SOIL SEALING IN INDIVIDUAL NUTS 3 REGIONS IN THE CZECH REPUBLIC

[Zastavování území v jednotlivých regionech NUTS 3 v České republice]

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Abstract: The use of an agricultural land in the Czech Republic is one of the increasingly topical topics. In recent years, an agricultural land in the country has been steadily declining and becoming a valuable natural resource. In recent years, agricultural land has given way mainly to construction activities, most often to the construction of development projects on the outskirts of larger towns and the construction of new economic entities. In this case, we are talking about inefficient land use, because in the case of suburbanization, the land is stopped on greenfields. A possible solution is to find the effective use of abandoned buildings and areas in the given places, the so-called brownfields, which are supported in recent years by individual ministries in the Czech Republic, which deal with the situation within the usability of individual grant titles. The presented article aims is to determine the impact of soil sealing on an agricultural land in individual NUTS 3 regions in the Czech Republic. For the purposes of the article, data on the state of the soil were obtained through the Czech Surveying and Cadastre Office. Other secondary data for the needs of the article were obtained through the Czech Statistical Office.

Introduction

The loss of agricultural land is, more pronounced today than in previous decades. Nowadays the soil is becoming a valuable natural resource (factor) around the world, with an emphasis on minimizing its loss. In recent years, the land has often given way to construction activities, including the construction of logistics center, development projects and commercial housing in a suburban area. In today's global world, the construction of industrial and commercial zones on greenfields is becoming a major threat, which over time will not withstand the pressure and leave the market due to increasing competition. This situation then led to the degradation of the soil fund. When looking for new potential opportunities, business entities focus primarily on areas that are logistically interconnected and close to large agglomerations.

This situation is also evident in all regions of the Czech Republic. Potential business entities usually build their intentions mainly near large agglomerations, which have effective interconnections. The given subjects are looking for suitable land and premises, which would be easily accessible and on the other hand, the costs of their construction were at an appropriate level. In a given country, the differences between individual regions increase. Business entities often neglect the possibility of construction on the so-called brownfields, which nowadays often occur mainly in urbanized zones. Abandoned buildings and areas may already have a secure infrastructure and the state and the EU offer various subsidy titles, which are aimed at their regeneration or reclamation. Abandoned buildings and sites can be a potential way to prevent land loss and degradation. Agricultural land should be treated with caution. The motivation for writing the paper is to find out the fact about the state of agricultural land in individual regions in the Czech Republic and to find out whether the variables listed in this paper below, they have some dependence on each other.

The presented article aims is to determine the impact of soil sealing on agricultural land in individual NUTS 3 regions in the Czech Republic. The presented article is conceived as follows, where the Introduction is followed by another chapter, Theoretical background of the issue, where a literary search of domestic and foreign authors is performed. The third chapter acquaints with the chosen methodological procedure of the article, which is focused mainly on performing correlation analysis, where the results are presented in the following chapter. In the end, the Conclusion is drafted, where the most important conclusions of the article are published.

1 Literature review

Land use and land change belong these days and times between the main engines of global change (Lambin and Geist 2006). Growing demand for food triggered rapid agricultural expansion, the loss of forests, pastures, and wetlands (Meyer and Turner 1992, Ramankutty and Foley 1999). Changing the use of agricultural land is now becoming a common process in many parts of the world as a result of trade, socio-economic shocks, institutional structures and land-use policies (Gellrich et al. 2007, Haddway et al. 2014, Meyfroidt et al. 2016, Müller et al. 2009). Agricultural land often supports a range of basic ecosystem and social services (Gardi et al. 2015). Today, conservationists and food security advocates see the loss of farmland near urban areas as a major problem (Godfray et al. 2010). Towns represent both opportunities and challenges to the increasing concentration of people, wealth, and consumption (Baabou et al. 2017).

Urbanisation and growing global demand for biofuels, foods and feeding stuffs are causing conflict and land use at the expense of the ecosystem services that come from them (Bringezu et al. 2012, UNEP 2014). Urbanisation is a particularly disruptive form of land transformation mainly on a bona fide agricultural or farmland (Imhoff et al. 2004). Due to the rapid urbanization in the developing countries, metropolitan regions are experiencing deterioration of the natural environment (Das 2017, Osman et al. 2018). This urbanization has led to unprecedented land use and land cover changes, in and around the towns. Moreover, the rapid urbanization has resulted in a significant loss of agricultural land, particularly around the megacities (Smidt et al. 2018). Current land, as taken as a result of urban development throughout Europe seems to be a threat to sustainable land use (Henning et al. 2015). Soil sealing connected to urbanisation is perceived to be one of the most pressing environmental protection themes in the European Union (EU), where no positive trends in land management improvement are visible (EEA 2015). Urban and infrastructure development often takes place in areas of high-quality agricultural land with the consequence of an irreversible loss of EU agricultural productive capacity (European Commission 2012).

The rapid increase in global population reflects the dynamic development of civilization (Parry at al. 2018a, Zambon et al. 2019), which creates unprecedented demand for land serving other purposes than agricultural or forest production (Bradbury et al. 1996). Bisht and Kothyari (2001); Helmer (2004); Munsi et al. (2012) demonstrated that farmland and forest resources are being depleted around the world. Green development in urban areas is a major problem these days because the commercial construction is at the forefront on "green areas" (Benfield et al. 1999), where construction on greenfield sites is primarily the focus. In today's global world, the construction of industrial and business zones on greenfield sites are becoming a major threat and over time, when the businesses in question cannot withstand competitive pressure and exit the market. In this case, brownfields, which are not so interesting for economic actors, they can create and can have negative effects on the environment, the health of the population and, last but not least, the effect on the development of the region (Skrabal 2019a). According to

Tureckova et al. (2018), soil degradation is one of the most important environmental challenges facing our society in recent times. According to data from the European Environment Agency, the residential area and construction sites in the 28 countries of the European Union grow around 100,000 hectares of land every year. Sustainable land use is considered to be one of the largest environmental threats in the European Union in the context of economic development. The gradual loss of quality agricultural land by soil sealing significantly affects agricultural production capacity (Vejchodska and Pelucha 2019). Agricultural land often gives way to construction activities, leading to the degradation of land resources almost all over the world (Skrabal 2020b).

