CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

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ARTIFICIALIZATION OF AGRICULTURAL LAND IN PRAGUE METROPOLITAN AREA

Master Thesis

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Artificialization of agricultural land in Prague metropolitan area

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Objectives of thesis

Land grabbing is not only the issue located in the countries of Global South, but it is also the important driver of landscape changes in Europe. Therefore, it is important to study the causes and consequences of this process. The main aim of this thesis is to process quantitative and qualitative analysis of artificialization in selected villages in metropolitan area of Prague. The thesis would like to contribute to the knowledge of landscape planners aimed at the protection of agricultural land according to its soil quality.

Methodology

To achieve the main aim of the thesis, the villages will be randomly selected within the metropolitan area of Prague and considered the basic study areas. The analysis in the selected areas will be processed by GIS tools using the data from Master Plans and the data about the classification of agricultural land protection. The results will be mostly presented by charts, processed tables and map layouts with the accompanying text.

The proposed extent of the thesis

50 – 60 stran

Keywords

land grabbing, artificialization, landscape protection, GIS, suburbanization

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Recommended information sources

Leetmaa K. et Tammaru T., 2007: SUBURBANIZATION IN COUNTRIES IN TRANSITION: DESTINATIONS OF SUBURBANIZERS IN THE TALLINN. Geografiska Annaler: Series B, Human Geography, Volume 89, Issue 2.

Planting A. J. et Miller D. J., 2001: Agricultural Land Values and the Value of Rights to Future Land Development.Land Economics, vol. 77.

The peer-review articles from scientific databases.

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Dean

Prague on 01. 04. 2016

DECLARATION

I hereby declare that the thesis entitled “Artificialization of agricultural land in Prague metropolitan area” has been carried out in the Faculty of Environmental Sciences, Czech University Of Life Sciences Prague, Czech republic, under the guidance of Ing. Vratislava Janovská, Ph.D. The work is original and has not been submitted in part or full by me for any degree or diploma at any other University.

I further declare that the material obtained from other sources has been duly acknowledged in the thesis.

Date: 19/04/2016

Place: Prague, Czech Republic

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ABSTRACT, KEY WORDS

The paper provides quantitative and qualitative analysis of the agricultural land loss due to urbanization in 71 randomly selected villages within the Prague metropolitan area. The built-up and buildable areas were mapped and vectorized from the raster satellite imagery and the spatial planning documentation. The artificialized area was subsequently classified into the agricultural land protection classes and the quality of artificialized land was examined. The dependencies of the soil loss on the impact of metropolitan area were analyzed through the correlation with the location-related, socio-economic and planning determinants. The distance from the core city boundaries, the commuting time and distance to the core city, the size of the cadastral area, population and population density, the number of commuting people and the closeness to the main transport network were selected as the examined indicators.

The results show that the built-up and buildable area ratio in the selected municipalities is higher, than the national average and depends on the urban-rural gradient of metropolitan area. The ratio of artificialized and sealed area within the selected villages is even higher than the EU average. The analysis indicates the biggest land grabs of high quality agricultural land in the nearest Prague hinterland, where the fertile soil is located and where is put strong suburban pressure on the land use change at the same time. The most important factors influencing the size of artificialized area are the total municipality population, the population density and number of people commuting to Prague together with the commuting distance to Prague city center. According to the analysis, the municipalities with larger built-up areas, which experienced bigger suburban growth, are planning more regulated development meanwhile the less urbanized municipalities in the 40 minutes commuting distance from Prague are planning significant urban growth.

Key words: land grabbing, land use change, suburbanization, agricultural land protection, spatial planning, GIS

ABSTRAKT, KLÍČOVÁ SLOVA

Práce se zabývá kvantitativní a kvalitativní analýzou ztráty zemědělské půdy způsobené urbanizací v 71 náhodně vybraných obcích v Pražské metropolitní zóně. V první části je zmapováno a vyhodnoceno aktuálně zastavěné území podle ortofoto mapy a území zastavitelné, určené pro budoucí rozvoj v územně plánovací dokumentaci. Druhá část se zabývá klasifikací artificializovaného území do tříd ochrany zemědělského půdního fondu. Ve třetí části jsou zkoumány vlivy a dopady metropolitní zóny na zábor zemědělské půdy a její kvalitu. Pro analýzu byly použity socioekonomické faktory vzdálenosti zkoumaného území od hranic jádrového města, času a vzdálenosti dojížďky do jádrového města, počtu a hustoty obyvatelstva a územní faktory velikosti katastrálního území, vzdálenosti od jádrového města a vzdálenosti od páteřní dopravní sítě.

Výsledky ukazují, že průměrná zastavěnost v metropolitní zóně je vyšší, než je celostátní průměr a závisí na urbánně-rurálním gradientu metropolitní oblasti. Podíl urbanizované a fakticky zastavěné plochy je vyšší, než je celoevropský průměr. Studie dále prokázala, že k záborům vysoce kvalitní zemědělské půdy dochází nejvíce právě v okolí Prahy, kde se kvalitní orná půda vyskytuje, ale kde je také největší suburbanizační tlak na změnu jejího využití. V rámci práce bylo zjištěno, že nejvýznamnějšími faktory na velikost zastavěných a zastavitelných ploch jsou celková dojížďka, hustota obyvatelstva, počet obyvatel a dojezdová vzdálenost od Prahy. V rámci zmapování plánovací dokumentace bylo zjištěno, že více zastavěné obce plánují svůj růst regulovat a naopak obce méně stavebně rozvinuté v dojezdové vzdálenosti do 40 minut od Prahy plánují významný růst.

Klíčová slova: artificializace, změna využití půdy, suburbanizace, třídy ochrany zemědělského půdního fondu, suburbánní vztahy, GIS

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1. INTRODUCTION

The land is limited natural resource and Europe is the only continent, where the land cover change is not dominated by agricultural demand. Nowadays 75% of the European population lives in the urban areas, which are expanding towards agricultural land and therefore causing soil loss. The enormous changes of the countryside around large cities in the last decades can be called the landscape revolution (Cílek & Baše, 2005). The villages around capitals are losing their Genius loci (Norberg-Schultz, 1994) and the agricultural land is wasted for commercial and residential purposes.

Land grabbing is not only the issue located in the southern parts of Africa and South America, but it is the issue in Europe as well (Borras, et al., 2013). The land related issues become one of the main targets of European Union, which need to be challenged in close future. For the mitigation and prevention of land take the phenomenon of artificialization needs to be described and examined.

Artificialization is the underlying process of land grabbing and closely relates to the trend in landscape changes during last decades, especially in the metropolitan areas. The pattern usually consists of higher artificialization ratio close to the core cities and spreading of their suburban areas towards fertile agricultural land in their surroundings. Almost half of the artificialized land is sealed and therefore irreversibly damaged.

The area of the Czech Republic is limited and we have no big natural entity, such as high mountains or a sea, which can defend itself and cannot be easily destroyed. Therefore we should look after our natural heritage even more carefully than the others (Fingerová, personal communication, 2013).

2. AIMS

The main aim of this work is to make quantitative and qualitative analysis of agricultural land grabbing due to artificialization in the selected municipalities. The research is focused on the impact of the capital city's gravitation to agricultural land in the metropolitan area. The analysis intents to summarize the amount of artificialized land in the selected study areas in connection to the population and the distance from the core city. The second part of the analysis will focus on the Spatial planning documentation. As a result there will be indicated the amount of agricultural land in selected municipalities classified as buildable in actual urban plans.

The summarized artificialized land in selected villages will be qualified to the classes of soil protection according to The Decree of establishing the classes of protection No.48/2011. The obtained data will serve for an overview of built-up area soil quality and buildable area soil quality. The analysis aims to show the dependencies of artificialization of the most fertile soils on the location-related, socio-economic and planning determinants, if there are any.

The aims will be reached by elaborating the following analysis:

- Built-up are mapping
- Buildable area mapping from spatial planning documentation
- Agricultural land protection classes of artificialized land evaluation
- Spatial distribution of high quality agricultural land and the dependence on the selected factors

3. LITERATURE REVIEW

The literature review introduces the terminology of the main land issues in Europe and focuses on land grabbing, land take, artificialization and its underlying processes, such as suburbanization. The review contains short insight into the problematics of artificialization, the methods of land use change examination and brings examples of Montpellier, Tallinn and Barcelona metropolitan areas. The role of planning in prevention of agricultural land loss is described as well as the context of the Czech Republic, with the spatial planning system and specific tools.

3.1 LAND ISSUES IN EUROPE

The states worldwide are suffering the land related issues, not only the Global South. Land issues and land sovereignty are one of the main stones of European Union (EU) policies (Borras, et al., 2013; EEA, 2014). The concentration of land under ever larger holdings controlled by fewer owners resulting from land grabbing is causing more problems when accessing the land for small scale food producers (Borras, et al., 2013). The degree of land-based inequality is comparable to Brazil, Colombia or Philippines, countries with inequitable distribution of land ownership and land-based wealth. The privatization in post socialist European countries rapidly alternated landscape and livelihoods. The CAP (Common Agricultural Policies) subsidy scheme of EU, tied directly to the production, benefits bigger land holdings and pushes away thousands of famers out of farming every year (Borras, et al., 2013). The agricultural land is disappearing due to the rapid urban growth, which increases higher than the population rate (EEA, 2006).

3.2 LAND GRABBING

Land grabbing is a pressure of the society to the land and water resources in all continent with exception of Antarctica (Rulli, et al., 2013). The term is usually used for purchasing or leasing large portions of land from public or private owners (Szocs, et al., 2015).

The phenomenon of land grabbing is mainly considered as a problem in the context of Africa, Latin America and Asia, but it has significant impact on European counties as well. Europe is connected to the land grabbing phenomenon in three directions: as a context for land grabbing, as the origin of land owners and as the site for land use change (Borras, et al., 2013). Over 50% of agricultural land in Europe is owned by only 3% of land owners (Szocs, et al., 2015). We can see the land grabbing struggles inside EU in the newer Member States such as Romania, Bulgaria or Hungary, but also in Germany, Italy or Spain. From non EU countries Ukraine and Serbia recently reported serious cases. The land grabs are confined by foreign investors and domestic actors as well. The propagation of biofuels in recent years caused the increase of so called green grabbing, the land take in the name of the environment (Borras, et al., 2013).

The land concentration is rapidly spreading through EU countries, the number of holding is decreasing the same as the number of farm smaller than 2ha, meanwhile the farms larger than 50ha are spreading (Borras, et al., 2013). According to estimation of (Záhorka, 2009) almost the third of the agricultural land in the Western part of Czech Republic is owned by foreign investors and the prices of land in Moravia are reaching the EU Western countries level.

In Europe the highest land take occurred between the years 2000-2006 and the highest urban development was located in Albania with 4,6% of annual urban land take increase, Iceland with 3,2% and Spain with 2,8%. The Czech Republic is below the EU average of 0,5% with 0,4% of annual urban land take increase. In this period Spain was the leader in contributing with urban land take within the EU, for comparison the Czech Republic contributed by 1,8% of mean annual urban land take (EEA, 2015). The total agricultural land loss due to urbanization was the highest in Germany, Spain and France, due to their surface area (JRC, 2012). The daily loss of agricultural land in the Czech Republic is According to the Czech Research Institute for Soil and Water Conservation (VUMOP) (MA, 2015).

The EU introduces the policies for decreasing the pressure on the land (EEA, 2014). One of the targets of long term environmental EU policy for year 2050 is no net land take, mainly because it is causing the negative consequences as soils sealing, soil degradation and erosion, decrease in soil organic content, decrease in agricultural production and productivity, and impacts the carbon cycle, biodiversity, water cycle and microclimate (Zoppi & Lai, 2013; EEA, 2014).

3.3 ARTIFICIALIZATION

Artificialization is one of the underlying processes for land grabbing, land concentration and green grabbing, mentioned before, and is often connected with urbanization processes (Borras, et al., 2013) (Pointereau & Coulon, 2009). This type of land grabbing occurs close to the cities where are located the soils of highest quality and contributes to the great loss of agricultural land (Ody, 2013). The term artificialization is mainly used by French researchers (Pointereau & Coulon, 2009; Chéry, et al., 2014) and identifies the phenomenon of built-up area expansion towards natural or agricultural soils (Kapur & Erşahin, 2013). Artificialization refers to the land use change to non-agricultural and non-forestry purposes, such as urbanized areas, industrial or commercial zones, communication networks, cemeteries, mines, landfill sites and building sites (Pointereau & Coulon, 2009; Kapur & Erşahin, 2013).

Urban spread and the pattern of individual houses construction were the main drivers of artificialization in France (Pointereau & Coulon, 2009). The non-agricultural use of farmland is supported mainly by the proximity to currently built-up areas (up to 100m), proximity to the large municipality (over 5000 inhabitants), travelling time to the core city (up to 1h) and access to the land through the transport network (Sklenicka, et al., 2013).

The phenomenon directly tied up with the construction is called soil sealing and is directly connected with artificialization. Nevertheless not all the artificialized land is always sealed as visualized in Figure 1 (Prokop, et al., 2011). The average trend in the EU shows that usually one half of the artificialized land is sealed (EEA, 2014). The soil sealing is the most intense form of land take and is irreversible. It is a process of covering and destruction of the soil with buildings and other artificial materials (Prokop, et al., 2011).

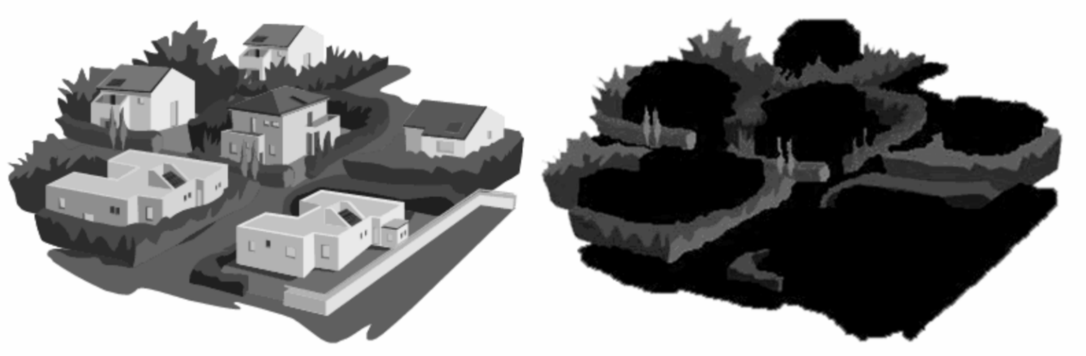

Figure 1 Artificialized area vs sealed soil, source Umweltbundesamt, 2010 ex. Prokop, et al., 2011

According to European Environment Agency (EEA) in 2006 4.4% of total EU area was artificialized and 2.3% sealed. Which shows the 51% ratio between urbanized and compacted land. In the year 2006 was each EU citizen stocked with 389 m² artificial surface and 200 m² sealed surface. The national averages of land take vary from more than 1000 m2 to 200 m2 per capita depending on the country. The average EU trend is an increase in artificialized area, just few exceptions experienced the negative annual land take between 1990-2006, such as Malta, United Kingdom, France, Austria, Netherlands and Luxembourg. The strong land use pressure, determined as the share of artificialized land higher than 8%, and the high sealing rates, determined as the share of sealed surface higher than 3,8%, are identified in Malta, the Netherlands, Belgium, Germany, Luxembourg, and Cyprus (Figure 2) (Prokop, et al., 2011).

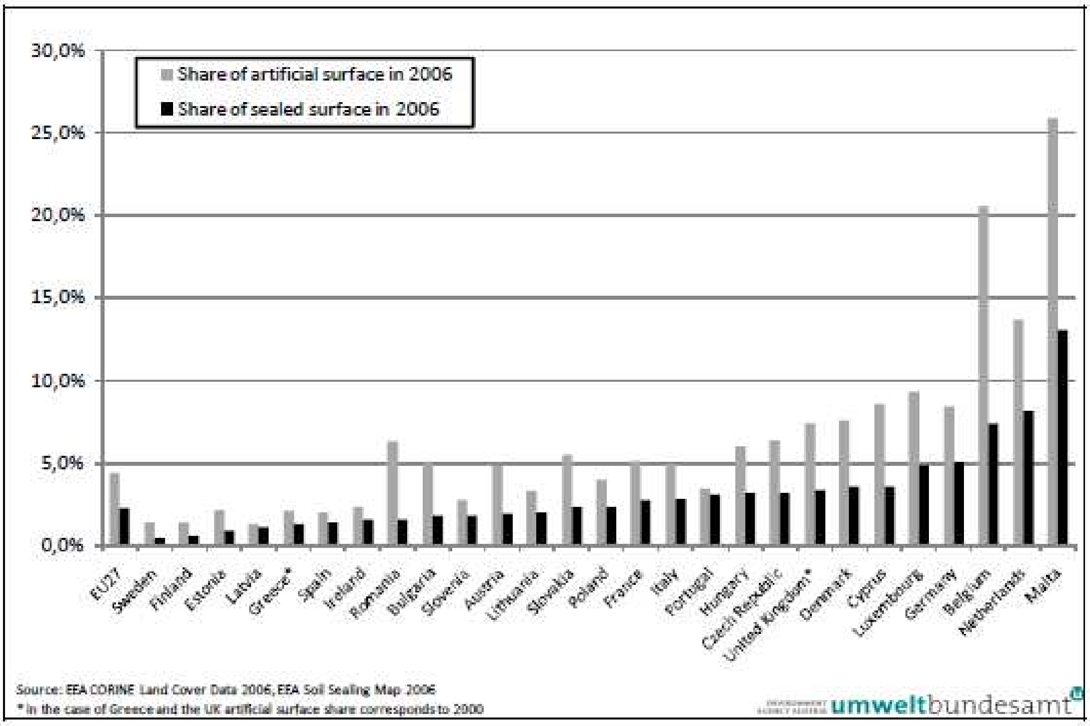

Figure 2 Artificial surfaces and sealed surfaces per capita in EU 27, source Umweltbundesamt, 2010 ex. Prokop, et al., 2011

3.4 SUBURBANIZATION PROCESSES

Suburbanization is a socio-economic process which leads to artificialization of land in the countryside (Cílek & Baše, 2005). The process can be characterized as a migration of inhabitants from the city to the hinterland (Ouředníček, 2006). Therefore agricultural land values are highly dependent on the population dynamics and the access to the urban area (Plantinga & Miller, 2001).

The process of suburbanization was originally described in the USA, where the urban structures of low population density deeply penetrated to the countryside and caused the metropolitan decentralization towards extensive commuting hinterland or commuting ring (Champion, 2000). The Metropolitan Statistical Areas (MSA) in the USA are less dense and more suburbanized than metropolitan areas in other comparable countries with high income such as Canada, Germany or Japan. The phenomenon of suburbanization in the USA is caused mainly by the attribute of the land abundance in the USA together with greater dependence of individual transportation, higher criminal rate in the inner cities and greater fiscal autonomy of the suburbs and higher social and ethnical diversity (Mieszkowski & Mills, 1993). In Europe, and mainly in the post-socialist countries, the suburbanization is caused by different factors and creates different patterns as in the USA (Sýkora, 2002; Stanilov & Sýkora, 2014).

One of the most problematic types of suburbanization is urban sprawl. The term urban sprawl is a synonym for unplanned urban growth, with patchy, discontinuous, low-density urban fabric. Even though many cities in Europe suffer the effects of this self-development without any vision or plan, the increment of urban fabric is still more compact than in the USA (EEA, 2006; Hnilička, 2012).

3.5 LAND ISSUES STUDY AND EXAMINATIONS

The land cover and land use changes can be studied in different levels and by various approaches depending on available data. The land use and land cover could be analyzed within the frame of mutual influence of natural conditions and socio-economic factors (Eiden, et al., 2002).

The analysis can be focused on changes of estimation area share, the land cover flows dynamics, the dynamics of land cover dominants within segment and many others (Eiden, et al., 2002). For the potential of soil loss in the peri-urban areas, the land fragmentation and the land concentration can be used the Sensitivity index of Agricultural land tool (Mazzocchi, et al., 2013). On the other hand for the urban sprawl analysis, the specific land use policies evaluation and the landscape protection assessments, are recommended the dimension related sprawl type indicators with specific environmental and economic attributes rather than composite sprawl indexes[1]. (Fina & Siedentop, 2008)

	Artificial surfaces	**Land take**	**Sealed surfaces**
Source	CORINE Land Cover	CORINE Land Cover	EEA Soil Sealing Map of Europe
Time reference	1990, 2000, 2006	Comparison of the periods: 1990 – 2000 2000 - 2006	2006
Geographical coverage	1990: EU27 without Cyprus, Finland, Malta, Sweden 2000: EU 27 2006: EU27 without Greece and the UK	Comparison of the periods: 1990 - 2000: EU 27 without Cyprus, Finland, Malta, Sweden 2000 – 2006: EU27 without Greece and the UK	EU 27

Figure 3 Data sources for the assessment of artificial surface, source: Prokop, et al., 2011

[1] Indicators according to Fina & Siedentop, 2008 : Share of urbanized land indicator; New urban area consumption dynamic surface indicator; Conversion of sensitive areas indicator; Openness index; Total Core Area Index; Jaggedness indicator

Nevertheless the tools broadly used as a data source for artificialization and soil sealing analysis are developed within a framework of the land and ecosystem accounts method by EEA and Eurostat statistical unit of European Commission (EC) (EEA, 2006). The extent and period covered by the EU land cover surveys are closely described in Figure 3. Corine land cover project and Land use and Cover Areas frame survey are commonly used for analysis of land use changes (Eiden, et al., 2002).

Corine land cover project is part of EU program launched in 1985. Corine land cover (Coordination of information on the environment) contains the inventory of 44 classes of land cover and is presented as cartographic product with scale of 1:100000. The minimum mapping unit in 25 hectares and minimum linear feature width 100m (EEA, 2007). The Land Cover vector map (CLC) defines four classes of artificial areas: urban fabric; industrial, commercial and transport units; mine, dump and construction sites; and artificial, non-agricultural vegetated areas (Zoppi & Lai, 2013) (Eiden, et al., 2002).

LUCAS, the Land Use and Cover Areas frame Survey (LUCAS) of Eurostat has an advantage in precisely defined methodological approach which allows the international comparison (Eiden, et al., 2002). In LUCAS the artificial land is defined as the land taken by land-taking processes and id divided into two categories: the built-up area and non-built up area (EUROSTAT, 2001; Zoppi & Lai, 2013).

The statistical land use data provide only information about macrostructure of landscape, but do not speak in detail about the composition and concrete changes of landscape elements (Lipsky, 1995). For the analysis of land use changes in the Czech Republic individual mapping and analysis of selected municipalities should be applied (Sklenicka, 2002).

3.6 METROPOLITAN AREA

As artificialization is a process mainly occurring in the hinterland of core cities, there is a need to delineate the sphere of the city's impact radius (Plantinga & Miller, 2001; Pointereau & Coulon, 2009). The unit of metropolitan areas is widely used in USA, where first MSA were established for easier territorial statistical comparison (Mieszkowski & Mills, 1993). There was done quite deep research of artificialization in metropolitan area in France and for those purposes were established Zones of urbanized areas. The areas are divided into four groups: the rural space, the urban centers, the suburban peripheries, and the multicentric municipalities. The zoning is based on population census data, especially the employment and daily commuting to work (INSEE, 2016).

3.7 EXAMPLES

3.7.1 FRANCE, PARIS AND MONTPELLIER METROPOLITAN REGION ARTIFICIALIZATION

In France is about 60000ha of agricultural land lost due to the artificialization every year according to (Ody, 2013). The phenomenon of large–scale artificialization in France begun in the 1960's (Pointereau & Coulon, 2009) and nowadays in the Mediterranean zone hardly 20% of the area is utilized as agricultural land (Ody, 2013). The artificialization processes are most evident around major cities, on the coast and in the Grand Ouest, Alsace and Rhône-Alpes regions. The artificialization is closely connected to the population growth and demand on secondary residential settlements not only in France (Pointereau & Coulon, 2009).

Paris region is one of the most populated metropolitan areas in Europe. Almost 48% of all the area is covered by agricultural land and threatened by urban expansion (Mazzocchi, et al., 2013). For the purpose of peri-urban relationship analysis, PLUREL[2], was selected the Montpellier region in the littoral urbanized zone. The city of Montpellier already reached it boundaries in terms of artificialization. Due to the housing policy of the municipality, the commune experienced rapid growth after the year 2000 and contributed to the artificialization of Mediterranean cost (Buyck, et al., 2008).

The best data for comparing the artificialization rate in France are supplied by TERUTI[3] land use survey (Eiden, et al., 2002) Even though the Montpellier study uses the Corine land cover analysis, which allows better comparison in European scale (Buyck, et al., 2008). On the other hand, the research of (Chéry, et al., 2014) analyses all the TERUTI land cover survey, the urban zoning land cover survey and CORINE land cover together, to bring more reliable results.

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2 Peri-urban Land Use Relationships research project of European Union focused on the rural-urban relationship and seek to provide more detailed information on urbanization processes and develop new tools for sustainable development. (University of Copenhagen, 2011)

3 TERUTI is the tool for land cover analysis conducted by the Central Statistical Office of the French Ministry of Agriculture. It consist of the network of 500000 points with land use information proportionally covering the Territory. The information is obtained through direct investigation and updated manually since 1980's (Chéry, et al., 2014).

