

Review paper

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ANALYSIS OF CONFLICTS IN THE USE OF SPACE IN MINING BASIN “KOLUBARA”

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Abstract: Consequence of impact of the surface exploitation on the environment is manifested in the form of physical, social, and environmental conflicts. The dominant conflicts of the Kolubara lignite basin space occurs between mining and agriculture, which indicates the importance of the process of rehabilitation and revitalization of contaminated land and its effective bringing to the original purpose. Another significant conflict appears between the existing settlements and mining, infrastructural, water management and other facilities, which are located in areas of mining works, so the solution is in their displacement. As consequence of development of the mining-energy-industrial system there is an adverse impact on the environment, which is reflected in the pollution of air, land, groundwater and surface water. Ecological dimension of this conflict presents clear and limiting factor for the mine development, which directly points that the economic development of mining basin “Kolubara” is directed toward the rational exploitation of natural resources (coal, water, land, etc.). In the process of harmonization of these conflicts, it is necessary to take into account that the energy policy acts at the national level, as the public interest, and therefore has priority over all other interests.

Keywords: Kolubara lignite basin, conflict, development, urban planning

Introduction

Kolubara lignite basin extends between 44° 39' and 44° 45' of the north geographic latitude and 19° 53' and 20° 30' of the east geographic longitude in an area of 547.14 km². From the aspect of exploitation possibilities, the basin occupies an area of about 139.9 km². Available exploitable reserves are estimated at 1.230 million tons. According to current estimates for 518 million tons of coal is planned to be used until 2020., which will result in “occupation of about 50 km² of forest and agricultural land, as well as relocation of 10 villages with approximately 6.000 inhabitants” (Spasić N., Vujošević M. 2009).

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Methodology of work

The subject of work is reflected in the research and analysis of spatial conflicts occurred as a result of intensive development and expansion of mining basin "Kolubara". Discussed factors that affect the creation of development conflicts such as the incompatibility of business functions (mining and agriculture), the concept of public interest and its importance in the process of expropriation; problems caused by the relocation of settlements, households and infrastructure, a high level of environmental pollution.

The aim of this paper is to show the possible approaches for mitigating and resolving of spatial, ecological and social conflicts and contradictions caused by the exploitation of lignite. By presenting the issues of transformation processes in the influence area of the mine works, it is perceived the importance of planning guidance, control regulation and utilization of space.

The methodology of this paper is based on the analysis of research and analytical documents containing information about the state of lignite basin, its potentials and limitations, and the impact of the mining-energy- industrial system Kolubara on the environment and its presents the basis for the implementation of inductively deductive method, as well as the method of analysis and synthesis. The achieved results, obtained by the individual areas, were the starting point for the evaluation and ranking of development goals. By applying the method of analysis and synthesis, as well as comparison of domestic and international experience, the task of this paper is to emphasize the importance of certain acts and to draw an attention to all possible actions that should be taken in order to mitigate and neutralize the spatial conflict.

Occupation of land for the surface exploitation of lignite

The largest part of Kolubara lignite basin is agricultural land 76.1 %. By expanding of the surface mines come to repurposing of land and the incensement of infertile surfaces. Incompatibility of the mining production functions on one hand and of agriculture on the other hand points to one of the main conflict. Land as an economic and natural category is limited good that is not able to increase itself and it is the part of the renewable natural resource. From degraded areas, it has been recultivated 870 ha of forest land, 298 ha of agricultural land, 17 hectares of orchards, 12 ha of nurseries, for a total around 1.197 ha.

Table 1. Reclamation of degraded land areas

Reclamation of land	in (ha)
Agricultural land	298
Forest land	870
Orchards	17
Nurseries	12
Total	1 197

Source: Popadić V., Tojaković M., & Todorović N. (2005)

According to Nikolic and Jovanovic (2009) by the expansion of the “Field E”, village Zeoke will lose about 40% of agricultural land until 2020, followed by Baroševac village, where, by the expansion of “Fields B/C”, will come to the temporary occupation of about 31%, and Medoševac with 16% of the agricultural land. Bonnet structure of Kolubara lignite basin “ is characterized by high proportion of land degraded by mining activities (V and VIII), on the one hand, and land without major constraints for the intensive and diversified agricultural production (I and II) on the other hand (Nikolić, Jovanović 2009). Occupation of land for the needs of surface exploitation is a temporary and time-limited, while the programs for the implementation of rehabilitation and revitalization of degraded space must be defined in the initial phase of technical and technological design of mining works.

