



ANNEX 5

South Dalmatia: Prud, Klokun and Mandina spring (PA2.4.1)

SET-UP OF PILOT-SPECIFIC MANAGEMENT PRACTICES

D.T2.1.2 Transnational case review of best management practices in pilot actions

BEST MANAGEMENT PRACTICES REPORT IN PILOT ACTION

***“SOUTH DALMATIA - PRUD, KLOKUN
AND MANDINA SPRING ”***

FINAL VERSION

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1. Introduction

In this report best management practices are presented on the level of Pilot Action “South Dalmatia: Prud, Klokun and Mandina spring” (Figure 1.), regarding potential conflicts of interest between land use management and water protection.

The aim of this report is to provide the review of best practices regarding different types of land use (agriculture, grassland, forestry) respectively vegetation cover (wetland), aiming at water protection and mitigating floods in the Pilot Action.

For this, first of all human activities have to be identified, which are posing risk to water quality and quantity; flooding and consecutive to water management. Finally, review of best management practices in the Pilot Action is presented.



Figure 1. Pilot Action South Dalmatia: Prud - Klokun - Mandina spring



2. Land use, drinking water and flood protection in the Pilot Action

2.1. Land use

In the Republic of Croatia, Ministry of Construction and Physical Planning performs administrative and other tasks related to physical planning, regulations for land use and protection of space. Every county, municipality and city must have the cartographical representation of land use, as well as prescribed conditions of land use.

Pilot Action South Dalmatia: Prud-Klokun-Mandina spring is located in the southern part of Split-dalmatia County and in the northern part of Dubrovnik-neretva County. Spatial Plan of the Dubrovnik-neretva County and Spatial plan of Split-dalmatia County define the goals of spatial development and organization, protection, use and purpose of space with appreciation to the protection and conservation of natural, cultural - historical and landscape values. Also, spatial plans define the land use in compliance with the protection of human health against negative impacts such as floods, pollution etc. Therefore, some land uses are prohibited in flood risk areas and areas with high groundwater levels (e.g. construction of industrial facilities, cemeteries, landfills etc.).

As indicated in The State of the Environment Report of the Republic of Croatia comprehensive policies and legislation for the implementation of the rational and sustainable management and protection of land is not yet established and also there is no systematic monitoring of changes in land use in Croatia. Land use maps of the Republic of Croatia were created within the Corine land cover project for years 1980, 1990, 2000, 2006 and 2012. Corine land cover is available to the public via web page (<http://corine.azo.hr/corine/hr#sthash.oqXIRm9d.dpbs>). Also, the Physical planning information system (ISPU) as an application of the Ministry of Construction and Physical Planning that merges Geoportal, Cadaster and spatial plans into one unit, enables the end users simple access to the information on the rules of land use.

Land use in Pilot Action South Dalmatia: Prud-Klokun-Mandina spring is presented in Table 1. and Figure 2. Broad-leaved forests (37919 ha) along with the transitional woodland-shrub areas (12125 ha) covers the majority of Pilot Action area. Agricultural production composed of complex cultivation patterns, agricultural land with significant areas of natural vegetation, pastures, fruit trees and vineyards is concentrated in Rastok field, Vrgorac field and areas near Neretva river. Water courses cover 256 ha, while 195 ha is covered with water bodies. Salt marshes (287 ha) and inland marshes (1693 ha) are present north of the Neretva river.



Table 1. Corine Land Cover in the Pilot Action South Dalmatia: Prud-Klokun-Mandina spring

Corine Land Cover in the Pilot Action South Dalmatia: Prud-Klokun-Mandina spring		
CLC code	CLC category	Area (ha)
311	Broad-leaved forest	37919.21
324	Transitional woodland-shrub	12125.97
243	Land principally occupied by agriculture, with significant areas of natural vegetation	6494.50
323	Sclerophyllous vegetation	4920.62
321	Natural grasslands	4479.70
242	Complex cultivation patterns	2954.09
411	Inland marshes	1693.24
333	Sparsely vegetated areas	1550.35
231	Pastures	1080.20
222	Fruit trees	1076.61
221	Vineyards	958.85
122	Road and rail networks and associated land	650.28
312	Coniferous forest	596.77
112	Urban area (<80% constructed)	567.87
523	Sea and oceans	563.32
313	Mixed forest	438.79
133	Construction sites	371.54
421	Salt marshes	287.07
511	Water courses	256.39
121	Industrial or commercial units	241.58
223	Olive groves	204.02
512	Water bodies	195.64
123	Port areas	29.99

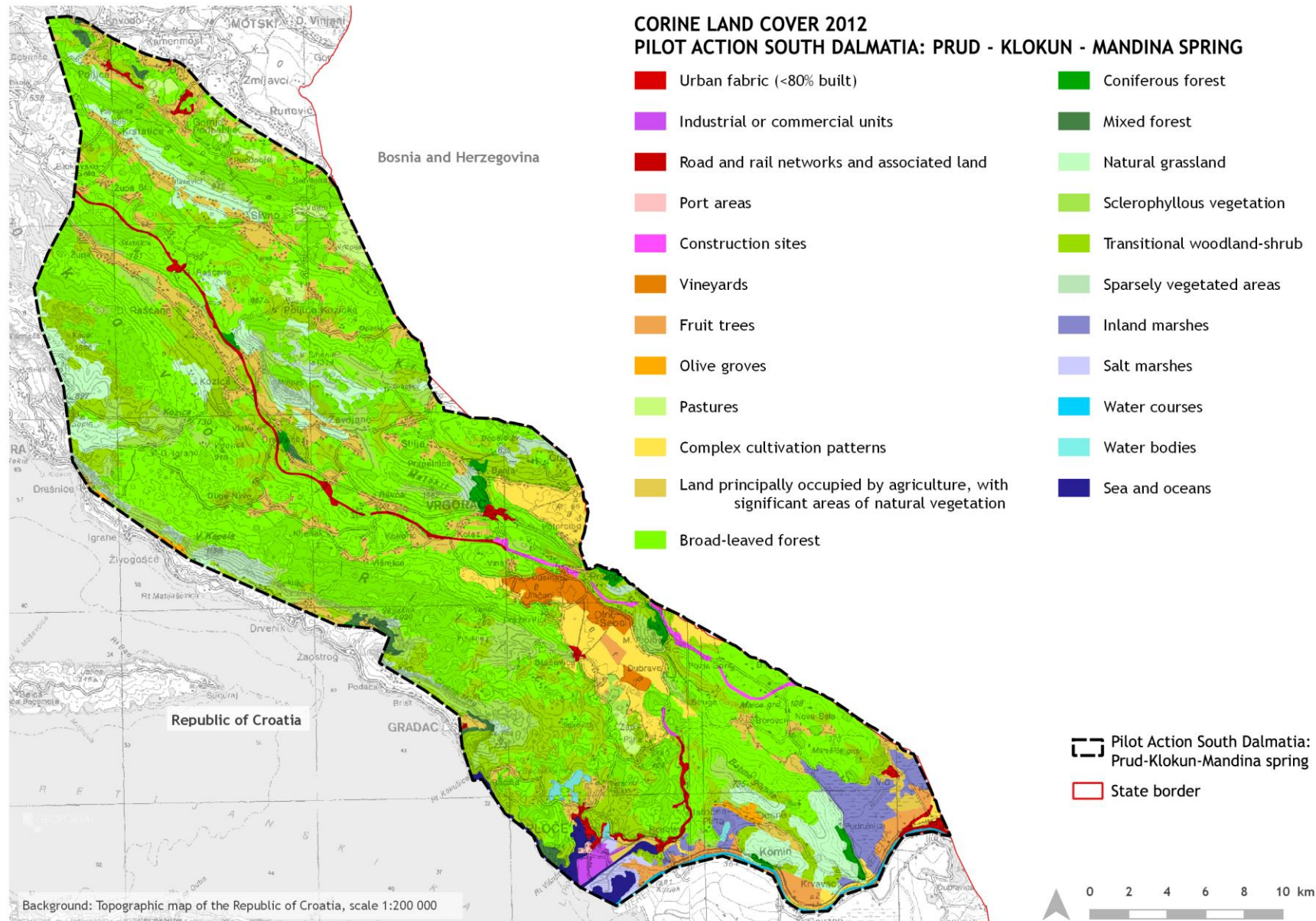


Figure 2. Corine Land Cover 2012, Pilot Action South Dalmatia: Prud-Klokun-Mandina spring



Agriculture

Valuable agricultural soil is concentrated in the Neretva delta, near Baćinska lakes, karst fields, sinkholes and karstic plains. The soils that are used in agricultural production are anthropogenic soils on karst, fertile calcocambisol on limestone (black soil, so-called *crnica*) and hydromeliorated soils near Neretva delta. As mentioned in the previous chapter, agricultural production in the Pilot Action area is composed of complex cultivation patterns, agricultural land with significant areas of natural vegetation, pastures, fruit trees and vineyards (concentrated in Rastok field, Vrgorac field and areas near Neretva river).

