

ANALYSIS OF BROWNFIELD SITES IN THE VILLAGES AND TOWNS IN THE CZECH REPUBLIC*

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Abstract

The issue associated with the situation of brownfields around the world is a very current topic today. This article focuses on the situation of the existence of brownfields in the Czech Republic. The aim of this article is to assess the current situation of brownfields from the perspective of municipalities and cities in the Czech Republic. The data in the paper were collected by means of a questionnaire applied to towns and villages in the Czech Republic. The existence of brownfields in regions can have a negative impact on the development of the relevant areas, such as villages, towns or higher-level administrative units. The research took place from 9 July 2018 to 31 January 2019. The rate of return on the primary research was 43.2% of the respondents. The results showed that brownfields mainly occur in former industrial regions. The predominant form of ownership of abandoned buildings and grounds was private ownership. It can be stated that agricultural, industrial activity and former civic amenities dominated in the previous use. Last but not least, the study points to regional differences that are noticeable between municipalities and cities in individual NUTS 3 regions in connection to the issue of brownfields.

Keywords: brownfields, public administration, municipalities, cities, NUTS 3, Czech Republic.

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1. Introduction

Spatial planning is considered to be one of the key tools of how to increase the sustainability of cities and contribute to their development on a global scale (UN, 2015). One of the key aspects of sustainable spatial planning is sustainable land use, i.e., a more deliberate approach towards which type of land is used for the development of cities. It is particularly necessary in cities with a growing population to make a decision which areas are most suitable for future development. A promising approach seems to be a re-development of formerly used sites that are vacant now, such as brownfields, for new projects of city development, especially the ones that are situated in central localities (Bartke and Schwarze, 2015).

In the professional literature, we find many definitions of the term 'brownfield', which differ between individual disciplines and actors. The term 'brownfield' refers to a relatively wide range of landscapes characterized by various features (Loures and Vaz, 2016). The different meanings of the term brownfield depend on the definition by national government or agencies and, in part, on the different groups related to brownfields (Alker *et al.*, 2000). In general, the term brownfield can be understood as 'previously used or built-up land'. According to Alker *et al.* (2000), brownfields can be considered all spaces that have been used economically in the past that are not currently being fully utilized. They may be abandoned or even contaminated, and therefore are not available for further use without additional intervention. Thomas (2003) states that brownfields are abandoned and unused objects that are perceived mainly due to their contamination and represent social and financial demands for their eventual reuse. Davis and Sherman (2010) note that abandoned buildings and grounds are associated with metropolitan areas that have been heavily industrialized in the past. According to Adeleja *et al.* (2010) brownfields are generally abandoned or underused old industrial or commercial facilities and can be a significant health hazard to the inhabitants of the communities in which they are located. Another definition indicates that brownfields are predominantly located in developed urban areas and require some intervention in order to be used repeatedly (CABERNET, 2006). The term 'brownfield' refers to a rather wide range of landscapes characterized by different features (Loures and Vaz, 2016).

Brownfields represent significant social and environmental issues across the world (Thornton *et al.*, 2007), and are recognized by the international association UN and the European Union (EC, 2012). Brownfields are of various origin, are distributed across the entire country, yet they represent a significant issue in densely urbanized areas, such as cities (Burinskiene *et al.*, 2017). Abandoned buildings and sites are an integral part of cities in Central Europe (Tureckova *et al.*, 2017). Brownfields that are in the inner city, near the inner city or near other municipal subcentres are generally well-connected with the current technical and social infrastructures (Koch *et al.*, 2018; Skrabal, 2020). The existence of brownfields in urban space has its historical justification. It is not possible to move them outside the city limits (Kunc *et al.*, 2014). The level of brownfield regeneration reflects the cultural and economic development

of the country, region, city or village as it reflects the strategies of sustainable development of sites (Wedding and Crawford-Brown, 2007). Re-using and regenerating derelict and abandoned areas constitutes an important element in sustainable land use policy and planning (Klusacek *et al.*, 2021). Abandoned buildings and sites left without any effort to find some alternative use prevent a further development of built-up sites, unfavorably influence the environment and have a bad impact on the given region in general (Tureckova *et al.*, 2019).

The development of brownfields involves both private and public costs, due to possible soil contamination. In addition, brownfields create negative externalities related to real estate viability and are considered risky and costly to develop. Regeneration of abandoned buildings and sites is increasingly recognized as a key tool for sustainable land management, as free development land ('greenfields') is a more expensive resource, especially in densely populated areas (Limasset *et al.*, 2018).

This article focuses on the issue of brownfields in the Czech Republic. The aim of this paper is to evaluate the current situation of brownfields from the perspective of municipalities and cities in the Czech Republic. The introduction is followed by a chapter that pays attention to the data and methodology of the paper using the method of primary research of municipalities and cities in individual regions (NUTS 3 (3rd level of region according to the Nomenclature of Territorial Units for Statistics of the EU)) in the country. The next chapter (Chapter 3) focuses on the results of the regional and national level of the research. The fourth chapter focuses on the discussion. At the end, the conclusion is drafted, which summarizes the previous findings of the authors.