3.7.2 Spain, Barcelona metropolitan region soil sealing

The case of Barcelona described by Ranalli & Salvati (2015) showed that the soil sealing ranges from the core city, with high compactness share, to the rural areas with low compactness. Therefore the distance from the core city has proportional influence to the spatial distribution of sealed soil. The research showed urban-rural gradient plays important role in case of intensity of land use (Ranalli & Salvati, 2015).

The analysis was based on the EEA high resolution soil sealing map and was focused on defining, what is the spatial pattern of soil sealing in Barcelona region. The study area was comprised of Barcelona core city and 311 municipalities in the metropolitan area. In the soil sealing evaluation the authors used four basic proxy variables: the average soil sealing intensity index weighted by the surface land of each imperviousness class, the percentage of pervious land, the sealed land per capita and the heterogeneity in imperviousness level. The elemental variables were compared with the population factors, such as the population density and the population changes, the distance from the core city and the total area of the municipality (Ranalli & Salvati, 2015).

The dependencies of selected factors on the municipality variables were analyzed by the linear (Pearson) and non-linear (Spearman) correlation analysis. The relationship between the soil sealing indicators and the distance from core city was studied by Pearson and Spearman correlations. The Spearman correlation only was used for analysis of dependence of the selected indicators on the population based variables. The results from both analysis were corrected by Bonferroni test for multiple comparisons. After all the selected indicators were performed in the principal correlation analysis to show the patent pattern of soil sealing in the region (Ranalli & Salvati, 2015).

3.7.3 Estonia, Tallinn metropolitan region post-socialist suburbanization

Tallinn metropolitan region experienced special type of suburbanization thanks to the movement of the young families with low social and economic status to the abandoned multifamily housing structures abandoned after the soviet period (Leetmaa & Tamaru, 2007). But the new suburban residential areas are located on the former agricultural land such as in all European suburbanization trends as seen in Figure 4. The analysis of Kährik & Tammaru (2008) describes the same trend as other metropolitan areas: as distance from the capital city increases the settlements built up in the open agricultural land decreases and the new development happens closer to the existing urban structures and forested areas.

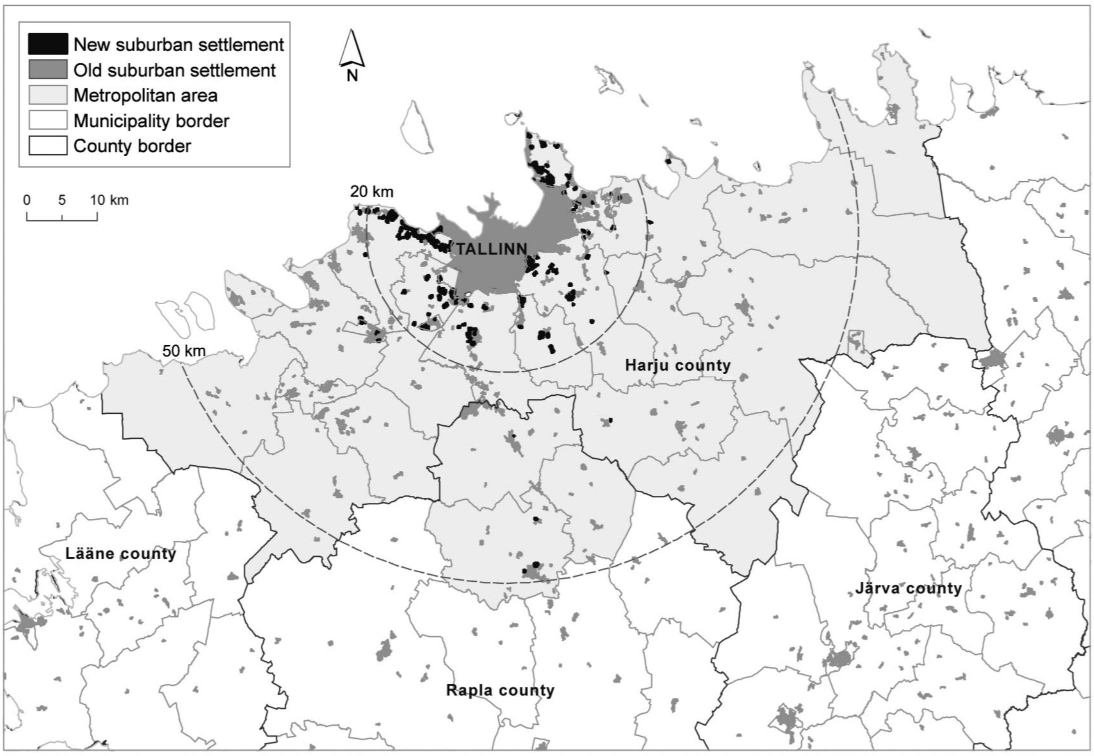

Figure 4 Distribution of old (pre-1991) and new (post-1991) settlements in the Tallinn, source: (Kährik & Tammaru, 2008)

The study of Leetmaa & Tamaru (2007) shows that the most land demanding suburban pattern, the individual housing in open land, was moderately developing after the 1990 and was generated mainly by the high population status subgroup. This type of artificialization, caused by rich suburbanizes, invaded mainly the attractive natural locations and the coastal zone. The socialist planning was keeping the settlement development compact, but all the patterns changed during the period of transition after the regime was released. The restitutions and privatizations caused that the land was divided into many small owners, which were not interested in agriculture and sold for the development (Leetmaa & Tamaru, 2007). Nevertheless the biggest increase of artificialized area was caused by non-residential purposes (Stanilov & Sýkora, 2014). The Tallinn case stresses out the importance of planning initiative in the metropolitan area (Leetmaa & Tamaru, 2007).

3.8 THE ROLE OF PLANNING IN LAND ISSUES

We can change existing trends in territory development due to spatial planning (Seltzer, 2002). Specific policies, such as spatial planning regulations, on different levels should be applied and the approach may be integrative (Prokop, et al., 2011). The planners need detailed knowledge about the land use changes and landscape dynamics to introduce new action mechanisms and to define new policies consistent at territorial scale to preserve agricultural resources (Balestrat, 2009).

The spatial planning and regional policies are in charge to resolve the trade-off question of land use change. The agricultural area converted into the area designated for residential or commercial development increases the market value of the land. On the other hand the municipality should is in charge to provide sustainable land management and apply the conservation policies (Zoppi & Lai, 2013) (Ody, 2013). The municipalities are the basic scale on which the majority of urban policies is defined and where are taken the decisions on the construction development. Therefore the municipalities play the key role in land take mitigation and prevention (Ranalli & Salvati, 2015).

In case of land use/cover changes, the urbanization processes are not significantly reliant on the Common agricultural policies (SENSOR, 2009). Therefore establishing the principles for sustainable development in spatial planning, such as steering the development to the already developed area or preferring less valuable soils, is one of the main ways how EU wants to prevent soil sealing and land take (Prokop, et al., 2011).

According to (Fina & Siedentop, 2008) the Netherlands and The United Kingdom, which are applying responsible and sustainable land policies, can show the good examples of relatively compact urban growth and urban structure with 300m^2 of artificial surface area per capita (Prokop, et al., 2011). In opposite Belgium has twice as high share of urban land as Netherland, even the population is one third lower (EEA, 2015). The artificial surface per capita is about 600m^2 (Prokop, et al., 2011). The protection of natural areas plays important role in preventing land take. Zoppi & Lai (2013) say that the land take occurs more in places where the conservative planning regulations are weaken, especially where the old regional plans are not in force anymore.

3.8.1 Dependence of planned development on population, distance to the core city and transport infrastructure

According to the findings of Padeiro (2014) the projected land use conversions are not dependent on the closeness to highway entry points or distance to the core or region's secondary city centers. The planned suburban development is not linearly related to the infrastructure, but it spreads widely around. The future development should be kept inside the core municipality area to prevent agricultural land takes. However the municipalities in the metropolitan area with the rapid dramatic population growth might not increase more their buildable area. The urban spread should be controlled. The land consolidation should be supported in already urbanized areas to prevent the spread towards open land (Padeiro, 2014).

The accessibility of transit stations plays a relevant role in planning. When there are no variables controlled by municipalities, the pressure to the agricultural land is higher closer to the transit stations, but paradoxically when the variables are controlled the land consumption increases with the distance. Therefore the biggest land conversions are projected in municipalities with greater distances to the transit network. The higher opportunity for land conversions is in areas located more than 10 km from the station where are controlled all the variables (Padeiro, 2014).

The study case of Portugal shows, that even if there is more room for improving the geographical distribution of future development according to the Traffic Oriented Development, the main factors for planning are still the urban dynamics and surrounded structure patterns (Padeiro, 2014). The Czech Republic spatial development is as well driven by the already existing urbanized pattern and the population dynamics. The new settlement is usually directly connected to the already built-up area and the size of the buildable area is influenced by the population and the importance of the municipality (Sklenicka, et al., 2013).

3.9 THE CONTEXT OF CZECH REPUBLIC

Czech Republic belongs to the group of Central and East European (CEE) post socialist countries. Under the Soviet Union influence there was a strict control over the private property and economic flow, including the ownership, development, rent or trade with the land (Stanilov & Sýkora, 2014). In the Czech Republic as well as in the other post-socialist European countries takes place progressive relocation of urban settlement and radial urban growth in suburban villages (TACR, 2013).

Suburbanization in Czech Republic is not claiming the same dimensions as In the USA and other Western European countries but brings together quite radical and final changes to our traditional urban structure and land use pattern (Sýkora, 2002). The suburbanization can be classified as residential and non-residential (Sýkora & Ouředníček, 2007). According to (Gremlica, 2002) the actual model of land use is benefiting tertiary commerce and services sector over primary productive sector. The productive agricultural land is consumed by urbanization and its consequences. The fields are built up with urban sprawls and divided by transport infrastructures. The resting agricultural land is worked in large concentrated units and farmed by large holdings. The pattern of suburbanization does not correspond to the western concept, but it is still irreversibly changes the landscape in the cities' hinterland and the metropolitan areas (Cílek & Baše, 2005; TACR, 2013).

3.9.1 METROPOLITAN AREA IN CZECH REPUBLIC

The Integrated territorial investment (ITI) tool defines Prague metropolitan region (PMR) for European Union subsidizing purposes (Figure 5). The delimitation is based on selection of Municipalities with extended authority[4], the definition of suburban zone, the commuting area based on mobile operator analysis and other delimitations, together with the consideration of big stakeholders in the area (IPR Prague, 2015).

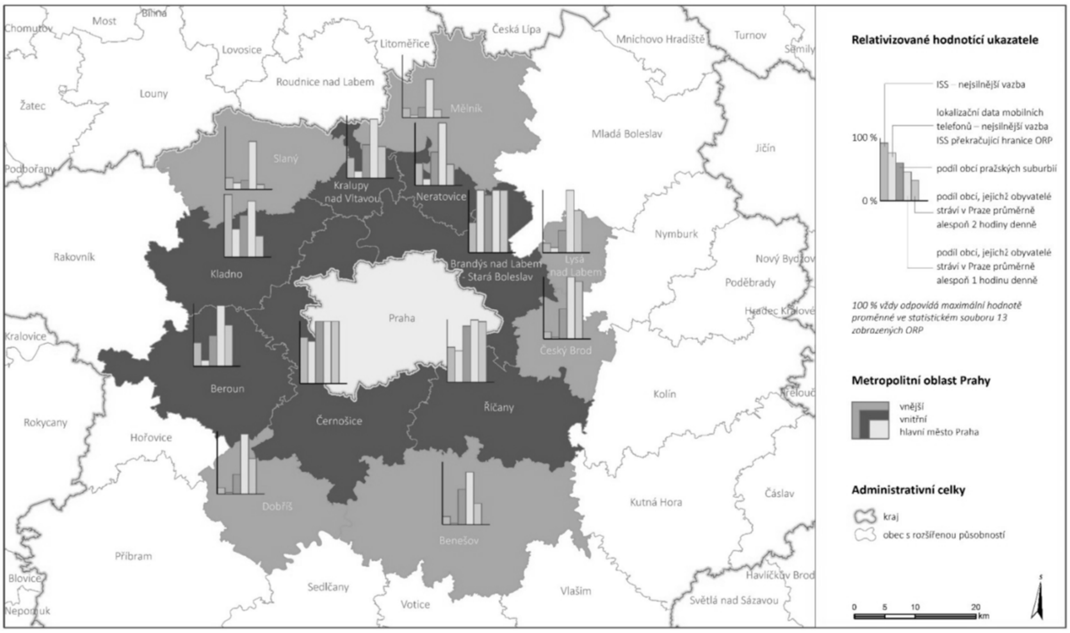

Figure 5 Synthetic delimitation of Prague Metropolitan Region, source: IPR Prague

Before ITI PMR there was currently no official definition of metropolitan areas in Czech Republic, however (Kostelecký & Čermák, 2004) provisionally delineated 4 metropolitan areas of Prague, Brno, Pilsen and Ostrava. Prague represents the only example where the core city is a municipality and region at the same time.

The criteria for metropolitan area demarcation in the study of Kostelecký & Čermák, (2004) were set under the International Metropolitan Observatory Project framework, such as the population greater than 200000 inhabitants or the rate of daily commuting. The commuting data obtained from Czech Statistical Office (CZSO) are not fully reliable due to the split in the number of permanent inhabitants and inhabitants actually living in the municipality[5]. Especially in the suburbs many of the newcomers are keeping their permanent residence in the core city. In the time when (Kostelecký & Čermák, 2004) started the study CZSO as collected only the information about

[4] Municipality with extended competences are defined by Act No. 314/2002 Coll., as amended, and represent the interrelated authority between the region and the municipality.
[5] In Czech Republic the official „permanent residence“ does not have to be the place, where people stay (Kostelecký & Čermák, 2004).

economically active inhabitants commuting to another municipality within the same district. Therefore authors limited the span of metropolitan areas to the administrative districts only. The intensity of commuting is decreasing with the distance from the core city and oscillates in the range of 20% - 70% (Figure 6). The metropolitan area was divided into two suburban zones - inner with commuting rate higher than 40% and outer with commuting rate between 30% and 40% (Figure 6) (Kostelecký & Čermák, 2004). Nevertheless the actual data from CZSO show the significant trajectories of total interregional commuting from Ústí nad Labem, South Bohemia, Liberec and Pilsen region (CZSO, 2014).

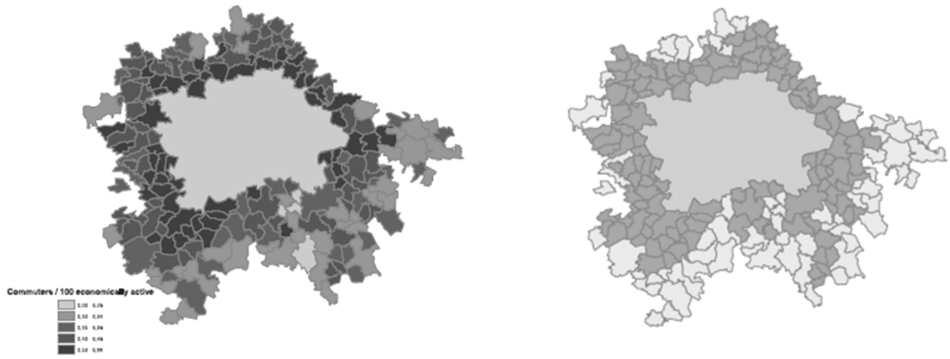

Figure 6 Prague metropolitan area daily commuting and suburban zones (Kostelecký & Čermák, 2004)

3.9.2 Czech Spatial planning

The basic legal tool for spatial planning in Czech Republic is Act No. 183/2006 Coll., on Spatial planning and building rules, as amended (hereafter the Building Act). According to the Spatial Development Policy of Czech Republic the planning may take into account the development of primary sector with aim to protect quality agricultural land and ecological functions of the landscape (MRD, 2015). All the planning documentation has to be approved by EIA/SEA process according to the Building Act.

According to the Building Act, municipalities, regions and Ministry of Regional Development are in charge of spatial planning in Czech Republic. (Plesnik, 2008)The Spatial planning frame consist of the hierarchical structure according to scale:

Spatial Development Policy (hereafter only Policy) sets the priorities for entire Czech Republic. The policies are purchased by Ministry of Regional Development and approved by Government. The Policy is revised every 4 years. The international, national and supra-regional areas of interest are determined in this level (Building Act).

Spatial Development Principles (hereafter only Principles) define strategies at regional level and have to be in accordance with the Policies. The Principles are purchased by the regional office and approved by regions assembly. The Principles are revised every 4 years (Building Act).

Masterplan defines the basic strategies for municipality development, such as spatial planning concept, landscape planning concept, public infrastructure concept. The masterplan delimitates the built-up area, the buildable area, the planned land use, the territorial system of ecological stability and other regulations. The master plan is purchased by the municipality, published by the assembly and has to be revised every 4 years. If there is no masterplan, the municipality can purchase the **Delimitation of built-up area**, which serves for further spatial planning decision making process (Building Act). The acquirers and planners are obliged to follow the Principles of protection of Agricultural land resources set in § 4, part III. of Act No. 334/1992 Coll., on the Conservation of agricultural land resources, as amended (hereafter referred to as Act on Conservation of agricultural land resources). The planners should mainly try to decrease the agricultural land grabs, plan the development on the non-agricultural land and if it is necessary use the soils of lower quality. The most valuable land should not be removed from the resources unless the other public interest overcomes the public interest of land protection according to the Act on Conservation of agricultural land resources.

Regulatory plan is more detailed than masterplan and defines regulations for defined area. It sets concrete demands and restrictions and can replace the zoning permit (Building Act). The regulatory plan is not often used, for example in Prague is nowadays only one in operation (IPR Prague, 2016).

3.9.3 AGRICULTURAL LAND RESOURCES

Agricultural land stock is the basic natural resource and unreplaceable production medium, which is defined and protected under the law. The resource mainly consist of agricultural sites, such as arable land, hop yards, vineyards, gardens, orchards and permanent grasslands. The agricultural land resource contains as well waterbodies used for livestock production and other non-agricultural land necessary for the agricultural production, such as dirt roads, irrigation reservoir and other auxiliary elements (Act on Conservation of agricultural land resources).

3.9.4 SYSTEM OF EVALUATED SOIL ECOLOGICAL UNITS

The System of Evaluated Soil Ecological units (BPEJ) is unique and "independent measure in soil, water and landscape conservation in the Czech Republic". (Novotný & Vopravil, 2013). The project of Agricultural land fund evaluation was started in the year 1971 to evaluate the price and relative and absolute productive capacity of agricultural land, which served for long time planning during socialist regime. The project was driven under the Research Institute for Soil and Water Conservation (VÚMOP) (Vopravil, 2011) and in January 2016 was the register moved under the agenda of the Czech Office for Surveying, Mapping and Cadaster (CUZK).

Up to date the database contains 2278 BPEJ codes and is provided from Evaluating Information System as ESRI geodatabase with polygon layer, Information table and Numeric database (ESRI Inc., Redwoods, USA). The numeric database contains the 5 digits number, which serves for identification of the unit and contains the basic information about the unit. (Vopravil, 2011)

The BPEJ code provides information about main characteristics and classification of soils together with characteristics of stand, such as slope, exposition to cardinal points and climatic conditions. The BPEJ units serve as a base for economic evaluation, tax determination and conservation policies. The system is used in soil erosion conservation measures, land consolidation, soil recultivation, flood protection, etc. The BPEJ system forms a part of land register and it is the main determinant for Agricultural land protection classes (Vopravil, 2011).

3.9.5 Agricultural land protection classes

The classes of agricultural land protection (ALP) are determined by BPEJ according to the Decree of establishing the classes of protection No.48/2011. There are set five classes containing certain codes BPEJ[6]. The protection level decreases from number I. to IV.

Characteristic of ALP classes cited from (VÚMOP, 2015):

I. Class

The most fertile soil within climatic regions, prevalently in flat or slightly sloped spots, which could be converted to non-agricultural use only exceptionally, mainly because of establishing the elements of Territorial System of Ecological Stability (TSES) or for linear built-up features with special importance.

II. Class

Agricultural land with outstanding production potential within climatic regions. The land is highly protected and only conditionally withdrawable from the Agricultural land fund with regard to SPD and only conditionally usable for building purposes.

III. Class

The soils with average productive capacity within climatic regions, which can be used for building development and other non-agricultural purposes within spatial planning.

IV. Class

The soils with substandard production capacity and limited protection which can be used for building development and other non-agricultural purposes.

V. Class

Collection of resting BPEJ units with low production capacity, such as shallow soils, hydromorphic soils, highly skeletal or highly endangered by erosion, which is usually expendable for agricultural purposes. More effective than agricultural use is allowed. The soils have low protection level, with exception of delimitated protected zones and areas.

[6] Table of BPEJ codes and its allegiance to ALP classes can be found as appendix to the Decree of establishing the classes of protection No.48/2011

3.9.6 WITHDRAWAL FROM THE AGRICULTURAL SOIL STOCK

According to the Act on Conservation of agricultural land resources for the non-agricultural purposes should be used non-agricultural land. The removal of land from Agricultural land resources[7] can be temporal or permanent, has to be approved by the official authorities for protection of agricultural resources[8] and the fee is charged according to the Schedule of charges for removal of land from the agricultural land stock. In case of temporal removal the fee is payed yearly, but for permanent land use conversion single fee is charged. The fee depends on:

- BPEJ unit and the base price per m^2 determined by the Decree No. 441/2013 Coll. for execution of the Act on Property Valuation (Valuation Decree).
- Factor of negative impact to natural environment and its Ecological impact weight ALP class and its coefficient.

3.9.7 PRICES OF AGRICULTURAL LAND

The prices of farmland vary according to the future land development. (Plantinga & Miller, 2001). The transactions with land have speculative character. The buyers often pay an extra for obtaining the agricultural land. The higher conversion level of farmland to residential and commercial use is reported in areas where the growth is occurring and depends on the closeness of settlement. (Foster, 2006) According to Sklenička, et al. (2013) the most significant factor behind the price rise is the proximity to the settlement, up to 100m from the border of the built-up area, which correlates with the easier future land use change of the land for non-agricultural purposes.

[7] Conversion of land use from agricultural to non-agricultural use

[8] The same authorities as in spatial planning Framework, according to the scale and importance

4. CHARACTERISTICS OF STUDY AREA

The selected municipalities are located in the hinterland of Prague, the capital of Czech Republic. The study areas belong to Central Bohemia region and to region Ústí nad Labem (Figure 7). The total cadastral area of 71 allocated municipalities is 44678 ha and is scattered within the Prague metropolitan area.

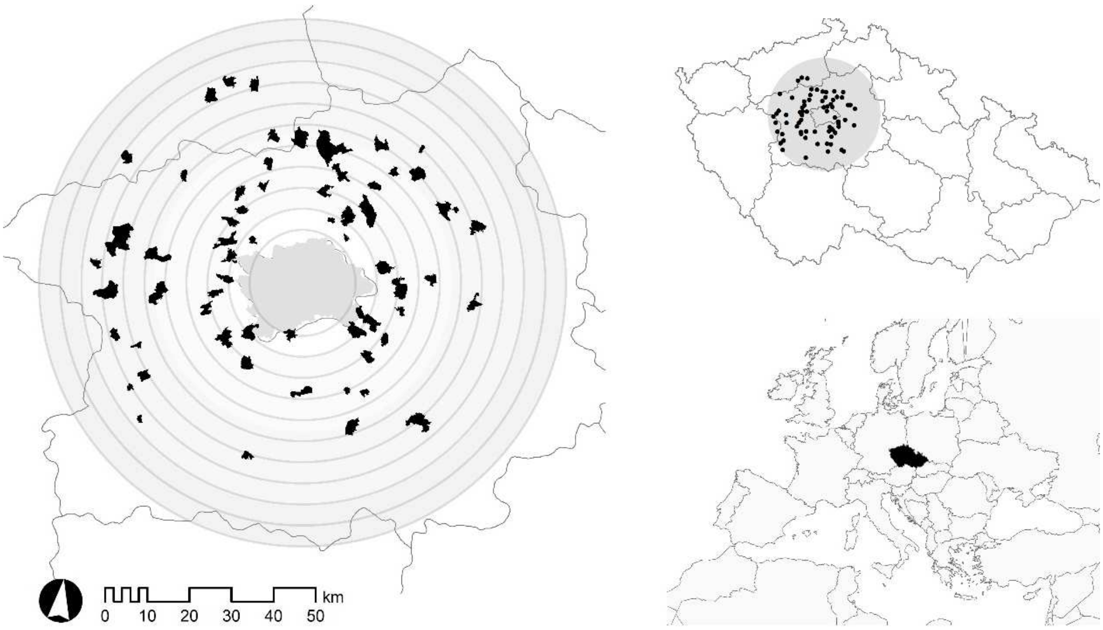

Figure 7 Location of study areas, Europe, Czech Republic

Total land cover of Czech Republic is 7886500ha and almost 4% of the area is artificialized[9]. The Prague metropolitan area has big potential of agricultural production. Almost 30% of Prague territory is covered by agricultural land (Siebielec, et al., 2010) but thanks to the spreading of artificialized areas (Table 1) the agricultural land is disappearing.

