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SUSTAINABLE MANAGEMENT OF THE BEGA CHANNEL

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Abstract: For hundreds of years, the Bega Channel was one of the most circulated rivers in the southwestern part of Europe. It was open to navigation in November 1728. For more than a century, until the construction of the first railways, the Bega Channel was the main way of transporting goods. Timisoara and Bega Channel have been mutually conditioned over the centuries. The Bega Channel is, in many ways, one of the defining elements of Timisoara, and can be considered a backbone of the city. Bega is of urban, aesthetic and life-like importance (it is a source of water and a small amount of food, can become an important element for city traffic and, at the same time, a living boulevard). Bega Channel also is part of the hydrotechnical system Costei - Topolovat, with the role of defending the city of Timişoara against floods, but also to provide a water flow channel for periods of drought, for water supply of the city. Currently, Bega Channel have a number of problems: high degree of water pollution, clogging of the bottom bed (which leads to the impossibility of re-shipping), and destruction of aquatic ecosystems.

The objective of this paper is to present a short history, functions, problems and projects for sustainable management of Bega Channel.

Keywords: Bega Channel, sustainable management, problems, projects.

1. INTRODUCTION

Timis-Bega basin area is part of the Banat hydrographical space (Figure 1). Bega springs in Poiana Rusca Mountains at an altitude of 890 m below the peak Pades and water catchment area (4470 km^2) has a general east-west orientation (course length is 170 km). The length of the Bega River hydrographical network is 1418 km, its density being 0.32 km/km^2. Bega is poured into the river Tisa on territory of Serbia. Average yearly leakage varies with altitude, with values between 2 and 18 l/s/km^2.

The total length of the channel is about 119 km, of which 44 km in Romania and 75 km (63%) in Serbia. Navigable Bega has a length of 115 km ofwhich 75 km on the territory of Serbia, and 40 km on the Romanian territory. [1]

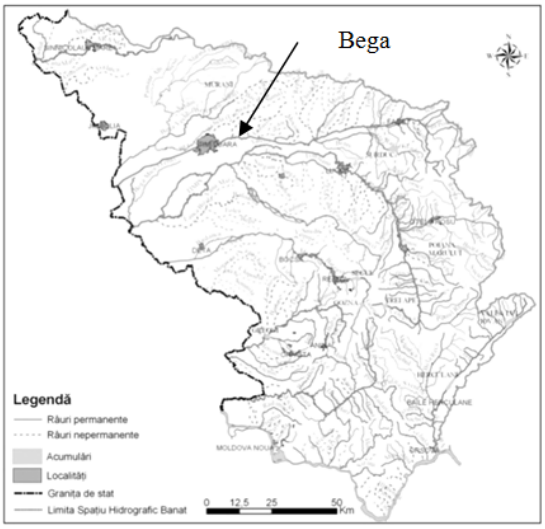

Figure 1. Banat hydrographical space

2. SHORT HISTORY OF BEGA CHANNEL

Timisoara and Bega Channel have been mutually conditioned over the centuries. In the Middle Ages, the settlement was founded near the course of a river, which was an important source of water, and the location of the settlement was chosen in such a way that its defense was relieved by the marshy area and the arms of Timisul Mic, which made the attacks from the south difficult.

In the period 1727-1733 the Bega Channel is upstream from Faget to Timisoara.

In 1732, the Bega Channel can be reached, on a distance of 92 km, on the current route from Central Scudier Park to today's Serbia.

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Maximilian Fremaut engineer began in 1757 to build a lock on the Bega Channel at Costei and a large ditch to Timis and the execution took place between 1759 and 1761. This allows the transfer of flow between Bega and Timis according to needs and the problem of the flow on the Bega Channel, improving water management in an area historically known for marshy landscapes and frequent floods.

In 1764 a navigable channel is projected on a circular route south of the fortress, because the water "washes" the foundations of the fortifications. It is the current Bega Channel, from the present-day Dimitrie Gusti Street to the "A. Scudier" Central Park, from where it connects to the current Iosefin channel (executed in 1732). In 1765 the channel was designed in 1764 on the current route around the fortress (Figure 2 and Figure 3).