2. Data and methodology

The second chapter focuses on the data and methodology of the paper. The aim of this article is to assess the current situation of brownfields from the perspective of municipalities and cities in the Czech Republic. The paper is focused on the topic of brownfields from the perspective of municipalities and towns in the Czech Republic. The authors of the article created a structured questionnaire (electronic questionnaire), which was designed for all municipalities and cities in the country. The results, collected on the basis of the primary research, were then aggregated into higher-level administrative units (NUTS 3). The results of the research in this work are expressed in relative frequency. The distribution of NUTS 3 regions on the territory of the Czech Republic is shown in the figure below (Figure 1).

Primary research based on the method of questioning was performed. The questionnaire survey was created via Google Forms. A total of 6,252 municipalities, cities and city districts (Prague) were addressed with a total rate of return of 43.5%. The respondents were addressed on the basis of sending a cover letter with a link to the questionnaire. The research commenced on 9 July 2018 and the end of the collection of information from municipalities and cities was on 31 January 2019. The results of



Figure 1: NUTS III Regions in the Czech Republic

Source: CSO, own processing

the questionnaire survey were subsequently selected according to individual NUTS 3 regions. The table below (Table 1) shows the rate of return of answers for each area. Data on the number of municipalities and cities in the given regions (NUTS 3), which are shown in the table below, were obtained through the Czech Statistical Office, hereinafter referred to as ‘CSO’.

Table 1: Return on primary research within individual regions

Name of the region (NUTS 3)	Number of municipalities and cities (city districts) in absolute terms	Number of answers in absolute terms	Total return in %
Prague	57	37	64.9
Central Bohemian Region	1,145	485	42.4
South Bohemian Region	623	263	42.2
Plzeň Region	501	224	44.7
Karlovy Vary Region	132	71	53.8
Ústí nad Labem Region	354	142	40.1
Liberec Region	215	84	39.1
Hradec Králové Region	448	191	42.6
Pardubice Region	451	176	39.0
Vysočina Region	704	255	36.1
South Moravian Region	673	290	43.1
Olomouc Region	399	190	47.6
Zlín Region	307	137	44.6
Moravian-Silesian Region	300	176	58.7
Total	6,252	2,721	43.5

Source: CSO; Own results based on research

Before sending the electronic questionnaire, the authors of the paper created a cover letter, which contained all the necessary details that are necessary for the respondents to be acquainted with the research. The accompanying letter contained a link under which prospective respondents could find the questionnaire. The accompanying letter was then sent to villages and towns in individual NUTS 3 regions via data boxes (mojedatovaschranka.cz). Since 2009, the data box has been defined in the Czech legal system as an electronic repository, which is intended for the delivery of electronic documents between public authorities on the one hand and natural and legal persons on the other. Data boxes are set up and managed by the Ministry of the Interior of the Czech Republic and the operator of the data box information system is Česká pošta s. p., which holds a postal license. The information was filled in either by the mayors of the municipality or by authorized city officials who are aware of the situation concerning brownfields in their cadastral territory (e.g. the regional development department).

The questionnaire survey consisted of two mandatory questions that had to be completed before being sent. Only one of the given questions will be presented in the paper, due to the fact that this question, which is listed below, is taken as one of the main questions of the research. It was a question that was focused on whether the addressed respondents registered abandoned buildings or areas in their cadastral territory. The mentioned data in connection with the given question are shown in Table 2. In connection with the structure of the questionnaire survey, it is important to point out that the respondents had the opportunity to choose more than one answer option. Therefore, the total amount of answers to each question varies. The issues mentioned included the ownership and previous use of brownfields, which are presented in the paper in the comparison at the regional level under Table 4 and Table 5 and in the national comparison in Figure 3 and Figure 4.

3. Results of primary research

The chapter deals with the interpretation of results of the survey on both the regional and national level. The questionnaire survey contained 16 questions. The most important questions of the survey are interpreted below.

The first question (Table 2) examined the existence of abandoned buildings or areas of the so-called brownfields in municipalities and cities in individual regions in the Czech Republic. It was found at the regional level that the most abandoned buildings and areas are in the Liberec Region, the Karlovy Vary Region, the Ústí Region and the Moravian-Silesian Region. From this point of view, we can conclude that the predominant occurrence of brownfields is mainly in the regions (NUTS 3) previously marked by heavy industry.