It was partially taken care of the selective disposal of tailings in procedures of the reclamation, and it did not come to any planned interference of layers in order to get the optimum granulometric composition. The result of these proceedings is that on the surface there is either sand or heavy clay, whose biological properties are not suitable for agricultural or forest production. The process of digging on the surface mines of Kolubara lignite basin is done by excavator-transporter-stacker system, whose main role is excavating of overburden above the first layer of coal. However, the excavations in this way does not give the best results, because with such work the capacity of the overburden excavation decreases and this system is difficult to fit into the delay function, because of the low probability of matching the height work of an excavator and a stacker (*Studija o proceni uticaja na životnu sredinu za PK „Polje C“*, 2011).

In the initial stages of the opening of the surface mines, so-called external landfills are formed in an attempt to occupy as little as possible of fertile land. Landfills are lifted up to the maximum level, which is why it is technically

impossible to turn them into lands suitable for agricultural production, so the recultivation is often done by the reforestation. Technical recultivation involves leveling of the landfills and making horizontal surface with a small drop of 1-2°, as well as making of drainage network for controlled drainage of surface water. Leveling is done by bulldozers and making channels with excavators. In order to achieve a better quality of land on a landfill, the phases formation of overburden is done in, which involves reclamation of the overburden layers one to other, of a certain thickness, to the projected elevations. Humus layer of land is placed on the surface at a height of about 0.5 meters followed by the stabilization process of land.

At landfills, which were previously excluded from the exploitation until 1992., such as villages Zeoke and Baroševac, biological recultivation was conducted. Besides that, on about 115 ha plant cover was established by spontaneous fouling of overburdens with plant species that indicate on the enormous potential power of plants in the close surroundings of mining works. The research results indicate that, in the first year of fouling, over forty plant species occur, while the most successful are the mixture of spontaneous and indigenous species in combination with some of the cultivated plant species of, primarily with alfalfa, what should be applied in the future as a solution for the implementation of biological cultivation. At approximately 43% of the total area of the Kolubara lignite basin phytocenoses, in which forests dominate, were established.

Table 2. The structure of forest plantations on reclaimed land

Reclamation of land	In percentage (%)
Coniferous culture	53
Deciduous culture	15
Mixed cultures	23
Total area under forest plantations	91

Source: Nikolić M. & Jovanović B. (2009)

During the first years of recultivation, forestation was done with black pine, which develops branched root system with mail vein that penetrates deep into the substrate and requires a minimum of conditions. The current structure of forest plantations makes up 53% coniferous, 15% deciduous species, 23% of mixed cultures (Nikolić M., Jovanović B. 2009). This means that coniferous covers 68% of the area and 32% of deciduous crops, and in order to boost the pedological process it is necessary to increase the proportion of broadleaf crops. By analyzing the results of height gain, good results gives black pine in sandy

loam, and alder and linden of deciduous. Based on the Spatial plan of Kolubara lignite basin from 2008., in the period from 2005. to 2020., by recultivation of the landfill, it was plan increasing of the forest area, it was anticipated increasing from the current 3100 ha to 4807 ha. Forestation of significant size can be calculated only after 2020. (Nikolić M., Jovanović B. 2009).

Recultivation for the purpose of agricultural production recovery, involves preparing of the land substrate, cultivation of certain crops and proper land preparation. During the first years, an advantage in growing has grasses and legumes that increase the amount of organic matter and nitrogen in the land. Later, other crops can be grown. However, the best economic results give planting of orchards. The flattening of landfill field "B" started during 1985, for organizing of the intensive production of field crops and fruit crops. On deposol in Rudovci, plantations of fruit trees and vines are planted. According Čolić, Zec and Rosić (2008) planting was done in the spring of the 1986, in area of 5.4 ha on the ground with the fall of 3%, from south to north. A greater number of species was used, cultivars and rootstocks of apple stone fruit and nuts fruit, berry fruit and vines. The results of the research showed that the examined cultivars of apples began to breed after three years, quinces and plums began to breed in the third year, and the highest viability of the examined nuts fruit showed nut. During 20 years, not a single quince tree had dried, while the existence of little depression in the orchard influenced to dry a small number of pear trees, and a small percentage of drying has been noted in apple orchards of 1.5% and plum of 3%. This experiment demonstrated that the good results in terms of the vitality achieved apple fruits (quince, apple and pear) and stone fruit - plums (Čolić S., Zec G. & Rosić O. 2008).

