

REVITALIZATION OF DEGRADED AREAS OF THE TUZLA BASIN AND FORMING ARTIFICIAL LAKES IN THE FUNCTION OF TOURISM DEVELOPMENT

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ABSTRACT. – **The revitalization of degraded areas of the Tuzla basin and the formation of artificial lakes in the function of tourism development.** The Tuzla basin is located in the central part of the region of north-eastern Bosnia. It covers an area of 1,405 km² consisting of five municipalities: Tuzla, Živinice, Lukavac, Banovići and Kalesija. It is surrounded by mountains Majevisa, Ozren, Konjuh and Javornik. It has a favorable geo-traffic position because it represents the intersection of roads leading to Belgrade, Orašje, Sarajevo and Doboj. The area of Tuzla basin has significant resources of coal and rock salt on the basis of which was developed chemical industry. The period of industrialization has considerably affected the economic situation of the entire region, and particularly the development of the central places of the Tuzla basin. Intensive exploitation of rock salt has significantly influenced the subsidence in the metropolitan area of Tuzla and turned it into an unordered wetlands. After the end of coal mining in the abandoned mining pits in the area of the municipalities of Živinice, Tuzla and Banovići were formed lake depressions. In order to improve and protect the environment, there were implemented several environmental projects which reconstructed coastal areas of lakes in the area of Živinice, Tuzla, Lukavac and Banovići, and in the metropolitan area of Tuzla there were built three artificial salt lakes in the function of the city outdoor pool. The paper places particular emphasis on the promotion of values of artificial lakes created by revitalization of degraded areas in the Tuzla basin and future directions in the development of the same. Moreover, considerable attention is given to the system of planned realisation of environmental projects for the improvement of environment in the towns of Tuzla, Živinice, Lukavac, Banovići and solving environmental problems. The aim of this study is to point out the proper management and use of hydrographic resources in the function of tourism development in the area of the Tuzla basin.

Key words: the Tuzla basin, revitalisation, artificial lakes, tourism.

1. INTRODUCTION

According to the regional-geographical position, the Tuzla basin belongs to the north-eastern part of the Northern Bosnia region. It is one of the greatest depressions in the interior of the Dinara mountain range oriented in Dinaric northwest - southeast direction at length of 40 km and width of 5-30 km.

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It is surrounded by mountains Majevica, Ozren, Konjuh and Javornik. (Jovanovic, 1987) The Tuzla basin has a favorable geotrafical position, which is characterized by its openness to the Pannonian region and transport links to the Adriatic coast. The most important road Županja-Orašje-Srebrenik-Tuzla-Sarajevo-Mostar enables movements of visitors from Central and Western Europe to Northeastern Bosnia and the Tuzla basin. In addition to exiting to the international E-70 corridor Zagreb-Belgrade, this road connects the Pannonian and Continental

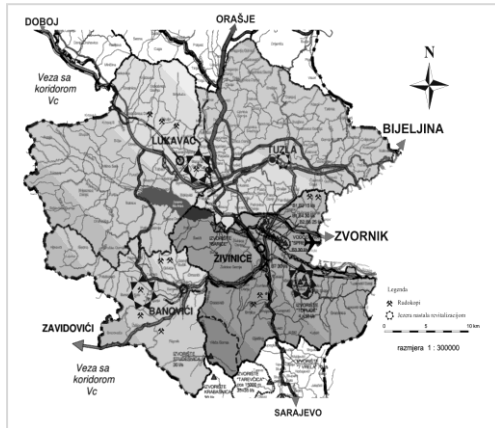


Fig. 1. Territory of Tuzla basin settlements

(the author edited according to the source of Tuzla Canton infrastructure)

parts of the region to the Adriatic Sea, and it outputs all regional roads. Contacts with different regions are expressed by the road Tuzla-Doboju-Slavonski Brod. Through Tuzla goes the road Banja Luka-Doboju-Zvornik-Valjevo. Railway traffic, which was once the backbone of economic development of Tuzla and Banovići, is not operational. Air traffic is carried over the Tuzla International Airport located 8 kilometers south-east of Tuzla. (Fig. 1.)

Researched area has a surface of 1.114 km² within which are located the municipalities of Tuzla, Živinice, Lukavac and Banovići inhabited by 251,804 residents, which is 6.6% of the total population of Bosnia and Herzegovina. (Table 1.) (Agency for Statistics of Bosnia and Herzegovina, 2013).

