SPATIAL DEGRADATION WITHIN THE „JADAR“ PROJECT

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Abstract

The realization of the "Jadar" project is planned in the vicinity of the town of Loznica, on several thousand hectares of forest and agricultural land as well as urban areas. Opening of mines, formation of landfills, exploitation of groundwater, treatment of ore with sulfuric acid, construction of access roads, and permanent change of land use will irreversibly change and degrade the existing landscape and endanger biodiversity. The eventual beginning of the exploitation of the mineral jadarite implies massive earthworks, subsidence of the terrain on almost 850 hectares, and backfilling of the upper part of the Štavica stream basin. The significant potential of the already defined tourist region, with sites of cultural-historical and spiritual significance, will be irretrievably destroyed. The displacement of the local population, permanent elimination of opportunities for advanced and profitable agricultural production, the constant risk of air, water, and soil pollution, essentially diminish the economic and ecological perspective of Radjevina. The town of Loznica is located at a short distance from dangerous pollutants such as tailing dumps of the mines "Stolice" (antimony ore) and "Zajača" (antimony and lead ores), and in the city area, there is an abandoned factory complex "Viskoza", with huge amounts of toxic and carcinogenic substances. The "Jadar" project is located only 15 kilometers from the center of Loznica. Rio Tinto's current international reputation does not instil confidence in the safety of production processes, environmental protection, and treatment of workers. The benefit for the state of Serbia is particularly unclear considering the fact that hardly any compensation could make up for such a massive spatial degradation and a permanent risk to the health and safety of the population.

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1. INTRODUCTION

Passenger cars are the source of about 12% of carbon emissions in Europe, while the Paris Agreement requires a reduction of 37.5% by 2030, which is in line with the EU's plan to reduce total greenhouse gas emissions by 55% [1]. At the same time, a ban on the sales of fossil-powered vehicles is proposed, with an increase in the number of electric vehicles from the current 2 to 40 million, by 2030. European manufacturers import almost all lithium that is installed in car batteries, mobile phones and laptops. Almost 55% of the world's total lithium production is in Australia, followed by Chile (23%), China (10%), and Argentina (10%) [1].
The mineral jadarite, which was discovered in the Jadar valley, near Loznica, is presented as one of the most promising natural materials for the production of batteries, due to its high lithium content, which is the most important component for the production of rechargeable batteries used in electric vehicles.

2. LOCATION AND BASIC CHARACTERISTICS OF THE "JADAR" PROJECT

The planned location of the mine, accompanying infrastructure and production facilities is in the western part of Serbia, on the border with Republika Srpska, i.e. Bosnia and Herzegovina, about 15 km from the town of Loznica (Figure 1), in a highly agricultural area (Figure 2) with several thousand inhabitants. According to the available spatial planning documentation [2], the planned location will occupy the territory of the villages of Gornja Nedeljica, Brezjak, Slatina, Brnjac, Veliko Selo, Jarebica, Stupnica, and Shurice, with a population of about 4,000 people, in 1,422 households, in order to create conditions for the annual production of 1.6 million tons of the jadarite ore, 286,000 tons of boric acid, 58,000 tons of lithium carbonate and 259,000 tons of sodium sulfate. The planned working lifetime of the mine is 30-60 years, with 500-700 workers mostly employed in underground exploitation. The deposit of the jadarite ore extends 3 km in the west-east direction and 2.5 km in the north-south direction and corresponds to the so-called "Lower Jadarite zone", with estimated reserves of about 136 million tons (Figure 3).