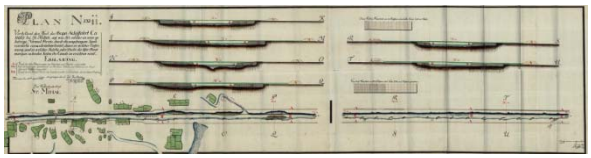

Figure 2. Longitudinal profile and projected cross sections in the year of 1786

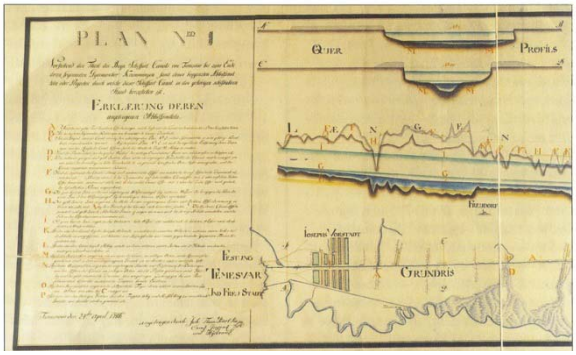

Figure 3. The Bega Project by Johann Theodor Kostka in 1786

In 1902, engineer Szilard Emil proposed the regularization of the Bega Channel, on the current Fabric district, and during 1907-1910, this project is being executed. The current channel is split between Sarmisegetuza Square and Dimitrie Gusti Street, and the bridges on this route are executed. Since then, the Bega Channel keeps its course unchanged until today.

In the years 1906-1910 a belt of green spaces along the Bega Channel is being built. The parks on the right bank of the Bega Channel and the strip of unspoiled green spaces on the left bank develop.

Goods transport

In 1752 Timisoara Harbor was already in the Iosefin district. The quantity of goods transported on Bega was 20 000 tons / year. Until the beginning of the First World War, 563 commercial vessels were sailing on the channel for 305 days a year. The volume of goods transported reaches a maximum of 250 000 tons / year, between 1937-1938 (Figure 4).

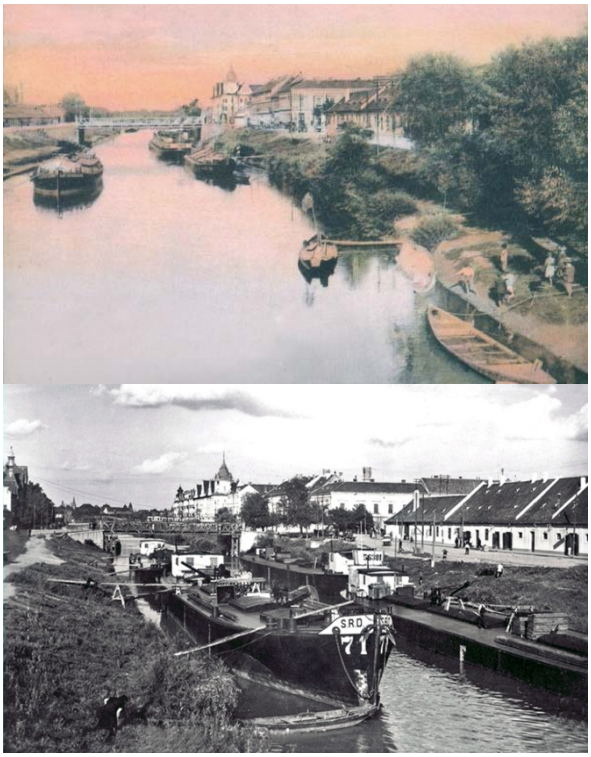

Figure 4. Goods transport on Bega Channel

Traffic suffered severely from the Second World War, and in 1958 the transport of goods ceased.

Passenger transport

In 1869 on the Bega Channel, the first passenger races are made. Timisoara becomes one of the first cities on the current territory of Romania to use this means of transport. Passenger transport on the channel has peaked at around 500 000 passengers in 1944, the navigation on Bega being interrupted in 1954.