From the crop yields at the level of the national average gives the production of wheat, corn, sunflowers, but there are many indicators suggesting that the quality of the grain is unsatisfactory. Experimental recultivated land can be used for production of many kinds of vegetables; especially good results are achieved with carrots and potatoes.

Purpose and use of recultivated land in the future

Due to the need to provide strategic assessments in the energy sector, which are based on long-term prognosis for period of 20 - 30 years or longer, planned prediction of spatial development of the mining basin can often be unreliable. Besides the basic forms of land use in the future, such as agricultural and forestry production, there are also other possibilities. On revitalized and recultivated land due to the proximity of Belgrade and higher education

institutions, it is possible to plan a unique complex intended for scientific research, which is certainly carried out, taking into account the various experiments from different fields that are made in the area of Kolubara basin. Tourist zone, according to current plans and projects, is planned in the central part of the basin. The goal is to create an environment that will be different from other conventional tourist zones.

A good example of unconventional tourist center is in the northern part of Greece, in mining areas of Western Macedonia. In this area 40 km² of degraded land has been rehabilitated so far. It was used the landfill near the oldest lignite mines and multifunctional center has been made, which consists of an open theater, a health center for the employees of the mine, school courses in the field of mining. Center includes space for experimental farming, nursery, church of St. Barbara, patroness of miners (Kavouridis K. 2007).

Residual depression of the surface mines after arrangement, can be used not only for water management purposes (as the basins for sedimentation and deposition of water for agricultural purposes, est.), but as ponds, for water sports, scientific research of ecosystem. The existing lakes need to be cleaned and arranged, the coast needs to be covered with sand and gravel, form meadows and open clearings within the forest massif, build walking paths and other communications. Agricultural areas, according to the plan, can be located around the perimeter of the basin. The role of such intended area is, in a time of increasing need for food, to produce food in sufficient quantities. With disappearance of mines, majority of the population would have to change occupations (farming) (*Studija o proceni uticaja na životnu sredinu za PK „Tamnava- Zapadno polje“*, 2011).

The establishment of stables and building of the Hippodrome is planned, at part of abandoned coalmine "Tamnava East Field", an area of 17 hectares on the border villages Cvetovac, Vreoci, Veliki Crljeni. Hippodrome is being built with the approval of the mining basin "Kolubara" management and the Power Industry of Serbia. In the plan is to build track, football and golf courses, which along with existing sport-shooting range and two artificial lakes in Cvetovcu form representative tourism offer.

Definition of problems and conflicts in the process of expropriation

The first research on the living conditions of the population and emigration from the lignite mines region were carried out in eighties of the last century. Problem

of emigration was focused on several issues: on the possible directions of displacement, defining reasonable time for displacement, the appropriate informing of the population about planned works, ensuring fair conditions of displacement.

Expropriation is done in the favor of the State for the purpose of achieving the public interest, such as the expansion of industrial zones for exploitation of mineral wealth. It presents a process of forced expropriation that implies a fair price that is equal to the market value of the expropriated property.

The 405 households were relocated in Kolubara basin area from the mining works until 1983. Constantly growing of need for energy and further exploitation of the lignite caused a resettlement of numbers of villages that were spared in the previous period. In recent decades, for need of exploitation, over 1,600 households have been moved in 15 villages. The resettlement between 1,200 and 1,500 households from 9 villages is expected until 2020., with the possibility that some settlements could disappear for ever (Vreoci and Mali Borak). Based on surveys of households that had to leave their homes because of the exploitation of lignite, a large number of inhabitants pleaded that reluctantly change their place of residence, while the decision for resettlement perceived as coercion. "Due to the previous experience, the problem of forced resettlement, respectively the resettlement caused by the expansion of open surface mines, nowadays is put in the context of social sustainability. The basic principle of sustainable development is the improvement / enhancement of human prosperity, with the aim that later generations live life as good, or better, than their parents' life" (Jokić V., Petovar K. 2010).