Table 2: Records of abandoned buildings and areas in individual NUTS 3 regions in relative terms

Name of the region (NUTS 3)	Yes	No
Prague	40.5	59.5
Central Bohemian Region	30.5	69.5
South Bohemian Region	30.0	70.0
Plzeň Region	35.7	64.3
Karlovy Vary Region	46.5	53.5
Ústí nad Labem Region	46.5	53.5
Liberec Region	48.8	51.2
Hradec Králové Region	44.0	56.0
Pardubice Region	32.9	67.1
Vysočina Region	32.5	67.5
South Moravian Region	34.8	65.2
Olomouc Region	37.9	62.1
Zlín Region	30.7	69.3
Moravian-Silesian Region	44.3	55.7

Source: Own results based on research (n = 2,721); (2019)

In the case of results at the national level, the situation is such that 36% of the respondents indicated that they register an abandoned building or complex in their cadastral territory (municipalities and cities). The remaining 64% of the surveyed respondents stated that they do not register any brownfields in their territory. To clarify, it is important to note that this issue has been identified as mandatory in the primary research. If the respondents did not indicate a certain option, namely 'Yes' (they register brownfields) or 'No' (they do not register brownfields), they could not send an electronic questionnaire. The situation concerning brownfields in the Czech Republic falls primarily within the competence of the ministries: the Ministry of Industry and Trade, the Ministry of Regional Development and the Ministry of the Environment.

Within the Ministry of Industry and Trade, the state-subsidized organization CzechInvest was established in 1992, which focuses on the support of business real estate in the Czech Republic and the support of business activities on brownfields. According to Tureckova *et al.* (2021), in 2020, there were 572 abandoned buildings and sites in the public brownfields database, coordinated by the organization, which are intended to be regenerated, and the owners agree to its public publication and promotion on the organization's website. It is also important to note that the real estate that is declared to be a brownfield carries a decline risk in the value of the property price. The effects of brownfields on real estate prices have been addressed, for example, by authors such as De Sousa *et al.* (2009); Linn (2013); Tureckova *et al.* (2017); Martinat *et al.* (2018) etc.

The following question within the primary research was focused on the total area of municipalities and cities registering brownfields in their cadastral area. Response

options and regional comparisons between regions (NUTS 3) are provided in the table below (Table 3). If we do not take into account the ‘Not specified’ option, then in almost all regions except the capital city of Prague and their city districts, towns and cities register abandoned buildings and areas in the ‘Less than 1 hectare’ option. Most answers to this possibility were registered in the Karlovy Vary Region, South Bohemian Region and Olomouc Region.

Table 3: Area of brownfields in individual regions in relative terms

Name of the region (NUTS 3)	I can't guess	Less than 1 hectare	1 to 2 hectares	3 to 4 hectares	More than 5 hectares	Not specified
Prague	2.7	8.1	8.1	5.4	16.2	59.5
Central Bohemian Region	9.1	12.8	5.9	3.5	3.1	65.6
South Bohemian Region	6.1	21.7	3.4	1.9	1.9	65.0
Plzeň Region	9.8	18.3	7.6	2.7	2.2	59.4
Karlovy Vary Region	7.0	25.4	9.9	1.4	4.2	52.1
Ústí nad Labem Region	11.9	16.2	8.5	7.8	4.9	50.7
Liberec Region	10.7	16.7	13.1	5.9	3.6	50.0
Hradec Králové Region	8.5	19.9	8.9	5.7	5.2	51.8
Pardubice Region	6.8	19.3	6.3	2.8	1.1	63.7
Vysočina Region	7.5	20.0	6.3	1.2	0.8	64.2
South Moravian Region	10.0	18.6	5.5	3.1	2.4	60.4
Olomouc Region	6.8	20.5	9.5	0.5	2.1	60.6
Zlín Region	7.3	13.9	5.8	0.7	5.8	66.5
Moravian-Silesian Region	6.8	18.2	7.4	3.4	9.1	55.1

Source: Own results based on research (n = 2,721); (2019)

The issue will then be commented at the national level. As we can see from the figure below (Figure 2), the largest relative share of the possibility of answering, if we do not take into account that the respondents did not answer the question (60.6%), is a brownfield with an area of less than one hectare, with a relative frequency of 17.8%.

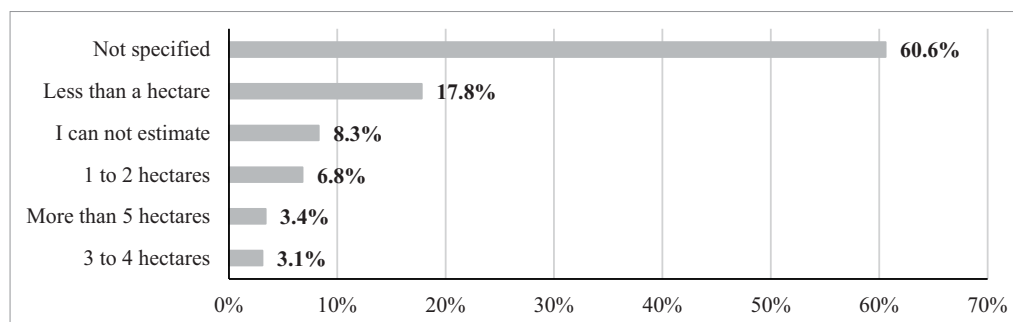


Figure 2: The size of brownfields in relative terms

Source: Own results based on research (n = 2,721); (2019)

Osman *et al.* (2015) in their study point to the fact that in the case of brownfield regeneration, the size of the abandoned building or area is decisive. Industrial and military brownfields are more often regenerated due to the size of the building or area. These brownfields are more aimed at building development projects (apartment buildings) or building business zones. Smaller brownfields tend to be regenerated by municipalities, or smaller investors or business units, which are more aimed at new uses, mostly of a civic nature or small business.

