

Land Use in Large Mining Basins in Post-Exploitation Period: The Example of Serbia

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Abstract

The paper highlights the problems of land use change and land degradation in large mining basins and focuses on the possible directions for resolving the spatial, ecological and social conflict in large mining basins in Serbia. Special attention is paid to the problems of land sanitation and recultivation in large open pit mining basins in Serbia (Kolubara, Kostolac-Kovin and Bor-Majdanpek basins) and to certain “black ecological spots” in these basins, regarding the fact that recultivation and remediation of degraded land in Serbia is mandatory. In that sense, a review of legislative, institutional and organizational measures is provided. Also, important aspect that the authors consider is the possibility of using the expropriated land in the post mining period and ownership transformation that process of expropriation entails.

Relevant results are shown through the analysis of land recultivation dynamics in the previous period and of a numerous spatial-planning documentation regarding those large mining basins. It is expected that paper will give a contribution to some possible directions for the use of degraded / recultivated land and to land policy for the sustainable spatial and regional development in Serbia, respectively.

Keywords: land use, land degradation, large mining basins, open pit mining, recultivation, Serbia

Introduction

Land use in Serbia is regulated by several laws, but these sectoral treatments of land cause a numerous spatial, ecological and social conflicts in spatial development. One possible way to overcome these conflicts is consistent land policy, which has the aim to achieve sustainable land management and access to land use, including land tenure rights (Popović and Živanović Miljković, 2013).

For a long period, the development of mining activities in Serbia was occurred by occupation of agricultural land and, partly, of building areas in rural settlements. Expansion of open pit mines necessarily lead to a limitation of the spatial spread of the surrounding settlements, resettlement of people and infrastructure, relocation of watercourses that are in the direction of expansion of mines, but also to a high degree of environmental vulnerability by pollutions from energy-industrial complex. Encouraging in such a situation is that numerous studies have shown that in areas degraded by mine can be created new agricultural, forest, water, grassland and other ecosystems (Jovanović *et al.*, 2005).

There is increasing competition between land use for agricultural and non-agricultural purposes (Živanović Miljković *et al.*, 2012). Open pit mining brownfields and agriculture are the main competitors for land in the area of large mining basins in Republic of Serbia. In 2012, the Government of Republic of Serbia established the Strategy of mineral resources management, which, as the relevant strategic document, defines the dynamic plan of development until 2030 and refers to all segments of the mining industry in the country. Starting from the geological potential and the need to improve the work of the mining industry, the competent ministry

department has determined the long-term goal - to increase the participation of the mining industry in gross national income from the current 2% to over 5% by 2020.

However, the development of open pit mines as energy-industrial complexes are followed by numerous negative impacts on the environment, which binds to the integrated planning, rehabilitation and development of degraded areas and their versatile use in the post-mining period. Subjects of degradation due to mining activities in the large mining basins are: (1) tier flat of open pit mines, which should be joined to the areas in its directly vicinity, with accompanying mining activities, such as ore transport, slag, mining machinery and equipment, objects related to mine drainage, objects under the direct influence of noise, dust and flying pieces (which are the result of demolition), (2) external overburden dumps and overburden materials³⁸, (3) zone of mineral refining (crushers, flotation, separation, dryings, etc..) and (4) dumps of other types of hazardous and non-hazardous mining waste (flotation tailings, ash and slag dumps are present) and others.

Large extent, intensity and degradation area require proper planning activities of land sanation. Recultivation and sanation in large mining basin are dynamic processes, conducted according to the dynamics dictated by production - development of open pit mining and other production processes in the basin. They are the final, very important phase in the cycle of activities including: information technology, research, planning, programming, development and recultivation (Spasić *et al.*, 2009a) and have a base in appropriate spatial and urban plans, and in appropriate development of medium-and short-term plans, programs and investment documentation, respectively. This is, perhaps, the most important specific feature of large mining basin that is related to spatial planning (Spasić and Vujošević, 1997). To avoid adverse consequences of the open pit mines development, mining activities should be accompanied by biological recultivation of tailings and development of degraded landscapes, in order to establish a variety of vegetation and other ecosystems of the newly formed deposols.

Materials and Methods

The paper is based on the results of scientific and professional researches conducted in the Institute of Architecture an Urban & Spatial Planning of Serbia in the period 2005-2013. Scientific projects *Methods for strategic environmental assessment in spatial development planning of lignite basins* (2005-2008) and *Spatial, social and environmental aspects of the development in large mining basins* (2008-2010) were going parallel with the *development of analytical documentation* in domain of spatial planning for the areas of special purposes (Spatial plans for Kolubara, Kostolac and Bor-Majdanpek mining basins), as so with *resettlement programmes* for residentials directly affected by mine expansion, in which development the authors of the paper had been involved. Also, the basis of the paper is in a numerous legal provisions and sectoral laws in this area, which are directing for the planning of mining basin, as well as in the current strategic documents of national importance.

