33% of the total Vipava river basin area. The impact of climate changes on the agriculture sector is important and must be taken into consideration. They are reflected in agricultural droughts and in pressures on water use in the growing season (especially in summer months). The bundle includes water management options addressing improvements in agriculture to the existing and forthcoming conditions, considering global change. Options included have the objective to optimise agricultural practices. This bundle addresses two identified challenges: water availability and appropriate water quality.

Proposed combination of options

Context

Water management options included in this bundle have the objective of improving conditions for agriculture that lack water for irrigation. Objectives of proposed water management options included in the bundle primarily address the challenge of water availability. The majority of options complement each other and have scored co-benefits.

Water management options

1	Establish an intermunicipal expert working group	The task of the inter-municipal working group is to direct spatial planning considering water management in the river basin. Representatives of each local authority with external help of requisite expert knowledge will be included in the working group. The position would last through the financial cycle of river basin management plan.
3	Awareness campaign for farmers	The objective is to analyse existing agricultural practices together with suggestions for improvement. It is also to prepare guidelines for proper agricultural practices considering changing climate conditions.
7	Setting up monitoring for water abstractions	The objective is to verify existing water rights in Vipava river basin and actual water consumption. This is precondition for monitoring illegal water abstractions.
8	Construction of water reservoirs	The objective is to construct water reservoirs that are already part of the "Development Plan for Irrigation till 2020". There are planned four new water reservoirs in the Vipava river basin: • Košivec – in municipality Ajdovščina, volume 1.176 million m^3 • Vrnivec – in municipality Ajdovščina, volume 1 million m^3 • Svinjšček – in municipality Ajdovščina, volume 1 million m^3 • Pasji rep – in municipality Vipava, volume 2.5 million m^3
10	Reconstruction of water reservoir Vogršček	The objective is to reconstruct the Vogršček water reservoir. The "Reconstruction of the Vogršček Barrier" is already planned and documentation is in preparation.
11	New irrigation systems	The objective is to develop new irrigation systems that are part of "Action plan for development of irrigation in Republic of Slovenia until 2020". There are 3,979.00 ha of new irrigation systems planned in the Vipava valley together with WMO 8 mentioned water reservoirs.
12	Reconstruction of existing irrigation system	The objective is to verify status of 1546 ha of existing irrigation systems in the Vipava valley and to recognize needs and scope of reconstruction works which will take place in the second phase of the option.
19	Improve the system of payment for water use	The objective is to improve the system of payment in a way to collect more money for water used for irrigation. A possible solution proposed by the option is to lower the limit of yearly consumption (from 5,000 m^3 to 2,500 m^3), when farmers do not need to pay for actual water use.

'adaptation pathway'

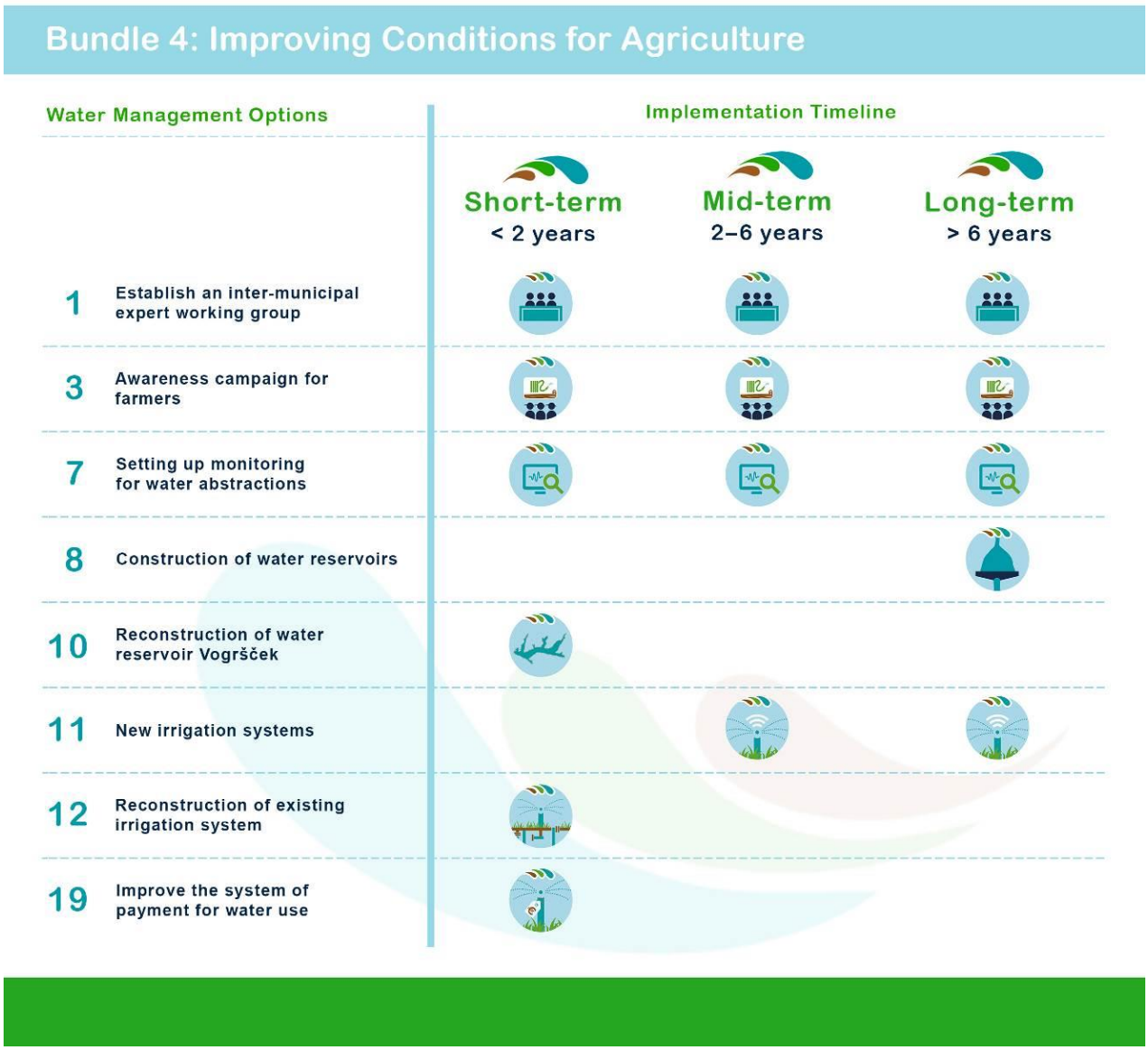
With the establishment of an inter-municipal expert working group (WMO 1), the much needed cooperation between municipalities and experts and the main objectives for agriculture is first set. Together with the options of setting up monitoring on actual water use (WMO 7) and raising awareness (WMO 3), they should be implemented first, in the first year (short term). Despite minor barriers due to limited financial capacities or varying acceptability according to stakeholders, they show many policy synergies. They form the basis for the preparation of more concrete options that would improve the conditions for agriculture production.

Despite minor barriers due to varying acceptability among stakeholders and low policy synergies (lacking strong political support/back-up), improvements to the system of payment for water used for irrigation (WMO 19) should also be implemented in the first two years' time. This option could make financing the operation of irrigation systems (WMO 12 and 11) more feasible.

Despite minor barriers due to high costs, the reconstruction of the existing Vogršček water reservoir (WMO 10) as such is already envisaged by the Ministrstvo za okolje in prostor (Ministry of the Environment and Spatial Planning) and is consequently placed in the short term (first two years' time).

WMO 10 is logically followed by reconstruction of existing irrigation systems derived from Vogršček (WMO 12) that despite limited financial capacities shows strong support from stakeholders and many policy synergies. New irrigation systems (WMO 11) derived from the Vogršček water reservoir would follow in the mid-term if there is shown a clear need by stakeholders (farmers). Due to the identified low feasibility and low preference regarding the results of multi-criteria analysis, the priority level for this option is low.

Although synergies with policy objectives do exist, major barriers due to high implementation costs and varying acceptability of stakeholders have been identified for implementing new water reservoirs (WMO 8) and are as such placed at the very end of the option list. It is more reasonable to verify the functionality and optimal utilization of existing irrigation infrastructure (WMO 10, WMO 12) before investing in new water reservoirs and irrigation systems derived from new reservoirs (WMO 11).



Way forward/implementation avenues

Water management options show synergies with the river basin management plan, except for WMOs 10 and 12, which do not show any connections. WMOs 8 and 11 show a negative connection with the river basin management plan [29] due to the measure of restricting the granting of water rights, as is a precondition for the construction of water reservoirs and building new irrigation systems. WMOs 8 and 10 are in synergy with the flood risk management plan [63]. The Natura 2000 management programme [70] is in synergy with WMOs 3, 8, and 10. WMOs 1, 8, 10, 11, and 12 are in synergy with the national irrigation strategy in preparation [79]. WMO 1 is in synergy with the resolution on the national environmental action programme (2005–2012) [89], and others (e.g.: the local self-government act [90]) that allow the establishment of such associations. Option could help achieve objectives of programme 5.1 "A comprehensive spatial development of the region" of regional development programme of Northern Primorska (Goriška development region) 2014-2020 [91]. WMO 3 is supported also by the national adaptation strategy for forestry and agriculture (2008) [94] and its implementation document action plan from 2011 [95] - Pillar II: education, awareness, and counselling. Measures that are already in place and are planned in the future: 7. Raising awareness of farmers of the impact of climate change on agriculture. The spatial plan of municipality Ajdovščina and its amendments [92], together with the draft spatial plan of the Municipality of Ajdovščina (June 2014) plans two water reservoirs, Košivec and Vrnivec (WMO 8). This option is also supported by the regional development programme of Northern Primorska (Goriška development region) 2014-2020 [91] within a measure that plans a selection of the optimal project solutions of flood safety measures, which will allow for multipurpose use and the integration of financial resources across sectors and, consequently, best solutions from a technical, environmental, and economic point of view.

Funding for water infrastructure could be provided by the Vodni sklad (Water fund). Other water management options can be financed through other mechanisms, such as the Rural Development Plan 2014-2020, the Development Programme of Northern Primorska [91], Horizon 2020, the Common Agricultural Policy, and the European Regional Development Fund.