The following laws are taken into account in the situation regarding the efficient use of agricultural land in the Czech Republic. It is the choice of laws that are taken as the most important. The main legal regulations concerning soil protection in the Czech Republic are: Act No. 334/1992 Coll., On the protection of agricultural land, as amended. The agricultural land fund is the basic natural wealth of our country, the fund is an irreplaceable means of production enabling agricultural production and it is one of the main components of the environment. Another important law is: Act No. 183/2006 Coll., On Spatial Planning and Building Regulations (Building Act), as amended. This law regulates the matters of urban planning in particular objectives and tasks of spatial planning, the system of spatial planning, spatial planning tool, evaluation of impacts on sustainable development of the territory, deciding the area, the possibility of a merger procedures under this law practices assessment, projects on the environment, conditions for construction, territorial development and for the preparation of public infrastructure, records of spatial planning activities and qualification requirements for spatial planning activities. In particular, the extent of soil sealing, and the location defined in the spatial planning can have a major impact on soil degradation (especially Soil Sealing). Among other laws, the author of the article states: Act No. 17/1992 Coll., On the Environment, as amended; Act No. 289/1995 Coll., On Forests and on Amendments to Certain Acts (Forest Act), as amended; Act No. 139/2002 Coll., On Land Adjustments and Land Offices and on the Amendment of Act No. 229/1991 Coll., On the Adjustment of Ownership Relations to Land and Other Agricultural Property, as amended; Act No. 252/1997 Coll., On Agriculture, as amended; Act No. 89/2012 Coll., Civil Code, as amended, and others.

2 Data

The second chapter focuses on the data contained in the post. The period analysed was from 2010 to 2019. For the purposes of the article, data within the Czech Republic were divided into the county level (NUTS 3, 3rd level of the region according to Nomenclature of Territorial Units for Statistics of the EU). The situation concerning the state of agricultural land and the development of buildings in the country was obtained through the Czech Bureau of Land Survey and Land Registry (hereinafter referred to as 'CUZK'). Data on the state of economic operators for the period was obtained through the Czech Statistical Office (CSO). In the figure below is shown the division of the individual regions in a given country. The division of the individual regions in a given country is shown in the figure below (Figure 1).

Figure 1: NUTS 3 Regions in the Czech Republic

Source: CUZK, own processing

Within the researched issues, the author of the thesis, below focuses on the area of regions at the NUTS 3 level and the development of the population in regions. Due to the character of the capital city of Prague, the data contained in this chapter and results in the fourth chapter (Results) are incorporated into the data within the Central Bohemian Region. The table below (Table 1) pays attention to the area of individual regions at the regional level in the Czech Republic.

Table 1: Area of individual NUTS 3 regions in the Czech Republic (in ha)

Prague and Central Bohemian Region	1,151,100	**Pardubice Region**	451,900
South Bohemian Region	1,005,700	**Vysočina Region**	679,600
Plzeň Region	756,100	**South Moravian Region**	718,800
Karlovy Vary Region	331,400	**Olomouc Region**	526,700
Ústí nad Labem Region	533,500	**Zlin Region**	396,400
Liberec Region	316,300	**Moravian-Silesian Region**	542,700
Hradec Králové Region	475,900		

Source: CUZK, own processing

In the next table (Table 2), the author of the article focuses on the development of the population in the given regions at the NUTS 3 level within the time period (2010 - 2019). Within the given values, we determine a certain migration of individual inhabitants between the given regions. From this point of view, it is clear that larger regions, which have quality infrastructure and transport accessibility, more working conditions, quality of living, the population is growing. There are regions where there is a noticeable outflow of labour and thus a lesser interest of business entities in the given regions to start their business activities, as they are not attractive for the given business entities of the given region. It is important to note that the regions at the NUTS 3 level are further divided into lower territorial units (MEC) and therefore it is appropriate not to comprehensively take into account the issue of the regions as a whole, but to take into account the situation, when there are certain differences between the region at the level of lower territorial units. As mentioned above, the table below deals with the development of the population in each regions. From the given table it is then clear that most of the population is in the capital city of Prague and the Central Bohemian Region, further Moravian-Silesian and South Moravian Region. For a better overview of dwellings or depopulations within the given regions (NUTS 3), attention is paid to Table 3, which is given below.

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Table 2: Population in individual NUTS 3 regions in the Czech Republic (2010-2019)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Prague and Central Bohemian Region	2,522,136	2,521,009	2,538,596	2,545,537	2,574,378	2,594,325	2,619,490	2,647,308	2,677,964	2,709,418
South Bohemian Region	638,706	636,138	636,611	636,707	637,300	637,834	638,782	640,196	642,133	644,083
Plzeň Region	572,045	571,709	572,687	573,469	575,123	576,616	578,629	580,816	584,672	589,899
Karlovy Vary Region	307,444	303,165	301,726	300,309	299,293	297,828	296,749	295,686	294,896	294,664
Ústí nad Labem Region	836,045	828,026	826,764	825,120	823,972	822,826	821,377	821,080	820,789	820,965
Liberec Region	439,942	438,600	438,594	438,609	438,851	439,639	440,363	441,300	442,356	443,690
Hradec Králové Region	554,803	553,856	552,946	551,909	551,590	551,421	550,804	551,089	551,021	551,647
Pardubice Region	517,164	516,411	516,440	515,985	516,372	516,149	517,087	518,337	520,316	522,662
Vysočina Region	514,569	511,937	511,207	510,209	509,895	509,475	508,952	508,916	509,274	509,813
South Moravian Region	1,154,654	1,166,313	1,168,650	1,170,078	1,172,853	1,175,025	1,178,812	1,183,207	1,187,667	1,191,989
Olomouc Region	641,681	638,638	637,609	636,356	635,711	634,718	633,925	633,178	632,492	632,015
Zlin Region	590,361	589,030	587,693	586,299	585,261	584,676	583,698	583,056	582,921	582,555
Moravian-Silesian Region	1,243,220	1,230,613	1,226,602	1,221,832	1,217,676	1,213,311	1,209,879	1,205,886	1,203,299	1,200,539

Source: CUZK, own processing

The next table (Table 3) pays attention to the situation regarding the increase or decrease of the population during the observed period. It is clear from the table that the largest increase in population during the given period is evident in Prague and the Central Bohemian Region, followed by the South Moravian and Pilsen Region. On the other hand, we can notice that the largest decrease is evident in the Moravian-Silesian Region in the given period, when a total of 42,681 inhabitants in the given region decreased over 10 years. Other regions that can be included in the population decline is the Ústí nad Labem and Karlovy Vary Region. There are many factors that can affect the values, such as migration, number of newborns, number of deaths, etc.

