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The assessment of brownfields reutilisation based on meta-analysis and survey results[1]

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In the last decades an increasing attention has been paid to the risks deriving from the existence and the contamination of brownfield areas. Economic, environmental and social aspects are strived to be examined to assess the possible impacts. The growing number of abandoned industrial areas, left as the fingerprints of the deindustrialization and structural change of the industry, can rightfully represent a major challenge for development plans in the 21st century. In our study we give a global picture about the already known brownfield assessment methods by meta-analysis and we examine the factors (economic, environmental, social) which play the most important role in investment decisions. In addition, we give an overview of the revitalization and rehabilitation opportunities of brownfields in the North Hungarian Region. The goal is to explore the different interest groups and investigate how we can contribute to sustainable urban and regional development in time with the revival of large expanded brownfields.

Keywords: brownfields reutilisation, meta-analysis, North Hungarian Region

JEL classification: R11.

Introduction

In the last decades an increasing attention has been paid to the risks deriving from the existence and the contamination of brownfield areas. Economic, environmental and social aspects are strived to be examined to assess the possible impacts. The growing number of abandoned industrial areas, left as the fingerprints of the deindustrialization and structural change of the industry, can rightfully represent a major challenge for development plans in the 21st century. Brownfields located in urban areas have the biggest potential to be the target of development

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projects. It is a fact, not a question, that we need to address these landscape wounds with their risk factors, as well as their utilisation and resource exploitation options. Emphasize should be on the approach we follow to select a successful and sustainable alternative for revitalization or rehabilitation.

Accordingly, in our study, we will give a global picture about the already known brownfield assessment methods by meta-analysis and we examine the factors (economic, environmental, social) which play the most important role in investment decisions. In addition, we give an overview to the revitalization and rehabilitation opportunities of brownfields in the North Hungarian Region. The goal is to explore the different interest groups and investigate how we can contribute to sustainable urban and regional development in time with the revival of large expanded brownfields.

About brownfield sites

The concept of brownfield firstly appeared in the American literature in the 1980s, when these sites have been identified as abandoned industrial areas (ICF Consulting - The E.P. Systems Group Inc. 1999). The relatively narrow definition has constantly changed and became wider as the deindustrialization process deepened and the number of abandoned industrial sites significantly increased. Although different definitions exist in Europe and in the U.S., their essential elements are the same, so they describe and identify the brown zones similarly.

In the past decades, health risks related to contaminated brownfields have gained a more significant attention, while the interests about its economic risks remained stable (US Environmental Protection Agency 1996; Albanese et. al 2010). This obviously influenced the definition of the term 'brownfield' and the identification of these areas. The consideration of related risks is an important question from another point of view: it can significantly limit the reutilisation possibilities of the areas. As a result, according to the new definition of CLARINET Working Group, brownfields are those fields that had been used before, but the activity was abandoned and they have left the utilised area with

different environmental impact, so an intervention is required in order to reutilise them (Federal Environment Agency 2002).

The expanded meaning of the term 'brownfield' is confirmed by the fact that not only industrial areas, but dilapidated housing stocks, extensively utilized agricultural lands and areas with transport functions were later classified in the literature as brownfields. In the U.S. the number of brownfield sites were estimated between 400,000 and 500,000 in the early 2000s, in the European Union between 300,000 to 1,500,000 and in Canada more than 30,000 areas were considered to be brownifield sites (Manion et.al 2010).

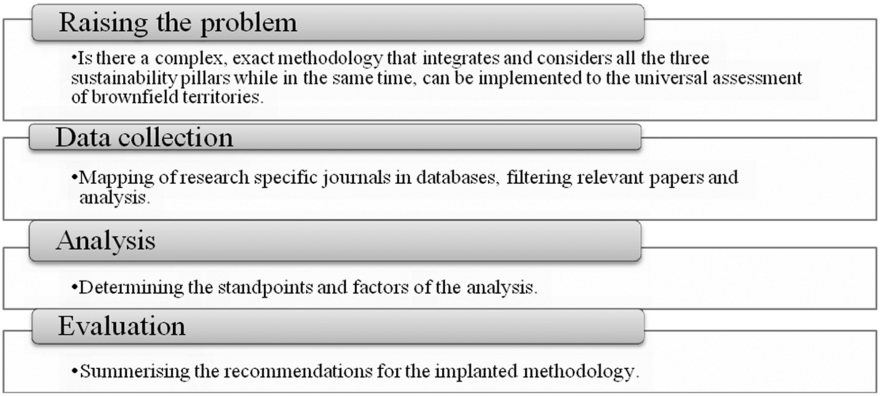
It can be seen as a positive progress that, in the recent years, several former industrial areas had been renewed from the United Kingdom to the United States. Budapest and other cities of Hungary have positive examples of rehabilitation or revitalization as well. The development of brownfields has been integrated into the regional and urban development plans, mainly because of two reasons. On one hand, due to the realization that the reutilisation of these areas can prevent the overexpansion of the urban areas and can preserve space for agricultural lands and green zones for recreation, on the other hand the strengthening of environmental awareness and more focus on the concept of sustainability has largely contributed to this trend (Barta, 2007). Although brownfield rehabilitation (revitalisation) is discouraged by heavy costs originated from the environmental remediation, 50 percentage of non-refundable support are offered to make these development projects attractive for the investors.