The main actor identified for the implementation of the bundle is the Ministrstvo za kmetijstvo gozdarstvo in prehrano (Ministry of Agriculture, Forestry and Food) with its Svetovalna služba (Advisory Service) and the Kmetijsko gozdarska zbornica Slovenije (Chamber of Agriculture and Forestry of Slovenia). On the part of water rights, the Ministrstvo za okolje in prostor (Ministry of the Environment and Spatial Planning) with its Direkcija Republike Slovenije za vode (Slovenian Water Agency) and the Agencija Republike Slovenije za okolje (Slovenian Environmental Agency) should take over the main role. The Inštitut za vode Republike Slovenije (Institute for Water of the Republic of Slovenia) could be included. With water management options, where big interventions are planned, the Zavod za varstvo narave RS (Institute of the republic of Slovenia for Nature Conservation) plays the main role. At the local level municipalities and regional development agencies could serve as the main actors for this bundle.

During the third workshop (March, 2016) local farmers and the Biotehniška šola (Biotechnical School) indicated their willingness to take up the individual water management options (irrigation and the awareness campaign respectively) with differing roles in the implementation process.

2.4.3.5 Adaptation of agriculture to climate change impacts

Focus of the bundle

Agricultural land comprises 33% of the total Vipava river basin area. Impacts of climate changes on the agriculture sector are important and need to be taken into consideration. They are reflected in agricultural droughts and in pressures on water use in the growing season (especially in summer months). The bundle includes water management options addressing the adaptation of agriculture and its practices to the existing and forthcoming conditions in terms of global climate change. This bundle addresses two identified challenges: water availability and appropriate water quality.

Proposed combination of options

Context		
Water management options included in this bundle have the objective of adapting agriculture to the impacts of global change. The options aim to lower water consumption. All options show co-benefits when implemented together.		
Water Management Options		
1	Establish an intermunicipal expert working group	The task of the inter-municipal working group is to direct spatial planning considering water management in the river basin. Representatives of each local authority with the external help of requisite expert knowledge will be included in the working group. The position would last through the financial cycle of the river basin management plan.
3	Awareness campaign for farmers	The objective is to analyse existing agricultural practices together with suggestions for improvement. The objective is also to prepare guidelines for proper agricultural practices considering changing climate conditions.
20	Preservation and introduction of shelterbelts	The objective is to preserve the existing and introduce new shelterbelts. Implementation of shelterbelts includes tree seedlings (4 seedlings per meter of approx. 50 cm high), with their marking and protection with poles.
23	Cultivation of climate change resistant crops	The objective is selection of new varieties and alternative crops that are more adapted to the climatic conditions influenced by global changes. It includes a review and analysis of suitable crops and also a market analysis if there exists a market for those crops.

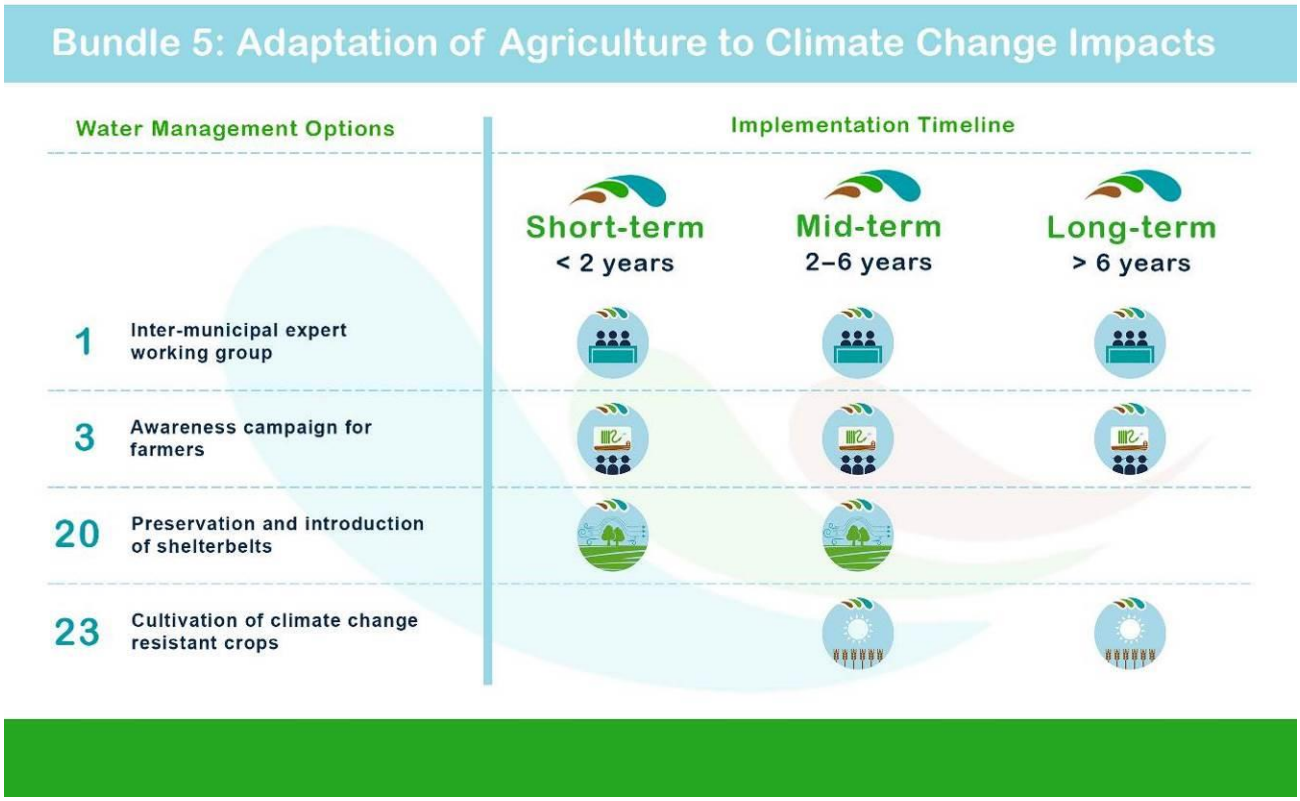
'adaptation pathway'

With the creation of an inter-municipal expert working group (WMO 1), the much needed cooperation between municipalities and experts with the main objectives for the awareness campaign is first set.

Although there are minor barriers identified due to ensuring the active involvement of all local farmers (need for financial initiatives), raising awareness among farmers (WMO 3) shows many policy synergies and is expected to be established in the beginning and continued for several years to come.

The preservation of the existing and introduction of new shelterbelts (WMO 20) should be implemented after WMO 3. WMO 3 will make farmers more aware of the positive effects of shelterbelts.

The cultivation of crops that are resistant to climate change (WMO 23) is involved with high costs and has varying acceptability amongst stakeholders. Therefore, the implementation of this option should start mid-term with the precondition that such crops are available for cultivation.



Way forward/implementation avenues

Water management options except WMO 20 present synergies with river basin management plan. WMO 23 is in synergy with the flood risk management plan. WMOs except WMO 1 are in synergy with the Natura 2000 management programme [70]. WMO 1 is in synergy with the resolution on the national environmental action programme (2005–2012) [89], and others (e.g.: local self-government act [90]) that allow for the establishment of such associations. Options could help achieve the objectives of programme 5.1 “A comprehensive spatial development of the region” of the regional development programme of Northern Primorska (Goriška development region) 2014-2020 [91]. WMO 3 is also supported by national adaptation strategy for forestry and agriculture (2008) [94] and its implementation document action plan from 2011 [95] - Pillar II: Education, awareness, and counselling. Measures that are already in place and are planned in future: 7. Raising the awareness of farmers of the impact of climate change on agriculture.

Funding could be provided by the development programme of Northern Primorska [91], Horizon 2020, INTERREG MED Programme 2014-2020 and the Common Agricultural Policy.

The main actor identified for the implementation of this bundle is the Ministrstvo za kmetijstvo gozdarstvo in prehrano (Ministry of Agriculture, Forestry and Food) and its Svetovalna služba (Advisory Service) and the Kmetijsko gozdarska zbornica Slovenije (Chamber of Agriculture and Forestry of Slovenia) and the Zavod za gozdove Slovenije (Slovenia Forest service). The Ministrstvo za okolje in prostor (Ministry of the Environment and Spatial Planning) and its bodies can be partners especially in implementing WMO 20 (determination of the operator of shelterbelts). At the local level municipalities and the Regional Development Agency could be the main actors for this bundle.

During the third workshop (March, 2016) local farmers and the Biotehniška šola (Biotechnical School) indicated their willingness to take up the individual water management options with differing roles in the implementation process. The local farmers would be involved in the cultivation of crops, the implementation of shelterbelts, and the awareness campaign. The Biotehniška šola (Biotechnical School) declared an interest in being a part of the awareness campaign.

2.4.3.6 Development of sustainable tourism

Focus of the bundle

With its rich natural and cultural heritage, the Vipava valley, especially in the upper part, has a great potential for the development of ecotourism. There is a substantial desire from stakeholders for the further development of such tourism. Sustainable water management is the basis for improving water quality and indirectly enriching habitats and biodiversity. Water management options in the bundle beside the primary objectives of addressing the identified challenges also address the objective of sustainable tourism development.

Proposed combination of options

Context

The water management options included do not directly address tourism development but they provide the basis for sustainable tourism, which will support more sustainable water quality and quantity management in touristic areas.

The majority of WMOs are complement with each other and have scored co-benefits. 21 combinations out of 45 have scored no interlinkage as no co-benefit or conflict was assessed between them.

Low conflicts are shown for pairs WMO 8-13 and WMO 8-14, the reason being that WMO 8 can have a negative effect on the ecological state of water. This is in contradiction to the objectives of WMOs 13 and 14 of restoring natural hydromorphology.