Table 3: Increase or decrease in population in individual NUTS 3 regions in the Czech Republic for the period 2010-2019

Prague and Central Bohemian Region	187,282	**Pardubice Region**	5,498
South Bohemian Region	5,377	**Vysočina Region**	-4,756
Plzeň Region	17,854	**South Moravian Region**	37,335
Karlovy Vary Region	-12,780	**Olomouc Region**	-9,666
Ústí nad Labem Region	-15,080	**Zlin Region**	-7,806
Liberec Region	3,748	**Moravian-Silesian Region**	-42 681
Hradec Králové Region	-3,156		

Source: CUZK, own processing

The table below (Table 4) shows the relative share of agricultural and non-agricultural land in the individual analyzed years. Concerning relative shares of agricultural land in the given years, it is evident that each year its relative share (%) is smaller compared to the relative share of non-agricultural land. It is mainly a change of the soil type when agricultural land is transformed into other types of non-agricultural land such as built-up area, courtyard and other areas.

Table 4: Share of agricultural and non-agricultural land in the Czech Republic (relative values)

|	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Agricultural land	53.68	53.62	53.56	53.51	53.45	53.40	53.36	53.32	53.31	53.28
Non-agricultural land	46.32	46.38	46.44	46.49	46.55	46.60	46.64	46.68	46.69	46.72

Source: CUZK, own calculations

Figure 2 focuses on the situation of agricultural land and the year-on-year change for the whole region of the Czech Republic within a given period. Agricultural land consists of arable land, hop gardens, vineyards, orchards, and permanent grassland. On the other hand, there is non-agricultural land consisting of forest land, water areas, built-up areas and courtyards and other areas. The distribution of agricultural land in the Czech Republic is always greater than non-agricultural land.

The left axis represents the state of agricultural land in hectares in a given year and the right axis focuses on year-on-year changes in the agricultural area in hectares in the territory of the Czech Republic. The picture shows that we can see a steady decline in the land (agricultural land) since 2010. The most significant land loss is mainly recorded between 2010 and 2014. The year-on-year comparison for 2010 recorded the most significant land loss in the period analysed. In given year decreased 5,475 hectares of farmland decreased. This state of soil loss is also evident in other years analysed. In the last years analysed, we can see the year-on-year loss of the land. As can be seen from this figure on the right-hand axis, between 2018 – 2019, a loss of 2,214 hectares was recorded.

Land change is mainly affected by land grabs and the transfer of agricultural land to another type of land (Skrabal 2019a). Among the other significant effects on the land change is suburbanisation, with family and satellite estates being built around large towns and villages. Another problem remains the constant large-scale construction of logistics centres and logistics parks close to the country's road and rail network in the given country.

Figure 2: Development of an agricultural land in the Czech Republic
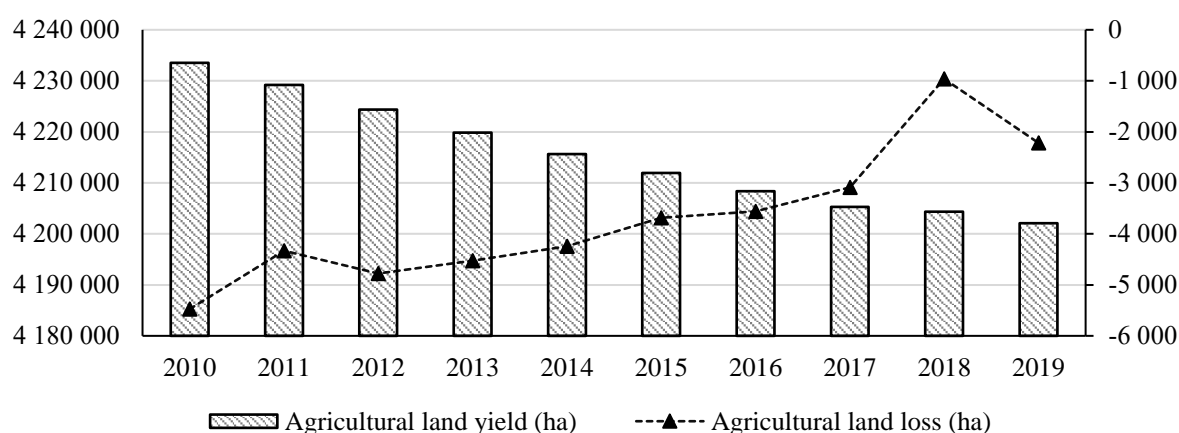
Source: CUZK, own processing

The table below (Table 5) focuses on the situation of farmland in individual regions (NUTS 3) in the Czech Republic. Each region is specific and most land take is mainly in regions where arable land is predominant. The mentioned table contains values on the state of soil in the given regions in the Czech Republic in individual years (in ha).

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Table 5: Situation of soil status in NUTS 3 regions expressed in hectares

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Prague and Central Bohemian Region	683,867	683,337	682,625	681,660	680,905	680,230	679,423	678,650	678,259	677,924
South Bohemian Region	491,753	491,150	490,527	490,052	489,693	489,367	489,107	488,917	488,928	488,916
Plzeň Region	380,330	379,930	379,335	378,868	378,166	377,762	377,477	377,203	377,106	377,137
Karlovy Vary Region	123,956	124,061	124,027	124,032	124,012	123,964	123,990	123,922	124,027	124,155
Ústí nad Labem Region	275,921	275,682	275,490	275,319	275,324	275,317	275,109	274,899	274,776	274,539
Liberec Region	140,013	139,896	139,826	139,748	139,690	139,521	139,350	139,233	139,273	139,534
Hradec Králové Region	278,162	277,926	277,690	277,506	277,229	277,099	276,917	276,799	276,652	276,483
Pardubice Region	272,179	271,914	271,564	271,146	270,881	270,566	270,348	270,150	270,681	270,000
Vysočina Region	410,389	409,911	409,470	409,161	408,939	408,737	408,543	408,361	408,169	407,983
South Moravian Region	427,411	426,703	426,041	425,765	425,168	424,577	424,021	423,770	423,318	422,902
Olomouc Region	280,129	279,763	279,361	279,086	278,562	278,209	277,850	277,525	277,319	277,074
Zlín Region	194,130	193,937	193,632	193,067	192,967	192,739	192,593	192,488	192,586	192,393
Moravian-Silesian Regionon	275,260	274,957	274,802	274,457	274,087	273,848	273,646	273,371	273,233	273,073