		Part of total land cover [%]	Artificial land [ha]	Built-up area [ha]	Non Built-up area[ha]
2009		3,927	309700	101400	208300
2012		3,962	312500	122900	189600
Land cover	**[ha]**		+2800	+21500	-18700
change	**[%]**	+0,04	+0,90	+21,20	-8,98

Table 1 Artificialized area in the Czech Republic, source: LUCAS

[9] EUROSTAT LUCAS, data actual to the date 27/03/2016

4.1 NATURAL CONDITIONS AND SOIL QUALITY

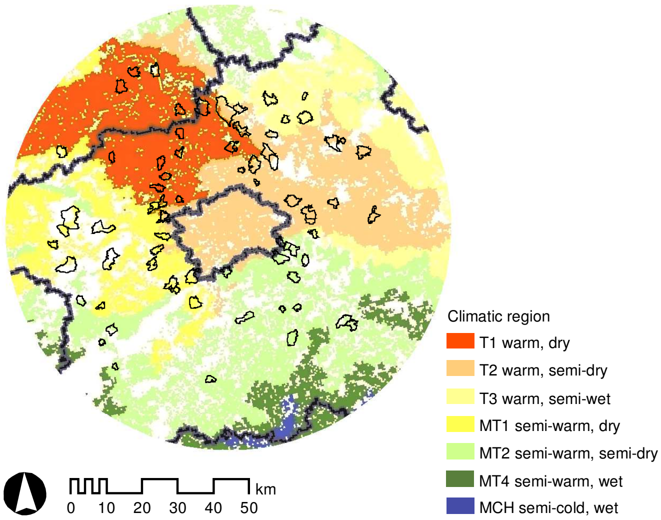

Figure 8 Climatic regions, source: VÚMOP

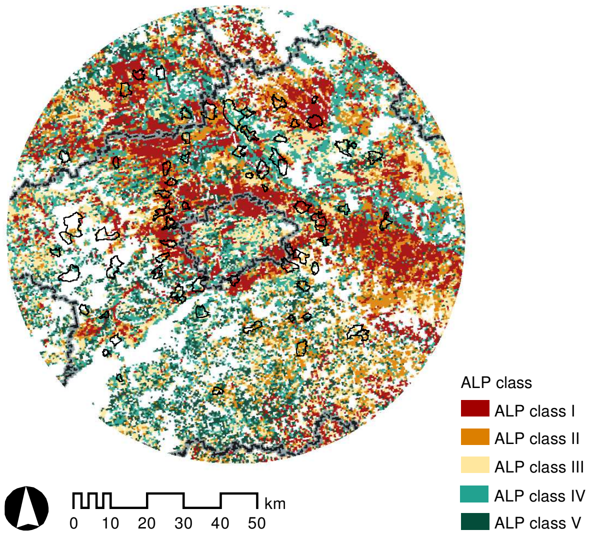

Figure 9 Agricultural land protection classes, source: VÚMOP

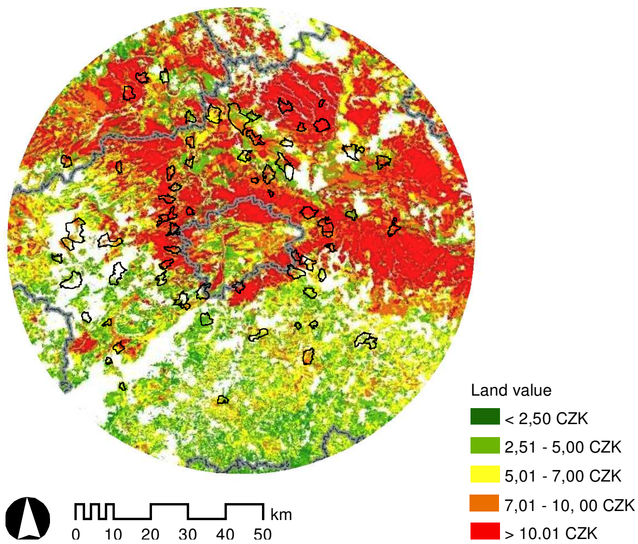

Figure 10 Agricultural land value, source: VÚMOP

The landscape character of Central Bohemia is heterogeneous, with the mosaic of distinctive valuable natural areas. The study area covers the part of Czech flatland in the North, North-East from Prague on the confluence of Vltava and Danube river. The southern part can be characterized as hillier and less fertile. The most fertile and therefore most protected soils can be found in the warm climatic region in the part of Czech flatland.

The municipalities prevalently belong to warm and moderately warm regions (Figure 8), where the average annual precipitation range varies between 500-650 mm and the average annual temperature oscillates between 7-10°C. The soils around Prague are very fertile, therefore the Agricultural land protection Classes I and II are located close to the borders The ALP class IV and V is located mainly in the South-East (Figure 9).

The basic value of agricultural land is based on soil quality, determined during the BPEJ unit determination. The most valuable land are in outskirts of

Prague, in the North and North-East from the capital (Figure 10). The price varies between 1-16 CZK/m^2 according to the Decree No. 441/2013 Coll. for execution of the Act on Property Valuation (Valuation Decree).

4.2 SOCIAL AND ECONOMIC CONDITIONS

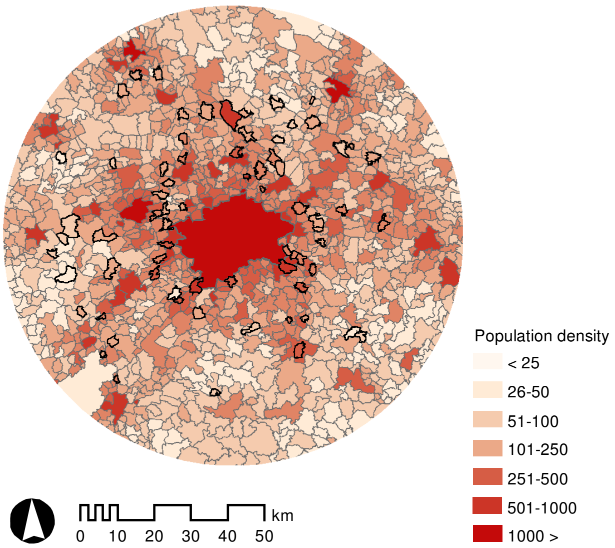

Figure 11 Population density (inhabitants/km²) for 1.1.2015, source Cenia

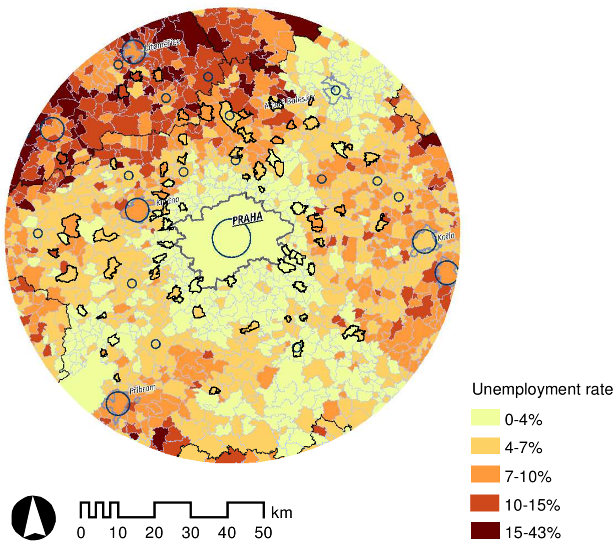

Figure 12 Registered unemployment rate in 2006-2008 (annual average of reachable unemployed job applicants per 100 labor force, source (URRlab, 2013)

The Central Bohemian region [10] has the highest population within regions of Czech Republic with around 1400000 inhabitants. Many of the municipalities in Prague metropolitan area experience constant demographic growth, mainly due to the immigration. However according to CZSO the trend of population grow is declining since its peak in between years 2007-2008. The highest immigration rate was experienced in the districts Of Prague-East and Prague – West.

The total population within selected municipalities varies from less than 63 to more than 19600 inhabitants. The population density ranges between 8-1900 inh/km^2 (Figure 11) and is higher in the municipalities with extended competence and municipalities closer to Prague.

[10] To see rough estimation of population dynamics and economic factor were studied the data in Central Bohemian region.

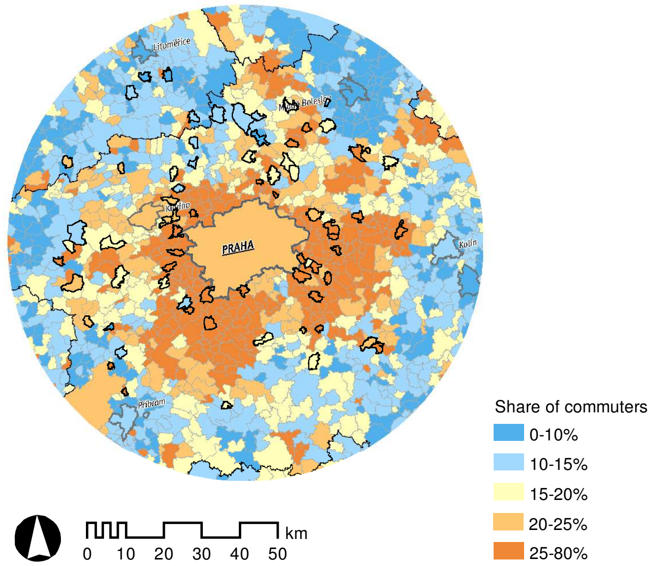

Figure 13 Share of people commuting to work more than 45 minutes in 2001 (number of people per 100 daily commuters from the municipality), source (URRlab, 2013)

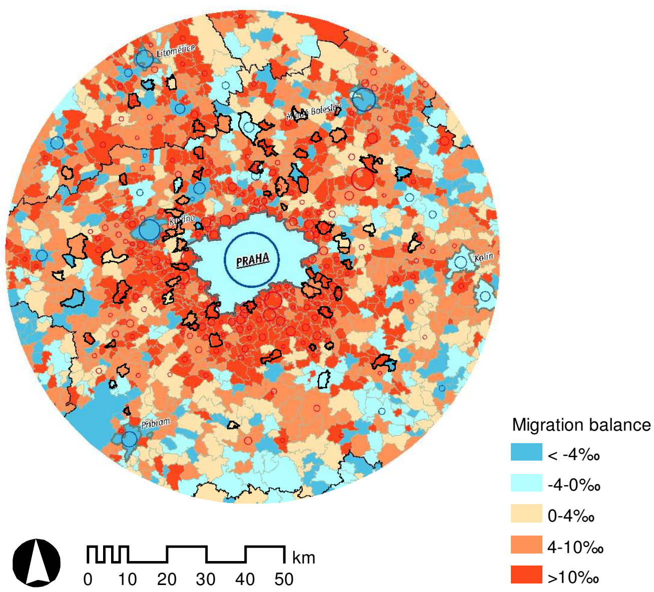

Figure 14 Net migration rate between 1995-2006 (average net annual migration per 1000 inhabitants), source (UURlab, 2013)

The unemployment rate (Figure 12) in Central Bohemian region is lower than in the other regions, mainly because of almost one third of population commutes to Prague. The rate of economic activity reaches 61%, the wages in Central Bohemian region correlate with the national average (CZSO, 2014).

The Prague hinterland has high percentage of population commuting to work longer than 45 minutes (Figure 13), mainly because the municipalities provide labor to the capital (URRlab, 2013). The Central Bohemian region has high migration balance (Figure 14) which explains the population growth in the region. The municipalities in the close surrounding to the capital are experiencing the impacts of suburbanization. The migration is highly dependent on the working opportunities provided by the capital. An important role in the migration balance plays the foreign migration (URRlab, 2013).

4.3 CHANGES OF BOHEMIAN LANDSCAPE AND URBANIZATION IN THE TIME

We can track the changes in landscape due to suburbanization processes to the late Baroque and early Classicist era. In the 18C the urban spreading was dependent on the industrial potential of the cities, the land grabs had small scale and were covered by further development (Cílek & Baše, 2005). The increase in agricultural land due to the need to satisfy the food demand of European gradually growing population can be tracked until the end of 19C (Bičík, 2004).

The industrial revolution changed the demands on landscape (Bičík, 2004). During the Industrial revolution were mostly developed areas with metallurgical and mining perspective, such as Kladno region. Mixed mining-agricultural residential colonies were emerging along the pits and together with the metallurgical and mining utilities created the mosaic, which completely destroyed the original landscape character. Before the IWW were growing up the residential villa settlements in the outskirts of Prague. The recreational settlement of wealthy people arose along the railway in the entire region. In between the wars the villa development in Prague continued (Cílek & Baše, 2005). In the same period occurred the last increase of agricultural land, when the small producers strove to self-supply and intensify the production (Bičík, 2004).

After the wars, in the communist era, the development of Prague was based on concentrated urban entities in the outskirts of the compact city, meanwhile the core was stagnating (Posová & Sýkora, 2011). The suburbanization process was replaced by the complex housing estate development (Ouředníček, 2003). In addition the agricultural land was decreasing due to the mechanization and the inability to cultivate small or shape complicated parcels (Bičík, 2004).Thanks to the densifying of urban structure the inhabitants started to run away to the recreational cottages in the countryside. The cottage-ing[11] is one of the characteristic features which shaped the countryside in former Czechoslovakia during the socialist period. In the end of communist era the individual self-construction development of individual housing begun and it has the consequences in inappropriate urban structure until nowadays. The socialist government proclaimed the protection of agricultural land, which led to minimizing the parcels up to 400m^2. The regime influenced the individual development

[11] People were massively leaving the core city during the weekends and run out to the countryside, where took care about their recreational houses and cottages. (Cílek & Baše, 2005)

in the countryside through catalogues with standardized family and semidetached houses, planned in special state office (Cílek & Baše, 2005).

Prague metropolitan area suffered dramatic changes after the end of socialist era (Posová & Sýkora, 2011). Thanks to the analysis of migration balance we can identify the period of stagnation in the first years after the Velvet revolution in 1989 and then concentrated suburban flow towards the Prague region since the second half of the 90's (Ouředníček, 2006).

The release of the regime led to opposite trend in the region development. The low density suburbanization took place instead of concentrated block of flats. The demand of land increased. The investors, as a reaction to the former communist orders, asked for larger parcels and plots for individual housing. Today we can experience dramatic differences between the new low-rise low-density development and the concentrated high-rise housing estates. The urban structure is discontinuous and creates huge social segregation (Cílek & Baše, 2005).

Until nowadays the precipitous development of small villages in the metropolitan areas is often understood by the municipalities as an economic success, even the foreign experiences prove the opposite (Cílek & Baše, 2005). The rapid expansion, experienced in the western European cities during the 50's - 80's, caused many problems and the municipalities therefore introduced the restrictions to preserve and enhance the cultural values and favorable living conditions (Cílek & Baše, 2005).

Almost 55% of European population wants to live in their own house on their own land, and 60% of Czech population has the same preferences. Therefore we experienced the same frame of suburban development as the western European countries experienced decades ago and which was postponed by the communist regime (Cílek & Baše, 2005).

The socialist period had not only the impact on the suburban pattern but as well on the landscape on itself. The socialist regime had prevalently negative impact on land use and landscape structure. The landscape heterogeneity significantly decreased and resulted in biodiversity and landscape stability deterioration. The arable land dropped out by 15.5 % during this period (Sklenicka, 2002), but mainly because of the land was worked mechanically and the small pieces unsuitable for the machinery were left as permanent grasslands (Lipsky, 1995).

4.4 ACTUAL STATE

Artificialization in Prague metropolitan area is caused mainly by the process of suburbanization, which brings about 50-70% of new residents in the suburban villages, but tangential[12] migration plays important role as well. One of the main driving factors for residential development is the natural quality of the site. The suburbs are emerging in the places, which were before used as a recreational areas for Prague citizens (Ouředníček, 2006).

According to the research of (Ouředníček, 2006) within the mayors, there was only small amount of houses built in isolation from former built up area and the suburban pattern differs from the USA model. Czech suburbanization pattern is specific and does not correspond to the western concept (TACR, 2013). The urban sprawl is an overestimated phenomenon according to (Ouředníček, 2006). The analysis of social environment showed massive support of new development by mayors of the villages[13]. New economically strong and active inhabitants bring higher financial support for the village and higher social capital which can lead to more active public life (Ouředníček, 2006).

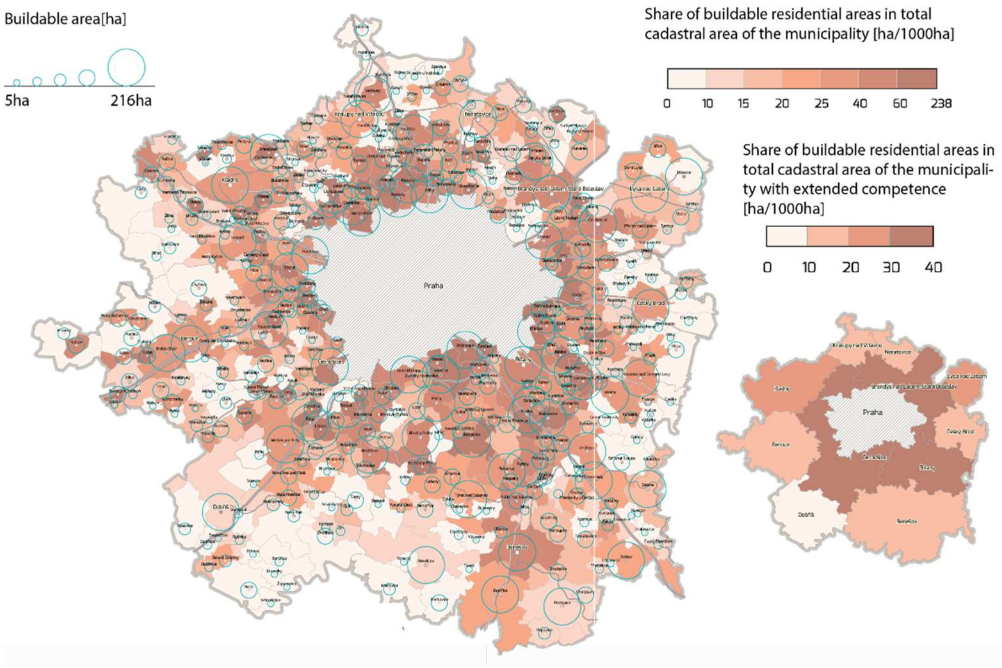

Figure 15 Buildable area for residential purposes in Prague suburban zone, source: (URRlab, 2013)

[12] The population is concentrating in larger municipalities. The process is caused by the movement within the hinterland itself (Ouředníček, 2006).

[13] The financial support in Czech Republic is based on the number of permanent residents due to the amended Act no. 243/2000 Coll., on the Budgetary allocation of taxes from certain taxes to municipal authorities and to some state tax funds (the Act on Budgetary allocation)

The prognosis of future suburban development of URRlab (2013) predicts that the Prague region will increase in population of 17% until 2030. One of the main factors for future land use changes was the willingness of the municipalities to support the suburban growth. The prevalent trend out coming from the survey is to keep the already delineated buildable area. A part of the municipalities aims to slightly increase the buildable area and only the minority, for example Dolní Břežany, aims to restrict the suburban development. Other important factor in suburban spreading is the accessibility of the municipalities according to URRlab (2013), the critical isochrones for suburban development area are 30 and 40 minutes. As an outcome of the analysis of URRlab (2013) the natural development of suburbanization is expected.

5. METHODOLOGY

Geographic Information Systems (GIS) were fundamental for data preparation, processing and their further analysis. All the data were either obtained as shapefile or vectorized over raster layers from reliable official sources. For the analysis were used only cadastral territories of selected villages.

5.1 SELECTION OF STUDY AREA

All 71 villages were randomly selected within the Prague metropolitan area. For use of this analysis the metropolitan area was defined by the 50 kilometers radius from Prague. The problem of defining metropolitan area in Czech conditions is specified in previous chapter.

5.2 VECTOR DATA

5.2.1 CORINE

For the CORINE analysis were used two datasets of land cover from year 1990, CLC90 and 2012, CLC12 provided by national geoportal of Infrastructure for Spatial Information in the European Community (INSPIRE) both as web map services (WMS) viewing services and vector data. All the 10 "artificial surface" land cover classes were considered as urbanized area for the analysis.

5.2.2 BUILT-UP AREA

The exact vector data for built-up area were vectorized in ArcMap using the ortofoto base map provided by national geoportal[14] as a WMS service (Figure 16). Built up area information could be obtained as well from the SPD documentation, but in actual state the plan and reality can vary.

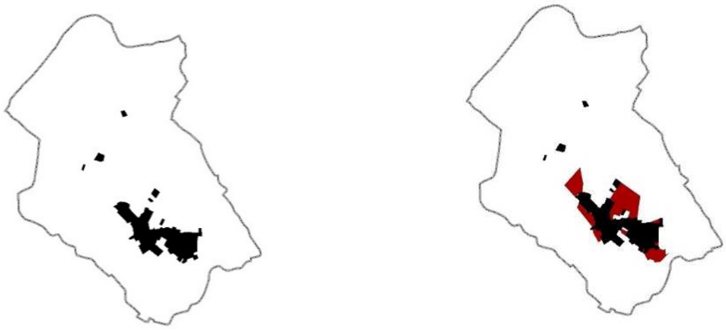

Figure 16 Methodical procedure: Built-up area > Buildable area, source: author

[14] Ortofoto map actual to the year 2015

5.2.3 Buildable area

The buildable area is an area allocated future residential, commercial or other building development in the SPD. In Czech Republic buildable area is delineated by the Master plan and the development permits are usually granted in the border with the current built-up area (Sklenicka, et al., 2013).

The dataset for possibly buildable area was created by vectorization of Spatial planning documentation (SPD). Part of the masterplans for villages in Central Bohemia Region is available as WMS, part had to be obtained as raster or PDF file from the municipalities and georeferenced. Both data sources served as an underlay for manual vectorization (Figure 16). The main focus was zoomed in the residential suburban development, but for the buildable area were mapped the possible future industrial zones and infrastructure areas as well.

5.2.4 Soil sealing

Soil sealing map was obtained as a raster dataset in GeoTiff format freely available on the EEA website. The pixel resolution is 20m x 20m and contains the information of soil sealed areas including continuous degree its intensity ranging from 0 - 100%. The data contain information from the year 2006 and were revised in 2009 (EEA, 2014).

5.2.5 Agricultural land protection classes

Data for Classes of agricultural land protection for built-up and buildable areas were obtained partly from VUMOP directly as shapefile and partly as BPEJ classification unit shapefile. The BPEJ units needed further reclassification according to The Decree of establishing the classes of protection No. 48/2011. After the reclassification the tool Intersect was used (Figure 17)

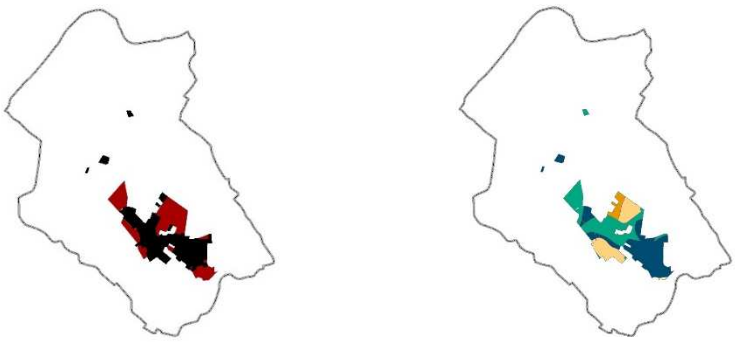

Figure 17 Methodological procedure: Artificial area > ALP classes, source: author

5.3 TABULAR DATA

The information about population, population densities, commuting and housing units were retrieved from Czech Statistical Office. All the used information was published as a result of SLDB 2011.

The data on time of commuting and commuting distance were retrieved from the mapping portal Mapy.cz and represent the estimation of time needed to get into the Prague city center. The data on public transport commuting time were retrieved from Idos.cz

5.4 GEOGRAPHICAL ANALYSIS

All the vectorizing and analytical part was processed in the ArcMap Desktop 10.3.1. In the following paragraphs is described the data processing together with used tools provided by ArcGIS (ESRI Inc., Redwoods, USA).

5.4.1 CLC ANALYSIS

The dataset of CLC90 and CLC12 were reclassified through the Field Calculator to urbanized areas. In the CLC90 the urbanized area contains the Corine class 1. Urbanized areas with subclasses 1.1.2. Discontinuous urban settlement, 1.2.1. Industrial and commercial areas, 1.2.2. Railway and road network, 1.2.3. Harbors , 1.2.4. Airports , 1.3.1. Mining areas , 1.3.2. Dumpsites and landfills, 1.4.1. Urban green areas 1.4.2. Recreation and sport areas. In the dataset CLC12 was used 112,121,122,123,124,131,132,141,142 correlating with the CLC90 classes. The urbanized area was Intersect with the selected cadastral areas polygon and summarized for each municipality.

5.4.2 BUILT-UP AND BUILDABLE AREA ANALYSIS

The main analysis was made in ArcMap by summarizing the built up area and buildable area for each municipality and Intersect with the selected cadastral areas polygons. This data was compared with the total area of cadaster territory and output as a total artificialized area in hectares and percentage information.

5.4.3 ALP PROTECTION CLASSES

The layer with BPEJ codes was manually reclassified in ArcMap to ALP protection classes according to The Decree of establishing the classes of protection No.48/2011. The Built-up and Buildable area layers were Intersected with the ALP protection classes layer. For all datasets were set the Classes of agricultural land protection and the outputs were summarized for individual protection levels separately. Basic units of measurement are hectares and percentage expression. For easier representation in GIS output layouts kilometers squared are used, because they allow to be visualized proportionally.

5.4.4 SOIL SEALING

The sealed soil was obtained as a raster dataset, Projected, Clipped to study cadastral areas and Tabulated for further analysis. The the raster in .tiff formate had to be Projected, clipped to selected area and Tabulated.