Estimation of the pressures on agricultural land due to applied nitrogen and phosphorus was carried out by determining the spatial distribution of nitrogen and phosphorus deposited on agricultural land via mineral and organic fertilizers. According to the River Basin Management Plan (2016.-2020.), the organic nutrients pressure is also related to cattle keeping and grazing and application of manure on agricultural land. Since the Pilot Action is located in Dubrovnik-neretva County and Split-dalmatia County, the data for these counties is applicable to this area. The amount of applied nitrogen and phosphorous on agricultural land in Dubrovnik-neretva County is around 34 kg/ha for N and 5 kg/ha for P. The amount of applied nitrogen and phosphorous on agricultural land in Split-dalmatia County is 29 kg/ha for N and 5 kg/ha for P.

Ecological, organic agricultural production in the Republic of Croatia is regulated by the Action plan for the ecological agriculture development in Croatia from 2011. to 2016. and Ordinance on ecological agricultural production (Official Gazette No. 19/16). Notable fact is that within the II. sanitary protection zone (zone of strict limitations and surveillance) only ecological agricultural production is allowed. The data on the amount of ecological plant production related to the Pilot Action area is represented in the Table 2.

Table 2. Ecological (organic) agricultural production (data for the whole Split-dalmatia County and Dubrovnik-neretva County, provided by Ministry of Agriculture)

County	Area (ha) 2009.	Area (ha) 2010.	Area (ha) 2011.	Area (ha) 2012.	Area (ha) 2013.	Area (ha) 2014.
Split-dalmatia	105,5829	174,9263	455,233	387,35	5711,53	6407
Dubrovnik-neretva	17,0018	69,7017	245,86	154,63	225,46	214



Irrigation

There are two irrigation plans that are relevant for the Pilot Action area: Irrigation plan of Dubrovnik-neretva County that was created by Faculty of civil engineering, architecture and geodesy, University of Split in 2006 and Irrigation plan of Split-dalmatia County which was created by Institute for Adriatic culture and melioration of karst in Split in 2006.

The irrigation plan of Dubrovnik-neretva County is aimed at ensuring the further development of existing irrigation systems and its quality. Irrigation plans of the County included guidelines from the national irrigation plan and certain conditions for the improvement of irrigation projects. Spatial plan of Dubrovnik-neretva County also prescribes that water for the irrigation of agricultural land in Vrgorac field, will be used from several different sources:

- water from Matica river,
- springs located at the northern edge of Vrgorac field,
- water from irrigation system of Rastok field, from which it will be transported through the tunnel Rastok - Vrgorac field.

Melioration

Spatial plan of Dubrovnik-neretva County prescribes the need for the construction of melioration system in Vrgorac field, while further development of melioration system near Neretva river is postponed until existing system is improved.

In the Adriatic basin area, water for the purpose of irrigation is used from watercourses (Neretva) or from mixed melioration systems for drainage and irrigation of closed karstic fields (Vrbničko, Sinjsko, Imotsko, Vrgorsko, Vransko field). Smaller part of the water used for irrigation comes from groundwater sources especially in areas like Istria, Kaštela and Ravni Kotari. Profitable agricultural production (of fruit and vegetables) is not feasible without proper irrigation system.

Urban Area

Sewage systems

Sewage systems are planned for all larger settlements, settlements near lakes, water courses and drinking water protection zones. According to the Spatial plan of Dubrovnik-neretva County the priority of construction of sewage systems have following settlements:

- Otrić seoca, Kobiljača and Staševica located in pilot area,



- Ploče, Metković and Opuzen located near pilot area.

As a solution for the wastewater drainage, construction of local drainage systems is planned. Among planned systems are wastewater drainage system Vrgorac (located in the II. sanitary protection zone of Butina spring).

Waste management

Table 3. Waste management plans in the Pilot Action area (according to the Croatian Agency for environment and nature, 2017)

Metković	Waste management plan for the period 2011.-2018.
Vrgorac	Waste management plan for the period 2008.-2015.
Prgomet	Waste management plan for the period 2009.-2017.
Podgora	Waste management plan for the period 2010.-2018.
Pojezerje	Waste management plan for the period 2010.-2017.
Opuzen	Waste management plan for the period 2010.-2017.
Gradac	Not adopted
Kula Norinska	Not adopted
Zagvozd	Not adopted
Ploče	Not adopted, existing Draft

According to the Spatial plan of Dubrovnik-neretva County, landfills located near or within the Pilot Action South Dalmatia: Prud-Klokun-Mandina spring are Lovornik (near Ploče) and Dubravica (near Metković) (Table 4.). They will be in function until the County waste management center in Lučino razdolje is completed (after its construction, inert waste will be disposed on existing sanitary landfills). Also, Spatial plan prescribes immediate sanitation of unsanitary landfills. On Lovornik landfill located near City of Ploče, waste has been disposed in an inadequate way from 1970.

Table 4. Landfills located within Pilot Action South Dalmatia: Prud-Klokun-Mandina spring

Municipality or city	Settlement	Locality	Type of waste management facility	Area (ha)	Status
Ploče	Baćina	Lovornik	OK, OI, GO, PS	2.3	existing
Metković	Dubravica	Dubravica	OK, OI, GO, PS, RD	3.1	existing

(OK- municipal waste landfill, OI- inter waste landfill, GO- construction waste treatment facility, PS- transshipment station, RD- recycling yard)

According to the Environment Contamination Register by Croatian Environment Agency, waste producers in the Pilot Action South Dalmatia: Prud, Klokun and Mandina spring are presented in Table 5. and Table 6.



Table 5. Waste producers in the Pilot Action South Dalmatia: Prud, Klokun and Mandina spring
(data for the Split-dalmatia County for year 2016)

Waste producer	City/settlement	Type of waste	Amount of produced waste
Industry for processing and preserving meat	Vrgorac	Hazardous	0.6 t/year
Industry for processing and preserving meat	Vrgorac	Harmless	126.1 t/year
Electrical power distributor	Vrgorac	Hazardous	0.88 t /year
Hotel	Gradac	Harmless	26.62 t/year

Table 6. Waste producers in the Pilot Action South Dalmatia: Prud, Klokun and Mandina spring
(data for the Dubrovnik-neretva County for year 2015)

Waste production source	City/settlement	Type of waste	Amount of produced waste
Construction of water management objects	Opuzen	Hazardous	2.21 t/year
Gas station	Opuzen	Hazardous	0,7 t/year
Maintenance and repair of motor vehicles	Opuzen	Hazardous	4.8 t/year
Commercial shops	Opuzen	Harmless	381.54 t/year
Maintenance and repair of motor vehicles	Ploče	Hazardous	60.67
Commercial shop and storage	Ploče	Hazardous	120.3
Service activities related to land transport	Ploče	Harmless	1
Waste trade	Ploče	Harmless	154.2
Community health center	Metković	Hazardous	2.9
Maintenance and repair of motor vehicles and vessels	Metković	Hazardous	2.65
Maintenance and repair of motor vehicles and vessels	Metković	Harmless	46.4
Storage of goods	Metković	Harmless	43.1

Industry

Table 7. Industry in the Pilot Action area

Municipality or city	Settlement	Locality	Type of waste management facility	Area (ha)	Status
Ploče	Staševica	Staševica	I3	9.0	planned
Ploče	Rogotin/Banja/Šarić Struga	Rogotin	I3	31	Planned - existing
Ploče	Plina Jezero	Karamatići - Eraci	I1, I3	6	planned
Pojezerje	Pozla gora	Industrial zone near D62 road	I2	25	planned

*data from Spatial plan of Dubrovnik-neretva County; I1 - mainly industrial use, I2 - craft, I3 - food-processing

Forests

In the Pilot Action area coastal thermophilic forests and shrubbery prevail (according to the information system of nature protection provided by State Institute of nature protection). In the thermophilous forests there are *Quercuss pubescens*, *Pinus sylvestris* and *Pinus nigra*, and on smaller surfaces are also shrubbery and maquis as endangered habitat types. Some of these habitats are protected by Nature protection act (OG 80/13). Forest vegetation is protected within nature park Biokovo and wetland areas Orepak and Prud which are proclaimed as special reserves.

Grassland

In the most part of Pilot Action area submediterranean and epimediterranean dry grassland prevail, while wet meadows and riparian forests are in the area of Neretva river (according to the information system of nature protection provided by State Institute of nature protection). Some parts of submediterranean and epimediterranean dry grassland along with other wetland habitat type are protected within significant landscape Modro oko, nature park Biokovo, special reserve Pod Gredom and special reserve Orepak.