Source: CUZK, own processing and calculations

In the above table (Table 5) we can see that in the given years and regions there is a noticeable decrease in agricultural land. If we look at the total land loss in the local regions, the largest decrease was recorded mainly in the Central Bohemian Region, South Moravian Region, Pilsen Region, South Bohemian Region and Olomouc Region. These are regions that are among the largest regions in the Czech Republic and thus their share of agricultural land is much larger than in other regions. On the other hand, we can notice that in most regions there is a noticeable decline in agricultural land. If we look at the total loss of agricultural land in the analysed period (2010 to 2019) in a year-on-year comparison, we can say that the loss of agricultural land in the regions amounted to a total of 31,387 hectares. These facts, which have been described above, shows the table below (Table 6).

Table 6: Increase or decrease of agricultural land in individual NUTS 3 regions in the Czech Republic (2010-2019)

Prague and Central Bohemian Region	-5,943	**Pardubice Region**	-2,179
South Bohemian Region	-2,837	**Vysočina Region**	-2,406
Plzeň Region	-3,193	**South Moravian Region**	-4,509
Karlovy Vary Region	199	**Olomouc Region**	-3,055
Ústí nad Labem Region	-1,382	**Zlin Region**	-1,737
Liberec Region	-479	**Moravian-Silesian Region**	-2,187
Hradec Králové Region	-1,679	**Total**	-31,387

Source: CUZK, own processing

The next part of the article will deal with the situation of economic entities, first at the national level and then in individual regions in the country. From the figure below (Figure 3) we can see a graphical representation of the development of economic entities in the Czech Republic. The left axis shows the development of the total number of economic entities and the right axis shows the number of economic entities with detected activity. The subject with the detected activity is the subject that shows economic activity. The figure below shows that the overall development of economic entities in the analyzed period was on an increasing trend. Between 2018 and 2019, a slight stagnation can be seen within the given development. The situation is different in the Czech Republic in the development of economic entities with identified activity. Here we can see the situation showing an increasing tendency from 2010 to 2012. From 2012 to 2016, the number of economic entities with detected activity decreased. The smallest number of economic entities with detected activity was in 2016, if the beginning of the analyzed development is not taken, namely the year 2010. The given number of active companies in 2016 was 1,429,680 and the year-on-year decrease in active companies between 2016 and 2015 was -10,067 companies. The most significant year-on-year change in the number of companies is

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mainly between 2014 and 2013, where a significant decrease in the number - 24,636 companies. Since 2016, an improvement in business conditions and an increase in the number of economically active companies can be seen. If we focus on the year-on-year change in the number of companies between 2019 and 2018, we can see an increase in the number of economically active companies, namely by 28,214. A more detailed situation on the development of the number of companies at the regional level is shown in the table below (Table 7).

Figure 3: Development of economic entities in the Czech Republic
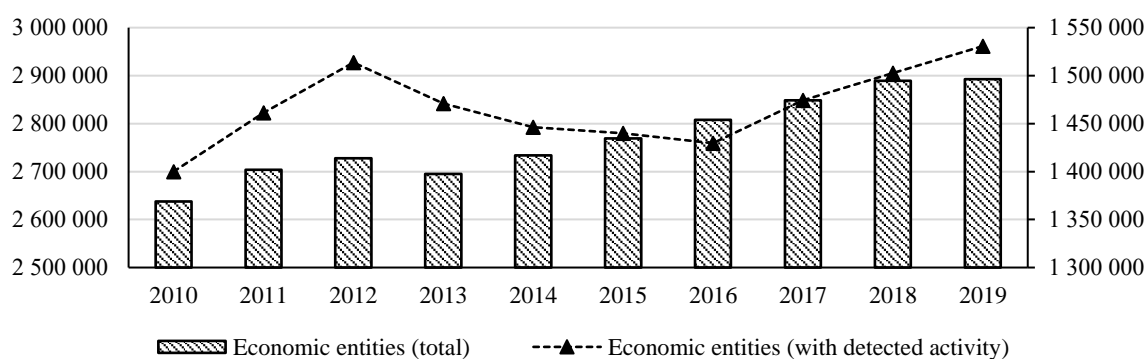
Source: CSO, own processing

Another table (Table 7) pays attention to the situation of economic entities with identified activity in individual NUTS 3 regions in the Czech Republic in absolute terms.

Table 7: Situation on the number of entities with identified activity in NUTS 3 regions

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Prague and Central Bohemian Region	439,740	467,115	495,687	488,046	487,219	489,958	491,447	514,375	529,568	544,169
South Bohemian Region	84,357	87,415	89,380	86,354	84,784	84,076	82,819	84,462	85,312	86,316
Plzeň Region	75,384	77,246	78,591	75,152	72,481	71,043	69,886	71,136	71,676	72,249
Karlovy Vary Region	38,508	38,700	39,250	37,389	35,511	34,278	33,017	33,512	33,232	33,145
Ústí nad Labem Region	85,317	87,525	89,723	86,190	83,107	81,319	79,589	80,465	81,156	82,311
Liberec Region	56,832	58,376	59,537	56,799	55,462	54,618	54,016	55,223	55,717	56,339
Hradec Králové Region	73,025	75,565	78,161	75,140	72,692	72,381	71,317	72,435	72,650	73,423
Pardubice Region	60,954	63,019	64,564	62,706	61,768	61,512	61,239	62,734	63,521	64,545
Vysočina Region	59,698	62,059	63,874	62,046	61,051	61,226	61,079	62,195	63,094	64,088
South Moravian Region	155,739	163,547	168,603	164,026	161,931	161,177	161,172	165,556	169,722	172,890
Olomouc Region	70,968	73,644	75,639	73,005	70,866	70,182	69,048	70,899	72,121	73,339
Zlín Region	72,808	75,598	77,018	74,501	73,096	72,457	71,538	73,421	74,370	75,118
Moravian-Silesian Region	126,653	131,392	133,529	129,575	126,325	125,520	123,513	127,794	130,396	132,817

