

ROLE OF BROWNFIELDS REGENERATION IN SUSTAINABLE USE OF NATURAL RESOURCES

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Abstract

With growing importance of the global economy, one of the basic natural resources - intensity of land use - is also increasing, which often is the cause of land degradation processes. The causes and manifestations of brownfields are diverse, and their elimination is the first prerequisite for the sustainable use of land resources and development of each region. Improvement, maximal and efficient engagement in economic activity of brownfields is one of the key challenges for sustainable resource use that makes significant contribution to regional development. The reuse of brownfields has significant impact on sustainable development as it meets all three of its objectives: improving the economy, improving social cohesion and the environment. The aim of the article is on the basis of special literature examples to examine issues of sustainable development, evaluation and restoration of brownfields, transformation of brownfields into recreational areas, as well as further use of brownfields in cities and rural areas.

Key words: degraded territory, brownfield, land resources, regeneration, sustainable development.

Introduction

The land is non-renewable resource with limited accessibility, so it is very important to ensure conservation and sustainable use of beneficial properties of the land. With the growing importance of the global economy, intensity of land - one of the basic natural resources, also is increasing, which often is the cause of land degradation processes. Sustainable land management is a key factor in the rational use of land resources, including the reduction of land degradation and putting in order of degraded territories. At the end of 2014, Land Management law in Latvia was adopted, the main aim of which is to promote the protection and sustainable land use. Great attention in this law is paid to land and soil degradation issues. Two terms has been differentiated separately: soil degradation and land degradation. An explanation of the degraded area has been provided. Soil degradation is defined as changes occurring or on-going under the influence of natural processes and human activities, due to which the possibility to use the soil in the implementation of economic, environmental protection and cultural functions is reduced. Land degradation is defined as the reduction or disappearance of the economic or ecological value of land and associated resources as a result of natural processes or human activity or inaction. On the other hand, degraded area is explained as an area with damaged surface of the earth, or abandoned build-up, mining, economic or military activity territory (Land Management Act, 2014). This study explores the brownfields that have arisen as a result of land degradation processes.

Arrangement of brownfields, maximal and efficient its engagement in economic activity is one of the key challenges for sustainable resource use, which makes significant contribution to development of the regions. In recent years have been accepted a number of high-level decisions in regard to land and soil degradation and its prevention. In 2015 the General Assembly of United Nations adopted the resolution "Transforming our World: the Program 2030 for Sustainable Development". This resolution sets 17 goals for sustainable development that includes an economic, social and environmental dimension.

One of objectives of environmental dimension (Objective 15) is - to renew degraded land and to try to achieve a world which is neutral to land degradation. In mentioned resolution has been stated an aim - to combat desertification by 2030, to renew degraded land and soil, including land affected by desertification, dryness and floods (United Nations ..., 2015). Desertification has not been observed in Latvia however risk of land degradation exists. The process of formation of brownfields in Latvia has been similar to other Eastern European countries and partly to Western Europe. Most of the brownfields occurred after collapse of the Soviet Union. Their development was influenced by transition to market economy and changes in industry. Most typical brownfields are industrial sites and their infrastructure, abandoned military bases and sites where construction started many years ago but still is not completed. Compared to some Eastern European countries, such as the Czech Republic

and Romania, total area of brownfields is considerably small in Latvia. According to the information given by Ministry of Environmental Protection and Regional Development, 5826 ha of municipal and private land is degraded (Gerhards, 2018).

The Land Management law emphasizes that objective of land degradation prevention measures is to eliminate the causes and consequences of degradation in order to promote sustainable land use. The causes and manifestations of brownfields are diverse, and their elimination is the first prerequisite for sustainable use of land resources and development of regions. The general objective of brownfields revitalization is to promote the sustainable development of urban and rural area: maximal elimination of brownfields thus contributing to environmental regeneration. This includes solving of environmental problems and increasing the economic efficiency of territory use, improving visual and structural functional quality of environment, as well as humanization elements of the social environment. Specific circumstances in each region determine which aspects should be more observed in the context of real situation. Also important factor is that providing arrangement of brownfields not only landscaping and functionally suitable areas which promote attractiveness and sustainability of the cities and towns are created, but also existing engineering networks and other communications have been economically used in these areas.