Kolubara lignite open pit mine is placed 60 km south-west from Belgrade, the capital of Serbia, and covers the area of about 600 km², of which so-called “productive area”, that is, geological contours of lignite deposits in which the exploitation is possible, covers about 520 km² (Spasić *et al*, 2005) contain four active open pit fields, with lignite production that provides 52% of electric power per year in Serbia³⁹, that is about 75% of the lignite used for thermal generation

³⁸ Current planning documentation preferences the establishment of internal dumps, but in the case of opening new mines or due to disorders of mine dynamics, it is necessary to activate the dump outside the open pit mine contour, in certain cases at the part of already recultivated land.

³⁹ http://www.rbkolubara.rs/index.php?option=com_content&view=article&id=75&Itemid=181&lang=sr

of Electric Power Industry of Serbia⁴⁰. Above lignite, predominantly high quality agricultural land is located, but also very important roads and railways passing through this area. In the past period, mainly during the 1980s to 2005, approximately 1, 235 ha of tailings had been recultivated. During the last years, part of recultivated area, bound for arable land as well as for the stable forest stands, had been re-involved in the lignite exploitation. This led to reduction about 242 ha of the total recultivated area in 2012 comparing with 2005, because, in the meantime realized, partial recultivation programs had mostly experimental character, so their practical effects can be noticeable only in the future. Recultivation of agricultural land in the period 2005-2012 carried out on about 257 hectares (mainly arable land), which is quite less compared with 708 ha of recultivated land under forest plantations (IAUS, 2013a). This situation is caused by the limitations of technology used, but still stands the appraisal that the recent results of recultivation of degraded mining land are more than modest, not only in quantitative, but also in qualitative terms. These relations of recultivated areas (which, depending on the mining fields, ranges from about 0.33%-32% of agricultural and 67% - 99.67% of forest land (^{ibid.}) are not in accordance with provisions of the Law on agricultural land, neither with the situation before process of exploitation.

Kostolac lignite open pit mine is placed 90 km east from Belgrade, on the right bank of Danube River and cover area of approximately 100 km². From 1991 slowed down and since 1996 stopped biological and technical recultivation, elaboration of long-term operational plans and recultivation projects had been neglected; that situation had been aggravated by organizational problems in the process restructuring of the Electric Power Industry of Serbia (Popović and Živanović Miljković, 2013). Until 2010 technical and biological recultivation by permanent vegetation was accomplished on 623.4 ha of degraded land, which makes 22.1% of the total area of 2817.1 ha, successively occupied for the exploitation of lignite in the past period, excepting thermal power plants (TEKO A - 21 ha and TEKO B - 150 ha). Largest recultivated areas are located within the boundaries of temporarily closed mine “Ćirikovac” (about 40% of the total occupied area), ash dump in the Middle Kostolac island (about 32%), temporarily closed mine “Klenovik” (about 26%), while within the area of the largest, and now the only active, mine “Drmno” 73.5 ha of land had been recultivated, which is about 6.0% of its total area. Recultivation is largely conducted outside the tailings ponds and ash, which still account for around 32.4% of the total area of temporarily occupied mining and energy activities.

Bor-Majdanpek copper open pit mine is located in Eastern Serbia, where approximately 1,270 ha are directly occupied by mining and metallurgical activities. It is estimated that for over hundred years of mining and processing of copper, open pit mines, tailings ponds and tailings dams degraded approximately 4,600 ha of land, mainly forestry land and meadows, and smaller surfaces of arable land. In the past, the implementation of the program of recultivation is not significantly affected the rehabilitation of degraded area and improving the general environmental conditions in this area. In the period from 1992-1998 about 600 ha of degraded land, absolutely without preparing the terrain with appropriate measures of technical recultivation, forestation was performed. Technical recultivation conducted partially in flotation tailings “Bor” and “Veliki Krivelj”, at the surface where the latter biological recultivation conducted, mainly growing crops. Because of the serious economic and organizational problems of the mining company during the transition process, in the period 1997-2007 works on preservation of previously recultivated areas and works on implementation of the new programs of recultivation and sanation and developing degraded landscape had been completely neglected. Anyhow, in the future it is expected to fulfill the requirements for recultivation and rehabilitation of degraded land (brownfield) on which mining exploitation has completed, and which became

⁴⁰ http://www.rbkolubara.rs/index.php?option=com_docman&task=doc_view&gid=53&Itemid=212

state ownership in 2010 by the decision of the Government of the Republic of Serbia. These lands include the locations expected to be fully recultivated by the end of 2013, with the total area of 575 ha (IAUS, 2013b).

