

Structural Development of Utilised Agricultural Area in EU Countries

Subsidy Policy of the Czech Republic

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Abstract

In the introductory part the authors deal with the importance of agricultural land, its influence on water management, on the production of food for inhabitants, the utilization of land in agriculture, the influence on the climatic condition and the global ecosystem. They point out the problems related to the reduction of agricultural areas and they quote opinions of selected environmental specialists. They mention the issue of the subsidies in the Czech Republic, their sources and accounting.

In the next part the authors focus on the analysis of the reduction of and the situation in the utilized agricultural area in thousands of hectares in EU countries. For this purpose, they utilize historic statistical data on the quantity and structure of utilized agricultural area. They represent the respective time series in tables and figures, calculate and compare their average absolute changes (increments or reductions) and percentage coefficients of growth (decrease). These coefficients are also used for the establishment of simple predictions obtained by extrapolation methods and by means of the linear trend function. The comparison of the results from individual EU countries was also represented graphically.

More advanced and exact forecast models, which also provide interval forecasts, not only point forecasts, are applied on the CR and its neighbours, on the EU and its largest countries, by means of SPPS software. Balanced values and forecasts for 5 successive periods since 2017 have been calculated and tabulated. Everything is represented by means of suitable figures.

Key words: utilised agricultural area in EU countries, average annual changes in utilized agricultural area, average growth/reduction rate, forecasts of the condition of the utilized land, subsidies.

Introduction

Breathable air together with water form the basis for the life. Like the heart and the lungs form communicating vessels, the land quality and water depend on each other in the landscape. Land is a natural product, but is not freely available. Under the term land as a factor of production economists understand the land used for agricultural production, or a place where other economic activities (e.g. construction) take place, but also all the natural resources. We must realize that their value is still growing.

The goal of the article is to compare the development of the structure of utilized agricultural area in EU countries, to compare and highlight the importance of the present permanent reduction of agricultural land, particularly in the new EU countries, and to carry out prediction of the condition of agricultural land up to the present on the basis of historic data. Such forecasts can be useful for example for the preparation of the economic policy in the individual countries, which might influence the behaviour of the time series.

Data and methodology

Ecological materials, literature searches and the applied methodology

Blackbourn (2009) points out that there are no doubts of the devastating human influence on the world of nature in the late 18th century. It started before the industrialization era based on fossil fuels and led to devastation of the biological diversity in numerous areas.

People have been breeding animals and growing plants purposefully for about ten thousand years. Land treatment related to the start of farming is a great turning point in the human history (Haptnan, Pošmourný and Němec, 2009).

According to the Directive of the European Parliament and of the Council establishing a framework for the protection of soil, soil is essentially a non-renewable resource in that the degradation rates can be rapid whereas the formation and regeneration processes are extremely slow. Its fundamental functions are biomass production, storing, filtering and transformation of nutrients and water, providing the background for biological diversity, acting as a platform for most human activities, providing raw materials, acting as a carbon pool and storing the geological and archaeological heritage. It should be used in a sustainable manner which preserves its capacity to deliver ecological, economic and social services, while maintaining its functions so that future generations can meet their needs. In fact, numerous areas are degraded to lands poor with water. The highest quality soil is being removed from the natural cycle as a consequence of urbanization. Soil is contaminated with gas emissions, dust, inputs of chemicals are increasing with the intensive agricultural methods, soil is degraded by waste dumping or ecological disasters. (European Parliament, 2019).

According to the Draft Directive of the European Parliament and of the Council soil is mostly in private hands in the Community. Despite this fact we need to protect it for future generations as it is a natural resource of public interest. As a consequence of the

rapid growth of municipalities and the increasing demand for soil from numerous spheres of the economy the coverage of soil is alarmingly increasing, which requires even more sustainable use of soil.

Soils started to appear on the Earth surface at the same time when life started to appear on the land. The presence of live microorganisms and their remnants is one of the most important definitional conditions. Nevertheless, agricultural land is exposed to degradation as a consequence of more and more unscrupulous exploitation and it is more and more receding from its natural character. Soil is not protected sufficiently due to the demand for the generation of profit by its conversion to construction plots. The appropriation after 1948 led to the breakage of the relations to the land built during generations. The condition of the soil is also a significant cause of the occurrence of extreme phenomena like floods or droughts. Soil has lost its ability to eliminate hard rains as well as longer periods without precipitations.

Soil is also an important aspect of water management. It holds water in the landscape as water is infiltrated through it and creates underground storages. On its way to the ground water is enriched with minerals, its pH is modified and harmful substances are separated. Soil is being destroyed by wrong cultivation of fields, wrong choice of crops, insufficient balks in large fields, compaction. The total reduction of soil, which is one of the main causes of the fluctuation of temperature, is probably the most significant problem. The ideal state is, when a part of the soil is covered with grass and serves as pasture (Janků, 2016).

The government should subsidize the maintenance of the landscape and its functions. Quantity is being preferred instead, still bigger and heavier mechanisms, which compact the soil and destroy water springs, are used in forests. Landscape drainage is another long-standing problem.

The general knowledge of the importance of soil and the necessity of its protection should be improved. It is a non-renewable component, which has a direct influence on human life as the environment for food production. However, the pressure from developers, speculators, governments and local governments continues, and real needs are overlooked under the pretext of public interest. Areas with quality arable land are chosen for the construction of highways, roads, stores and residential houses, and there is only a minimum interest in the utilization of the areas of old factories.