Table 4 shows the results of the question focused on the ownership of brownfields from the perspective of municipalities and cities in a regional comparison. It is important to note that the 'Not listed' option is not displayed in the results, for better clarity of the regional results. The respondents could choose several variants concerning the ownership of brownfields. The table shows that most abandoned buildings and areas in all regions are mostly in private ownership, followed by public ownership and combined ownership. Ownership of brownfields is usually cited as a basic factor that affects the subsequent process of regeneration of abandoned buildings and areas not only in the country. In the case of private ownership, there is usually a problem when the owner does not show interest or does not have enough funds for the regeneration of the brownfield. The transfer of property from private to public ownership is then complicated, which is also related to the regeneration. The largest share of private ownership is in the South Bohemian Region, Pardubice Region and Hradec Králové Region. In the case of public ownership, the largest share of ownership of brownfields is in the Karlovy Vary Region, the Zlín Region, and the Ústí Region. Within public ownership, there is a certain problem in financing the regeneration of brownfields, namely their cost. The costs of a given regeneration or reclamation tend to be large and municipalities or cities, if they decide on a given regeneration, try to help with various financial instruments, such as European operational programs, national grant titles and other forms of assistance that may or may not be approved. The entities can then use non-financial instruments such as consultations, collections and other forms. It is important to mention that the resources of municipalities and cities are not large enough to always cover each regeneration of brownfields. Such an intention is usually planned for several years.

Figure 3 shows the results for the question which focused on the ownership of brownfields. As with the regional comparison, it should be noted that the possibility of respondents not answering was not included in the result of this question. This option is not shown below. Within the given question, it is clear that most brownfields are in private ownership, followed by public ownership and the last one is combined. The above results subsequently reflect the reality as in the regional comparison.

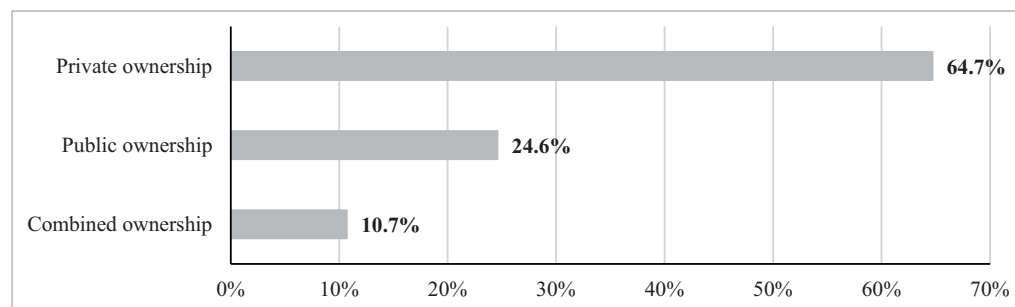
In the case of abandoned buildings and areas registered in the National Database of Brownfields (CzechInvest), it can be said that even in the given database, private dominates over public and combined ownership. According to the authors of the contribution for 2020, the relative frequency of private ownership was 65%, public

Table 4: Ownership of brownfields in individual regions

Name of the region (NUTS 3)	Public ownership	Private ownership	Combined ownership
Prague	26.3	42.1	31.6
Central Bohemian Region	20.0	67.2	12.8
South Bohemian Region	19.8	75.8	4.4
Plzeň Region	21.2	67.7	11.1
Karlovy Vary Region	40.5	57.1	2.4
Ústí nad Labem Region	32.0	58.3	9.7
Liberec Region	25.5	68.6	5.9
Hradec Králové Region	20.0	71.6	8.4
Pardubice Region	19.4	74.6	6.0
Vysočina Region	22.6	67.7	9.7
South Moravian Region	25.0	58.9	16.1
Olomouc Region	20.5	66.3	13.2
Zlín Region	37.3	51.0	11.7
Moravian-Silesian Region	32.0	56.0	12.0

Source: Own results based on research (n = 2,151); (2019)

ownership 29% and combined ownership 6%. Following the results of the primary research, these are approximately the same values as the data of the given database from the CzechInvest organization.

**Figure 3:** Ownership of brownfields

Source: Own results based on research (n = 2,151); (2019)

The next table (Table 5) focuses on the previous use of brownfields at the regional level. Respondents were asked to provide an estimate of the number of brownfields in relation to previous activities. From the table below (Table 5), it is clear that most abandoned buildings and areas were formerly used for agricultural activity as regards zoning status in relative frequency. The main reason for the emergence of agricultural brownfields is that the economy was transformed in the Czech Republic after 1989. Cooperatives and other agricultural areas were not as much needed as before 1989. For this reason, they became abandoned and unused. These brownfields are mainly

located in agricultural or farming areas in individual regions of the Czech Republic. Post-agricultural brownfields emerge in multiple manners across national, regional and local levels (Krejci *et al.* 2021).