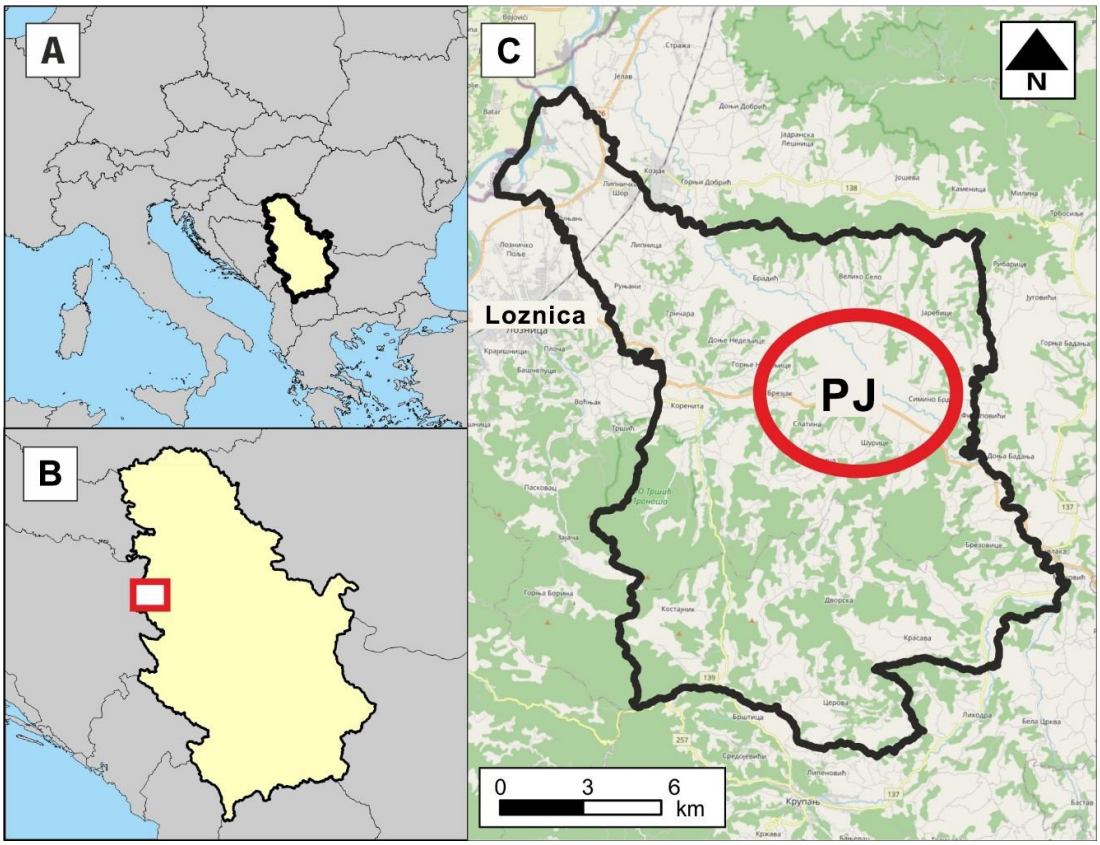

Figure 1. The wider and narrower locations of the "Jadar" project (PJ)

Exploitation fields cover an area of more than 100 ha and can be expanded by up to 500 meters, measured from the defined limit, to form the so-called "protective space" which is in the function of further mining activities, i.e. the expansion of the space provided for mining activities can be expected (Article 71, Law on Mining and Geological Research, Official Gazette of the RS No. 101/2015, 95/2018 and 40/2021).

Figure 2. Typical agricultural landscape in the Jadar valley (Photo: Ratko Ristić)

3. RESEARCH RESULTS

The preliminary estimated spatial coverage of the Jadar project is 2,031-2,431 ha [2]. Already in the initial phase of project implementation, 533 ha of land would be destroyed, of which 203 ha of forests and 317 ha of arable land (Table 1). The excavation of jadarite would be possible only after massive earthworks, and the process of ore excavation and groundwater abstraction would lead to the subsidence of almost 850 ha of land. The establishment of landfills in the immediate coastal zone of extremely torrential watercourses of the Korenita and Jadar rivers, would create a constant threat of torrential flood waves that could destroy the protective embankments and bodies of landfills, blow up toxic waste and permanently contaminate the entire valley. This could create the possibility of transport of large quantities of pollutants to the courses of the Drina and the Sava, with unpredictable consequences for the downstream sections, which include the coast of Sabac, as well as Makis, which is the water source of Belgrade. Only one planned landfill (near the village of Gornje Nedeljice; Figure 4) occupies an area of 19.5 ha, with 10-meter high floors, from level 137 to level 197, with a total height of 60 meters [3]. It is planned to dispose about 9.4 million tons of material (tailings and poor ore), on a 1.5 mm thick foil, to protect groundwater reserves from the leakage of toxic substances. The Jadar valley is one of the most important groundwater