Source: CSO, own processing and calculations

The above table (Table 7) focuses on the regional comparison of economic entities with the identified activity. The highest number of recorded economic entities is mainly in the capital city of Prague and the Central Bohemian Region, South Moravian Region and Moravian-Silesian Region. These are regions that have a favourable business environment for business and another reason for the higher number of economic entities is mainly in terms of geographical, which is influenced by road and rail networks and other factors that affect the emergence of economic entities. The least registered active economic entities within the observed period are in the Karlovy Vary Region and Liberec Region. From the geographical point of view, the mentioned regions are among the smallest regions, which from this point of view influence the development of the number of given economic subjects. Another factor that affects their number is mainly the interest of business entities to run their business plans in the given regions.

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The author of the article also focused on the regional comparison of the increase or decrease of economically active entities between regions in the given years (2010 - 2019). These findings are characterized by the table below (Table 8). From the table below, it is clear that most economic entities with detected activity were registered in the given period, mainly in Prague and the Central Bohemian Region, at the value of 104,429 business entities. Another region includes the South Moravian region. The region where the largest decrease in economically acute entities was evident during the given period (2010 - 2019) is the Karlovy Vary Region, where it is a decrease in 5,363 economically active entities. In the coming years, especially in the year-on-year comparison of 2020 and 2019, it will be marked by a rapid decline in economically active entities in all regions, which was mainly affected by the pandemic situation. In the coming years, especially in the year-on-year comparison of 2020 and 2019, it will be marked by a rapid decline in economically active entities in all regions, which was mainly affected by the pandemic situation.

Table 8: Increase or decrease of economic entities in individual NUTS 3 regions in the Czech Republic (2010-2019)

Prague and Central Bohemian Region	104,429	Pardubice Region	3,591
South Bohemian Region	1,959	Vysočina Region	4,390
Plzeň Region	-3,135	South Moravian Region	17,151
Karlovy Vary Region	-5,363	Olomouc Region	2,371
Ústí nad Labem Region	-3,006	Zlin Region	2,310
Liberec Region	-493	Moravian-Silesian Region	6,164
Hradec Králové Region	398	Total	130,766

Source: own processing and calculations

The figure (Figure 4) focuses on the number of constructions in a given country (the Czech Republic) and the year-on-year change in each number of constructions. The data on the number of constructions include constructions with a descriptive, registration number and without a number. The right axis of the picture focuses on the year-on-year change in the number of buildings in each period. The left axis shows the number of buildings in each year (2010 - 2019). Within the given figure and mainly based on the values shown on the left axis, it can be said that the number of constructions in the Czech Republic is constantly growing, namely thanks to the favourable economic situation, which was favourable during this period. The largest year-on-year change in the number of constructions was mainly between 2010 and 2009; 2018 and 2017 in the last two analyzed years, between 2019 and 2018. In these years, the year-on-year change in constructions were over 30,000. The smallest year-on-year change in the number of constructions in a given country was recorded mainly between 2014 and 2013; 2015 and 2014 and subsequently between 2016 and 2015.

Figure 4: Status and development of the number of buildings within the analyzed period on the territory of the Czech Republic

Source: CUZK, own processing

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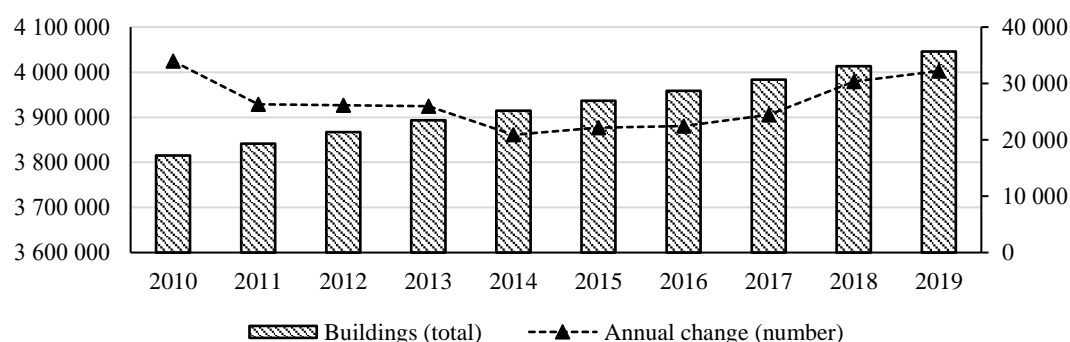
The table below (Table 9) focuses on a several buildings in the regional comparison at the NUTS 3 level within the analyzed period. Within the given table it is evident that the largest share of constructions is mainly in the Central Bohemian Region, South Moravian Region and Moravian-Silesian Region within the analyzed period. These are regions that are characterized primarily by their geographical location, where infrastructure, quality of living and business environment play a major role. The table then shows that the Karlovy Vary Region has the smallest number of constructions in the analyzed period. This situation is mainly influenced by the area, the location of the region and other factors that have a proper impact on the situation.