Land grabbing for the construction of new roads, highways and industrial areas is an everyday problem in the Czech Republic. The costs of the toll and fuel in the Czech Republic belong to the lowest in Europe. According to an analysis carried out by the Centre of Economic and Market Analyses, heavy trucks pay in average CZK 1,195 per 100 km for the toll and fuel in the Czech Republic. In Austria this amount is about CZK 1,346 in Germany 1,500, in Poland 1,499 and in Slovakia 1,421. As the costs in the neighbouring countries are higher, the CR is used as a transit country. This is why valuable arable land is being damaged due to the profits of private entities in the Czech Republic (Czech Statistical Office, 2019).

The industry, transport and decisions made by politicians endanger the environment in general. Thousands of hectares of arable land are covered by industrial zones, warehouses, highways, even though politicians claim that they want to protect the land fund. These operations do not have resources of industrial water for their operation, so they use potable water and they often even draw ground water. Agriculture deserves higher attention than industry, even though it has not such a financial effect for the state. However, it feeds us (Nikitina, 2014).

According to Kabourková (2018), in addition to capital and labour, the basic economic factor is soil. Unlike other factors, soil does not lose its value over the years; in fact, its value increases over the years. It is an irreplaceable natural resource, valuable asset of society.

Adherence to agricultural procedures favourable for the climate and the environment, the so-called Greening, has been one of the conditions for the use of agricultural subsidies within the EU Common Agricultural Policy since 2015. An applicant for such a subsidy has to use 5% of the cultivated land as ecological focus area (EFA — areas with crops retaining nitrogen). Lands left fallow belong among ecological focus areas according to a Regulation of the European Commission (European Commission, 2019).

It is necessary to start to respond to the incoming climatic conditions and to work with the landscape. To set such conditions for farmers and tree farmers that would lead to the recovery of the retention potential of soil, which we imprudently reduced so significantly in previous years. A landscape with large areas of cultivated land hardly copes with extremes like droughts and floods. (Sklenička, 2017).

The goals of the sustainable development of the United Nations pronounce plans of the global solution of problems related to soil. The Global Land Indicators Initiative was founded in 2012. Its main task is to elaborate a set of soil indicators, which could be prepared globally and compared on a long-term basis. The European Environment Agency (EEA) and the Institute for Advanced Sustainability Studies have proposed soil indicators for the monitoring of the fulfilment of the goals of the sustainable development from the point of view of the changes of the landscape surface — the use of areas, soil productivity, and the content of organic carbon in soil. Land grabbing, soil impermeability, landscape fragmentation, erosion and soil humidity are studied.

United Nations present and systemically evaluate the condition and the development of the environment in the world. It comes with warning facts on the climate change, biodiversity reduction, including the drop of pollinators, soil degradation and contamination of all components of the environment.

The UN Report points out that the rate of the degradation of the condition of the environment is faster than ever before. 75% of the terrestrial environment and 66% of the sea surface are seriously damaged (Fritz, 2019).

The damaged ecosystems can only be saved by a totally complete change of the approach to agricultural production and consumption (Fanta, 2018).

The change of agricultural land accompanied with the reduction of the number of insects is a serious threat. This might lead to an even worse imbalance of the environment. Traditional agricultural landscape is disappearing and being replaced with large monocultural fields. Modern industrial agriculture destroys soils, which also leads to reduction of underground water. Water is moreover often led beyond its natural flow for the agriculture (Etienne, 2019).

Soil is the top layer of the Earth surface, which originates from organic matter and erosion of the fundamental stone. It is bound to a certain location, has typical structure. It is a dynamic system permanently developing as a consequence of the activity of organisms living therein.

Agricultural land is a part of the Earth surface used for crop growing or animal grazing. It also includes fruit orchards, vineyards or gardens.

The agricultural land fund is the basic natural asset of our country, and irreplaceable means of production. It consists of agricultural land and land that should be farmed but is not temporarily farmed.

The maintenance and renewal of quality environment costs, however, it leads to results that cannot be expressed in economic terms. Agriculture has always been and still is a part of the care about the landscape. Here comes the subsidy policy, which is intended to maintain the landscape in highlands and mountains in cultivated condition and to award farmers for these activities, to grass or afforest arable land where it is possible, to return cattle to the landscape and to maintain soil fertile (van der Ploeg, 2019).

From the economic point of view a subsidy means a free payment provided directly or indirectly from the government budget, from the state financial assets, from the National Fund, from state funds, from the budget of a regional authority, from European Community funds, from the public funds of a foreign country, from PHARE or a similar programme. It is a transfer of resources to an entity, where such an entity is obliged to meet certain conditions, which are usually linked to its business activity. If an entrepreneur fails to meet the subsidy condition, he/she has to return the subsidy. Subsidies are basically divided into those for the reimbursement of costs and those for the acquisition of fixed tangible assets (through a purchase or own activity). Subsidies are only booked at the moment of the receipt or at the moment when their approval is unquestionable or highly probable. No estimated receivables or deferred revenues are prepared for them as if the exact amount of the subsidy is unknown on the balance sheet day or the unquestionable legal entitlement to it is not given, this would lead to unjustified overvaluation of revenues. If a subsidy has to be returned, this fact is booked in the costs of the accounting period when the decision on the subsidy return comes into force. If a subsidy for acquisition of fixed assets has to be returned, their purchase price is increased and an additional depreciation is entered as if the increased purchasing price were depreciated from the beginning (Ryneš, 2018).

In the Czech Republic, grant resources can be divided into two basic groups by the source of funds. After the accession of the CR into the European Union (EU), farmers are offered

European subsidy programmes (mostly partly co-financed from the state budget of the CR), which are suitably complemented by national subsidy programmes (fully financed from the state budget). European subsidy programmes, together with the national supplementary programmes, are administered and paid by the State Agricultural Intervention Fund.