5.5 THE INDICATORS

The indicators were selected according to the literature review and represent the location-related (LR), socio-economic (SE) and planning determinants (SPD) (Table 2). The planning part in the analysis is represented by the Buildable area allocation within the SPD of the municipalities. Part of the indicators was obtained as the tabular data, as described before, and part was obtained as a result of partial analysis in ArcMap. The distance represents the planar measuring of the Prague center towards the municipalities. The indicators of the transport network dependence were first located, manually determined and then the Proximity Tool was used to determine the closest distance from the municipality.

5.6 STATISTICAL ANALYSIS

The importance of the delineated factors was compared in the statistical analysis in the software STATISTICA 12 (STAT Software Inc., Tulsa, Oklahoma, USA) using the Pearson linear correlation with and Spearman correlation p <0.50000. The parametric Pearson and non-parametric Spearman analysis allow to check for the normality and linearity within the relationship of the variables (Ranalli & Salvati, 2015). As a result of the correlation analysis were obtained the tables with r values. The highest positive correlation is represented by +1.00, no correlation by 0.00 and the biggest negative correlation by -1.00.

Indicators used in GIS analysis			
Group	**Name**	**Description**	**Unit**
LR	AREA	Total cadastral area	ha
LR	DIS	Planar distance of cadastral area from Prague	km
LR	DIS2	Planar distance of cadastral area from Prague center	km
SE	POP	Population of municipality	inh
SE	DISC	Commuting distance from the municipality to Prague from mapy.cz	km
LR,SE	TIMC	Commuting time to Prague by car retrieved from mapy.cz	min
LR,SE	TIMP	Commuting time to Prague by public transport retrieved from idos.cz	min
SE	COM	Number of people daily commuting to Prague	inh
LR	BTO	Total built-up area in selected villages	ha
LR	BTO_p	Share of built-up area in cadasters of selected villages	%
SPD	ZTO	Total buildable area in selected villages	ha
SPD	ZTO_p	Share of buildable area in cadasters of selected villages	%
LR, SPD	TTO	Total amount of built-up and buildable area in selected villages	ha
LR, SPD	TTO_p	Total share of artificialized area in cadasters of selected villages	%
LR	SSA	Sealed area in selected municipalities	ha
LR	SSA_p	Share of sealed area in the cadasters of selected municipalities	%
LR	TO	ALP class	ha
LR	BTO_0	Built-up area on non-agricultural land	ha
LR	BTO_1	Built-up area on ALP class I	ha
LR	BTO_2	Built-up area on ALP class II	ha
LR	BTO_3	Built-up area on ALP class III	ha
LR	BTO_4	Built-up area on ALP class IV	ha
LR	BTO_5	Built-up area on ALP class V	ha
LR, SPD	ZTO_0	Buildable area on non-agricultural land	ha
LR, SPD	ZTO_1	Buildable area on ALP class I	ha
LR, SPD	ZTO_2	Buildable area on ALP class II	ha
LR, SPD	ZTO_3	Buildable area on ALP class III	ha
LR, SPD	ZTO_4	Buildable area on ALP class IV	ha
LR, SPD	ZTO_5	Buildable area on ALP class V	ha
LR	BTO_I_II	Built-up area, high quality soil	ha
LR, SPD	ZTO_I_II	Buildable area, high quality soil	ha
LR	NR	Distance from the main road	km
LR	NHE	Distance from the highway exit	km
LR	NME	Distance from the main road exit	km
LR	NS	Distance from the nearest train station	km
LR	PROX	Closeness of the buildable area from the built up area	m
LR, SE	BTO_index	The built-up area per capita in selected municipalities	m^2/inh
LR, SPD, SE	TO_index	The built-up and buildable area per capita in selected municipalities	m^2/inh
LR, SE	SSA_index	The intensity of land use, sealed soil area per capita	m^2/inh

Table 2 Indicators for GIS analysis. The indicators belong to group of LR location related determinants, SE socio economic determinants and SPD planning determinants, source: author

6. OUTCOMES

In the analysis were first compared the data of Corine Land cover for the years 1990 and 2012, which showed the decline of agricultural land and increase in urbanized area. Than the manually vectorized built-up area with buildable area were analyzed. The portion of already artificialized area varies from 5-65% of total cadastral area and in total reaches 5799ha nowadays with planned 7550ha in SPD (Table 3). Both built-up and buildable areas were sorted out to corresponding ALP classes. In the end were created the maps and graphs showing the dependencies of artificialization within the metropolitan area on population, distance and commuting time. All the resulting data can be find in the Appendix (Annex 13-Annex 20)

6.1 CORINE LAND COVER ANALYSIS

According to Corine land use changes mapping, the agricultural land area is on decline in the Czech Republic (Figure 18, Table 3). The total area decreased by 2.5%, 755ha between the years 2009-2012. The urbanized area was 4993 ha in 1990 and increased to 5471ha in 2012. There is a difference of 500 ha, which means 10% increase of urbanized area in 22 years. The forested land and natural areas grew up 277ha, which represents 1.93%. The water bodies remained the same.

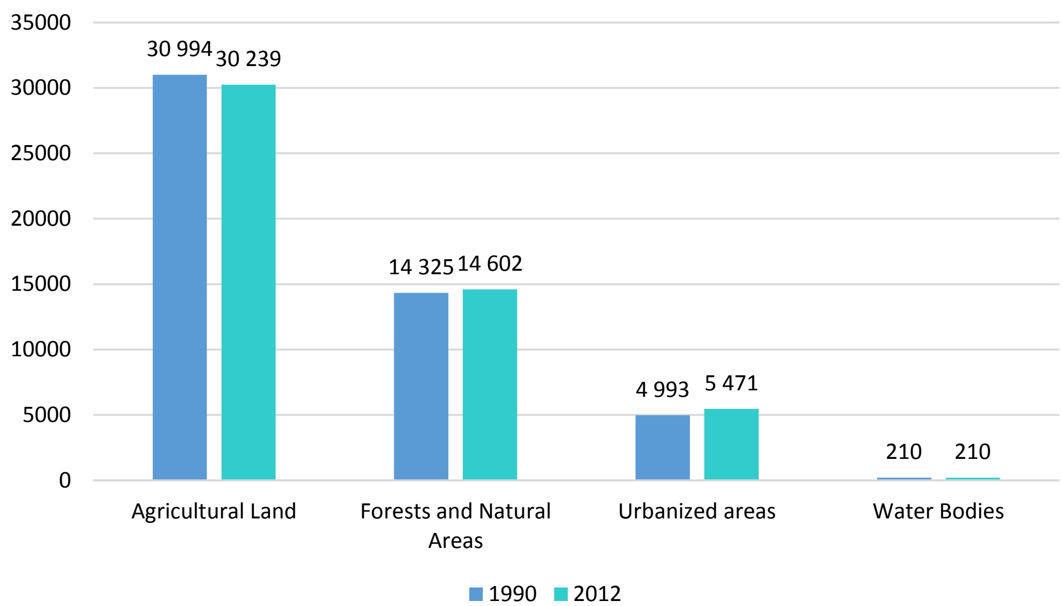

Figure 18 Corine Land cover change in study area between 1990 and 2012, data source: Corine

The simple proportional division of artificialized area per year says that every year the urbanized area increases by 22ha, which represent 0.45% rise. Following the trend was counted the average artificialized area of 5536 ha for the year 2015 and the artificialized surface rate of 515m^2/inhabitant.

Corine Land Cover change							
	Area [ha]		Total difference		Difference/year		Area [ha]
	1990	2012	[ha]	[%]	[ha]	[%]	2015
Agricultural Land	30994	30239	**-755**	**-2,44%**	-34,31	-0,11%	30136
Forests and Natural Areas	14325	14602	277	1,93%	12,59	0,09%	14640
Urbanized areas	4993	5471	478	9,57%	21,73	0,44%	5536
Water Bodies	210	210	0	0,00%	0	0,00%	0

Table 3 Corine Land cover change in study area between 1990 and 2012, data source: Corine

6.2 ANALYSIS OF BUILT-UP AND BUILDABLE AREA

Build up area in selected village varies between 1% to 57% of their cadastral area (Figure 19, Table 4). The buildable area varies from 0% to 34% of total cadastral area. The villages with smaller built up area have biggest proportional increase in buildable area than more artificialized municipalities. Total actual artificialized area in selected villages is 5799 ha of 44678ha cadastral area. In the SPD are another 1751ha designated as buildable area. Therefore the theoretical planned artificialized rate in selected villages is 702m2 per inhabitant with no calculation of population growth. The average proximity of the buildable area to the built-up area is 16,13m.

Built-up and Buildable area in selected municipalities		
	Area [ha]	Share [%]
Total cadastral area	44677,75 ha	100,00%
Built up area	5799,19 ha	12,98%
Buildable area	1751,14 ha	3,92%
	7550,33 ha	16,90%
Sealed soil	3260,34 ha	7,30%
Population	107517 inhabitants	
Artificialization rate per catpita in 2015	539 m^2/inh	
planned in SPD	702 m^2/inh	
Land use intensity = sealed soil per capita	303 m^2/inh	

Table 4 Built-up and buildable area average for study area, source: author

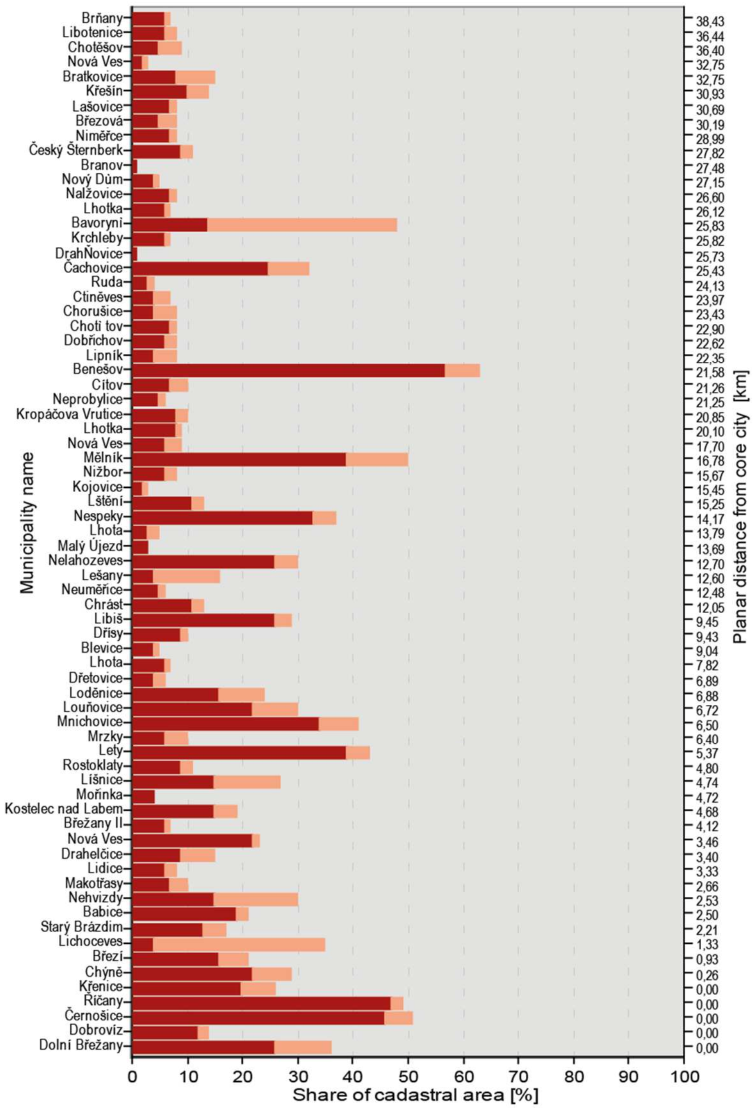

Figure 19 Percentage of Built-up and Buildable are in cadasters, source: author

In 37 municipalities the buildable area is directly connected to the built-up area. As sen from the Figure 20 all of the municipalitie are planning to increase their built-up area. The municipalities closer to Prague are planning to grow up more than the municipaties in the outer part of the selected area.

6.3 SEALED SOIL IN SELECTED VILLAGES

The average share of soil sealing in the study area is 7.30%. The average intensity of land use in the study area is 303m^2 per capita. Even though the intensity varies between 48m^2/inh to 1689m^2/inh. The difference between artificialized and sealed soil is 56.22%. The spatial distribution of sealed soil within municipalities is visualized in Annex 1.

6.4 ANALYSIS OF ARTIFICIALIZED SOIL QUALITY

The biggest portion of the artificialized land is from the ALP class IV, followed by class III, class I, class II and class V. The trend in planning documentation increases the amount of the soil quality grabs proportionally by average 30% to the already built up area (Table 5). The total land take of the soil of good quality, ALP Class I and II, reaches 2128 ha and another 658 ha are planned to be artificialized. The biggest proportional increase is in the soils of ALP class V. with the lowest quality, but the total increase in hectares is in the ALP class IV. The proportional increase of artificialization in all ALP classes is showed as well in the Figure 21.

Agricultural land protection classes land grab						
ALP class	0	1	2	3	4	5
Built-up area [ha]	169,11	1035,71	1092,44	1199,91	1586,38	715,64
Buildable area[ha]	46,35	334,67	322,904	334,99	464,89	247,33
Total artificialized area [ha]	215,46	1370,39	1415,34	1534,91	2051,27	962,97
Increase [%]	27,41%	32,31%	29,56%	27,92%	29,31%	34,56%
Total cadastral area [ha]	44677,75					
Portion of cadastral area						
Built-up [%]	0,38%	2,32%	2,45%	2,69%	3,55%	1,60%
Buildable [%]	0,10%	0,75%	0,72%	0,75%	1,04%	0,55%

Table 5 ALP classes artificialization, source: author

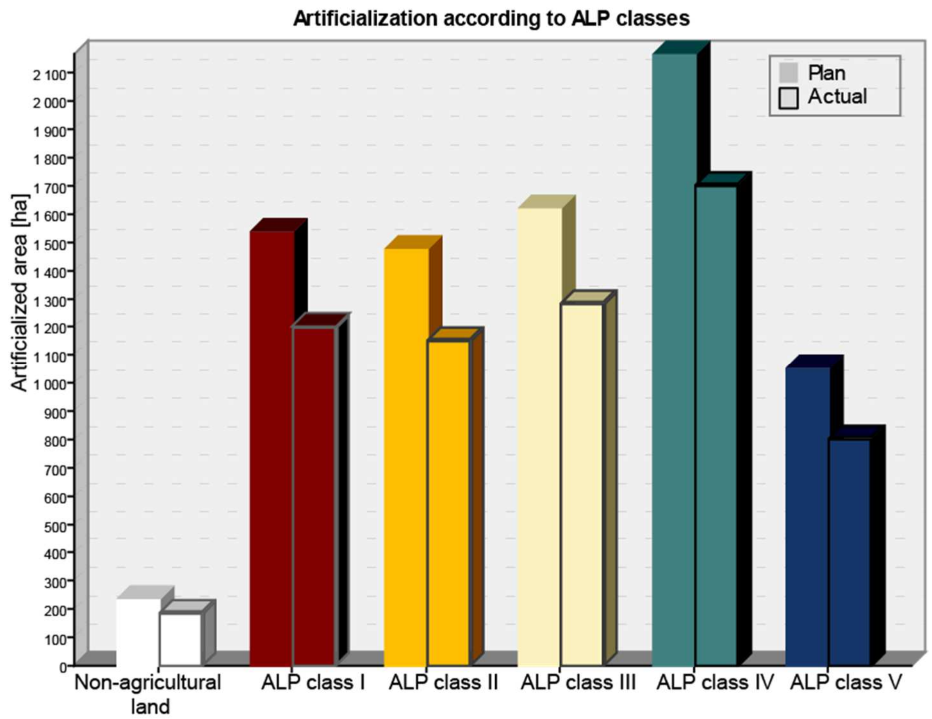

Figure 20 Total area of artificialized land by ALP classes for actual state and plan, source: author

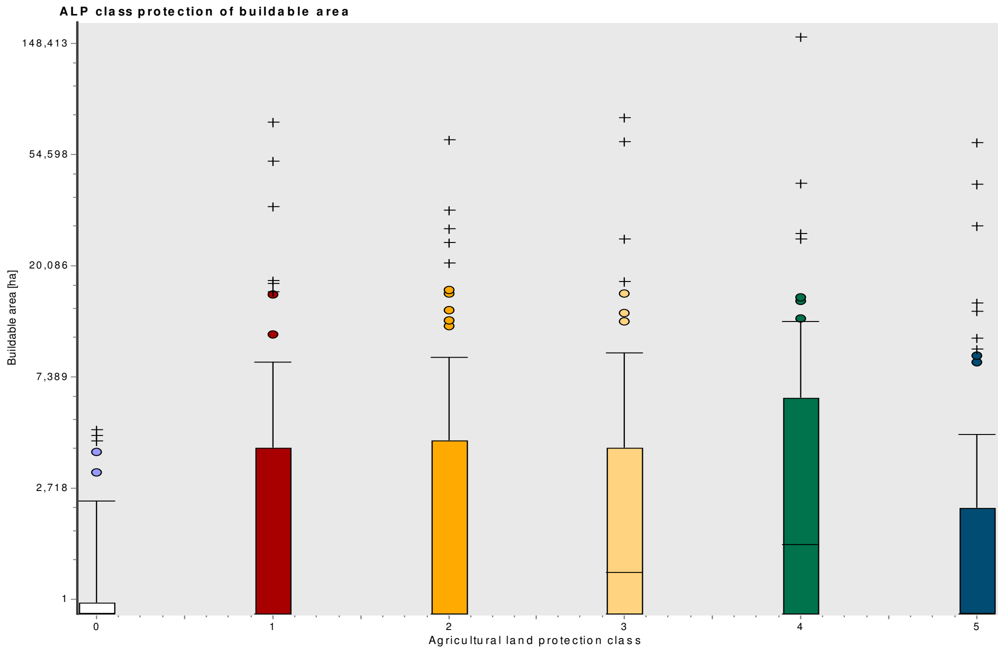

Figure 21 Amount of artificialized land in ALP classes, average size of land take, source: author

The Figure 22 show the average size of buildable area of different soil quality within the municipalities. The biggest land take occurs in the ALP class IV, which his positive, but the big portion is represented by the ALP class I and II as well. In the schemes in Figure 23 can be seen that the biggest artificialized areas of high quality soil (BTO_I_II) are located closer to Prague, meanwhile the buildable area on high quality soil (ZTO_I_II) is located moreover in the outskirts of the study area. The graphs for the distribution of individual actual and planned ALP classes land grabs can be seen in the Appendix (Annex8-1Annex12).

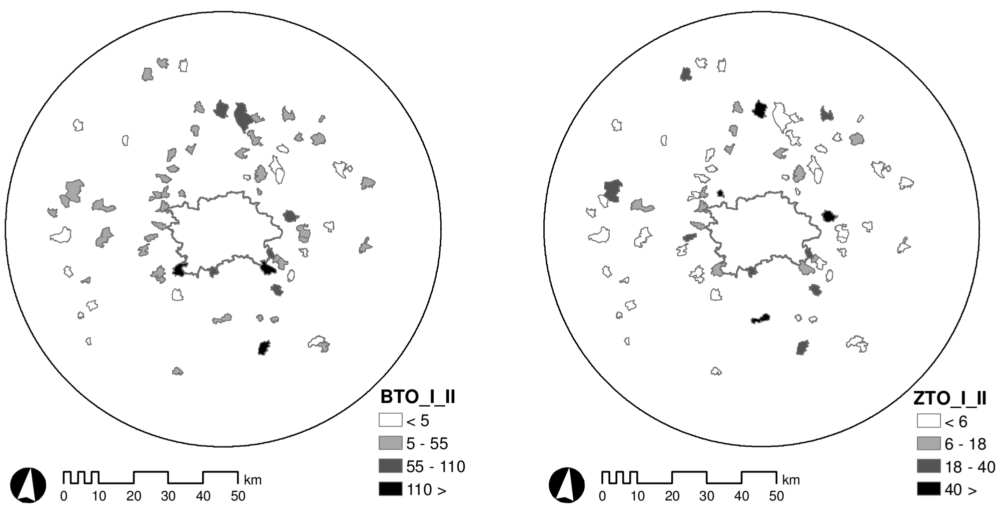

Figure 22 Built/up and buildable area on high quality soil [ha], source author

6.5 TRENDS AND DEPENDENCIES WITHIN THE METROPOLITAN AREA

The size of cadastral areas is increasing with the distance from Prague, meanwhile the population and built up area is decreasing. The trend of built up area decrease with longer travelling time to the city center is steeper than the reduction of buildable area (Figure 23). According to the Annex 7 the number of people daily commuting t Prague is as well decreasing with the distance. The municipalities in the closest hinterland of Prague have high built-up area share, but not that high buildable area share as the municipalities with the 30 minutes accessibility to the core city center (Figure 20, Annex4).

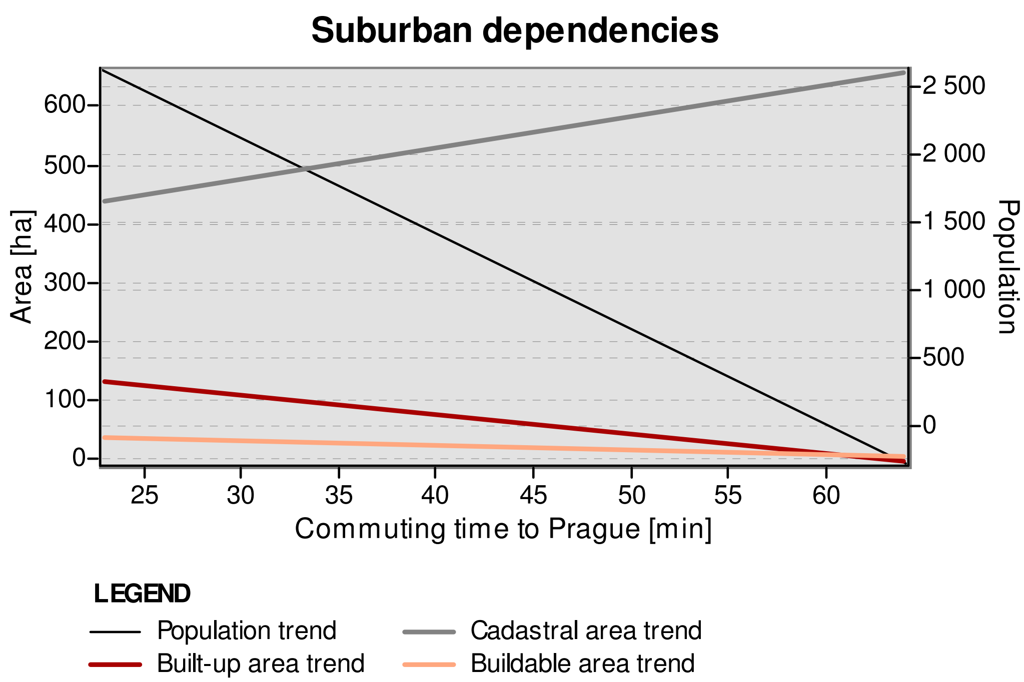

Figure 23 Trend of dependencies of Built-up and Buildable area on commuting time to the core city and municipality population, source: author

The biggest land takes of the ALP class I happen in the border of the capital on the south part (Figure 22, Annex 1, Annex3, Annex 4). The big municipalities, such as Mělník, area constructed on the less quality soil and therefore does not have that big impact.

