WP5.1

Joined report on historical development of cross-border drinking water supply systems

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DRINK ADRIA

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1 Introduction

Overview of historical development of cross-border drinking water supply systems in Adriatic area has not been performed until now. The issue was not really in the focus of any stakeholder and the reason for the absence of this is not so easy to identify. Based upon the experience gained in the DRINKADRIA project there are several reasons why the issue of cross border water supply is not in the centre of attention:

1) The state level governance system is not really aware of the reality of individual water supply systems. Local water utilities and local communities are left alone in resolving the water supply issue without backstopping entity.
2) General reservation relative to the idea of close cooperation among the countries and partners which have on other levels also other historically developed and unresolved disputes.
3) Unclear system of procedures and relative competences on the functionality, and optimization of the water supply. Water supply is sometimes considered as a stable system with major focus on infrastructure and investments, but less in the field of efficient operational management and human resources management.

It was the aim of DRINKADRIA project to overcome the identified obstacles and create the systematic overview of the historical development of the cross-border water supply systems.

Systematic data collection for following groups was done: (1) general data, (2) legal framework, (3) CB WSS economics, (4) technical issues, (5) management issues, (6) SHP files and (7) annexes. All collected data was integrated into DRINKADRIA platform.

Analysis of water demand trends are playing one of key roles in long term planning of WSS development in the world and also in Adriatic area. Multiple factors were considered in analysis: (1) growth/decline of population, (2) growth/decline of tourism (there is an issue with the seasonal dynamics of water supply during the peak summer season), (3) growth/decline of industry and growth/decline of agriculture.

Guidelines were prepared for development of framework for the systematic analysis of the experiences in the comparable water supply systems.. A catalogue of criteria that should be taken into account is considered: (1) number of population that water is supplied, (2) state of infrastructure, (3) financial sustainability of WSS & Financial resources reserved for maintenance, (4) significance of impact of tourism, industry and agriculture and (5) long term programming of WSS in cross-border context.

2 Overview of Historical Cross-Border Water Supply Systems (CBWSS) Development

Main objective of the task 5.1 is a systematic data collection for available cross-border and cross-regional water supply systems. For this purpose a specific questionnaire was developed and distributed among partners. The data provided by partners was analysed and published on dedicated web GIS platform.

Collected and analysed data can be gathered in following groups:

- **General data** (between which countries, management of origin side, amount of water supplied,…).
- **Legal framework** (existing legal framework for the CB WSS, contracts,…).
- **CB WSS economics** (how is the price for water defined, penalties,...).
- **Technical issues** (water quality monitoring, trends in water demand,…).
- **Management issues** (long term planning mechanisms, contingency plans,…).
- **SHP / DWG files** (spatial data).
- **Attachments** (PDF files that are relevant for DRINKADRIA project).

The collected data was integrated into DRINKADRIA platform. Analysis of following reasons was made:

1) why WSS ceased to operate
2) interest in building new WSS

Some WSS managers have pointed out positive and negative experiences in cross-border (cross–regional) management. Key issues for CB WSS and CR WSS are described in conclusions.

2.1 Description of Cross Border and Cross Regional Water Supply Systems

The chapter contains general information of all presented cross border and cross regional water supply systems, which were collected during the reporting process of the WP5 – the comments and comparisons are outlining the most significant information on a specific WSS as a base for the further development of the CB WSS. A table of all partners that were collaborating and reporting was also prepared.

2.2 Cross-Border Water Supply Systems (CB WSS)

2.2.1 Slovenia / Italy

On the cross-border zone between Slovenia and Italy information was collected on 8 CBWSS with different statuses (active, inactive and potential CBWSS) (Figure 1).

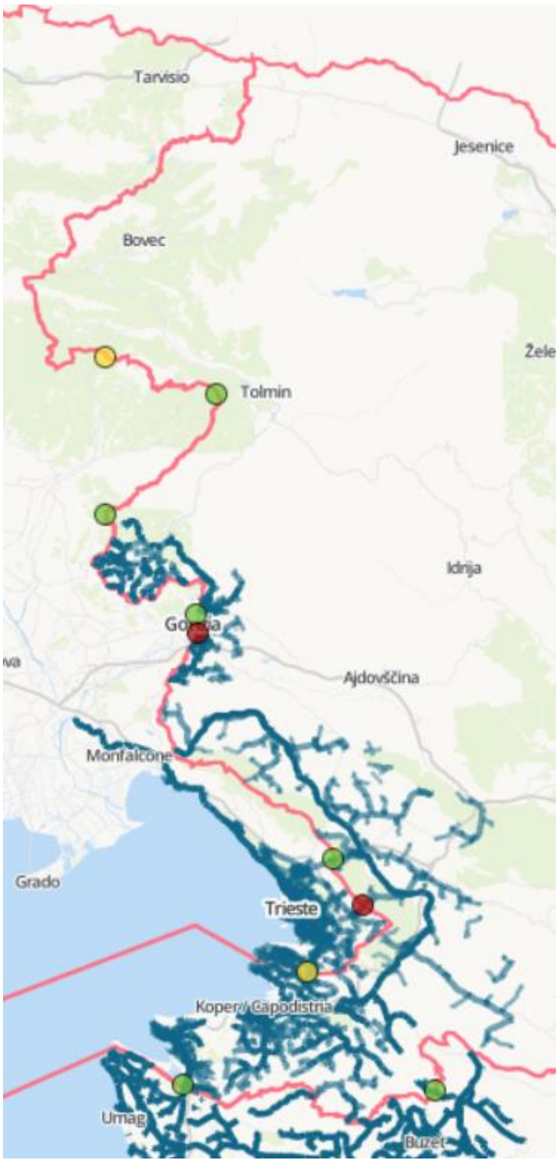

Figure 1: CBWSS on border between Slovenia and Italy.

In following paragraphs status of these systems is described, showing out main characteristics and also key challenges related to the functioning and further development of CB WSS.

2.2.1.1 CB WSS: from Mrzlek (Slovenia) to Gorizia (Italy)

The Water supply system from Slovenia to Italy has a very long tradition. The supply is active since 1936. General nature of the system is permanent water supply of the urban area of Gorizia (Italy). It was agreed to provide an annual supply of 2.000.000 m^3. Agreement between both WSSs is based on Paris Peace Treaty and other agreements. Water supply can be interrupted due to technical reasons.

The WSS is an example of CB WSS with long term history, which is based upon a good framework of institutions and legal acts. The missing is more active issue of the long term delivery/demand planning and the issue of pricing.

The CBWSS data in full extent was provided by project partner in requested time. Beside the spatial definition of the topology of the WSS also other information was supplied (scanned key documents on the status of the WSS). As outstanding information we would like to underline, that the listed CB WSS is specific, because its existence and functioning is defined already by the Paris peace treaty 1947.

The CBWSS data in full extent was provided by project partner in requested timeframe.

2.2.1.2 CB WSS: from Trieste (Italy) to Sežana (Slovenia)

CB WSS is operating since December of 2001. General nature of WSS is emergency supply in the case of unexpected supply conditions for a period of maximum 10 days and for temporary water supply, which is a scheduled water supply with a 10-day notice and duration for more than 1 month. Currently there is going on an active discussion about the increase of the supplied water and change it to the permanent water supply.

The CB WSS is a good example of recently developed CB-WSS (new by 2001) with clear intention to improve the water supply reliability. The supplying period is by now quite short, and it is already providing framework also for the expansion of the emergency water supply to the continuous water supply. It is clear that this upgrading is not a straightforward process as it significantly increases the annual delivery and therefore the pricing issue is even more important. The continuous water supply is on the other hand important for the reason of water age and preventing the stagnant water in the emergency connection.

The CBWSS data was provided by project partner in requested timeframe.

2.2.1.3 CB WSS: from Albana (Italy) to Golo Brdo (Slovenia)

Golo Brdo in Slovenia is an extremely small WSS that doesn’t have its own water resources. The nearest Slovenian WSS is a WSS of Nova Gorica. Construction of water distribution system from national water source is not economically justified due to difficult terrain and the distance. Currently the water is supplied from Albana WSS in Italy.

The cross – border water supply in this framework is of continuous nature and provides water for a small number of inhabitants (less than 50). The main reason for the connection is economical. Interesting feature is that the status of the end-users of water is equal to the users of the service on Italian territory for which the public service is performed.

2.2.1.4 CB WSS: from Kambreško (Slovenia) to Strada Provinciale (Italy)

The water is supplied from Ročinj (Slovenia) to Italy. The system has similar status as the system under the item 1.3. No other data is currently available.

2.2.1.5 CB WSS: from Trieste (Italy) to Lipica (Slovenia)

This is an inactive CB WSS. No other data is currently available.

2.2.1.6 CB WSS: from Gorizia (Italy) to Šempeter (Slovenia)

The water supply from Gorizia WSS, (Italy), to Šempeter zone (Slovenia) was meant as an emergency water supply enabling the emergency water supply for hospital, located in Šempeter, Slovenia. The hospital currently supplied by the Mrzlek WSS. Currently the water supply from Italy is inactive. No other data is currently available.

2.2.1.7 CB WSS Robič (Slovenia) – Cividale (Italy)

This is a potential cross-border WSS. The proposed initiative is based upon both emergency water supply and improved economic efficiency of the supply zone of the city of Cividale (Čedad) in Italy supplied from the water resources in Slovenia – river Nadiža (Natisone).

The proposed development has already resulted in some hydrogeological research and initial stages – pre-feasibility studies.

2.2.1.8 CB WSS Rabuiese (Italy) - Škofije (Slovenia)

This is a potential cross-border WSS potentially enabling water supply from the Trieste WSS to the WSS of Rižanski vodovod supplying water to three municipalities in Slovenia (Koper, Izola, Piran) the water supply would predominantly serve as a source of emergency water supply.

Currently the additional water for the municipalities in Slovenia is supplied by Kraški vodovod from Sežana city. AcegasAps has started first analysis and first meetings between the parties to establish and verify their interest.

No specific data on the potential CB WSS is available.

2.2.2 Slovenia / Croatia

On the border between Slovenia and Croatia data was collected about 15 CBWSS with different statuses (active, inactive and potential CBWSS) (Figure 2).

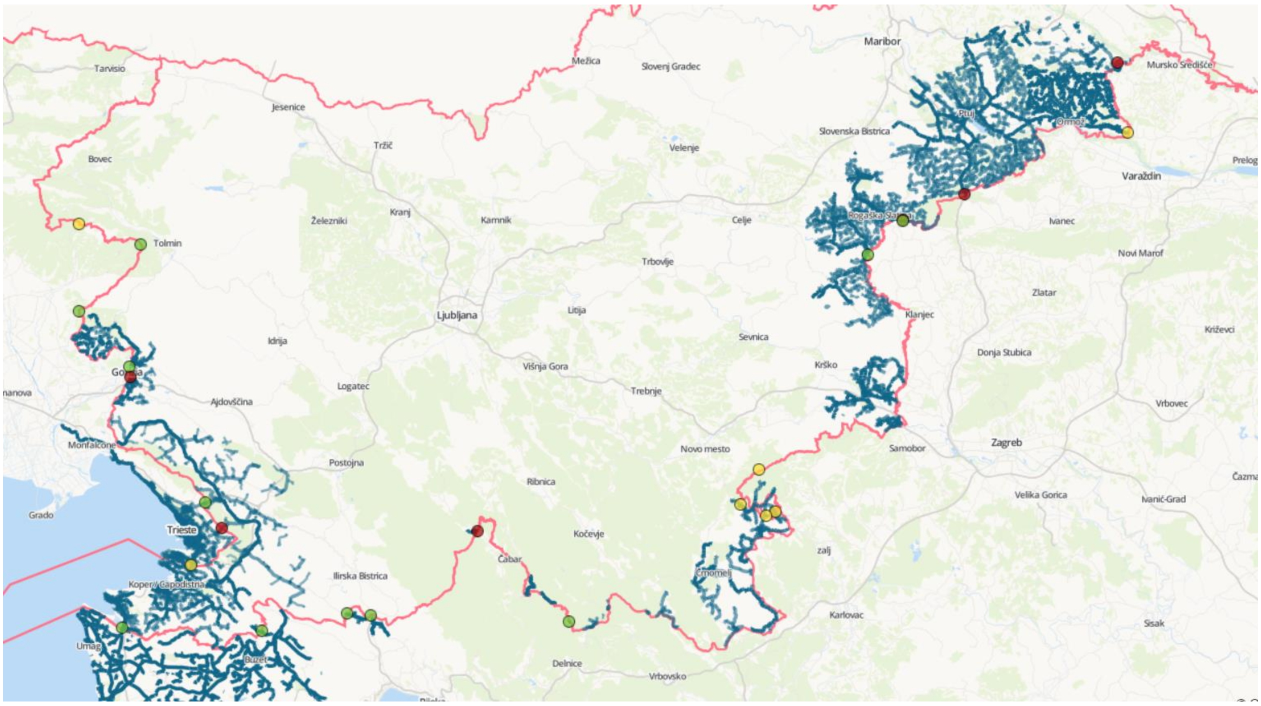

Figure 2: CBWSS on border between Slovenia and Croatia.

2.2.2.1 CB WSS: from Buzet (Croatia) to Koper (Slovenia)

CBWSS from Gradole to Koper was established in 1969 and is used as permanent water supply for Koper. Minimal volume of water that is supplied is 500.000 m^3/year and maximum discharge is set at 150 l/s. The contract ends 1.4.2015 with the possibility of extension if there is interest on both sides. Istarski vodovod d.o.o. is not obliged to supply water to Rižanski vodovod during extraordinary circumstances until it normalizes the production process. Contracts have recently been concluded and also the question of the legal heritage was resolved.

The identified weakness of this CB WSS is the issue of short term contract framework and the absence of the general framework on the cross-border water delivery which should exist on the state level. Beside the Gradole water resource and treatment facility there is also a water resource of Bužini – Gabrijeli, which is currently also under the dispute regarding the ownership between Slovenia and Italy. This resource and the cross-border delivery are managed by the same water utilities as the CB WSS Gradole – Koper.

The CBWSS data was provided by project partner in requested timeframe.

2.2.2.2 CB WSS: from Atomske toplice (Slovenia) to Luke poljanske (Croatia)

Cross border WSS is active. Water is shared from Slovenia to Croatia and supplies approximately 20 – 30 households, currently being operated by OKP Rogaška Slatina. No other data is currently available.

2.2.2.3 CB WSS: from Ilirska Bistrica (Slovenia) to Starod (Slovenia), Šapjane (Croatia), Jelšane (Slovenia), Klana (Croatia), Mučići (Croatia), Matulji (Croatia)

CB WSS network was constructed in 1937 and it included Buzet – Starod – Šapjane – Jelšane – Klana – Mučići. Change in water supply was made in 1962: Ilirska Bistrica – Starod – Šapjane – Jelšane – Klana – Mučići – Matulji. Today water from Slovenia is delivered to Brdce, Pasjak and Šapjane, and to Jelšane. Only in dry period, Rupa and Klana still get water from Slovenia.