Subsidies, together with quotas and duties, represent the most common trade barriers. According to the author of this contribution, governments often use taxpayers' money for providing subsidies to local manufacturers, which artificially reduces the price of domestic goods and puts the imported goods at disadvantage.

According to international accounting standards, state subsidies for biological assets measured at fair value are divided into conditional and unconditional. Fair value here refers to the quoted price of a biological asset in its active market. Biological asset includes animals and plants that are subject of a company's agricultural activity. Conditional subsidy is recognised as income after the conditions related to the state subsidy are met. Unconditional subsidy is recognised as income at the moment it is granted to the company (Kouřilová, Nývltová, Rybová, 2016).

The development of the utilized agricultural land in the individual EU countries and in the EU average is going to be compared in the following analytic part on the basis of historic data, and its reduction is going to be pointed out. The basic numeric characteristics of the appropriate time series are going to be determined and interpreted and their point as well as interval predictions carried out.

The statistic means applied here are tabular and graphic means of descriptive statistics, the analysis of time series, particularly trend analysis, linear and non-linear regression, and Holt's smoothing as a more advanced prediction method.

Numeric calculations are carried out by means of Excel and IBM SPSS Statgraphics v. 25 (Chajdiak, 2013, Stuchlý, 2004, Řehák et al., 2015).

Results and Discussion

Analysis of the development of utilized agricultural land in EU countries

The applied historic data on the structure and price of land represent moment time series. This is why we use usual means used for the calculation and interpretation of some numeric characteristics of numeric time series and their average values for their analyses. Time series are illustrated graphically. Trend analyses and more advanced statistic methods are particularly used for more detailed assessment of the results from EU countries. (Stuchlý, 2015, Cipra, 1986 and 2013).

The development of the overall structure of utilized agricultural land in EU countries

From the Eurostat internet output (Eurostat, 2019) we have used the current data of the development structure Utilised agricultural area by categories in 2007 to 2017 in EU countries in thousand hectares (see table 1). The utilized agricultural area (abbreviated UAA) describes the area utilized for agriculture. This includes the following land

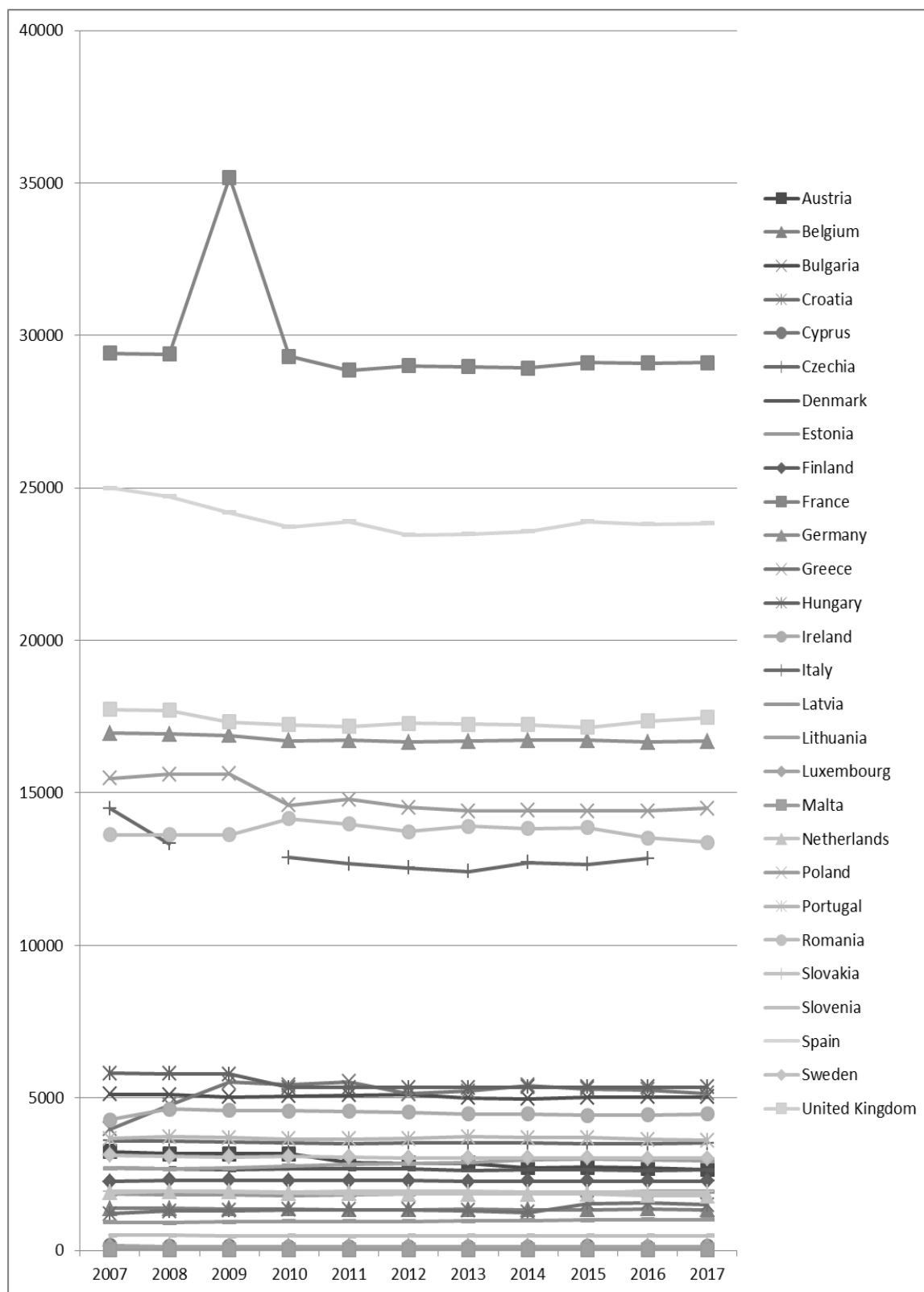
categories: arable land; permanent grass greens; permanent crops; other agricultural land, like kitchen gardens (even though they only represent small areas of the overall UAA). The term does not include unused agricultural land, forests and land covered with buildings, farm courts, warehouses, lakes etc. These data are illustrated in Figure 1.