Table 9: Situation on the number of buildings in each NUTS 3 regions

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Prague and Central Bohemian Region	748,567	754,613	761,005	767,428	773,946	780,302	786,793	794,212	803,138	812,429
South Bohemian Region	305,09	307,48	309,616	311,609	313,14	314,882	316,652	318,687	320,816	323,022
Plzeň Region	258,845	260,495	262,046	263,62	264,988	266,474	268,042	269,303	271,132	273,022
Karlovy Vary Region	105,441	106,194	106,825	107,561	107,89	108,267	108,721	109,047	109,537	110,133
Ústí nad Labem Region	279,209	280,872	282,547	284,125	285,291	286,78	288,215	289,733	291,829	293,715
Liberec Region	175,161	176,434	177,596	178,626	179,38	180,319	181,222	182,131	183,399	184,655
Hradec Králové Region	235,352	236,606	238,112	239,418	240,285	241,367	242,127	243,088	244,325	245,798
Pardubice Region	222,276	223,986	225,463	226,86	227,849	228,792	229,975	231,336	232,886	234,941
Vysočina Region	242,827	244,317	246,102	248,043	249,214	250,495	251,879	253,37	255,369	257,74
South Moravian Region	430,669	433,18	435,627	438,589	440,428	442,733	445,046	447,611	450,571	454,055
Olomouc Region	231,243	232,908	234,346	235,677	236,876	237,889	239,163	240,159	241,79	243,398
Zlín Region	229,512	230,932	232,307	233,597	234,802	236,014	237,04	238,172	239,414	240,638
Moravian-Silesian Region	350,722	353,218	355,796	358,218	360,175	362,089	363,965	366,432	369,409	372,261

Source: CUZK, own processing and calculations

The following table (Table 10) focuses on the total sum of the number of constructions in individual regions (NUTS 3) in a given time period. As mentioned above, most buildings were mostly built in Prague and the Central Bohemian Region, followed by the South Moravian and Moravian-Silesian Regions. The fewest buildings were built in the Karlovy Vary Region and the Liberec Region during the given period. The two regions are among the smallest in the area of regions in the Czech Republic. With this fact, it is an important to point out the fact that we must take the given area of regions within the number of buildings built.

Table 10: Increase or decrease in the number of constructions in individual NUTS 3 regions in the Czech Republic (2010-2019)

Prague and Central Bohemian Region	63,862	**Pardubice Region**	12,665
South Bohemian Region	17,932	**Vysočina Region**	14,913
Plzeň Region	14,177	**South Moravian Region**	23,386
Karlovy Vary Region	4,692	**Olomouc Region**	12,155
Ústí nad Labem Region	14,506	**Zlin Region**	11,126
Liberec Region	9,494	**Moravian-Silesian Region**	21,539
Hradec Králové Region	10,446	**Total**	230,893

Source: own processing and calculations

3 Methodological procedure

The presented article aims is to determine the impact of soil sealing on an agricultural land in individual NUTS 3 regions in the Czech Republic. Based on a given aim, the author of the paper dealt with the corrective analysis between two variables within the above data. The author of the article included among the assessed variables: *(1) Agricultural land in (ha)* and *Economically active subjects (number)* further *(2) Agricultural land in (ha)* and *Buildings (number)* among the last two variables were included *(3) Economically active subjects (number)* and *Buildings (number)*. Based on the given variables, a correlation analysis was performed first at the state level and then for NUTS 3 regions.

The observed period is from 2010 to 2019 (n=10). The method of correlation analysis is applied as one of the possible analytical approaches to the problem. Correlation can be defined as a measure of the relationship between two or more statistical variables. Correlation can be measured in several ways. The choice of measurement method depends on the type of statistical variables. Among the most used correlation coefficients is Pearson's correlation coefficient. The selection correlation coefficient is given by:

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}} . \tag{1}$$

The values of the Pearson correlation coefficient are in the range <-1.1>. Boundary values indicate a perfect linear relationship. The values of the correlation coefficient can be verified by a statistical test. In the case of the t-test, the null hypothesis is tested, which is the assertion that the selection comes from the two-dimensional normal distribution in which a correlation coefficient of zero (e.g. Hebak et al., 2007, Hendl, 2004). The test statistic is then defined as follows:

$$t = r_{xy}\sqrt{\frac{n-2}{1 - r_{xy}^2}}, \tag{2}$$

where it has a distribution t of n - 2 degrees of freedom, where n is the number of pairs (x_i, y_i). The meaning of the resulting values of the correlation coefficients is as follows:

$\rho(x,y) = 1$ - there is a perfect direct dependence between the quantities x and y;
$\rho(x,y) = 0$ - quantities x and y are not correlated;
$\rho(x,y) = -1$ - there is a perfect inverse relation between the quantities x and y.

4 Results

The fourth chapter deals with the results of the correlation analysis based on the data presented in the second chapter. The author of the paper performed calculations of correlation dependence based on the assessment of three mutual relations, namely whether there is a dependence between the state of agricultural land and economically active subjects. Another relationship was assessed between whether there was a relationship between the condition of agricultural land and the number of buildings. The third assessment of independence was observed between the number of economically active entities and the number of constructions. An observation period of 10 years (n=10) was determined for the calculation. This chapter presents both the results of the relations within the country (Czech Republic) and individual regions (NUTS 3).

The table below (Table 11) shows the results of observations in the context of dependence between the state agricultural land and the number of economically active enterprises. Based on the data in the table below, we can say that the correlation coefficient is -0.46 and there is a moderately negative correlation. Therefore, we cannot confirm that there is a strong inverse relationship between the decline of agricultural land and the number of economically active entities.
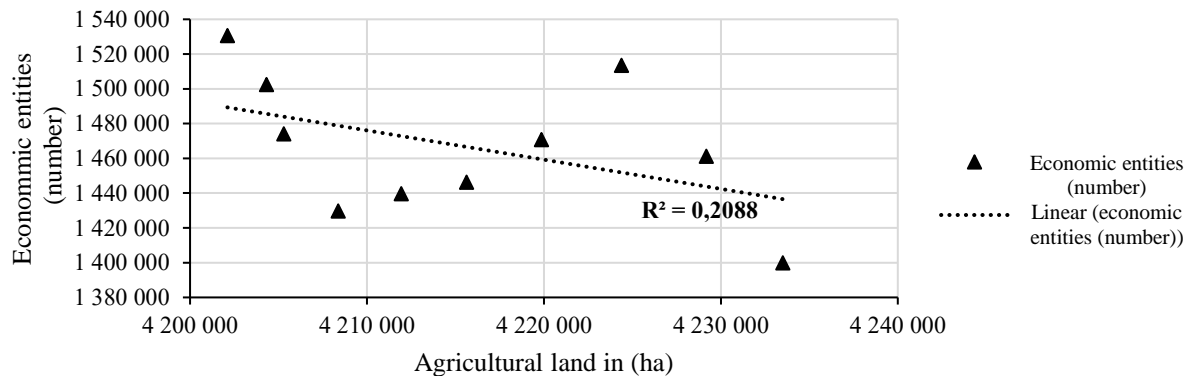
Table 11: Values between agricultural land and economically active entities

	Agricultural land (in ha)	Economically active entities (number)
Average	4,215,459	1,466,888
Standard deviation	10,396	38,276
Number of observations	10	10
Correlation coefficient	-0.456912	

Source: own processing based on own calculations

Figure 5 focuses on depicting the linear dependence between agricultural land and economically active entities in the Czech Republic. The figure shows a moderately negative correlation. The coefficient of determination from the given image is at the value of 0.21.