Several foreign and Latvian scientists dealing with spatial planning and sustainable development issues in their scientific publications have shared an experience in evaluation and restoration of various brownfields. Systematic approach to land degradation issues has been demonstrated in investigations of Western European scientists (Ferber, 2006), also significant contribution to this problem has been made by Central and Eastern European scientists (Barta, Beluszky, et al., 2006; Kunc et al., 2014; 2016; Frantal, Greer- Wootten et al., 2015; Martinát et al., 2014; 2016; Simion, 2016). Russian scientists have given an overview on transformation of brownfields into recreational areas (Быкова, Косточкина et al., 2018). Authors of this article during the planned study trip have familiarized themselves with nature in various types of former industrial objects and examples of brownfield regeneration in Germany and Poland (Industrial Lodz ..., 2018; Natur-Park Schöneberger ..., 2018; Park am Gleisdreieck, 2018).

Methodology of research and materials

The **purpose** of the article is to evaluate Latvian and foreign experience in brownfield regeneration on the basis of scientific literature and other information, as well as analyse its benefits.

To achieve this goal tasks were performed as follows:

- information on brownfields and their regeneration in foreign and Latvian scientific literature has been gathered and analysed;
- an overview on possible solutions in regeneration of brownfields and benefits of brownfield regeneration for development and sustainable use of resources has been made.

The **object** of research is degraded build-up area. As it can be seen from the explanation of degraded territory provided by the Land Management law, processes of land degradation can express in different ways. So far there were no criteria in Latvia for determining the existence of degradation, as well as classification of brownfields. According to the Land Management law, in 2019 the Cabinet of Ministers has developed draft of classification of types of land and soil degradation and rules for its evaluation, public discussion has been opened (Table 1).

Table 1 shows that degraded build-up territories are one of the types of land degradation and they can be divided into three sub-types: degraded residential or public build-up, industrial and military territories. In all cases there are located abandoned buildings, constructions or other objects that are not managed and endanger human health or life due to their physical wear and tear or harm the environment.

In the research scientific publications of Latvian and foreign scientists, knowledge and impressions obtained during planned study trip in Poland and Germany on regeneration of brownfields have been used. There general scientific methods of theoretical research: analysis and synthesis, induction and deduction, as well as monographic method have been used.

Table 1

Classification of types of land and soil degradation and order for its evaluation
(draft, developed by Cabinet of Ministers of Latvia)

Type of land degradation	Sub-type of land degradation	Feature
Degraded build-up area	Degraded residential or public build-up area	Territory on which are located abandoned or incompletely used residential buildings or public buildings which do not fulfil their intended function, or which are not managed, or endanger human health or life due to their physical wear and tear, or harm the environment
	Degraded industrial area	Territory on which are located abandoned or incompletely used production facilities where economic activity has been suspended, or they do not fulfil its intended function, or they are no longer managed, or endanger human health or life due to their physical wear and tear, or harm the environment
	Degraded military territory	Territory on which is located abandoned military object, which do not fulfil its intended function, or is no longer managed and endanger human health or life due to physical wear and tear, or harm the environment
Degraded mineral extraction site	Non-recultivated mineral extraction site	Territory greater than 0.5 ha, where is located abandoned and non-recultivated mineral extraction site
Waste disposal at non-designated for this purpose sites	Waste disposal, preservation and storage in non-designated for this purpose sites	Territory on which is located waste deposit area or dumping-ground, which has not been recultivated after its closure and is not subject to monitoring and proper management. Territory where waste disposal, preservation and storage takes place in non-designated for this purpose sites
Land pollution	Pollution of the territory by hazardous substances	Territory in which local or diffuse contamination by pollutants has been detected to such extent as to pose a significant risk to normal functioning of the ecosystem and appropriate actions should be taken to mitigate this undesirable effect on the basis of the criteria laid down in regulatory enactments regarding soil and ground quality standards and regulatory enactments regarding surface and groundwater quality, as well as taking into account the regulatory framework for the identification and registration of polluted and potentially polluted sites
Spread of invasive plants	Territory infested with invasive plants	Unmanaged area where grows at least one invasive plant

Discussions and results

Studying scientific publications on land degradation problems it can be concluded that in the world, especially in Europe, there already has been developed some theory and experience of brownfields regeneration. Also it can be concluded that brownfields are developing in process of social and economic changes. Abandoned territories, visual collapse, symptoms of chronic unemployment and social stratification of society always have very negative economic and physical impact on the territory, and it shows the lack of social administration. Brownfields also are closely linked to the transformation of industrial society in post-industrial period. This means that strong changes not only in economy but also in spatial standards, land use, property governance and in people's lifestyles have happened. In post-industrial society much less space is needed for production, but much more for services, consumption and entertainment (Brownfields ..., 2010). In other countries the issue of brownfield regeneration began to play a prominent role in political programs in the 1970s. This means that the search for solutions with international approach has taken place for almost 50 years. Now they are closely linked to a wider range of issues of sustainable urban and regional development. The regeneration of brownfields not only strengthens the vitality and efficiency of urban area, but also helps to remove the developmental pressures of greenfields located on the outskirts of cities.