Table 1: Total utilized agricultural area (thousands of hectares) in EU countries

Country/year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	průměr m	směrodatná odchylka s	var. koeficient V	stats. chyba Δ	prům. přírůstek	předpověď na rok 2018	předpověď na rok 2019	prům. koef. růstu	prům. koef. růstu v %
Austria	3238.6	3171	3168.6	3165.8	2868.15	2863.58	2862.44	2716.16	2720.4	2688.83	2655.56	2919.92	223.76	0.077	150.32	-58.30	2597.26	2538.95	0.980	-1.97
Belgium	1370.3	1373.8	1365.2	1358.02	1337.25	1333.91	1338.57	1333.4	1330.88	1352.95	1329.15	1347.58	16.87	0.013	11.33	-4.11	1325.04	1320.92	0.997	-0.30
Bulgaria	5116.2	5100.8	5029.6	5051.86	5087.95	5122.98	4995.11	4976.82	5011.49	5021.41	5029.53	5049.43	50.23	0.010	33.75	-8.67	5020.86	5012.20	0.998	-0.17
Croatia	1201.76	1289.09	1299.58	1333.84	1326.08	1330.97	1300.81	1240.87	1537.63	1546.02	1496.66	1354.85	117.74	0.087	79.10	29.49	1526.15	1555.64	1.022	2.22
Cyprus	149.5	126.51	124.52	114.79	115.89	115.94	107.13	107.03	126.47	112.31	121.73	120.17	11.96	0.100	8.04	-2.78	118.95	116.18	0.980	-2.03
Czechia	3596.72	3571.59	3545.84	3523.86	3504.03	3525.89	3521	3515.56	3493.72	3488.79	3521.33	3528.03	32.40	0.009	21.77	-7.54	3513.79	3506.25	0.998	-0.21
Denmark	2694.5	2682.9	2639	2676.2	2672.6	2663.6	2627.8	2652	2632.95	2625.1	2631.3	2654.36	24.73	0.009	16.61	-6.32	2624.98	2618.66	0.998	-0.24
Estonia	914.7	906.5	931.8	948.8	946	955.9	965.9	974.8	993.6	1003.51	1007.24	958.52	33.29	0.035	22.37	8.75	1010.99	1019.75	1.009	0.92
Finland	2255.3	2296	2295.9	2291.5	2286.7	2285.2	2258.6	2267.2	2273.3	2274.5	2272.2	2277.85	14.25	0.006	9.57	1.69	2273.89	2275.58	1.001	0.07
France	29413.9	29385	35177.8	29311.03	28852.55	29000.83	28975.97	28929.82	29115.25	29088.88	29101.33	29668.40	1836.46	0.062	1233.75	-31.26	29070.07	29038.82	0.999	-0.11
Germany	16954.3	16925.7	16889.6	16704.04	16721.3	16667.3	16699.6	16724.8	16730.7	16658.9	16687.3	16760.32	107.93	0.006	72.51	-26.70	16660.60	16633.90	0.998	-0.16
Greece	3968.66	4758.34	5507.39	5425.62	5532.34	5134.71	5213.04	5406.72	5291.71	5259.7	5152.43	5150.06	447.33	0.087	300.52	118.38	5270.81	5389.18	1.026	2.64
Hungary	5807.1	5789.7	5783.3	5342.7	5337.23	5338.02	5339.53	5346.3	5346.45	5348.97	5352.28	5466.51	210.05	0.038	141.11	-45.48	5306.80	5261.32	0.992	-0.81
Ireland	4275.89	4629	4593.92	4568.93	4555.5	4532.29	4477.39	4465.37	4429.08	4446.84	4470.24	4494.95	97.33	0.022	65.39	19.43	4489.68	4509.11	1.004	0.45
Italy	14490.3	13337.7		12885.19	12670.2	12548.1	12426	12720.15	12660.89	12843.32		12953.54	631.38	0.049	451.66	-183.00	12477.32	12294.33	0.987	-1.33
Latvia	1839.2	1825.1	1833	1805.5	1815.9	1840.9	1877.7	1872.5	1884.8	1930.6	1932.2	1859.76	43.52	0.023	29.24	9.30	1941.50	1950.80	1.005	0.49
Lithuania	2695.9	2672.1	2689	2772.3	2805.9	2842.2	2891.4	2952.4	3005.96	2954.07	2935.31	2837.87	119.32	0.042	80.16	23.94	2959.25	2983.19	1.009	0.85
Luxembourg	130.9	130.5	130.8	131.22	131.27	131.42	131.04	131.08	131.38	130.65	131.16	131.04	0.30	0.002	0.20	0.03	131.19	131.21	1.000	0.02
Malta	10.33	10.33	10.33	11.45	11.45	11.45	11.69	11.69	11.69	11.58	11.58	11.23	0.59	0.052	0.39	0.13	11.71	11.83	1.011	1.15
Netherlands	1886.4	1933.2	1921.4	1872.36	1858.39	1841.6	1847.6	1839	1845.75	1796.26	1789.99	1857.45	44.73	0.024	30.05	-9.64	1780.35	1770.71	0.995	-0.52
Poland	15477.2	15607.7	15624.6	14603.2	14780.2	14529.4	14409.9	14424.2	14398.2	14405.6	14497.6	14796.16	510.39	0.034	342.88	-97.96	14399.64	14301.68	0.993	-0.65
Portugal	3660.98	3725.7	3695.16	3653.93	3649.56	3664.7	3718.16	3699.69	3695.03	3636.46	3602.68	3672.91	37.30	0.010	25.06	-5.83	3596.85	3591.02	0.998	-0.16
Romania	13629.81	13633.81	13620.86	14156.48	13981.62	13733.14	13904.64	13830.42	13858.42	13520.85	13377.93	13749.82	222.90	0.016	149.75	-25.19	13352.74	13327.55	0.998	-0.19
Slovakia	1930.6	1936	1930.3	1921.61	1929.7	1927.45	1928.51	1924.73	1921.56	1918.88	1910.65	1925.45	6.97	0.004	4.68	-1.99	1908.66	1906.66	0.999	-0.10
Slovenia	498.47	492.42	468.5	482.65	458.2	479.65	478.89	482.21	476.86	477.67	481.42	479.72	10.64	0.022	7.15	-1.71	479.72	478.01	0.997	-0.35
Spain	25003	24718.1	24190.4	23719.23	23894.37	23463.12	23494.57	23571.78	23897.14	23816.33	23840.7	23964.43	493.03	0.021	331.22	-116.23	23724.47	23608.24	0.995	-0.47
Sweden	3120.9	3075.8	3067.2	3073.7	3063.1	3031.5	3036.08	3036.07	3028.35	3020.92	3011.37	3051.36	32.00	0.010	21.50	-10.95	3000.42	2989.46	0.996	-0.36
United Kingdom	17737.1	17703.4	17325	17231	17172	17182	17259	17240	17144	17357	17472	17356.59	200.77	0.012	134.88	-26.51	17445.49	17418.98	0.998	-0.15
EU (28 countries)	183088.5	182807.8		180136.8	179365.4	178197.8	178098.1	178392.8	178993.7	178736.9		17955.29	1911.77	0.011	1284.34	-481.29	17774.29	177292.99	0.997	-0.27