	Pearson linear correlation Bold type indicates a significant relationship at p < 0,05; N=71												
Variable	**DIS**	**POP**	**DEN**	**COM**	**DISC**	**TIMC**	**TIMP**	**NR**	**NHE**	**NME**	**NS**	**AREA**	**BTO**
BTO	-0,22	**0,96**	**0,73**	**0,81**	-0,18	**-0,24**	-0,21	-0,23	0,06	-0,26	-0,22	**0,55**	1,00
ZTO	-0,18	**0,63**	**0,32**	**0,43**	-0,15	-0,20	-0,15	-0,18	0,02	-0,18	-0,14	**0,52**	**0,72**
SSA	-0,19	**0,96**	**0,72**	**0,77**	-0,15	-0,22	-0,19	-0,22	0,10	-0,25	**-0,25**	**0,56**	**0,98**
BTO_I_II	-0,23	**0,78**	**0,87**	**0,80**	-0,22	**-0,28**	-0,20	-0,21	-0,02	-0,26	-0,20	**0,26**	**0,65**
ZTO_I_II	**-0,31**	0,13	0,19	**0,24**	**-0,30**	**-0,25**	-0,05	-0,00	-0,08	-0,00	-0,05	0,11	0,09

Table 6 Linear correlation of metropolitan area factors

Variable	**Spearman non-linear correlation** Bold type indicates a significant relationship at p < 0,05; N=71 DIS	POP	DEN	COM	DISC	TIMC	TIMP	NR	NHE	NME	NS	AREA	BTO
BTO	**-0,43**	**0,82**	**0,59**	**0,75**	**-0,40**	**-0,48**	**-0,36**	**-0,32**	-0,21	**-0,35**	**-0,25**	**0,40**	1,00
ZTO	**-0,29**	**0,52**	**0,36**	**0,54**	**-0,34**	**-0,39**	-0,16	**-0,24**	**-0,30**	**-0,26**	-0,10	**0,30**	**0,58**
SSA	**-0,42**	**0,82**	**0,53**	**0,68**	**-0,39**	**-0,44**	**-0,30**	**-0,34**	-0,22	**-0,35**	-0,23	**0,49**	**0,81**
BTO_I_II	**-0,42**	**0,67**	**0,54**	**0,63**	**-0,39**	**-0,44**	-0,20	**-0,30**	-0,18	**-0,36**	-0,10	**0,26**	**0,63**
ZTO_I_II	**-0,41**	**0,44**	**0,28**	**0,47**	**-0,44**	**-0,44**	-0,13	-0,20	**-0,28**	-0,21	0,07	0,22	**0,32**

Table 7 Non-linear correlation of metropolitan area factors

The linear dependencies of built-up and buildable area on selected factors show partly surprising results (Table 6, Figure 25). The values of selected factors are almost proportionally changing within the metropolitan area (Table 7, Figure 24). The size built-up and buildable area are highly dependent on the population factor, such as total number of inhabitants, number of people commuting to Prague and population density. Another factor with high correlation is the cadastral area. The built-up area

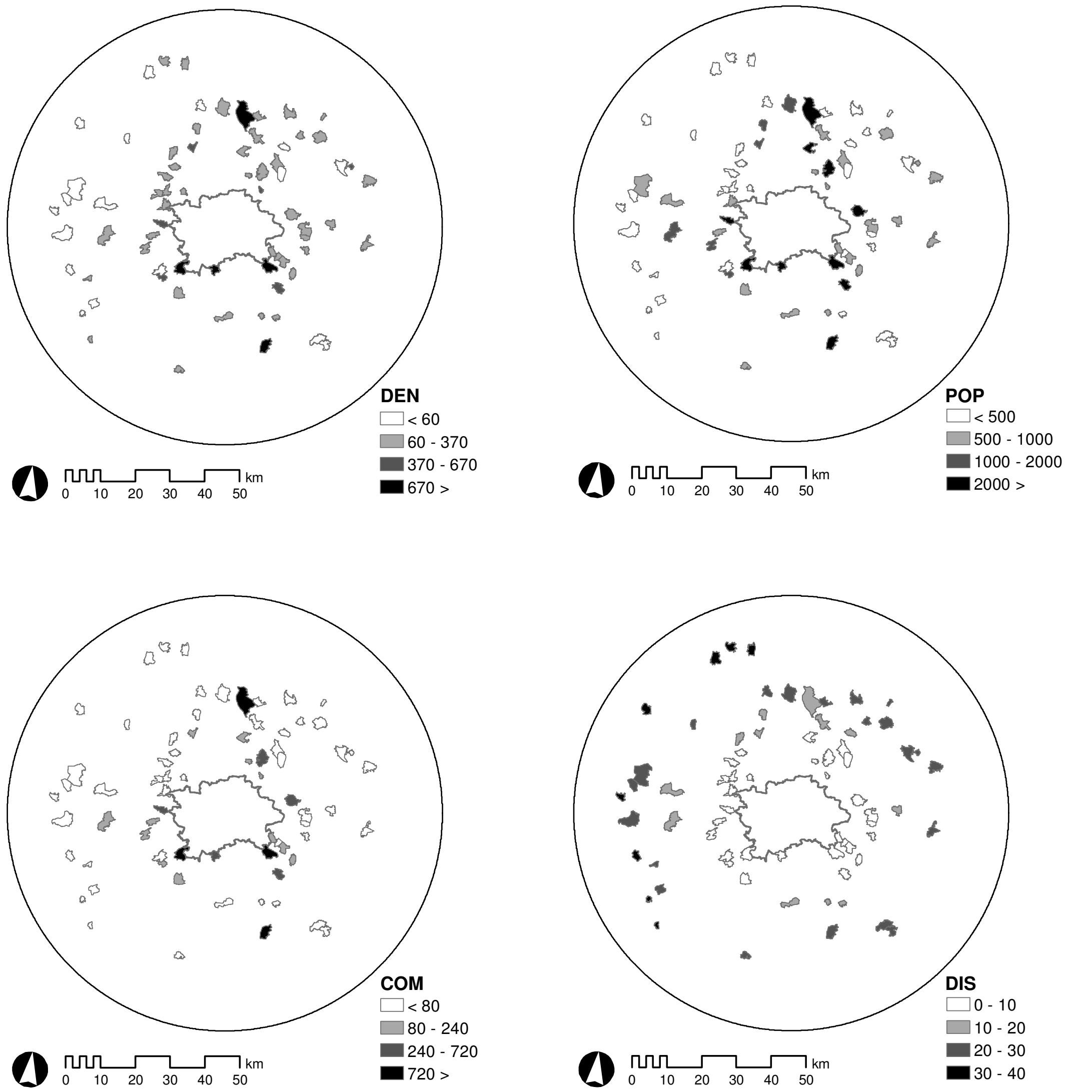

Figure 24 Variation of factors within the metropolitan area, source: author

moderately decreases with the commuting time to Prague by car and road accessibility. The soil sealed area highly depends on the built-up area, and to other variables behaves the same as built up area as well. The planned land take of good quality soil as the unique variable decreases with the absolute distance, the commuting distance, the commuting time. The highest quality soils are planned to be artificialized in the short distance from Prague (Figure 25, Annex 3, Annex 5).

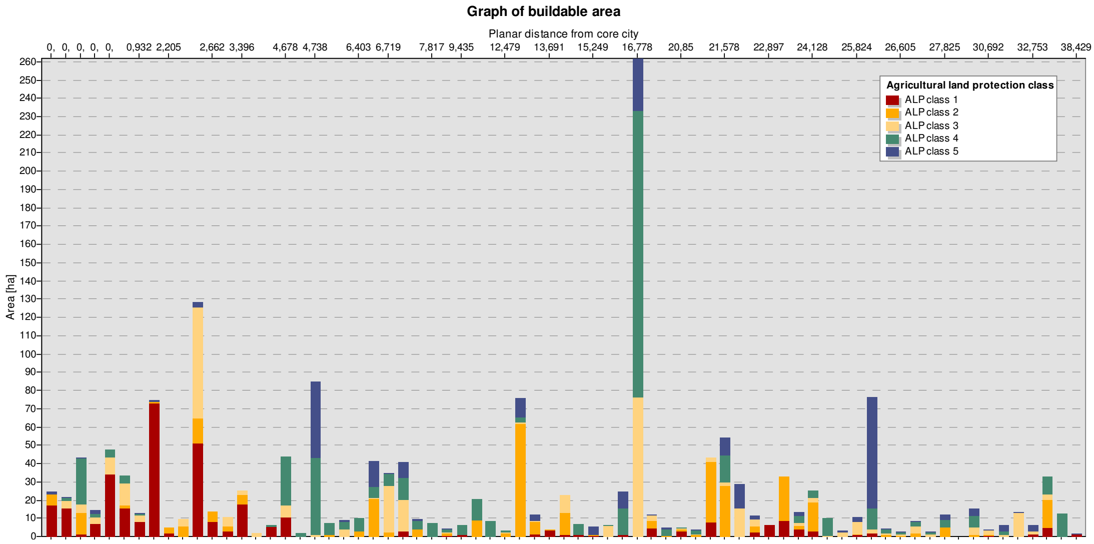

Figure 25 Buildable area ALP classes in dependence on distance from Prague, source: author

	Spearman correlation, p <,05000									
Variable	**DIS**	**POP**	**DEN**	**COM**	**DISC**	**TIMC**	**TIMP**	**NR**	**NHE**	**NME**
ZTO_I_II	**-0,40**	**0,44**	**0,28**	**0,47**	**-0,44**	**-0,44**	-0,13	-0,20	**-0,28**	-0,21
BTO_I_II	**-0,41**	**0,67**	**0,54**	**0,63**	**-0,39**	**-0,44**	-0,20	**-0,30**	-0,18	**-0,36**

Table 8 Quality agricultural land grab dependence on the selected factors

The high quality land grab depends mainly on the population factors (Table 8) and on the commuting time by car to the core city. The built-up area BTO shows higher correlation than the planned area ZTO. The size of planned development on the quality soils shows is dependent on the number of commuting people. The factors of the distance from the highway/main road exits show only small to moderate dependence. The spatial distribution of different ALP classes can be observed in the Annex 2 and Annex 3.

As mentioned before, the distance is one of the main factors influencing the artificialization. As seen from the Table 9, the highest amount of built-up, buildable area in selected municipalities happened within the 10 km buffer from the Prague border.

DIS [km]	0-10		10-20		20-30		30-40	
	Total [ha]	Mean [ha]	Total [ha]	Mean [ha]	Total [ha]	Mean [ha]	Total [ha]	Mean [ha]
BTO	**2965,24**	98,84	1434,62	119,55	1202,56	57,26	196,76	24,59
ZTO	**823,12**	27,44	451,33	37,61	374,30	17,82	102,39	12,79
SSA	**1615,42**	53,85	862,27	71,85	679,96	32,37	102,67	12,83
BTO_I_II	1136,05	37,86	242,42	20,20	688,38	32,78	61,28	7,66
ZTO_I_II	374,47	12,48	100,70	8,39	156,80	7,46	25,60	3,20

Table 9 The Built up and Buildable area in different distance from the core city, source: author

7. DISCUSSION

For the use of this analysis, the metropolitan area was delineated by the 50 kilometers radius from Prague and, as Kostelecký & Čermák (2004) mention, the area represents the typical nodal structure with dominating core city surrounded by numerous small suburban municipalities. The ITI PMR covers only limited surrounding of Prague and counts mainly with the municipalities with extended power, which does not satisfy the needs of municipal heterogeneity for this analysis. The main commuting trajectories show the as well the movement from other regions towards Prague (CZSO, 2014). The ITI PMR is not dogmatic, the possibility to change the Prague metropolitan area delimitation for purpose of specific analysis is mentioned in the methodology of IPR Prague (2015) itself. Even though the results show that the municipalities located further than 40 minutes by car from Prague have no daily commuters.

7.1 CORINE INADEQUACY

During the data extraction there was a problem with data accuracy in Corine land cover change comparison. For this analysis the European Union's project is not precise enough as mentioned in many researches (Fina & Siedentop, 2008). In cases of small urbanization in selected villages the urbanized pattern does not appear. Corine land cover analysis is not reliable for the analysis of this scale. As Sýkora (2002) mentions, this rough statistical data gives only information about the macrostructure of the landscape. The land cover changes in Czech conditions should be studied in more local scale as mention Sklenicka (2002) and Lipsky (1995). The mapping and analysis of artificialized area should be conducted in the municipality planning office and covered in the analytical documentation.

Even though there is not mapped all the urban development, from the results we can see the increase of urbanized area and area of frorests and another natural areas, menwhile the agricultural land area decreases. The trend shows the rising trend of artificialization in the selected villages up to 0.45% per year, which correlates with the trend of 0,4% for entire Czech Republic according to Eurostat.

7.2 ARTIFICIALIZATION OF SOILS

The total share of artificial soil in the study area is 13% and the share of sealed soil is about 7 % of total selected cadastral areas. The share is almost double than the national average provided by EEA (2015) in 2006. Comparison of the intensity of land use with Barcelona case shows that Prague metropolitan area has lover land use intensity. The sealed area per capita is about 303m^2 meanwhile Barcelona has about 80m^2(Ranalli & Salvati, 2015). In the Czech conditions the sealed and artificialized area does not change that much as the number of inhabitants do, therefore the per capita rates in the municipalities with low population reach enormous values, comparable for example with Cyprus (Prokop, et al., 2011).

The strong pressure to land in the southern part of the metropolitan area share of buildable area on the described by (URRlab, 2013) matches with the findings of this analysis. The municipalities in the south of Prague have much higher share of built-up and buildable area, which is alarming because in this part of the region are located the most fertile soils (Annex 3).

7.3 METROPOLITAN AREA GRAVITATION FORCES

The analysis proved that population density in the municipality has positive impact on the land taking processes as other authors mention Zoppi & Lai (2013). As a result of the Prague metropolitan analysis we can consider that the municipalities with bigger population and higher population density have higher percentage of artificialized and sealed soil area. On the other hand the intensity of land use is higher and the amount of artificialized/sealed land per capita is smaller than in less populated municipalities. The number of inhabitants daily commuting to Prague is one of the main factors showing, how much is the municipality influenced by the core city. As can be seen from the Table 6 and Table 7, the COM is the only factor shoving high correlation with all types of indicators in both linear and non-linear analysis.

The same statement is valid for the commuting distance/accessibility of the municipality from the core city, these factors have strong positive impact on the soil artificialization. The hypothesis of Zoppi & Lai (2013), that the better accessible municipalities are more suitable for land take, matches with the finding of this analysis. Zoppi & Lai (2013) propose balancing the accessibility opportunities as a regional strategy for limiting the concentration of land take and as a long term consequence to mitigate the agglomeration effect on the land use change. The goal according to Zoppi & Lai (2013) could be reached by subsidizing the public road network to provide proportional accessibility within all municipalities in the metropolitan area.

The socioeconomic factor of the average household income of a municipality could be according to Zoppi & Lai (2013) the significant factor in maintaining and possibly increasing the agricultural land. In this analysis, this factor wasn't evaluated.

7.4 TRENDS IN SPATIAL PLANNING

The municipalities with high percentage of built-up areas are growing moderately. In opposite the municipalities with small built up area nowadays, are planning to grow up more than one times (Appendix 1). Therefore the trends in planning correlates with the findings of Padeiro (2014)

Zoppi & Lai (2013) mention that the extensive urbanization and the planning codes preventing the artificialization of vast land should lead to prevention of land take. In the Czech Republic the continuous settlement development is supported by the Act on Conservation of Agricultural land resources and as Sklenicka, et al., (2013) mention the planning authorities usually grant the construction permit in borders of already built-up area. This is proved by the results of this analysis. The average distance of buildable area from the built-up structure is about 16m, but in many municipalities is the planned development connected seamlessly to the existing structure. This fact as well supports the findings of Padeiro (2014), that the new development relies on the existing urban patterns.

The analysis of artificialization dependence on the distance from the highway exits does not show reliable results in the original form as described by Padeiro (2014). The highway exits were supplemented with the exits from the main road and then the factor started to show comparable outputs. There is no dependence of planning on the TOD (transit oriented development), which correlates with the findings Padeiro (2014). In this paper was not distinguished between the residential and non-residential type of artificialized area. Higher dependence of non-residential artificialization on the transport network is expected.

The spatial distribution of high quality land grab is visualized in the Annex 2 for built-up area and Annex 3 for total built-up and buildable area. From the spatial structure can be seen that the highest amount of quality soil is artificialized in the border of Prague cadaster, where the most fertile soil is located as seen in the maps of VUMOP (2015). This correlates with the prognosis of UURlab (2013), which is showing the higher buildable area ratio in the close Prague hinterland.

8. CONCLUSION

The land use change in Prague metropolitan area correlates with the trend within the EU. The amount of agricultural land annually decreases, meanwhile the artificialized land increases. The analysis showed the need of detailed evaluation of quantitative and qualitative impacts of artificialization on agricultural land in Czech conditions. More research and detailed mapping should be done on the municipality level. The Corine land cover tool is not precise enough and does not catch the detailed grain of Czech suburban pattern, which is different from the pattern of western suburbanization. The development is more compact, the buildable area is mainly connected to already built-up area.

The amount of built-up area in the selected municipalities is higher than the national average, which proves the influence of the metropolitan area. Prague, as a core city, has significant impact on the surrounding municipalities in case of land artificialization. The majority of the artificialized land in the study areas is located within the 10 km distance from the Prague cadastral boundary. The ratio between the artificialized and sealed land is higher than the European trend. The artificialization affects all soil qualities, the highest portion impacts the average quality soil, but the high quality soil are affected almost the same. The lowest land grabbing occurs on the land with the lowest quality. The most fertile soil is urbanized in the nearest hinterland of Prague. The future development proportionally increases the land take of all the soil qualities.

The main determinants for artificialization within the metropolitan area are connected with the population and the distance from the core city. The important socio-economic factors are the number of commuting people, the population density and total municipality population. The municipalities closer to the core city evince higher quantity of built-up area and plan average development. The accessibility by car is more important, than the planar distance from the core city. The connection to the railway network does not play a key role. The villages with the 40 minutes car accessibility to the Prague city center have an average built-up share nowadays, but thanks to the good location and potential for future development, plan significant urban growth in their spatial planning documentation.

Thanks to natural conditions the most fertile soils in the study area are located near Prague, therefore the municipalities most influenced by suburban land pressure are bargaining the soil of a good quality. From the analysis we can say that the municipalities, which undergone the biggest suburban growth in the last decades, are planning only the regulated development, meanwhile the less built-up municipalities, with good accessibility to Prague, plan massive extensions. The municipalities and the planners will play an important role in conserving the agricultural resources for future generations.

9. ABBREVIATIONS

GIS	Geographic Information Systems
SPD	Spatial Planning Documentation
CZSO	Czech Statistical Office
CAP	Common Agricultural policy
TOD	Transit Oriented Development
EU	European Union
BPEJ	Bonited Pedo-Ecological Unit
LUCAS	Land Use and Cover Area frame Survey
CORINE	Coordination of Information on the Environment
TSES	Territorial System of Ecological Stability
MSA	Metropolitan Statistical Area
CUZK	Czech Office for Surveying, Mapping and Cadaster
INSPIRE	Infrastructure for Spatial Information in Europe
VUMOP	Research Institute for Soil and Water Conservation
EEA	European Environment Agency
ITI	Integrated Territorial Investment
PMR	Prague Metropolitan Region

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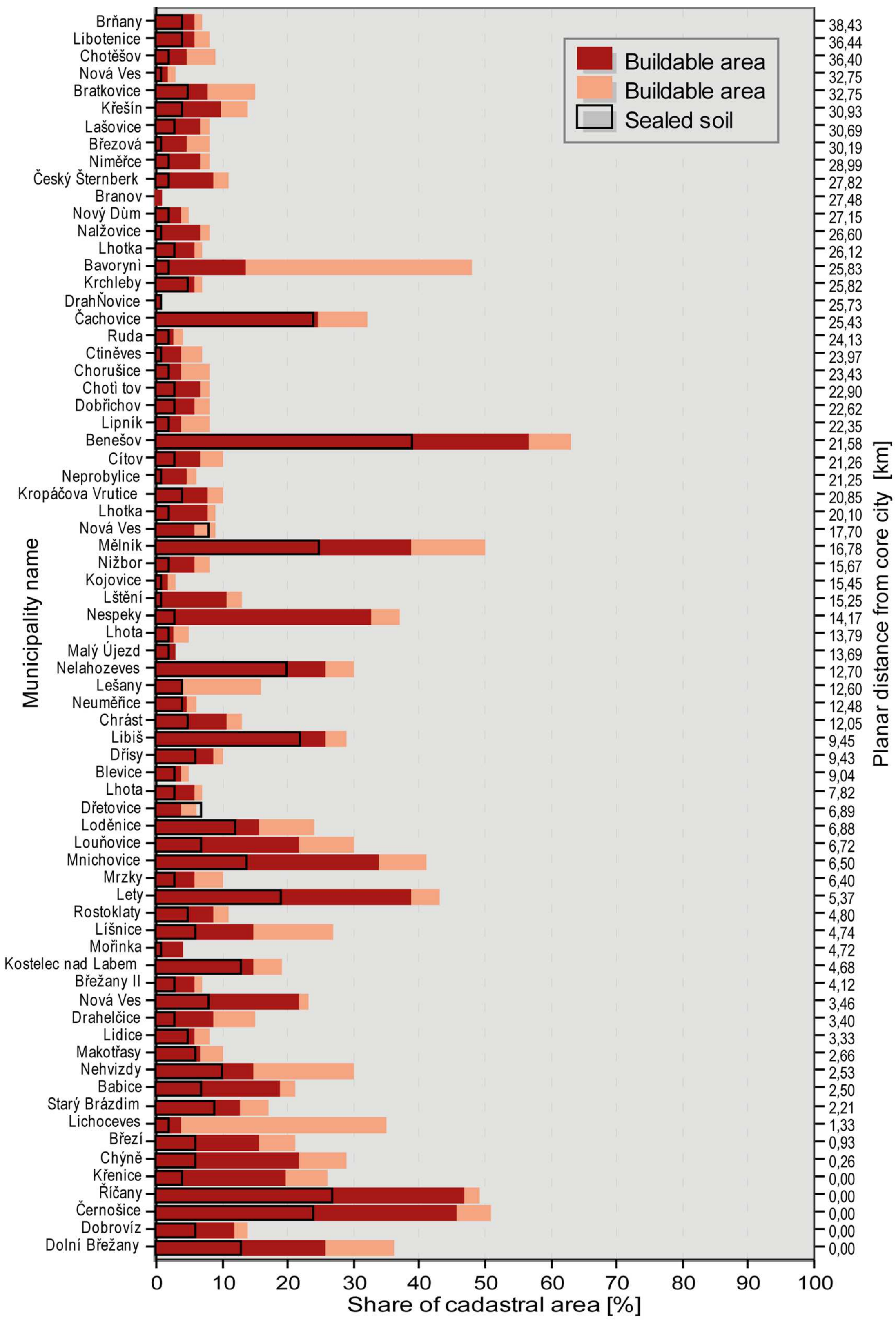
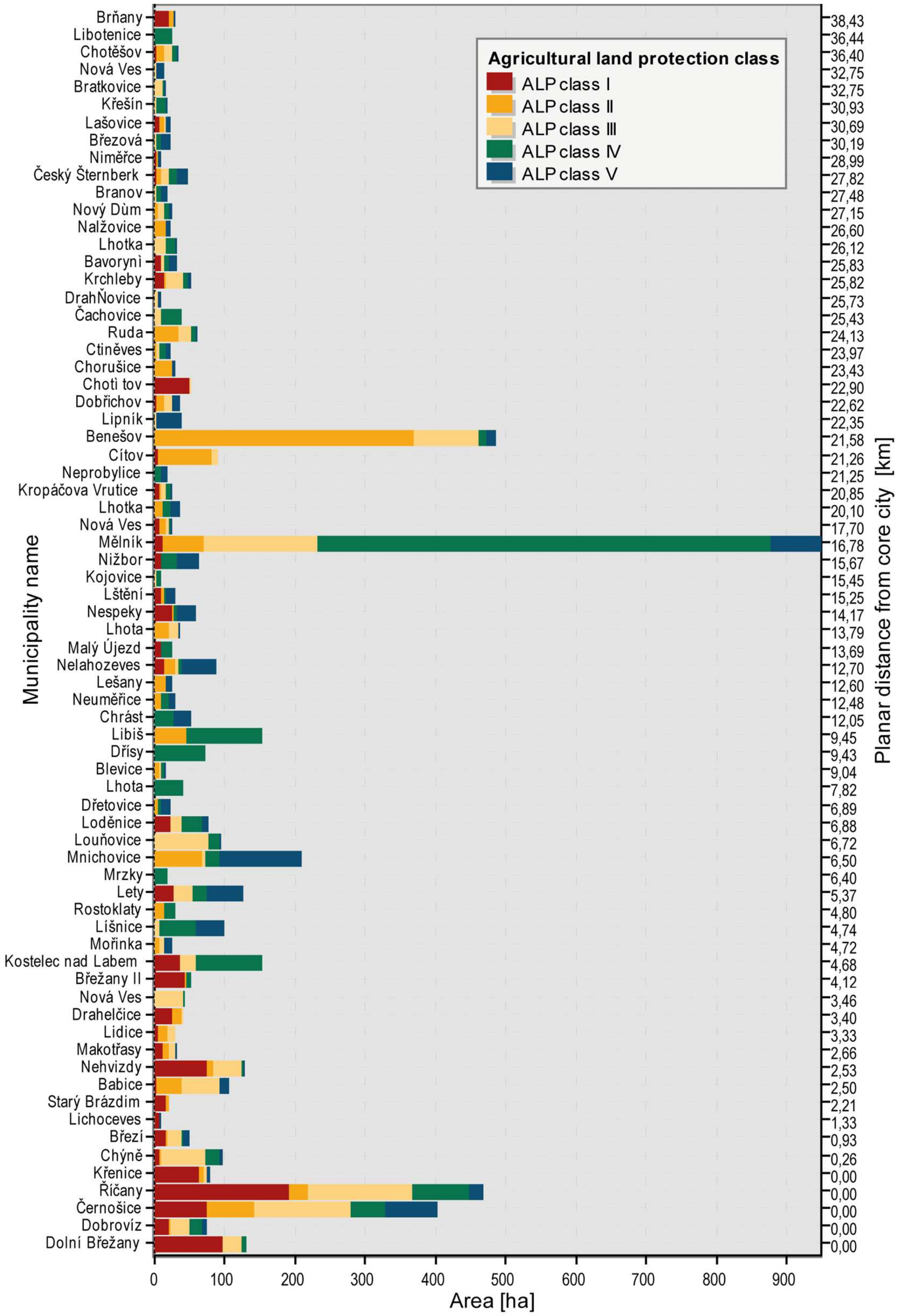
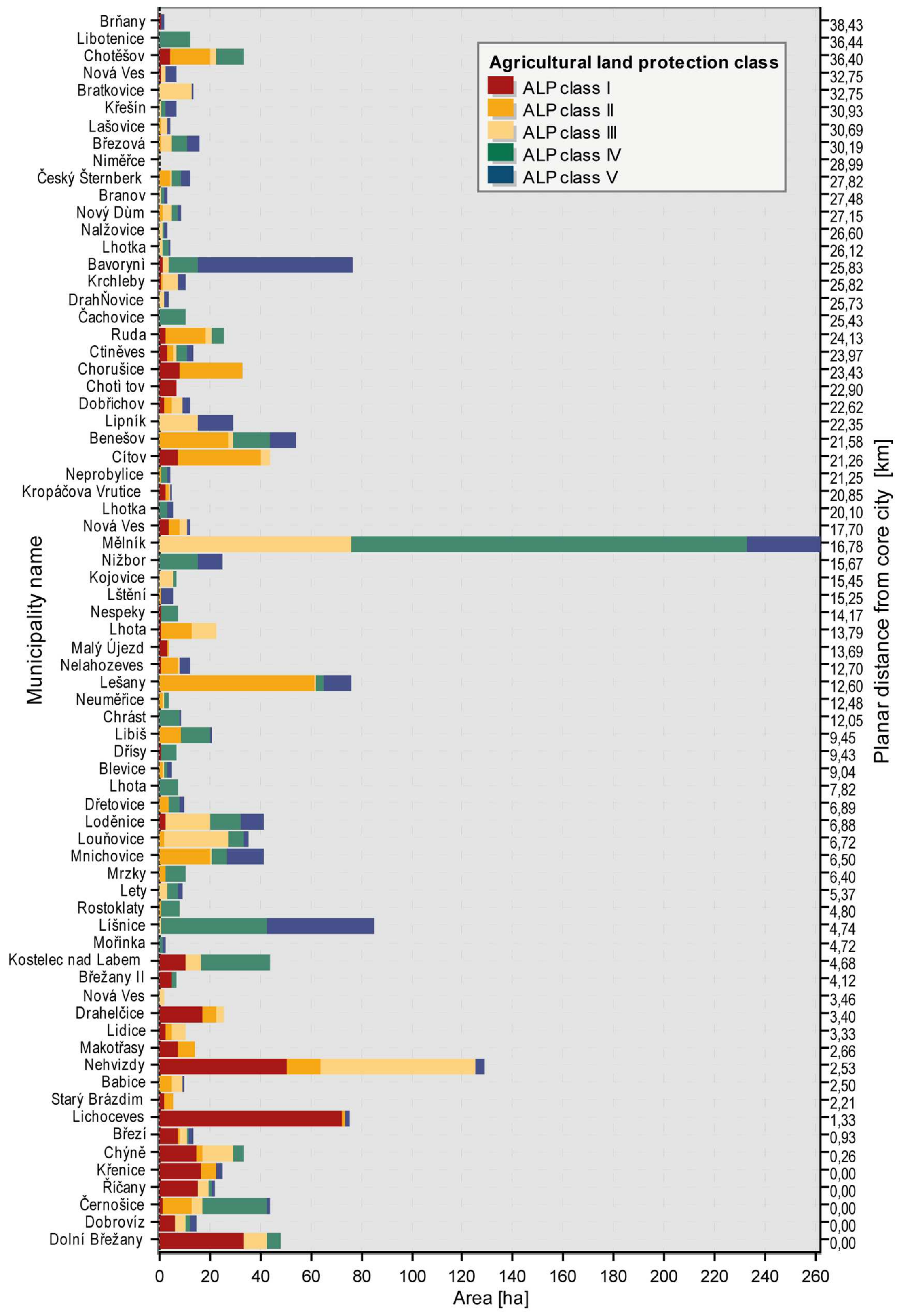
Annex 4 Graph of suburban dependencies, source: author