As the development of brownfield sites has become a priority, more and more researchers have set the target to find the appropriate methods which can optimise the targeted or the external factors[4] of the developments or their alternatives - remediation, rehabilitation, regeneration (Yasushi and Arata 2011). In the following, we discuss the comparison and the analysis of these methods by meta-analysis.

[4] such as risk reduction, cost, environmental impact, resource utilization

Meta-analysis and results

Meta-analysis is one of the preferred research methods nowadays, which can shorten the time demand of primary research by restructuring and reconsidering the achievements of formerly introduced analysis and studies of various disciplines. Although meta-analysis was introduced 30 years ago, the new type of questioning simply created a new variation of researches, bringing a new method to life (Schulze 2007). Its aim is to synthesize and evaluate the scientific knowledge of the area and the findings of the already acquired quantitative researches. Techniques of meta-analytic synthesis are different; we followed the direction of problem raising, data collection, data analysis and evaluation (Figure 1).



Source: own compilation

Figure 1. Steps of meta-analysis

As we previously mentioned, our goal is to develop a complex methodology that integrates in the analysis all three aspects (pillars) of sustainability. But the problem is that at the present time we have no methodology that complies with all the following factors:

– implements a holistic and sustainable approach;

– is suitable to serve the given area's regional development and local sustainability goals,

– ensures a long-term evaluation;

– formulates simple / easy-to-understand message, so it can support decision-makers;

– can be prepared and it is implementable (eg. data requirements).

The requirement and importance of a multi-aspect brownfields evaluation is approved/confirmed and highly supported by several authors[5], highlighting the necessity of eco-efficient sustainable solutions (Yasushi and Arata 2011, Pediaditi et. al 2010, Kielennivaa et. al 2012). Above this, it fits with the development goals defined by individual professional groups, institutions, regional development and EU directives in the past few years (for example the National Remediation Program, the Urban II program and the Bellagio rules).

Table 1. Sustainability aspects of brownfield investments

Economic	**Social**	**Environmental**
Economically efficient, self-sustaining	Social inclusion and cohesion strengthening	Minimizes the exploitation of non-renewable resources
It has employment potential	Contributes to the health and well-being	Contributes to the quality improvement of the land, water and air
Contributes to local and regional economic regeneration	Provides the access to green areas and local facilities	Supports biodiversity and natural environment
Fits in the creation of attractive, functional landscape	Promotes education	Conserves the natural and cultural heritage
Contributes to social well-being and community development	Reduces crime and anti-social behaviour	Fits into the requirements of global warming

Source: own compilation, based on Pediaditi et. al. (2010)

[5] In general, two-dimensional/factor analysis were in focus (economic – environmental, environmental – social)

The brownfields' revitalization has become the focus of interest across the whole world, as their number have significantly increased (mainly because of the structural economic changes), while their contamination and dilapidated condition has become unfavourable or even risky. At the same time, investors paid more and more attention to the relatively cheap, unused brownfield zones, because of the growing scarcity of available green fields. By today, several studies deal with the rehabilitation of brownfield sites, most of them are case studies, introductions of "best practices", demonstrations of new evaluation methodologies or studies summarising the key elements of reutilisation problems in brownfield zones.

The assessment of brownfields definitely needs an interdisciplinary approach: knowledge from the field of natural science should play a dominant role in it, but a holistic approach can only be achieved if social and economic aspects are integrated in the evaluation. Most of the studies which were selected as a basis of our meta-analysis followed this approach; biology, chemistry, social geography, economic geography, geographic information, urban and regional development, economic and statistical principles occurred with different share.