Source: Eurostat, 2019.

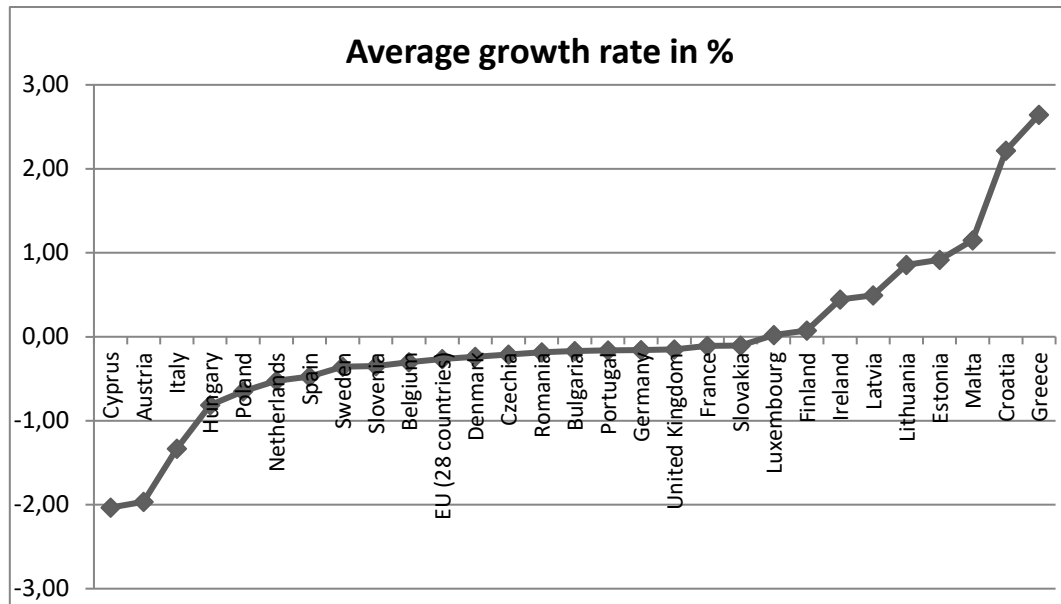
Figure1: The course of the dependence of the values of agricultural area in all EU countries (in thousands of hectares)