Water Management Options

1	Establish an intermunicipal expert working group	The task of the inter-municipal working group is to direct spatial planning considering water management in the river basin. Representatives of each local authority with the external help of requisite expert knowledge will be included in the working group. The position would last through the financial cycle of the river basin management plan.
2	Awareness campaign for water management experts	The objective of the awareness campaign for water management experts in the first place is to educate them on impacts of their work on hydromorphological pressures. The second objective is to educate them about more sustainable techniques in designing interventions on watercourses. The last objective is to collect existing good practices with suggestions for improvements and a complementing database of good practices.
4	Awareness campaign for local public	The objective is to inform the local public about the kind of impact on water management their actions have. The objective is also to prepare educational material for schools with the objective of presenting water-related challenges in Slovenia, focusing on Vipava river basin.
6	Upgrade and update the monitoring network	The objective is to review all of existing monitoring stations and their status and in the second phase to upgrade the network system with new stations where needed.
8	Construction of water reservoirs	The objective is to construct water reservoirs that are already part of the "Development Plan for Irrigation till 2020". There are planned four new water reservoirs in Vipava river basin: • Košivec – in municipality Ajdovščina, volume 1.176 million m^3 • Vrnivec – in municipality Ajdovščina, volume 1 million m^3 • Svinjšček – in municipality Ajdovščina, volume 1 million m^3 • Pasji rep – in municipality Vipava, volume 2.5 million m^3
10	Reconstruction of water reservoir Vogršček	The objective is to reconstruct Vogršček water reservoir. The "Reconstruction of the Vogršček barrier" is already planned and now documentation is in preparation.
13	Restoration of Vipava river and its tributaries	The objective is to establish original state of the Vipava river and its tributaries with removal of transversal and longitudinal protection objects. It proposes 16 potential locations for the restoration of the Vipava river and seven locations of its tributaries in total length of 21,926 m.

14	Restoration of old meanders and oxbows	The objective is to establish original state of old meanders and oxbows with restoration of former connection of main watercourse with old meander and oxbow. It proposes restoration of old meanders on nine potential locations in total length of 2,721 m.
20	Preservation and introduction of shelterbelts	The objective is to preserve existing and introduce new shelterbelts. Implementation of shelterbelts includes seedling of trees (four seedlings per meter of approx. 50 cm high), with their marking and protection with poles.
22	Construction of municipal wastewater treatment plants	Agglomerations under 2,000 population equivalent (PE) – overall 21,225.44 PE is without existing public sewage system, 21.137,05 PE is without existing WWTP. Agglomerations above 2,000 PE – overall 4,767.36 PE is without existing public sewage system, 5,207.80 PE is without existing WWTP.

'adaptation pathway'

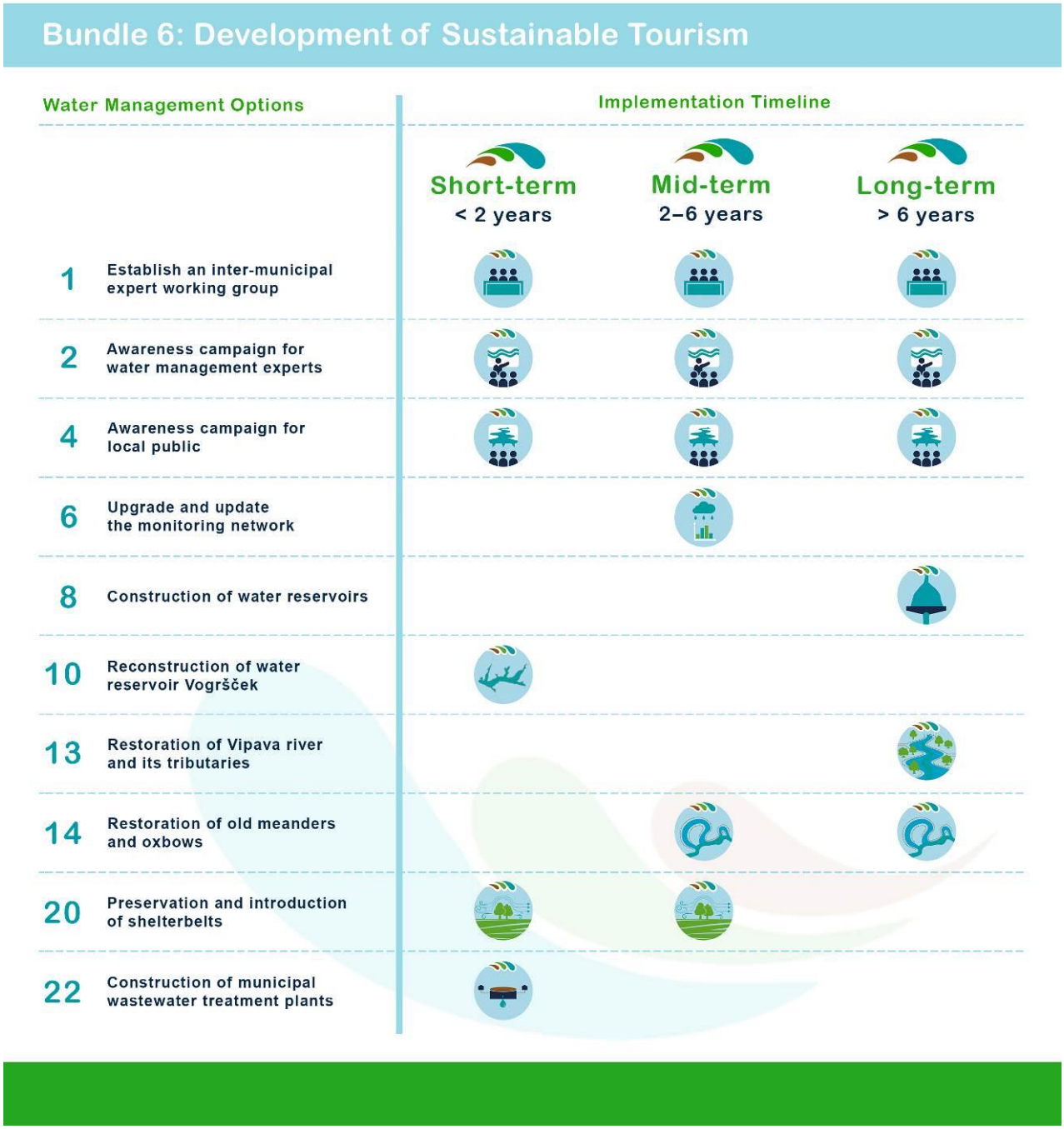
With the establishment of an inter-municipal expert working group (WMO 1), the much needed cooperation between municipalities and experts and the main objectives for developing tourism is first set. Together with WMO 2 and 4, they should be implemented first, in the first year (short term). Despite minor barriers due to limited financial capacities, they show many policy synergies. Activities planned in WMO 4 include the main elements of the educational tourism to be developed and should start being implemented in the first year. This also goes for WMO 2, the *awareness campaign focused on educating experts. By using more sustainable techniques in water management WMO 2 can achieve an attractive appearance and conditions of the aquatic and riparian ecosystems that can be integrated in the range of tourism services offered.*

Although minor barriers exist due to high costs, reconstruction of the existing Vogršček water reservoir (WMO 10) as such is already envisaged by the Ministrstvo za okolje in prostor (Ministry of the Environment and Spatial Planning) and is consequently placed in the short term (first two years' time). Together with upgrading and updating the existing measurement network (WMO 6) they can serve as a tourist service linked to water environment.

Despite barriers due to high costs, constructing sewage and municipal wastewater treatment plants across the river basin (WMO 22) shows high policy synergies. WMO 22 can reduce burdening waters with pollutants (organic, nutrients, pathogens) and results in better water quality, especially in good quality for bathing waters. As such, WMO 22 should be implemented in parallel with WMO 10 and WMO 6.

Minor barriers due to high costs also accompany the next three proposed options, the restoration of old meanders and oxbows (WMO 14) and the preservation of the existing and introduction of new shelterbelts (WMO 20) could enrich the cultural landscape that plays an important role for the development of tourism. With that said, also the restoration of the Vipava river and its tributaries (WMO 13) could be implemented in the later stage. Both options show high co-benefits. If both applied, they improving the status of ecosystems in larger scale and give the variety of scenery that is a major attraction to visitors.

An additional option proposed by stakeholders (third workshop), namely multifunctional water reservoirs (WMO 8), can if planned from the beginning also function as a local tourist attraction. Although many synergies with policy objectives do exist, major barriers due to high implementation costs and varying acceptability of stakeholders have been identified and this option is consequently placed at the very end of the option list. This option shows high co-benefits with WMO 1 and 2, but shows conflicts with WMO 13 and 14, as water reservoirs on watercourses can affect structural water quality.



Way forward/implementation avenues

Water management options are show synergies with the draft river basin management plan, except options no. 10, 20, and 22. WMO 8 is in conflict with the river basin management plan due to the measure of restricting the granting of water rights, which is a precondition for the construction of water reservoirs. WMOs 8, 10, 13, and 14 are in synergy with the flood risk management plan. Except for WMOs no. 1, 2, and 22, other WMOs show synergy with the Natura 2000 management programme [70]. WMO 13 is in synergy with the programme for the management of fish in inland waters [76]. WMOs 1, 8, and 10 are in synergy with the national irrigation strategy in preparation [79]). WMO 1 is in synergy with the resolution on the national environmental action programme (2005–2012) [89] and others (e.g.: local self-government act [90]) that allow for the establishment of such associations. Option could help achieve objectives of the regional development programme of Northern Primorska (Goriška development region) 2014-2020 [91]. WMO 22 is in line with the operational programme for the discharge and treatment of urban waste water [69], which determines priority areas for the construction of sewerage systems and municipal wastewater treatment plants.

Funding of WMOs could be provided by the development programme of Northern Primorska [91], Horizon 2020, INTERREG MED Programme 2014-2020, the Common Agricultural Policy, the European Regional Development Fund, and the Cohesion Fund.

The main actor for the implementation of this bundle is the Ministrstvo za okolje in prostor (Ministry of the Environment and Spatial Planning) with its bodies the Direkcija Republike Slovenije za vode (Slovenian Water Agency) and the

Agencija Republike Slovenije za okolje (Slovenian Environmental Agency). The Inštitut za vode Republike Slovenije (Institute for Water of the Republic of Slovenia) and the Zavod za varstvo narave Republike Slovenije (Institute of the Republic of Slovenia for Nature Conservation) should be involved in WMO 13 and 14. Reconstructing and building new water reservoirs is an area where the Ministrstvo za kmetijstvo gozdarstvo in prehrano (Ministry of Agriculture, Forestry and Food) and the Ministrstvo za obrambo (Ministry of Defence) should actively cooperate and support the implementation. Important local actors are municipalities, Regional Development Agencies, and the Tourist Office.