Table 1. Demogeographical indicators of the Tuzla basin 2015

Territory	Area km ²	Number of residennts	Municipalities of Tuzla basin	Area km ²	Number of residennts
Bosnia and Herzegovina	51,129	3,812,785	Tuzla	296	120,431
Northeastern Bosnia	6,628	1,041,043	Lukavac	338	46,731
Tuzla basin	1,114	251,804	Živinice	298	61,201
			Banovici	182	23,431

Sources: The Agency for Statistics of Bosnia and Herzegovina (2013): *The only relevant data of the Population and Housing in BiH 2013, officially published results of the Agency for Statistics BiH and Entity Statistics Bureau.*

The development of the mentioned settlements was significantly affected by its traffic position and mineral resources (coal and salt). The area of Tuzla basin was the subject of geological research which confirmed significant sedimentary deposits represented by marl sandstone, layers of coal and salt in the northern and northwestern parts of the area. (Jovanovic, 1987) Mineral resources were the basis of economic development of the Tuzla basin.

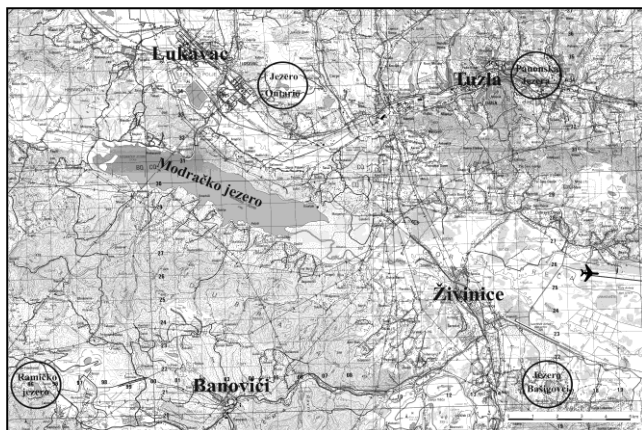
With the exploitation of rich coal and salt deposits began development of chemical industry (HAK) which made the Tuzla basin and the entire area of Northeast Bosnia one of the largest economic regions of the country.

Intensive exploitation of minerals in the area of Tuzla basin left behind a large number of abandoned mining pits, coal mines, quarries, clay deposits and similar degraded areas that can be significantly exploited. Degraded areas appear as a flat floor surface mine, the level of the high slopes, tailings, dents in the form of craters and subsidence.

This paper considers the processes of revitalization of degraded land as a process of improvement of environmental factors of the environment with particular reference to the formation of lakes in order to develop tourism in the municipality of Lukavac, Živinice, Banovići and Tuzla. Some of these lakes according to their size, location in space, quality of the environment, a high degree of integration into the existing ecosystems as well as the construction of tourist facilities, have become a desirable tourist destinations.

2. REVITALISATION OF DEGRADED AREAS IN THE TUZLA BASIN

Starting the process of revitalization of degraded areas of the Tuzla basin



dates back to the late eighties of the last century, when coal exploitation was stopped on surface mines (PK): PK Bašigovci-Živinice (1984), PK Turija-Banovići (1985) and PK Šiški Brod-Lukavac (1986). (Figure 2.)

Fig. 2. Revitalized surface mines of the Tuzla basin (the author)

Surface mine Bašigovci is located in the eponymous town Bašigovci, which belongs to the southeastern part of the municipality Živinice. On the cultivated part of the surface mine Bašigovci, in a crater measuring 40m of depth, appeared a lake. The depth of the lake in the coastal zone is 2.5-5 meters. Shallower side of the lake is covered with reeds and rushes, the water has no pollutants. Excess water from the lake drains into a stream river Spreča. (<http://www.bistrobih.ba>, January 10, 2016) According to the Regulation on classification of water, the quality of lake water has the quality of bathing water and is considered the II class. (<http://www.zivinice.ba>, January 13, 2016)

With the realization of the ecological project " *Rajsko jezero Bašigovici* ", there was made a gravel beach and the lake is in the function of the bathing area.

Surface mine Turija is located within the Banovići coal basin. Intensive exploitation of brown coal on more surface mines has left behind degraded areas where lakes appeared. One of major reservoirs is located in the village Ramići and it represents a residual depression of tailings near Ramići stream in the southern part of the *surface mine Turija* which is not covered by mining operations. (Institute for protection, ecology and education of Tuzla, 2011) Accumulation of Ramići lake is filled by precipitation waters of its own catchment area of approximately 0.6 square kilometers, and partly by underground flows. (Environmental study of facilities of the accumulation "Ramići", 2014) In Ramići lake, the dominant is surface-water runoff into the eponymous Ramići stream. The preparation of the Elaborate on the extension of the accumulation of Ramići lake is in progress.