In the 1960s, it was also attempted to introduce Bega public transport, which only functioned temporarily. A small portion remains navigable within the radius of Timisoara for a small number of recreational ships. [2] [3] [4]

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3. FUNCTIONS OF BEGA CHANNEL

Water source for supply and waste water emissary for partially / totally treated wastewater. In upstream (East), Aquatim takes over water from the channel for water supply of Timisoara. Waste water resulting from domestic and industrial activities is discharged into the Bega Channel downstream of the municipality (West) after its treatment. The Bega Channel also serves as the emissary for most of the wastewater from factories located along the canal.

Navigation. Initially, the channel was built for the floating of wood in the mountainous / hilly area of Banat. Prior to 1958, ships of up to 500 tons sailed between the Danube and Timisoara, transporting raw materials and industrial products produced in Timisoara and its surroundings. It has also served as a transport route for agricultural products and especially for the transport of bovines from farms along the channel. Last but not least, this was an important route for trafficking in and from Timisoara. Now the roads and the railways have taken over these functions. Thanks to Sanmihaiu's sluice gate renovation work, the Bega Channel is closed for any type of navigation. After resuming and finalizing the works, the channel can be reopened for ship navigation of up to 500 tons. However, a real opening to Western Europe will only be achieved when Timisoara ships can navigate directly on the Danube and the Rhine. In this case, the Romanian side and a small Serbian side of the Bega Channel have to be adjusted for ships of up to 1000 tons.

Drainage. At the beginning of the eighteenth century, the lowlands of Banat were covered with marshes, not suitable for agriculture and human settlements. The Bega Channel has played an important role in land reclamation in the western part of Timisoara. This is the main channel in which excess water on the ground is discharged by collecting them through drainage channels, then pumping them into the Bega Channel. This task of managing excess water on the ground lies with ANIF.

Irrigation. In dry periods, the Bega River and Channel serves as a source of irrigation water for 8747 ha of land. Following the improvement of the water quality downstream of Timisoara and the optimization of the Timis - Bega system, there is the possibility of extending this area.

Production of electricity. In the Timis-Bega system, the relatively small water level differences are used to generate electricity. Power stations were built in Topolovat, Timisoara and Sanmartinu Maghiar. The last two are not functional, the Timisoara power plant is undergoing renovation, and the Sanmartinu Maghiar (which would produce enough energy to handle the locks) is not economically efficient.

Recreation. The Bega Channel runs through the center of Timisoara. The main tourist attractions and recreation areas along the channel are: Michelangelo Bridge, Roses Park, Orthodox Cathedral, Children's Park, a number of parks, restaurants and clubs. On the water, the only activity is rowing and boat rides, especially for children. A rather poorly developed activity is fishing. [2] [5]

4. PROBLEMS OF BEGA CHANNEL

Water pollution due to economic activities. Economy of watershed cover major industries: chemicals, construction machinery, animal husbandry, agriculture. These units contribute significantly to the degradation of Bega water quality, both the upstream sector of Timisoara, especially the downstream sector.

Because of decomposition of organic substances in the upstream border, result pollution problems due to oxygen deficiency. Oxygen regime was seriously threatened. Complete lack of oxygen was recorded from 15% to 46% of cases were examined. Low dissolved oxygen concentrations that correspond to the situation "to classify" were recorded in 69% to 85% of the cases examined. [1]

Water pollution due to sediment. Mud deposited on the bottom slab in addition to reducing channel flow section focuses materials present in the water and from wastewater. In mud remain organic matter, nitrogen and phosphorus compounds, and toxic materials (phenols, pesticides, heavy metals and radionuclide's). In addition to material that easily consume all the oxygen deposited on the bottom of the watercourse (oxygen being a vital issue for aquatic flora and fauna) in the sediment is deposited and amounts of biological materials which are decompose slowly. Mud deposited near the watercourse (the banks) through the rain washes and the migration of materials from wastewater, affect negatively the quality of water current. [1]

Changing the geometrical and hydraulic characteristics of the riverbed. By human intervention on the river by sewage, development banks, impoundment and other hydraulic structures for navigation and water supply have changed the natural conditions of the river slope, roughness, water velocity etc., which leading to new areas of deposition and erosion. The massive sediment intake can cause

filling the bed, leading to increase of slope and water velocity, and to bed instability. Fine sediment in suspension affects aquatic fauna if turbidity remains high long periods of time. The most dramatic changes are induced by hydrotechnical structures building needed to ensure a minimum level of water for navigation. They retain the sediments transported normally from upstream and evacuate in downstream clean water with an increased transport capacity. Downstream of these structures occur pronounced erosion of the riverbed.