During the third workshop (March, 2016) the municipalities, Regional Development Agencies, and the local Tourist Office indicated their willingness to take up the bundle or individual water management options with differing roles in the implementation process.

2.4.3.7 Implementation of nature protection management

Focus of the bundle

Water management in Slovenia is highly connected with nature protection management due to the fact that a lot of species and habitats are dependent on water. In the Natura 2000 management programme for 2015-2020 [70] there are a lot of species and habitats that have not achieved favourable conservation status and some extra options would be needed in order to restore the favourable conservation status of species and habitats. Options included in this bundle present the actual implementation of restoration options or options supporting the restoration of natural hydromorphology, which is an important element of nature conservation. This bundle addresses two identified challenges: water availability and appropriate water quality.

Proposed combination of options

Context

Water management options included indirectly address the objectives of nature protection by supporting the restoration of natural hydromorphology in the river basin, which is an essential part of nature protection.

The majority of WMOs are complement with each other and have scored co-benefits. 13 combinations out of 28 have scored no interlinkage as no co-benefit or conflict was assessed between them.

Low conflicts are shown for pairs WMO 13-17 and WMO 14-17 due to the effect on interrupted sediment transport. This is in contradiction to the objectives of WMOs 13 and 14 of restoring the natural hydromorphology.

Water Management Options

2	Awareness campaign for water management experts	The objective of the awareness campaign for water management experts in the first place is to educate them on impacts of their work on hydromorphological pressures. The second objective is to educate them about more sustainable techniques in designing interventions on watercourses. The last objective is to collect existing good practices with suggestions for improvements and a complementing database of good practices.
4	Awareness campaign for local public	The objective is to inform the local public as to the kind of impact on water management their actions have. The objective is also to prepare educational material for schools with the objective of presenting water-related challenges in Slovenia, focusing on the Vipava river basin.
13	Restoration of Vipava river and its tributaries	The objective is to establish the original state of the Vipava river and its tributaries with removal of transversal and longitudinal protection objects. It proposes 16 potential locations for the restoration of the Vipava river and seven locations of its tributaries in total length of 21,926 m.
14	Restoration of old meanders and oxbows	The objective is to establish original state of old meanders and oxbows with restoration of the former connection of the main watercourse with its old meander and oxbow. It proposes restoration of old meanders on nine potential locations in total length of 2,721 m.
17	Reconstruction of stabilizing and transverse constructions	The objective is to locate existing transversal and stabilizing construction in the tributaries of the Vipava river and set the priority for their reconstruction. Their function is to stabilize water bed and prevent erosion. Reconstruction is conceived with the use of all known sustainable techniques.
20	Preservation and introduction of shelterbelts	The objective is to preserve existing and introduce new shelterbelts. Implementation of shelterbelts includes seedling of trees (four seedlings per meter of approx. 50 cm high), with their marking and protection with poles.
21	Removal of invasive non-native species	The objective is to collect data on invasive non-native species in the Vipava river basin. It is also to determine the method of removal and disposal for each species and prepare a work programme for invasive non-native species.
23	Cultivation of climate change	The objective is the selection of new varieties and alternative crops that are more adapted to the climatic conditions influenced by global changes. It includes review

	resistant crops	and analysis of suitable crops and also a market analysis if there exists a market for those crops.

'adaptation pathway'

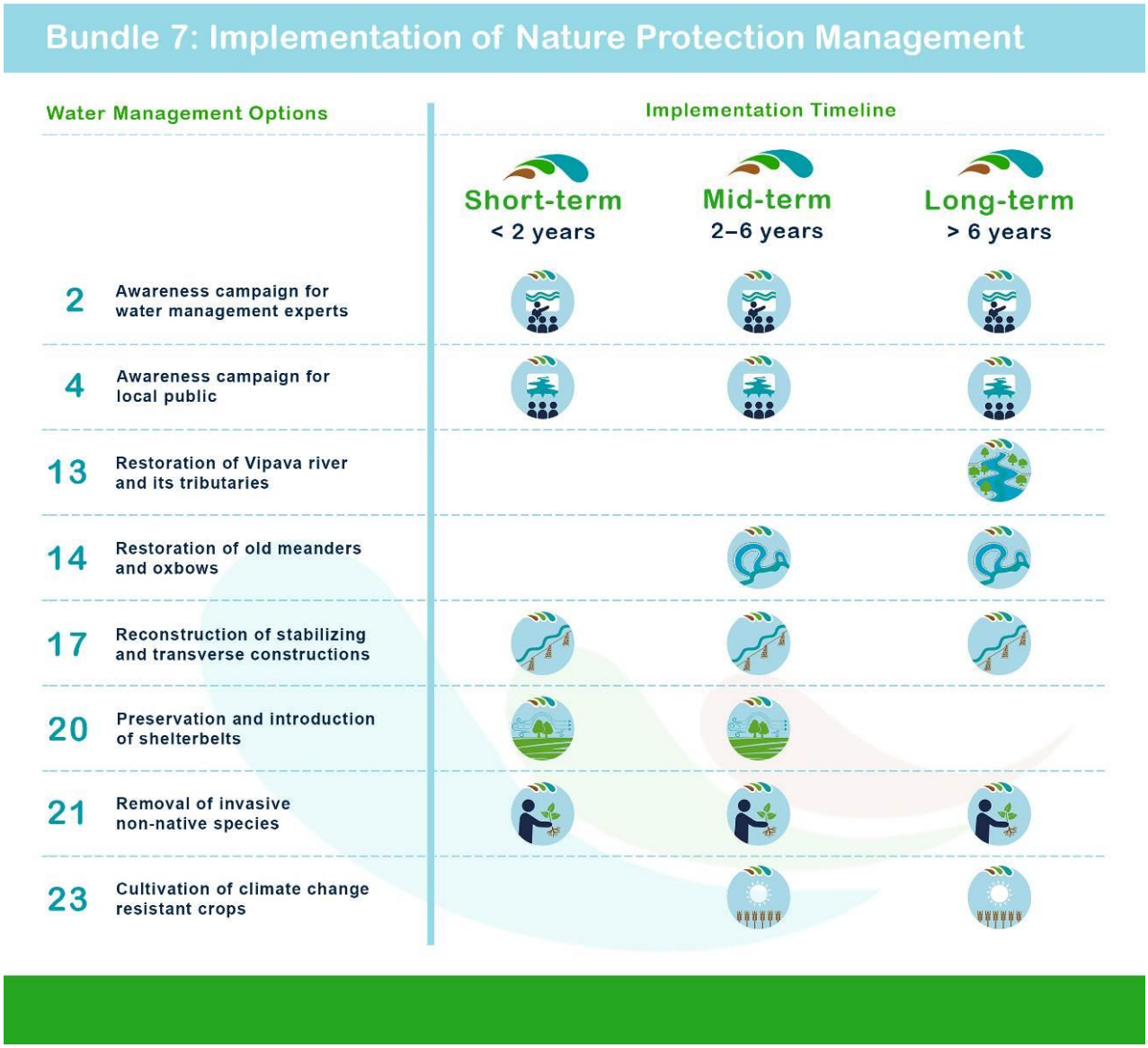
Raising awareness among experts (WMO 2) and local communities (WMO 4) about the positive effects of the proposed options with the aim of restoring natural elements is needed in the first year. In this sense nature protection management must be presented to society in a proper manner. Despite minor barriers due to limited financial capacities, WMO 4 shows many policy synergies.

Although minor barriers exist due to high costs, the preservation of existing and introduction of new shelterbelts (WMO 20) should begin to be implemented in the first year.

With low policy synergies (no National action plan of prevention and management of the introduction and spread of invasive alien species in Slovenia is in place) but low costs, removal of invasive non-native species (WMO 21) should also be implemented in the short term (first two years' time).

Restoration of old meanders and oxbows (WMO 14) and the restoration of the Vipava river and its tributaries (WMO 13) due to high costs or varying acceptability of stakeholders should be implemented in the next phase, with WMO 14 first in line. Both options would improve the ecosystem services of the river and riparian zones (including sediment and nutrient filtering, water storage, bank stabilization and provision of habitat for biodiversity). Both options show high co-benefits. If both applied, they would improve the status of ecosystems in a larger scale.

The cultivation of crops that are resistant to climate change (WMO 23) is a measure that can support the reduction of water consumption (irrigation) and supports the objectives of nature protection. However, high costs are involved. Therefore, the acceptability of stakeholders is not uniform. The implementation of the option should start in the mid-term, as some exotic or tropical crops are being already cultivated for research purposes. Therefore costs might decrease and acceptability increase.



Way forward/implementation avenues

Except WMOs 17 and 20, other WMOs are in synergy with the draft river basin management plan [29]. WMOs 13, 14, and 17 are in synergy with the flood risk management plan [63]. Except WMO 2, other WMOs are in synergy with the Natura 2000 management programme [70]. WMOs 13 and 21 are in synergy with the programme for the management of fish in inland waters [76].

Funding of options can be made through the development programme of Northern Primorska [91], Horizon 2020, INTERREG MED Programme 2014-2020, the Common Agricultural Policy, the European Regional Development Fund, LIFE, and the Cohesion Fund.

The main actor identified for this bundle is the Ministrstvo za okolje in prostor (Ministry of the Environment and Spatial Planning) together with the Zavod za varstvo narave Republike Slovenije (Institute of the Republic of Slovenia for Nature Conservation) and other bodies such as the Direkcija Republike Slovenije za vode (Slovenian Water Agency) and the Agencija Republike Slovenije za okolje (Slovenian Environmental agency). By implementing WMOs 20, 21, and 23 the Ministrstvo za kmetijstvo gozdarstvo in prehrano (Ministry of Agriculture, Forestry and Food) and the Zavod za gozdove Slovenije (Slovenia Forest service) should be involved. At the local level municipalities and Regional Development Agencies could take the initiative.

According to third workshop (March, 2016) the Zavod za varstvo narave Republike Slovenije (Institute of the Republic of Slovenia for Nature Conservation), municipalities, and the local Tourist Office indicated their willingness to take up the bundle or individual water management options with differing roles in the implementation process.