Source: Authors

This data on the individual EU countries represent time series about the condition of the utilized agricultural area in thousands of hectares in individual years, some with missing data. The highest values of utilized agricultural area are achieved in large countries (France, Spain, Great Britain and Germany) and the lowest values in the smallest countries (Malta, Luxembourg, Cyprus and Slovenia). The most fluctuating data is in Greece between 2007 and 2014. Columns 13 — 16 contain calculated basic numeric characteristics of the variable, utilized agricultural area in individual EU countries and in the whole EU: the average m , standard deviation s , coefficient of variation V and the statistical discrepancy of the average value Δ . In the whole EU these characteristics are: $m = 179,755.3$ thousand ha, $s = 1,911.8$ thousand ha, $V = 0.011$, $\Delta = 1,284.3$ thousand ha; in the CR these characteristics are: $m = 3,528$ thousand ha, $s = 32.4$ thousand ha, $V = 0.009$, $\Delta = 21.8$ thousand ha; in the SR these characteristics are: $m = 1,925.5$ thousand ha, $s = 7.0$ thousand ha, $V = 0.004$, $\Delta = 4.7$ thousand ha. The highest relative variability of the data is in Cyprus (0.10), in Greece and Croatia (0.087). The double of the statistical discrepancy represents in average a 95% width of the confidence interval of the average. Column 17 contains calculated average annual increments (decrements with negative value) of utilized agriculture area during the whole period of 2007 — 2017. Columns 18 and 19 contain approximate estimations of the predictions of utilized agricultural area in 2018 and 2019 obtained by means of interpolation from the linear trend. The last but one column contains determined average growth (fall) coefficients of utilized agricultural area. They state how many times the value of utilized agricultural area increased (decreased) in average per year during the whole period of 2007 — 2017. The last column contains a relative representation of the results in %. Figure 2 shows a comparison between the individual countries according to the relative percentage growth coefficient. The highest average relative decreases of utilized agricultural land are in Cyprus (by 2.03% — in absolute numbers by 2.78 thousand ha), in Austria (by 1.97% — in absolute numbers by 58.3 thousand ha) and in Italy (by 1.33% — in absolute numbers by 183 thousand ha). The highest average relative increases of utilized agricultural land are in Greece (by 2.64% — in absolute numbers by 118.4 thousand ha), Croatia (by 2.22% — in absolute numbers by 29.5 thousand ha) and Malta (by 1.15% — in absolute numbers by 0.13 thousand ha). The average relative decrease in the whole EU is 0.27% — in absolute numbers by 481.1 thousand ha. In the CR there is an average annual decrease of 0.21% — in absolute numbers by 7.54 thousand ha, and in the SR the decrease is 0.10% — in absolute numbers by 1.99 thousand ha.

Figure 2: Comparison of the values of average relative growth (fall) coefficients of utilized agricultural area (in %) according to the size.



Source: Authors

Forecasting by extrapolation by means of the linear trend cannot be considered optimal for most countries. The quality of smoothening of a time series by means of a suitable trend function can be assessed on the basis of various rates of smoothening accuracy (e.g. the determination coefficient R^2 , mean squared error MSE, mean absolute percentage error MAPE, mean absolute error MAE). Accuracy can also be enhanced by the application of adaptive smoothening methods, which weight individual members of a time series by means of assigning higher weights to newer values than older ones (method based on exponential smoothening and on weighted moving averages). Applied statistical models should moreover have good statistical properties. We assess them according to the properties of residues.

Holt's smoothening, offered in software IBM SPSS v. 25 provides more accurate and adequate results of forecasts based on linear trend (the method is described for example in Stuchlý, 2004. Cipra, 2013). Calculations are carried out for the CR, its neighbours, the largest EU countries and finally for the whole EU. Table 2 shows absolute and relative precision rates of the applied Holt's smoothening. Exponential smoothening of the level and the direction of the trend function was used. The programme chooses the optimum smoothening constants. We applied MAPE (MAE) to the comparison of the smoothening accuracy. It expresses the average relative (absolute) errors of the smoothening of the individual values in % (thousands of hectares).

The most accurate results are in Slovakia (0.18% — in absolute numbers 3.49 thousand ha) and in Germany (0.25% — in absolute numbers 41.50 thousand ha). The least

accurate results are in France (3.63% — in absolute numbers 1,136.03 thousand ha) and in Austria (1.89 % — in absolute numbers 54.64 thousand ha). In the CR MAPE = 0.40%, MAE = 13.97 thousand ha and in the whole EU MAPE = 0,98%, MAE = 1,773.21 thousand ha.

Table 2: Precision rates of the Holt's smoothening

Model	Model Fit Statistics			
	R-squared	RMSE	MAPE	MAE
Czechia-Model_1	0.648	20.263	0.396	13.971
Slovakia-Model_2	0.622	4.514	0.181	3.489
Hungary-Model_3	0.610	138.210	1.360	73.215
Austria-Model_4	0.897	75.661	1.889	54.644
Germany-Model_5	0.663	66.016	0.248	41.496
Poland-Model_6	0.650	318.419	1.601	236.537
France-Model_7	0.031	1905.561	3.630	1136.025
Spain-Model_8	0.716	276.774	0.798	190.537
UnitedKingdom-Model_9	0.428	160.042	0.555	96.116
EU-Model_10	0.427	2403.426	0.977	1773.207