Discussion and Results

Management of changes that occur in the areas of extensive mineral exploitation requires the operationalization of specific developmental planning system, rehabilitation and spatial organization of the large mining basins. Revitalization and space development are, in fact, the final stages of research and process of planning development relating to the areas of open pit mining of mineral resources. Large intensity of works and extent of degraded area require proper planning interventions in revitalization and territorial organization. It is a complex process with a numerous aspects, such as the recultivation of degraded land, regulation of water management, landscape planning, construction of road networks and other technical infrastructure, construction and planning of settlements, etc. Revitalization of the areas extensive exploitation of mineral resources is a dynamic process that is dictated by the dynamics of mining process (Spasić *et al.*, 2009b).

To avoid adverse consequences of the development of open pit mines, mining activities necessarily involve recultivation of tailings and slag, as so as landscape regulation, with the aim of establishing the various vegetation and other ecosystems of the newly formed deposols. Depending on the type of degraded areas, certain categories of recultivation are applied: self-recultivation, half-recultivation and eu-recultivation. In addition, the eurecultivation is process of completely recultivation, including integrated implementation of all necessary measures for technical and biological recultivation, with prior selective removal and disposal of top soil. Biological recultivation of agricultural land need to have a basis in the policy documents of national importance.

Usually, design solutions for external tailings and other mine waste recultivation are based on the conversion of this artificially created unfertile land into arable, through the implementation of extensive and specific works on technical landscaping, hydro and agro-technical works. The obligation of the mining companies is to conduct technical remediation and removal, storage and return of humus, technical landscaping and hydro-technical works which set the appropriate water regime in the soil and biological reclamation (land preparation for agricultural production). At the same time, the use of agricultural land is projected in accordance with the climatic characteristics of the area and with the realistic possibilities to reach certain pedological and hydrographic features. Procedure and deadline of determination of dangerous and harmful substances in the recultivated land are established, too. Also, the obligation is raising agri-protection and windbreaks belts, and long term procedures performing, specifically provided in the project of monitoring system.

The first and most obvious aspect of land degradation by mining activities is the occupation of agricultural land for non-agricultural purposes in the long period. Although the importance of agricultural land as a resource of general interest is legally regulated by the Law on Agricultural Land (Official Gazette of RS, No. 62/2006), arable land may be used for non-agricultural purposes for the exploitation of mineral resources and performance work on the tailings, ash dumps, slag and other hazardous and noxious substances in arable land for a specified time, upon the consent of the competent ministry department. The same law establishes the prohibition of discharge and disposal of hazardous and harmful substances on agricultural land, and inorganic and organic compounds, which include toxic, corrosive, flammable, pyrophoric, and radioactive products and waste in solid, liquid or gaseous state and which have dangerous and harmful effects the land. Therefore recultivation is included in the program of works on protection,

development and use of agricultural land, which is determined on annual basis by the Republic of Serbia Government, in accordance with current legislation.

In practice, this would mean that the mining company is not left to the independent action, but can fully rely on the institutional, informatic and scientific support in achieving its legislative obligations. Regarding that is stipulated that such programs define the type and scope of work on the protection, development and use of agricultural land, such as drainage and irrigation, rehabilitation of field roads, control of arable land fertility and improving its quality, converting non-arable to arable agricultural land, and melioration of meadows and pastures, anti-erosion measures and actions on agricultural land, obligation for the mining companies etc., dynamics of recultivation and funds from mining company had been controlled. These funds are usually the costs of production, and by its technical and technological importance having the character of investments.

The suitability of this approach is in direct application of the procedures and mechanisms as otherwise determined by the program of works on the protection, development and use of agricultural land and are conducted in accordance with that program, which are important for the sustainable management and use of recultivated land in post-exploitation period such as: de-expropriation, lease and purchase of arable land, study and research activities relevant to the successful implementation of remediation, such as fertility control and identification of hazardous and harmful substances in the soil, the development of methods and tools for calcification of acid soil, successfully implementation of land policy measures, especially of land consolidation and voluntary grouping of plots.

Some Open Issues Regarding Land Use in Post-Mining Period

After the processes of exploitation and recultivation, there is the issue regarding **further land management and land use**. The owner of that land is the Republic of Serbia, considering that it is obtained into *public ownership*, as a rule, in the process of expropriation after the affirmation of public interest for a certain purpose - the exploitation of mineral resources and, as such, it can be used for this purpose only. Therefore, the institute of *expropriation*, as a tool for obtaining the access to the land and properties, contained in the internal legal systems of almost all countries, is applied and signifies forced and law-regulated taking private property by the state, for public interest. In most cases, neither the state as a owner, nor mining company as the beneficiary of expropriation, are not interested in further use of recultivated land, but the new *ownership transformation* in this area is characterized by a numerous legislative restrictions.