Floods

Nearly half of the Pilot action South Dalmatia: Prud-Klokun-Mandina spring is under the potentially significant flood risk. These areas include areas south of Imotsko field, coastal area, Vrgorac field and areas around Neretva river (Figure 4.). All the information regarding Preliminary flood risk assessment, Flood Hazard Maps and Flood Risk Maps are available to the public via web pages (<http://korp.voda.hr/>; <http://voda.giscloud.com/>), provided by Hrvatske vode (Croatian Waters).

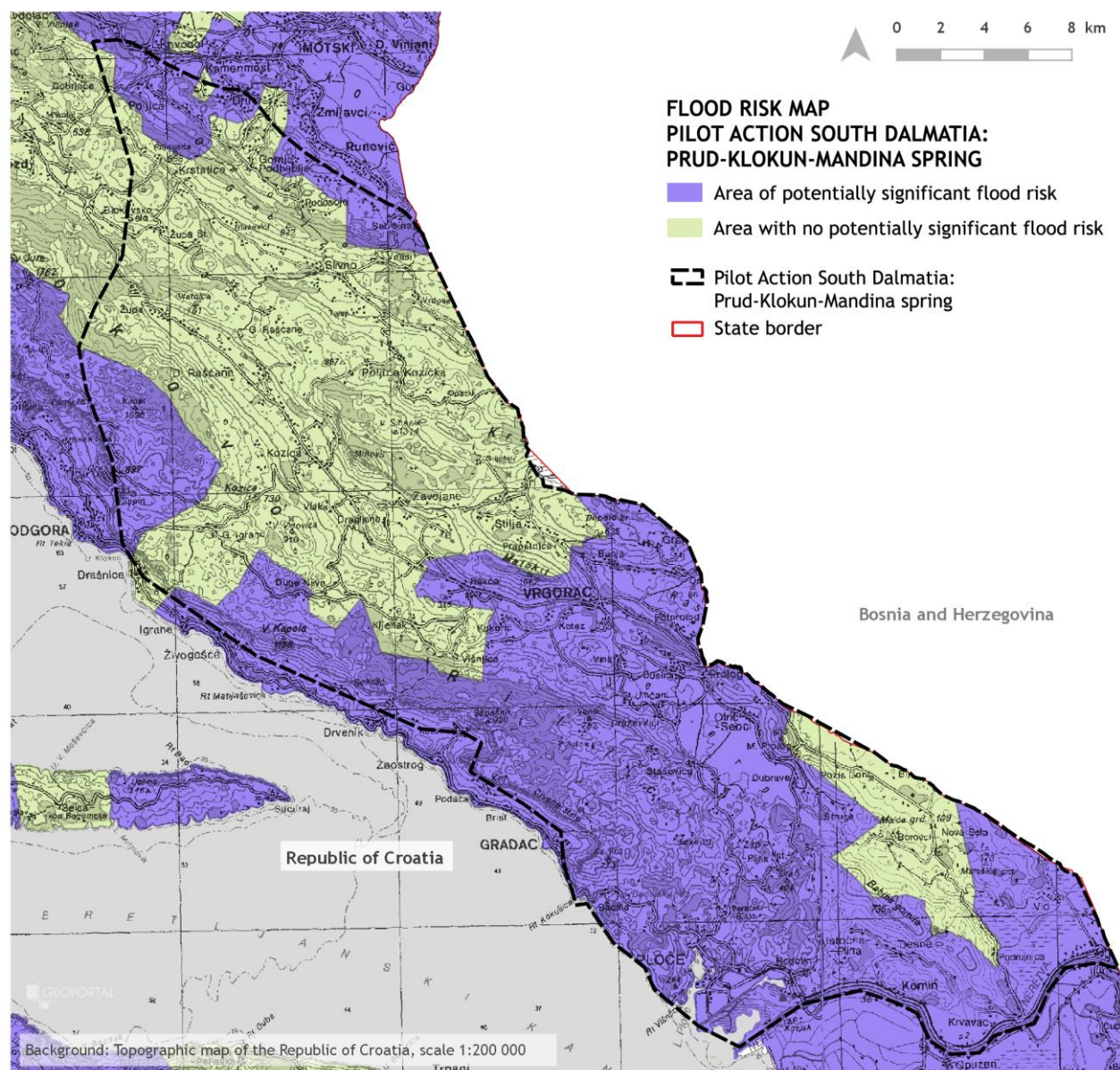


Figure 4. Flood risk map for the Pilot Action South Dalmatia: Prud-Klokun-Mandina spring (data provided by Hrvatske vode)

Existing water regulation objects in Pilot Action area are:

- dam “Crni vir” in Vrgorac field, (0,20 km in length),
- Vrgorski tunnel in Vrgorac field, (2,19 km in length),
- planned circumferential channel in Vrgorac field from Stinjevac to Matice vrgorske river,
- planned securing of the shores of Birina lake and connecting channels between Birina lake and Crna river,
- planned Brina tunnel between Vrgorac field and lake Birina,
- concrete overflow facilities on the Vrgorac tunnel entrance and Birina tunnel entrance,



- Baćina tunnel near Baćina lakes (0,12 km in length).

According to the Spatial plan of Dubrovnik-neretva County flood protection is based on the protection significance (e.g. highest degree of protection is aimed at residential areas, infrastructure facilities are defended at the middle level of protection, and the amelioration surfaces to a somewhat lower degree of protection).

In order to protect Vrgorac field against the flood, construction works for the increased capacity of existing drainage objects in Vrgorac field and Rastoka is needed. Construction works encompasses following:

- regulation of Matica river in the Prigon area,
- on the existing channel upstream of the "Krotuša" tunnel a threshold preventing the sediments to enter Baćinska jezera should be build,
- increase the channel throughput between Baćina lakes and the sea.
- construction of the additional peripheral channel in the Vrgorac field
- construction of new drainage tunnel from Krotuša to Birina lake
- a joint of the new tunnel with the river Matica needs to be constructed on the upstream side, as well as the threshold preventing the sediments to enter Birina lake
- in the downstream area, a passage to the lake has to be made, the connecting channels need to be deepened and expanded while the facilities on them need to be constructed.

2.2. Drinking water protection

For the purpose of protection of surface and groundwater resource and unique and valuable ecosystems dependent on water, protected areas are established by Water Act and other legislatures. Water that is intended for human consumption or is reserved for public water supply is or will be identified by Hrvatske vode (Croatian Waters) in every water basin area. Determination of drinking water protection zones (DWPZ), obligatory measures and limitations that are conducted in them as well as the deadlines for decisions on protection and the process of making these decisions are governed by The Ordinance on the conditions for the establishment of sanitary protection zones (Official Gazette No. 66/11 and 47/13). Established sanitary protection zones are implemented into spatial planning documents (spatial plans of counties, cities or municipalities).

Sanitary protection zones in aquifers with fracture and fracture-cavernous porosity are divided into:

- zone of limitation (IV. zone),
- zone of limitation and surveillance (III. zone),
- zone of strict limitation and surveillance (II. zone),
- zone of strict protection regime and surveillance (I. zone).

According to the data provided by Hrvatske vode, proclaimed sanitary protection zones are presented in Table 8., Figure 2. and Figure 3.

Table 8. Drinking water protection zones in Pilot Action South Dalmatia: Prud-Klokun-Mandina spring

Zone	Water source
III	Grebice and Vratak Podgorski
IV	Grebice and Vratak Podgorski
III	Izbitac
IV	Izbitac
II	Izbitac
III	Orašje
IV	Orašje
III	Prud
II	Prud
IV	Vratak Makarski