Source: Authors

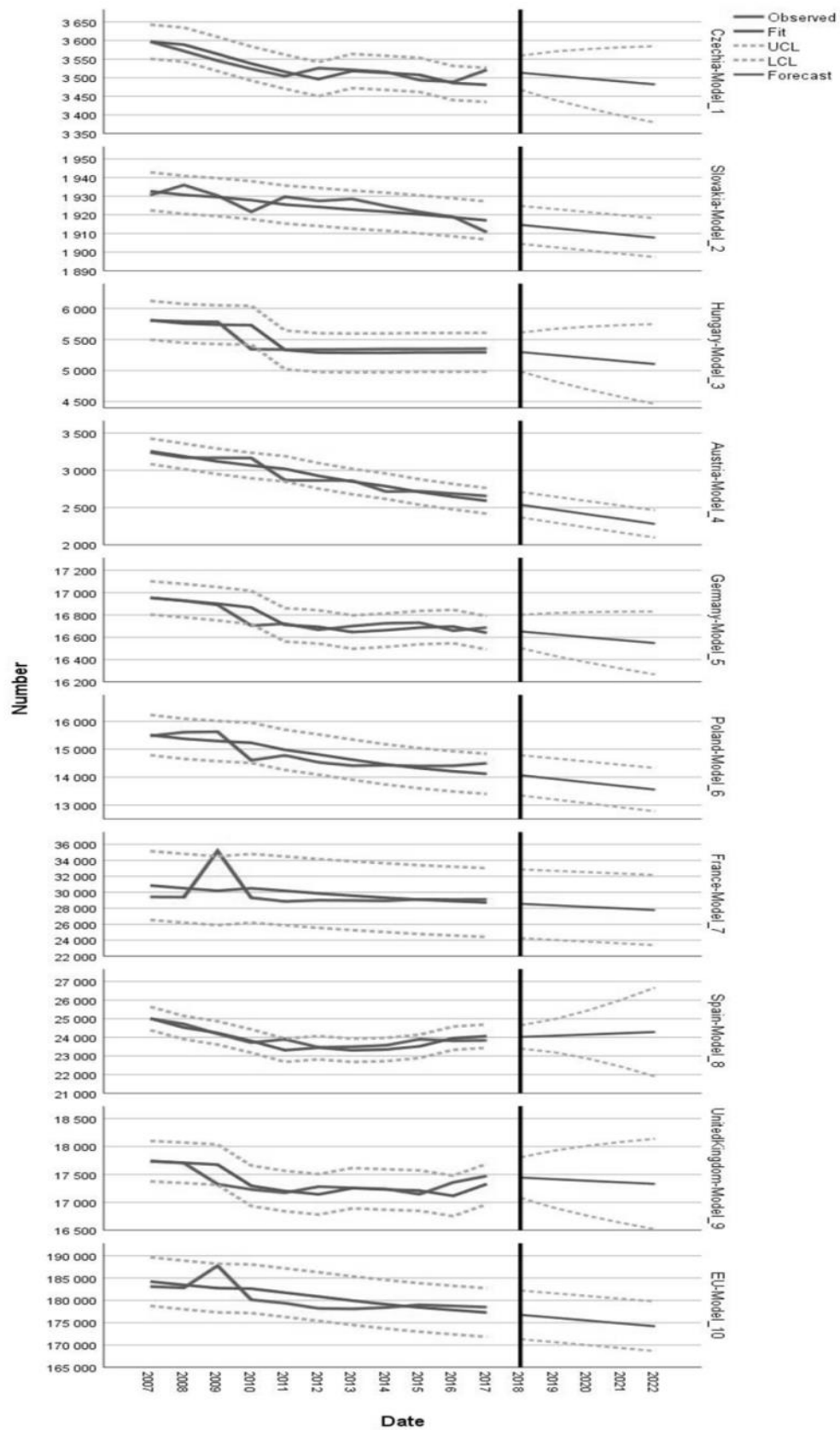
Table 3 shows point and 95% interval forecasts of the utilized agricultural area in 2018 — 2022 in the monitored countries by means of Holt's method. These forecasts for the individual countries are illustrated in the following Figure 3 together with the measured and the smoothened values. Holt's method predicts a permanent decrease of the utilized agricultural area in all countries except for Spain. The growth in Spain can be explained by the fact that Holt's method prefers current measurements to older measurements, and as we can see in Figure 1, the utilized agricultural area has really been growing in Spain in recent years.

Table 3: Point and interval forecasts of the situation in utilized agricultural area according to Holt's model

Model		2018	2019	2020	2021	2022
Czechia-Model_1	Forecast	3,513.47	3,505.62	3,497.76	3,489.90	3,482.05
	UCL	3,559.31	3,570.44	3,577.15	3,581.57	3,584.54
	LCL	3,467.63	3,440.79	3,418.37	3,398.23	3,379.56
Slovakia-Model_2	Forecast	1,914.61	1,912.89	1,911.16	1,909.44	1,907.72
	UCL	1,924.82	1,923.15	1,921.48	1,919.81	1,918.14
	LCL	1,904.40	1,902.62	1,900.85	1,899.08	1,897.30
Hungary-Model_3	Forecast	5,298.00	5,249.48	5,200.95	5,152.43	5,103.90
	UCL	5,610.65	5,670.10	5,707.02	5,731.46	5,747.69
	LCL	4,985.35	4,828.85	4,694.89	4,573.39	4,460.11
Austria-Model_4	Forecast	2,538.76	2,474.28	2,409.79	2,345.30	2,280.82
	UCL	2,709.92	2,648.64	2,587.30	2,525.90	2,464.46
	LCL	2,367.61	2,299.92	2,232.28	2,164.70	2,097.18
Germany-Model_5	Forecast	16,651.92	16,625.92	16,599.93	16,573.94	16,547.95
	UCL	16,801.25	16,817.19	16,825.46	16,829.17	16,829.77
	LCL	16,502.58	16,434.66	16,374.41	16,318.71	16,266.13
Poland-Model_6	Forecast	14,065.33	13,937.02	13,808.72	13,680.41	13,552.10
	UCL	14,785.64	14,671.40	14,556.89	14,442.13	14,327.13
	LCL	13,345.02	13,202.65	13,060.54	12,918.69	12,777.07
France-Model_7	Forecast	28,556.44	28,360.32	28,164.19	27,968.07	27,771.95
	UCL	32,867.12	32,691.97	32,516.72	32,341.37	32,165.92
	LCL	24,245.76	24,028.67	23,811.67	23,594.77	23,377.97
Spain-Model_8	Forecast	24,019.41	24,085.92	24,152.43	24,218.94	24,285.46
	UCL	24,645.52	24,971.53	25,443.54	26,017.87	26,670.40
	LCL	23,393.31	23,200.31	22,861.32	22,420.02	21,900.51
UnitedKingdom-Model_9	Forecast	17,443.38	17,414.77	17,386.16	17,357.55	17,328.94
	UCL	17,805.42	17,926.82	18,013.36	18,081.87	18,138.85
	LCL	17,081.34	16,902.72	16,758.96	16,633.23	16,519.02
EU-Model_10	Forecast	176,758.53	176,119.69	175,480.85	174,842.02	174,203.18
	UCL	182,195.45	181,583.85	180,972.12	180,360.26	179,748.28
	LCL	171,321.60	170,655.53	169,989.58	169,323.77	168,658.08

Source: Authors.