Problems and conflicts of relocation of settlements are reflected in the redistribution of economic and other functions among settlements, changes in land use, in finding locations for new settlements. Resettlement is done in stages, leading to disruptions in the functioning of the existing settlements, through relocation of the public services buildings. Settling in already established settlements initiates the problem of providing building land for the formation of new lots, as well as the adaptation of a relocated population. An important is the problem of property rights and a form of compensation that may be in cash or in goods - land. The Institute of Architecture and Urban & Spatial Planning of Serbia in 2005. conducted the survey in Vreoci, which showed that in the structure of household types are represented the traditional three-generation families. In the process of expropriation, it comes to segregation - "splitting" of multigenerational households and separating of the older generation. "Elderly households" are formed in which it is necessary to provide adequate social

protection. To the segregation of households comes because of the way for determining the compensation for expropriated property.

Relocation of the settlements and the population is a problem that must be solved in consultation with the population. The aim is to defuse conflicts and to reduced the negative effects to a minimum, as well as that resettled population get better conditions on new housing sites. An example of conflict of interest in the process of expropriation within the mining basin "Kolubara" is the settlement Vreoci. The conflict resulted in the decision of the Administrative Court in Kragujevac 2011, by which was annulled the decision of the Government of the Republic of Serbia, which set a general-public interest for the expropriation of the property in the settlement Vreoci for expanding the surface mines. As the main reason is a stated disrespectful right of citizens to participate in the process of expropriation.

In the process of determining the public interest, the highly significant are scientific research institutes, university centers, non-governmental organizations, that should develop a comprehensive strategy and establish the control over the strategies of energy companies, whether they are in private hands or in the state government hands, which has a dominant role in controlling the creation of national energy policy. The basis for determining the public interest should form the results obtained in scientific research, rather than a partial political interests. The problem of political domination and conflict of interest in the development of the mining basin also had countries of Western Europe, and it was best described by the German statesman Walter Ulbricht, saying "It has to look democratic, but we have to have everything in our hands" (Jeffrey H.M. 2006).

In order to prevent conflicts and problems that occur in the process of expropriation it is necessary to respect the "right to be informed, including the right to access to information on environmental conditions and access in the procedures and participation in decision-making related to the quality of life of citizens" (Petovar K. 2003).

The Institute for Architecture and Urban Planning of Serbia with the holders of the planned activities in the development of spatial plans at the Kolubara lignite area included the resettlement program, as an integral part of the planning

documents² in the zone of the mines expansion. This program defines the concept of resettlement, conditions, dynamics of the population resettlement and the settlement (cemeteries), manner of gaining rights and obligations of participants in the implementation of resettlement, conditions for implementing the social safety program, a way to relocate cemeteries and relocation cost estimates.

In addition to the settlements, development of the mining-energy-industrial system is not possible without the relocation of infrastructure systems (roads, power lines and streams) from the surface mines zones. The goal is reflected in the rationality of construction and the formation of unique and functional infrastructure corridors. By 2015 it was planned relocation of watercourses Kolubara, Peštan and Lukavica and heir tributaries, state roads of I and II order, power and other infrastructure systems. The ideal solution was that all infrastructure systems follow the route of one corridor (Vlada Republike Srbije, 2008).

Ecological conflicts

Surface mines are specific units that can not be located according the legal and technical requirements and parameters such as the distance in relation to the settlements, traffic flows, and the quality of the land according to capability classes. They open where the mineral deposits are and can not be relocated, spatial shape or organize. They can be located next to settlements, on the quality land, in areas that are interesting for tourism, even in national parks. In the area of Kolubara basin there is a large number of concentrated, bulk and line contaminants, which are unevenly distributed in space, and which are in conflict with the sensitive elements of the space such as air, land, groundwater, surface water, agriculture, flora and fauna, etc. Air pollution from the point sources was consequence of outdated or not well-maintained technology in the industrial sector, as well as the lack of facilities for purification of flue gases. The major air pollution results from fossil fuels of poor quality that includes the lignite. Basic characteristics of the lignite are low calorific value, high moisture content, which combustion produces large amounts of ash, sulfur and nitrogen oxides.