General nature is permanent water supply and minimum of supplied water is 24.5 l/s from Slovenia to Croatia (according to Contract from 1972).

The CBWSS data was provided by project partner in requested timeframe.

2.2.2.4 CB WSS: from Rogaška Slatina (Slovenia) to Hum na Sutli and Zagorska sela (Croatia)

Water supply is currently active and it is supplying approximately 15.000 m^3/year. A closure of this pipeline and cessation of the delivery is planned, after that a supply to Hum na Sutli and Zagorska sela will be done from water resources on the territory of Croatia. Closure will be done after the construction of water supply network in Croatia.

The CBWSS data was provided by project partner in requested timeframe. However the WSS network does not exist in digital form and therefore a GIS representation and other documentation including legal contracts and financial data is missing.

2.2.2.5 CB WSS: from Brest (Croatia) to train station Rakitovec (Slovenia)

A spring in Croatia near the village Brest in municipality Lanišće is used to supply a part of Slovenian settlement Rakitovec (part near the train station Rakitovec). Water supply system Brest-train station Rakitovec was built in year 1876, at the time when railway Divača-Pula was built, and then it was used for water supply of steam locomotives. With the cessation of steam locomotives water demand this WSS wasn't abolished and train station Rakitovec and family buildings which are built nearby are still supplied by the system. That system does not fall under the jurisdiction of any utility company which deals with water supply, but the residents of village Brest, together with municipality Lanišće, take care of it in order to maintain it in good working order. The object requires a thorough reconstruction and rehabilitation of underground and above-ground parts, because it has been operating for

138 years. However, the municipality and the residents don't have enough financial resources to do that.

The CBWSS data was provided by project partner in requested timeframe. Due to the ownership structure of the WSS and the WSS age, the GIS representation and other documentation including legal contracts and financial data is missing.

2.2.2.6 CB WSS: from Rogaška Slatina (Slovenia) to Rogatec (Croatia)

The supply is currently inactive. Rogaška Slatina had been supplying water to Steklarna Rogaška facility located in Rogatec, Croatia. The supply was about 1000 m^3 of water a month. It ended in year 2013. Since then Steklarna Rogaška adopted its own water supply. No other information is currently available.

2.2.2.7 CB WSS: from Ptuj (Slovenia) to Gruškovje (Croatia)

The supply is currently inactive. Komunalno podjetje Ptuj used to deliver water to the international border crossing Gruškovje. No other information is currently available.

2.2.2.8 CB WSS: from Babno Polje (Slovenia) to Prezid (Croatia)

The supply is currently inactive. The CB water supply system has been active until 1995. No other information is currently available.

2.2.2.9 CB WSS Vodice (Croatia) – Hrušice (Slovenia)

Water supply connection is identified. Current status is unknown.

2.2.2.10 CB WSS Čakovec (Croatia) – Ormož (Slovenia)

A potential CB water supply connection could be from Međimurske vode d.o.o. Čakovec (Croatia) to Komunalno podjetje Ormož d.o.o. (Slovenia). With a surplus of the water supply capacities on the Croatian territory it would be possible to supply the drinking water from Croatia to the WSS of Ormož. Komunalno podjetje Ormož is treating the water from the water wells Mihovci with special treatment procedure. It is a demanding and expensive treatment process. On the other side, drinking water from water wells Nedelišće (in Međimurje, Croatia) is not purified, but only preventively treated with chlorine, for health correctness during flow through pipelines.

The potential connection between the two water supply systems would be important at least as an emergency water supply.

No other information is currently available.

2.2.2.11 CB WSS: from Rajakovići (Croatia) to Brezovica (Slovenia), Bušinja vas (Slovenia), Suhor (Slovenia), Lokvice (Slovenia) and Trnovec (Slovenia)

Water supply system Radatović was built in 1939 and was supplying water to villages in Croatia: Rajakovići, Kuljaji, Dučići, Radatovići, Pilatovci, Goleši and Brezovica. The system was also developed to supply the drinking water to some villages in Slovenia: Brezovica, Bušinja vas, Suhor, Lokvice and Trnovec. After the 2nd World war the Water Utility Metlika has been operating the WSS and collecting payments for water. Few years ago Water Utility from Ozlja has taken over this water supply network (currently it is not known if only part of network or whole). No other information is currently available.

2.2.2.12 CB WSS: from Jamnik (Croatia) to Slamna vas (Slovenia), Boldraž (Slovenia)

From Jamniki reservoir (Croatia) water was delivered to Bojanji hrib (new reservoir was built there). In 1966 a new water supply system was built to deliver water to Slamna vas and Boldraž. No other information is currently available.

2.2.2.13 CB WSS: from Jamnik (Croatia) to Radovice (Slovenia), Brašljevica (Croatia), Drašiče (Slovenia)

In 1975 a new water supply system is built. Water is supplied from Jamniki (Croatia) to village Radovice (Slovenia) and from there through Croatian village Brašljevica to Slovenian village Drašiče. No other information is currently available.

2.2.2.14 CB WSS: from Rajakovići (Croatia) to Hrast (Slovenia), Dole (Slovenia), Drage (Croatia)

Renovated water supply system Rajakovići (Croatia) was opened in 1988. From reservoir Kuljaji (Croatia) water was once again delivered to villages Brezovica and Hrast (Slovenia). In 1998 a new water supply system was built to deliver water to villages Dole (Slovenia) and Drage (Croatia). No other information is currently available.

2.2.2.15 CB WSS Ormož (Slovenia) – Banfi (Croatia)

Until the year 1995, about 60 houses in Croatian settlement Banfi (Municipality Štrigova) were connected to Slovenian WSS, and water was delivered from Komunalno podjetje Ormož. A new WSS was built for these households and in 1995 connection to WSS managed by Međimurske vode d.o.o. was enabled, with supply of drinking water from water wells Nedelišće (in Međimurje, Croatia). Currently this case is inactive.

2.2.3 Bosnia and Herzegovina / Croatia

On the border between Bosnia and Herzegovina and Croatia data was collected about 6 active CBWSS (Figure 3).

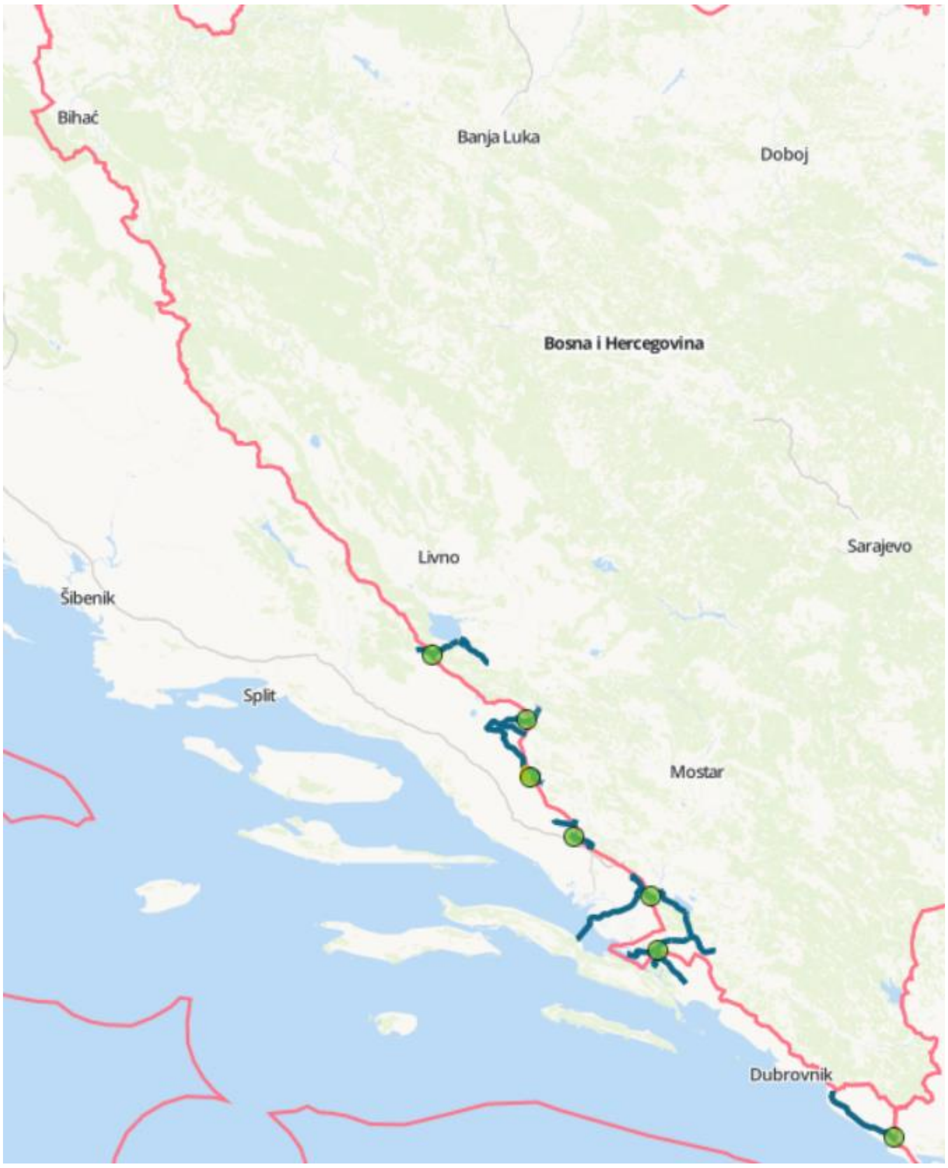

Figure 3: CBWSS on border between Bosnia and Herzegovina and Croatia.

2.2.3.1 CB WSS Neum (Bosnia and Herzegovina) – Dubrovačko Primorje (Croatia)

Cross-border water supply was established in 1982. General nature of the CBWSS is permanent water supply of some settlements in the Dubrovačko Primorje (Croatia). Minimal water consumption is 15 l/s according to contract signed between Communal labour organization Vodovod Dubrovnik and Municipal building authority of Neum in 1982. Currently the supply is less than agreed due to decreased water demands. There is an issue with the seasonal dynamics of water supply during the peak summer season when local demands multiply (in summer touristic season the population rises from 5.000 to around 20.000).

The CB WSS and the main water supply system have severe difficulties due to the shift of the WSS of Neum from regional WSS to more local WSS.

The CBWSS data was provided by project partner in requested timeframe.

2.2.3.2 CB WSS Tomislavgrad (Bosnia and Herzegovina) – Imotski (Croatia

Legal framework

Agreement between the Council of Ministers of Bosnia and Herzegovina and the Croatian Government on the rights and obligations at water supply systems slashed with state border is currently in the phase of signing. There is the Committee for Water Management of the Republic of Croatia and Bosnia and Herzegovina. After signing, this Committee will be responsible for the above agreement implementation. The legal framework for the CB WSS bilateral agreements is missing and the economic and technical framework are adequate. The CBWSS is a positive component in the framework of general cross-country relationships.

General perception_assessment

The legal framework for the CB WSS bilateral agreements is missing and the economic and technical framework are adequate. The CB WSS are positive component in the framework of general cross-country relationships.

Basic characteristics of CB WSS

Regional Water Supply System "Josip Jović" was established in 2001. Management of origin side of the WSS is PUC Vodogradnja d.o.o. Tomislavgrad and management of delivery side of the WSS is PUC Vodovod Imotske krajine d.o.o. Imotski. Water supply is defined by contract. Concession for water is on protocol for signature. Defined water supply is 50 l/s but for now, water supply is only 3 l/s.

CB WSS Economics

Water price is not defined because the contract is not signed yet. System currently works with low delivery capacity because Croatia is not taking as much water as defined by the contract. Water management plans indicated that the needs will be higher in the future. Because payment is still not regulated by the contract, there are no minimal charges, no special charges for the excessive water supply, no insurance costs covered, no mutual inspection of records and no payment statistics for the last 5 years.

Technical issues

Continuity of water supply is not an issue. Delivered water is measured by the water meters on the CRO/B&H border, which is often not working because of the low flow. System is oversized and it works with only about 12 % of its capacity. Part of the system on Croatian side is still not completed. Water quality monitoring is not jointly controlled. B&H side is monitoring water quality in the system according to water legislative and praxis in B&H. Croatian side is monitoring water quality in the system according to water legislative and praxis in Croatia. Temperature and pressure are not regulated by the contract. The discharge/pressure is measured on the specific cross border structure. There is plan for the construction of new project facilities - Duvno ring which will have demand of 10 l/s during summer months. The daily and seasonal dynamics of water supply are not an issue because of low demand. There are also no water losses and no problems related to water availability (water source).

Management issues
Because there's no contract, no long term planning mechanisms are yet established, there is no joint supervision of the water supply system and no joint management of the water resource.

2.2.3.3 CB WSS: from Vrgorac (Croatia) to Ljubuški (Bosnia and Herzegovina)

Legal framework
Agreement between the Council of Ministers of Bosnia and Herzegovina and the Croatian Government on the rights and obligations at water supply systems slashed with state border is currently in the phase of signing. There is the Committee for Water Management of the Republic of Croatia and Bosnia and Herzegovina. After signing, this Committee will be responsible for the above agreement implementation. The legal framework for the CB WSS bilateral agreements is missing and the economic and technical framework are adequate. The CB WSS is a positive component in the framework of general cross-country relationships.

General perception assessment
The legal framework for the CB WSS bilateral agreements is missing and the economic and technical framework are adequate. The CB WSS are positive component in the framework of general cross-country relationships.

Basic characteristics of CB WSS
Water supply system Vrgorac is established in 1994. Water is coming from Republic of Croatia to B&H. The origin side of the WSS is managed by Public Utility Company Vrgorac and the delivery side is managed by WSS PU Parkovi. There is no contract. There was contract between municipalities before, but it's no longer valid.

CB WSS Economics
Water price is not fixed. When price on Croatian side goes higher it goes higher on Bosnian side as well. Currently water price is 5,80 kn + customs. Water charges are defined by the water meter on the CRO/B&H border. If payment is delayed there are warnings for the

exclusion of water. Because there's no contract there are no minimal charges, no special charges for the excessive water supply, no insurance costs covered, no mutual inspection of records and no payment statistics for the last 5 years.

Technical issues

Continuity of water supply is not usually an issue. There was a problem of water supply this summer (2014). The daily and seasonal dynamics of water supply is not an issue. Also there are no problems related to water availability (water source). There are about 30-40 % of water losses due to old pipes on Bosnian side. There are plans for construction of new facilities from Bosnian side. Because of dissatisfaction with the mutual cooperation, water price and paying for customs for water delivered from Croatia, there is a plan to deliver water from local water sources.

Management issues

Because there's no contract no long term planning mechanisms is yet established, there is no joint supervision of the water supply system nor joint management of the water resource.