reserves in Western Serbia, and its primary function should be to supply water to the population, refraining from activities that could disrupt the quality and quantity of this precious resource.

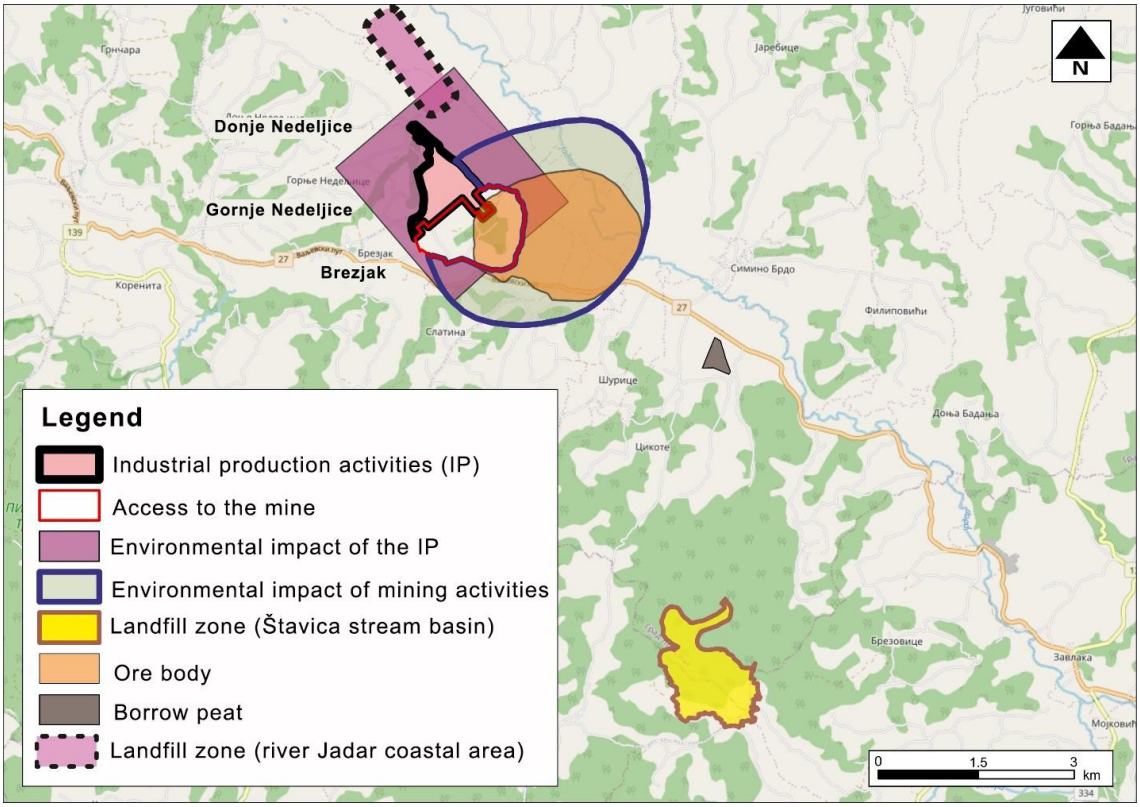

Figure 3. The layout of planned facilities and impact zones at the project location