In the case of regional differences, we can first look at the capital, namely Prague. In the case of previous use, industrial activity dominates. Such brownfields are mainly located in more distant places from the center of Prague. Other activities that had equally relative shares in the capital city of Prague are agricultural activities and transport. Subsequently, there was a relative level of 15.8% of brownfields after civic amenities, which can include shops (shopping centers), office buildings, schools, offices, health centers, hospitals, cultural centers, cinemas, playgrounds, stadiums, etc. The following region is the Liberec Region, which is dominated by brownfields after industrial activity. The above-mentioned region, as described above, was mainly industrially based before 1989. As a result of the process of economic transformation and privatization activities in the 1990s, abandoned and unused industrial areas were created within the country, mainly in industrial regions such as the Liberec Region.

Another region is the Karlovy Vary Region. As we can see from the table, the most frequent past activities of brownfields are former civic amenities, at a relative frequency of 37.5%. Other regions, which have not been commented on in more details here, state that they have agricultural brownfields in the highest relative frequency. For a given question, respondents had the option of multiple answers to choose from. For this reason, the results were selected according to the answers and the number of respondents who answered this question Table 5. The respondents who had not answered the question were not taken into account in the interpretation of the results.

The next figure (Figure 4) focuses on the results of the previous use of brownfields at the national level. From the given results, where the possibility that the respondents did not answer is not mentioned, it is evident that agricultural use dominates in almost 40%. Other options with a high relative frequency were industrial activity (20.4%) and former civic amenities (16.8%). These three possibilities of the previous use of brownfields were also mentioned to a greater extent in the regional comparison.

The evaluation of the issue at the national level proved the dominant position of agricultural brownfields. These brownfields are mainly former agricultural cooperatives, which gradually disappeared in the Czech Republic after 1989. Another wave of extinctions of agricultural cooperatives and other agricultural buildings due to growing competition for agricultural food imports from abroad took place in the mid-1990s. The occurrence of post-agricultural brownfields, their abandonment and the reuse of agricultural premises are deeply rooted in the agricultural transformation.

The following figure (Figure 5) draws attention to the interpretation of the results of the question which focused on the existence of brownfields in the vicinity of a residential area. If we do not take into account the cases when the respondents answered

Table 5: Previous use of brownfields in individual regions

Name of the region (NUTS 3)	Industrial activity	Agricultural activity	Army	Mining	Former civic amenities	Transport	Other
Prague	31.6	15.8	0.0	5.3	10.4	15.8	21.1
Central Bohemian Region	18.5	45.4	5.8	1.9	10.3	3.9	14.2
South Bohemian Region	6.8	47.0	7.8	0.0	20.7	1.9	15.8
Plzeň Region	17.8	45.7	5.9	0.9	8.5	1.7	19.5
Karlovy Vary Region	18.6	18.8	4.2	2.1	37.5	6.3	12.5
Ústí nad Labem Region	23.9	29.9	3.4	4.3	16.2	6.0	16.3
Liberec Region	29.1	25.3	5.1	0.0	22.8	2.5	15.2
Hradec Králové Region	23.9	42.5	3.5	0.9	15.9	1.8	11.5
Pardubice Region	26.0	44.2	1.3	1.3	9.1	0.0	18.1
Vysočina Region	15.0	43.4	2.7	0.9	17.7	1.8	18.5
South Moravian Region	20.6	44.0	4.3	1.4	14.2	1.4	14.1
Olomouc Region	21.7	37.0	3.3	0.0	21.7	1.1	15.2
Zlín Region	24.1	36.2	1.7	1.7	20.7	0.0	15.6
Moravian-Silesian Region	22.0	38.1	2.5	1.7	24.6	0.9	10.2

Source: Own results based on research (n = 1,399); (2019)

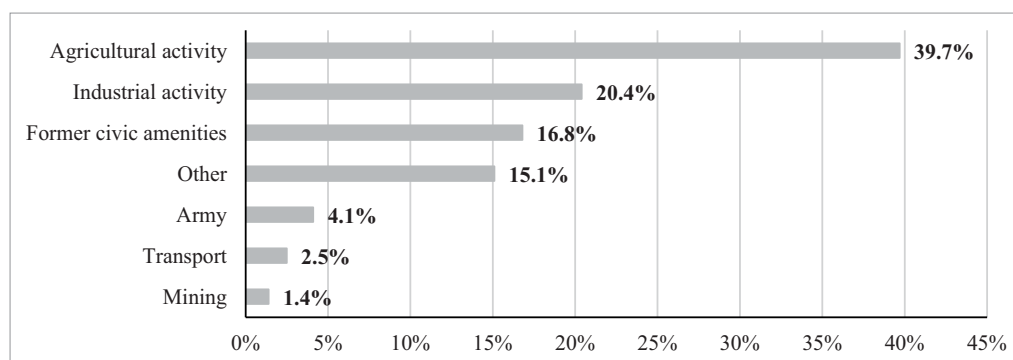


Figure 4: Previous use of brownfields

Source: Own results based on research (n = 1,399); (2019)