2.2.3.4 CB WSS: from Imotski (Croatia) to Drinovačko Brdo and Puteševica (Bosnia and Herzegovina)

Legal framework

Agreement between the Council of Ministers of Bosnia and Herzegovina and the Croatian Government on the rights and obligations at water supply systems slashed with state border is currently in the phase of signing. There is the Committee for Water Management of the Republic of Croatia and Bosnia and Herzegovina. After signing, this Committee will be responsible for the above agreement implementation. The legal framework for the CBWSS bilateral agreements is missing and the economic and technical framework are adequate. The CBWSS is a positive component in the framework of general cross-country relationships.

General perception assessment

The legal framework for the CB WSS bilateral agreements is missing and the economic and technical framework are adequate. The CB WSS are positive component in the framework of general cross-country relationships.

Basic characteristics of CB WSS

Cross-border water supply system Drinovačko Brdo and Puteševica was established in 14.06.2005. Management of origin side of the WSS (Water Supply System) is LC Drinovačko Brdo and management of delivery side of the WSS is PUC Imotske Krajine. Amount of water supplied per contract is 5 l/s which is 50.000 m^3/year. Water is coming continuously to reservoir D. Brdo (capacity 100 m^3) and is distributed from there to 100 houses in settlements D. Brdo and Puteševica. The cross-border infrastructure is owned by PUC Komunalno Grude (B&H area) and PUC Imotske krajine (CRO area).

CB WSS Economics

The water price is not defined by the contract. There is a constant water price: 9 kn (1,18 Euro) for Imotski (CRO) and 4 kn (0,53 Euro) for BiH. Pricing mechanism is defined by the water meter on the CRO/B&H border. The non-payment procedure is regulated by the reminder and all the issues are solved at the local level. There are no minimal charges foreseen. Because of sparsely populated settlements there is no special tariff for the excessive water supply. Insurance costs are covered. Depreciation of the infrastructure and maintenance plans are covered by the water price. Penalties for unfulfilment of contractual obligation are water delivery discontinuation. There is no mutual inspection of records/book-keeping established due to diligence approach. Generally, system is the verge of profitability. Payment statistics for the last 5 years does not exist in B&H, but there is in Imotski (Croatia).

Technical issues

Delivered water is measured by the water meter on the CRO/B&H border. Intermittent water supply is an issue because there are no restrictions at the water delivery. Delivered water quality is regulated by the water legislation in Croatia. PU Imotski (Croatia) has the obligation to deliver water with good quality in accordance with Croatian regulations on sanitary drinking water. Water quality monitoring is not jointly controlled. In B&H, there is no control of water quality. Temperature and pressure are not regulated by the contract. The discharge/pressure is measured on the specific cross border structure. The structure is mutually accessible.

Existing infrastructure covers distribution network and water tank 100 m^3 and there are no plans for new infrastructure. Because of the relatively new system there are no losses in the system on B&H side and there is no problem with water demand from B&H side. Also a transitional phenomenon is not an issue.

Management issues:

There are no plans for expansion, because the B&H water supply area is rarely populated. Communication process is not determined and is not functioning. There is no joint supervision of the Water Supply System, no joint management of the water resource, and no existence of contingency plans.

2.2.3.5 CB WSS: from Posušje (Bosnia and Herzegovina) to Imotski (Croatia)

Legal framework

Agreement between the Council of Ministers of Bosnia and Herzegovina and the Croatian Government on the rights and obligations at water supply systems slashed with state border is currently in the phase of signing. There is the Committee for Water Management of the Republic of Croatia and Bosnia and Herzegovina. After signing, this Committee will be responsible for the above agreement implementation. The legal framework for the CB WSS bilateral agreements is missing and the economic and technical framework are adequate. The CBWSS is a positive component in the framework of general cross-country relationships**.**

General perception assessment

The legal framework for the CB WSS bilateral agreements is missing and the economic and technical framework are adequate. The CB WSS are positive component in the framework of general cross-country relationships.

Basic characteristics of CB WSS

Cross- border water supply system Tribistovo Vinjani was established in 2012. Management of origin side of the WSS is PU Posušje and management of delivery side of the WSS is PUC Imotske Krajine. Amount of water supplied per contract is 60 l/s and the water supply is permanent. The infrastructure is on territory of B&H and is owned by PU Posušje.

CB WSS Economics

Water price includes transportation charge, treatment charge, resource charge, etc. Water price is 0,25 Euro and is defined by legislation and praxis in B&H. Minimal charges are not foreseen and the non-payment procedure is regulated by the contract. There is also no a special tariff for the excessive water supply. Insurance costs are not covered. Pipeline from Croatia is part of water supply system Posušje and is also used for population in B&H. Investments/maintenance and amortization are at PU Posušje competency. In case of unfulfilment of contractual obligations there is suspension of water delivery. Mutual inspection is done only for water meter reading and work control. There are expectations for more efficient operation of the CB WSS, when the water demands from Croatian side become higher. CB WSS is relatively new and works less than one year, therefore there are no payment statistics for the last 5 years. It currently works with low delivery capacity and only in the short term period during summer when the Croatian water needs are higher. The former water management plans indicated that the long-term needs will be higher in the future.

Technical issues

Continuity of water supply is not an issue and it is managed by the contract. For now, there is only continuous water supply during summer period. Delivered water is measured by the water meter on the CRO/B&H border. PU Posušje is responsible to ensure water quality. Public health institute Mostar is monitoring water quality in the system according to water legislative and praxis in B&H. The necessary construction of new project facilities is planned and will be constructed and managed as joint activities. There are no water losses because of a new pipeline to transport water to Croatia. The pipeline, as part of WSS Posušje is dimensioned to transport to Croatia higher water quantity - 60 l/s. Also there are no problems related to water availability (water source) in B&H side.

Management issues

As for the long term planning there is the common plan for drinking water treatment plant building in the future. For now, there is only water chlorination at water sources. Water resources management is ensured from B&H side by PU Posušje and there is joint supervision of the Water Supply System. There is no contingency plan existing.

2.2.3.6 CB WSS: from Doljani (Bosnia and Herzegovina) to Metković (Croatia)

Croatian water supply Metković is supplying the town of Metković and suburban areas, including the municipality Zažablje and village Doljani. The extraction from Doljani spring started in 1966 when former Yugoslavian Republic still existed. At that time no concession for the extraction of water was given. With the breakup of former Yugoslavia the Croatian company has no water permit for water withdrawal (Doljani spring is now located in Bosnia and Herzegovina). The issue could be resolved in the intergovernmental negotiating committee of Croatia and Bosnia and Herzegovina.

The CB WSS data was provided by project partner in requested timeframe. Scanned documents were not collected because their existence is questionable. There are no documents between Vodovod Metković and authorities of Bosnia and Herzegovina. The price of water is divided in three categories: (1) the price for households is 13,69 KN/m^3; (2) the price for business companies is 16,52 KN/m^3 and (3) the price for people of poor economic status is 11,43 KN/m^3. The price list is the same for the citizens of Croatia and Bosnia and Herzegovina.

2.2.4 Croatia / Montenegro

On the border between Croatia and Montenegro data was collected for 1 active CBWSS (Figure 4).

Figure 4: CBWSS on border between Croatia and Montenegro.

2.2.4.1 CB WSS: from Bileća Lake (Bosnia and Herzegovina) through Konavle (Croatia) to Herceg Novi (Montenegro)

These three countries, that are included in CBWSS, make a very interesting case of multinational cooperation. Water is acquired from the accumulation Bileća Lake, Bosnia and Herzegovina and is distributed through Croatia to Herceg Novi, Montenegro. The water from the lake is distributed through the 15 km long hydropower tunnel to the surge tank Plat (Croatia) and then to hydroelectric power plant Plat.

Bileća Lake is the largest man-made reservoir on the Balkan Peninsula, built in 1968 in a submerged part of the Trebišnjica valley by building a 123 m high arch dam. Water from Bileća Lake has an excellent quality so that it does not need any special treatment apart from ordinary filtration and disinfection. Storage capacity is large and it amounts to 1260 million m^3, which enables safe water quantity during the summer.

The surge tank Plat is located on the Croatian territory at ground level 257 m above sea level and with the elevation of the free level at 260 meters above sea level. The pipeline is 23.17 km long from the surge tank Plat through Croatia.

On the border of Croatia and Montenegro (Debeli Brijeg) is another surge tank, built at 185 meters above sea level. The water from Debeli Brijeg is gravitationally distributed to the Mojdež filter station, which reservoir bottom is at the level of 151.60 meters a.s.l.. Water that comes from Plat and the local source Lovac is collected there and subjected to treatment that provides chemical and microbiological quality of drinking water in accordance with the regulations of the country of Montenegro. Treated water from filter station Mojdež enters the distribution network of various villages, which is due to the configuration of the terrain and villages divided into three altitude zones.

The CB WSS data was provided by project partners in requested timeframe. However the financial data and the GIS representation of Montenegro side are still missing. Project partner has requested financial data and the GIS representation from the Public Utility Vodovod I kanalizacija Herceg Novi and it was not possible to obtain the data in the direct contact or through any other competent authority.

2.2.5 Albania / Italy

On the border between Albania and Italy data was collected for 1 active CBWSS (Figure 5).

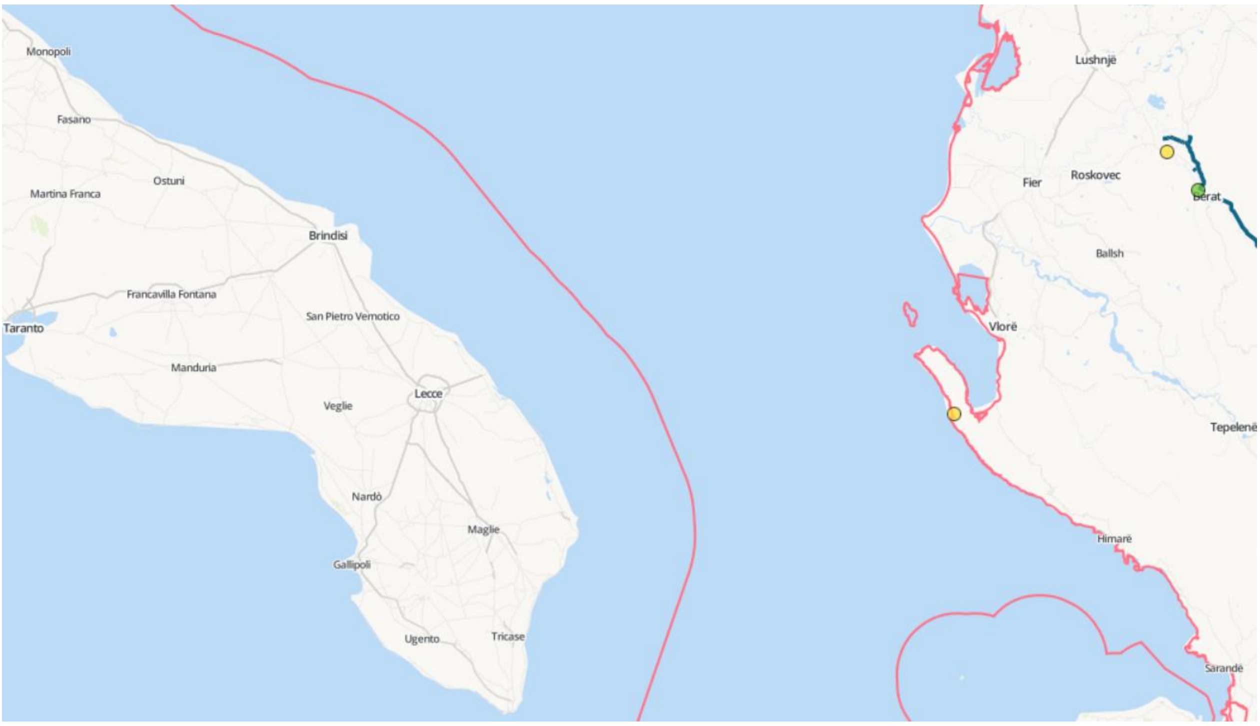

Figure 5: CBWSS on border between Albania and Italy.

2.2.5.1 CB WSS: from Syri i Kalter (Albania) to Puglia (Italy)

Plans for delivering water from Syri i Kalter (Albania) to Puglia (Italy) have existed for a very long time. The request from the Italian Government to supply water from Syri i Kalter (Albania) to Puglia (Italy) was denied from the Albanian Government in 1995. But even after 1995 there were still discussions about plans to build an underwater pipeline of 80 km between two shores on the Adriatic Sea that would provide 150 million cubic meters water per year. Such amount of water would significantly fulfil the needs of requirements for drinking water in that region (CDS, 2002; ItalPlanet, 2003; AIbrahimllari, 2014).

2.2.6 Albania / Greece

On the border between Albania and Greece data was collected for 1 active CBWSS (Figure 6).

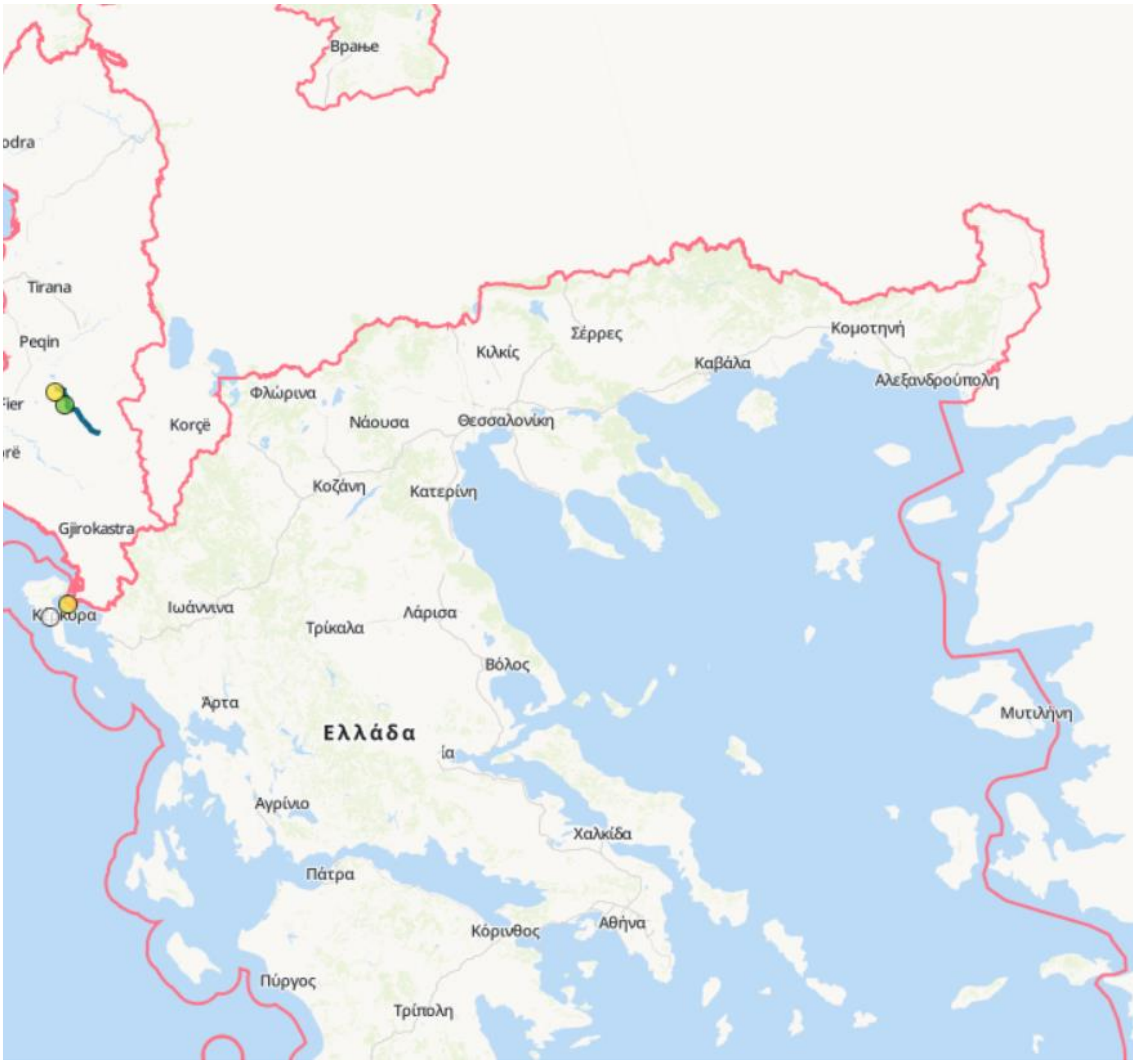

Figure 6: CBWSS on border between Albania and Greece.