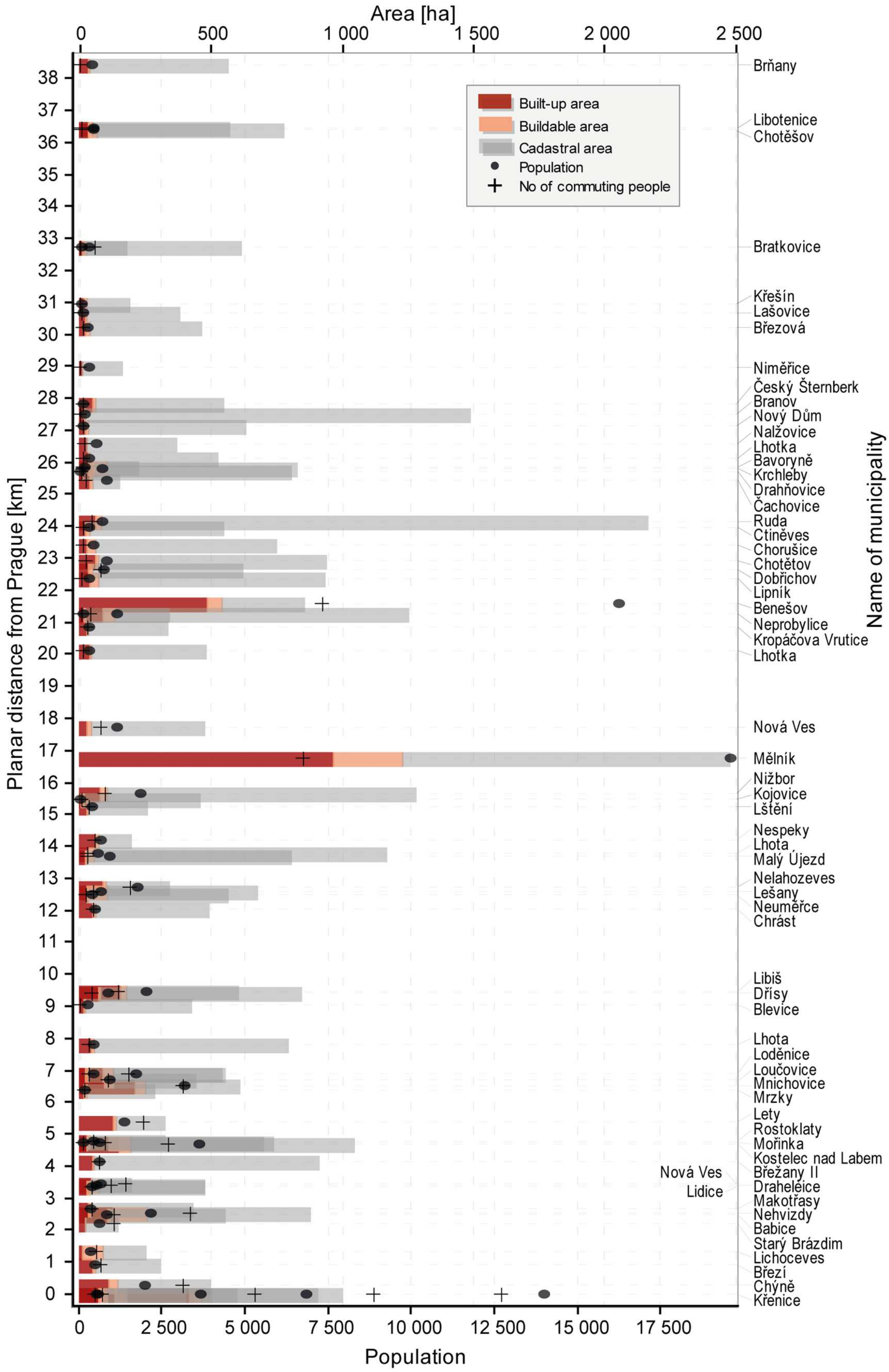
Annex 5 Graph of built-up area soil quality, source: author



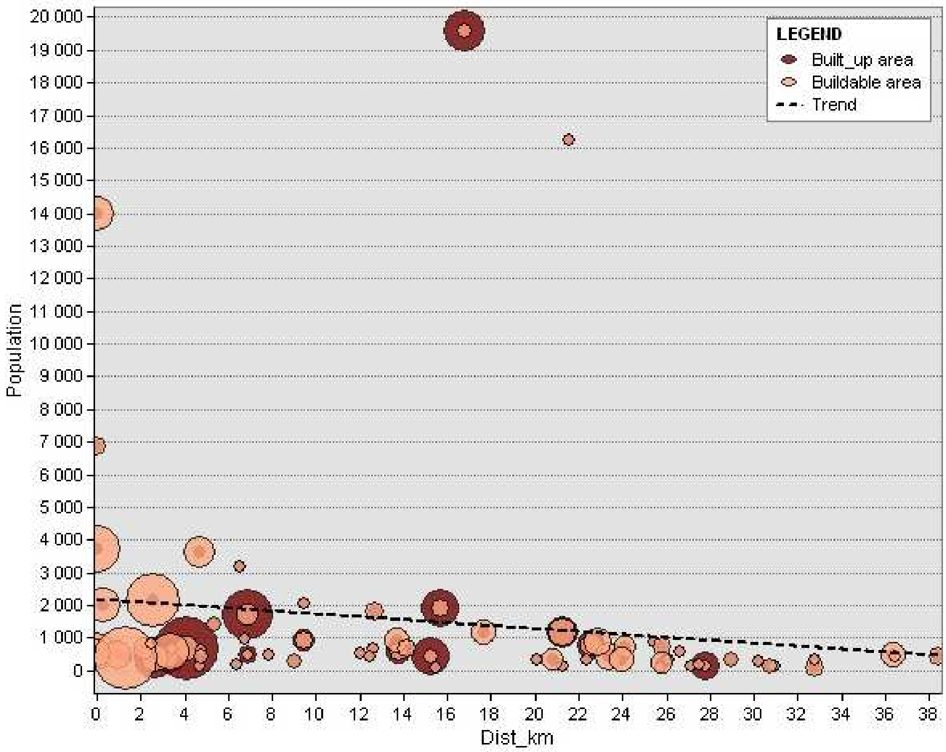
Annex 6 Graph of buildable area soil quality, source: author



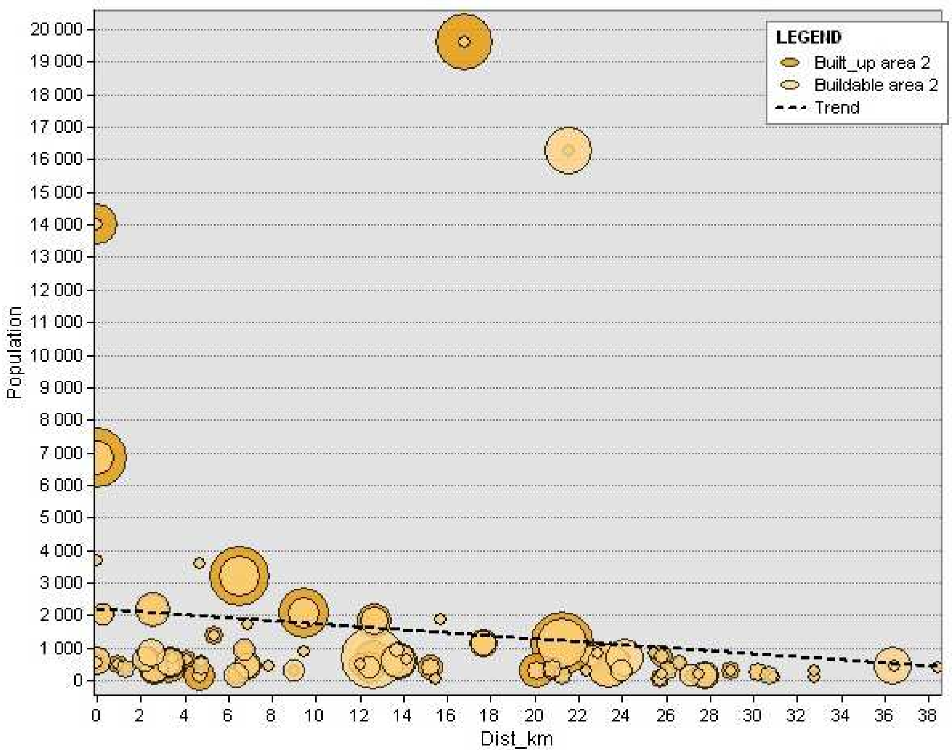
Annex 7 Graph of suburban dependencies, source: author, data on population CZSO



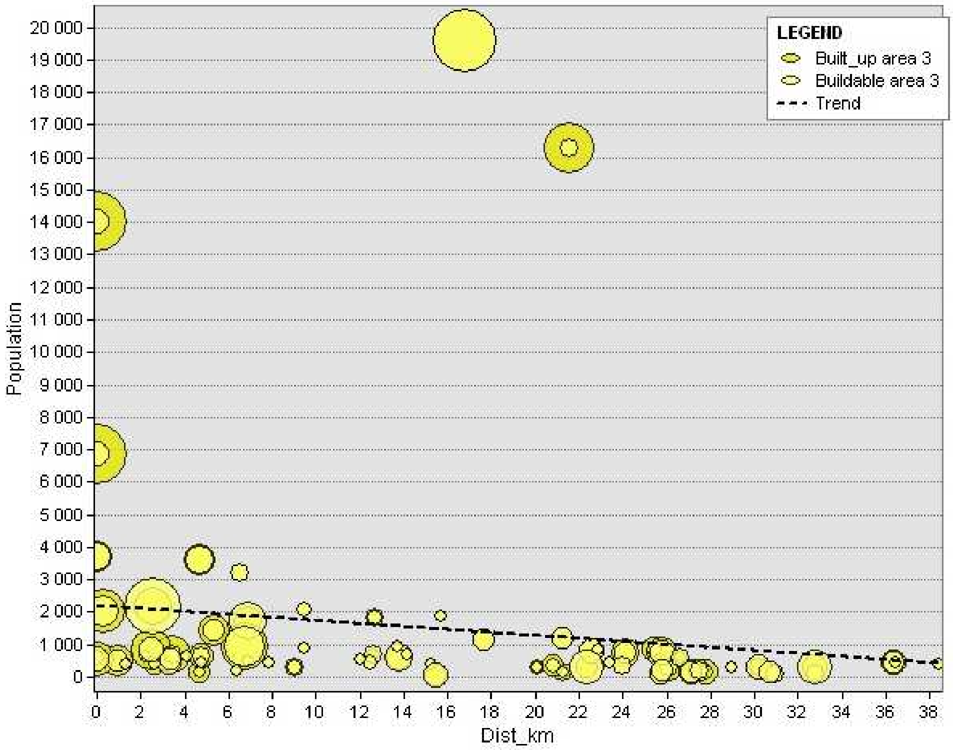
Annex 8 Distribution of ALP class I in selected municipalities, source: author



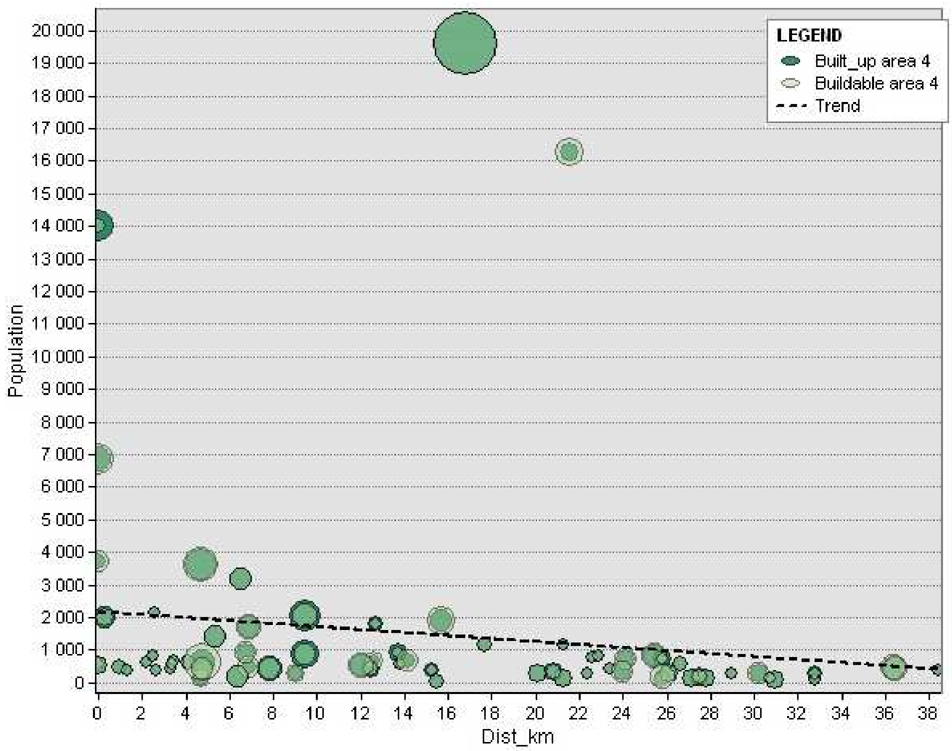
Annex 9 Distribution of ALP class II in selected municipalities, source: author



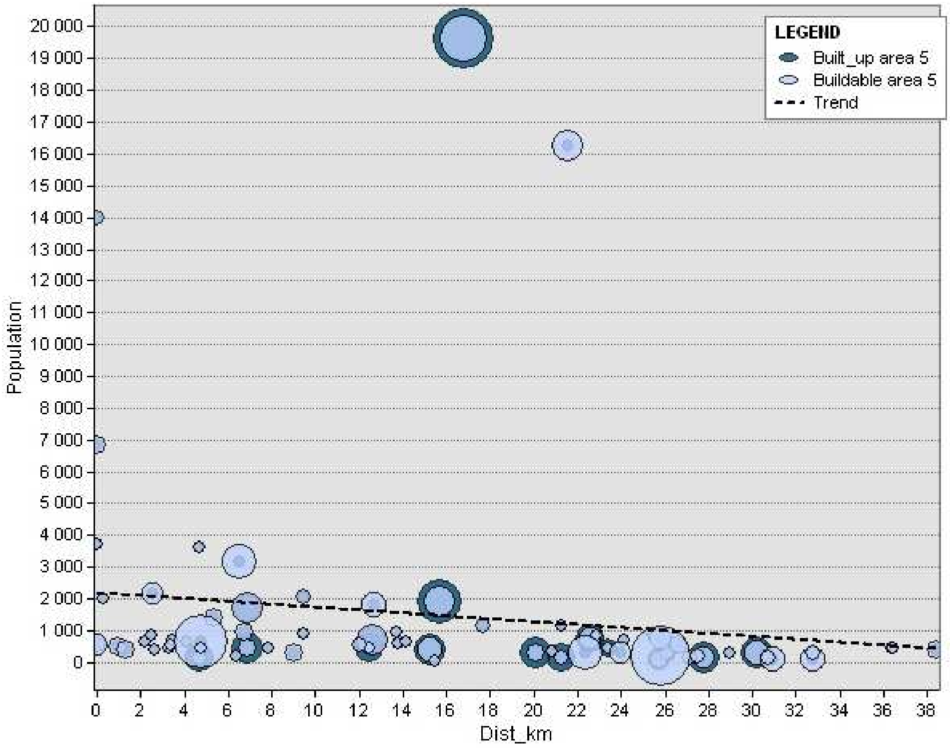
Annex 10 Distribution of ALP class III in selected municipalities, source: author



Annex 11 Distribution of ALP class IV in selected municipalities, source: author



Annex 12 Distribution of ALP class V in selected municipalities, source: author



Annex 13 List of municipalities with administrative affiliation, source: author, data od administrative units provided by CZSO

FID	NAME_PART	CODE_MUN	LAU1	NAME_LAU1	CZNUTS3	NAME_CNUTS3	AREA [ha]
1	**Benešov**	529303	CZ0201	Benešov	CZ020	Středočeský kraj	857,93
2	**Český Šternberk**	529541	CZ0201	Benešov	CZ020	Středočeský kraj	547,07
3	**Drahňovice**	532151	CZ0201	Benešov	CZ020	Středočeský kraj	807,09
4	**Lštění**	532193	CZ0201	Benešov	CZ020	Středočeský kraj	258,75
5	**Lešany**	530051	CZ0201	Benešov	CZ020	Středočeský kraj	678,61
6	**Bavoryně**	534421	CZ0202	Beroun	CZ020	Středočeský kraj	224,18
7	**Březová**	531090	CZ0202	Beroun	CZ020	Středočeský kraj	463,12
8	**Lhotka**	533335	CZ0202	Beroun	CZ020	Středočeský kraj	526,55
9	**Loděnice**	531464	CZ0202	Beroun	CZ020	Středočeský kraj	554,00
10	**Mořinka**	533912	CZ0202	Beroun	CZ020	Středočeský kraj	700,12
11	**Nižbor**	531596	CZ0202	Beroun	CZ020	Středočeský kraj	1282,60
12	**Blevice**	532100	CZ0203	Kladno	CZ020	Středočeský kraj	422,78
13	**Dřetovice**	532282	CZ0203	Kladno	CZ020	Středočeský kraj	540,82
14	**Lhota**	513041	CZ0203	Kladno	CZ020	Středočeský kraj	1171,33
15	**Lidice**	532584	CZ0203	Kladno	CZ020	Středočeský kraj	478,14
16	**Makotřasy**	532622	CZ0203	Kladno	CZ020	Středočeský kraj	429,63
17	**Neprobylice**	571521	CZ0203	Kladno	CZ020	Středočeský kraj	342,99
18	**Neuměřice**	532665	CZ0203	Kladno	CZ020	Středočeský kraj	566,18
19	**Břežany II**	533220	CZ0204	Kolín	CZ020	Středočeský kraj	911,98
20	**Dobřichov**	533289	CZ0204	Kolín	CZ020	Středočeský kraj	619,10
21	**Mrzky**	513288	CZ0204	Kolín	CZ020	Středočeský kraj	287,40
22	**Mělník**	534676	CZ0206	Mělník	CZ020	Středočeský kraj	2478,51
23	**Cítov**	534731	CZ0206	Mělník	CZ020	Středočeský kraj	1255,79
24	**Dřísy**	534781	CZ0209	Praha-východ	CZ020	Středočeský kraj	843,44
25	**Chorušice**	534838	CZ0206	Mělník	CZ020	Středočeský kraj	747,00
26	**Kostelec nad Labem**	534935	CZ0206	Mělník	CZ020	Středočeský kraj	1047,20
27	**Lhota**	534986	CZ0209	Praha-východ	CZ020	Středočeský kraj	795,54
28	**Lhotka**	531898	CZ0206	Mělník	CZ020	Středočeský kraj	482,81
29	**Libiš**	571784	CZ0206	Mělník	CZ020	Středočeský kraj	604,86
30	**Malý Újezd**	535036	CZ0206	Mělník	CZ020	Středočeský kraj	803,72
31	**Nová Ves**	535117	CZ0206	Mělník	CZ020	Středočeský kraj	477,05
32	**Nelahozeves**	535079	CZ0206	Mělník	CZ020	Středočeský kraj	340,69
33	**Čachovice**	535621	CZ0207	Mladá Boleslav	CZ020	Středočeský kraj	148,84
34	**Chotětov**	535931	CZ0207	Mladá Boleslav	CZ020	Středočeský kraj	938,51
35	**Kojovice**	536181	CZ0207	Mladá Boleslav	CZ020	Středočeský kraj	458,93
36	**Kropáčova Vrutice**	536181	CZ0207	Mladá Boleslav	CZ020	Středočeský kraj	334,70
37	**Lipníşk**	565563	CZ0207	Mladá Boleslav	CZ020	Středočeský kraj	936,99
38	**Niměřice**	571121	CZ0207	Mladá Boleslav	CZ020	Středočeský kraj	162,29
39	**Chrást**	537233	CZ0208	Nymburk	CZ020	Středočeský kraj	495,12
40	**Krchleby**	537390	CZ0208	Nymburk	CZ020	Středočeský kraj	829,03
41	**StarStarý Brázdim**	538108	CZ0209	Praha-východ	CZ020	Středočeský kraj	146,51
42	**Křenice**	564991	CZ0209	Praha-východ	CZ020	Středočeský kraj	402,88
43	**Mnichovice**	538493	CZ0209	Praha-východ	CZ020	Středočeský kraj	611,07
44	**Nehvizdy**	538540	CZ0209	Praha-východ	CZ020	Středočeský kraj	879,24
45	**Babice**	538043	CZ0209	Praha-východ	CZ020	Středočeský kraj	554,87
46	**Louňovice**	538451	CZ0209	Praha-východ	CZ020	Středočeský kraj	441,75
47	**Březí**	564869	CZ0209	Praha-východ	CZ020	Středočeský kraj	306,21
48	**Nová Ves**	538558	CZ0209	Praha-východ	CZ020	Středočeský kraj	194,03
49	**Říčany**	538728	CZ0209	Praha-východ	CZ020	Středočeský kraj	1003,71
50	**Černošice**	539139	CZ020A	Praha-západ	CZ020	Středočeský kraj	905,28
51	**Dobrovíz**	539171	CZ020A	Praha-západ	CZ020	Středočeský kraj	598,19
52	**Dolní Břežany**	539210	CZ020A	Praha-západ	CZ020	Středočeský kraj	502,79
53	**Drahelčice**	531146	CZ020A	Praha-západ	CZ020	Středočeský kraj	476,24
54	**Chýně**	539309	CZ020A	Praha-západ	CZ020	Středočeský kraj	499,26
55	**Lety**	539406	CZ020A	Praha-západ	CZ020	Středočeský kraj	323,70
56	**Lichoceves**	571326	CZ020A	Praha-západ	CZ020	Středočeský kraj	249,17
57	**Líšnice**	539457	CZ020A	Praha-západ	CZ020	Středočeský kraj	736,06
58	**Bratkovice**	539988	CZ020B	Příbram	CZ020	Středočeský kraj	180,72
59	**Křešín**	540587	CZ020B	Příbram	CZ020	Středočeský kraj	189,77
60	**Nalžovice**	540790	CZ020B	Příbram	CZ020	Středočeský kraj	367,35
61	**Branov**	541672	CZ020C	Rakovník	CZ020	Středočeský kraj	1485,92
62	**Nový Dům**	542181	CZ020C	Rakovník	CZ020	Středočeský kraj	631,54
63	**Ruda**	542326	CZ020C	Rakovník	CZ020	Středočeský kraj	2167,45
64	**Brňany**	564613	CZ0423	Litoměřice	CZ042	Ústecký kraj	563,11
65	**Ctiněves**	564672	CZ0423	Litoměřice	CZ042	Ústecký kraj	549,03
66	**Chotěšov**	564940	CZ0423	Litoměřice	CZ042	Ústecký kraj	776,47
67	**Libotenice**	565172	CZ0423	Litoměřice	CZ042	Ústecký kraj	572,59
68	**Nová Ves**	542636	CZ0424	Louny	CZ042	Ústecký kraj	612,75
69	**Rostoklaty**	533661	CZ0204	Kolín	CZ020	Středočeský kraj	325,59
70	**Nespeky**	530263	CZ0201	Benešov	CZ020	Středočeský kraj	193,26
71	**Lašovice**	542008	CZ020C	Rakovník	CZ020	Středočeský kraj	379,86