2.4.4 Monitoring

Adaptive management assigns a strategic and central role to monitoring processes. An adaptive management approach means that plans are adjusted to future conditions as they unfold, taking account of uncertainty over future developments, and constantly updating the adaptation plan with new information from monitoring, evaluation, and learning [96]. Therefore, this section aims to outline the main elements that should be taken into account when monitoring the outcomes and impact of the proposed adaptation options.

Monitoring the environmental outcomes of implementing a particular water management option in a specific place and time is fraught with difficulties, as it is normally impossible to isolate the water system from the numerous external drivers and pressures affecting it alongside the implemented option. For instance, it is generally very hard to directly measure the impact of an option's generated water savings on the river flow, as the natural water availability in a system will depend on manifold factors such as recent meteorology, land use and its changes in the basin, the behaviour of other users, and so on. The same applies to measures addressing other goals, such as water quality. In view of the extreme complexity and the multiple causal chains impinging on single parameters, environmental programmes usually resort to monitoring the (degree of) implementation of a measure. In effect, they rely on scientific consensus about whether a measure delivers the desired effect on a certain parameter and about the expected range of this effect.

In addition to monitoring measures as described, monitoring in adaptive management often also addresses the overall system (the river basin in this context), so as to track its development over time and to enable reactions to unforeseen trends and developments.

Indicators for monitoring

Indicators for monitoring can assume various forms, each of which contributes to building a comprehensive overview of the option's or bundles' implementation. Types of monitoring indicators include [97]:

- *financial input indicators* that are used to monitor progress in terms of the annual payment of the funds available for any operation
- *output indicators* that measure activities directly realised within options (e.g. the number of training sessions organised)

When developing the water management options for this plan, a review of and comparison with existing management plans focusing on the river basin was undertaken (see Part 2). These existing plans, such as the River Basin Management Plans [27, 28, 29] developed in compliance with the European Water Framework Directive [21], have a monitoring and evaluation network in place in which the monitoring and evaluation of the presented water management options can be integrated. Such potential monitoring synergies exist, for example, with regards to the option of Reconstruction of the existing Vogršček water reservoir (WMO 10) and Reconstruction of the existing irrigation system (WMO 12).

Existing monitoring of the Vogršček water reservoir and its accompanying irrigation systems includes indicators showing water quantity and quality in the reservoir together with the quantity of water used for irrigation. Monitoring is under the responsibility of the operator of the facility and rules are laid down in the Operating Regulations. The existing practice is that the water reservoirs together with their monitoring are managed by concessionaires carrying out the Water Management Public Service. This is not the case in the existing irrigation systems, namely they are usually managed by agricultural cooperatives.

However, some water management options are unique to this river basin adaptation plan and therefore do not have specific links to existing monitoring efforts. For some of these options, opportunities exist for their implement within the frame of an ongoing project, such as those financed under the LIFE programme, which includes a budget for monitoring and evaluation activities and requires output monitoring for all projects. Within this river basin adaptation plan, monitoring for the following options could be funded via an external financing scheme: Preservation of existing and introduction of new shelterbelts (WMO 20) and Removal of invasive non-native species (WMO 21). More specifically, preserving and introducing new shelterbelts (WMO 20) or so-called green windbreaks could be funded within the LIFE sub-programme Climate Action. Based on expected changes in the climate of this region, the frequency of extreme events (including strong and gusty bora winds) will increase. As green windbreaks are a well verified measure for reducing damage from strong gusty winds by lowering wind speed, their installation could increase the resilience of the Vipava river basin against climate change. As the expected impact of green windbreaks is on reducing wind speed, measurements of wind speed would be the most appropriate output indicator. To monitor the actual effects of green windbreaks, measurement points should be adequately determined. The option on the removal of invasive non-native species (WMO 21) could also be funded within the LIFE programme. Namely, invasive alien species have multiple impacts (ecological, economic and human health), but are recognized first and foremost as a major threat to Europe's biodiversity and can cause the local extinction of indigenous species, for instance through competition for limited resources such as food and habitats, inter-breeding, or the spread of exotic diseases. The impact of invasive alien species may sometimes be so profound that they can alter the structure and functioning of entire ecosystems, compromising their ability to provide valuable ecosystem services, such as pollination, water regulation, or flood control [98]. As such, "invasive alien species (IAS) or other threats" (unit specimen/ha) or "species and number of non-native plant and animal (fish) species detected and removed" could be a potential indicator for the option on removal of invasive non-native species (WMO 21).

2.5 From planning to action: recommendations for implementation

The Vipava River Basin Adaptation Plan is based on a participatory approach, which was followed so as to develop a set of targeted water management options and, subsequently, bundles of these options. The outlined (bundles of) options serve to address the main challenges that were identified by the basin's stakeholders. This chapter provides guidance and recommendations for decision-makers, individuals, and entities that are in a position to implement bundles of synergistic water management options or individual options. The information provided throughout the plan is thus intended to serve as a tool to help to guide policy and decision makers in selecting appropriate options or sets of options to implement within the basin to address the basin's specific needs.

Implementation of all options within a given bundle

The bundles presented in chapter 2.4.3 are sets of options that have been grouped together on the basis of their foreseen abilities to collectively address the identified challenges within the Vipava river basin and react to additional local needs (e.g. increasing sustainable tourism in the area). Implementation of an entire bundle ensures a high occurrence of synergies between the options and the pursuit of one or more common objectives. Two water management options that are strongly aligned may decrease the implementation or maintenance costs if they are implemented together. Other combinations may lead to an increased impact with regards to addressing an existing threat.

In the bundle factsheets in chapter 2.4.3, extensive information is provided on the interaction of the water management options to support decision-making processes. This includes, for example, indications of the objectives that may be reached by choosing to implement a given bundle, the costs involved, the ideal phasing of the options in time, etc. If an entire bundle is to be implemented, the 'adaptation pathway' provides further information about which options are critical to implementation before other water management options in the bundle. For example, implementing the bundle Implementation of Sustainable Water Management would focus on achieving sustainable water management at the river basin level, and could be estimated at €63,798,691.00. Should sustainable water management at the river basin level be prioritised as a key objective and limited financing be a main consideration, the bundle Organisation of Sustainable Water Management would better suit the objective.

Implementation of individual water management options

The existence of very specific objectives, resource or capacity limitations or other considerations may make the implementation of an entire bundle unfeasible. In this case, deciding instead to implement one or more individual options will not necessarily have a negative impact on the performance of these options. While all of the water management options presented are suitable for implementation in the river basin, the decision to implement individual options on their own requires verifying that the option is not dependent on any other water management option. Information on the relationship between the options is outlined in the bundle factsheets in chapter 2.4 and should be consulted in order to reach such conclusions.

Here, particular focus should be given to prioritised water management options, which have been identified based on the wishes and needs of the stakeholders engaged in the process and by taking into account implementation-oriented factors, such as the multi-criteria analysis, performance with regards to the challenges, feasibility, acceptability, and policy synergies. As such, these options are strongly aligned with community interests and are foreseen to offer large potential in addressing the targeted challenges identified within the basin (see Table 4.2). In order to assess the best implementation timing, the adaptation pathways as presented in chapter 2.4

should be consulted. Following these criteria, the following water management options are recommended within the river basin:

- *Establishment of an inter-municipal expert working group* (WMO 1) addresses all three challenges, meaning water availability during droughts in the growing season (challenge A), flood risk reduction (challenge B) and appropriate water quality (challenge C). The option presents a path to a more coherent spatial development in the Vipava river basin, showing many co-benefits with other options. Hence, the option included in five out of seven bundles can help other options to be implemented easier and with the desired impact. The option represents a soft approach to adaptation, which was most preferred among stakeholders, having low implementation and operational costs and the most preferred outcome for all three identified challenges of Vipava river basin.
- *Awareness campaign for local public* (WMO 4) also addresses all three challenges, meaning water availability during droughts in growing season (challenge A), flood risk reduction (challenge B), and appropriate water quality (challenge C). The aim of the option would be to increase the awareness of the general public on the impacts of biological, chemical, hydrological and morphological pressures, biological pressures, the impacts of various pollution sources, etc. The option represents a soft approach to adaptation, which was most preferred among stakeholders, having low implementation and operational costs and the most preferred outcome for all three identified challenges of Vipava river basin.
- *Construction of water reservoirs* (WMO 8) addresses two challenges, meaning water availability during droughts in the growing season (challenge A) and flood risk reduction (challenge B). Water reservoirs would be used for two main purposes during droughts: 1) for irrigation of agricultural land and so avoiding agricultural drought and 2) as a water source in the function of enriching low waters by maintaining environmentally acceptable flow downstream and so avoiding hydrological drought. During short but heavy rainfall, water reservoirs would minimize floods downstream by retaining high waters. Although the option has most preferred evaluation outcome for the two identified challenges of the Vipava river basin, the option is a technical solution (grey approach to adaptation) with high implementation costs. As such it is also involved with low feasibility, but also with low co-benefits or even conflicts with other options and objectives of Water Framework Directive [21].
- *Awareness campaign for water management experts* (WMO 2) also addresses all three challenges, meaning water availability during droughts in the growing season (challenge A), flood risk reduction (challenge B), and appropriate water quality (challenge C). The aim of the option would be to increase the awareness of experts involved in water management (concessionaires for river management) so as to use more sustainable techniques when designing interventions on water bodies. The campaign would also increase the awareness of experts on the impacts of the effects of hydromorphological pressures (inadequate implementation of construction works). The option represents a soft approach to adaptation, which was most preferred among stakeholders, having low implementation and operational costs and the most preferred outcome for all three identified challenges of Vipava river basin.
- For many stakeholders the option *Improve the financing system for water infrastructure* (WMO 5) is one of the prerequisites for sustainable water management. The option addresses two challenges, meaning water availability during droughts in the growing season (challenge A) and flood risk reduction (challenge B). Through changes in legislation, this option aims to improve and optimize the system of financing water infrastructure from the national Water Fund; with the introduction of dedicated funding to finance measures to help achieve the objectives of water management and River Basin Management Plan. This option can result in the sustainability of water infrastructure, the prevention instead of recovery, sustainable flood protection and higher life quality, and reducing the damage caused by floods and droughts to different sectors (meaning also maintenance of the Vogršček water reservoir to help prevent damages to the agriculture in growing season). The option represents a soft approach to adaptation, which was most preferred among

stakeholders, having low implementation and operational costs and the most preferred outcome for all three identified challenges of Vipava river basin.