2.2.6.1 CB WSS: from Syri i Kalter (Albania) to Corfu (Greece)

The agreement between the Albanian Government and the Greek Government to supply water from Syrin i Kalter (Albania) to Corfu (Greece) was signed in December 2001. External expert Ervin Bucpapaj that is working for Albanian partner FB11 has also pointed out that there is some inconsistency in Albanian legislation since Syri i Kalter (Natural Monument) is a protected area by law as well as community and usage of water resources of mentioned area to supply the other neighbouring countries is almost hopeless (based on DoCM No. 102 date January 15.1996).

There is no information on any further analysis of this project (AIbrahimllari, 2014).

2.3 Cross-Regional Water Supply Systems (CRWSS)

2.3.1 Albania

For Albania data was received for 1 active CRWSS (Berat Kucove WSS – their main source is Bogova spring) and also 1 potential WSS that could be connected to Bogova spring (Figure 7).

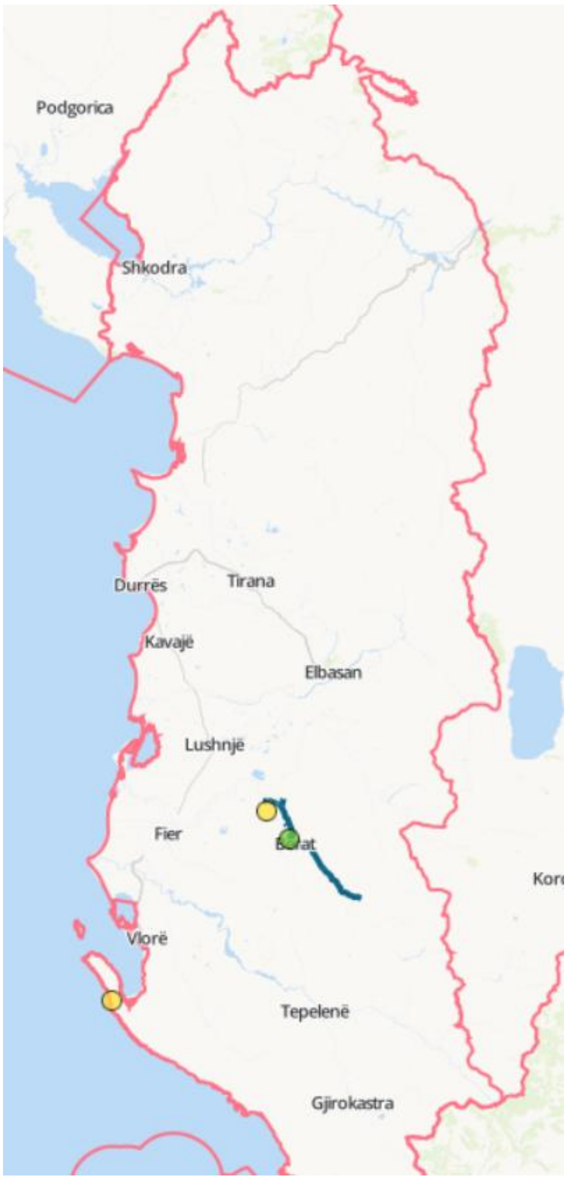

Figure 7: CRWSS in Albania.

2.3.1.1 Cross – Regional WSS Berat – Kucove

Like the vast majority of the Water Supply & Sewerage Utilities in Albania, both Berat and Kucove Water Supply and Sewerage Utilities were transformed into commercial companies, with the legal status of a Joint Stock Company, respectively with Court Decision No. 24148 date 17.07.2000 and Court Decision No. 26008 date 21.06.2001. The shares and ownership rights of these Joint Stock Companies, at the of transformation, remained with the Central Government under the administration of the Ministry of Economy, Energy and Trade as a sole owner, until the transfer of ownership to Local Government took place on January 1st 2008 based on the Council of Ministers Decision No. 660 date 12.09.2007.

Both Berat and Kucove Water Utilities have started operating as a Regional Water Supply System (CRWSS) in 2011. The CRWSS Berat and Kucove is the only regional water service provider in Albania. The merger of Berat and Kucove former municipal water utilities has been formalized in a legal binding agreement negotiated between the shareholders of those two utilities, and has been registered in the Court of Tirana.

The utility of Berat-Kucove is responsible for water supply and wastewater disposal in two municipalities Berat and Kucove as well as four communes of Otllak, Vertop, Perondi and Kozare in which areas the service is provided in retail form. According to the benchmarking data for 2013, the company covers 89.7% of its service area/population with water supply (94.1% in urban area and 74.1% in rural area). Over 89.6% of the water generated is with gravity. Water Utility does not provide continuous water supply service. Continuity of water supply service is 11.3 hours per day as reported at benchmarking unit in 2013.

The Water Supply and Sewerage Utility of Berat-Kucove supplies its service area with water from the spring of Bogova at a distance approximately 37 km. The spring of Bogova is located in Mount of Tomori at an altitude of 343 m above sea level and supplies the service area by gravity flow. The average yield of the source is 540 l/s while the minimum amount of yield is 350 l/s at the end of summer. The figures are based on observation data of the past 20 years.

Because of very old transmission mains, depreciated distribution network and many illegal connections most of them (ab)-used for irrigation, water losses go up to 80-82 %. Due to high administrative and technical losses (80-82%) the system cannot meet continuous supply and therefore an intermittent supply was introduced.

Besides the above mentioned issues, during the summer period (August-October) the yield of Bogova spring goes down. As a result, CRWSS is obliged to pump water from Uznova well-field in order to cope with water demand.

The CRWSS Berat - Kucove has started operating in 2011. General nature is permanent water supply of two municipalities – Berat and Kucove. The system cannot meet continuous supply due to high administrative and technical losses (80%) and therefore an intermittent supply was introduced. As a consequence there is not enough water for consumers during hydrological dry years and in most critical summer periods (August – October). The water is also used for the irrigation and the system has to comply with the minimum source yield used for irrigation downstream of source, which is also an issue at the local authority level.

The cross-regional WSS data was provided by project partners in requested timeframe.

2.3.1.2 Cross – Regional WSS Berat – Ura Vajgurore

Ura Vajgurore is potential Water Utility that could be supplied with drinking water from Bogova spring.

The utility of Ura Vajgurore is responsible to provide water supply service for the town of Ura Vajgurore as well as villages of Pashalli, Allvaxhias, Konizbalte, Skrevan, Vokopole and partly village of Poshnje in which areas the service is provided in retail form and village of Morave where the service is provided in bulk. According to the benchmarking data for 2013, the company covers 70.7 % (11 435 inhabitants) of its service area (72.4 % in urban area and 68.5 % in rural area). Water Utility does not provide continues water supply service. Continuity of water supply service is 5.24 hours per day as reported at benchmarking unit in 2013. The town of Ura Vajgurore is currently supplied from a natural spring “Guri i Bardhe”, whose yield is approximately 100 l/s. From the captures, water is pumped up by an associated nearby pumping station which is comprises by one operation pump and one stand by pump. The operational pump deliver water to the storage tank “Guri i Bardhe” and directly to the distribution network. The quality of water from Guri i Bardhe spring is not good due to upstream wastewater discharges. The above mentioned villages of Ura Vajgurore are currently supplied from a natural spring “Poshnje” whose yield is approximately 135 l/s. From the capture, water is pumped up by an associated nearby pumping station which comprises by three operation pumps. The first pump deliver water to the storage tank “Vokpola”, the second pump deliver water to the storage tank “Reparti Ushtarak” and the third pump deliver water directly to the distribution network of villages Pashalli and Poshnje Utility of Ura Vajgurore abstract approximately 35 l/s (based on benchmarking data 2013) from both Guri i Bardhe and Poshnje springs and pump the water to supply its service area. If there is a better management of water to the Bogova source and better management of water losses into the transmission pipeline, that could help the Utility of Ura Vajgurore to reduce or even eliminate the amount of water generated from their pumping stations for urban area and to supply water with high quality for the urban area.

2.3.2 Serbia

Data about 3 active CRWSS and also 5 potential connections (Figure 8) was received for Serbia.

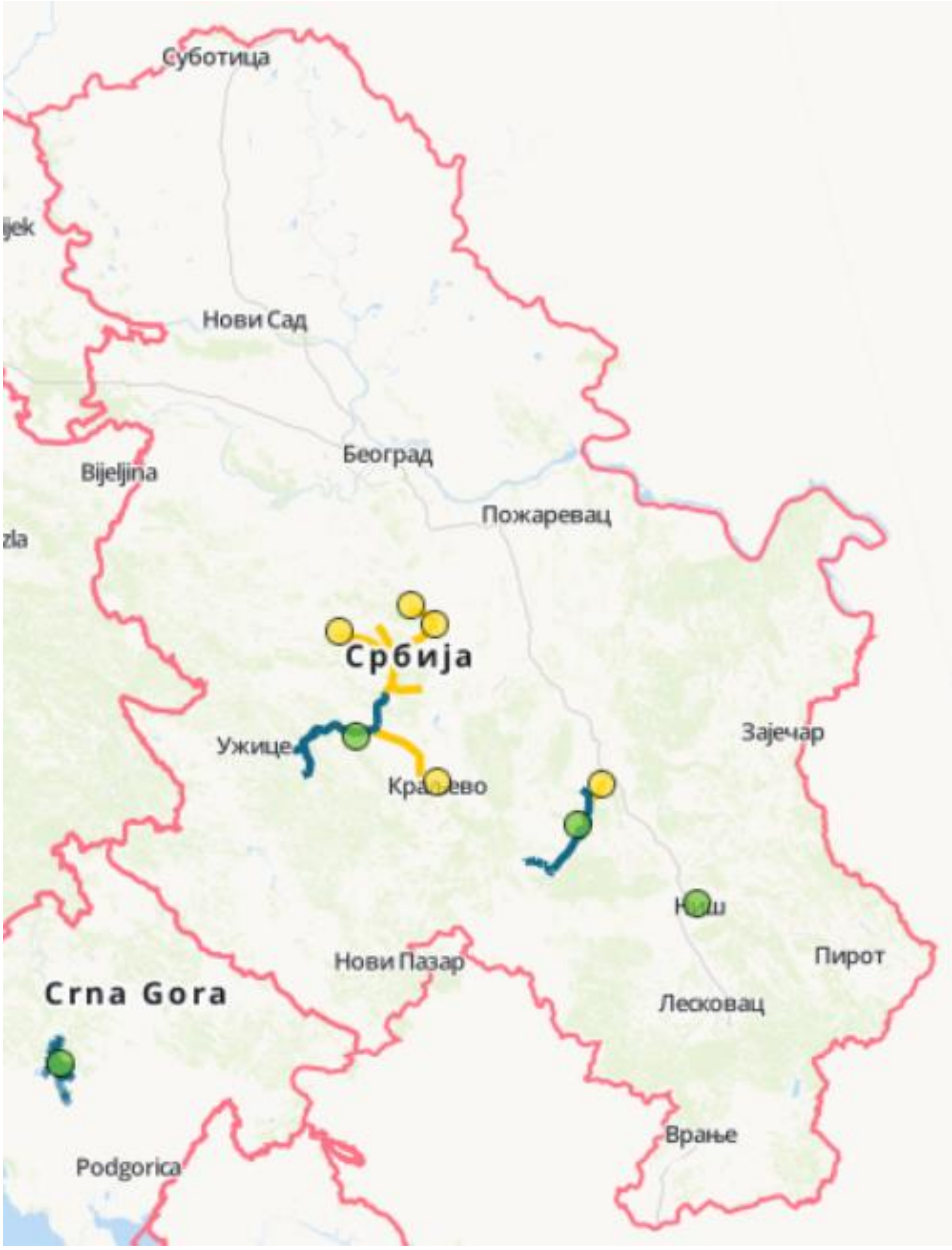

Figure 8: CRWSS in Serbia.

2.3.2.1 Cross – Regional WSS Rzav

Existing Rzav Cross - Regional Water Supply System today includes a water intake on the Rzav River, a raw water pipeline to a water treatment plant (WTP), a WTP – capacity 1.200 l/s, and a 1.200 l/s water main to the water reservoirs of 5 current users – the municipalities of Arilje, Požega, Lučani, Čačak and Gornji Milanovac.

The current Rzav CRWSS provides drinking water supply to 5 municipalities:

1. Arilje, Požega, Lučani and Čačak since 1993, and
2. Gornji Milanovac since 1996.

The construction project is divided into two phases. **Phase 1** has been completed; its total drinking water treatment and distribution capacity is 1.200 l/s. It should be noted that the water main from Kratovska Stena to Čačak and Gornji Milanovac and all branches to the serviced towns have already been constructed for the ultimate capacity of 1550 l/s. Completion of **Phase 2** of the project would result in a total treatment and distribution capacity of 2.300 l/s.

A temporary solution, prior to the erection of a dam, is to collect water from the main stream of the Rzav River at an existing check dam in Ševelj. Following treatment at the WTP in Arilje, water is distributed to the various municipalities. At this stage, the rate of raw water withdrawal is Q_{av}=550 l/s, or Q_{max}=750 l/s. The amount of delivered (invoiced) water is Q_{av}=530 l/s, or Q_{max}=700 l/s (or roughly half the capacity of the already constructed water treatment and distribution facilities), while the total current capacity of the water intake, including pump station and transformer station (based on existing pump units), is 840 l/s.