Annex 14 Summary of Built-up, Buildable and Sealed soil in selected municipalities, source: author

FID	NAME_PART	AREA [ha]	BTO [ha]	ZTO [ha]	TO [ha]	SSA [ha]	BTO index [m²/inh]	TO index [m²/inh]	SSA index [m²/inh]
1	**Benešov**	857,93	486,27	53,99	540,26	337,34	299	332	207
2	**Český Šternberk**	547,07	47,72	13,54	61,26	9,76	3039	3902	621
3	**Drahňovice**	807,09	9,75	3,60	13,35	11,99	1374	1881	1689
4	**Lštění**	258,75	29,06	5,49	34,55	1,95	712	847	48
5	**Lešany**	678,61	25,70	78,36	104,07	24,07	370	1497	346
6	**Bavoryně**	224,18	31,12	76,53	107,66	4,96	1468	5078	234
7	**Březová**	463,12	22,58	16,09	38,67	4,67	833	1427	172
8	**Lhotka**	526,55	32,75	4,43	37,18	13,76	1060	1203	445
9	**Loděnice**	554,00	86,78	43,29	130,07	64,87	505	758	378
10	**Mořinka**	700,12	25,40	2,13	27,53	7,20	1789	1939	507
11	**Nižbor**	1282,60	78,51	26,67	105,17	22,25	416	558	118
12	**Blevice**	422,78	15,35	5,08	20,43	14,42	539	717	506
13	**Dřetovice**	540,82	21,81	9,75	31,55	36,07	468	677	774
14	**Lhota**	1171,33	35,74	22,56	58,30	20,29	600	978	340
15	**Lidice**	478,14	28,34	10,60	38,93	25,36	664	912	594
16	**Makotřasy**	429,63	30,79	13,77	44,56	27,36	825	1195	734
17	**Neprobylice**	342,99	18,06	4,02	22,08	5,11	1348	1648	381
18	**Neuměřice**	566,18	30,39	3,54	33,92	21,96	718	802	519
19	**Břežany II**	911,98	52,05	6,50	58,55	24,10	797	897	369
20	**Dobřichov**	619,10	35,70	11,88	47,57	18,14	468	624	238
21	**Mrzky**	287,40	18,60	10,13	28,73	7,90	1057	1632	449
22	**Mělník**	2478,51	968,39	262,74	1231,12	620,41	494	628	317
23	**Cítov**	1255,79	89,82	43,74	133,56	42,20	773	1149	363
24	**Dřísy**	843,44	72,13	6,75	78,88	53,56	804	879	597
25	**Chorušice**	747,00	29,04	33,31	62,35	15,41	644	1383	342
26	**Kostelec nad Labem**	1047,20	152,86	44,10	196,95	131,23	423	545	363
27	**Lhota**	795,54	46,65	7,54	54,19	25,59	1021	1186	560
28	**Lhotka**	482,81	38,59	5,81	44,40	9,04	1245	1432	292
29	**Libiš**	604,86	157,89	20,85	178,75	132,79	764	865	642
30	**Malý Újezd**	803,72	24,61	3,93	28,55	14,09	261	303	150
31	**Nová Ves**	477,05	30,37	13,46	43,82	37,23	264	381	324
32	**Nelahozeves**	340,69	87,31	12,28	99,59	67,32	484	552	373
33	**Čachovice**	148,84	37,53	10,11	47,63	36,03	442	561	424
34	**Chotětov**	938,51	63,34	6,62	69,96	31,79	747	825	375
35	**Kojovice**	458,93	7,89	6,47	14,36	4,16	1252	2280	661
36	**Kropáčova Vrutice**	334,70	27,32	5,24	32,56	14,04	808	963	415
37	**Lipnísk**	936,99	40,20	33,66	73,86	17,82	1305	2398	579
38	**Niměřice**	162,29	12,14	1,78	13,92	2,91	389	446	93
39	**Chrást**	495,12	52,51	8,69	61,21	22,68	1006	1173	435
40	**Krchleby**	829,03	52,33	10,56	62,89	42,27	703	845	568
41	**StarStarý Brázdim**	146,51	19,74	5,21	24,94	13,42	302	381	205
42	**Křenice**	402,88	79,67	24,70	104,37	16,63	1330	1742	278
43	**Mnichovice**	611,07	210,20	41,70	251,90	86,79	661	792	273
44	**Nehvizdy**	879,24	127,97	128,91	256,88	86,42	591	1186	399
45	**Babice**	554,87	104,73	10,65	115,38	38,43	1242	1369	456
46	**Louňovice**	441,75	95,86	35,52	131,38	31,53	1009	1383	332
47	**Březí**	306,21	49,60	14,23	63,83	19,42	994	1279	389
48	**Nová Ves**	194,03	43,59	1,81	45,39	15,96	647	674	237
49	**Říčany**	1003,71	468,43	21,87	490,30	273,75	335	350	195
50	**Černošice**	905,28	417,60	45,74	463,34	216,94	610	677	317
51	**Dobrovíz**	598,19	74,22	14,76	88,97	37,81	1354	1624	690
52	**Dolní Břežany**	502,79	132,62	47,79	180,40	64,29	359	488	174
53	**Drahelčice**	476,24	43,88	29,62	73,50	14,07	785	1315	252
54	**Chýně**	499,26	111,51	35,34	146,85	29,00	556	732	145
55	**Lety**	323,70	127,79	12,98	140,77	59,96	908	1000	426
56	**Lichoceves**	249,17	10,23	78,29	88,52	3,76	273	2367	100
57	**Líšnice**	736,06	109,92	85,88	195,80	40,74	1770	3153	656
58	**Bratkovice**	180,72	14,99	13,43	28,42	9,81	487	923	319
59	**Křešín**	189,77	18,75	6,80	25,54	7,83	1674	2281	699
60	**Nalžovice**	367,35	25,97	3,54	29,52	5,12	460	522	91
61	**Branov**	1485,92	16,92	3,09	20,00	5,36	837	990	266
62	**Nový Dům**	631,54	23,87	8,40	32,27	14,00	1717	2322	1007
63	**Ruda**	2167,45	60,17	25,60	85,77	35,05	838	1195	488
64	**Brňany**	563,11	32,13	6,24	38,37	23,65	786	938	578
65	**Ctiněves**	549,03	23,95	14,85	38,81	7,88	760	1232	250
66	**Chotěšov**	776,47	35,31	34,55	69,85	18,21	766	1515	395
67	**Libotenice**	572,59	35,25	13,74	48,98	20,56	799	1111	466
68	**Nová Ves**	612,75	12,86	6,59	19,45	8,13	1225	1852	774
69	**Rostoklaty**	325,59	29,06	7,63	36,70	16,07	652	823	360
70	**Nespeky**	193,26	64,15	7,14	71,30	5,86	959	1066	88
71	**Lašovice**	379,86	24,90	4,97	29,87	9,82	1872	2246	738

Annex 15 Table summarizing the land grabs of quality agricultural soil and share of artificialization in selected cadastral areas, source: author

FID	NAME_PART	AREA [ha]	BTO_I_II [ha]	ZOT_I_II [ha]	TO_I_II [ha]	BTO [%]	ZTO [%]	TO [%]	SSA [%]
1	**Benešov**	857,93	370,36	27,97	398,33	57	6	63	39
2	**Český Šternberk**	547,07	11,55	4,81	16,37	9	2	11	2
3	**Drahňovice**	807,09	0,85	0,20	1,04	1	0	2	1
4	**Lštění**	258,75	16,08	1,06	17,14	11	2	13	1
5	**Lešany**	678,61	16,89	62,01	78,91	4	12	15	4
6	**Bavoryně**	224,18	12,12	1,99	14,11	14	34	48	2
7	**Březová**	463,12	0,83	1,11	1,94	5	3	8	1
8	**Lhotka**	526,55	0,00	0,84	0,84	6	1	7	3
9	**Loděnice**	554,00	25,29	2,96	28,25	16	8	23	12
10	**Mořinka**	700,12	9,81	0,15	9,97	4	0	4	1
11	**Nižbor**	1282,60	12,13	0,82	12,95	6	2	8	2
12	**Blevice**	422,78	8,63	2,07	10,71	4	1	5	3
13	**Dřetovice**	540,82	7,36	4,19	11,55	4	2	6	7
14	**Lhota**	1171,33	23,26	13,38	36,65	3	2	5	2
15	**Lidice**	478,14	20,64	5,67	26,31	6	2	8	5
16	**Makotřasy**	429,63	23,45	13,77	37,22	7	3	10	6
17	**Neprobylice**	342,99	0,13	1,25	1,38	5	1	6	1
18	**Neuměřice**	566,18	10,28	2,11	12,39	5	1	6	4
19	**Břežany II**	911,98	47,13	5,51	52,64	6	1	6	3
20	**Dobřichov**	619,10	16,03	5,36	21,39	6	2	8	3
21	**Mrzky**	287,40	1,51	3,25	4,77	6	4	10	3
22	**Mělník**	2478,51	72,70	0,08	72,78	39	11	50	25
23	**Cítov**	1255,79	83,06	40,83	123,88	7	3	11	3
24	**Dřísy**	843,44	1,57	1,00	2,57	9	1	9	6
25	**Chorušice**	747,00	27,94	33,02	60,95	4	4	8	2
26	**Kostelec nad Labem**	1047,20	39,00	10,86	49,86	15	4	19	13
27	**Lhota**	795,54	0,00	0,01	0,01	6	1	7	3
28	**Lhotka**	482,81	13,87	0,68	14,55	8	1	9	2
29	**Libiš**	604,86	47,63	8,87	56,50	26	3	30	22
30	**Malý Újezd**	803,72	10,28	3,93	14,21	3	0	4	2
31	**Nová Ves**	477,05	16,91	8,37	25,28	6	3	9	8
32	**Nelahozeves**	340,69	32,06	7,95	40,01	26	4	29	20
33	**Čachovice**	148,84	0,68	0,00	0,68	25	7	32	24
34	**Chotětov**	938,51	51,11	6,61	57,72	7	1	7	3
35	**Kojovice**	458,93	0,00	0,00	0,00	2	1	3	1
36	**Kropáčova Vrutice**	334,70	12,02	4,06	16,08	8	2	10	4
37	**Lipnísk**	936,99	0,00	0,00	0,00	4	4	8	2
38	**Niměřice**	162,29	6,45	0,23	6,68	7	1	9	2
39	**Chrást**	495,12	2,10	0,00	2,10	11	2	12	5
40	**Krchleby**	829,03	17,35	1,65	19,00	6	1	8	5
41	**StarStarý Brázdim**	146,51	19,74	5,21	24,94	13	4	17	9
42	**Křenice**	402,88	72,93	23,09	96,02	20	6	26	4
43	**Mnichovice**	611,07	70,25	20,61	90,86	34	7	41	14
44	**Nehvizdy**	879,24	84,57	64,67	149,24	15	15	29	10
45	**Babice**	554,87	39,70	5,66	45,36	19	2	21	7
46	**Louňovice**	441,75	1,04	2,56	3,60	22	8	30	7
47	**Březí**	306,21	20,11	8,23	28,34	16	5	21	6
48	**Nová Ves**	194,03	1,43	0,00	1,43	22	1	23	8
49	**Říčany**	1003,71	219,65	15,84	235,49	47	2	49	27
50	**Černošice**	905,28	144,70	13,40	158,10	46	5	51	24
51	**Dobrovíz**	598,19	25,10	6,94	32,05	12	2	15	6
52	**Dolní Břežany**	502,79	99,97	34,24	134,21	26	10	36	13
53	**Drahelčice**	476,24	39,88	22,94	62,82	9	6	15	3
54	**Chýně**	499,26	11,02	17,43	28,44	22	7	29	6
55	**Lety**	323,70	29,50	0,18	29,68	39	4	43	19
56	**Lichoceves**	249,17	9,40	74,12	83,51	4	31	36	2
57	**Líšnice**	736,06	0,00	0,00	0,00	15	12	27	6
58	**Bratkovice**	180,72	0,76	0,03	0,79	8	7	16	5
59	**Křešín**	189,77	0,00	0,00	0,00	10	4	13	4
60	**Nalžovice**	367,35	17,51	0,47	17,97	7	1	8	1
61	**Branov**	1485,92	0,00	0,00	0,00	1	0	1	0
62	**Nový Dům**	631,54	7,18	1,83	9,01	4	1	5	2
63	**Ruda**	2167,45	35,03	18,89	53,91	3	1	4	2
64	**Brňany**	563,11	28,70	1,34	30,03	6	1	7	4
65	**Ctiněves**	549,03	5,16	6,12	11,28	4	3	7	1
66	**Chotěšov**	776,47	15,39	20,50	35,89	5	4	9	2
67	**Libotenice**	572,59	0,00	0,00	0,00	6	2	9	4
68	**Nová Ves**	612,75	0,52	1,39	1,90	2	1	3	1
69	**Rostoklaty**	325,59	15,04	1,04	16,09	9	2	11	5
70	**Nespeky**	193,26	29,73	0,98	30,71	33	4	37	3
71	**Lašovice**	379,86	15,09	1,24	16,33	7	1	8	3

Annex 16 Table of built-up area in selected municipalities, source: author

FID	NAME_PART	AREA [ha]	BTO_0 [ha]	BTO_1 [ha]	BTO_2 [ha]	BTO_3 [ha]	BTO_4 [ha]	BTO_5 [ha]	BTO [ha]	BTO _p [%]
1	**Benešov**	857,93	0,00	0,00	370,36	93,60	9,64	12,67	486,27	57
2	**Český Šternberk**	547,07	1,26	4,86	6,70	10,41	12,59	11,91	47,72	9
3	**Drahňovice**	807,09	0,05	0,00	0,85	6,53	0,30	2,03	9,75	1
4	**Lštění**	258,75	0,12	11,02	5,06	0,00	2,09	10,78	29,06	11
5	**Lešany**	678,61	0,71	0,00	16,89	0,01	0,00	8,09	25,70	4
6	**Bavoryně**	224,18	0,35	12,12	0,00	4,43	5,75	8,48	31,12	14
7	**Březová**	463,12	0,00	0,00	0,83	3,25	6,72	11,78	22,58	5
8	**Lhotka**	526,55	0,29	0,00	0,00	17,47	13,63	1,36	32,75	6
9	**Loděnice**	554,00	10,23	25,29	0,00	14,18	29,27	7,81	86,78	16
10	**Mořinka**	700,12	0,86	0,00	9,81	4,98	1,89	7,86	25,40	4
11	**Nižbor**	1282,60	15,36	12,13	0,00	0,00	21,11	29,90	78,51	6
12	**Blevice**	422,78	0,00	0,21	8,43	2,07	4,54	0,11	15,35	4
13	**Dřetovice**	540,82	0,00	0,62	6,74	0,16	4,79	9,50	21,81	4
14	**Lhota**	1171,33	0,02	2,43	20,83	12,44	0,00	0,02	35,74	3
15	**Lidice**	478,14	0,00	7,86	12,78	7,70	0,00	0,00	28,34	6
16	**Makotřasy**	429,63	0,00	14,25	9,20	6,93	0,37	0,04	30,79	7
17	**Neprobylice**	342,99	0,41	0,00	0,13	2,31	8,97	6,24	18,06	5
18	**Neuměřice**	566,18	0,09	0,00	10,28	0,34	12,65	7,03	30,39	5
19	**Břežany II**	911,98	0,05	45,55	1,58	0,00	4,86	0,00	52,05	6
20	**Dobřichov**	619,10	0,06	5,36	10,67	10,65	0,00	8,96	35,70	6
21	**Mrzky**	287,40	0,50	0,00	1,51	0,00	16,59	0,00	18,60	6
22	**Mělník**	2478,51	19,85	13,40	59,30	160,09	645,23	70,52	968,39	39
23	**Cítov**	1255,79	0,77	7,01	76,05	5,99	0,00	0,00	89,82	7
24	**Dřísy**	843,44	0,05	1,57	0,00	0,00	70,51	0,00	72,13	9
25	**Chorušice**	747,00	0,00	0,00	27,94	0,00	0,00	1,10	29,04	4
26	**Kostelec nad Labem**	1047,20	0,80	39,00	0,00	21,83	91,23	0,00	152,86	15
27	**Lhota**	795,54	6,20	0,00	0,00	0,00	40,45	0,00	46,65	6
28	**Lhotka**	482,81	2,67	0,00	13,87	0,21	9,60	12,24	38,59	8
29	**Libiš**	604,86	5,42	0,75	46,87	0,34	104,50	0,00	157,89	26
30	**Malý Újezd**	803,72	0,00	10,15	0,13	0,00	14,34	0,00	24,61	3
31	**Nová Ves**	477,05	4,80	8,97	7,94	5,21	2,38	1,07	30,37	6
32	**Nelahozeves**	340,69	0,34	15,81	16,26	3,17	5,08	46,66	87,31	26
33	**Čachovice**	148,84	0,00	0,68	0,00	9,73	27,12	0,00	37,53	25
34	**Chotětov**	938,51	12,22	51,11	0,00	0,01	0,00	0,00	63,34	7
35	**Kojovice**	458,93	0,00	0,00	0,00	5,21	2,67	0,00	7,89	2
36	**Kropáčova Vrutice**	334,70	1,50	10,03	1,99	5,42	6,47	1,91	27,32	8
37	**Lipnísk**	936,99	2,16	0,00	0,00	5,36	0,00	32,68	40,20	4
38	**Niměřice**	162,29	2,41	5,36	1,09	0,00	0,43	2,85	12,14	7
39	**Chrást**	495,12	0,00	0,00	2,10	0,00	28,08	22,33	52,51	11
40	**Krchleby**	829,03	0,00	15,25	2,10	25,19	7,88	1,91	52,33	6
41	**StarStarý Brázdim**	146,51	0,00	17,83	1,90	0,00	0,00	0,00	19,74	13
42	**Křenice**	402,88	0,19	64,60	8,33	2,69	0,00	3,86	79,67	20
43	**Mnichovice**	611,07	1,82	0,00	70,25	3,29	21,08	113,76	210,20	34
44	**Nehvizdy**	879,24	0,00	75,39	9,18	42,07	0,54	0,79	127,97	15
45	**Babice**	554,87	0,00	3,90	35,80	55,80	0,00	9,22	104,73	19
46	**Louňovice**	441,75	0,59	0,00	1,04	78,12	15,67	0,44	95,86	22
47	**Březí**	306,21	0,40	18,73	1,38	20,24	1,73	7,12	49,60	16
48	**Nová Ves**	194,03	0,00	0,00	1,43	42,06	0,10	0,00	43,59	22
49	**Říčany**	1003,71	1,01	194,27	25,39	150,09	79,51	18,16	468,43	47
50	**Černošice**	905,28	14,76	77,08	67,62	136,66	49,13	72,36	417,60	46
51	**Dobrovíz**	598,19	0,07	23,36	1,74	27,63	15,99	5,43	74,22	12
52	**Dolní Břežany**	502,79	1,60	99,97	0,00	25,44	5,62	0,00	132,62	26
53	**Drahelčice**	476,24	3,41	27,59	12,29	0,59	0,00	0,00	43,88	9
54	**Chýně**	499,26	14,06	7,91	3,11	63,35	20,34	2,74	111,51	22
55	**Lety**	323,70	1,47	28,39	1,11	26,85	19,94	50,03	127,79	39
56	**Lichoceves**	249,17	0,47	9,40	0,00	0,00	0,00	0,36	10,23	4
57	**Líšnice**	736,06	11,37	0,00	0,00	9,45	50,18	38,93	109,92	15
58	**Bratkovice**	180,72	0,00	0,00	0,76	12,43	1,52	0,28	14,99	8
59	**Křešín**	189,77	0,05	0,00	0,00	3,61	14,70	0,39	18,75	10
60	**Nalžovice**	367,35	3,22	0,00	17,51	0,11	0,73	4,40	25,97	7
61	**Branov**	1485,92	0,00	0,00	0,00	4,96	6,30	5,65	16,92	1
62	**Nový Dům**	631,54	0,00	0,86	6,32	8,86	6,77	1,07	23,87	4
63	**Ruda**	2167,45	0,21	1,83	33,20	18,40	6,53	0,00	60,17	3
64	**Brňany**	563,11	2,16	22,85	5,85	0,00	0,00	1,28	32,13	6
65	**Ctiněves**	549,03	2,33	0,29	4,87	3,82	9,78	2,86	23,95	4
66	**Chotěšov**	776,47	1,21	4,40	10,99	11,81	6,82	0,07	35,31	5
67	**Libotenice**	572,59	11,39	0,00	0,00	0,00	23,86	0,00	35,25	6
68	**Nová Ves**	612,75	0,18	0,52	0,00	3,27	0,12	8,77	12,86	2
69	**Rostoklaty**	325,59	0,00	0,27	14,78	0,00	14,02	0,00	29,06	9
70	**Nespeky**	193,26	5,89	26,82	2,91	0,00	3,51	25,03	64,15	33
71	**Lašovice**	379,86	1,74	8,68	6,41	3,09	0,16	4,81	24,90	7