SANITARY PROTECTION ZONES - PILOT ACTION SOUTH DALMATIA: PRUD-KLOKUN-MANDINA SPRING

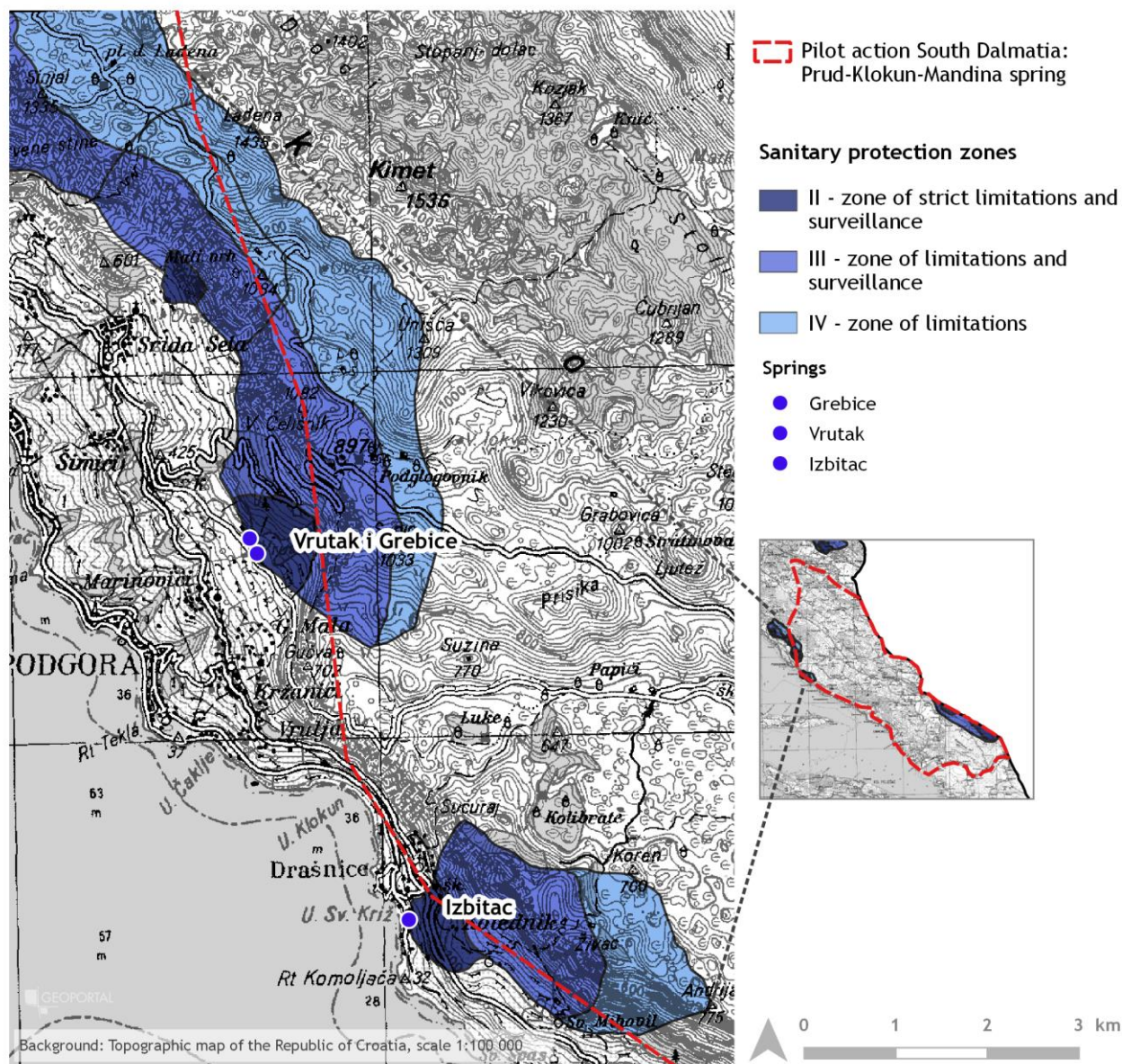


Figure 5. Sanitary protection zones within Pilot Action South Dalmatia: Prud-Klokun-Mandina spring

SANITARY PROTECTION ZONES - PILOT ACTION SOUTH DALMATIA: PRUD - KLOKUN - MANDINA SPRING

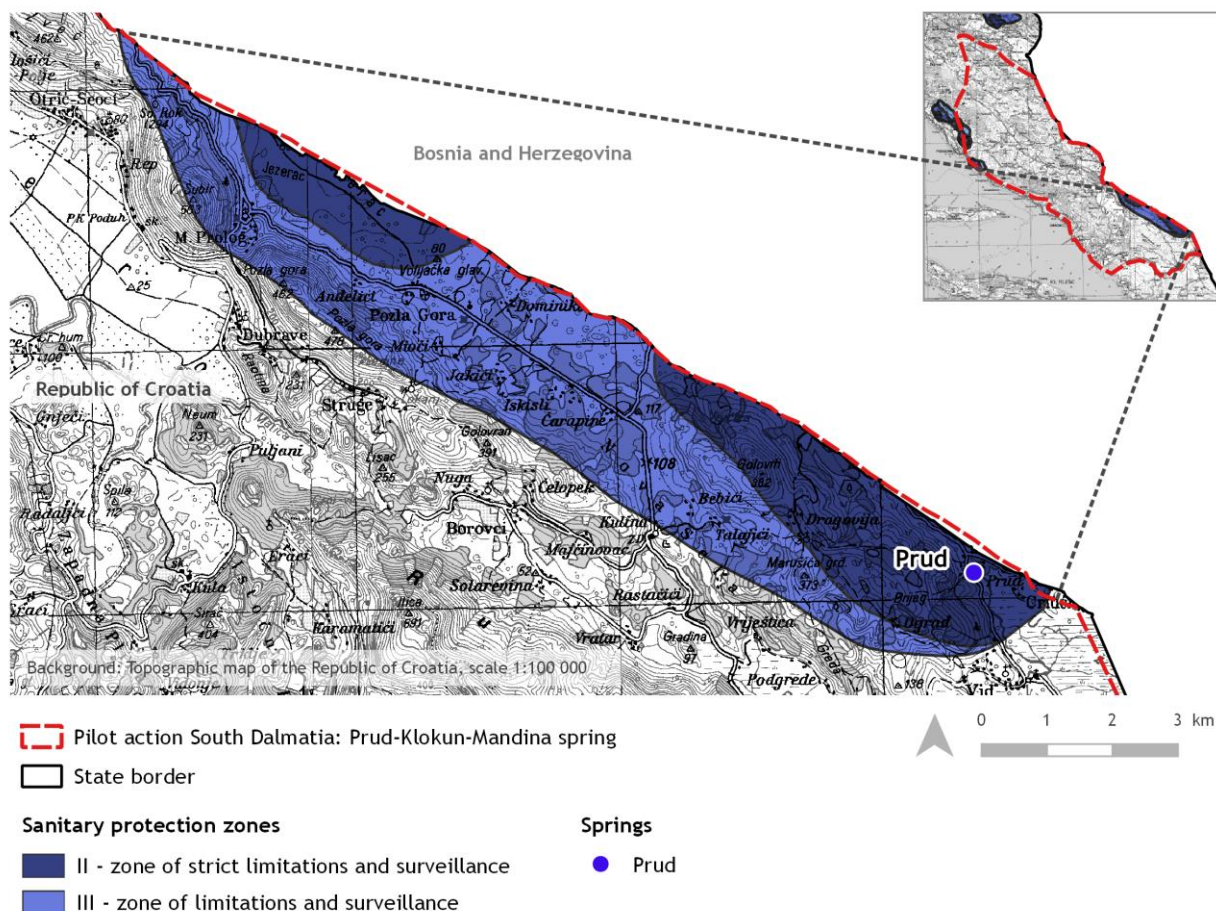


Figure 6. Sanitary protection zones within Pilot Action South Dalmatia: Prud-Klokun-Mandina spring

Spatial plan of Dubrovnik-neretva County prescribes that spatial distribution, supplies and characteristics of water, identification of water needs, conditions of water supply system, significant pressures and impacts of human activities on surface water and groundwater, goals and measures for the water and environment protection, identification of needs and most favorable technical and other solutions for water management and flood protection, the reservation of space for the construction of regulative-protective water objects, as well as other measures of importance for water management must be in accordance with the Water Act (OG No. 153/09, 63/11, 130/11, 56/13 and 14/14) and River Basin Management Plan (2016.-2020.).



Table 9. Water supply systems in the Pilot Action South Dalmatia: Prud-Klokun-Mandina spring

Water supply system zones	Water supply system	Number of citizens (2011. list)	Number of citizens connected to water supply system
Imotski-Vrgorac	Water supply system Imotska krajina	29739	26616
	Water supply system Vrgorac (Banja and Butina)	8465	8050
Neretva-Pelješac	Neretvansko-Pelješko-korčulansko-lastovnsko-mljetski water supply system	47229	42885
Ploče	Ploče water supply system	11783	11716

According to the Development Strategy of Split-dalmatia County 2011.-2013. the main problem of the existing water supply networks is relative neglected state that causes great water losses (“system leaking”). Therefore, minimization of impacts on the existing water resources should be based on more rational water use and improvement of water supply network.

3. Best Management Practices

Water management

Measures and guidelines related to water management and protection are prescribed by strategic and planning documents of counties, cities and municipalities. Some of these documents that are relevant for the Pilot Action area are mentioned below. Development Strategy of Dubrovnik-neretva County 2016-2020. prescribes measures for the sustainable space, resources and infrastructure management that include following:

- construction of water supply system
- maintenance of existing water supply network
- construction of water treatment facility
- construction and maintenance of water drainage system
- increase of connections to the water supply network
- construction and maintenance of sewage system
- establishment of sanitary protection zones

Furthermore, Development Strategy of Dubrovnik-neretva County 2016-2020. prescribes measures of environment protection, among which are:

- implementation of preventive measures against floods, which include retention construction, reactivation of former wetland areas, renewal of watercourses,

- monitoring system of water salinization in the area of Neretva river,
- monitoring system of transboundary activities related to water,
- informing citizens and raising awareness on the need and importance of environmental protection.