Figure 5: Relationship between agricultural land and economically active entities

Source: own processing based on own calculations

Another mutual assessment of the two variables will be between agricultural land and the number of buildings in a given country. From the table below (Table 12) we can interpret the result within the correlation coefficient (-0.98) that there is a strong, statistically significant, negative dependence between the data on the condition of agricultural land and the number of buildings. We can therefore state that within a given country there is a strong linear relationship between the loss of agricultural land and the number of buildings.

Table 12: Values between agricultural land and the number of buildings

	Agricultural land (in ha)	**Buildings (number)**
Average	4,215,459	3,926,912
Standard deviation	10,396	71,171
Number of observations	10	10
Correlation coefficient	-0.981457	

Source: own processing based on own calculations

The following figure (Figure 6) presents a representation of the linear relationship between agricultural land and the number of buildings in a given country. Based on the figure below, we can show that there is a strong negative linear dependence between the given variables. The value of the determination is 0.96, we can talk about a perfect prediction of the values of the dependent variables.

Figure 6: Relationship between agricultural land and the number of buildings

Source: own processing based on own calculations

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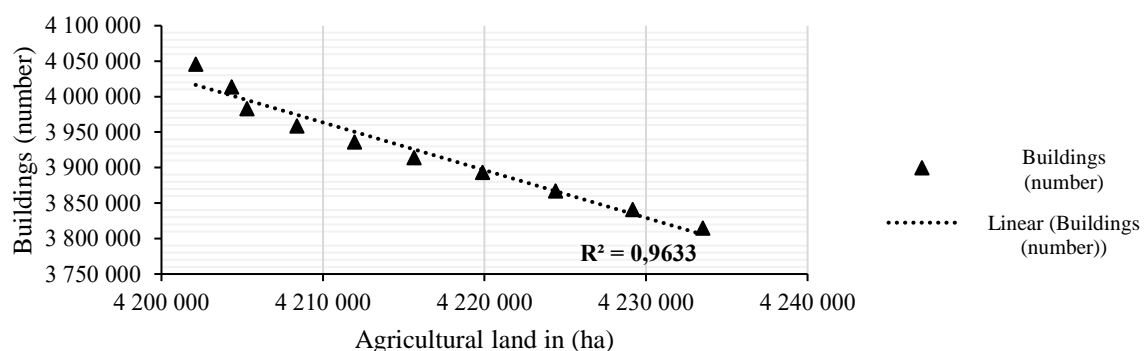
The author of the article also compared the relations between economically active subjects and the number of constructions based on a given time development. The results of the correlation analysis are then interpreted below in the table (Table 13). The correlation coefficient is 0.55 and it can therefore be said that there is a weak positive correlation between the given variables. From the given table, which is given below, we can say that there is a certain relationship between the number of buildings and economically active entities, but this relationship is not strong.

Table 13: Values between economically active entities and the number of buildings

	Economically active subjects (number)	Buildings (number)
Average	1,466,888	3,926,912
Standard deviation	38,276	71,171
Number of observations	10	10
Correlation coefficient	0.549827	

Source: own processing based on own calculations

The figure below (Figure 7) presents the dependencies between economically active entities and the number of constructions in a given country. The given figure shows a weak positive linear dependence between the given variables. The value of the coefficient of determination is 0.30 and we say that the relationship is not strong.

Figure 7: Relationship between economically active subjects and the number of constructions
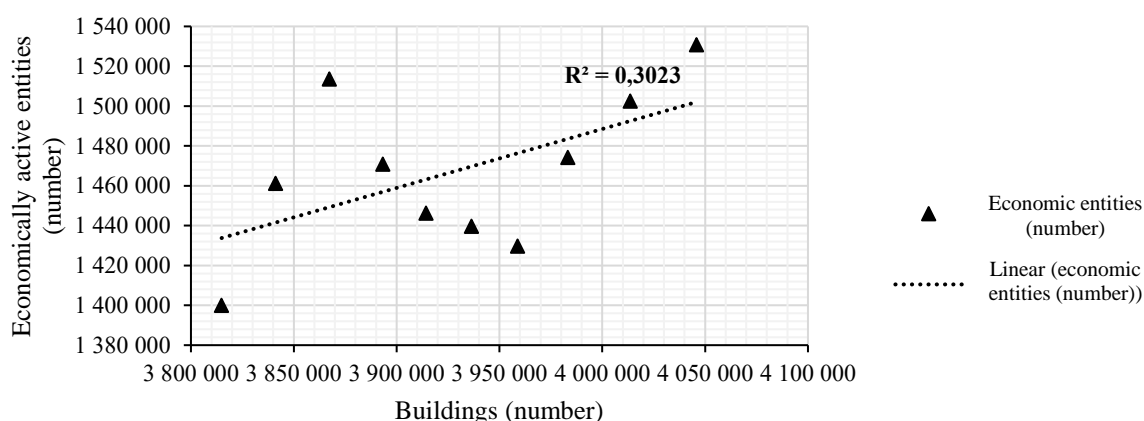
Source: own processing based on own calculations

The next part of the article will focus on regional comparisons at the NUTS 3 level within the given variables, which were listed above. The table (Table 14) shows the names of the regions at the regional level (NUTS 3) together with the given variables. The results contained in the given table show the values of the correlation coefficient based on the existing variables contained in the given column. The observation period is 10 years (n=10).

If we look at the relationship between the first variables (agricultural land (in ha) and economically active entities (number)) at the regional level, we can notice that the results differ significantly in individual regions. It is among the strongest negative correlations in Prague and the Central Bohemian Region. Here we can state that with the decline of agricultural land, the number of economically active entities increases. Within the given variables, we can say within the Karlovy Vary Region that there is almost no relationship between the variables since correlation coefficient is practically at 0. The Pilsen Region is characterized by a very strong

positive correlation. Based on the above value, it can be said that with the decrease in agricultural land, the number of economically active subjects also decreases.