Annex 17 Table of buildable area in selected municipalities, source: author

FID	NAME_PART	AREA [ha]	ZTO_0 [ha]	ZTO_1 [ha]	ZTO_2 [ha]	ZTO_3 [ha]	ZTO_4 [ha]	ZTO_5 [ha]	ZTO [ha]	ZTO _p [%]
1	**Benešov**	857,93	0,00	0,00	27,97	1,91	14,66	9,45	53,99	6
2	**Český Šternberk**	547,07	1,48	0,00	4,81	0,43	3,81	3,01	13,54	2
3	**Drahňovice**	807,09	0,00	0,00	0,20	2,10	0,30	1,01	3,60	0
4	**Lštění**	258,75	0,03	0,27	0,79	0,00	0,00	4,40	5,49	2
5	**Lešany**	678,61	2,43	0,00	62,01	0,80	2,68	10,45	78,36	12
6	**Bavoryně**	224,18	0,00	1,99	0,00	1,98	11,81	60,75	76,53	34
7	**Březová**	463,12	0,16	0,00	1,11	4,07	6,63	4,12	16,09	3
8	**Lhotka**	526,55	0,00	0,00	0,84	1,14	2,17	0,28	4,43	1
9	**Loděnice**	554,00	2,25	2,96	0,00	17,43	12,20	8,45	43,29	8
10	**Mořinka**	700,12	0,00	0,00	0,15	0,01	1,63	0,34	2,13	0
11	**Nižbor**	1282,60	1,82	0,82	0,00	0,00	15,13	8,91	26,67	2
12	**Blevice**	422,78	0,39	0,43	1,65	0,32	1,52	0,77	5,08	1
13	**Dřetovice**	540,82	0,07	0,00	4,19	0,00	4,48	1,01	9,75	2
14	**Lhota**	1171,33	0,00	1,10	12,29	9,17	0,00	0,00	22,56	2
15	**Lidice**	478,14	0,00	2,86	2,81	4,93	0,00	0,00	10,60	2
16	**Makotřasy**	429,63	0,00	7,89	5,88	0,00	0,00	0,00	13,77	3
17	**Neprobylice**	342,99	0,00	0,00	1,25	0,09	2,46	0,23	4,02	1
18	**Neuměřice**	566,18	0,00	0,00	2,11	0,29	1,14	0,00	3,54	1
19	**Břežany II**	911,98	0,00	5,51	0,00	0,00	0,99	0,00	6,50	1
20	**Dobřichov**	619,10	0,00	2,64	2,71	4,25	0,00	2,27	11,88	2
21	**Mrzky**	287,40	0,00	0,00	3,25	0,00	6,88	0,00	10,13	4
22	**Mělník**	2478,51	0,82	0,08	0,00	76,27	156,86	28,70	262,74	11
23	**Cítov**	1255,79	0,18	7,89	32,94	2,73	0,00	0,00	43,74	3
24	**Dřísy**	843,44	0,06	1,00	0,00	0,00	5,70	0,00	6,75	1
25	**Chorušice**	747,00	0,29	8,41	24,60	0,00	0,00	0,00	33,31	4
26	**Kostelec nad Labem**	1047,20	0,16	10,86	0,00	6,30	26,77	0,00	44,10	4
27	**Lhota**	795,54	0,00	0,01	0,00	0,00	7,53	0,00	7,54	1
28	**Lhotka**	482,81	0,51	0,00	0,68	0,00	3,21	1,41	5,81	1
29	**Libiš**	604,86	0,02	0,07	8,81	0,18	11,46	0,31	20,85	3
30	**Malý Újezd**	803,72	0,00	3,71	0,22	0,00	0,00	0,00	3,93	0
31	**Nová Ves**	477,05	1,34	4,33	4,04	3,10	0,34	0,31	13,46	3
32	**Nelahozeves**	340,69	0,01	1,43	6,52	0,50	0,00	3,82	12,28	4
33	**Čachovice**	148,84	0,00	0,00	0,00	0,61	9,50	0,00	10,11	7
34	**Chotětov**	938,51	0,01	6,61	0,00	0,00	0,00	0,00	6,62	1
35	**Kojovice**	458,93	0,00	0,00	0,00	5,99	0,48	0,00	6,47	1
36	**Kropáčova Vrutice**	334,70	0,16	3,20	0,85	0,58	0,43	0,00	5,24	2
37	**Lipnísk**	936,99	4,60	0,00	0,00	15,66	0,09	13,31	33,66	4
38	**Niměřice**	162,29	1,55	0,23	0,01	0,00	0,00	0,00	1,78	1
39	**Chrást**	495,12	0,00	0,00	0,00	0,00	8,39	0,30	8,69	2
40	**Krchleby**	829,03	0,00	1,19	0,47	6,20	0,00	2,70	10,56	1
41	**StarStarý Brázdim**	146,51	0,00	2,16	3,05	0,00	0,00	0,00	5,21	4
42	**Křenice**	402,88	0,00	17,13	5,96	0,24	0,00	1,37	24,70	6
43	**Mnichovice**	611,07	0,13	0,00	20,61	0,77	5,80	14,40	41,70	7
44	**Nehvizdy**	879,24	0,00	51,19	13,48	60,98	0,00	3,26	128,91	15
45	**Babice**	554,87	1,03	0,00	5,66	3,93	0,00	0,03	10,65	2
46	**Louňovice**	441,75	0,32	0,00	2,56	25,52	6,12	0,99	35,52	8
47	**Březí**	306,21	0,85	8,17	0,06	3,49	0,71	0,96	14,23	5
48	**Nová Ves**	194,03	0,00	0,00	0,00	1,81	0,00	0,00	1,81	1
49	**Říčany**	1003,71	0,01	15,84	0,00	4,12	1,24	0,65	21,87	2
50	**Černošice**	905,28	1,93	1,72	11,68	4,10	25,47	0,83	45,74	5
51	**Dobrovíz**	598,19	0,00	6,94	0,00	3,84	1,90	2,07	14,76	2
52	**Dolní Břežany**	502,79	0,00	34,24	0,00	9,16	4,38	0,00	47,79	10
53	**Drahelčice**	476,24	4,38	17,59	5,36	2,29	0,00	0,00	29,62	6
54	**Chýně**	499,26	1,95	15,47	1,95	12,20	3,77	0,00	35,34	7
55	**Lety**	323,70	3,77	0,18	0,00	3,63	4,33	1,06	12,98	4
56	**Lichoceves**	249,17	3,14	72,78	1,33	0,00	0,00	1,04	78,29	31
57	**Líšnice**	736,06	0,98	0,00	0,00	0,96	42,10	41,85	85,88	12
58	**Bratkovice**	180,72	0,00	0,00	0,03	13,13	0,02	0,25	13,43	7
59	**Křešín**	189,77	0,18	0,00	0,00	1,18	1,82	3,62	6,80	4
60	**Nalžovice**	367,35	0,27	0,00	0,47	1,27	0,70	0,84	3,54	1
61	**Branov**	1485,92	0,00	0,00	0,00	1,51	1,02	0,56	3,09	0
62	**Nový Dům**	631,54	0,00	0,00	1,83	3,50	2,63	0,44	8,40	1
63	**Ruda**	2167,45	0,03	2,80	16,09	2,27	4,42	0,00	25,60	1
64	**Brňany**	563,11	4,16	1,31	0,03	0,00	0,00	0,74	6,24	1
65	**Ctiněves**	549,03	1,43	3,93	2,19	1,47	3,99	1,85	14,85	3
66	**Chotěšov**	776,47	1,39	4,91	15,59	2,66	9,99	0,00	34,55	4
67	**Libotenice**	572,59	1,30	0,00	0,00	0,00	12,44	0,00	13,74	2
68	**Nová Ves**	612,75	0,00	1,39	0,00	1,54	0,06	3,60	6,59	1
69	**Rostoklaty**	325,59	0,00	0,10	0,94	0,00	6,59	0,00	7,63	2
70	**Nespeky**	193,26	0,00	0,98	0,00	0,00	6,16	0,00	7,14	4
71	**Lašovice**	379,86	0,75	0,38	0,86	2,35	0,00	0,63	4,97	1

Annex 18 Total artificialization including built-up and buildable area in selected municipalities, source: author

FID	NAME_PART	AREA [ha]	TO_0 [ha]	TO_1 [ha]	TO_2 [ha]	TO_3 [ha]	TO_4 [ha]	TO_5 [ha]	TO [ha]	TO _p [%]
1	**Benešov**	857,93	0,00	0,00	398,33	95,52	24,30	22,11	540,26	0,00
2	**Český Šternberk**	547,07	2,74	4,86	11,51	10,84	16,40	14,92	61,26	2,74
3	**Drahňovice**	807,09	0,05	0,00	1,04	8,62	0,60	3,04	13,35	0,05
4	**Lštění**	258,75	0,15	11,29	5,85	0,00	2,09	15,17	34,55	0,15
5	**Lešany**	678,61	3,14	0,00	78,91	0,80	2,68	18,54	104,07	3,14
6	**Bavoryně**	224,18	0,35	14,11	0,00	6,42	17,55	69,24	107,66	0,35
7	**Březová**	463,12	0,16	0,00	1,94	7,33	13,35	15,89	38,67	0,16
8	**Lhotka**	526,55	0,29	0,00	0,84	18,61	15,80	1,64	37,18	0,29
9	**Loděnice**	554,00	12,48	28,25	0,00	31,61	41,47	16,26	130,07	12,48
10	**Mořinka**	700,12	0,86	0,00	9,97	4,99	3,51	8,20	27,53	0,86
11	**Nižbor**	1282,60	17,18	12,95	0,00	0,00	36,23	38,81	105,17	17,18
12	**Blevice**	422,78	0,39	0,63	10,08	2,39	6,06	0,88	20,43	0,39
13	**Dřetovice**	540,82	0,07	0,62	10,92	0,16	9,27	10,51	31,55	0,07
14	**Lhota**	1171,33	0,02	3,52	33,12	21,61	0,00	0,02	58,30	0,02
15	**Lidice**	478,14	0,00	10,72	15,59	12,63	0,00	0,00	38,93	0,00
16	**Makotřasy**	429,63	0,00	22,14	15,08	6,93	0,37	0,04	44,56	0,00
17	**Neprobylice**	342,99	0,41	0,00	1,38	2,40	11,43	6,47	22,08	0,41
18	**Neuměřice**	566,18	0,09	0,00	12,39	0,63	13,79	7,03	33,92	0,09
19	**Břežany II**	911,98	0,05	51,06	1,58	0,00	5,86	0,00	58,55	0,05
20	**Dobřichov**	619,10	0,06	8,01	13,38	14,89	0,00	11,23	47,57	0,06
21	**Mrzky**	287,40	0,50	0,00	4,77	0,00	23,47	0,00	28,73	0,50
22	**Mělník**	2478,51	20,67	13,48	59,31	236,35	802,09	99,22	1231,12	20,67
23	**Cítov**	1255,79	0,95	14,90	108,98	8,73	0,00	0,00	133,56	0,95
24	**Dřísy**	843,44	0,10	2,57	0,00	0,00	76,21	0,00	78,88	0,10
25	**Chorušice**	747,00	0,29	8,41	52,54	0,00	0,00	1,10	62,35	0,29
26	**Kostelec nad Labem**	1047,20	0,96	49,86	0,00	28,13	118,00	0,00	196,95	0,96
27	**Lhota**	795,54	6,21	0,01	0,00	0,00	47,97	0,00	54,19	6,21
28	**Lhotka**	482,81	3,18	0,00	14,55	0,21	12,82	13,64	44,40	3,18
29	**Libiš**	604,86	5,44	0,82	55,68	0,53	115,97	0,31	178,75	5,44
30	**Malý Újezd**	803,72	0,00	13,86	0,35	0,00	14,34	0,00	28,55	0,00
31	**Nová Ves**	477,05	6,14	13,30	11,98	8,30	2,72	1,38	43,82	6,14
32	**Nelahozeves**	340,69	0,35	17,24	22,77	3,67	5,08	50,47	99,59	0,35
33	**Čachovice**	148,84	0,00	0,68	0,00	10,34	36,62	0,00	47,63	0,00
34	**Chotětov**	938,51	12,22	57,72	0,00	0,01	0,00	0,00	69,96	12,22
35	**Kojovice**	458,93	0,00	0,00	0,00	11,21	3,15	0,00	14,36	0,00
36	**Kropáčova Vrutice**	334,70	1,66	13,24	2,84	6,00	6,90	1,91	32,56	1,66
37	**Lipnísk**	936,99	6,76	0,00	0,00	21,02	0,09	45,99	73,86	6,76
38	**Niměřice**	162,29	3,96	5,59	1,09	0,00	0,43	2,85	13,92	3,96
39	**Chrást**	495,12	0,00	0,00	2,10	0,00	36,47	22,63	61,21	0,00
40	**Krchleby**	829,03	0,00	16,43	2,57	31,39	7,88	4,61	62,89	0,00
41	**StarStarý Brázdim**	146,51	0,00	19,99	4,95	0,00	0,00	0,00	24,94	0,00
42	**Křenice**	402,88	0,19	81,73	14,30	2,93	0,00	5,23	104,37	0,19
43	**Mnichovice**	611,07	1,95	0,00	90,86	4,06	26,88	128,16	251,90	1,95
44	**Nehvizdy**	879,24	0,00	126,57	22,66	103,05	0,54	4,06	256,88	0,00
45	**Babice**	554,87	1,03	3,90	41,46	59,74	0,00	9,25	115,38	1,03
46	**Louňovice**	441,75	0,91	0,00	3,60	103,64	21,79	1,43	131,38	0,91
47	**Březí**	306,21	1,24	26,90	1,44	23,72	2,44	8,08	63,83	1,24
48	**Nová Ves**	194,03	0,00	0,00	1,43	43,87	0,10	0,00	45,39	0,00
49	**Říčany**	1003,71	1,03	210,10	25,39	154,22	80,76	18,81	490,30	1,03
50	**Černošice**	905,28	16,69	78,80	79,30	140,76	74,60	73,19	463,34	16,69
51	**Dobrovíz**	598,19	0,07	30,30	1,74	31,47	17,89	7,50	88,97	0,07
52	**Dolní Břežany**	502,79	1,60	134,21	0,00	34,60	10,00	0,00	180,40	1,60
53	**Drahelčice**	476,24	7,79	45,18	17,64	2,89	0,00	0,00	73,50	7,79
54	**Chýně**	499,26	16,00	23,38	5,06	75,55	24,12	2,74	146,85	16,00
55	**Lety**	323,70	5,25	28,58	1,11	30,48	24,27	51,09	140,77	5,25
56	**Lichoceves**	249,17	3,60	82,18	1,33	0,00	0,00	1,40	88,52	3,60
57	**Líšnice**	736,06	12,34	0,00	0,00	10,41	92,28	80,78	195,80	12,34
58	**Bratkovice**	180,72	0,00	0,00	0,79	25,55	1,54	0,53	28,42	0,00
59	**Křešín**	189,77	0,23	0,00	0,00	4,79	16,51	4,01	25,54	0,23
60	**Nalžovice**	367,35	3,49	0,00	17,97	1,38	1,43	5,24	29,52	3,49
61	**Branov**	1485,92	0,00	0,00	0,00	6,47	7,32	6,22	20,00	0,00
62	**Nový Dům**	631,54	0,00	0,86	8,15	12,36	9,40	1,50	32,27	0,00
63	**Ruda**	2167,45	0,24	4,63	49,28	20,67	10,95	0,00	85,77	0,24
64	**Brňany**	563,11	6,31	24,16	5,88	0,00	0,00	2,02	38,37	6,31
65	**Ctiněves**	549,03	3,76	4,22	7,06	5,29	13,77	4,71	38,81	3,76
66	**Chotěšov**	776,47	2,60	9,31	26,59	14,47	16,81	0,07	69,85	2,60
67	**Libotenice**	572,59	12,69	0,00	0,00	0,00	36,29	0,00	48,98	12,69
68	**Nová Ves**	612,75	0,18	1,90	0,00	4,82	0,18	12,37	19,45	0,18
69	**Rostoklaty**	325,59	0,00	0,37	15,72	0,00	20,61	0,00	36,70	0,00
70	**Nespeky**	193,26	5,89	27,80	2,91	0,00	9,67	25,03	71,30	5,89
71	**Lašovice**	379,86	2,49	9,06	7,27	5,44	0,16	5,44	29,87	2,49

Annex 19 Table of Population and Commuting depending factors, source: author, information on data collection are described in chapter 5. Methodology

FID	NAME_PART	POP [inh]	DEN [inh/km²]	COM [inh]	DISC [km]	TIMC [min]	TIMP [min]
1	**Benešov**	16264,00	33,45	923,00	46,00	38,00	53,82
2	**Český Šternberk**	157,00	3,29	11,00	53,00	37,00	121,36
3	**Drahňovice**	71,00	7,28	4,00	52,00	36,00	128,80
4	**Lštění**	408,00	14,04	35,00	37,00	30,00	54,58
5	**Lešany**	695,00	27,04	52,00	43,00	49,00	91,64
6	**Bavoryně**	212,00	6,81	11,00	45,00	35,00	64,11
7	**Březová**	271,00	12,00	11,00	52,00	45,00	101,44
8	**Lhotka**	309,00	9,43	9,00	54,00	47,00	15,71
9	**Loděnice**	1717,00	19,79	182,00	27,00	26,00	128,80
10	**Mořinka**	142,00	5,59	10,00	30,00	41,00	63,33
11	**Nižbor**	1885,00	24,01	96,00	41,00	42,00	60,53
12	**Blevice**	285,00	18,56	0,00	33,00	39,00	71,96
13	**Dřetovice**	466,00	21,37	32,00	28,00	31,00	70,11
14	**Lhota**	596,00	16,68	30,00	39,00	40,00	65,68
15	**Lidice**	427,00	15,07	46,00	25,00	26,00	29,69
16	**Makotřasy**	373,00	12,12	47,00	23,00	24,00	48,12
17	**Neprobylice**	134,00	7,42	6,00	44,00	38,00	67,12
18	**Neuměřice**	423,00	13,92	20,00	45,00	36,00	62,19
19	**Břežany II**	653,00	12,55	71,00	36,00	40,00	60,58
20	**Dobřichov**	763,00	21,38	79,00	65,00	52,00	90,91
21	**Mrzky**	176,00	9,46	15,00	39,00	42,00	55,12
22	**Mělník**	19599,00	20,24	848,00	48,00	39,00	48,06
23	**Cítov**	1162,00	12,94	38,00	43,00	36,00	74,71
24	**Dřísy**	897,00	12,44	45,00	40,00	39,00	54,58
25	**Chorušice**	451,00	15,53	11,00	58,00	58,00	91,64
26	**Kostelec nad Labem**	3616,00	23,66	335,00	27,00	30,00	48,12
27	**Lhota**	457,00	9,80	34,00	39,00	35,00	53,96
28	**Lhotka**	310,00	8,03	11,00	44,00	46,00	58,12
29	**Libiš**	2067,00	13,09	145,00	28,00	26,00	74,71
30	**Malý Újezd**	942,00	38,27	28,00	39,00	39,00	59,91
31	**Nová Ves**	1149,00	37,84	78,00	34,00	26,00	50,55
32	**Nelahozeves**	1804,00	20,66	190,00	35,00	35,00	57,35
33	**Čachovice**	849,00	22,62	20,00	54,00	47,00	94,35
34	**Chotětov**	848,00	13,39	25,00	56,00	43,00	79,61
35	**Kojovice**	63,00	7,99	4,00	57,00	51,00	63,15
36	**Kropáčova Vrutice**	338,00	12,37	28,00	57,00	50,00	53,63
37	**Lipnísk**	308,00	7,66	8,00	52,00	43,00	13,46
38	**Niměřice**	312,00	25,70	1,00	67,00	52,00	96,29
39	**Chrást**	522,00	9,94	53,00	46,00	40,00	53,96
40	**Krchleby**	744,00	14,22	12,00	67,00	52,00	106,15
41	**StarStarý Brázdim**	654,00	33,14	127,00	19,00	30,00	29,52
42	**Křenice**	599,00	7,52	86,00	28,00	29,00	94,35
43	**Mnichovice**	3180,00	15,13	394,00	29,00	29,00	145,00
44	**Nehvizdy**	2166,00	16,93	417,00	32,00	28,00	25,64
45	**Babice**	843,00	8,05	129,00	30,00	34,00	24,19
46	**Louňovice**	950,00	9,91	107,00	34,00	37,00	70,11
47	**Březí**	499,00	10,06	76,00	28,00	31,00	20,12
48	**Nová Ves**	674,00	15,46	172,00	24,00	24,00	28,39
49	**Říčany**	14003,00	29,89	1607,00	24,00	23,00	25,15
50	**Černošice**	6849,00	16,40	1117,00	20,00	27,00	22,58
51	**Dobrovíz**	548,00	7,38	57,00	23,00	26,00	29,69
52	**Dolní Břežany**	3696,00	27,87	663,00	20,00	24,00	13,46
53	**Drahelčice**	559,00	12,74	115,00	23,00	25,00	19,35
54	**Chýně**	2006,00	17,99	394,00	22,00	28,00	15,71
55	**Lety**	1408,00	11,02	239,00	30,00	38,00	95,54
56	**Lichoceves**	374,00	36,56	63,00	19,00	28,00	90,91
57	**Líšnice**	621,00	5,65	95,00	29,00	28,00	19,35
58	**Bratkovice**	308,00	20,55	0,00	68,00	54,00	87,94
59	**Křešín**	112,00	5,97	0,00	61,00	53,00	91,29
60	**Nalžovice**	565,00	21,75	17,00	66,00	61,00	84,25
61	**Branov**	202,00	11,94	0,00	60,00	60,00	142,67
62	**Nový Dům**	139,00	5,82	9,00	55,00	50,00	85,63
63	**Ruda**	718,00	11,93	45,00	49,00	38,00	52,06
64	**Brňany**	409,00	12,73	0,00	58,00	45,00	85,15
65	**Ctiněves**	315,00	13,15	9,00	43,00	38,00	96,19
66	**Chotěšov**	461,00	13,06	8,00	60,00	46,00	111,28
67	**Libotenice**	441,00	12,51	8,00	61,00	47,00	96,19
68	**Nová Ves**	105,00	8,16	58,00	58,00	52,00	81,56
69	**Rostoklaty**	446,00	15,35	48,00	34,00	36,00	36,66
70	**Nespeky**	669,00	10,43	56,00	41,00	33,00	67,46
71	**Lašovice**	133,00	5,34	6,00	68,00	64,00	121,36

Annex 20 Table of factors retrieved by Proximity ArcGIS tool, source: author

FID	NAME_PART	DIS [km]	DIS2 [km]	NR [km]	NHE [km]]	NME [km]	NS [km]	PROX [m]
1	**Benešov**	21,58	33,79	0,95	11,69	0,98	0,42	0
2	**Český Šternberk**	27,82	42,46	1,93	2,27	2,27	0,31	19
3	**Drahňovice**	25,73	40,30	1,82	2,32	2,32	2,63	0
4	**Lštění**	15,25	28,51	0,90	5,04	1,16	1,55	0
5	**Lešany**	12,60	23,65	11,42	13,18	11,42	2,41	141
6	**Bavoryně**	25,83	40,00	0,46	0,69	0,69	1,91	4
7	**Březová**	30,19	44,51	3,22	4,14	4,14	6,86	0
8	**Lhotka**	26,12	41,15	7,80	8,05	8,05	2,19	173
9	**Loděnice**	6,88	21,03	0,26	0,51	0,51	0,64	0
10	**Mořinka**	4,72	19,56	6,41	6,59	6,59	2,55	0
11	**Nižbor**	15,67	31,11	6,55	6,75	6,75	0,20	209
12	**Blevice**	9,04	21,64	4,34	5,43	5,43	2,35	20
13	**Dřetovice**	6,89	20,86	1,00	1,96	1,96	2,44	0
14	**Lhota**	13,79	31,10	3,12	5,18	5,18	5,98	0
15	**Lidice**	3,33	19,89	0,41	2,32	2,32	4,70	0
16	**Makotřasy**	2,66	18,37	0,54	0,76	0,76	3,44	8
17	**Neprobylice**	21,25	36,86	0,86	3,82	3,82	4,37	15
18	**Neuměřice**	12,48	25,18	2,95	7,61	3,07	2,04	0
19	**Břežany II**	4,12	21,44	2,34	5,68	2,65	4,57	53
20	**Dobřichov**	22,62	39,75	3,77	5,48	3,80	1,27	16
21	**Mrzky**	6,40	22,67	2,87	10,55	2,95	5,38	0
22	**Mělník**	16,78	29,11	0,19	13,07	0,90	0,98	6
23	**Cítov**	21,26	32,70	3,43	9,10	3,84	3,15	0
24	**Dřísy**	9,43	22,62	6,04	6,21	6,21	1,29	0
25	**Chorušice**	23,43	36,59	4,65	15,18	5,01	5,51	3
26	**Kostelec nad Labem**	4,68	17,51	6,35	8,18	6,44	4,02	9
27	**Lhota**	7,82	21,38	4,40	4,73	4,73	1,64	0
28	**Lhotka**	20,10	32,80	4,57	17,94	4,57	1,27	21
29	**Libiš**	9,45	21,85	0,89	9,08	1,64	1,07	0
30	**Malý Újezd**	13,69	26,54	0,03	14,61	1,96	4,19	47
31	**Nová Ves**	17,70	28,49	0,40	0,50	0,50	3,25	27
32	**Nelahozeves**	12,70	23,93	1,18	4,67	3,51	1,47	0
33	**Čachovice**	25,43	40,19	0,86	7,58	1,05	0,17	5
34	**Chotětov**	22,90	36,37	1,92	5,22	1,92	0,49	0
35	**Kojovice**	15,45	28,48	3,12	9,36	3,65	3,61	0
36	**Kropáčova Vrutice**	20,85	33,76	2,07	9,48	2,77	1,37	0
37	**Lipníşk**	22,35	37,01	3,10	5,98	3,35	2,49	104
38	**Niměřice**	28,99	42,23	3,15	5,78	3,69	5,49	0
39	**Chrást**	12,05	29,34	0,91	3,60	3,60	2,72	0
40	**Krchleby**	25,82	42,04	0,11	13,62	0,11	2,76	0
41	**StarStarý Brázdim**	2,21	14,98	5,84	6,17	6,17	4,53	0
42	**Křenice**	0,00	14,07	3,31	3,52	3,52	4,00	0
43	**Mnichovice**	6,50	21,15	1,44	2,46	2,46	3,05	6
44	**Nehvizdy**	2,53	18,27	0,31	1,98	1,98	2,85	0
45	**Babice**	2,50	18,11	1,97	4,14	2,38	4,19	0
46	**Louňovice**	6,72	22,40	0,44	7,37	1,55	7,20	2
47	**Březí**	0,93	16,45	2,38	2,77	2,77	3,01	6
48	**Nová Ves**	3,46	16,58	2,85	5,02	3,09	2,30	0
49	**Říčany**	0,00	14,11	0,87	0,99	0,99	0,51	46
50	**Černošice**	0,00	13,33	2,89	3,10	3,10	3,48	0
51	**Dobrovíz**	0,00	16,22	1,58	1,58	1,58	2,06	0
52	**Dolní Břežany**	0,00	10,12	1,66	2,35	2,35	4,08	27
53	**Drahelčice**	3,40	18,37	0,53	0,74	0,74	1,80	117
54	**Chýně**	0,26	15,90	2,27	3,81	3,81	2,70	0
55	**Lety**	5,37	21,10	4,53	4,80	4,80	1,04	86
56	**Lichoceves**	1,33	14,44	3,17	3,38	3,38	0,81	142
57	**Líšnice**	4,74	20,41	1,20	2,33	2,33	3,57	27
58	**Bratkovice**	32,75	48,56	4,81	7,40	5,25	0,24	0
59	**Křešín**	30,93	46,23	8,01	8,29	8,29	3,66	53
60	**Nalžovice**	26,60	41,04	3,20	16,73	6,13	6,28	0
61	**Branov**	27,48	43,34	14,83	14,88	14,88	2,57	0
62	**Nový Dům**	27,15	44,43	8,63	9,48	8,84	3,25	0
63	**Ruda**	24,13	41,59	3,17	3,39	3,39	1,92	19
64	**Brňany**	38,43	49,66	3,21	5,21	3,53	1,11	17
65	**Ctiněves**	23,97	34,65	3,27	6,05	6,05	4,97	0
66	**Chotěšov**	36,40	48,11	2,84	6,04	6,04	0,96	17
67	**Libotenice**	36,44	47,23	5,38	5,49	5,49	1,90	12
68	**Nová Ves**	32,75	49,55	3,76	4,76	3,78	6,50	1
69	**Rostoklaty**	4,80	22,04	0,27	7,69	1,43	4,57	29
70	**Nespeky**	14,17	26,15	1,85	7,12	1,93	2,98	0
71	**Lašovice**	30,69	47,57	12,98	14,15	13,01	1,47	0