In order to assure the successful implementation of individual water management options or bundles of options, the development and execution of a monitoring plan including sound indicators is crucial. Therefore, the suggestions made in section 2.4.4**Error! Reference source not found.** regarding the alignment of existing monitoring plans with the needs of the water management options specified in this plan should be considered. This includes finding synergies with existing monitoring schemes regarding the identification of suitable indicators for measuring the output.

References

[1] Verkerk H, Robert N, Varela E, Martinez de Arano I, Libbrecht S, Dude R, Boiten V, Broekman A, Sánchez A, Giannakis E, Bruggeman A, Zoumides C, Jebari S, Oussaifi D, Daly H, Magjar M, Krivograd Klemenčič A, Smolar-Žvanut N (2015). Four reports with the water management options and the evaluation, one per case study river basin. Deliverable D3.3, BeWater, FP7 project no. 612385-SIS.2013.1.2-1 European Commission, 308 pp.

[2] Haasnoot, M., Kwakkel, J.H., Walker, W.E., ter Maat, J. (2013). Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. Global Environmental Change 23(2), 485-498.

[3] European LEADER Association for Rural Development (2016). The Bottom Up approach. Retrieved from http://www.elard.eu/en_GB/the-bottom-up-approach

[4] Glossary, A. D. (2015). Intergovernmental Panel on Climate Change (IPCC), nd http://www. ipcc. ch/publications_and_data/ar4/wg2/en/annexessglossary-ad. html. Accessed June, 30.

[5] European Commission. Adaptation to climate change. Retrieved from http://ec.europa.eu/clima/policies/adaptation/index_en.htm

[6] European Climate Adaptation Platform. Glossary. Retrieved from http://climate-adapt.eea.europa.eu/glossary/index_html/#linkClimateChangeScenario

[7] Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K. B., ... & Miller, H. L. (2007). Contribution of working group I to the fourth assessment report of the intergovernmental panel on climate change, 2007.

[8] Adapted from FCMappers (2009). What is a fuzzy cognitive map? Retrieved from http://www.fcmappers.net/joomla/index.php?option=com_content&view=article&id=56&Itemid=59

[9] U.S. Global Change Research Program. Glossary. Retrieved from http://www.globalchange.gov/climate-change/glossary

[10] Environment Agency. (2005). Ecology and the Water Framework Directive - Briefing note.

[11] Hufty, M. (2011). Investigating policy processes: the governance analytical framework (GAF). Research for sustainable development: Foundations, experiences, and perspectives, 403-424.

[12] Nations, U. (1992). Convention on biological diversity. United Nations.

[13] Karst Waters Institute. What is karst? And why is it important? Retrieved from http://karstwaters.org/educational-resources/what-is-karst-and-why-is-it-important/

[14] Goodwill, R. J. (2012). Engaging staff communities in a knowledge transfer strategy: a case study at the University of Melbourne. Journal of Higher Education Policy and Management, 34(3), 285-294.

[15] Saarikoski, H.; Barton, D.N.; Mustajoki, J.; Keune. H.; Gomez-Baggethun, E. and J. Langemeyer (2015): Multi-criteria decision analysis (MCDA) in ecosystem service valuation. In: Potschin, M. and K. Jax (eds): OpenNESS Ecosystem Service Reference Book. EC FP7 Grant Agreement no. 308428.

[16] Missouri Botanical Garden (2002). What is an oxbow lake? Retrieved from http://www.mbgnet.net/fresh/lakes/oxbow.htm

[17] Mackay, M. (2011). Understanding and Applying Basic Public Policy Concepts. University of Guelph.

[18] Gabrielsen, P., & Bosch, P. (2003). Environmental indicators: typology and use in reporting. EEA, Copenhagen.

[19] European Climate Adaptation Platform. Glossary. Retrieved from http://climate-adapt.eea.europa.eu/glossary/index_html/#linkResilience

[20] European Commission. Introduction to the new EU Water Framework Directive. Retrieved from http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm

[21] WFD, E. (2000). Directive 2000/60/EC of the European Parliament and of the Council Establishing a Framework for the Community Action in the Field of Water Policy. The European Parliament and the Council of the European Union: Brussels, Belgium.

[22] Government of the Republic of Slovenia (2015). Protocol on sediment management to the framework agreement on the Sava River Basin. Retrieved from http://www.savacommission.org/dms/docs/dokumenti/documents_publications/basic_documents/protocols/protokol_nanos.pdf

[23] Tnau Agritech Portal (2016). Dryland Technologies. Retrieved from http://agritech.tnau.ac.in/agriculture/agri_majorareas_dryland_drylandtechnologies.html

[24] Glaser, M., Krause, G., Ratter, B., & Welp, M. (2008). Human-Nature-Interaction in the Anthropocene. Potential of Social-Ecological Systems Analysis. Preparation Paper for the DGH-Symposium „Human-Nature-Interactions in the Anthropocene: Potentials of Social-Ecological Systems Analysis", Sommerhausen, 29th–31st May 2008. Available from: http://www.dg-humanoekologie.de/pdf/DGH-Mitteilungen/GAIA200801_77_80.pdf

[25] Paulson, LD (2015, February 25). What Is Water Scarcity? Retrieved from https://www.rwlwater.com/what-is-water-scarcity/

[26] Milwaukee Riverkeeper (2015). What's a River Basin? What's a Watershed? Retrieved from http://milwaukeeriverkeeper.org/whats-a-river-basin-whats-a-watershed/

[27] MOP. (2015a). Draft River Basin Management Plan for the Adriatic Sea Basin for the period 2015 – 2021. Retrieved from http://www.mop.gov.si/fileadmin/mop.gov.si/pageuploads/podrocja/voda/nuv_II/Osnutek_NUV_II_VO_Jadransko_morje__21sep15.pdf

[28] Decree on the river basin management plan for the Danube Basin and the Adriatic Sea Basin (Official Gazette RS, no. 61/11 and 49/12). Retrieved from http://www.pisrs.si/Pis.web/pregledPredpisa?id=ODLO1596

[29] MOP. (2009). River Basin Management Plan for the Danube Basin and the Adriatic Sea Basin for the period 2009 – 2015, textual and cartographic part. Retrieved from http://www.mop.gov.si/si/delovna_podrocja/voda/nacrt_upravljanja_voda/nuv_besedilni_in_kartografski_del/ and the programme of measures Retrived from http://www.mop.gov.si/fileadmin/mop.gov.si/pageuploads/podrocja/voda/nuv_donava_jadran_2015/program_ukrepov_upravljanja_voda.zip

[30] Integrated River Basin Management (IRBM). Briefing notes prepared by Peter Millington. Retrieved from http://wwf.panda.org/about_our_earth/about_freshwater/rivers/irbm/

[31] Directive 2007/60/EC of the European Parliament and of the Council of 23 October 200\7 on the assessment and management of flood risks. Retrived from http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32007L0060

[32] GeoZS (2015). Basic Geology Map of Slovenia. Geological Survey of Slovenia, Ljubljana. Retrieved from http://kalcedon.geo-zs.si/website/OGK100/viewer.htm

[33] MKGP. (2015). Land use, Slovenia, 2015. Layer of digital cartography. Ministry of Agriculture, Forestry and Food, Ljubljana.

[34] MKGP. (2002). Land use, Slovenia, 2002. Layer of digital cartography. Ministry of Agriculture, Forestry and Food, Ljubljana.

[35] Nature Conservation Act (Official Gazette RS, no. 96/04 - official consolidated text, 61/06 - ZDru-1 8/10 - ZSKZ-B and 46/14). Retrieved from http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAKO1600

[36] SURS, Si-Stat. (2014). Land use and use of arable crops (ha), Slovenia, annually. Statistical Office of the Republic of Slovenia, Ljubljana. Retrieved from http://pxweb.stat.si/pxweb/Dialog/varval.asp?ma=1502401E&ti=&path=../Database/Environment/15_agriculture_fishing/04_crop_production/01_15024_crops_area/&lang=1

[37] MOP-ARSO. (2016). Meteo.si - Uradna vremenska napoved za Slovenijo - Državna meteorološka služba RS - Bilje. Retrieved from http://meteo.arso.gov.si/met/sl/climate/diagrams/bilje/

[38] ARSO. (2015a). Surface Water Data Archive. Slovenian Environment Agency, Ljubljana. Rertieved from http://vode.arso.gov.si/hidarhiv/pov_arhiv_tab.php

[39] Rules on determing and classification for water bodies on surface water (Official Gazette RS, no. 63/05, 26/06 and 32/11). Retrieved from http://www.pisrs.si/Pis.web/pregledPredpisa?id=PRAV6946

[40] MOP-ARSO. (2014). Groundwater chemical status assessment in Slovenia in 2013. Ministry of the Environment and Spatial Planning, Slovenian Environmental Agency (in Slovene), Retrieved from http://www.arso.gov.si/vode/podzemne%20vode/publikacije%20in%20poro%C4%8Dila/Porocilo_podzemne_2013_12.12.2014_popr.pdf

[41] MOP. (2014). Overview of significant water management issues on river basin districts of the Danube and Adriatic sea, Republic of Slovenia, Ministry of the Environment and Spatial Planning (in Slovene), Retrieved from http://www.mkgp.gov.si/fileadmin/mkgp.gov.si/pageuploads/podrocja/voda/nuv_II/PZUV.pdf

[42] ASTIS project. (2015). Groundwater and Transition Isonzo / Soča, Pre-Accession Assistance (IPA). Retrieved from http://www.ita-slo.eu/projects/projects_2007_2013/2012111313373778

[43] Market Sector Scan of Water Management of Slovenia (39 pp.). (2013). TC Vode d.o.o. Retrieved from https://www.google.si/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwiS59zjoL3JAhUCXBoKHcs0BBwQFggjMAE&url=http%3A%2F%2Fwww.nwp.nl%2F_docs%2Fnieuwsbrief_bijlagen%2FWatMngSlov_MarketScan20130205_TCVodeFinal05022013.pdf&usg=AFQjCNEgjSc_xSq72yike2j8ENOVO1A2PA&sig2=07MXY5_xC8M-mxpfIMV29w

[44] Anonymus, A. (2007). Handbook on good practices for flood mapping in Europe. Excimap (European exchange circle on flood mapping). Endorsed by Water Directors, 29-30 November 2007. Retrieved from http://ec.europa.eu/environment/water/flood_risk/flood_atlas/pdf/handbook_goodpractice.pdf

[45] Brenčič M. (2013). Water. Vipava Valley. Abiota, flora, fauna, history, art history, material culture, economy and nature conservation. Pavšič J. (Ed.). Slovenska Matica, Ljubljana, 19-37 pp. (in Slovene)

[46] Pintar, M., Tratnik, M., Cvejić, R., Bizjak, A., Meljo, J., Kregar, M., ... & Mohorko, T. (2010). National research project V4-0487 CRP: Assessment of Water Perspective in Slovenia and Possibility for Water Use for Agricultural Production (in Slovene). Biotehniška fakulteta, Univerza v Ljubljani. Ministrstvo za kmetijstvo, gozdarstvo in prehrano RS, 158.