First of all, it is necessary to timely and precisely **define the options for returning expropriated land to the previous owners** (the most reliable way of regulating this is obligated questioning of parties during the process of expropriation and, if the interest is mutual, determination of the form for compensation of expropriated property). According to the Law on expropriation (OG of the RS, No.53/95, 23/01, 20/09), expropriation is governing- legislative manner of acquiring state property, whereby the former owner or holder of the property stops to be that (for a fee corresponding to the market price or by ownership acquisition on another property) in such a way that ensure protecting of fundamental rights and freedoms, on the one hand, and that the population resettlement from the subject area ought to be conducted in such a manner to accomplish socio-economic development of the community, on the other hand. Regarding that the process is conducted by the local authorities, in cooperation with the beneficiary of expropriation, it should provide an adequate formation, storage, and update of documentation about previous owners or users of agricultural land (land registry papers, a copy of the cadastral plan, new residence, periodically informing and participation in programs of agricultural education of interested members of the households).

Nevertheless, so-far experience, e.g. in the eastern part of the Kolubara lignite basin where were recultivated outer landfills in the oldest open pit mines (Field "A" and Field "B") indicates the complexity of the process of de-expropriation, as a process of returning of the expropriated land to its previous owner, in accordance with legal framework. The problem is that, before the occupation of the land by mining activities, resettled households used that land or for non-agricultural purposes, or for additional activities. Structure of land holdings indicates that the parcels are fragmented, so that during the appropriation process, land consolidation must be taking into account, which further complicates the return of the land. The ownership structure is inadequate regarding the numerous property relationships, usually resulted by inheritance. Average household and farm became smaller because of migration, primarily of young people in the cities, but also the open possibility of mass employment in the mining sector, changed the structure of population, households and farms. Specific continuation of the decades-long trend is the need for resettlement of former owners' households of expropriated agricultural land in the area of mining activities, which is why they are generally not interested in de-expropriation and return to the area of former settlements after 20 years or more. In support to this, during the survey for the preparation of the resettlement programme for entire village with 900 households (IAUS, 2005), due to the expansion of four open pit mines in the Kolubara lignite basin, only nine householders of Vreoci settlement opted for the organized resettlement to the new settlement of rural character, with the possibility of the formation of the farm. In addition, the return of de-expropriated land makes harder the existence of a significant number of single elderly households, which is anyway a serious social problem in rural areas in Serbia.

In these conditions, due to the change of living conditions of the resettled population, and regarding available information about the former state, it is assessed that the possibility of a successful de-expropriation is significantly reduced, and thus the efficient use of recultivated land for agricultural activity of family farms.

Of course, the real and legitimate option is **transfer of recultivated land for non-profit purposes** to the scientific and educational institutions in the field of agriculture, social services and institutions for the enforcement of criminal sanctions, in which case, for example, nurseries for the production of reproductive material fruity grape and forest trees would be established. Another possibility is organizing public works by the local governments, as a measure of temporary employment of citizens.

The state and local governments has obligation to provide financial support and other measures for effective land management and other estates management on the basis of spatial sustainable development in order to achieve and improvement of the areas of state interest (and that are undoubtedly areas of extensive exploitation of mineral resources). Hence, it is necessary and it is a priority to ensure the legal, institutional, IT and researching support for appropriation and rational use of recultivated land. An innovative approach is the challenge of land policy and management, and should be implemented in terms of promotion of integrated rural development. In accordance with current international trends, it should be strengthened the coordination between sectors, different levels of government and between public and private actors and to promote the *concept of multifunctionality of agriculture*, which besides to its basic function, has a numerous positive non-productive external effects to the sustainable rural development. This seems to be particularly effective solution in the case that *Agricultural base* or recultivation project determined that it would be more rational if that land would be turned into artificial meadows and pastures, where it is possible to develop specialized tourism and recreational offer or hunting. A good model is organization of modern, business and marketing-oriented agricultural cooperatives. Through those associations, but at the level of local government, and through the de-expropriated land use, local residents and governments could partially have compensations for the long-term negative impacts of mining activities in the region.

Taking into account that recognition and safeguard of legitimate tenure rights against threats and infringements, especially in the transfer of tenure rights and duties through markets, investments, land consolidation, restitution, or expropriation are of particular state responsibility and serve as a reference of responsible tenure governance (FAO, 2012), in large open pit mining basins in Serbia is necessary to solve some open issues regarding land use in post-mining period. In the future, to all of three large mining basins in Serbia are forthcoming the final works recultivation and further land use change, for what in most cases need to be accompanied with ownership transformation.

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