Within the frame of meta-analysis, our aim was to examine the evaluation methods applied and the approaches regarding the reutilisation brownfield of sites. We greatly relied on the article of Pediaditi et. al (2010) published in *Landscape and Urban Planning*, which describes a detailed meta-analysis about brownfield evaluations up to 2010. We completed this study with the newest findings published in the later years, highlighting the results of those, which can be relevant for our assessment's purposes.

We identified the following factors as the criteria-system of the assessment:

- aim of methodology,
- intermediated targets of the sustainability aspects (pillars),
- used statistical and analytical tools.

The following examples may be the basis of the assessment of reutilisation brownfields investments (Table 2).

Table 2. Analytical methods related to the brownfield sites' assessment and monitoring

Name of the method	**Appliers / developers**
Ex-ante sustainability assessment of projects/premises	RESCUE, Arup Environmental, SEEDA & BRE Kidd and Fisher
Sustainability analytical toolbar	The Wildlife Trust, Greenspace Scotland, Groundwork UK, NEF Schädler et al.
Analysis of available benefits	BUGS consortium, De Ridder ESRI
Settlement planning applications	Federal Highway Administration, Greenspace EU consortium, Various (under Fifth EU Framework Program) Californian Energy Commission
Material flow and LCA analysis	Lesage et al., 2007 Cappuyns et Kessel, Brecheisen&Theis, Morais et al., 2010
Assessment methods related to environment protection areas	WWF and World Bank, UNESCO/IUCN

Original target/possibility of use	Potential applicability for greening brownfields
Brownfield regeneration projects / products / sustainability evaluation of organizations for investor decisions / regional plans, policies, strategies.	Comprehensive evaluation, integrating more assessment tools. Different benchmarks and system critical thinking. Market valuation plays an important role in it.
Impact analysis of green projects, with the aspect system of local communities.	User-friendly and comprehensive approaches for local implementation of specific projects reviews.
Urban green space effects of environmental quality. This utilization measured in USD (with GIS software).	Establishment of environmental benchmarks and complex, scientific models. Computer modelling. GIS-based.
Establishment of regional planning, economic, social, environmental and accessibility factors with different emphasis. Analysis of various land-use alternatives, standard-elaboration.	Scenario analysis. GIS-based index / composite indicator analysis. Pollution indicators are displayed less, applied set of indicators can form a basis for the new methodology. Stakeholder orientation appears more.
Examination of the environmental impacts of remediation and off-site and in-site cleaning. Comparison of development options from stakeholders point of view, and environmental risk assessment.	With the adaptation of the life-cycle approach, pollution level, trends of recycling, cleaning solutions can be optimized, decision-support.
Evaluation, monitoring and effectiveness evaluation related to landscape protection management.	The focus is on the untouched areas, but the structured system aspect can apply for brownfields.

Source: own composition using and expanding K. Pediaditi et. al (2010)

Characteristics of methodologies are summarized below:

• *Ex-ante sustainability assessment of projects or sites:* A widely used method, which is often used by government and the private sector. Thus, its applicability in decision-making is more established. It has medium data demand, assures long-term evaluation and applies simple methodological models.

• *Sustainability assessments:* A widely used method used mainly by the local government in form of case studies. It has significant data requirement, ensures long-term evaluation and operates with simple methodological models.

• *Analysis of available benefits:* can be characterised by significant, extensive data demand and with complex analysis, while their scientific basis is outstanding. It is necessary to involve external experts as they are based on mathematical or even computer based modelling. It has gained ground in the U.S so far. It allows long-term evaluation.

• *Settlement planning applications:* usually they have significant, extensive data demand analysis, often applies GIS-based modelling, but rather integrating short-term planning. Their established indicator-system adapts well to the specifics of individual spatial analysis.

• *Material flow and LCA analysis:* Life-cycle analyses are becoming more important as decision-supporting tools to select the right decisions and cleaning technologies to remove pollution. For inherent environmental impacts and remediation processes secondary impacts can be ordered; however for development options or after cleaning, tertiary effects can be related (Lesage et al. 2007). So in case of the primary effect the attributive (ALCA), while in case of the latest two, the analysis of those major environmental factors are examined that can specify the longer-term consequences; so the use of consequent, consequences-examining life-cycle assessment (CLCA) comes into force (Morais et al. 2010). It uses a complex methodology and individual measurements on specific, territorial/sectoral date. It requires large dataset.

• *Assessment methods related to environment protection areas:* methodologies with notable international practice, have relatively low data-need, but project a long-term perspective. Periodically repeat the

monitoring and evaluation activities. Their usage is limited, because they focus specifically on pristine areas.