Further development includes the erection of the Svračkovo Dam on the Rzav River near Arilje (reviewed detail design available), and the construction of water mains and reservoirs (feasibility study of further development prepared), from Gornji Milanovac via Mt. Rudnik to Topola, Arandjelovac and Ljig, and from Čačak via Mrčajevci to Kraljevo.

Results to be achieved for the investment

A long-term solution would be provided for some 70.000 inhabitants who currently do not have access to public water supply, and for 250.000 inhabitants who are experiencing various degrees of water supply restrictions. The potential capacity of the system is roughly 1,5 m^3/s or, with relatively minor add-ons, greater than 2 m^3/s.

Strategic justification

The project is consistent with the National Water Strategy (Water Master Plan).

Additional comments on the project

The timeframe depends on the sources of funding. If well organized, the project could be completed within no more than 7 years.

Potential risks are related to negotiations between current and new user municipalities in the financing area, and to a lesser extent in the water distribution area. Other details are included in the description.

Estimated Budget:

Dam + new distribution: 70 + 40 = 110 x 10^6 €

2.3.2.2 Cross – Regional WSS Kruševac

More intensive urban development of water supply system for the Municipality of Kruševac has started in mid 1950s. At that time, the designed capacity of water supply system was 104 l/s, foreseen for meeting the needs of approximately 40.000 inhabitants. The system was consisted of two groups of wells at the River Zapadna Morava bank area, pumping station "Čitluk", main pressurized - distributive pipeline with 300 and 400 mm in diameter, distributive water supply network in diameter range 80 to 200 mm, and the water tank on Bagdala hill, with the volume of 2.800 m^3 and overflow level at 212 m above the sea level.

Increasing water consumption, due to rapid population and industry growth, especially in the city area, caused the need for water sources capacity extension, starting from the mid-1960s. In early 1980s, long term plans and orientation regarding water supply issue, had been redirected towards the "Ćeliije" accumulation and water treatment plant (WTP) "Majdevo".

Until 1984, the construction of: "Ćelije" dam, pipeline connecting dam and WTP "Majdevo", WTP "Majdevo" with the capacity of 650 l/s and pipeline connecting WTP with "Bagdala" reservoir, have been finished. Since then, water supply has been carrying out from this direction.

Raw water pipeline, connecting "Ćelije" accumulation with WTP "Majdevo", is 3.400 m long, with internal diameter of 1.014 mm and designed maximal flow of 1.180 l/s for the water level in accumulation of 263 m above the sea level. Treated water pipeline is about 20.400 m long with internal diameter of 1042 mm. Before the "Bagdala" reservoir has been connected to the system, a measuring and control unit for the regulation of whole water supply system has been installed on the pipeline. At the same point, a branch of the pipeline for Varvarin and Ćićevac settlements water supply was placed as well. Altitude of WTP "Majdevo" allows gravity flow of treated water to its consumers. Within WTP "Majdevo" facilities a pumping station connected with pressurized pipeline for Aleksandrovac Municipality water supply has been built. Recently, at "Bagdala" reservoir location, a new reservoir chamber has been built, increasing the total efficient reservoir volume to 8.600 m^3.

According to the long term development program of the City of Kruševac, the connection of almost all surrounding villages to the water supply system of WTP "Majdevo", have been planned. Also, local government set the decision about water supply of following Municipalities: Aleksandrovac, Ćićevac, Varvarin and a part of Trstenik Municipality with water from "Ćelije" and WTP "Majdevo" system.

The above mentioned facts caused a need for WTP capacity upgrading. Between the year of 1995 and 2000, preparation activities regarding the extension of existing plant have been conducted, bringing up the conclusion that the existing capacity should be increased from

650 l/s to 950 l/s, and water treatment process improved, in order to reach better potable water quality.

With the support of EU funds, during the year of 2010, the realization of project “Reconstruction and extension of water treatment plant “Majdevo” has begun. The construction works finished in 2013, while in June 2014, technical inspection with the affirmative Commission Report obtaining has been conducted as well. The plant operates in line with the new-designed criteria and innovated technological process.

At this period WTP “Majdevo” supplies the City of Krusevac and 75 local villages (out of 101) with potable water, which makes the total number of 107.000 inhabitants, i.e. 85 % of the population. The total length of the water supply network amounts cca 750 km, with about 29.000 connections.

Also, the biggest part of Aleksandrovac Municipality is connected to the system together with three settlements in Trstenik Municipality.

The construction of main pipelines with the belonging facilities towards the Ćićevac and Varvarin Municipalities, was finished, and the connection of these Municipalities to the water supply system is expected to be achieved until the end of 2014.

2.3.2.3 Cross – Regional WSS Niš

Three water supply systems provide water to city Niš:

1. WSS Mediana (the source of groundwater bed previously purified water from watercourses Nisava, capacity 100-500 l / s),
2. WSS Studena (karst natural source of supply and pipeline facilities with a capacity of 220 to 340 l /s) and
3. WSS Ljuberđa – Niš (a series karst natural resources (Krupac, Wet, Divljan and Ljuberađa) and supply pipeline with facilities, capacities from 800 to 1.450 l/s).

They supply water to about 240.000 people and Nis industry, with the amount of 37.732.608 m^3 / year or 103.377 m^3 / day. The functioning of WSS is reliable and stable, and there is a high level of water quality control.

2.3.3 Italy

For Marche Centro in Macerata (Italy) data was received for 6 active CRWSS (Figure 9).

Figure 9: CRWSS in Macerata (Italy).

2.3.3.1 Cross – Regional WSS: from Cingoli to Camerano

The cross-regional WSS was built in 1985-1987 and is operated by ACQUAMBIENTE Marche Srl, one of the utilities responsible for water systems management in ATO 3 area of interest. It is a 60 km long steel pipe, diameters ranging between 800 and 300 mm, operating by gravity from Castreccioni Treatment Plant (Cingoli) to the coast. The water delivered is abstracted by Castreccioni artificial lake (el. 340 m above sea level, maximum capacity 55 million m^3). Maximum flow rate is 500 l/s.

The cross-regional WSS data was provided by project partner in requested timeframe.

2.3.3.2 Cross – Regional WSS: from Sefro to Matelica

The cross-regional WSS was built at the end of ‘60s and is operated by A.S.SE.M. Spa, one of the utilities responsible for water systems management in ATO 3 area of interest. It is a 25 km long steel pipe, with a diameter of 250 mm, operating by gravity from the San Giovanni

Source (spring). Maximum flow rate is around 50 l/s, but according to some recent (and less recent) hydrogeological studies the WSS in use could provide up to 90 l/s.

The cross-regional WSS data was provided by project partner in requested timeframe.

2.3.3.3 Cross – Regional WSS: from Montefortino, Sarnano to Montecosaro

The WSS, was built in the beginning of 1900 and renewed in '50s and '90s, is operated by Tennacola Spa (www.tennacola.it), water utility responsible for water systems management in ATO 4 area of interest; it is also delivering water to Montecosaro (ATO 3) since 2002.

The cross-regional WSS data was provided by project partner in requested timeframe.

2.3.3.4 Cross – Regional WSS: from Montefortino, Sarnano to Civitanova Marche

The system has been operating since 1997. General nature is permanent water supply from the sources (springs and wells) located in Montefortino and Sarnano to Civitanova Marche. Current amount of water provided by the Supplier is 70 l/s, but in the next step the amount will be increased up to 100 l/s.

The cross-regional WSS data was provided by project partner in requested timeframe.

2.3.3.5 Cross – Regional WSS: from Bolognola to San Ginesio

The WSS was built in the mid of '70s and is operated by a Consortium participated by 4 municipalities (Bolognola, Acquacanina, Cessapalombo, belonging to ATO 3, and San Ginesio, belonging to ATO 4). It is a 19 km long steel pipe, operating by gravity from a group of springs and a well, located in Bolognola (1200 m).

The cross-regional WSS data was provided by project partner in requested timeframe.

2.3.3.6 Cross – Regional WSS Venice

For Veneto Region in Italy data was received for 1 active CRWSS (Figure 10).

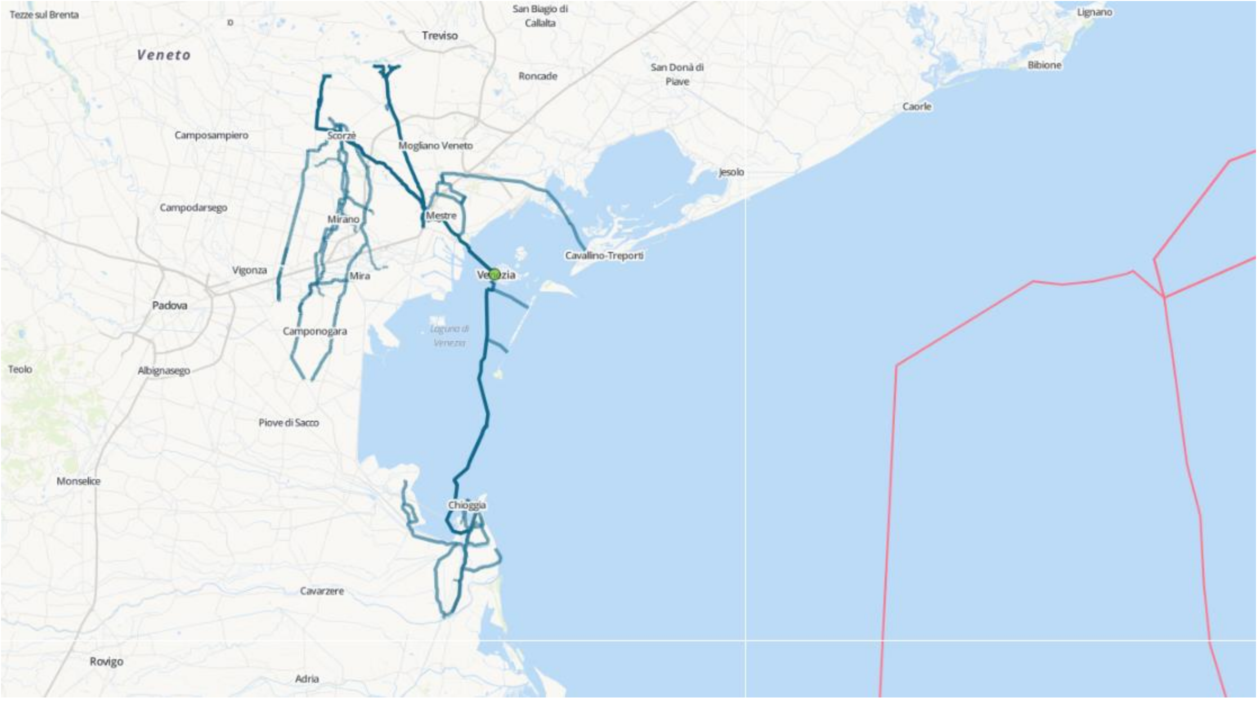

Figure 10: CRWSS in Veneto Region (Italy).

Description of Veritas

Veritas, is a Stock Company, entirely owned by Councils of Venezia, Chioggia, Mira, Mirano, Spinea, Martellago, Dolo, Scorzè, Noale, Santa Maria di Sala, Salzano, Cavallino-Treporti, Meolo, Camponogara, Campolongo Maggiore, Pianiga, Vigonovo, Stra, Campagna Lupia, Fiesso D'Artico, Fossò, Marcon, Quarto D'Altino, Cavarzere, San Donà di Piave, Mogliano Veneto, Morgano, Preganziol, Quinto di Treviso, Zero Branco, Annone Veneto, Caorle, Cinto Caomaggiore, Concordia Sagittaria, Fossalta di Portogruaro, Gruaro, Portogruaro, Pramaggiore, San Michele al Tagliamento, San Stino di Livenza, Teglio Veneto, with a population of 750,000 residents (over 80% in the province of Venice - 20% of the Veneto population), and more than 23 million tourists who visit Venice, Lido and the surrounding areas each year.

The company has its head office in Venice and several offices in Mestre, Chioggia, Dolo and Mogliano Veneto.

Services provided by Veritas:

Water: the company manages water cycle (drawing, pumping stations, treatments and distribution) for industrial and civil use, waste water treatment plants, industrial and civil sewers.

Energy: Veritas is improving its know-how in energy management and energy production with renewable energy (solar, biomasses, etc.). Veritas sells natural gas and energy to industry, little and medium company, public offices, flats and houses.

Waste: Veritas manages solid waste cycle, from waste collection to treatment and, through his controlled company Ecoprogetto, manages plants as: RDF Production plants, recycling, recovery and disposal. Fusina site is one of the biggest treatment sites in Europe (as treated quantity and capability).

Urban services: Veritas manages also cemetery services, wholesale markets, environmental remediation, green area services, renewable energy plants, and other like runway for high tides, snow cleaning, fire hydrant, etc.,

About water supply system, sewage and waste water treatment

Veritas manages water production plants and wells areas and delivers water using over 3.600 km of potable water pipes. Veritas manages 5 large waste water treatment plants, 4 smaller WWTP in Treviso area and several smaller plants in Venice area. Veritas has an internal chemical and biological laboratory (Certificated by ACCREDIA - UNI CEI EN ISO/IEC 17025) and Veritas Drinking water is one of the best quality waters in Italy.

Drinking water is controlled several times a day, analysing 10.000 samples /year and 200.000 parameters, samples are collected and analysed from wells to piping and pumping station, also with continuous monitoring systems.

Water quality is also controlled by Arpav (regional environmental protection agency) and Usl (health service).Veritas created a web site entirely dedicated to drinking water: www.acquaveritas.it, where citizens can find water quality analyses, costs and other useful information.

About WSS in Veneto region

The local Authority for Integrated Urban Water Management planning and control, since 15/01/2013, is the “Consiglio di Bacino Laguna di Venezia” (from Regional Law n. 17 issued in 27.04.2012 "*Provisions concerning the water resources*"), founded in July 1998 as “Autorità d'Ambito Territoriale Ottimale Laguna di Venezia” (ATO Laguna di Venezia).

As defined by Italian Decree n. 152/2006, the “Consiglio di Bacino” plans and controls integrated Urban Water Management for 36 municipalities in the Venezia and Treviso Provinces.

The district has 1.866 Km^2 area and 790.000 inhabitants, the management companies are VERITAS S.p.A. and ASI S.p.A.

Since 2012, due to the decree n. 201/11 (art. 21, comma 19), the Italian Authority for Integrated Urban Water Management regulation and control is the “Autorità per l'Energia Elettrica e il Gas (AEEG)”.

AEGG defines eligible costs and criteria for rates determination.

The resolution n. 643/2013/R/idr issued in 27 December 2013, defines the method for rate calculation (Metodo Tariffario Idrico – MTI) for both 2014 and 2015.

Rates (and investments plan) provided by companies which are in charge of Integrated Urban Water Management, are subject to a double check for approval: first level is Consiglio di Bacino, second and final level is AEEG.

2.4 Collaboration with partners

With the collection of the information on the cross-border and cross regional water supply systems it became very soon evident that it will not be a completely straightforward task. While on one hand it is quite clear that the requested information is of public nature and therefore there should not be any limitations it became quite clear that this is not completely the situation. The main reason is probably the fact that there was no request on the systematic collection of the data that are descriptive enough to give a clear insight on different (technical, economic and legal) aspects of the CB WSS until the DRINKADRIA project.