In addition, the formation of one of the landfills is planned in the Štavica stream basin (on an area of 166 ha), where about 26,000 m^3 of wood mass would be removed, which would permanently destroy the ecosystem and economic services of the existing forests: protection from erosion and torrential floods; spring recharge; the conservation of biodiversity; favorable microclimatic conditions; tourist-recreational and hunting resources. Habitat destruction and fragmentation will have a strong negative effect on the living world, which includes several hundred plant and animal species, of which 145 have the status of strictly protected and protected species [2]. The "Jadar" project usurps the potential of the planned "Podrinje-Jadar" tourist destination, which includes the protected landscape of outstanding features "Tršić-Tronoša", a monument in Draginac and another 50 objects of architectural heritage and archaeological sites of historical, cultural and spiritual significance [2].

Figure 4. The potential location of a landfill (near the village of Gornja Nedeljica) (Photo: Ratko Ristić)

In addition, the project brings about a permanent usurpation of agricultural production, creating risks for water, air and soil pollution and transformation of a stable, nature-friendly landscape into a devastated and extremely polluted environment that diminishes the economic prospects of Radjevina and the town of Loznica.

Land use	**Area (ha)**
Forest and scrub	203,636
Agricultural land	316,694
Households	8,325
Orchards	4,199
Total	**532,854**

Table 1. Complete land use change in the initial phase of the "Jadar" project implementation

There are three major pollutants In Loznica and its immediate vicinity (Figure 5): the ruins of the abandoned complex of the cellulose factory "Viskoza" on almost 79 hectares (2 km from the city center), with large amounts of stored toxic and carcinogenic substances; the landfill of the Stolice mine (distance: 30 km) with 600,000 m^3 of antimony sludge; the landfill of the "Zajača" mine with 250,000 m^3 of antimony sludge and lead ore (12 km from Loznica).

Figure 5. The spatial disposition of the town of Loznica, the existing pollutants, and the planned jadarite mine

The location of the planned jadarite mine, with accompanying infrastructure, is just 15 km from the center of Loznica. It is a source of potential pollution of water, groundwater, soil and air. The results of soil resources research in ten villages of the Jadar and Radjevina valleys, on a total area of 4,821 ha [4] (villages: Bradić, Brezjak, Gornje Nedeljice, Donje Nedeljice, Donji Dobrić, Draginac, Jelav, Lipnica, Lipnički Šor, Straža), show a possible income from agricultural activities estimated at 81.96 million euros per year, or 17,000 EUR / ha.