² Urban development plan Vreoce-2008. year, the General Regulation Plan for the settlement Baroševac, Zeoke, Burovo, Medoševac-2008 and construction design for surface mine zone "Radljevo"

According to the Republic Agency for Spatial Planning (2010), in the Kolubara basin, there are the thermal power plants "Nikola Tesla A and B" as well as thermal power plant "Kolubara A", their installed capacity is 3160 MW, emits 162,000 tons of sulfur oxides (SO_x), 38,280 of nitrogen oxides (NO_x) and more than 18,000 tons of particulate matter per year. Thermal power plants produce 6-8 million tonnes of low-toxicity dust, which causes uncontrolled secondary emissions, and they are equipped only with electric filters. There are no facilities for desulphurization or reduction of emissions of nitrogen oxides.

It is the best to look for the solution within the concept of "clean coal." The concept involves the modernization and replacement of the existing installations and the construction of new thermal power plants for reduction of the emissions of SO₂, NO_x, ash. The vision of the future in line with this concept is presented by the zero CO₂ emissions, and implies the process of capture and storing of CO₂ produced during the combustion of fossil fuels (European Association for Coal and Lignite, 2007). On the ninth Council of the UN Commission for Sustainable Development, it was decided that the technology of "clean coal" economically should be available "in developing countries, as well as income countries with economies in transition, in order to achieve common interests and influence the reduction of the global CO₂ emissions" (World Energy Council, 2004).

Technology of lignite processing is done within the company "Kolubara-Processing" in Vreoci and includes the wet separation process - cleaning coal in a difficult environment, then drying and classification. As a waste product of this process occurs barrens (about 300 000 t, which is disposed at the landfill) and wastewater with high concentrations of organic and inorganic substances, which drains into the treatment plant. In the process of wastewater treatment, separation and settling of particulate matter is done, and derived sludge of the coal dust is transported away in the plant for wastewater treatment. From dryer is emitted during the process of separation and drying of coal an average of 410g/h H₂C, 180 g/h CO₂, 23 g/h NO_x, 38 g/h of phenol, and 1.82 kg/h of solid particles. Within the "Kolubara-processing," Heating plant produces thermal energy in the form of steam, which is used in the drying plant, as well as for industrial heating, greenhouse and town Lazarevac. According to the measurement results from the Heating plant is emitted in the atmosphere 42 kg/h of carbon monoxide, from 298 to 322 kg/h of sulfur dioxide, 34 to 72 kg/h of nitrogen oxides, from 0.525 to 1.970 t/h of solid particles. Drainage of flue gases is done through electrostatic precipitators for separation of ash, and then through the reinforced concrete chimney, height of 80 meters, a diameter of 3 meters. Ash and slag are mixed with water in the ratio 1:8 and then hydraulically

transported to the landfill in Junkovci, area of 54 ha. Wastewater from the Heating plant with water from other processing is undergoing treatment process (*Studija o proceni uticaja na životnu sredinu za PK „Polje C“*, 2011).

Supporting industry is the company "Kolubara-Metal" Vreoci, which is specialized in producing, repairing and installation of machinery and equipment for the production of coal. It also has driven of foundry gray iron, bronze and silumin. In the production process, the gases pollutants are emitted CO₂, CO, SO₂ and smoke, these gases are emitted into the atmosphere through the 6 meters height chimney.

"Kolubara-Universal" in Veliki Crljeni, was presented with three drives: the production of raw rubber, production of technical rubber goods, and the production and regeneration of rubber conveyor belts. Annual capacity is 10.000 tons of raw rubber, 750 t rubber-technical belts, and 90,000 m of conveyor belt. In the production process, the classic rubber technique is used, and is followed by the production of air pollution by solid particles, steams, gases, organic solvents. Wastewater from the drives is purified in the plant "Biorol", before discharge into the river Turija. Solid waste is presented as municipal waste and scrap tires.