Most partners had problems with following types of data:

(1) spatial data (GIS). Some water supply systems are very old and aren't in any evidence or data digitalised yet,
(2) payment statistics for last 5 years (what was the price and the quantity of the water sold per),
(3) with scanned documents (legislation, contracts, annexes). In most cases legislation on national level exists and also contracts between WSS that delivers water and WSS that buys water. Contracts that are signed are different from case to case and will be analysed in next activity.

The table 1 shows a general overview on the status of the cross-border water supply system reporting by the partners of DRINKADRIA project (status by June 27th 2014).

Table 1: Problem of acquiring data (analysis as per June 27th 2014)

Legend:

(green)	All the requested information on CB WSS was submitted
(yellow)	Partially submitted information on CB WSS
(red)	Limited or no information submitted

Project Partner		Questionnaire	SHP/DWG of network	Annexes	Payment statistics for 5 years
LP	Area Council for Eastern Integrated Water Service of Trieste (CATO)				
FB1	VERITAS Joint Stock Company – Multiutility Water Service of Venice				
FB2	OPTIMAL TERRITORIAL AREA AUTHORITY N.3 MARCHE CENTRO-MACERATA				
FB4	Water Utility of Nova Gorica – Sector of Development and Investment				
FB7	Water utility of Istria – Team for installation remote reading system for water meters				
FB8	University of Rijeka – Faculty of Civil Engineering				
FB9	Croatian Geological Survey – Department of hydrogeology and engineering geology				
FB10	Institute for Development of Water Resources 'Jaroslav Černi' – The Department of Water Supply, Sewerage, AND Water Protection				
FB11	Water Supply and Sewerage Association of Albania				
FB12	Hydro-Engineering Institute of Sarajevo Faculty of Civil Engineering				
FB13	P. C. UTILITY NEUM				
FB14	Public utility 'Vodovod i kanalizacija' Niksic – Technical Department				
FB15	Region of Ionian Islands – Directorate of Developmental Programming				

2.5 Conclusions

It was discovered that CBWSS is very common in most involved countries.

An overview of all reported CB WSS is displayed in Table 2. CB WSS are divided into three categories:

1.) Active WSS – it is currently operating.
2.) Inactive WSS – it was operating in the past.
3.) Potential WSS – agreements are being signed or WSS is the phase of construction.

Table 2: Table of CBWSS reported by project partners.

CBWSS	***Active WSS***	***Inactive WSS***	***Potential WSS***
SLO-IT	4	2	2
SLO-CRO	7	2	5
CRO-BIH	6	0	0
CRO-MNG	1	0	0
ALB-GRC	0	0	1
ALB-ITA	0	0	1

Four project partners have reported that they have either active or potential CRWSS (Table 3).

Table 3: Table of CRWSS reported by project partners.

CRWSS	***Active WSS***	***Inactive WSS***	***Potential WSS***
Serbia	3	0	5
Albania	1	0	1
Italy (FB1)	1	0	0
Italy (FB2)	5	0	0

Positive experiences described by partners:

(1) A CBWSS can be used as a more cost efficient solution for covering water supply in remote areas (e.g. Golo Brdo in Slovenia is covered by Italian WSS Iris Acqua).

(2) Due to redundancy of water sources a CBWSS can be used as a reliable source in case of emergency (hydrological draught, pollution of water source…).

(3) A guaranteed source of water in case that water source is insufficient (Ura Vajgurore WSS).

Negative experiences described by partners:

(1) payment discipline can be worse due to cross country relations.

(2) water extraction is lower than contracted (oversized WSS, problem with maintenance (WSS Josip Jović)).

(3) Some WSSs were separated into two parts after breakup of Yugoslavia - for some is doesn't exist even a concession for a water source, contracts, there is a problem of heritage or even the price for water is not defined (example: Metković WSS, Kuželj WSS).

(4) High administrative and technical losses (example: Berat Kucevo WSS has them from 70 -80%) – in this extreme situation an intermittent supply was introduced.

3 Analysis of present and elaboration of scenarios for future drinking water demand

Water demand trends are playing one of key roles in long term planning of WSS development. The trends depend on multiple factors that include: growth/decline of population, growth/decline of tourism (there is an issue with the seasonal dynamics of water supply during the peak summer season), growth/decline of industry and growth/decline of agriculture.

The development of the agriculture can deeply affect the water demand due the specifics of the crops and country climate (the need for irrigation).

3.1 The World

The historical development of the cross border water supply system is essential, because it shall probably mirror the situation of the identified cross-border water supply systems and recognized issues hindering their efficient and effective operation. At the first step it is also used for the evaluation of the current and future water demand.

Table 4: Current and future water demand - examples from world

Country	Present water demand	Future scenario	Reasons
China	Current supply amounts to just over 618 billion m^3	By 2030 is expected to reach 818 billion m^3	Population growth (by 2040 they expect 16% increase from current levels because of additional people), urbanization (increase in domestic water demand could be bigger by 50%, there will be big need for recycling techniques of domestic water), income growth, industry (industrial water demand has grown on annual rate by 6%, trends are it will grow at least until 2025) (Upali et. al., 2005; WRG2030, 2009)
India	Current water supply is approximately 740 billion m^3.	By 2030, demand in India will grow to almost 1.5 trillion m^3	Population growth, urban development, growing industries and food production (WRG2030, 2009; SaciWATERs, 2013)

São Paulo state	Current accessible, reliable water supply is 18.7 billion m^3.	Projected water demand until 2030 is around 20.2 billion m^3 – it will require that water will be transferred from neighbouring basins.	Agriculture requirements, population and industrial growth (WRG2030, 2009).
South Africa	Current water supply in South Africa amounts to 15 billion m^3.	Demand in South Africa is projected at 17.7 billion m^3 in 2030.	Population growth, power generation and other industry, growing urban centres (WRG2030, 2009).

3.2 Europe

Table 5 displays analysis of present water demand in Europe. Analysis was limited to countries in Adriatic Area (there was no fresh data available for Albania, Italy and Montenegro).

Table 5: Water use by economic sector and public water supply in Europe, 2014

Country	Present water demand [million m^3]	Future scenario	Reasons
Greece	1009,9 *	Trends for Europe show that water demand is in trend of decrease in many addressed countries.	Large population growth it is not expected. There is also a decline of water-intensive industries (e.g. mining, steel) and more efficient irrigation techniques are used. A trend of increased use of cleaner production technologies and reduced losses in pipe networks is being detected.
Slovenia	157,2 *		
BiH	186,6 *		
Serbia	594,4 *		
Croatia	398,19 *		

* Water Statistics Europe (Eurostat, 2014)

3.3 CB/CRWSS in Adriatic Region

Some partners in DRINKADRIA project have already done studies on future water demand for their WSS.

Table 6 displays analysis of present water demand and also provides guidelines for developing more complex cross border/ cross regional scenarios of future water demand.

Table 6: Present and future analysis of water demand (all data was provided by project partners in DRINKADRIA project in 2014)

Cross-border/ cross-regional	Name of WSS	Present scenario	Future scenario
Cross-border	from Mrzlek (Slovenia) to Gorizia (Italy)	It is agreed that yearly supplied amount of water is 2.000.000 m^3.	No changes are currently foreseen.
Cross-border	from Trieste (Italy) to Sežana (Slovenia)	Currently there is continuous supply of a yearly maximum quantity of 1,2 Mm^3 with instant maximum flow rate of 150 m^3/hour.	Currently water supply of drinking water exists between Trieste and Sežana. In the future Trieste is planning to improve the principal aspects of alignment with the Italian and European standards, one of important aims is a revision of water tariff. Sežana is showing interest for expansion of the water supply. Trieste considers this as an opportunity for a potential new connection to Koper. Main reason is a lack of water in Koper during summer season.
Cross-border	from Albana (Italy) to Golo Brdo (Slovenia)	Currently amount of water that is delivered is around 2.000 m^3/year.	No changes are currently foreseen.

Cross-border	from Buzet (Croatia) to Koper (Slovenia)	Minimal amount of water that is supplied is 500.000 m^3/year and maximum is set at 150 l/s.	
Cross-border	from Atomske toplice (Slovenia) to Luke poljanske (Croatia)	20-30 houses are currently supplied.	
Cross-border	from Ilirska Bistrica (Slovenia) to Starod (Slovenia), Šapjane (Croatia), Jelšane (Slovenia), Klana (Croatia), Mučići (Croatia), Matulji (Croatia)	Minimum of supplied water is set at 24.5 l/s from Slovenia to Croatia (according to Contract from 1972).	Water demand will stay the same or decrease. Main reason: they think water is too expensive. This indicates that they are not interested in buying more water. In May 2014 came to overturning point since WSS Ilirska Bistrica has dropped their price for water from 2 €/m^3 to 0,5 €/m^3.
Cross-border	Čakovec (Croatia) – Ormož (Slovenia)	Currently doesn't exist.	It is possible to supply water to Slovenia from Croatia. Reason: Komunalno podjetje Ormož purifies water from water wells Mihovci with special procedure. It is extremely demanding and expensive purification process. On the other side, drinking water from water wells Nedelišće (in Međimurje, CRO) is not purified, but only preventively treated with chlorine, for health correctness during flow through pipelines.

Cross-border	Neum (Bosnia and Herzegovina) – Dubrovačko Primorje (Croatia)	Minimal water consumption is 15 l/s.	Water supply is decreasing.
Cross-border	Tomislavgrad (Bosnia and Herzegovina) – Imotski (Croatia)	Agreement was signed but amount of water that is currently being delivered is only 3 l/s.	The agreed amount is 50 l/s. It will be delivered after concession will be provided.
Cross-border	from Vrgorac (Croatia) to Ljubuški (Bosnia and Herzegovina)	Amount of water that was set in agreement is 20 l/s or 200.000 m^3/year.	
Cross-border	from Imotski (Croatia) to Drinovačko Brdo and Puteševica (Bosnia and Herzegovina)	Agreed amount of delivered water is 5 l/s (50.000 m^3/year).	
Cross-border	from Posusje (Bosnia and Herzegovina) to Imotski (Croatia)	Amount of water that is currently being supplied is 20 l/s.	
Cross-border	from Doljani (Bosnia and Herzegovina) to Metković (Croatia)	Currently is being delivered approximately 60 l / s or 1,870,000.00 m^3 / year	

Cross-border	from Bileća Lake (Bosnia and Herzegovina) through Konavle (Croatia) to Herceg Novi (Montenegro)	At the peak of tourist season, at least 450 l/s.	
Cross-regional	Berat – Kucove	Average amount of water that is being delivered is 540 l/s.	
Cross-regional	Rzav	The amount of delivered (invoiced) water is Q_{av}=530 l/s or it is possibility of Q_{max}=700 l/s.	
Cross-regional	from Cingoli to Camerano	Maximum flow rate is 35 l/s, min. 18 l/s.	35-40 l/s (1 Million cubic meter of water per year). Reason: Meeting drinking water demand.
Cross-regional	from Sefro to Matelica	Average flow rate is around 2 l/s.	
Cross-regional	from Montefortino, Sarnano to Montecosaro	Average water supply is 15 l/s (about 480.000 m^3/year), maximum water supply is 20 l/s and minimal is set at 13 l/s.	

Cross-regional	from Montefortino, Sarnano to Civitanova Marche	Current amount of water provided by the supplier is 70 l/s.	In the next step the amount of water will be increased up to 100 l/s. Reason: Meeting drinking water demand, also assuring good quality water delivery.
Cross-regional	from Bolognola to San Ginesio	Water supplied: 14 - 22 l/s.	

3.4 Conclusions

Water demand scenarios differ greatly from country to country. In developing countries in the world is most common response to increase demand for water ‘supply-side’ (they meet the demand with finding new resources). In developed countries it is more typical ‘demand-side’ oriented – they try to manage consumptive demand itself to postpone or avoid the need to develop new resources (Butler and Memon, 2006).

The trends in Europe show a gradual reduction of water consumption. Main reasons are:

(4) large population growth it is not expected,
(5) water-intensive industries (e.g. mining, steel) are in declination,
(6) more efficient irrigation techniques are used and
(7) reduction of losses in pipe networks.

On the other hands the developing countries (China, India, Pakistan, South Africa, …) all show trends of increasing water consumption. Reasons are the exactly opposite:

(1) large growth of population is expected (consequently this means more household connections),
(2) increased food production (and implementation of poor irrigation techniques),
(3) development of industry which is a large consumer of water,
(4) most countries in development do not show interest in more effective water supply management and recycling techniques for already used water (this usually means higher financial input).

4 Comparative study of the situation in the world experiences in comparable situations

Guidelines for development of framework for the systematic analysis of the experiences in the comparable water supply systems are presented. Some guidelines were set for identification of markers for meaning ‘comparable situations’. A list of criteria that should be taken into account regarding the approach towards the contractual procedures was for CBWSS is presented:

1. Number of population that water is supplied to – in the case of extremely small water supply systems (i.e. supplying up to 100 inhabitants the legal documents are extremely simplified) (1.3 CB WSS from Albana (Italy) to Golo Brdo (Slovenia)).
2. State of infrastructure (in case of some cross-border water supply systems we can identify the system as heavily degraded and in a need for significant reconstruction. This could be considered also as a re-building of the system. WSSs in such a condition are not in the position to approach a really well managed cross-border water supply, but should be first reconstructed to the technically satisfactory level. (2.5 CB WSS from Brest (Croatia) to train station Rakitovec (Slovenia), 3.1 CB WSS Neum (Bosnia and Herzegovina)).
3. Financial sustainability of WSS & Financial resources reserved for maintenance - General framework of the national and cross-border water supply systems heavily depends on the adequate pricing mechanisms enabling long term the operation and management of WSS. In the case that the pricing mechanism is regulated and does not enable adequate O&M this is a serious issue on the national level, but perhaps even more challenging in the case of CB-WSS.
4. Significance of impact of tourism, industry and agriculture - Some water supply systems have serious seasonal fluctuations of the water demand. The issue could be resolved also by the cross border connection of water supply (2.1 CB WSS from Buzet (Croatia) to Koper (Slovenia), 3.1 CB WSS Neum (Bosnia and Herzegovina), 1.1 Cross – Regional WSS Berat – Kucove).
5. Long term programming of WSS in cross-border context – the WSS should enable and support the water demand in long-term planning period. The long-term planning period is not in the management procedures for any of the analysed CB WSS, and this might be especially one of the outcomes of the DRINKADRIA project.