Reuse of brownfields has significant impact on sustainable development because it meets all three of its objectives: improvement of economy, social cohesion and environment. It helps to return unused land and improves land use economy. When economic activities return to degraded areas, firstly, these areas have been significantly improved and, secondly, areas of greenfields are preserved. New

activities taking place on former brownfields create new opportunities for public, increase employment, income, etc. Remediation of brownfields can also improve social cohesion, prevent risks to the environment, protect cultural and historical values and improve quality of life. Development of brownfields has the added benefit strongly influencing the surrounding urban environment. Importantly, renovation of brownfields has positive impact on real estate prices in the territory. Further savings are achieved through the opportunities offered by existing resources and infrastructure (buildings, energy, sewerage networks, etc.) and transport options.

Customized planning suggestions that take into account public needs can maximize investment in brownfield redevelopment not only for the general public but also for builders and landowners. As a result, the sustainability of specific brownfields and the wider area is promoted.

One of the main drivers of brownfield regeneration is the economic revitalization of the urban area and potential profits. Assessing the impact of economic globalization and increasing difficulties on the current European real estate market, it can be concluded that the role of brownfields in supporting economic development and competitiveness in Europe has become increasingly important. This is most often case in traditional former industrial areas, where economic opportunities are increasingly becoming evident as a result of change of development of brownfields. Revitalization of brownfields is an incentive for economic development and it affects different market areas: land market, real estate market, labour market, capital market, financial market, resources market; infrastructure market; innovation market. The link between land market and real estate market with revitalization of brownfields has been identified as the most influential factor in the revitalization process (Brownfields. Handbook, 2010). Analysing foreign experience, it can be concluded that, irrespective of the end use of brownfields, aim is to develop sustainable localities with higher quality of life. In the past too little attention was paid to the areas where people live, work and spends their free time. One of the key elements of high-quality urban development is accessibility and good connection with open space. Essential importance for design of these public spaces has good quality of pedestrian and bicycle roads and public transport, as well as a great sense of space. Many of regenerated sites once have been an “engines” that fuelled the industrial revolution - coal mines, quarries and edges of channels. With the decline of heavy industry, often these vast territories became abandoned. Many of them were unofficially used as playgrounds and recreation areas, but mostly they fall by the wayside and become abandoned, sometimes dangerous.

There are many examples in the world with a long history and relevant experience, where public and commercial centres, museums and exhibition galleries, relax and recreation areas, amusement parks, sports centres etc. cultural objects for local public and visitors have been created. Often they change the habits of the city and people. The development of urban areas takes place on the basis of more efficient use of existing built-up land and with infrastructure for new construction and thus preventing new investments in the construction and maintenance of transport and other infrastructure (Barta, Beluszky, et al., 2006).

Getting acquainted with activities of several Eastern European countries (Czech Republic, Hungary, East Germany, Romania, Poland) in the regeneration of brownfields can be recognized several similar features. Major cities are undergoing major changes in functions. New activities take place in the premises of former industrial companies and in areas where military objects and railway lines were predominant. These spontaneous changes in post-socialist countries occurred in a shorter period of time than in Western Europe. As a result, rehabilitation of brownfields became one of the first issues of territorial development along with changes in property rights after cessation of industrial activity and real estate market reorganization after 1990. Functional changes are characteristic in industrial zones close to the city center and having other priority features to replace industry with other functions. More exposed to reconstruction are former production sites in industrial areas with good location, where it was easier and cheaper to reconstruct or completely demolish the buildings. Functional changes are also characteristic for less favoured areas of industry, where typical phenomenon is continuous preservation of previous buildings, simply replacing their earlier functions with commercial, warehouse and logistics functions. However, the growing importance in many abandoned industrial and infrastructure territories has feature of preserving industrial buildings and structures as monuments of the era and their use for cultural, educational and tourism purposes (Barta, Beluszky, et al., 2006; Frantal, Greer-Wootten, et al., 2015).