Brownfield sites in the North Hungarian region

The specific situation of the North Hungarian region within Hungary can be well characterized by its compliance with the convergence criteria: it is permanently the penultimate (succeeded only by the Northern Great Plain region). The dependency ratio is significantly higher (48.2% in 2012) than the national average (45.7%, KSH), while the average income reaches only 84% of the national average, unemployment rate is higher and activity rate lower than the national average. The development lag has been deepened by the economic crisis. Small, fragmentised villages comprises significant part of the region's settlement structure; this make it difficult to maintain the population, which is decreasing even in the county seat.

After the changing of the system (1989), crisis management dominated the economic development policy of the region, later, in the second half of the 1990's it was followed by dynamising activities. These processes have softened, but did not solve the structural problems of the region. In the 2000s, regional economic development measures were implemented, financed by the Structural Funds, to facilitate especially new jobs creation, promote employment focusing on industrial restructuring, tourism and transport development, to create an attractive environment for the competitive private and corporate/entrepreneurial sector (ÉMOP 2007-2013). The region's environmental potential is particularly good, but the out-of-function heavy industrial centre and its facilities spoil the region's attractiveness. Koszorú (2001) also confirms the negative effects of existing rust zones: in his study, he emphasizes that brownfields can have significant consequences on the development path of a city, but they can effect the surrounding settlements' development possibilities from social, economic and environmental aspects, too.

Brownfield sites may contribute to the relocation of economic activity and may hinder their settlings, because investments on these fields

implies higher costs, risks, and more difficult permitting procedures, while it is difficult to depend on the already existing physical conditions. Furthermore, their transport connections are not favourable as they are connected to the previous transport/logistics nodes and road networks (Koszorú, 2001). From social point of view, brownfield sites enhance the emergence of depopulation and deterioration of residential areas, where social tensions notably accumulate. Special circular migration occurs because of successional and filtration process, which leads to reduction of human potential and ultimately the slumming, crime and with strengthening of anti-social behaviour and finally the general degradation of social capital (Dabasi-Halász et al. 2011). From environmental point of view the hardly measurable and assessable environmental risks, associated high costs and recultivation projects not necessarily assuring complete remediation can raise further questions.

In the region there are several typical negative examples for such areas, where such industry dominated which perfectly fitted into the CMEA's division of labour, ruled by socialist industrial development policy. The established industrial structure aimed mainly to employ the large number of local labour utilising low standard technology and a labour-intensive production. After the change of the system, at first, these rural sites were liquidated; besides long distance-commuters were also fired from the central sites (Kiss 2001). Since then, at some sites production has restarted, but aside from a few exceptions there were hardly any major investments; therefore technological standards has not grown significantly. Among cities with huge former industrial potential, several – like Miskolc and Ózd- could not manage to take over the place of the deteriorating, but dominating mining and metallurgical industries by settling down other industries. Horváth et al. (2002) analysed the legal, economic and environmental issues of brownfield reutilisation in Borsod County; he concluded that only one or two significant new foreign investments[6] existed and the major plants (e.g. Diósgyőr Steel Works) were still struggling to survive. (Kukely – Zábrádi, 2004)

[6] e.g.: Shinwa, Bosch, Halna.

Other larger brownfield sites integrated into the settlement structure can be found in Balassagyarmat, Salgótarján, Bátortenyere, Borsodnádasd, while there are brownfield areas in further 22 municipalities or in their outskirts (ÉMOP, 2007). In 2006, a VÁTI study estimated the regional brownfield area to 2213 hectares (ÉMOP, 2007), other analysis quantify approx. 1561,2 million HUF economic value for these function-lost premises[7]. Another research (Madarász 2007) gives the size of regional brownfields in functional breakdown. According to this report these are mostly abandoned industrial areas (46%), ex-mining areas (5%), barracks or military-related sites (8%) and other (41%) type of sites; 13% of the 2579 hectares' brownfields is closely related to the golden ages of steel production.

Western European countries have more significant experience in government intervention aimed to develop brownfields. Adams et al. (2000) carried out a case study in the United Kingdom and found that financial support provided by the government (local government) to strengthen the cash flow and the return of the investment proved to be the most effective tool to support the development of brownfield sites; neither tax concessions nor punishments[8] helped the revitalisation of the privately owned, often frittered, mixed ownership brownfield zones.