A list of criteria that should be taken into account regarding the approach towards the contractual procedures was for cross-river problems:

1. Abundance of water resources in the case of extremely abundant water resources (i.e. Bihačko jezero) the details related to the amount of water supplied, its limitations

are often not elaborated to the adequate level. (2.1 CB WSS from Buzet (Croatia) to Koper (Slovenia), 4.1 CB WSS from Bileća Lake (Bosnia and Herzegovina) through Konavle (Croatia) to Herceg Novi (Montenegro))

2. Significance of impact of tourism, industry and agriculture - Some water supply systems have serious seasonal fluctuations of the water demand. The issue could be resolved also by the cross border connection of water supply (2.1 CB WSS from Buzet (Croatia) to Koper (Slovenia), 3.1 CB WSS Neum (Bosnia and Herzegovina), 1.1 Cross – Regional WSS Berat – Kucove).
3. Long term programming of WSS in cross-border context – the WSS should enable and support the water demand in long-term planning period. The long-term planning period is not in the management procedures for any of the analysed CB WSS, and this might be especially one of the outcomes of the DRINKADRIA project.

These criteria should be considered for further analysis of CBWSS and cross-river disputes should be made.

4.1 Identified international cross-border water supply

Several cases of cross-border have been identified and will be presented in this chapter.

4.1.1 Kuwait / Iraq

In 2003 a water pipeline was opened to southern Iraq to port city of Umm Qasr and nearby Umm Kayy. New cross- border WSS connection presented only source of potable water at that time (Society Guardian, 2003).

4.1.2 Djibouti / Ethiopia

In January 2013 there was signed an Agreement between Ethiopia and Djibouti. Djibouti will construct a pipeline to carry water from the Ethiopian town of Hadagala 70 kilometres to the Guelileh border crossing, then all the way to Djibouti City (Sahabi, 2013).

4.1.3 Turkey / Cyprus

The construction of a water pipeline between Turkey and the Turkish Republic of Northern Cyprus (TRNC) has been 55% complete. This 80 km long pipeline will provide a solution to the island's age-old water crisis (WorldBulletin, 2014).

4.1.4 Istrael / Palestinians

Water Transfers between Israel and the West Bank are agreed as following: Israel supplies 30 million m^3/year of water to the Palestinians in the West Bank from within its territory (within the "Green Line"). In no case does Israel transfer water from the West Bank to areas inside the "Green Line". Israel claims that they are meeting all obligations that were set for them in Water Agreement. They even claim that in terms of the additional quantities of water to the Palestinians, they have even exceeded the requirements. Israel complains that are Palestinians breaching Water Agreement in two important points:

1. Drilling of unauthorized wells and consequently they steal even higher amounts of water from them.
2. Failure to treat wastewater – consequently they are contaminating the environment and the ground water.

And that presents problem for them because Israel is compelled to supply even larger amount of water than it was agreed with Water Agreement (WaterAuthority, 2009).

One very specific chapter are water supply systems in Gaza that is currently a warzone (IsraelGazaConflict, 2014). Agreement on the Gaza Strip and the Jericho Area, 1994 – "Cairo Agreement" relates to the question of water in the Gaza region. In the framework of agreement implementation, control over the water supply system in the Gaza Strip was transferred to the Palestinians, who assumed responsibility for management, development and maintenance of the water supply and sewerage systems. Not included were Israeli communities, mainly Gush Katif, where the wells, piping and storage reservoirs remained under Israeli ownership. In 2005, as part of Israel's disengagement from Gaza, water supply systems that had served the Israeli communities, including 25 wells, storage reservoirs and a well-developed transmission system, were also transferred to the Palestinians. At the end of the process, all water supply and sewerage systems in the Gaza Strip were under exclusive Palestinian control (Water Authority, 2009).

4.1.5 Malaysia / Singapore

Singapore is depending on cross border water supply from Malasya for nearly 40 % or more. Problems have started after 1965 when Malaysia and Singapore have been separated. On several occasions when it came to disagreements and tensions there have been threats of cutting of water supply (Kog, 2002; Long, 2002; Tan, 1997, 2001). Detailed description of this area has provided Long (2001).

Several issues are tied together with water. They are:

1. the use of Malaysian airspace by Singapore's air force,
2. the withdrawal of Central Provident Funds (CPF) by West Malaysians,
3. the location of Malaysia's customs, immigration and quarantine facilities,
4. the development of the Malayan Railway land in Singapore,
5. construction of a bridge to replace the present causeway.

They have tried to resolve these points together with price of raw water. Malaysian government believes that Singapore is paying too low price for water. Instead of solely negotiating on a price agreeable to both countries, Singapore and Malaysia are now also disputing over the right to revise the price of water, given that the package approach has been unilaterally disbanded by Malaysia. In addition, Malaysia not only wants to revise the price of water in 2002, but to backdate this price to 1986 and 1987. Singapore, in turn, will only allow Malaysia to revise prices now if it agrees to continue supplying water to the Republic after 2061. Any future negotiation on the water issue has currently ended on a rather bleak note, with Malaysia now stating that it may be resorting to national laws rather than arbitration to resolve the current impasse, something which was mooted in October.

Several issues now stand out and may need to be resolved in a sequential manner:

1. that of coming to an agreement by Singapore that the current price of water can be reviewed and backdated, given Malaysia’s changed stance that future water negotiations are to be decoupled from other bilateral issues;
2. if such an agreement cannot be reached, both countries have to start negotiations fresh by setting new terms and conditions for another round of water negotiations, or

resort to the Permanent Court of Arbitration for a resolution of the current deadlock on the right to revise the price of water and also to set a new price that is agreeable to both Malaysia and Singapore.

Because of these long-term ongoing negotiations with Malaysia, Singapore has been forced to try to find alternative water sources. One possibility is Indonesia (Onn, 2003). Singapore has also adopted an integrated and innovative approach to water management, which, together with careful planning and hard work for more than 40 years, enabled it to overcome water supply constraints and attain sustainable and cost-effective water management solutions (Chiplunkar, Seetharan and Tan, 2012).

4.1.6 Ghana / Togo

A memorandum of understanding was signed in 2013 between Ghana and Togo. Sogakope in the Volta Region will be the source of the supply and 17 communities along Volta Lake will benefit from this project (GhanaTogo, 2013). The Republics of Ghana and Togo have applied for Financing from the African Water Facility / African Development Bank (AWF/ADB) and from the African Legal Support Facility (ALSF) to finance the cost of services for the preparation of the Sogaokpe – Lome Trans boundary Water Supply Project (GPN, 2013).

4.1.7 Angola / Namibia

An interest was expressed to improve existing WSS between Angola and Namibia (Devex, 2007). In 2011 the project of trans-boundary water and sanitation project between Angola and Namibia has started. (ICP, 2011; CAI, 2012). The use of water in Namibia is regulated by South African legislation, the Water Act, 54 of 1956. Only one part could be applied to Namibia's specific case and as a result, this legislation is not considered to be suitable for regulation regarding, the utilisation of trans-boundary water resource management (Kunenerak, 2012).

4.1.8 Tajikistan, Kyrgyzstan / Uzbekistan, Turkmenistan, Kazakhstan

Tajikistan and Kyrgyzstan have been providing water to other three countries in Central Asia:

- Uzbekistan,
- Turkmenistan and
- Kazakhstan.

System had broken down by late 1990s. Ever since there have been severe political issues and disagreements between these countries. Some maintenance of existing WSS has been done, usually with donor aid. No large scale projects have been implemented, one of main reasons is widely spread corruption (CrisisGroup, 2002; CrisisGroup, 2014).

4.1.9 Tajikistan / Iran

An Agreement on water transportation was signed between Iran and Tajikistan in 2007. Very interesting point that is to be made is that there are at least two known countries (Iran and Kuwait) that have made offer to Tajikistan to exchange water for oil (EUdialogue, 2014).

4.2 Identified cross-river problems

Rivers are very important for area through which they flow. They were considered a bringer of life and prosperity. Because of their huge impact on agriculture and tourism they are very often also a reason for disputes between neighbouring countries.

4.2.1 Bulgaria / Greece: Nestos river

River Nestos runs through Bulgaria and Greece. It is the most important water resource for its region and has been the object of negotiations between Greece and Bulgaria for many years. Unfortunately its famous ecosystem is in danger because of the pollution caused by various human activities and the large-scale hydraulic works (dams) constructed along the river. The protection and management of Nestos waters are of great economic and ecological importance for both countries and should be based on a thorough environmental study carried out on a cross-country level (Papachristou, E., Efthymios, D. and Bellou, A., 2001).

Despite earlier agreements, Bulgaria has in the past withheld water for increased agricultural and industrial needs. Since 1975 the Nestos flow has declined from 1500 million m^3 to 600 million m^3 resulting in repeated Greek protests. A series of negotiations did not result in agreement and failure to resolve the situation resulted in conflicts between the two countries. Recently an agreement has been reached, but noticeable pollution from the Bulgarian part has raised the level of tension in a region of Greece highly dependent on irrigated agriculture and hydropower (Ganoulis, J., El Kolokytha, and Mylopoulos, Y., 2003).

4.2.2 Bulgaria / Greece: Strymon river

The situation is almost the same as in case of Nestos river (Kanakoudis-SK, 2014).

4.2.3 Greece / Albania: Aoos river

In the case of the Aoos River (between Greece and Albania) there have been protests from Albania regarding the construction of a large dam on the Greek side (Ganoulis, J., El Kolokytha, and Mylopoulos, Y.,2003).

4.2.4 Greece / FYROM: Vardar river

In the case of the Axios/Vardar River (between Greece and FYROM) the number of conflicts on water resources management issues has increased since 1965, due to intensive irrigation, plans for constructing new dams in FYROM, and the accelerating pollution of the river (Ganoulis, J., El Kolokytha, and Mylopoulos, Y. ,2003).

4.2.5 Greece / FYROM: Doiran Lake

Conflicts occurred mainly due to the irrational way the lake's waters were being managed by the two nations involved (Kanakoudis-SK, 2014).

4.2.6 Greece / Bulgaria / Turkey: Evros River and Ardas River

Evros is the biggest river in the area. Major political disputes over the years emerged. The basic problem are related to the way dams built on the upper flow of the river (Bulgaria) are being managed (when decided to let water go from the spillways then huge floods occur in the Greek part) (Kanakoudis-SK, 2014).

4.2.7 Greece / Albania/Bulgaria: Great Prespa lake

Conflicts occurred mainly due to the irrational way the lake's waters were being managed by all three nations involved (ZEC, 2004;Kanakoudis-SK, 2014).

4.2.8 Bosna and Herzegovina / Croatia: Neretva river

The plan for building the Hydro Power Plant Dabar has been part of a complex and old Yugoslavian project called 'Gornji Horizonti' (Upper Horizons) from 1950. Although it had never been built, it is now entering again the European scene. The original project, part of which is the HPP Dabar project, was reconsidered as Bosnia has faced growing demand for clean energy; however its economic viability is being criticized.

The construction of the HPP Dabar implies rerouting of the underground water from the catchment basins of the River Neretva to the basin of river Trebišnica in order to fill the reservoir.

The rerouting of water from the River Neretva basins represents a great threat to the Hutovo Blato Nature Park, one of the largest Ramsar habitats (7400 ha) of migratory birds in the Balkans, which could end up drying. It will also affect the Nature Park Neretva Delta in Croatia and more importantly reservoirs of fresh drinkable water and vast agricultural lands in lower Neretva valley, both in Bosnia and Herzegovina and Croatia (Klemenčič, M., 1994; Guo, R., 2007).

Moreover, the government of the Federation of Bosnia and Herzegovina entity has unveiled plans to build three more hydroelectric power plants with large dams (as over 150.5 meters in height) upstream from the existing plants, beginning with Glavaticevo Hydro Power Plant in the nearby Glavatičevo village, then going even more upstream Bjelimići Hydro Power Plant and Ljubuča Hydro Power Plant located near the villages with same names (DabarHPP, 2013; Vuković, M., 2008).

4.2.9 Egypt / Ethiopia: Nile river

The dispute between countries of the Nile Basin goes far back into the history. The newest is between Egypt and Ethiopia because of Ethiopian Grand Renaissance Dam project which was announced in 2011 (Brabeck, 2013). One of main problems is the double nature of the project: on the one hand the project promises abundant energy for Ethiopia, but on the other hand it presents potential crop failures, power cuts and political tumult for Egypt (Witte, 2013). Egypt is very dependant from water that comes from the Blue Nile – it supplies the Nile with about 85 % of its water. Also the population of Egypt is growing nearly 2% annually and the need for water is growing by every year. Some parts of Egypt are already facing water shortages and by building this dam it is expected to become even worse and political tensions in Egypt are rising (Al Jazeera, 2014).

4.2.10 India / Pakistan: Indus river

The Indus river has 5 main tributaries and Jhelum, that is the largest of these, originates in the Valley of Kashmir. In India there are also a lot of major inter-state river conflicts, for example on river Krishna, Godavari, Narmada, Vamasadhara, … Most conflicts are because of water for irrigation and hydropower (IRSAAXXII, 1992; GP, 1992; Mandhana, N., 2012; SaciWATERs, 2013).

4.2.11 Canada – USA: James Bay

New hydroelectric developments in James Bay, designed to supply clients in the north-eastern U.S., are threatening another large piece of aboriginal territory in northern Canada (Hornig, 1999; Schindler, D., W. and Hurley, A., 2004; Ma, J., Hipel, K. W. and Mitali, D. 2005; CBC-JB, 2014).

4.2.12 Canada – USA: St. Lawrence Great Lakes

The Great Lakes and St. Lawrence River are the world's single largest source of freshwater. They supply drinking water to 45 million people, and sustain half of U.S.-Canada trade. Most of Canada's manufacturing and 25% of its agriculture occur in the watershed of the Great Lakes. Ships transport $80 billion worth of goods annually through the lakes via the St. Lawrence Seaway. While the waters of the Great Lakes are vast, they are also heavily used. There is growing demand on the Ontario side of the Great Lakes, as the result of increased population and industrial growth. In particular, immigration from parts of the world where water is very scarce (Somalia, Sudan, China and India) is fuelling population growth in southern Ontario.The International Joint Commission has provided a mechanism for cooperative management of the St. Lawrence Great Lakes and other cross-border waters. The Great Lakes Water Quality Agreement and the Boundary Waters Treaty of 1909 are two binational agreements that have provided focus for IJC activity (Schindler, D., W. and Hurley, A., 2004).

The Great Lakes are a bi-national water bank of incalculable biological value and international significance. As such they contain 20 percent of the world's fresh water. Only the polar ice caps hold more blue gold. Although this percentage suggests incredible abundance, basic hydrology speaks otherwise. Only a small percentage of the Great Lake waters (approximately 1%) are renewable every year and this is what the region's residents have to use if they want to maintain water levels and their water-dependent economy (Nikiforuk, 2004). (Reinumagi, 2011)

4.2.13 Canada – USA: Lake Winnipeg

There is currently concern for the state of Lake Winnipeg, which is developing increasingly massive algal blooms. A large proportion of the nutrients causing this problem originate in the Red River drainage, which extends into the fertile farming country of the U.S. The cities of Fargo, Grand Forks, Moorhead and Winnipeg discharge sewage to the Red River, which drains to Lake Winnipeg. Also in North Dakota, the U.S. has recently decided to divert Devil's Lake into the Sheyenne River, a tributary to the Red River, in order to keep the lake from flooding surrounding lands. The U.S. Army Corps of Engineers has also proposed to connect Devil's Lake to the Missouri River, to stabilize and freshen the lake. This would connect the Mississippi-Missouri river system with the Nelson River, which drains Canadian waters from the Rockies to north-central Ontario (Schindler, D., W. and Hurley, A., 2004; Canada-Manitoba Memorandum, 2010; Skerritt, 2012).