Summarizing and analysing scientific publications on regeneration of brownfield sites and evaluating benefits from it, several regularities and variants of brownfield regeneration can be distinguished.

Arrangement and construction of shopping centers is one of widely used forms of abandoned brownfields in Eastern Europe. The changed economic environment also created changes in consumer habits and retail activity. In 1990s on abandoned production sites having good location (proximity to underground railways, traffic junctions, good access) started construction of a new type of shopping centres. For example, in Budapest at the end of the 1990s already were 33 such shopping centres (Barta, Beluszky, et al., 2006), several shopping centers in Lodz (Poland), of which the multifunctional shopping and entertainment center “Manufaktura” which was created on the site of former textile factory particularly should be mentioned (Industrial Łódź ..., 2018).

Arrangement of science and technology parks plays an important role in the development of brownfield sites in several countries. Former industrial and military territories were transformed to parks, and if such parks were located near universities, there were created research and technology-oriented companies. An example of this can be mentioned Budapest (Hungary), where park “Infopark” and “Graphisoft Park” was arranged. “Infopark”, established in 1996 was the first park of information and technological innovations in Central and Eastern Europe, first as an area for World Expo, but after closing of the exhibition in collaboration with two neighbouring universities there was established state-owned joint stock company “Infopark”. It promotes innovations, research and development, and supports start-ups. Thanks to proximity of universities, as tenants mostly are IT and software development companies, providers of telecommunications and Internet service (IBM, Hewlett-Packard, Magyar Telekom, Panasonic, Maxell, etc.). It is planned that around 4500 people will be employed there. In the long run “Infopark” could become a regional high-tech center (Barta, Beluszky, et al., 2006).

Preservation of industrial heritage is the problem how to develop post-industrial space. It has been affected many countries around the world - from the United States, France, England and Germany to Eastern Europe. Everywhere rural municipalities are looking for ways to preserve and redesign former factory buildings. Often they are monuments - valuable examples of 19th and 20th century architecture and important relics of the past. Protection of historic buildings and monuments is deliberate interference in the historical process of over a hundred years, characterized by the transformation and replacement of architecture heritage. The existence of an industrial culture was very important in Europe, it has been the driving force of the economy since the Industrial Revolution. As a result of restructuring of global economy significant production capacity no longer exists. This process ended after political and economic changes in the 1990s. Emphasis now is placed on reorganization of the physical environment, closure of factories and renovation programs. Buildings are the majority of industrial heritage, but equipment and technological devices can also play an important role. Reconstruction of industrial architectural monuments started in the 1960s, to preserve industrial heritage in Western Europe an extensive research was carried out. Industrial heritage can be protected by the state as industry museums and open-air museums with technologically significant monuments, as well as industrial buildings and complexes as industrial and cultural monuments of their time. By preserving these monuments as museums and using modern technology, double effects can be achieved – combination of industrial heritage with cultural tourism. The increasing number of technical and scientific museums points to this effect. For example, several military, transport and industrial museums - metalwork’s museum, a collection of electrical engineering, a museum of lifts, a museum of mills, a museum of fire fighting, etc. have been set up in Hungary. Successful example is the Millenaries Park, constructed in Budapest (Hungary), which is designed as comprehensive industrial rehabilitation project (Barta, G., Beluszky, et al., 2006). There are other examples of industrial heritage conservation in other countries, we can mention the old brewery in Poznan (Poland) (Stary Browar ..., 2019), the Zollverein Coal Mine Industrial Complex in Essen, Germany (Zollverein Park Essen, 2018) and others.

Development of cultural, educational and business centres is a part of national industrial heritage with its aesthetic values and individual look, suitable for cultural purposes. However, reconstruction costs are often very high, especially in case of monuments, and these costs are difficult to cover due to low profitability and non-profit character of cultural institutions. Use of industrial buildings for culture began in Europe in the 1960s and 70s as result of social and economic transformation, together with support for urban policy and at the same time with prestige large-scale publicly funded architectural and cultural investments, e.g. Pompidou Center, Musée d'Orsay in Paris, Tate Modern, Millennium Dome in London. Qualitative cultural life strengthened individual character of cities in tough competition between them. There was an increasing role of rural cultural policy which promoted projects for creation of cultural institutions. Most of these projects were related to reconstruction of