Surface mine Šiški Brod is located in the eponymous town Bistarac which belongs to the southeastern part of the municipality Lukavac. On the cultivated part of *surface mine Šiški Brod* near the spring of Bistarčić stream accumulated lake water on 295 m of altitude. The shores of the lake are sandy, surrounded by grass and deciduous vegetation, water inflow is continuous, and the excess water is drained into the Bistarčić stream, because of which it belongs to the group of lakes with the natural purification of water. In periods of abundant rainfall, the lake accepts the entire excess water and thus prevents flooding of settlements through which flows the Bistarac stream. (Report on the State of the Environment of Lukavac Municipality, 2011) According to the Regulation on classification of water, the quality of the lake water belongs to II class. (Mašala, 2009) With the realization of the environmental project " *Jezero Ontario Bistarac* ", the coast was arranged with the accompanying tourist contents. The period of industrialization and urbanization in the second half of the last century significantly affected the spatial development of Tuzla.

Intensive exploitation of rock salt has caused subsidence in the city center and turned it into an unordered wetlands. The problem of subsidence and flooding of parts of the northern highway was resolved by the realisation of environmental project in Tuzla by construction of three artificial reservoirs called Pannonian salt lakes. *Pannonian salt lakes* are built combining geosynthetic and natural materials, the surface of which has been covered by polyethylene planes, then with gravel that gives the appearance of the sea beach. The gravel beach has an area of 10,000 sq m and is 1,000 m long. Inflow of water into the lake is 95 000 m³ of which 30% is salt water characterized by a salinity of 33 g / l. Above Pannonian lakes were built *salt waterfalls* with salt water, and they have the characteristics of inhalation center in the open air. (Archive of Panonika company, Tuzla, 2015) Thanks to the water salinity that is equal to water salinity of the Adriatic Sea, they represent a unique example of saltwater lakes in the Balkans as well as in the whole Europe.

Due to the small surface, the water is constantly purified and disinfected with 0.2 mg / l of chlorine. On the basis of the Regulation on classification of waters, all



three lakes belong to the II class of water quality. (<http://www.zivinice.ba>, january 5, 2016) Pannonian salt lakes have been built in the shape of the foot, they have medicinal properties and function of the city open pool. The Complex of Pannonian lakes is managed by PUC "Pannonica." (Fig. 3.)

Fig. 3. Pannonian salt lakes in Tuzla (source: PUC Panonika)

The mentioned accumulations of lakes are an important element of the tourist stay in urban areas, are connected by traffic and in the function of tourism development. (Table 2.)

Table 2. Artificial lakes of the Tuzla basin

Municipality	Name of the accumulation	located from town	Area /m ²	Depth/m
Lukavac	Ontario Lake	2km from Lukavac	16,000	16
Živinice	Bašigovci Lake	6km from Živinice	13,000	40
Banovići	Ramičko Lake	10km from Banovići	89,218	20
Tuzla	Pannonian lakes	in the center of Tuzla	17,000	0
	Veliko jezero (Large Lake)		11,000	1,8
	Malo jezero (Smal Lake)		5,300	1,35
	Novo jezero (New Lake)		3,720	1,8

Sources:Archive of Panonika company, PUC Panonika, Tuzla,2015, Environmental study of facilities of the accumulation "Ramići",2014, <http://www.zivinice.com>,2016, Report on the State of the Environment of Lukavac Municipality,2011.

3. ARTIFICIAL LAKES OF THE TUZLA BASIN IN THE FUNCTION OF TOURISM DEVELOPMENT

With the realization of the ecological project, *Rajsko jezero Bašigovici* has become an attractive destination during the hot summer days for residents of Živinice and other neighboring municipalities. Tourism importance of Bašigovci lake is reflected in the following: an arranged beach where during the summer months there are more thousands of visitors, a popular vacation spot on a beach, bathing, swimming and jumping into the water. It is suitable for sports and recreational activities, organization of events, a stroll along the beach, enjoying the fresh air and sports activities by the lake such as volleyball and badminton.

During summer months at Rajsko jezero (Paradise lake) resides thousands of bathers, which is according to the number of visits the second bathing destinations in the Tuzla basin. Since its formation, there has been conducted fish restocking, which offers the possibility of fishing. Among fish species, there are pike, catfish, bream, tench, pearl roach and other small fish, which is the reason of a large number of fishermen every day. (Ministry of Tourism and Trade of Tuzla Canton, 2015) Care and maintenance of fish stocks have been entrusted to the fishing society Mrena from Živinice. In the future, it is planned to upgrade tourist facilities with catering facilities.