Clear is that Bega Channel bed tends to balance, which leading to erosion and deposition in different sectors. This process will continue even after channel dredging. For this reason the bed must be arranged, eventually regularize, because in the future these processes will be insignificant as to avoid every time dredging, which is very expensive and may adversely affect the ecological balance of the area. [6] [7]

5. PROJECTS FOR SUSTAINABLE MANAGEMENT OF BEGA CHANNEL

The objectives of sustainable management of the Bega Channel are the followings: improving water quality; removal of contaminated sludge from bed of Bega Channel; optimizing Timis – Bega system operation and maintenance; tourism and recreation.

The main beneficiaries of sustainable management of Bega Channel are the inhabitants of Timisoara because:

- more opportunities for recreation on the banks of the channel in Timisoara (boating, fishing, etc.) and a better environment along the channel;
- greater protection against floods;
- employment as a result of an increase of tourist facilities, the opening of the waterway to the west, allowing luxury yachts to sail on the Danube in Timisoara;
- modernization of the canal to become a shipping route for ships up to 1000 tons and the establishment of a port with an expansion of the industry, thus providing more jobs. [5]

Also, the north-west of Romania and Transylvania will have an opening to Western Europe through the Bega Channel (engaged in import/export industry, heavy industry, agriculture, food processing). Industry, trade and transport sectors are showing a downward trend in prices will receive an incentive through market expansion to Western Europe. Romanian companies will benefit from industrial and commercial change and for international companies Timisoara area will be an area of interest for investment.

Tourism and recreation sector will receive new opportunities by initiating activities related to Bega Channel. Romanian contractors and shipyards profit (to be established) will increase as a result of orders caused by the Bega Channel sustainable management. The treatment of water from Bega for water supply will be easier, due to lower amount of sediment floating. Optimization of Timis - Bega hydrotechnical system will create the possibility of sampling a higher flow for water supply, when population growth and industry will require. Environment in and around the Bega Channel will be better protected after achieving sustainable development and continuing of management operation of Bega Channel. [5]

RESTORATION OF BEGA CHANNEL CONSOLIDATIONS IN THE CITY OF TIMISOARA, TIMIS COUNTY - implemented by the National Administration "Romanian Waters" through the Banat Basin Water Administration, between 2014 and 2015. The purpose of the project was to render Bega Channel, inside Timisoara, section, uses and original layout.

The total value of the project was 17 484 649 lei (the equivalent of 3 875 316 euros). The duration of the investment was 12 months. 90% of funding for the project was provided from European Union, the remaining 10% was provided by the state budget. The project was co-financed by the European Union Cohesion Fund through the Sectoral Operational Program "Environment" 2007-2013 - Priority Axis 5 - Implementing the appropriate natural risk prevention infrastructure in the areas most exposed to risk. Major Area of Intervention I - "Flood Protection".

Through this project were executed arrangement works in riverbed and riverbanks in the urban area of Timisoara, which allowed the creation and maintenance of a section allowing the passage of high discharges in safe conditions for defense works and implicitly for protected areas. The works of the riverbed and banks in the urban area of Timisoara were performed on a length of 8.9 km. The works are located in the following sectors: Rozelor Park - U.H.E. with 4,7 km length, Modos bridge - Iosefin Square with 3,6 km length, and U.H.E. area for systematization and arrangement of a 0.6 km long return pool (figures 5, 6, 7). [8]

Figure 5. Location of arrangement works

Figure 6. Situation before to project implementation

CLEANING / DREDGING THE BEGA CHANNEL - At the end of 2008, the Bega Channel dredging and ecology works began within a joint project of Timisoara City Hall and the Banat Basin Water Administration. Since 2008, the Bega Channel sector, which stretches from Timisoara to the Serbian border, has undergone extensive greening and unclogged works.