Strategic Environmental Impact Assessment of the Development Strategy of Dubrovnik-neretva County 2016-2020. prescribes measures for environment protection (water protection) among which are:

- when planning the locations of water discharge, potential negative impact on environment and land use must be considered,
- ensure the construction of wastewater treatment facilities,
- coordinate the planning of infrastructure investment activities with the process of establishing the sanitary protection zones,
- when selecting hydrotechnical measure aimed at the protection against the floods, interventions that cause minimal impact on the flood regimes, significant wetland areas, forests and grasslands must have the priority.

Spatial plan of Dubrovnik-neretva County envisions encouragement for building individual water treatment objects in areas where is no technical or economic justification for the connection on public water drainage system with central water treatment object. As a measure for water protection, Spatial Plan of Dubrovnik-neretva County prescribes further development of sewage systems in settlements, with adequate water treatment objects and discharges into the recipients (e.g. mentioned systems are planned in Vrgorac field).

Spatial plan of Dubrovnik-neretva County prescribes measures for the prevention of negative impacts on the environment among which are some related to water:

- mandatory report on the state of the environment (state of groundwater and surface water, protected nature, forest, soil),
- mandatory programme of environment protection (forest, soil, water, air),
- mandatory monitoring of soil, air and water,
- ensure the construction of drainage systems,
- define sanitary protection zones around the water sources in accordance to the conducted hydrogeological studies, the County should bring the Decisions on the water protection zones of water sources Prud, Modro oko and Klokun, for which preliminary protection zones have been established,



- limit the use of mineral fertilizers and plant protection products and implement its monitoring,
- prohibit the construction of commercial facilities that release harmful and dangerous substances in the water source areas,
- prohibit the waste disposal on unsanitary landfills,
- implement regular monitoring of water quality in watercourses, lakes and sources,
- plan the construction of objects in a way that prevents pollution of groundwater with inorganic substances, oil and wastewater.

Komunalno d.o.o. signed a contract with the Hrvatske vode for financing the project documentation and construction of water structures in the area of Vrgorac. Hrvatske vode will finance 100% of:

- the project documentation for the completion of water treatment facility of Vrgorac,
- the project documentation for drainage and wastewater treatment system of the Dusina settlement and completion of the sewage system construction,
- completion of the wastewater treatment facility construction and testing
- restoration of the existing drainage system of Vrgorac

Contract value amount is 1,000,000.00 HRK and it is expected that the wastewater treatment plant will start operating by the end of 2017.

Spatial plan of City of Vrgorac prescribes priority improvement measures for water management that are relevant to the Pilot Action area:

- According to the Environmental Impact Study on the Exhaustion of Excess Water from the Vrgorac Field and the Resolution of the Ministry of Environmental Protection, Physical Planning and Construction, a variant of the 2nd intended operation was accepted: Construction of a new tunnel connecting the lower, southeastern part of the Vrgorac field and Lake Birina,
- Creation of the tunnel "Vrgorac 2", which draws water to Lake Birina, while the existing tunnel "Krotuša" is left in its present state,
- A channel with water coming to the entrance portal of tunnel "Vrgorac 2" was expanded,
- Making a concrete overflow block about 80 m upstream from the entrance portal of the tunnel "Vrgorac 2",
- Making a concrete overflow block about 80 m upstream from the entrance portal of the tunnel "Krotuša",
- Making the drainage channel from the tunnel "Vrgorac 2" to the lake Birina,



- Reconstruction of the connection channel between the Baćinska lakes and the sea,
- Extension of the Matica Vrgorska river bed through Prigon,
- Making a perimeter channel in the Vrgorac field that accepts the water from the tunnel Rastok and a part of the flood waters of the Vrgorac field,

As stated in the plan, the seriousness of water protection needs to be established for any significant construction and economic activity depending on the area of sanitary protection in which the facility is located and also on the time period of the creation of the facility and the common drainage system with the purification plant in the narrow city area.

As part of measures to prevent adverse impacts on the environment, in relation to water protection, protection measures are needed:

- to preserve water that is not polluted
- to stop the trend of water quality deterioration (by amending or removing pollution sources)
- ensure the rational use of water

Most of the pilot action area lies within the sanitary protection of the waterworks Banja, Butina, Modro Oko and Klokun. Associated with this and analyzed by the State Water Protection Plan (OG 8/99), this area falls into the "very sensitive area of water" - category I, where wastewater discharge is absolutely prohibited, regardless of the degree of purification. Since there is no other solution, the required degree of purification is the third stage of wastewater purification - as it is in the "sensitive area". The discharge of purified sewage from the subject area is only possible with the minimum second or third degree of purification depending on the gravitational area. A disjoined drainage system is applicable with complete purification of sanitary wastewater and possible cleaning of precipitation water. The basic principle is that the site of discharge of purified waste water should be outside the II. zone of sanitary protection of drinking water sources.

The method of collecting, purifying and discharging waste water from the town of Vrgorac is solved in the project documentation at the main project level. For other settlements in the administrative area of the City of Vrgorac, no conceptual wastewater disposal solutions have been developed. For the purpose of defining the drainage method, it is necessary to draw up a preliminary solution for the drainage and purification of the waste waters of the relevant areas, all in accordance with number of regulations. The exact location of the purification and drainage plant will be determined after the drafting of the wastewater drainage and purification project documentation of the subject area and hydrogeological investigations - microprocessing at



potential monitoring equipment locations and discharge sites. In order to minimize the possibility of groundwater pollution and avoid major adverse consequences in the event of havoc, several smaller separate drainage subsections are proposed for each settlement in relation to one pool that would collect the majority of wastewater from the settlements and thus concentrate pollution, thereby multiplying the danger of groundwater pollution.

In the area where no sewage drainage system was built or where no public system construction is planned, drainage of household wastewater should be solved by the construction of waterproof septic tanks that will be extracted through a competent utility company through the built drainage systems or disposed of on the landfill dump regulated by the sanitary authorities of the city.

The rules for discharged water will be determined according to the National Water Protection Plan (OG 8/99), and according to the Ordinance on Limit Values for Hazardous and Other Substances in Waste Water (NN 6/01). The Ordinances are based on the Water Act (OG 107/95) and are prepared in accordance with the EU Council Directive on the Cleaning of Communal Waste Water (91/271 / EEC). The water protection plan for the state has also determined the water categorization. According to the Annex D-2 of the National Plan of Groundwater used or planned to be used for water supply, mountain streams that lead to settlements, watercourses in the karst region up to settlements are classified as a "very sensitive area", the I. Water category. Consequently, groundwater in sanitary protection zones is planned as the 1st category of water. Therefore, the degree of selection and purification method is determined for the exact location according to its impact on the source. Purified waste water with the high 3rd degree of cleansing corresponds to the IV. - V. Type of water according to the Water Classification Regulation (OG 77/98), which in view of the planned categorization of groundwater, as well as the use of water for water supply, cannot be allowed. It is agreed that the groundwater should be water of the 2nd degree. According to the Water Classification Regulation Act, that water can be used in its natural condition for swimming and recreation, and after proper purification, even for drinking and other purposes in the industry. The above values can be achieved by technological procedures that are successfully applied in similar cases, i.e. with increased demand for waste water purification.

The protection of water, especially groundwater in the area of the City of Vrgorac, is of the utmost importance given that in the area of the town there are sanitary protection zones (different levels of protection), and several important captured karst springs (Banja, Butina, Klokun, Modro oko, Prud). A correct approach to planning and implementation in the use of space is needed. For these reasons, the construction of the Vrgorac sewerage network with the

purification plant represents a priority task for the protection of water and is of great importance for the State and the Split-Dalmatia County.

The need to obtain water regulation conditions and approval in construction is determined;

- outside the construction area,
- for the construction and extension of cemeteries,
- for commercial buildings,
- on a building lot larger than 5000 m².

Advantages

- further construction and maintenance of water supply system, water drainage system and sewage system will have cumulative positive impacts on the protection of water resources (surface water as well as groundwater),
- construction of water treatment plants will decrease the possibility of groundwater pollution due to discharged wastewater,
- monitoring system of water salinization in the area of Neretva river will help to mitigate this ongoing issue.

Challenges

- according to the Development Strategy of Split-dalmatia County 2011.-2013. the main problem of the existing water supply networks is relative neglected state that causes great water losses (“system leaking”). Therefore, minimization of impacts on the existing water resources should be based on more rational water use and improvement of water supply network,
- poor waste water management and purification; with further urbanization of City of Vrgorac, as well as with the possible additional sewerage network construction, the issue of wastewater disposal would become severe in a sanitary sense, to an extent that it could lead to serious health problems in the city. To prevent such a development, appropriate activities have been undertaken, which should result in the construction of a wastewater drainage system with a basic process that implies extended aeration, while simultaneous sludge stabilization,
- according to the Development Strategy of Dubrovnik-neretva County 2016.-2020.) surface waters and groundwater are endangered due to wastewater and industrial wastewater discharge into watercourses and groundwater,



- increased water salinization in the area of Neretva delta, which will not only cause adverse impacts on water supply system but also on agricultural production (crop loss due to decreased soil fertility).