4.2.14 Canada – USA: Souris River

Complex agreements exist for sharing the water of the Souris River, which flows from Saskatchewan to North Dakota, then to Manitoba. They have been renegotiated several times since the original agreement in 1958 (Schindler, D., W. and Hurley, A., 2004; Guo, R., 2007; Clancy, 2014).

4.2.15 Canada – USA: Milk and St. Mary's rivers

Farther west still, in arid southern Alberta and northern Montana, there is competition for the scarce waters of the Milk and St. Mary's rivers, a source for livestock and irrigation in both countries (SMRIDCA, 2014). A 1921 agreement apportioned the waters more or less equally between Alberta and Montana. However, Montana has recently asked the IJC to review the agreement, claiming that it should be entitled to more of the rivers' water, even though Montana's irrigation is the least efficient of any U.S. state. Following hearings in summer of 2003, the IJC must now decide whether Montana's complaint deserves further exploration (Schindler, D., W. and Hurley, A., 2004; Guo, R., 2007).

The International Joint Commission (IJC) was established with a purpose to prevent and resolve disputes between the United States of America and Canada under the 1909 Boundary Waters Treaty and pursues the common good of both countries as an independent and objective adviser to the two governments.

It is comprised of six commissioners – three appointed by the President of the United States, and confirmed by the U.S. Senate, and three appointed by the Canadian Governor-in-Council on advice of the Prime Minister.

The IJC investigates and provides advice on transboundary water and other environmental issues referred to it by the Canadian and U.S. governments; it rules upon applications for approval of projects affecting boundary and transboundary waters and may regulate the operation of these projects; in particular in this regard it oversees the apportionment of the St. Mary and Milk Rivers; and it alerts the governments to emerging issues along the boundary that may give rise to bilateral disputes.

Use of the St. Mary and Milk Rivers was one of the disputes that led to the negotiation of the 1909 Boundary Waters Treaty. Article VI of the treaty provides for apportionment of these two rivers to be made by two accredited officers – one Canadian and one American, under the direction of the IJC. Today, officials of the U.S. Geological Survey and the Water Survey Division of Environment Canada act as the Accredited Officers, reporting to the IJC on the measurement and allotment of St. Mary and Milk River water each year. The procedures now in use were established in 1921, under an Order issued by the IJC (referred to as the 1921 Order or the St. Mary-Milk Order).

In 2003, the State of Montana asked the IJC to reopen the order which provides the basis for the procedures used by the Accredited Officers to measure and apportion water from the two rivers in accordance with the 1921 Order, and determine whether or not the procedures need to be revised. The IJC was considering how to respond to that request. As part of that process, the IJC wanted to improve its understanding of current issues and concerns surrounding the use of St. Mary and Milk River water and because of that they held public consultations on the St. Mary and Milk Rivers in July 2004.

4.2.16 Canada – USA: British Columbia

In British Columbia, the Columbia River originates in Canada but eventually flows to the U.S. The 1964 Columbia River Treaty required Canada to build three dams on the upper Columbia to control flooding and maximize power production in the U.S. part of the watershed. Half the power generated was to have been Canada's. But the B.C. government negotiated a lump payment of $254 million instead. This sum did not even pay for dam construction. The anadromous salmon paths on the Canadian portion of the Columbia have been totally blocked by hydro dams. There was also considerable damage to Canadian agricultural lands, social disruption and forests, which were not considered in the treaty. It is critical that the Columbia River Treaty be revisited with a view to equalizing benefits (Schindler, D., W. and Hurley, A., 2004; Deborah, 2012).

4.2.17 Canada – USA: Passamaquoddy Bay

A group of Passamaquoddy Tribe members in Maine received in 2010 notice of an important decision by the United States Bureau of Indian Affairs (BIA) to cancel a long-term lease for the construction of a liquefied natural gas terminal on an area of Passamaquoddy land known as Split Rock. The decision represents a victory for both the group and the Passamaquoddy Tribe (Francis, 2010; Hoffner, 2011; LegislPassBay, 2012; Hollis, 2014).

4.3 Overview of all collected international water supply

Information about continuous water supply and long term planning is usually not known (exceptions: CBWSS Israel/Palestinians, CBWSS Malaysia/ Singapore). Information about water prices are known only for few water supply systems. An overview of all collected international water supply was made in Table 7.

Table 7: All collected international CBWSS

Countries	Status of CB WSS	Legal and regulatory framework (includes catchment management, protection and expansion of water sources)	Demand management (including water pricingand public education programs on water conservation)	Long term planning of water supply	Continuous/ intermittent water supply
Kuwait / Iraq	existing	unknown	unknown	unknown	unknown
Djibouti / Ethiopia	agreement signed	unknown	unknown	unknown	unknown
Turkey / Cyprus	being build	unknown	unknown	unknown	unknown
Israel / Palestinians	existing	existing, poor	unknown	doesn't exist	intermittent
Malaysia / Singapore (1)	existing	existing, efficient	efficient	it exists	continuous
Ghana / Togo	agreement signed	unknown	unknown	unknown	unknown
Angola / Namibia	existing	existing, poor	unknown	unknown	unknown
Tajikistan, Kyrgyzstan / Uzbekistan, Turkmenistan, Kazakhstan	existing	existing, poor	unknown	unknown	unknown
Tajikistan / Iran	agreement signed	unknown	unknown	unknown	unknown

(1) proposed as an example of good practice in the literature Chiplunkar, A., Seetharan, K. and Tan, C. K., 2012.

On the other hand cross-river problems are much better researched field in literature. A lot of research has already been done on this field. Most cases were collected for countries that are involved in DRINKADRIA project and other examples were examined on intentional scale (Table 8).

Table 8: All collected international cross-river problems

Countries	Case	Legislation	Problems	Dispoute resolution	Compliance & Monitoring	Dissolution & Termination
Bulgaria / Greece	Nestos river	Exists	Ecosystem is in danger because of the pollution caused by various human activities and the large-scale hydraulic works (dams) constructed along the river.	Unknown	Unknown	Unknown
	Strymon river	Exists	Ecosystem is in danger because of the pollution caused by various human activities and the large-scale hydraulic works (dams) constructed along the river.	Unknown	Unknown	Unknown
Greece / Albania	Aoos river	Exists	There have been protests from Albania regarding the construction of a large dam on the Greek side	Unknown	Unknown	Unknown
Greece / FYROM	Vardar river	Exists	Number of conflicts on water resources management issues has increased since 1965, due to intensive irrigation, plans for constructing	Unknown	Unknown	Unknown

			new dams in FYROM, and the accelerating pollution of the river.			
	Doiran lake	Unknown	Conflicts occurred mainly due to the irrational way the lake's waters were being managed by the two nations involved.	Unknown	Unknown	Unknown
Greece / Bulgaria / Turkey	Evroas and Ardas river	Exists	Evros is the biggest river in the area. Major political disputes over the years emerged. The basic problem are related to the way dams built on the upper flow of the river (Bulgaria) are being managed (when decided to let water go from the spillways then huge floods occur in the Greek part).	Permanent Greek-Turkish commission (Verwijmeren, J., Wiering, M. A., 2007)	Unknown	Unknown
Greece / Albania / Bulgaria	Great Prespa lake	Exists(ZEC, 2004)	Conflicts occurred mainly due to the irrational way the lake's waters were being managed by all three nations involved. Identification of critical problems (transboundary situation) was made: (1)	Each country has appointed one (ZEC, 2004).	Very complex, each of three countries has different rules (ZEC, 2004).	Unknown

			problems related to the resource, (2) problems associated to uses, needs and demands and (3) problems affecting ecosystems			
Bih / Croatia	Neretva river	Unknown	There are plans for building several hydro power plants. The rerouting of water from the River Neretva basins represents a great threat to the Hutovo Blato Nature Park, one of the largest Ramsar habitats (7400 ha) of migratory birds in the Balkans, which could end up drying.	Unknown	Unknown	Unknown
Egypt / Ethiopia	Nile river (2)	Exists	Most recent dispute is over Ethiopian Grand Renaissance Dam project. One of main problems is the double nature of project: on the one hand the project promises abundant energy for Ethiopia, but on the other hand it presents potential crop	No specific provision (UNDP-GEF, 2011)	Responsibility for compliance and monitoring of NBI's SVP projects rests with the Nile-SEC under the banner of the Shared Vision Coordination Project	No specific provision (UNDP-GEF, 2011)

			failures, power cuts and political tumult for Egypt.		(UNDP-GEF, 2011)	
India / Pakistan	Indus river	Exists	Building of dams.	Unknown	Unknown	Unknown
Canada / USA	James Bay	Exists (EIJBT, 2011)	New hydroelectric developments in James Bay, designed to supply clients in the north-eastern U.S., are threatening another large piece of aboriginal territory in northern Canada.	IJC commission	Defined in CWA, 1985.	Unknown
	St. Lawrence Great Lakes	Exists (Schulte, P. , 2011; SEAWAY, 2014):	There is growing demand on the Ontario side of the Great Lakes, as the result of increased population and industrial growth. In particular, immigration from parts of the world where water is very scarce (Somalia, Sudan, China and India) is fuelling population growth in southern Ontario.	IJC commission	Defined in CWA, 1985.	Unknown

	Lake Winnipeg	Exists (HYDROMB, 2014)	There is currently concern for the state of Lake Winnipeg, which is developing increasingly massive algal blooms.	IJC commission	https://www.hydro.mb.ca/corporate/water_regimes/lake_wpg_regulation.shtml	Unknown
	Souris river	Exists	Building of dams.	IJC commission	Unknown	Unknown
	Milk and St. Mary's river	Exists	Because of Milk and St. Mary's diversion	IJC commission	Unknown	Unknown
	British Columbia (2)	Exists, efficient	Considerable damage to Canadian agricultural lands, social disruption and forests, which were not considered in the treaty.	IJC commission or arbitration tribunal(UNDP-GEF, 2011)	Periodic reports (UNDP-GEF, 2011)	No end date defined (UNDP-GEF, 2011)
	Passamaquoddy Bay	Exists	A long term lease for liquid gas was planned.	IJC commission	Unknown	Unknown

(2) proposed as an example of good practice in the literature UNDP-GEF (2011).

4.4 Disputes about water on international level – water resources and water supply systems

Identification of conflicts over water supply and water sources was made. One very important document was found during this research – Water Conflict Chronology, last updated in 2008 (Gleick, 2008). In this paper a thorough research was made, an inventory of all known cases all over the world, dating from 3000 BC and up until 2008:

1. Parties involved,
2. basis of conflict,
3. nature of conflict (violent or not) and
4. over which source dispute was about,

Another very important database on world level was found – Transboundary Freshwater Dispute Database (TFDD, 2014). This database has spatial data and statistics for:

- Climate.
- Dams.
- Discharge.
- Irrigation.
- Landcover.
- Population.
- Projects.
- RBOs.
- Runoff.
- Tenders.
- Treaties.
- Water Stress.
- Water Access.
- No treaties.
- Large project.
- Transboundary Aquifers.

4.5 Conclusions

Conflicts between countries and water resources have existed for a very long time. As a very famous philosopher said: “Water can be a reason for war or peace”. Based on our research we can conclude that a lot of countries all over world have disputes on large scale either because of quantity of water that is being supplied to a neighbour country or because of the price that is being charged for supplied water. Our main focus was on identifying CBWSS but it was discovered through research that they are not very well documented on national scale. In general it could be said that legislation on cross border water supply in most countries, where some part of it exists, is usually very vague and indefinite. Most countries do not have cross-border water supply connections because of:

(1) Physical inconnectivity between systems,
(2) Domestic and political disputes.

Cross-river problems among different countries usually have a history of disagreements. Some countries have managed to resolve their differences and can be set to other countries as examples of good practices (Nile river basin, British Columbia). Most common reasons for dispute is:

1.) Irrational use of water by neighbouring countries.
2.) Building of dams (for irrigation and hydropower).
3.) Pollution of water source.

From cases that were set as examples of good practises there have been established following guidelines:

1.) A detailed written legislation is of key importance good cooperation between countries.
2.) Functions and organizational structure must be clearly identified and described.
3.) Bodies for settling disputes must be clearly identified (usually one of each neighbouring country appoints one of their member. Chairman of committee must be independent and look after interests of all parties included). Decision making process must be identified.
4.) Funding and financing of operational cost in short and long term must be carefully planned.
5.) Compliance and monitoring must be agreed and confirmed by both sides. Control over periodic reports must be initiated and implemented.
6.) Possibilities of dissolution and termination of agreement must be clearly clarified.

5 Conclusions

Analysis of all CB WSS by their status (inactive, active and potential) showed that Adriatic area is very rich with water in some parts while other lack on it. A lot of reported WSS systems were built in former Yugoslavia and they became CB WSS after the disintegration of Yugoslavia but they still exist. On the border between Croatia and Bosnia and Herzegovina few new water supply systems have been built after year 1995. Positive and negative experiences about CB WSS were described by our partners and collected in this deliverable.

Water demand scenarios differ greatly from country to country. In developing countries in the world is trend showing increase of demand for water: China, India, Pakistan, South Africa, etc. Reasons are: (1) large growth of population is expected, (2) increased food production, (3) development of industry which is a large consumer of water, and (4) most countries in development do not show interest in more effective water supply management and recycling techniques for already used water. The trends in Europe show, a gradual reduction of water consumption and main reasons are exactly the opposite. Some partners in DRINKADRIA project have already done studies on future water demand and have reported their results.

Conflicts between countries and water resources have existed for a very long time. Our research showed that a lot of countries worldwide have disputes on large scale either because of quantity of water that is being supplied neighbour country or because of water price. CBWSS were identified on world scale but study revealed that they are not very well documented on national scale. In general it could be said that legislation on cross border water supply in most countries, where some part of it exists, is usually very vague and indefinite. Most common reason why countries do not have cross-border water supply: (1) physical inconnectivity between systems and (2) domestic and political disputes. Reviewing examples of good practice revealed following key issues must be resolved between neighbouring countries: (1) a detailed written legislation is of key importance good cooperation between countries, (2) functions and organizational structure must be clearly identified and described, (3) bodies for settling disputes must be clearly identified, (4) funding and financing of operational cost in short and long term must be carefully planned and (5) Possibilities of dissolution and termination of agreement must be clearly clarified.

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7 Annexes

Annex 1 – Filled out questionnaires

Annex 2 – Albania: Water supply and sewerage code (draft of contract)

Annex 3 – USA: Water Supply Contract (draft)

Annex 4 – All documentation that was collected

Let’s grow up together

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