"Kolubara-Gradevinar" in Vreoci, produces building materials-light gas concrete blocks. As the raw material is used is quartz sand, lime, cement and aluminum powder. These raw materials are united and poured into molds that are exposed to the thermal treatment. This process is accompanied by pollution of air, land and solid particles, noise emissions and making a solid waste.

On the surface mining basin Kolubara "with continuing exploitation, every 10.000 tons of coal ruin 1.000 hectares of land" (Crnčević T. 2009), in the process of mining overburden the air is polluted with mineral airborne dust. The intensity and amount of fraction of suspended dust in the air depends on the primary point sources: excavators digging, excavators Spreader, supporting machinery, while secondary sources are all active areas, roads, overburden landfills, which by the influence of wind, emitted particulate fractions of deposited dust. Air pollution with dust is in conjunction with meteorological conditions, which means that during drought periods the fraction of dust is major air polluters. The solution is reflected in the actions of removal of dust through the processes of condensation and impoundment- by using a sprayer (*Studija o proceni uticaja na životnu sredinu za PK „Polje C“*, 2011).

As a consequence of the surface mining operation there is a change of the hydrological regime of the basin, due to the lowering of groundwater and water pollution. By lowering of the water level comes up to ground subsidence. "According to the analysis made so far and the calculations related to drainage pits "Tamnava - East Field" and "Tamnava - West area", settlement of the field of the future thermal power plant "Kolubara B" will be about 80-100 mm, while in the main corridor M 22 and the Belgrade-Bar railway is expected to be ground subsidence over 500 mm impact ("South field")" (Spasić N., Džunić G.& Đurđević J., 2009).

Present concept of sustainable spatial development, based on a policy of sustainable economic development, emphasizes the reduction of raw material processing and on the clearly defined and sustainable use of renewable resources. Sustainable development of the mining basin "Kolubara" must be based on knowledge, the application of technological innovation and efficient use of resources, including planned coal mining in accordance with modern economic and environmental standards, and real strategic needs of Serbia.

Conclusion

As part of the development goals of Kolubara lignite basin, priority is given to mining, but efforts are being made to the regeneration and revitalization of degraded land. For now the only way to resolve conflicts, arising from the incompatibility of business functions is the introduction of the priorities that are in the wider public interest. In the exploitation of natural resources, the basic requirements are their efficient use, which contributes to the growth of collective standards on the one hand, and respect for environmental and spatial constraints on the other. In order to achieve balance and avoid conflicts it is necessary to use resources (lignite, surface and ground water, agricultural land, etc.) rationally and try to gain the maximum of an economic equivalent in resource utilization.

Minimizing of the loss of agricultural land in size and quality can be achieved by the controlled distribution of the energy facilities, by the planned deposit of waste materials and reuse of the humus layer. Of great importance was the availability of practical experiences of developed countries in the process of recultivation and rehabilitation of degraded areas. Relatively high natural fertility of the land can meet the needs of domestic demand in agrarian products. This is affected by a favorable geographic position in relation to Belgrade, a large center in the consumption of food and vicinity of food industry (Valjevo, Lajkovac Obrenovac et al.). Agricultural production can be increased by using

maximum abundance of warm wastewater from thermal power plants, favoring development of profitable cultivation under plastic and glass production.

For now, due to the frequent omission of selective overburden and deposit of the humus layer during the lignite mining, forests are preferred in relation to agricultural reclamation, especially if it is considered from the standpoint of environment-friendly and safe production of biomass. Increased demand for technical wood on the world market indicates the possibility of return of previous investments.

Conflicting interests in the use of space in large mining basins often slow down its development. Therefore, the dominant role in the development of lignite basin has development strategies and their possible effects, planning and directing of the spatial development in direction of certain purposes. In the implementation of planning objectives, it is necessary to provide the necessary conditions for the further exploitation and processing of lignite, in accordance with the legislation. The priority has reparation of damages caused as a result of mining activities, than protection of social, economic and living conditions of the population, the implementation of technical and technological measures in the production process and the application of all environmental measures.

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