Floods

Flood Risk Management Plan emphasize the role of natural water retention areas and flood retention areas for the flood prevention and flood protection over the structural flood protection measures. Therefore, the application of retention measures such as green infrastructure is recommended where they are technically and economically feasible.

Spatial plan of Dubrovnik-neretva County recommends the need to record the existing state when planning water courses management and regulation aimed at preventing harmful effects of water (torrents and erosion). Also, Spatial plan of Dubrovnik-neretva County Plan prescribes the necessity to carry out recovery works on parts of the Neretva river coast that is endangered by erosion. It is necessary to continue with the works on the protection of settlements, agricultural areas and infrastructural facilities, in such a way that the high waters of the Neretva river are carried out in Neretva riverbed without its relieving through the corridor of Mala Neretva.

Non-structural measures for protection against the floods

Operative Protection against the Floods is conducted in accordance to the National plan for flood control (Official Gazette No. 84/10), which includes activities and measures for the protection against the ice in watercourse. Protection against the Floods is established for every river basin area and within them is divided by counties, sectors and watercourses sections. Operative Protection against the Floods is carried by the organizational units of the Hrvatske vode (Croatian waters). The main flood control center of the Republic of Croatia is located in Zagreb, while the headquarters for the river basin areas are located in Zagreb, Osijek, Rijeka and Split. Every county has flood control center in county centers. In addition to these flood control centers, in many places in the Republic of Croatia, field flood control centers, water protection areas and water monitoring objects have been established as field flood protection sites. Certified companies with its mechanization, equipment and professional staff, perform the interventions during the protection against the floods.

Operative Protection against the Floods functions well in the state, which has been confirmed by the successful evacuations of numerous high waters during the last decades (Sava 1990, Drava 1993, Danube 2002 etc.).

Monitoring and forecasting of hydrometeorological phenomena

For more efficient implementation of Croatia's flood defense operations, the Croatian waters, in accordance with the National Plan of Flood Defense, set up an automated one part of the relevant water meters, making water data available in real time in flood protection centers. Measured water data from automated water meters in real time are also available on the Teletext of the Croatian Television, on the official website of the Croatian waters and on mobile phones. Data on measured precipitation levels are largely unavailable in real time, which creates difficulties in operational flood defenses on smaller river basins with short runoff time. The systematic forecasting of water supply and flow in Croatian waters is carried out for 5 characteristic locations on the Sava River: from the state border with the neighboring Slovenia to Jasenovac (Jesenice, Zagreb, Rugvica, Sisak - Crnac and Jasenovac), and for Kupa River in Karlovac, which is insufficient.

Water resources

In order to prevent the inappropriate land use necessary for the maintainance and improvement of the water regime, i.e. for the normal functioning of the existing water management systems, for their regular economic and technical maintenance, and for their development, the Water Act stipulates that land particles involving water and abandoned river beds, structured and unstructured flooding areas, and islands in rivers are a defined water resource. The affiliation of a land plot to a water resource is entered into the cadastre, land registers and spatial plans, and special limitations and measures are required by the owners or users of such land parcels. Determination of the area of water resources and registration of the corresponding land parcels in cadastre and land registers is underway. Disrupted cadastres and land registers make it harder, and problems arise especially when determining the boundaries of untouched floodplain areas along the watercourses, in floodplain areas, in areas of large lowland retention of protective systems, and in protected areas of nature, but also in demarcations of water and seawater in regulating and protective water structures near the sea shore. Land parcels that belong to the water resource, owned by the Republic of Croatia, have the property of public water resources. For other land parcels that are not owned by the Republic of Croatia, but belong to the water resource, the Republic of Croatia has the right of preemption.



Financial assets security from uncovered flood risks

Financial assets from uncovered flood risks are almost unavailable, which is largely a result of acquired habits related to the former social structure. Changes in ownership relations and the development of a market economy, these measures will increasingly be applied, which will also require appropriate adjustments of the relevant institutions.

3.1. Forest

In the Pilot Action area forest can be divided into privately owned forests and forest land and forests and forest land owned by State. Also, forests are divided into protective, economic and special purpose forests. Protective forests mitigate or prevent negative, anthropogenic impacts or natural hazard effects on land, soil, water, settlements, people and their assets. The most significant protective functions of forests are reduction of floods effects (maintaining the “natural” flow regime by reducing and delaying the stormflow peaks) and reduction of soil erosion caused by water (reduction of sedimentation of deposits incurred due to soil erosion in water stream channels and stagnant water bodies).

According to the Spatial plan of Dubrovnik-neretva County, forestry development must be based on the principles of sustainable management, therefore all activities on forest land or near water bodies must be conducted in order to protect or preserve relative stable ecosystems by controlled use of natural resources.

Spatial plan of Split-dalmatia County prescribes measures for the protection of forests and forest land. These measures are aimed at:

- the sustainable forest management and forest conservation,
- protection of forests as part of valuable ecological systems and landscapes,
- achieving the development of forest land and forests planted for non-industrial purposes in order to support ecological acceptable afforestation programs of new and already afforested areas,
- improve the forest protection against fire, disease and parasites,
- stimulate the activities of greening the public space.

Part of the Pilot Action South Dalmatia: Prud-Klokun-Mandina spring is protected by Nature Protection Act (Official Gazette 80/13). Modro oko and lake near Desne settlement are protected in category of significant landscape.

Development Strategy of Dubrovnik-neretva County 2016-2020. prescribes measures of environment protection, among which are:

- afforestation of fire damaged forest areas,
- strengthening human and organizational capacities for fire protection,
- establishing monitoring system of initiatives, plans and proposals for forest land, conversion and other plans and activities for the integral environment protection,
- remediation of forest land damaged due to natural hazards,
- organizational and personnel capacity improvement of county institutions in the forest protection system

Strategic Environmental Impact Assessment of the Development Strategy of Dubrovnik-neretva County 2016-2020. prescribes measures for environment protection (water protection) among which are:

- when planning the development projects by which forest land conversion is planned, cross-sectoral and institutional cooperation on a vertical and horizontal basis level is needed,
- forest land conversion must be planned on areas with minimal negative erosion impact.

Advantages

- afforestation of forest land damaged due to natural hazards (e.g. forest fires and floods) offers a chance to expand the existing biodiversity and helps to secure the water protection functionality of forest ecosystems,
- afforestation can decrease soil erosion.

Challenges

- erosion due to forest loss that influences the water quality of the area,
- confusing ownership issues,
- dominance of tourism over forest protection.

3.2. Grassland

According to the Corine Land cover 2012 natural grasslands occupy 4479.70 ha while pastures cover 1080.20 ha (Table 1).

Spatial plan of Dubrovnik-neretva County prescribes the guidelines for the measures of ecological network protection:

- restoration of wet grasslands,
- maintaining the pastures,



- restoration of steppe grasslands and reintroduce steppe species,
- prevent grasslands succession,
- ensure the subsidies for mowing the grasslands in a way that does not endanger *Crex crex*,
- providing the subsidies for the conservation of biological diversity.

Furthermore, Spatial plan of Dubrovnik-neretva County prescribes the guidelines for the measurements of grassland protection in accordance with the Ordinance on list of habitat types, habitat map and threatened and rare habitat types in Croatia (OG 88/14):

- manage the grassland through pasture and mowing regime that is adapted to the habitat type and use mineral fertilizers and soil improvers sustainably,
- preserve biological species that are significant for the habitat type; prevent the introduction of foreign (allochthone) and genetically modified species,
- maintain a favorable ratio between grasslands and bush, prevent the succession processes of grasslands,
- preserve a favorable low level of mineral substances in the soils of dry and wet grasslands,
- maintain a favorable water regime, including high groundwater levels in wetland areas,
- encourage the revival of extensive livestock farming in mountainous grassland areas.

Croatian Ministry of agriculture issued conversion prohibition (in agricultural purpose) of permanent grassland and pastures in specific NATURA 2000 areas.

According to the Ordinance on the amendment of the Ordinance on agricultural land use records (35/15, 118/16, 26/17) “The edge buffers along water streams” are grassy belts that are at least 3 m wide and are at the interface of arable land that is at least 10 meters away from the edge of the water stream.

Advantages

- measures of ecological network protection will have positive impacts on ecosystem and biological diversity,
- by revegetation of degraded grassland areas surface run-off and soil erosion (by water and wind) will be decreased and soil will be improved (organic and mineral elements).

Challenges

- implementation and control of grazing activities and control of invasive species introduction are main challenges. According to the “Agriculture that protects nature,

Protection of nature through measures of Rural Development Programme of the Republic of Croatia 2014.-2020.”, decreasing number of grazing animals in the last decade is leading to the disappearance of grasslands rich in plant and animal species. Also, cattle is kept indoors in longer period through the year. The problem is particularly serious in the karst and mountainous areas where shrubs have suppressed the valuable grassland species adapted to survive in the poor soil or in holes between rocks with very little water,

- due to significant deruralization process (which is present in whole country) i.e. abandonment of villages and rural areas, meadows and pastures are neglected.