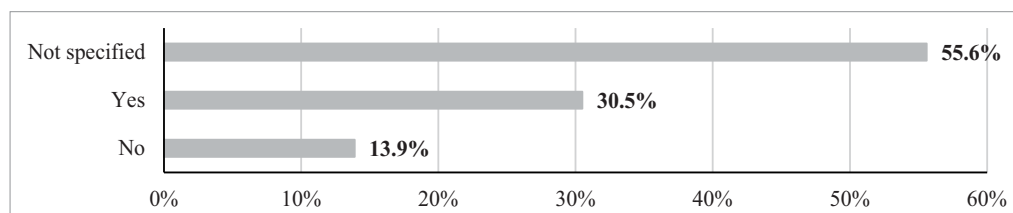


Figure 5: Brownfields near housing development

Source: Own results based on research (n = 2,721); (2019)

the question (Not specified), we can see that the existence of abandoned buildings and sites near the residential area is obvious. A relative frequency of cases when the respondents answered ‘Yes’ was 30.5%. It is important to note that the question was aggregated at the national level and was analyzed at the regional NUTS 3 level.

The next table (Table 6) focuses on a detailed analysis of the distance and approximate number of brownfields from the residential area. The most frequent distance of abandoned buildings and sites from the residential area is of max. 50 meters, followed by the variant of a max. 100 meters, and the last variant of max. 500 meters. The results shown in the table are stated in the relative frequency aggregated at the national level.

Table 6: Number of brownfields according to the distance from housing development

	0	1	2	3	4	5	Not specified
50 m	5.6	12.5	4.7	1.7	0.8	1.1	73.6
100 m	5.8	9.6	2.9	1.0	0.5	0.6	79.6
500 m	5.7	6.4	2.0	0.8	0.3	0.5	84.3

Source: Own results based on research (n = 2,721); (2019)

The table below (Table 7) shows the results of questions that can be considered as one of the key questions of the research. In this question, the authors of the article dealt with whether the abandoned buildings and areas have a negative impact on the development of the city or municipality.

Table 7: Negative impact of the existence of brownfields

Name of the region (NUTS 3)	Definitely yes	Rather yes	I can't judge	Rather not	Definitely not	Not specified
Prague	13.5	10.8	2.7	13.5	0.0	59.5
Central Bohemian Region	13.6	8.7	5.6	4.3	2.3	65.5
South Bohemian Region	9.9	8.8	5.7	6.5	3.8	65.3
Plzeň Region	9.8	10.3	10.7	9.4	2.2	57.6
Karlovy Vary Region	23.9	8.5	8.5	5.6	2.8	50.7
Ústí nad Labem Region	21.8	14.1	9.2	2.8	0.7	51.4
Liberec Region	24.3	0.0	10.8	8.1	0.0	56.8
Hradec Králové Region	17.3	12.6	4.7	10.5	1.1	53.8
Pardubice Region	13.1	7.9	5.7	6.3	3.4	63.6
Vysočina Region	10.2	11.8	3.5	9.4	2.4	62.7
South Moravian Region	12.4	9.3	7.6	7.2	2.4	61.1
Olomouc Region	9.5	16.3	5.3	8.9	1.1	58.9
Zlín Region	11.7	11.7	5.8	4.4	1.5	64.9
Moravian-Silesian Region	19.9	8.6	8.5	7.9	1.1	54.0

Source: Own results based on research (n=2,721); (2019)

The results of the question based on the national comparison will now be presented. As mentioned above, the question focused on whether brownfields have an impact on the development of cities or municipalities (Figure 6). Respondents most often chose the option ‘Definitely yes’, which had a frequency of 13.7%. The second option of the respondents was ‘Rather yes’, which cumulated 10.1%. 9.2% of the respondents considered that brownfields have ‘Rather not’ or ‘Definitely not’ impact on the development of cities. 6.5% of the respondents had a neutral opinion.

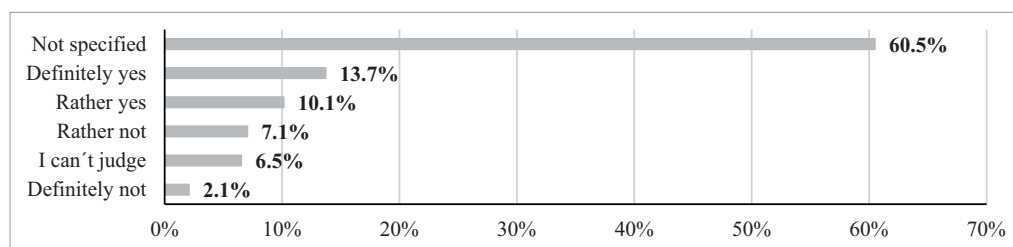


Figure 6: The influence of the existence of brownfields on the development of towns and municipalities in the Czech Republic

Source: Own results based on research (n = 2,721); (2019)

The questionnaire included the question focused on the existence of the industrial-business zone on the cadastral territory of villages and towns. The results aggregated at the regional level (NUTS 3) are shown in Table 8. The highest relative frequency of the existence of industrial-business zones can be seen mainly in the Zlín Region.