Figure 7. Situation after project completion

The total value of the investment in the works for unclogged of the entire channel, up to the border with Serbia, is 17 million euros, 19% of this amount was allocated by the Romanian Government through the Ministry of Environment and the rest of the money came from the Development Bank Council of Europe.

The greening and dredging of the Bega Channel on the Timisoara sector was on the list of investment objectives for 2008 in Timis County, costing 10 million lei, dredging 0.7 million cubic meters and finishing works in 2009 (Figure 8). [9]

Figure 8. Dredging the Bega Channel

VALORIFICATION OF THE TRANSBORDER TOURISTIC POTENTIAL, INCLUDING CYCLOTURISM TRACK ALONG BEGA RIVER, DOWNSTREAM OF TIMISOARA - implemented by the Banat Basin Water Administration, in partnership with Timis County Council and Zrenjanin City Hall, Serbia, between 2013 and 2015. The project, financed of European funds under the Romania-Serbia IPA Cross-border Cooperation Program, a non-reimbursable grant of EUR 2 346 495, aimed at developing local and regional tourism potential and promoting cross-border Romanian-Serbian cooperation by implementing alternative forms of tourism, as is the case for cycling. The construction of tracks was awarded with the sum of 1.8 million euros.

Cycling track starts at the edge of Timisoara, downstream of Modos Bridge, where the city's bicycle junction has already been made by Timisoara City Hall and continues 37 km along the Bega line, will connect the localities Utvin, Sanmihaiu Roman, Uivar, Otelec, to the border with Serbia. The track follows exactly the Bega line, being directly parallel to the Bega Channel, located on the crest of the dike, and is 37 kilometers long and 3.5 meters wide, including 2 meters of asphalt and 1.5 meters of broken stone (Figure 9). [10]

Figure 9. Bega bicycle track

REHABILITATION OF THE URBAN PUBLIC INFRASTRUCTURE OF BEGA CHANBEL BANKS

Timisoara City Hall implements the European-funded project "Rehabilitation of the Urban Public Infrastructure of the Bega Channel Banks" The project aims at rehabilitating urban public infrastructure and improving urban services, including urban transport in Timisoara, in order to increase the quality of life of the inhabitants of Timisoara and its adjacent area, impacting the overall development of the city and ensuring sustainable regional development.

Works, which are planned for the rehabilitation and modernization of the urban public infrastructure of the banks of the Bega Channel, comprising:

• Reconfiguration of perimeter aesthetics of paths and bicycle tracks;
• Setting up and rendering the green space aesthetic unit;
• Appropriate provision of the urban furniture promenade area according to urban units;
• Modernizing and rehabilitating the public lighting system;
• Rehabilitation and upgrading of the technical-urban infrastructure in the area (power and distribution networks for electricity, water supply and sewerage);
• Establishment of urban public transport infrastructure on the Bega Canal.

The arrangements were made 10 kilometers away, on both sides of Bega. The start of the works was in June 2012, and they ended on the deadline set in the contract, December 2015. The total value of the project was 49 207 387.67 lei (VAT included). [11]

Recreational opportunities on the Bega Canal can be seen in Figures 10 and 11.

Figure 10. Recreation possibilities on Bega Channel and banks

Figure 11. Recreation possibilities on Bega Channel and banks

RESUMPTION OF NAVIGATION ON BEGA CHANNEL

Through the project "Rehabilitation of the Urban Public Infrastructure of the Bega Channel Banks" Timisoara City Hall acquired seven boats, manufactured in Galati. The boats were named with the names of seven historical personalities: Burebista, Decebal, Traian, Glad, Huniade, Savoya and Economu. The price of a single vaporetto was 270 000 euros. The money for the boats was from the local budget, while the construction of the vaporetto stations, nine in number, was made through European funds, within the rehabilitation of the Bega Channel. For several months, the seven boats were used for public transport on Bega, but only "on demand". The circulation of the ships is done only in Timisoara, from the former "Solventul" factory to the water plant (Figure 12).