Other variables in the table below include the number of economies of active entities and the number of constructions based on regional comparisons. The existing results contained in the column indicate that there are differences in correlation coefficients between regions. The Karlovy Vary Region is characterized by a very strong negative correlation, where we can say that the number of constructions decreases with the growth of new economic entities. For us, we need above all data on a strong positive correlation. There is a strong positive correlation with the given variables in Prague and the Central Bohemian Region and another region includes the South Moravian Region. These regions are characterized by the fact that there is a high-quality business environment based on a given high-quality infrastructure and there is a higher geographical concentration of agricultural land than in other regions, which can then be used to capture the land and convert the land to greenfields.

The last comparison between the variables, namely agricultural land in (ha) and the number of buildings, shows the last column in the table. Within the results of correlation coefficients between individual regions except the Karlovy Vary Region, it can be stated that there is a very strong to strong negative correlation in the given regions. A very strong negative correlation within the given variables is evident in the Hradec Králové Region, Olomouc Region, South Moravian Region, etc. In the mentioned regions we can state that these are regions that are characterized by a high share of agricultural land, road and rail transport and, last but not least, there are large agglomerations, which subsequently contribute to new constructions or new suburban areas. Within the given variables, it can be said that in almost all regions (except the Karlovy Vary Region) the number of buildings is growing with a decrease in agricultural land.

Table 14: Values of correlation coefficients in individual regions (NUTS 3)

	Agricultural land in (ha) and economically active entities (number)	Economically active entities (number) and Buildings (number)	Agricultural land in (ha) and buildings (number)
Prague and Central Bohemian Region	-0.8870	0.9231	-0.9868
South Bohemian Region	0.3648	-0.2814	-0.9472
Plzeň Region	0.8438	-0.7500	-0.9620
Karlovy Vary Region	-0.0001	-0.9136	0.2704
Ústí nad Labem Region	0.6360	-0.7296	-0.9864
Liberec Region	0.6978	-0.5490	-0.8641
Hradec Králové Region	0.5268	-0.4819	-0.9948
Pardubice Region	-0.1495	0.3755	-0.9276
Vysočina Region	-0.4956	0.5116	-0.9778
South Moravian Region	-0.6303	0.6654	-0.9905
Olomouc Region	0.2942	-0.2023	-0.9919
Zlín Region	0.3215	-0.1668	-0.9545
Moravian-Silesian Region	0.0785	0.0540	-0.9877

Source: own processing based on own calculations

Conclusion

Within the given contribution, it can be said that each region is different, both in terms of the geographical, business environment and quality of living in individual agglomerations. This article currently deals with an important area, which is addressed at both regional and national level, what is more, mainly with the consequences of the loss of agricultural land in the regions. Agricultural land is currently a very significant and valuable natural resource (factor). Therefore, the soil must be handled with care. The cessation of agricultural land in the

construction of housing projects (development projects) in suburban areas, new commercial entities and currently increasingly solving the problem of new logistics center on agricultural land should be addressed in an adequately manner. Instead, they should be used and given more support for the above-mentioned purposes aimed at abandoned buildings or areas called brownfields.

The results show that the loss of agricultural land in a given period in the Czech Republic has a declining trend. A decrease land not only in a given country and their regions is primarily caused by an urbanization. Smidt et al. (2015) emphasize in their study that a dangerous phenomenon for the loss of agricultural land is the degree of urbanization, which reduces the available agricultural area to meet the needs of a growing society. The soil conservation is a common objective in urban planning, but little focus has been placed on targeting soil value as a metric for conservation. Based on the given results, it was found that the largest land loss is evident in large NUTS 3 regions with a high share of agricultural land such as the Central Bohemian Region, South Moravian Region, Pilsen Region and Olomouc Region. These regions also have in common that they have large urban agglomerations, transport networks and a high share of labor. These factors then will result in a share of an agricultural land loss in the years to come. As reported by the study of Osman et al. (2018) the loss of an agricultural land is evident near large towns and backbone roads, leading to more informal urban settlements in the future. Another study (Das 2017) focused on the cessation of areas in urban agglomerations, where it was demonstrated large negative correlation between built-up land and metropolitan territory. The study subsequently found that the loss of an agricultural land is declining, even though there are many abandoned buildings and areas, which would be appropriate to use. The contribution also focused on the development of economically active entities in individual regions in the Czech Republic. Based on the given time period, it was found that most economic entities are mainly in Prague and the Central Bohemian Region, South Moravian Region and the Moravian-Silesian Region. The decrease in economically active entities was proven mainly in the Karlovy Vary Region, Pilsen Region and Ústí nad Labem Region. The author also dealt with finding out the condition construction of buildings. It was found that most buildings in the time period (2010-2019) were mainly in Prague and the Central Bohemian Region, South Moravian and Moravian-Silesian Region.

The main focus of the whole contribution was on the correlation analysis based on the given time period. The given analysis was initially focused on the state level and then at the NUTS 3 regions in the country always between given variables. Based on the results of the correlation analysis from the state level, it was found that the strongest negative correlation is between the variables, agricultural land, and the number of constructions, where the result of the correlation coefficient reached (-0.98). At the regional level was compared among 13 regions. First, the variables between agricultural land and the number of economically active entities were compared, where the strongest positive correlation coefficient was found in the Pilsen Region and the weakest correlation coefficient based on these variables was demonstrated in Prague and Central Bohemian Region. Other variables in the article included the number of economically active entities and the number of constructions. With the exception of the Karlovy Vary Region, all values reached strong negative correlations. The strongest negative correlation was demonstrated mainly in the Hradec Králové Region, Olomouc Region, South Moravian Region. From this point of view, it can be said that in almost all regions the growth in the number of buildings has an impact on the loss of agricultural land in the region. It is important to note that the author of the article dealt with a period of ten years. Therefore, another effort of the author is to focus on a longer period and pay attention to other factors that may affect the

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change in land loss, among which we can include a change in the type of land, construction of transport networks etc.

Acknowledgement

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