[47] Directive, U. W. T. (1991). Council Directive 91/271/EEC concerning urban wastewater treatment. OJ L, 135. Retrieved from http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31991L0271

[48] SURS, Si-stat. (2015). Population by large and 5-year age groups and sex, settlements, Slovenia, annually. Statistical Office of the Republic of Slovenia, Ljubljana, Retrieved from http://pxweb.stat.si/pxweb/Dialog/varval.asp?ma=05C5002E&ti=&path=../Database/Demographics/05_population/10_Number_Population/25_05C50_Population_naselja/&lang=1

[49] Ogrin, D., Plut, D., Heraković, A., Hribar, N., Natek, K., & Repe, B. (2009). Aplikativna fizična geografija Slovenije. Ljubljana: Znanstvena založba Filozofske fakultete.

[50] What's the Difference Between Water Use and Water Consumption? Retrieved from http://www.wri.org/blog/2013/03/what%E2%80%99s-difference-between-water-use-and-water-consumption

[51] MOP-ARSO. (2015a). Water permits. Concessions for water use. Layer of digital cartography. Slovenian Environment Agency, Ljubljana. Retrieved from http://gis.arso.gov.si/wfs_web/faces/WFSLayersList.jspx

[52] MOP-ARSO. (2015b). Climate changes and the Slovenian Environmental Agency. Climate changes (in Slovene). Retrieved from http://www.arso.gov.si/podnebne%20spremembe/projekti/arso_klimatske.html

[53] Kajfež Bogataj L. (2006). Climate change and the future of Slovenia. Discussions on the future of Slovenia. 9th Discussion. The challenges of climate change. Office of the President of the Republic of Slovenia, Ljubljana, 62-69 pp. (in Slovene). Retrieved from http://www.prihodnost-slovenije.si/up-rs/ps.nsf/kk/08CA87C7AA6CAA0CC125729E0064929E/$FILE/izzivi_klimatskih_spremmeb.pdf

[54] Frantar, P. (1971). Vodna bilanca Slovenije 1971–2000. Water balance of Slovenia, 2000. Retrieved from http://www.arso.gov.si/vode/poro%C4%8Dila%20in%20publikacije/vodna%20bilanca/vodna_bilanca.html

[55] MOP-ARSO. (2015c). Meteo.si - Uradna vremenska napoved za Slovenijo - Državna meteorološka služba RS - Klimatološka povprečja 1981-2010. Retrieved from http://meteo.arso.gov.si/met/sl/climate/tables/normals_81_10/

[56] ARSO, 2015b. Climate Change in Slovenia - reports. Retrieved from http://www.arso.gov.si/podnebne%20spremembe/poro%C4%8Dila%20in%20publikacije/

[57] SPM, I. S. (2000). Summary for policymakers, emissions scenarios: a special report of IPCC Working Group III, IPCC. ISBN, 92(9169), 113. Retrieved from http://www.ipcc.ch/pdf/special-reports/spm/sres-en.pdf

[58] Bergant, K. (2010). The climate in the future – how much do we know about it? Environment is changing. Climate variability in Slovenia and its impact on the aquatic environment. Cegnar T. (Ed.). Slovenian Environmental Agency, Ljubljana, 141-159 pp. (in Slovene)

[59] Waters Act (Official Gazette, no. 67/02, 2/04 – ZZdrI-A, 41/04 – ZVO-1, 57/08, 57/12, 100/13, 40/14 and 56/15). Retrieved from http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAKO1244

[60] Directive, E. B. W. (2006). Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160. EEC.

[61] Parliament, E. (2008). Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental

policy (Marine Strategy Framework Directive). Official Journal of the European Union L, 164, 19-40.

[62] Decree on bodies affiliated to ministries (Official Gazette, no. 35/15 and 62/15). Retrieved from http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED6985

[63] MOP (2015b). Implementation of Floods Directive. Retrieved from http://www.mop.gov.si/si/delovna_podrocja/voda/poplavna_direktiva/

[64] Decree on the protection of waters against pollution caused by nitrates from agricultural sources (Official Gazette, no. 113/09, 5/13 and 22/15). Retrieved from http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED5124

[65] Environmental Protection Act (Official Gazette, no. 39/06 - consolidated text, 49/06 - ZMetD 66/06 - dec. U.S. 33/07 - ZPNačrt, 57/08 - ZFO-1A, 70/08, 108/09, 108/09 - ZPNačrt-A, 48/12, 57/12, 92/13 and 56/15). Retrieved from http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAKO1545

[66] Directive, N. (1991). Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources. official Journal l, 375(31), 12.

[67] Decree on groundwater status (Official Gazette, no. 25/09 and 68/12). Retrieved from http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED5121

[68] Directive, G. (2006). Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration. Official Journal of the European Union, L, 372.

[69] Operational programe for 2005 - 2017 (in Slovene). Retrieved from http://www.mko.gov.si/fileadmin/mko.gov.si/pageuploads/zakonodaja/varstvo_okolja/operativni_programi/operativni_program_komunalne_vode.pdf

[70] Natura 2000 Management programme for Slovenia for the period 2015-2020 (LIFE11 NAT/SI/880). Retrieved from http://www.natura2000.si/fileadmin/user_upload/C5_ProgrammeNatura2020.pdf

[71] Directive, E. E. C. (2009). Directive 2009/147/EC of the European parliament and of the Council of 30 November 2009 on the conservation of wild birds (codified version). Official Journal L, 20, 7-25.

[72] Council of the European Commission. (1992). Council directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal of the European Communities. Series L, 206, 7-49.

[73] The strategy of adaptation of Slovenian agriculture and forestry to climate change from year 2008 and its implementation document (Action plan, 2011). Retrieved from http://www.mkgp.gov.si/fileadmin/mkgp.gov.si/pageuploads/podrocja/Kmetijstvo/Naravne_nesrece/Akcijski_nacrt_za_leti_2010_in_2011__1_.pdf

[74] Rural Development Program. (2014). Information on Rural Development Programe 2014 – 2020. Retrieved from http://www.program-podezelja.si/sl/prp-2014-2020/kaj-je-program-razvoja-podezelja-2014-2020

[75] Freshwater Fishery Act (Official Gazette, no. 61/06), Retrieved from http://pisrs.si/Pis.web/pregledPredpisa?id=ZAKO3600

[76] Bertok, M., Bravničar, D. (2014). Programme for the Management of Fish in Inland Waters of the Republic of Slovenia. Ljubljana: RS, MKO. Retrieved from http://www.zzrs.si/en/uploads/files/Program_upravljanja_rib_CPVO_20_02_2014.pdf

[77] Fishery Planning. Fishery and Farming management Plan. (2016). Retrieved from http://www.zzrs.si/en/page/ribisko-nacrtovanje/

[78] Fishery Planning. Annual Programs of Fishery Management. (2016). Retrieved from http://www.zzrs.si/en/page/ribisko-nacrtovanje/

[79] Action plan for the development of irrigation in the Republic of Slovenia until 2020 with the programme of measures (in Slovene). [PDF]. (2015, June). Ljubljana. Retrieved from http://www.mkgp.gov.si/fileadmin/mkgp.gov.si/pageuploads/osnutki/2015/Nacrtnamakanjajuni2015.pdf

[80] Tratnik, M. (personal communication, 17th February 2015)

[81] Ministry postponed the remediation of Vogršček (in Slovene) [Press release]. (2013, September 06). Retrieved from http://www.delo.si/novice/slovenija/ministrstvo-odlozilo-sanacijo-vogrscka.html

[82] Kodrič, I. (personal communication, August 18, 2014)

[83] Libbrecht, S., Dude, R. E., Gramberger, M. and Watson, W. (2015). *Protocol for performance of participatory processes*, part of Deliverable D2.3 Guideline report on the BeWater approach outlining principles, methodology, concepts and protocols of the project. FP7 project no. 612385 - SIS.2013.1.2-1European Commission, 40 pp.

[84] Gramberger, M., Zellmer, K., Kok, K., & Metzger, M. J. (2015). Stakeholder integrated research (STIR): a new approach tested in climate change adaptation research. Climatic Change, 128(3-4), 201-214.

[85] Verkerk, H., Varela, E., Robert, N. and Martinez de Arano, I. (2015a), Protocol for formulation of water management options. Deliverable D2.3, BeWater, FP7 project no. 612385-SIS.2013.1.2-1 European Commission, 19 pp.

[86] Haasnoot, M., Kwakkel, J. H., Walker, W. E., & ter Maat, J. (2013). Dynamic adaptive policy pathways: a method for crafting robust decisions for a deeply uncertain world. Global environmental change, 23(2), 485-498.

[87] Štravs, L. fPDF] (2014). Retrieved from http://www.mop.gov.si/fileadmin/mop.gov.si/pageuploads/podrocja/voda/opvp/OPOPO.pdf

[88] Reed, M. S., Podesta, G., Fazey, I., Geeson, N., Hessel, R., Hubacek, K., ... & Ritsema, C. (2013). Combining analytical frameworks to assess livelihood vulnerability to climate change and analyse adaptation options.Ecological Economics, 94, 66-77.