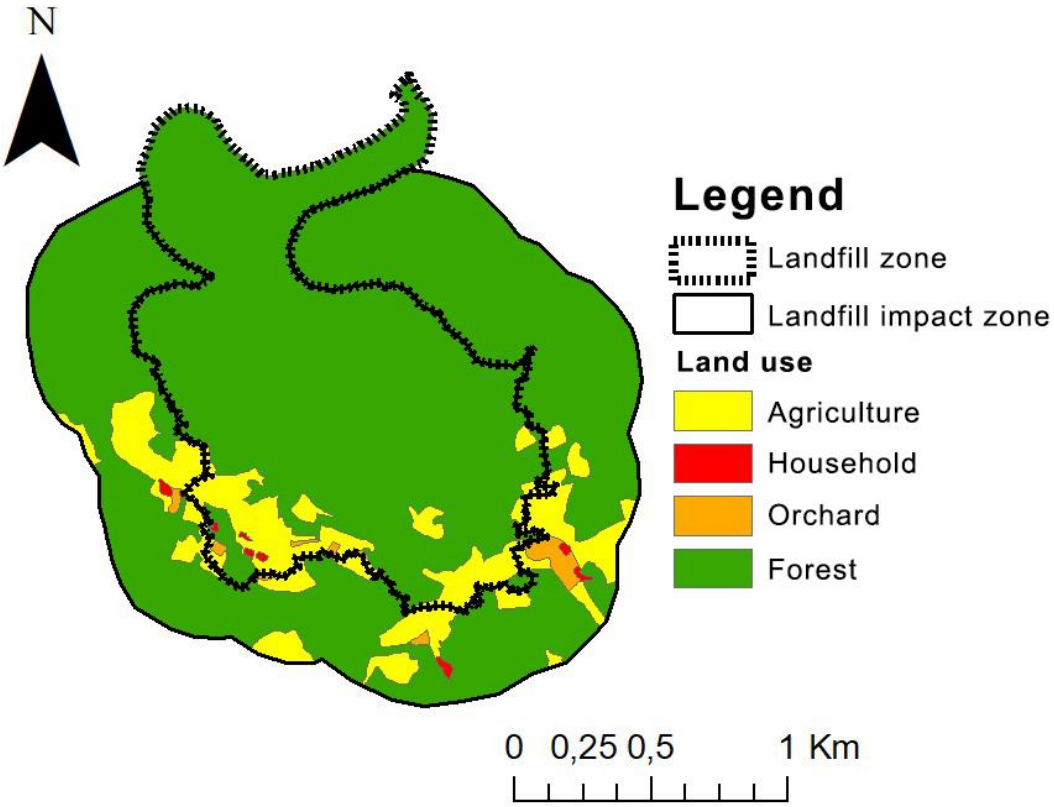

Figure 6. The surface structure of the Štavica stream basin

A highly productive use of agricultural potentials of the Jadar and Radjevina valleys is possible with an appropriate policy of incentives of the town of Loznica and the Ministry of Agriculture, Forestry and Water Management. The potential benefit of agricultural production far outweighs the income from ore rent and has no negative consequences on the quality of the environment and human health. In addition to that, numerous ecosystem services of the soil complex in the area of the planned project, that are expressed in monetary terms, were not evaluated: soil as a medium of water circulation, important for pedological and biological processes, the biological control of pests and disease vectors, capturing and storage of greenhouse gases, hydrological functions in erosion and flood prevention, retention of nutrients and pollutants and protection of water bodies, waste decomposition and detoxification [5], [6], [7], [8]. The minimum calculated value of the mentioned ecosystem services on the area of 4,821 ha is 9.642 million dollars annually. Only the hydrological functions in the prevention of soil erosion and floods are valued at 30-1,175 USD/ha, while the value of protection of water bodies from pollution ranges from 544 to 6,402 USD/ha.

4. DISCUSSION

The announced construction of a dam on the Štavica stream, to form a tailings dump (Figure 6), causes concern in case of a breakdown and spillage of the material. There is a known case of breakdown of a tailings dam (August 4, 2014), in the central part of British Columbia (Canada), in the Mount Polley mine, when almost 25 million m^3 of water and sludge, with huge amounts of toxic substances, polluted the soil, lakes and streams, and endangered the water supply, and salmon and trout habitats. The mine is owned by the Mount Polley Mining Corporation, a subsidiary of Imperial Metals, to which no legal sanctions have been applied [9]. If this happened in a highly developed and regulated country such as Canada, can anyone guarantee the safety of a similar facility on the Štavica stream? Of course, the planned removal of the forest ecosystem (150 ha) in the mentioned stream basin (clearcutting, which is prohibited by the Law on Forests - Article 9, paragraphs 1, 2, and 3) would lead to a disruption of the hydrological and psamological regime of watercourses, with a severe degradation of biological diversity. The removal of vegetation accelerates soil erosion, causes the drying of springs, disappearance of the living world in the basin and the riverbed, with a high risk of destructive torrential floods. This type of land degradation corresponds to the term "desertification" and represents a direct negation of the principles of "RIO" conventions (UNFCC-climate change, UNCBD-biodiversity, UNCCD-fight against desertification and land degradation), which have been ratified (confirmed) in the Serbian Parliament, and have the force of international laws. In addition, this project compromises the United Nations Sustainable Development Goals (especially goals: 3, 6, 11, 13, 14, 15, and 16) and the accepted Agenda 2030, as well as the domestic legislation related to nature protection.