Table 8: Existence of an industrial or business zone in the individual regions

Name of the region (NUTS 3)	Yes	No
Prague	40.91	59.09
Central Bohemian Region	42.41	57.59
South Bohemian Region	25.54	74.46
Plzeň Region	32.41	67.59
Karlovy Vary Region	40.00	60.00
Ústí nad Labem Region	40.21	59.79
Liberec Region	24.19	75.81
Hradec Králové Region	38.93	61.07
Pardubice Region	45.08	54.92
Vysočina Region	32.95	67.05
South Moravian Region	44.55	55.45
Olomouc Region	40.54	59.46
Zlín Region	52.63	47.37
Moravian-Silesian Region	41.55	58.45

Source: Own results based on research (n = 2,721); (2019)

In the analysis at the national level, it was found out that 39.3% of the respondents recorded an industrial-business zone on their territory, and the remaining 60.8% respondents stated they had not recorded any zone intended for business activities. It is important to mention that this question was mandatory for all respondents who participated in the survey.

Another question was closely connected with the previous question. If the respondents stated that there was an industrial-business zone on their cadastral territory, they were asked to select if the relevant zone had been developed on an abandoned site or brownfield. Table 9 shows the results aggregated in individual NUTS 3 regions. Respondents answered at a small relative frequency that the industrial-business zone had been developed on a brownfield.

Table 9: Construction of an industrial or business zone on brownfields in individual regions

Name of the region (NUTS 3)	Yes	No	I can't judge	Not specified
Prague	5.41	21.62	2.70	70.27
Central Bohemian Region	7.84	18.76	3.51	69.90
South Bohemian Region	1.52	15.59	1.90	80.99
Plzeň Region	3.13	17.86	2.68	76.34
Karlovy Vary Region	4.23	22.54	2.82	70.42
Ústí nad Labem Region	5.63	22.54	0.00	71.83
Liberec Region	2.38	16.67	1.19	79.76
Hradec Králové Region	7.85	15.18	3.66	73.30
Pardubice Region	21.59	6.82	3.41	68.18
Vysočina Region	7.06	14.12	2.75	76.08
South Moravian Region	10.34	21.38	3.45	64.83
Olomouc Region	7.37	20.00	4.21	68.42
Zlín Region	9.49	21.90	5.11	63.50
Moravian-Silesian Region	9.66	22.73	2.27	65.34

Source: Own results based on research (n = 2,721); (2019)

Figure 7 shows the results of the above question at the national level. From the figure below, we can say that 10.4% of the respondents stated that an abandoned building and premises were used for the given option. This way of transforming a brownfield into an industrial-business zone is right and in the future years this possibility of using the abandoned land should be considered, rather than occupying land that could be used for agricultural and farming purposes.

The authors of the paper then focused on the assessment of the analysis of correlation between selected variables. The following results of the correlation analysis apply to the whole Czech Republic. In assessing the correlation analysis, which used the Pearson correlation coefficient that measures the linear correlation between two quantities, the authors considered a 95% confidence interval. Among selected variables, three types of variables were taken into account; the first variables included:

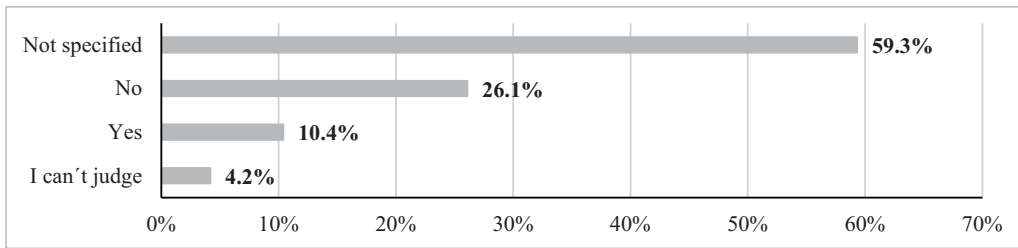


Figure 7: Regeneration of brownfields to an industrial or business zone

Source: Own results based on research (n = 2,721); (2019)

‘the existence of brownfields on the cadastral territory’ and ‘the number of inhabitants of the relevant cadastral territory’. A small linear dependency between the selected variables was determined based on the calculation, with a correlation coefficient of 0.121. When performing a correlation analysis, the statistical dependence between the variables was subsequently examined. In the case of the above variables, the significance rate was found to be less than $\alpha = 0.05$. From this point of view, we can say that there is a certain dependence between the examined variables and the correlation is statistically significant.