With the realization of environmental project “*Jezero Ontario Bistarac*“, there were created the preconditions for more forms of recreation, such as swimming, sport fishing and sporting events on water. In addition to the lake, there are arranged a parking area, motor camp and barbecue area. It has natural beaches with piers above the water and sports facilities for beach volleyball. Moreover, there is a fish restaurant and several smaller facilities for other purposes in order to have as better holiday as possible. *Ecological resort “Ontario”* (better known as Bistarac Lake) is one of three lakes in the area of Lukavac municipality, it is 2 km away from the city center, so it is a popular swimming area and a place to rest for a large number of residents of Lukavac and visitors from surrounding towns of the Tuzla basin. Ontario Lake is also one large fish pond because, in spite of the natural fish stock, the lake is stocked with various fish species every year. *Tourist offer* has been extended with organization of sports competitions, seminars and other activities important for the municipality of Lukavac and for the entire Bosnia and Herzegovina. In summer the lake is very visited making it necessary to expand the existing capacities. The plan for the future is to upgrade accommodation facilities, build new sports facilities for tennis, basketball and handball and improve complementary services, thus area of Lake Ontario will get even more visitors. (<http://jezerobistarac.com>, January 10,2016)

Ramičko jezero is one of the largest and most beautiful lakes in the municipality of Banovići. It is suitable for fishing because it is rich in carp, pike and pearl roach. On the lake, sports fishing contests regularly take place under the auspices. Surroundings of the lake is attractive and characterized by deciduous vegetation and grass areas. It has got an arranged coast and approachable entrance. The preparation of the environmental projects concerning the protection of the lake and putting into operation of tourism is in progress. (Fig. 4.) (<http://www.turizam banovici. com.ba>, January 4, 2016)



Fig. 4. The traditional competition of little fishermen on Ramići Lake

(Source <https://www.ribolovnaprica>)

Pannonian salt lakes represent a tourist potential for the development of bathing tourism. Apart from salt, lake water is enriched with minerals for which it has medicinal properties that help in the treatment of rheumatic and respiratory diseases. During summer months, Pannonian salt lakes have become the most preferred destination of inhabitants of Tuzla and surrounding settlements. During hot days of July, over 10,000 visitors of all ages daily enjoys swimming in the lakes; in the last season (2015) the lakes were visited by more than 300,000 visitors. (Archive of Panonika company, 2015) In the last five years the lakes have been visited by more than 1.5 million visitors. (Ministry of Tourism and Trade of Tuzla Canton, 2015) Tourist and catering facilities on the lakes provide visitors with services of accommodation and refreshments. *Tourist offer* of Pannonian lakes is complemented by the construction of Neolithic settlement and museum complex on Soni trg (Salt square) near Pannonian Lakes. In the future there are planned activities to build tourism facilities at the salt lakes complex. Spatial capacity of the salt lakes complex will function as a public good, thus creating the conditions for the construction of private complementary catering facilities outside of the Panonika complex. (Development Strategy of Tuzla municipality until 2026, Tuzla, 2012).

4. CONCLUSION

Realization of the above activities has shown that the local communities can successfully solve their own environmental problems. This is shown on the example of revitalization of degraded areas caused by mining activities in the area of Tuzla basin. The above experiences are very important and can be used in other local communities as positive examples in solving ecological problems. In the area of Tuzla basin, it should be continued with the implementation of environmental projects and revitalization of degraded areas which primarily refers to the accumulations of **Vijenac lake** (20 kilometers from Lukavac) and accumulations of **surface mine Šiški Brod lake** (5km from Tuzla). These reservoirs are located in a natural environment, rich in fish, which provides an opportunity for fishing and camping. /Fig. 5, Fig. 6.)



Fig. 5. Accumulation **Vijenac**
<http://boljatuzla.ba/wpcontent/uploads/>



Fig. 6. Accumulation of surface mine **Šiški Brod**
<https://www.google.ba/search,jezero+površinski+kop+tuzla>

With the revitalisation of degraded areas of the Tuzla basin and ecological landscaping of the surroundings of the mentioned reservoir lakes, there were created favorable preconditions for the development of recreational tourism. The Tuzla basin in this way has become a tourist center and well-known not only locally and regionally but also nationally. It is true that, for their full tourist valorization, there are missing tourist facilities with services of higher quality that would allow extended-stay for visitors.

All of this shows that the basis for the development of recreational tourism in the Tuzla basin exists. In this regard, the relevant ministries need to encourage the development of this segment of the tourist offer, especially as experience shows that the demand is growing.

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