[89] Resolution on the National Environmental Action Programme 2005–2012 (NEAP) (in Slovene) (Official Gazette of RS, No. 2/2006). Retrieved from http://www.uradni-list.si/1/content?id=67017

[90] Local Self-Government Act (Official Gazette of RS, No. 94/07 - official consolidated text, 76/08 , 79/09 , 51/10 , 40/12 - ZUJF and 14/15 - ZUUJFO). Retrieved from http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAKO307

[91] Development Programme of Northern Primorska (Gorizia development regions) 2014-2020 (in Slovene). [PDF]. (2015, January). Retrieved from http://www.ra-rod.si/images/stories/dokumenti/RRP%20Goriske%202014-2020_koncni.pdf

[92] Spatial Plan of Municipality Ajdovščina and its amendments (Official Gazette of the Municipality of Ajdovščina, no. 7/1997). Retrieved from http://www.lex-localis.info/KatalogInformacij/VsebinaDokumenta.aspx?SectionID=ab488cc7-1cd5-4e9f-aa13-60edfd5cca8b

[93] Annex 15: Financing the Joint Programme of Measures of draft The Danube River Basin District Management Plan – Update 2015 [PDF]. (2015). ICPDR – International Commission for the Protection of the Danube River.

[94] National Adaptation strategy for forestry and agriculture to climate change (in Slovene) [PDF]. (2008). Retrieved from http://www.arhiv.mkgp.gov.si/fileadmin/mkgp.gov.si/pageuploads/saSSo/Sektor_za_naravne_nesrece/Strategija_prilagajanja_slovenskega_kmetijstva_in_gozdarstva_podnebnim_spremembam.pdf

[95] Action plan for the National Adaptation strategy for forestry and agriculture to climate change for the years 2010 and 2011 (in Slovene) [PDF]. (2010). RS, MKGP. Retrieved from http://www.mkgp.gov.si/fileadmin/mkgp.gov.si/pageuploads/podrocja/Kmetijstvo/Naravne_nesrece/Akcijski_nacrt_za_leti_2010_in_2011__1_.pdf

[96] European Environmental Agency, 2013. Adaptation in Europe: Addressing risks and opportunities from climate change in the context of socio-economic developments. EEA Report No 3/2013

[97] European Commission (2015). Technical Handbook on the Monitoring and Evaluation Framework of the Common Agricultural Policy 2014-2020. Directorate-General for Agriculture and Rural Development, Brussels.

[98] Invasive Alien Species, European response [Brochure]. (2014). Kerstin Sundseth, Ecosystems LTD, Brussels under service contract N° 0307/2012/633322/SER/B3 Commission coordinators: Susanne Wegefelt and Myriam Dumortier, European Commission, DG ENV Units B.2 and B.3, - B-1049 Brussels. Retrieved from http://ec.europa.eu/environment/nature/invasivealien/docs/ias-brochure-en-web.pdf

[99] International Public Administration Review. Retrieved from http://uprava.fu.uni-lj.si/index.php/IPAR/article/view/42

[100] Financing of Municipalities Act (Official Gazette of RS, No. 32/06 - official consolidated text, 123/06 - ZFO-1 and 57/08 - ZFO-1A) Retrieved from http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAKO385

[101] Operation "Upgrade of the system for monitoring and analyzing the water environment in Slovenia". Retrieved from http://www.arso.gov.si/o agenciji/EU sofinancira/

[102] Presentation of the project »Upgrade of the system for monitoring and analyzing the water environment in Slovenia« [PDF]. (2010, November). Ljubljana: MOP-ARSO. Retrieved from http://www.arso.gov.si/o%20agenciji/EU%20sofinancira/Predstavitev%20projekta.pdf

[103] Ordinance of the municipal spatial plan of the Renče-Vogrsko Municipality (Official Gazette of the Municipality of Renče-Vogrsko, No. 10/2014). Retrieved from http://www.rence-vogrsko.si/images/stories/obcina/obcinsko_glasilo/2014/Uradne_objave_10-2014.pdf

[104] Resolution on the strategic orientations of development of Slovenian agriculture and food industry by 2020 - "Securing you food for tomorrow" (Official Gazette of RS, No. 25/2011). Retrieved from http://www.uradni-list.si/1/content?id=102992

[105] Tratnik, M., Batič, S., Steinman, F. and Pintar M. (2011). Sistem Vogršček – izzivi nove ureditve. Mišičev vodarski dan 2011: Conference Proceedings, Maribor : Vodnogospodarski biro Maribor, 2011. 148-154. Retrieved from http://mvd20.com/LETO2011/R19.pdf

[106] Agricultural Land Act (Official Gazette of RS, No. 27/16). Retrieved from http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAKO541

[107] Project Kučnica/ Kutscheniza (European Territorial Cooperation, the Operational Programme Slovenia–Austria 2007-2013). Retrieved from http://www.wasserwirtschaft.steiermark.at/cms/beitrag/11878958/99393634/

[108] Draft Spatial plan of the Municipality of Ajdovščina, June 2014. Retrieved from http://www.ajdovscina.si/javna_narocila_in_razpisi/druge_javne_objave/2014090214435154/

[109] Ordinance on Municipal Spatial Plan of the Municipality of Vipava (Official Gazette of RS, No. 9/14). Retrieved from http://www.uradni-list.si/1/content?id=116221#!/Odlok-o-Obcinskem-prostorskem-nacrtu-Obcine-Vipava

[110] Decree on the water fee (Official Gazette of RS, No. 103/02 and 122/07). Retrieved from http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED2657

[111] Decision determining the amount of water charge basis for the use of water, alluvial deposits and water areas (Official Gazette of RS, No. 64/14). Retrieved from http://www.pisrs.si/Pis.web/pregledPredpisa?id=SKLE9903

[112] McCormick, F. H., Contreras, G. C., & Johnson, S. L. (2010). Effects of nonindigenous invasive species on water quality and quantity. Dix, M. and Britton, K., eds, 2009-29.

[113] Non-native species in Slovenia. Retrieved from http://www.tujerodne-vrste.info/ukrepi/zakonodajni-mehanizmi/nacionalni-predpisi/

[114] Biodiversity Strategy. Retrieved from http://ec.europa.eu/environment/nature/biodiversity/strategy/index_en.htm

[115] Regulation, E. U. (2014). Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species. Official Journal of the European Union, 57(317), 35.

[116] Invasive Species: How They Affect the Environment. Retrieved from http://www.environmentalscience.org/invasive-species

[117] LIFE and Invasive Alien Species [PDF]. (2014). European Union. Retrieved from http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/life_ias.pdf

[118] National Restriction or Prohibition of the Cultivation of Genetically Modified Plants Act (Official gazette, no. 69/15). Retrieved from http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAKO7213

[119] Agricultural Experimental Centre Jable. Retrieved from http://www.spletna-stran.info/povezava-8438/Kmetijski-poskusni-center-Jable.html

[120] Gene bank of Crops. Retrieved from http://www.kis.si/Zacasna_resitev_genske_banke/

Annex I: List of engagement activities held in Vipava River Basin

Engagement activity	Objective	Target group	Dates
First stakeholder workshop	Identification of challenges regarding water management in the Vipava river basin, drawing an outline for future WMOs in the Vipava river basin.	A wide group of local, regional and national stakeholders.	6th June 2014
Stakeholder interviews	Collection of information from policy-makers on the current situation of adaptation to climate changes on national and river basin level, their experience with public participation in the design of policies and potential conflicts that may appear. Discussion on current water use problems and desired state for the Vipava river basin.	Policy-makers and other relevant stakeholders not able to attend the first workshop in June.	September – November 2014
Stakeholder consultations (I)	Validation and harmonization of FCM as a result of the first stakeholder workshop and stakeholder interviews.	A group of local, regional and national stakeholders actively engaged in the BeWater project.	February 2015
Second stakeholder workshop	Evaluation of WMOs as a result of the first stakeholder workshop.	A group of local, regional and national stakeholders actively engaged in the BeWater project.	27th May 2015
Expert/stakeholder consultations	Supplementation of information on implementation steps and costs of WMOs.	Selected experts and stakeholder actively engaged in the BeWater project from national instutites, agencies, university and companies.	August – October 2015
Stakeholder consultations (II)	Presentation and discussion of final list of WMOs.	A wide group of local, regional and national stakeholders.	12th October 2015
Third stakeholder workshop	Validation of draft adaptation plan for the Vipava river basin.	To be decided.	23rd March 2016
Fourth stakeholder worshop	Presentation of adaptation plan for the Vipava river basin.	A group of national stakeholders. / To be decided.	February 2017

Annex II: List of dissemination activities held in Vipava River Basin

Parallel to the stakeholder engagement, other dissemination activities are taking place in the Vipava river basin with the aim to forward results of the BeWater project, to expand the list of stakeholders, to raise social awareness and to encourage capacity building, empowerment and social formation in water management challenges and adaptation.

Dissemination activity	Content	Target group	Dates
GEP/BeWater meeting	Presentation of results of GEP Project, focusing on hydrogeological and spatial surveys on the Slovenian border area.	GEP and BeWater project team.	26th September 2014
Awareness Campaign	A mobile exhibition comprising of seven roll-up posters on display at key venues in critical communities throughout the Vipava river basin and in Ljubljana.	Venues: Development Agency ROD in Ajdoščina, Ministry of Agriculture, Forestry and Food (in cooperation with Ministry of the Environment and Spatial Planning) in Ljubljana, Municipalities Ajdovščina, Vipava, Miren-Kostanjevica and Šempeter-Vrtojba,Nova Gorica, Renče-Vogrsko, Central public library called "Lavričeva knjižnica Ajdovščina" in Ajdovščina and Vipava, Lanthieri mansion in Vipava.	27th November 2014 - ongoing
Event called „Water days of Primorska"	Presentation of BeWater project on 12th February in the session on ongoing projects and plans for the region.	A wide group of local, regional and national stakeholders.	11th – 12th February 2015
Awareness Campaign for Highschool Students	Presentation of BeWater project and organization of field trip to the Vipava river basin.	Students of Biotechnical Secondary School Nova Gorica.	15th April 2015
International workshop in the frame of 7FP Cropsustain	Presention of the objectives and results of BeWater Project, especially the participatory approach.	A wide group of international experts in the field of agriculture and environment.	24th November 2015

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