The ships were purchased to introduce public transport to Bega, a prerequisite for the Bega River rehabilitation project. Unfortunately, craft cannot make regular races because of bureaucratic problems.

More specifically, the Government of Romania must establish the Administration of the Navigable Way, an institution without which the Timisoara Public Transport Society cannot let the Bega transport by boat go. If the Administration of the Navigable Way is not set up by June 30, 2018, then the City Hall must reimburse the European Union for the rehabilitation of Bega banks, rides in the public transport system being a condition in this project.

Figure 12. Ships on the Bega Channel

If the public transport of Bega is to be introduced, Timisoara would be the only city in Romania where there are five public transport sub-systems: buses, trolleybuses, trams, bicycles and boats.

The next step will be the extension of the public water transport in the communes in the county to the sluice-gate at Sanmihaiu Roman. [11] [12] [13].

REPAIRING NAVIGATION INFRASTRUCTURE ON BEGA CHANNEL

The resumption of Bega navigation, from Timisoara to Serbia, is one of the most important projects on the agenda of the Timis County Council.

This is the objective of the project "Repairing the navigation infrastructure on the Bega Channel", a project financed by the Interreg-IPA CBC Romania-Serbia 2014-2020 Program. The project is carried out in partnership by the Banat Basin Water Administration – project leader, Timis County Council - project partner, Provincial Secretariat for Interregional Cooperation and Regional Administration - project partner from Serbia, VBP Vode Vojvodine – project partner from Serbia. The project has a total value of 13 877 987 euros (VAT included), of which the Romanian part is 6 929 795 euros, the rest being accessed by the partners in Serbia. All funding is non-refundable. The project is in the implementation phase, the duration is 48 months, August 2017 - August 2021.

On the Romanian sector, the main objective of the project is the restoration of the Sanmihaiu Roman hydrotechnical node (will be repaired the cylindrical and flat barrier, the maneuvering mechanisms, the access and evacuation sluice gates, the canton of exploitation) (Figure 13). In

addition to repairing the sluice gates, which will allow the passage of ships, the project also includes the Bega Channel unclogging works, the cleaning of the old moor spaces, the harbors.

Figure 13. Sanmihaiu Roman hydrotechnical node

For maintenance of the Bega Channel in order to navigate, a dear and two barges will be purchased. In order to ensure optimal navigation conditions, the signaling of the navigable channel will be secured and a feasibility study will be carried out for the state border crossing point. The Serbian sector will be aimed at repairing the hydrotechnical nodes Srpski Itebej and Klek plus the acquisition of a drag, the construction of a bicycle track and the feasibility study for the state border crossing point.

With the rehabilitation of the sluices, it will be possible to navigate on Bega from Timisoara to Zrenjanin to Titel. Here is the confluence of Bega with Tisa and the Danube. Navigating in upstream, Tisa can be reached via Novi Becej - Becej (Serbia) to Szeged (Hungary). Downstream, Tisa flows into the Danube. There are two ways: from Titel we can go on the Danube-Tisa-Danube Channel to Banatska Palanka - Bazias; on the other part, the Danube can be reached in Belgrade. [14][15]

6. CONCLUSIONS

Expected results of the Bega Channel sustainable management are: establish the technical, institutional and budgetary frame for an operational management of Timis – Bega hydrotechnical system; Bega Channel water and surrounding areas sustainable and integrated management; improving water quality; contaminated sludge dredging, setting its storage location without polluting the groundwater; optimization of Timis – Bega hydrotechnical system; increased tourism and recreational potential of a clean Bega Channel; establishment of a proper connection with Western Europe through waterway.

Timisoara could connect to the corridor Rhine - Main – Danube in case in which the Bega Channel where it becomes navigable again. Currently, the ships which traveling on the route Rhine - Danube cannot use the channel because the channel dimensions and locks permit only crossing of ships up to 500 tons.

Last but not least, Timisoara will be the European cultural capital in 2021, and the Bega Channel and its surrounding areas will be an attraction for foreign tourists, will be the business card of Timisoara

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