The correlation between the following variables was analyzed: ‘the former use of brownfields’ and ‘the impact of brownfields on the development of a town/village’. In case of brownfields left after former activities, abandoned buildings and sites were taken into account: industrial, agricultural, military, mining, former community facilities and transportation. Now, the results of the correlation analysis will be commented on the basis of collected correlation coefficients in connection with the relevant variable, from the strongest correlation coefficient downwards. The highest correlation coefficient was determined for brownfields that emerged as a result of agricultural activities in relation to the impact of brownfields on the development of the towns/municipalities; the correlation coefficient in this case is 0.573. The next value of the correlation coefficient applied to brownfields left after industrial activities, and the correlation coefficient was 0.438. For the above analysis, which focused on previous uses (‘agricultural’ and ‘industrial’ activities), the significance rate was less than $\alpha = 0.05$. Here, too, we can state that there is a certain dependence between the examined variables and the variables are statistically significant. It can be said there is a certain linear correlation between the relevant variables. In case of other brownfields left after the former activities, the values of correlation coefficients were low, so they are not discussed here in detail. The last correlation analysis was between ‘impact of the brownfield on the development of a town/village’ and ‘the number of inhabitants of the relevant cadastral territory’. On the basis of the correlation analysis, the Pearson correlation coefficient was 0.122. For the last examined variables, as in the previous examples, a statistically significant dependence between the variables was found.

It must be noted that all results are affected by the fact that the respondents did not always answer to the variables within the questionnaire. It should be pointed out that a more in-depth analysis is required in case of the variables so that we can find out a deeper meaning of the collected information resulting from the questionnaire survey. The use of a factor analysis is an example of another deeper direction of the results of the questionnaire survey.

4. Discussion

Based on the conducted research, it can be said that the participation in the research was adequate, with 43.5% of the respondents participating in the survey. On the basis of the results collected from the respondents, which were then aggregated into a higher-level territorial unit (NUTS 3), it was found that villages and towns contend with the existence of brownfields on their territory. The largest occurrence of these abandoned buildings and areas was especially in regions that were heavily industrialized in the past. Other results show that most brownfields in each region are around one hectare. There are regions that cover an area of more than one hectare. In this case, it is a large plot of industrial or agricultural area or land that was used by the military in the past for its training exercises. Another question asked respondents to indicate the ownership of the brownfields in its cadastral area. The results demonstrated the fact that most abandoned buildings and areas are privately owned in a regional and national comparison. An interesting finding of the research was that the respondents state the previous use of the abandoned facilities. Within the results of research at the national level, it was found that agricultural brownfields dominate in 39.6% of cases. In almost all regions, the respondents stated that there are abandoned buildings and sites left behind after the agricultural activities on their territory. On the basis of the results collected from the respondents, the highest relation frequency of brownfields left after agricultural activities were detected in NUTS 3 regions such as South Bohemian (47%), Plzeň (45.7%) and Central Bohemian regions (45.4%). The regions can be considered traditional agricultural regions. In the Liberec Region, which can be considered an industrialized region, abandoned buildings and premises after industrial activity prevail in a relative frequency of 29.9%. An important question of the research was to state whether brownfields have an impact on the development of cities and municipalities. In the case of the analysis of the results at the national level, we can say that in relative terms, 23.8% of the respondents answered that the abandoned buildings and areas have a certain impact on the development of cities and municipalities. Response possibilities such as 'Definitely yes' were recorded in this relative value, where the relative value is 13.7% and 'Rather yes' (10.1%). The brownfields on the territory of the Czech Republic are an important problem.

5. Conclusions

The aim of this article was to assess the current situation of brownfields from the perspective of municipalities and cities in the Czech Republic. The article presented the results first at the regional and then at the national level. Most abandoned buildings and areas are concentrated in an area that was previously marked by heavy industry, mining and now agriculture. The Czech agricultural sector has been weakening in recent decades, with many abandoned or under-used agricultural premises being found (Navratil *et al.*, 2020). The regions with the highest prevalence of the given occurrence include the Liberec Region, Ústí Region and Moravian-Silesian Region. The results also showed that the biggest problem in the process of brownfield regeneration is primarily ownership, which reflects the ability of municipalities and cities to carry out a brownfield's restoration. Ownership of brownfields is much discussed in other studies. In the Czech Republic, clarified ownership is a significant factor contributing to successful regeneration (Frantal *et al.*, 2015; Tureckova *et al.*, 2018). Other results paid attention to previous use.

Within the regional and national level, it was found that the largest share of previous use is mainly after agricultural activities, industrial activities and former civic amenities. It is important to point out that the previous activity and the location of the given brownfields reflect the ability of the subjects and possibly the investors to regenerate the abandoned building or area. An important question of the whole research was based on how municipalities and cities perceive the existence of brownfields within their development. The results speak for themselves, namely that the existence of these abandoned buildings and areas clearly influences them in further development.

Within the results of the correlation analysis, it was found out that there is a certain correlation between the studied variables. The strongest correlation was found in case of a former use of the brownfield after agricultural activities and the impact of the brownfield on the development of a village/town. As discussed in the paper, a more in-depth analysis of the results is required that can help us achieve an effective solution to the issue in case of the existence of brownfields in villages and towns not only on the territory of the Czech Republic. The situation of brownfields from the point of view of municipalities and cities today is not easy, as was discovered in the research. An important connecting element in the process of brownfield regeneration is to establish communication with the owners, securing a subsidy title or other resources for regeneration and, last but not least, the fact that the plans in case of reuse should be in the public interest.

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