Figure 3: Smoothened values and forecasts of utilized agricultural area



Source: Authors.

Conclusion

The analysis focused on the comparison of changes (decreases or increases) of utilized agricultural area in individual EU countries and the overall situation in utilized agricultural area in thousands of hectares (in the whole EU) in 2007 — 2017. We ascertained a significant drop of the area of agricultural land in most EU countries. With regard to the different sizes of countries the average percentage coefficient of growth (fall) was used for the comparison. The highest average relative drops of utilized agricultural area are in Cyprus (by 2.03% – in absolute numbers by 2.78 thousand ha) and in Austria (by 1.97 % — in absolute numbers by 58.3 thousand ha). The highest average relative increases of utilized agricultural land are in Greece (by 2.64% — in absolute numbers by 118.4 thousand ha) and in Croatia (by 2.22% — in absolute numbers by 29.5 thousand ha). In the whole EU there is a relative drop of 0.27% — in absolute numbers 481.1 thousand ha. In the CR there is a relative drop 0.21% — in absolute numbers 7.54 thousand ha.

The overall situation in agricultural land in EU countries was forecast approximately by means of interpolation. Holt's method was applied for the CR, its closest neighbours, the largest EU countries and the EU as a whole to obtain more accurate point and interval forecasts until 2022. The results are summarized in tables and figures.

References

- BLACKBOURN, D., 2009. *Podmaňování přírody*. Praha: BB Art. ISBN 978-80-7381-598-1.
- CIPRA. T., 1986. *Analýza časových řad s aplikacemi v ekonomii*. Praha: SNTL. ISBN 99-00-00157-X.
- CIPRA. T., 2013. *Finanční ekonometrie*. Praha: Ekopress. ISBN 978-80-86929-93-4
- EUROPEAN PARLIAMENT, 2019. *Environment policy: general principles and basic framework*. [online]. Bruxelles: European Parliament, 2019. [accessed: 2019-12-10]. Available at: <https://www.europarl.europa.eu/factsheets/en/sheet/71/environment-policy-general-principles-and-basic-framework>.
- CZECH STATISTICAL OFFICE, 2019. *Statistiky*. [online]. Praha: Czech Statistical Office, 2019. [accessed: 2019-11-08]. Available at: <https://www.czso.cz/csu/czso/statistiky>.
- ETIENNE, R. S., 2019. A Minimal Model for the Latitudinal Diversity Gradient Suggests a Dominant Role for Ecological Limits. *American Naturalist*. **194**(5), E122-E133. ISSN 0003-0147.
- EUROPEAN COMMISSION, 2019. *The common agricultural policy at a glance*. [online]. Bruxelles: European Commission, 2019. [accessed: 2019-11-03]. Available at: https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cap-glance_en.

EUROSTAT, 2019. *Utilised agricultural area by categories*. [online]. Luxembourg: Eurostat, 2019. [accessed: 2019-11-10]. Available at: https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=ta_g00025&plugin=1%20and%20internal.

FANTA, V., 2018. Equilibrium dynamics of European preindustrial populations: The evidence of carrying capacity in human agricultural societies. *Proceedings of the Royal Society B: Biological Sciences*. **285**(1871), unpag. ISSN 0962-8452.

FRITZ, S., 2019. Citizen science and the United Nations Sustainable Development Goals. *Nature Sustainability*. **2**(11), 1063-1063 ISSN 2398-9629.

HAUPTMAN, J., K. POŠMOURNÝ and J. NĚMEC, 2009. *Půda v České republice*. Praha: Consult. Pro. Ministerstvo zemědělství a Ministerstvo životního prostředí. ISBN 80-903482-4-6.

CHAJDIÁK, J., 2013. *Štatistika jednoducho v Exceli*. Bratislava: Statis. ISBN 978-80-85659-74-0.

JANKŮ, J. et al., 2016. Land Use Analysis in Terms of Farmland Protection in the Czech Republic. *Soil and Water Research*. **11**(1), 20-28. ISSN 1801-5395.

van der PLOEG, J. S., 2019. The economic potential of agroecology: Empirical evidence from Europe. *Journal of Rural Studies*. **71**(-), 46-61. ISSN 0743-0167.

SKLENIČKA, P., 2017. Success in preserving historic rural landscapes under various policy measures: Incentives, restrictions or planning? *Environmental Science & Policy*. **75**(-), 1-9. ISSN 1462-9011.

RYNEŠ, P., 2018. *Podvojně účetnictví a účetní závěrka*. Olomouc. 2018. Anag. ISBN 978-80-7554-116-1.

NIKITINA, N., 2014. Mineral resource dilemma: How to balance the interests of Government, local communities and abiotic nature. *International Journal of Environmental Research and Public Health*. **11**(9), 8632-8644. ISSN 1661-7827.

ŘEHÁK, J. et al., 2015. *SPSS Praktická analýza dat*. Brno: Computer Press. ISBN 978-80-251-4609-5.

STUHLÝ, J., 2004. *Statistické metody pro manažerské rozhodování*. Jindřichův Hradec: VŠE Praha. Fakulta managementu. ISBN 80-245-0153-8.

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