The North Hungary Operational Programme and its Action Plan points out the following reasons why reutilisation processes should be supported by the local economic policy:

- investments necessary for economic development have significant territorial demand, while the out-of-function industrial and mining areas are significant in the region[9];
- the existing brownfield areas are not suitable for industrial location due to the disordered, frittered ownership, potential environmental pollution, buildings hardly usable for any function.

[7] http://www.ktk-ces.hu/brownfield_database_start.html

[8] Site possession without rehabilitation/use.

[9] In 2006, the size of the fields in the North Hungarian region was estimated to 2,213 hectares.

In the frame of the regional support scheme (NHOP) investors could apply for a total sum of 4773 million HUF support, with 50% support intensity (NHOP Action Plan 2008-2009). The tenders had to target the areas listed in the NHOP documents[10]. Up to 2010 a number of 15 submissions were submitted, among these 11 were supported and four rejected. The amount of support – considering average support ratio – was of 4140 million HUF, resulting more than 9 billion HUF total private investment value for the region. Significant progress has been made in the region regarding industrial parks: the number of employed people and settled firms significantly increased in the new industrial parks. Although several projects started in order to develop brownfields – 45% in Miskolc subregion–, their implementation was slow. So the conclusion of Czira–Kukely (2004) is still valid in the North Hungarian region: industrial park development was successful, but mostly as greenfield investments, while in some urban settlements there are still numerous unutilized brownfields, occupying valuable territories. Their restructuring and utilization is essential because of urban policy, economic, environmental as well as other (e.g. social) reasons.

Survey results

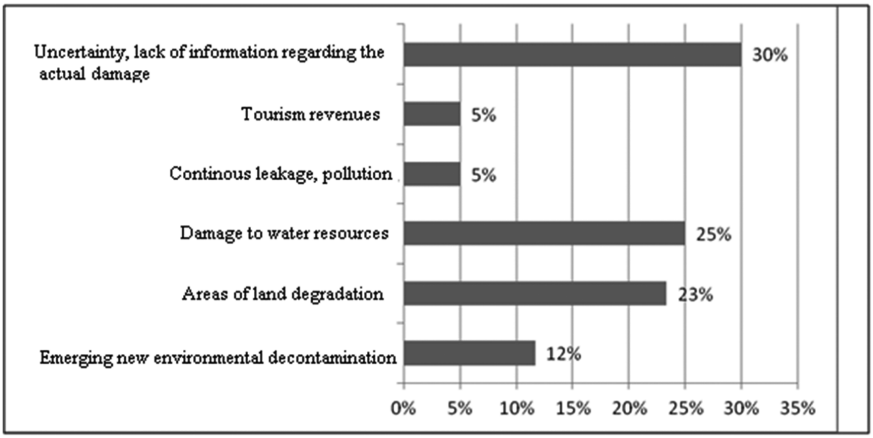
Most research projects tackle environmental evaluation (which synthesize measured and processed indicators of the environment) together with the analysis of the region's sustainable development[11]. This can only be realized if we examine the relationship between people and environment, involving the socio-economic relations as well, but comparison of typical processes and trends (impact factors and their effects) between the state of the environment and natural processes should be also analysed.

In our survey we explored the value-judgements existing in society regarding brownfields. We have asked 260 persons living in the neighbourhood of brownfield sites and mining areas located in Miskolc sub-

[10] Borsod County: 31 colonies; Heves: 23 colonies
[11] http://www.terport.hu/webfm_send/302

region. The answers were compared with the answers of people living near greenfields.

We found out that inhabitants lack information about brownfields, they are not aware of the environmental risks (Figure 3). Almost one third of the respondents were uncertain because of lack of information, 25% think that water contamination, 23% believes that land degradation is the most important problem and only 12% considered that new environmental problems can emerge during recultivation of the area.