In 1896, when the rapid development of the automobile industry began, it started the mass exploitation of rubber for making automobile tires. One of the most important rubber deposits were the forests of Congo, then a Belgian colony. Leopold II, King of Belgium, ordered intensive exploitation of rubber by private companies, in conditions of unprecedented brutality against the indigenous population [10].

At least six million people were killed, several million mutilated (by cutting off of hands or entire limbs) due to non-compliance with norms or punishments. Today, 125 years later, there

is again talk about the development of automobiles, this time electric vehicles, in a moment when Europe is trying to eliminate its dependence on Chinese battery manufacturers and reduce carbon emissions, while Serbian officials are promoting the Jadar project as a great development opportunity. At the same time, they either do not know or do not want to know that lithium is present in many European countries, where its exploitation in a way promoted in Serbia is not possible. Unfortunately, Serbia is being imposed the status of a modern colony, as a cheap resource base where it is possible to apply invasive, devastating technologies, with distinctly negative impacts on the environment, and the lowest possible costs for investors. This is a consequence of the hypocrisy in the relationship between European Union and Serbia, the servile attitude of the Serbian political "elite", the present system corruption, and weakness of the legislation and ignoring of the interests of Serbian people. The "Jadar" project is presented to the Serbian public through propaganda messages about the advantages of lithium-ion batteries, the growing demand for lithium at the global level, and the "historic" chance of Serbia to be a leader in the production of batteries for electric cars. This is an extremely debatable position in line with the fact that sodium-ion and graphene batteries, as well as the application of hydrogen technology, are already being preferred when it comes to electrically powered cars. The latest generation of sodium-ion batteries shows all the required performances [11], [12], [13] and incurrs lower production costs, which is why the world's largest manufacturer of batteries for electric cars CATL (Contemporary Amperex Technology Co.), a supplier of the Tesla Corporation, announced transition to their mass production instead of lithium-ion batteries starting in 2023 [14], [15].

GAC (Guangzhou Automobile Corporation) has announced promotion of the Aion V electric car, with graphene batteries, which allow autonomy of up to 800 km after an 8-minute charge and the use of a single set of batteries for about 1,000,000 km [16]. Germany has the largest reserves of lithium in Europe, which is dissolved in the warm groundwaters of the Rhine Valley, in the amount of 200-400 mg/l, at a depth of 3 to 5 km. The warmth is used for heating, the lithium separates on the filters and the cooled water is returned to the underground. In this process, there are no massive excavations, the use of acids or explosives, no formation of giant landfills, or the risk of water, air and soil pollution. The beginning of commercial production is planned for the middle of 2024, and already in 2025, five factories will produce about 40,000 tons of lithium per year, which is enough to produce batteries for about one million electric cars. Lithium produced in this way will be significantly cheaper, due to lower production costs. Therefore, the contracts have already been signed with leading

manufacturers of batteries and electric cars [17]. In 2020, "Cornish Lithium and Geothermal Engineering Limited" Company started a project to extract lithium from warm groundwater in the Cornwall area (South West England). The average concentrations of lithium are around 220 mg/l, with small amounts of other solutes, which enables relatively cheap and environmentally safe exploitation, which is the reason for marking these reserves as "globally important" [18].

Significant lithium reserves have been identified in Finland [19], Austria [20], and Portugal [21], so that from this perspective it sounds strange to estimate that Serbia has 10% of the world's land reserves, with suggestive messages impying that work on ore exploitation should begin as soon as possible. The growth in the number of produced electric cars leads to an increased demand of components made of specific metals and minerals, intensification of mining activities, degradation and destruction of ecosystems, pollution, and an over 38% increase of greenhouse gas emissions, than in diesel and gasoline car production [1]. The international reputation of the company "Rio Tinto" (in Spanish: red river), does not instil confidence in the safety of production processes, environmental protection, and treatment of workers. The examples of horrifying Rio Tinto practice worldwide (Panguna-Bougainville mine, Papua New Guinea; Freeport-Grasberg mine, Indonesia; mines in Cameroon, Mozambique, Madagascar) point to enormous levels of water, soil and air pollution, worker diseases and food shortages, total destruction of ecosystems, local war conflicts with thousands of victims and mass displacement of the local population [22], [23].