3.3. Agriculture

According to the Rural Development Programme of the Republic of Croatia, Good Agricultural and Environmental Conditions (GAEC) referred in Chapter I of Title VI of Regulation (EU) No 1306/2013 are defined in national laws and specified in the programs. GAEC are defined by the Ordinance on cross-compliances (OG No. 27/14 and 32/15) and Ordinance on the amendments of Ordinance on cross-compliances (OG No. 45/16) which was adopted, based on the Act on State Support in Agriculture and Rural Development (OG No. 80/13). The requirements concerning the use of fertilizers and plant protection products are laid down by the Ordinance on cross-compliance (OG No. 27/14 and 32/15). Agency for payments in agriculture, fishery and rural development controls meeting the rules of cross compliance by the obligors. Measures related to the cross-compliance that are prescribed by Rural Development Programme are Advice on cross-compliance; Vocational training for cross-compliance, agriculture, environment and climate measures and organic farming etc. The overall objectives of these measures are providing advice to farmers on cross-compliance and agricultural practices related to climate and the environment, advice on the adoption of practical measures to increase resistance of agricultural systems against erosion, floods and droughts, the maintenance of agricultural land in order to preserve it in good condition and the reduction of the negative impacts of agriculture on the environment and climate. Education of farmers on cross-compliance is regulated with Ordinance on system of farmers consulting on cross-compliance (OG No. 22/10) and Ordinance on implementation of measure 01 „Transfer of knowledge and informing activities“, submeasure 1.1. „Support for vocational training and activities for acquiring skills“, type of operation 1.1.1. „Vocational training on cross-compliance, package M“ (OG No. 96/15).

In accordance to The Ordinance on the establishment of a framework for action to achieve the sustainable use of pesticides (Official Gazette No. 142/12) all farmers who apply the pesticides on their agricultural land, all distributors and counselors must have appropriate training and



knowledge about the pesticides application. The education on the application of pesticides was conducted in the City of Vrgorac during the 2015 (according to the city's archives). Also, City of Vrgorac organized educational workshops for the farmers on the support for the development of small agricultural farms.

State of the Environment Report of Dubrovnik-neretva County states that a measure for achieving goals set with Environment Protection Programme of Dubrovnik-neretva County is implementation of subsidies for sustainable agriculture development. Split-dalmatia County plans to carry out the financial support for the further development of agricultural production by following projects:

- Construction of accumulations in agriculture (according to the Decision on publication of The Public Call for Measure 5. Support for the construction of simple accumulations in agriculture of the Agricultural and Rural Development Program in the Split-dalmatia County for year 2017)
- Infrastructure refurbishment (according to the Decision on the publication of The Public Call for the applications of support from Measure 11. Organization of the existing neglected field roads in Dalmatinska Zagora, coastal area and islands of the Agricultural and Rural Development Support Program in the Split-dalmatia County for year 2017)
- Support to the agricultural associations (according to the Decision on the publication of The Public Call for the applications for support from Measure 7. Support to the agricultural associations of the Agricultural and Rural Development Support Program in the Split-dalmatia County for year 2017)
- Encouraging the development of competitive agricultural production (according to the Decision on the publication of The Public Call for the application for the support from Measure 9. Support for the development of competitive agricultural production of the Agricultural and Rural Development Support Program in the Split-dalmatia County for year 2017)
- Subsidies for the agricultural production (according to the Decision on the publication of The Public Call for the application for the support from Measure 12. Support for the co-financing planting material in the Split-dalmatia County, Agricultural and Rural Development Support Program in the Split-dalmatia County for year 2017).

According to the City of Vrgorac, a contract worth 1.2 million kunas was signed for the development of the study documentation for the preparation of Flood Protection Project on the Rastok and Vrgorac field. Mentioned project aimed at the flood issues on the agricultural areas



in the karst fields, will be co-financed from the EU fund and the deadline for its development is 12 months. The contracts were signed with a consortium consisting of following companies: Split d.d., Elektroprojekt d.d., Institut za elektroprivredu i energetiku d.d., Institut IGH d.d. and SL Consult d.o.o.

Planned irrigation system for Vrgorac field must be in accordance to the Irrigation Plan for the Dubrovnik-neretva County. Spatial plan of Dubrovnik-neretva County prescribes the necessary interdisciplinary research (biological, ecological, pedological, hydrological-hydraulical, geomechanical and hydrogeological) by which the possibility for expanding melioration and irrigation systems will be tested. Depending on the results and aims for the protection of water, soil and biological diversity, amount of land for agricultural production will be determined. Due to the limited amount of water, State of the Environment Report of the Dubrovnik-neretva County prescribes measure for the irrigation system which is aimed at the artificial rainwater irrigation in Vrgorac field. The proposed irrigation system of Vrgorac field will take water from the irrigation system of Rastok field, from which it will be transported through the tunnel Rastok - Vrgorac field.

Development Strategy of Dubrovnik-neretva County 2016-2020. prescribes measures of environment protection, among which are:

- remediation of agricultural land damaged due to natural hazards,
- implementation of soil monitoring system,
- remediation of soil damaged due to erosion and floods.

Strategic Environmental Impact Assessment of the Development Strategy of Dubrovnik-neretva County 2016-2020. prescribes measures for agricultural production development in accordance to the environment protection:

- within the irrigation and hydromelioration projects envision the conditions of water regime so that the natural regimes of surface waters and groundwater would not be disturbed.

Spatial plan of Split-dalmatia County prescribes measures for the protection of valuable agricultural land:

- reduce the use of valuable agricultural land for other purposes,
- encourage the production of organic food,
- traditional agricultural production should have the priority (vineyards, olive groves etc.),
- the fundament of agricultural production should be homestead farms.



Advantages

- education of farmers on sustainable use of pesticides on their agricultural land, can have positive impacts on soil and water quality due to decreased amounts of applied pesticides,
- positive impacts on soil and water quality can be expected due to increased organic agricultural production, implemented soil monitoring system and remediation of soil damaged due to erosion and floods.

Challenges

- pollution of groundwater with nitrates and pesticides related to excessive use in agriculture production is one of the main problems, especially in karst fields (e.g. Vrgorsko field) with intensive agriculture production. Estimation of the pressures on agricultural land due to applied nitrogen and phosphorus was carried out by determining the spatial distribution of nitrogen and phosphorus deposited on agricultural land via mineral and organic fertilizers. According to the River Basin Management Plan (2016.-2020.), the organic nutrients pressure is also related to cattle keeping and grazing and application of manure on agricultural land. Since the Pilot Action is located in Dubrovnik-neretva County and Split-dalmatia County, the data for these counties is applicable to this area. The amount of applied nitrogen and phosphorous on agricultural land in Dubrovnik-neretva County is around 34 kg/ha for N and 5 kg/ha for P. The amount of applied nitrogen and phosphorous on agricultural land in Split-dalmatia County is 29 kg/ha for N and 5 kg/ha for P,
- according to the State of the Environment Report of Split-dalmatia County, traditional measures of agricultural soil protection, so-called terracing and construction and maintenance of supporting dry stone walls is being abandoned which has the repercussions such as erosion of soil due to torrents, soil loss and contamination of surrounding water bodies,
- intensive irrigation can cause decrease in water table height and increase of water salinity due to sea water.

3.4. Industrial areas

According to the Spatial plan of Split-dalmatia County, procedures in industrial objects can be approved only if they do not cause negative impacts on the environment. If the negative impacts occur, it is necessary to limit the possibility of retention in the area of industrial production.



According to the Spatial plan of Dubrovnik-neretva County, all industrial wastewater must be treated on water treatment objects before it is discharged into the public drainage system. Treated wastewater will be discharged into the sea. The level of water purification is dependent on the standards for recipient protection.

Waste

Waste management plan of Split-dalmatia County envisions the implementation of recycling measures and measure of separate waste collecting:

- recycling islands for separate waste collecting of paper, glass, PET packaging, metal packaging;
- collecting cardboard packaging from shops in cities and smaller settlements
- separate bulk waste collecting (Vrgorac in pilot action area),
- separate green waste collecting from public areas, compost of green waste from households and tourism objects (Vrgorac in pilot action area),
- measures that ensure the installation of construction waste recycling equipment (Vrgorac in the pilot action area)
- measures that ensure the collecting of waste in the recycling yards (Vrgorac in the pilot action area).
-

Spatial Plan of Dubrovnik-neretva County prescribes mandatory monitoring and implementation of protective measures against the potential negative impacts of landfills on surface water and groundwater. All wastewater generated in county waste management center must be collected and treated. Rainwater must be collected in rainwater pool before it is discharge into the recipient. Sanitary wastewater must be collected in a leak-proof pool, form where it is periodically transported in tanks to the water treatment facility. Landfill leachate must be collected through drainage system that is laid on waterproof base and disposed into a retaining reservoir.