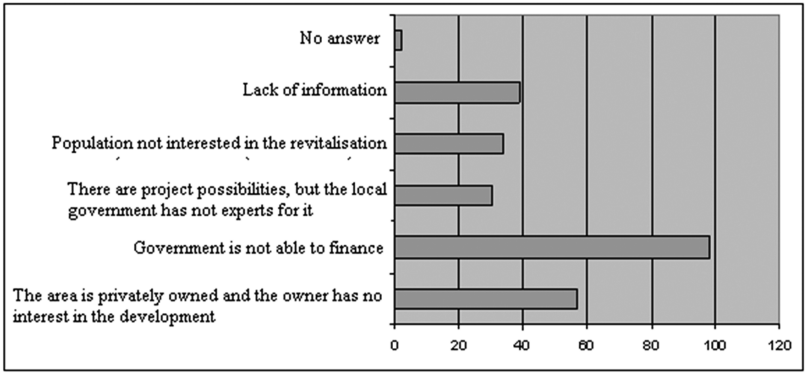


Source: own research

Figure 2. Opinion of the affected inhabitants in the brownfields

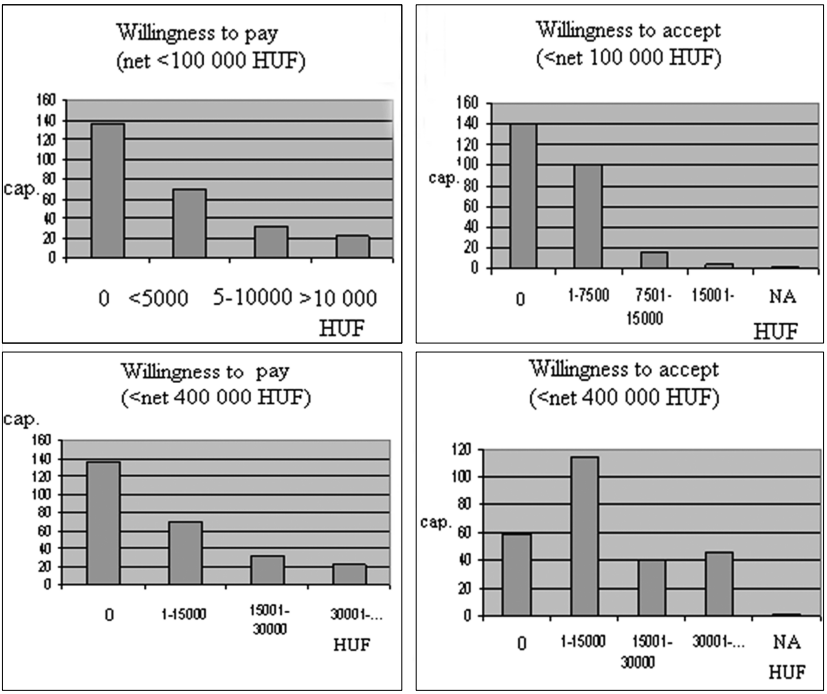
Most respondents (37%) considered that the main obstacle to brownfield development is lack of funds at the local governments. Private owners are blamed to be uninterested by 22% (Figure 3).

We tried to get information about how people evaluate the values of those brownfields sites which are located nearby, so we asked them about their willingness to pay and acceptation of payment (Figure 4). Majority (58%) of the respondents with a net monthly income of 100 000 HUF are not willing to pay anything for recultivation, while 34.5% would pay less than 5000 HUF, 6.9 % would be ready to spend 5 000 to 10 000 HUF, and 1.3 % would pay more than 10 000 HUF. In



Source: own research

Figure 3. The factors hindering brownfield development



Source: own research

Figure 4. Willingness to pay and accept in case of different income

contrast, 65.5% would ask nothing to give up the use of the area, 31% would ask less than 7 500 HUF and 3.5 % expect 7500 to 15 000 HUF.

Respondents from the 400 000 HUF net monthly income category are more ready to pay for recultivation: 42% would pay less than 15 000 HUF, 18% would be ready to pay 15 000 to 30 000 HUF and 18.7% would pay more than 30 000 HUF for the area's greening, while 20.3% would pay nothing. As regards payment acceptance, 23% would give up the area for free, 44% would ask less than 15 000 HUF, 20.7% an amount between 15 000 and 30 000 HUF, and 15.3% more than 30000 HUF (1% did not answer).

The average value of the two approaches is 9068 HUF. If we assume that the inhabitants of Miskolc would have the same willingness to pay and the same payment acceptance as the average, the brownfields from Miskolc would be 1.524 billion HUF worth, a value close to the numbers mentioned in previous reviews.

Conclusions

The purpose of the meta-analysis in the case of brownfields is to identify the optimal solutions, the best practices from an economic, environmental and social perspective, which can enable their optimal revitalization. The acceptable level of environmental risk is closely linked to land use, as well as regional and real-estate development. Occasionally, real-estate development or touristic utilization of an area is determined by the state of the subsurface environment.

An important aspect of brownfields' assessment is to reach a healthy compromise between the maximisation of the land's value (implementing valuable land use option) and minimization of the remediation costs (the optimum land use and distribution option). At the same time it should contribute to sustainable urban and regional development.

A complex approach should be followed to select successful and sustainable revitalization and rehabilitation alternatives; for this, economic, environmental and social considerations have to be considered.

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