former industrial buildings thus creating many symbolic values - protection of historic buildings, environmental protection, etc. Creation of cultural projects has added value to the economic and tourist attraction of cities and the value of urban land has also increased (Barta, Beluszky, et al., 2006). The Art Factory (Fabryka Sztuki) in Lodz (Poland) is a complex of three buildings provided for representatives of creative industry. The Center for Culture and Entrepreneurship "Art Incubator" was opened in 2014 and there are located art studios, conference rooms, art production rooms, halls and galleries, coffee-bar and club. Other former post-industrial buildings also have been modernized and expanded to include 3D cinema, science center, planetarium, studio, workshops and laboratories, gallery, sound theatre, seminar and conference rooms. It should be noted that several former factories have been transformed into museum of the history of industry sector concerned, e.g. in former Geyer Biała Fabryka for more than half a century is acting the Museum of Textile History (Industrial Łódź ..., 2018). An important art center in Poland is the old brewery "Stary Browar" in Poznan. Now it is not only modern shopping center, but also cultural and educational center (Stary Browar ..., 2019). There are also some excellent examples of transforming post-industrial objects into cultural and artistic objects in Germany. The best known is "Zollverein Coal Mine Industrial Complex" in Essen, which was granted the name of UNESCO's World Heritage Site in 2001 and is one of the most impressive industrial monuments on the planet. Since coal mining and industrial complex Zollverein has been closed in 1986, it has become as main object of art, culture and creative industries, attracting more than two million visitors a year. This building symbolizes structural changes in the metropolis of Ruhr more than any other (Zollverein Park Essen, 2018; Ferber, et al., 2006).

Arrangement of residential and office spaces can be the challenge of architecture, how to transform old abandoned industrial buildings into residential and office spaces. Former factories can be located in centers of cities and towns, they are more suited to both offices and apartments as the cities are growing. For example, one of the largest spinning factory of Lodz (Poland) founded the in 1825 now has been transformed into modern post-industrial living space. Monumental buildings were thoroughly renovated to emphasize the architectural features, while the creation of residential spaces is linked to the location of offices (Industrial Łódź ..., 2018). Examples of post-industrial transformations can be found in Latvia, too. Extraordinary residential complex "Gypsum Factory" in Riga is located on the bank of Daugava river and has wonderful panorama to Old Riga (Gypsum Factory, 2019).

Arrangement of parks for recreation and entertainment, amusement and sports activities is the problem how parks can be created in areas which are not intended for these purposes (shipyards, swamps, former factories or railway tracks) and on land that must first be cleared of harmful substances. In the same time their historical memory should be preserved. Foreign experience shows that it is possible. Since 1980s, two to six new recultivated post-industrial parks have been created in European countries every decade.

There are many examples of parks that have developed instead of former industrial or other economic sites, mainly from the 80s to 90s of the last century. However, as one of the first landscape architecture objects can be mentioned Tilerie Park in Paris (France) established in 1564 on the place of former tile manufacturing factory. Whereas in 1985 instead of former slaughterhouse and livestock market of Paris was established park "La Villette", in 1987 - Cloth Park in Barcelona (Spain) instead of a former factory and railway track, in 1995 - amusement park "Wunderland Kalkar" in Germany in the former nuclear reactor area and others. Development of such parks in post-industrial areas has evolved in the 21st century, and their national spectrum is very diverse, for example, in 2000 - park "Promenad Plante" in Paris (France) instead of former railway viaduct, in 2001 - park in Chiang Mai city (China) instead of shipyard, in 2002 - MFO in Zurich (Switzerland) at the site of former engine production plant, in 2003 - "Parque da Juventude" in San Paulo (Brazil), former investigative isolator, in 2006 - Diagonal-Mar Park in Barcelona (Spain), in 2007 - Cliché-Batihniola park in Paris (France) instead of the former railway station, in 2011 - Dora park in Turin (Italy), etc. (Быкова, Косточкина, 2018).

The most recent examples should be mentioned several parks in Germany, which have been developed on place of former industrial sites, maintaining historical evidence of these places. The most outstanding of them are Gleisdreieck park in Berlin (Germany) established in 2011 on the area of former railway, and the natur-park Schöneberger Südgelände in Berlin which after 50 years of desolation was arranged around closed Tempelhof railway station. Both of these parks have become real oases of natural diversity and historical experience in the city.

Conclusions and proposals

In large cities of Europe are undergoing major functional changes. In post-socialist countries these changes have taken place in shorter period of time than in Western Europe. For reconstruction more exposed have been former manufacturing sites with good location.

Reuse of brownfields has the significant impact on sustainable development – improvement of economy, social cohesion and environment.

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