Investment program for the remediation of illegal landfills and the allocation of funds of the County Budget to cities and municipalities in 2017.

According to the Development Strategy of Dubrovnik-neretva County 2016.-2020. a continuous education of citizens and economic subjects on the waste management is being implemented.



Advantages

- by implementing above mentioned measures the potential negative impacts of industrial wastewater and landfills on surface water and groundwater will be decreased,
- by educating citizens and economic subjects on the waste management (i.e. separate waste collecting, adequate waste disposal) the awareness of this significant environmental issue will be enhanced.

Challenges

- due to inappropriate waste management (unsanitary waste disposal or illegal disposal of construction waste) in the wider area of the Pilot Action, surface waters and groundwater are endangered (according to the Development Strategy of Dubrovnik-neretva County 2016.-2020.),
- lack of clear allocation of tasks and lack of co-ordination between the different administrative levels,
- insufficient (door-to-door) separate collection of waste,
- insufficient incentives to manage waste according to the waste hierarchy,
- Split-Dalmatia County is the worst in Croatia concerning waste recovery, with a rate of only 1.1%. At national scale, over 3000 illegal waste dump sites are present, many in Split-Dalmatia county and Dubrovnik-Neretva county (however, the exact number is unclear).

3.5. Wetland

The Republic of Croatia has numerous diverse and preserved natural and semi-natural habitat types with the abundance of species. Pursuant to the Birds Directive, Special Protection Areas (SPA) for bird species are proclaimed, while in accordance to the Habitats Directive Special Areas of Conservation (SAC) are proclaimed (Table 12.). In the Pilot Action South Dalmatia: Prud-Klokun-Mandina spring valuable wetland areas are delta Neretve, Modro oko and lake Desne (according to the Corine Land Cover inland marshes occupy 1693.24 ha, while salt marshes cover 287.07 ha). Delta Neretve is the most valuable wetland on eastern Adriatic coast and one of only few wetlands remained in Mediterranean region of Europe. It is internationally protected area in the Republic of Croatia that is included in the List of Wetlands of International Importance: Ramsar Convention. It contains a largest complex of wetlands in Croatian littoral with well-developed water-fringe vegetation, floating and submergent vegetation around Neretva and its tributaries. The mouth of the river Neretva is characterized by wide lagoons, sandflats and



saltmarshes. Reclaimed land is covered by agricultural landscape with many irrigation channels. Out of 12,742 hectares of the Neretva Delta Ramsar site in Croatia, five localities covering 1,724 ha are protected: ornithological Special reserve Pod Gredom, Prud, Orepak; ichthyologic and ornithological Special reserve Delta Neretve, and significant landscape Modro oko and Lake Desne (according to Natura 2000).

Table 11. Protected areas in the Pilot Action South Dalmatia: Prud-Klokun-Mandina spring

Natura 2000, SAC in the Pilot Action South Dalmatia: Prud-Klokun-Mandina spring	
Site code	Site name
HR2000007	Betina velika jama
HR2000019	Čočina jama
HR2000179	Velika špilja kod Antunovića
HR2000951	Krotuša
HR2001046	Matica-Vrgorac field
HR2001242	Izvor Vir
HR2001315	Rastočko field
HR2001321	Jasena ponor
HR2001350	Podbiokovlje
HR2001449	Izvor Dropulića vrilo
HR5000030	Biokovo
HR5000031	Delta Neretve
Natura 2000 SPA in Pilot Action South Dalmatia: Prud-Klokun-Mandina spring	
Site code	Site name
HR1000030	Biokovo i Rilić
HR1000031	Delta Neretve

In the Pilot Action South Dalmatia: Prud-Klokun-Mandina spring valuable wetland area that is included in the List of Wetlands of International Importance (Ramsar Convention signed in the Iranian city of Ramsar in 1971) is Neretva Delta, protected in 1993.

Spatial plan of Dubrovnik-neretva County prescribes the necessary prevention of unplanned and uncontrolled melioration in the remaining wetland areas. It also prescribes measures for the nature protection, among which are following:

- conservation of areas covered with autochthonous vegetation, puddles and surrounding area, natural watercourses and coast,
- necessary evaluation of cumulative impacts on downstream Neretva water regime and ecological network due to increased capacity of Prud and Modro oko water wells,
- evaluation of cumulative impacts that will be generated due to construction of additional melioration of Vrgorac field (planned channel Krotuša-Birina).



Furthermore, Spatial plan of Dubrovnik-neretva County prescribes the guidelines for the measurements of ecological network protection:

- keeping the water level that is necessary for the biological minimum and preservation of the habitats,
- careful conduction of melioration,
- careful conduction of watercourses regulation,
- revitalization of wetland areas,
- limit the spreading of areas under agricultural production,
- maintaining the pastures,
- define the visiting capacity of areas,
- ensure subsidies for the conservation of biological diversity

Spatial plan of Dubrovnik-neretva County prescribes the guidelines for the measurements of watercourses and wetland protection in accordance with the Ordinance on list of habitat types, habitat map and threatened and rare habitat types in Croatia (OG 88/14):

- preserve aquatic and wetland habitats in a natural state, and if necessary conduct the revitalization,
- provide a favorable amount of water in the water and wetland habitats, that is necessary for habitat survival and its significant biological species,
- if physical-chemical properties of water are unfavorable for the survival of habitat and its significant biological species, they must be preserved or improved,
- provide favorable water regime for the conservation of wetland habitats,
- preserve the biological diversity in watercourses and favorable water dynamics (meandering, sedimentation, occasional armlets etc.),
- prevent the wetland succession,
- avoid watercourse regulation and changes in water regime of aquatic and wetland habitats if it is not necessary for the protection of the lives of people and settlements,
- give the priority to natural retentions and watercourses for the purpose of flood mitigation etc.

State of the Environment Report of Dubrovnik-neretva County recommends the coordination of nature protection in wetland areas with agricultural production (e.g. construction of melioration system coordinated with the goals of nature protection).



Advantages

- wetlands have important role from biodiversity and landscape aspect,
- wetlands are important factors in water storage, groundwater recharge and reduction of down-stream runoff,
- high protection degree in selected location and designed sites,
- evaluation of potential cumulative impacts on water regime and ecological network.

Challenges

- the Strategy and Action Plan for the Protection of Biological and Landscape Diversity of the Republic of Croatia (OG No. 143/08) states that water courses, grasslands and wetlands are endangered due to degradation and reduction of biological and landscape diversity, excessive exploitation of natural resources, introduction of invasive species, construction of infrastructure (construction of roads, water management structures leads to habitat loss and fragmentation), agricultural activity (melioration, land consolidation, abandoning of agricultural lands) pollution, urbanization and global climate change,
- lack of and/or non-alignment of spatial plans of protected areas with spatial plans of local self-government units,
- input of allochthon (e.g. mouflon) and invasive (e.g. Caulerpa) species,
- the disappearance of domestic taxa and breeds; Insufficient expertise of the researchers.

4. Conclusion

The karstic fields, due to their natural characteristics, represent rare areas in the karst where there is a surface water flow yet at the same time they are very suitable for agricultural activity. Given the fact that agricultural activity has a negative impact on both quality and quantity karst fields represent a major challenge for water management and protection.

In the area of the Pilot Action "South Dalmatia: Prud, Klokun and Mandina spring", the following activities and phenomena that negatively reflect the quality and quantity of drinking water can be distinguished:

Intensive agricultural activity, especially in the Vrgorac Field and in the Neretva River valley, A separate problem is the drainage of karst fields (Rastok, Vrgorac field, Imotski field), which despite great efforts is still not adequately resolved. Regardless of numerous construction interventions (construction channel and tunnel for drainage of surplus water from the flooded fields), fields still occasionally flood,



There is still a lot of deficiencies in the sewerage and wastewater drainage system, there are many households that are not connected to the sewerage network

Illegal Waste Dumps

Water supply system losses

Unlike other watercourses in the area of Croatia, the large and medium annual flows rates in this area (Neretva (Metković) and Matica Vrgorska (Dusina)) tend to decrease.

Agricultural production in this area presents the greatest negative impact both on the quality and quantity of the water resources. Agricultural production is purely conventional and the use of pesticides and fertilizers is still under the motto of "the more the better". Despite the fact that in recent years it has been an ongoing struggle to optimize the use of protective agents, it will take years to change the awareness of the local community. Due to everything mentioned above, it is very important to carefully and professionally manage water resources in this area in order to achieve a balance between protection and the use of natural systems.



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- Act on sustainable waste management (Official Gazette No. 94/13)
- Act on State Support in Agriculture and Rural Development (Official Gazette No. 80/13)
- Council Directive 86/278/EEC of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture
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- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora
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