The company "Rio Tinto" is known for its copper, iron and gold mines, without significant references for the exploitation of lithium. Their intention to transport an experimental ore processing plant from Australia to Serbia is known, and the only location where they have their processing plant installed (with a capacity of 10 tons of lithium per year) is at the location of Boron, in California (USA). Thus, a company with no significant experience in lithium mining and processing announces "the largest lithium mine in Europe at least in the next decade." [24].

Serbia has no material or moral obligations to destroy primary natural resources and displace its population, to support the European Union in its efforts to reduce strategic imbalances in the production of batteries for electric cars, reduce carbon emissions and provide cleaner air for the residents of London, Copenhagen, Davos or Heidelberg. A good example of the

correction of the original plans is the announcement of the Portuguese government that it will suspend a lithium exploitation project in the area of Montalegra (initial investment of 0.5 billion dollars), due to an unconvincing Environmental Impact Assessment Study and great pressure from the local population. The project is planned on a location that is recognized as a globally important area of agricultural heritage, under the patronage of the United Nations. The planned occupation of 825 ha, the formation of mines, and ore processing capacity, the obvious threat to traditional agricultural activities, and the environmental quality triggered the mass uprising of the local population [25].

Of particular concern is the behavior of the Ministry of Mining and Energy, which often acts as an advocate for the interests of mining companies (foreign and domestic), neglecting the vital interests of the local population, while showing an extremely superficial attitude towards the problem of environmental protection. The so-called exploration rights for lithium (and other mineral resources) are easily granted, so in addition to Loznica, the towns of Valjevo and Jagodina, the municipalities of Požega, Gornji Milanovac and Rekovac are already targeted. Strict control over the work of this ministry is required, because it is obvious that someone sees Serbia as a cheap resource base that will give its most valuable natural potentials, regardless of the complete environmental degradation and endangering the vital interests of its population. The existence of an "Action Plan for the Displacement of the Population" [2], which deals with the relocation of the population of Jadar valley, is questionable.

The plan is already being implemented without the interference of the town of Loznica and state institutions. In the conditions of such an attack on the area where people mainly earn their living from agriculture, almost all of the land is cultivated, villages regulated, and where the harmony between human needs and nature protection is visible, the following question arises: “Whose interest is the realization of the "Jadar" project?“ However, the most difficult thing to accept is the fact that the private company "Rio Sava" (Serbian branch of "Rio Tinto") executes the displacement of the local population through the purchase of their properties, with the tacit support of the town of Loznica and the Serbian state. After all the troubles that have befallen them in the past 30 years, are Serbian people now facing the lack of existential security in their own country?!

5. CONCLUSIONS

- The realization of the "Jadar" project leads to massive spatial devastation, permanent change of the landscape character, degradation of biodiversity, soil, forests, water and groundwater, displacement of the local population, termination of sustainable and profitable agricultural activities;

- A scenario of permanent risk to the health of the inhabitants of nearby villages and the town of Loznica is being established;

- The destruction of primary natural resources, displacement of the local population, and constant risk of pollution are not indicators of pursuing the national interest;

- Ethical, ecological and social aspects of the implementation of the "Jadar" project are unacceptable;

- Urgent changes in legislation and strict control of the work of the Ministry of Mining and Energy are necessary;

- The continuation of uncontrolled implementation of similar mining projects would lead to serious ecosystem disturbances, environmental degradation and would be an indicator of the inability of the state and the wider community to realize the harmfulness of such activities to the public interest;

- The preservation of a healthy environment and respect of the existential security of the population represent basic human rights in accordance with the Constitution of the Republic of Serbia.

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