

# The Agrarian Structure of Horticultural Farms and Vegetable Production in the Czech Republic and in Poland

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**Abstract.** The aim of the study was to analyze and evaluate the agrarian structure of horticultural farms and the size of vegetable production in Poland and Czech Rep. These studies were preceded by a brief comparative analysis of the development of economies of both countries, including agriculture. Large fragmentation of Polish farms means that they cannot take advantage of economies of scale. Their effectiveness is low. It was noted that horticultural production in Poland is increasingly taking place in farms from 5 to 20 ha, also under cover. It is labor-intensive production, and there is a lot of work resources in agriculture in Poland. The agrarian structure of Czech agriculture is beneficial for large-area crops, the production of which can be mechanized. However, it is not conducive to the development of smaller horticultural farms. Vegetable production in this country does not cover domestic demand and many Czechs grow vegetables in home gardens.

**Keywords:** Horticulture, Vegetables, Farm Structure.

## 1 Introduction

Vegetables are annual, biennial or perennial plants. According to Welbaum [12], these are green plants or parts of plants. They can be eaten raw or after heat treatment. They can be eaten whole, but more often the usable parts are leaves, stems, tubers, roots or fruits. They can be a main dish or part of a main course. Salads and salads are prepared from them. They are not eaten for dessert. The vegetables must be handled skillfully in cultivation and after harvest to preserve their quality.

A healthy and varied diet should be rich in vegetables. They provide vitamins and minerals. The most valuable vitamins are C, A and E. Important minerals include sodium, potassium, calcium and magnesium. For human health, fiber and phytochemicals are also very important, especially antioxidant ones. They occur only in vegetables. It has been proven that people whose diet is rich in vegetables are less susceptible to cardiovascular diseases and some cancers [11, 6, 9].

Most valuable ingredients include fresh vegetables. The shorter the distance from the producer to the consumer, the less need for preservatives and refrigeration to maintain their good quality. Local vegetables are becoming more and more valued.

Domestic vegetable production should, above all, satisfy domestic demand. Production depends to a large extent on the agrarian structure of farms.

## 2 Data and Methods

The aim of the study was to analyze and evaluate the agrarian structure of horticultural farms and the size of vegetable production in Poland and Czech Republic. The studies used Eurostat and FAOSTAT data as well as statistical offices of the Czech (Czech Statistical Office) and Poland (Statistics Poland) for the years 2010-2017. The time range differed when analyzing the agrarian structure of agricultural holdings, including horticultural ones (the period 2010-2016 was adopted). The farm structure survey is a cyclic survey taking place every three years.

The study uses a descriptive analysis method, a method of analogy and comparisons, and a deductive reasoning method. Data are presented in tables and diagrams. Selected descriptive statistics were used, including structure and dynamics indicators. To assess the homogeneity of the distribution of land between farms, the concentration factor  $K$  was used, according to the formula [7]:

$$K = \frac{5000 - \sum_{i=1}^n a_i * b'_i}{5000} \quad (1)$$

gdzie:  $a_i$  – shares of units in area groups,  $b'_i$  – cumulative shares of a research variable in area groups.

## 3 Poland and Czech Republic – Resources and Development

The neighboring Poland and the Czech Republic are located in Central and Eastern Europe. There is a similar climate in them – moderate warm. In the Czech Rep. countryside is dominated by upland areas. In Poland, the majority of the area is occupied by lowlands. Poland covers an area of 312.7 thousand. km<sup>2</sup> and is almost 4 times bigger than the Czech Rep. Poland is inhabited by more people. In 2017, there were 38.4 million of them, ie 3.6 times more than in the Czech Rep. (Table 1). The Czech Rep., in turn, is more densely populated. There were 133 people per 1 km<sup>2</sup> (123 in Poland). The increase in the population is a pro-development stimulus of the Czech Rep. In 2010-2017 the number of inhabitants in this country increased by 73 thous. In the corresponding period in Poland, the population decreased by 0.2%. The growing population means an increase in demand for food, including vegetables.

In the Czech Rep. the standard of living is higher than in Poland. This is confirmed by the value of GDP per person. In 2017, it amounted to EUR 18,100 in the Czech Republic, compared to EUR 12,200 in Poland. In Poland, however, the rate of growth of this indicator was higher in 2010-2017. The value of GDP generated is influenced, among others, by the size and structure of employment in the national economy. In Rep.

Czech 50.5% of the total population is employed. The employment structure by economic sectors is as follows [3]:

- industrial sector – 36,8%,
- service sector – 59,9%,
- agricultural sector – 1,3%.

In Poland, 42.4% of the total population is employed, and the employment structure is slightly different [3]:

- industrial sector – 30,2%,
- service sector – 57,3%,
- agricultural sector – 12,5%.

**Table 1.** Selected data on the Polish and Czech economy. Based on [3].

Specification	2010	2017	2010=100
<b>Czech Republic</b>			
Total population (thous.)	10517	10590	100,7
Total employment (thous.)	5057	5346	105,7
Total unemployment rate (%)	7,4	2,9	-
Unemployment rate on rural areas (%)	7,7	3,0	-
GDP (mln euro, current prices)	156718	191643	122,3
GDP per capita (euro, current prices)	14900	18100	121,5
Gross value added total (mln euro, current prices)	141715	171981	121,4
Gross value added in agriculture, forestry and fishing (mln euro, current prices)	2381	3945	165,7
<b>Poland</b>			
Total population (thous.)	38517	38422	99,8
Total employment (thous.)	15370	16281	105,9
Total unemployment rate (%)	9,7	5,0	-
Unemployment rate on rural areas (%)	10,4	5,4	-
GDP (mln euro, current prices)	361804	467167	129,1
GDP per capita (euro, current prices)	9400	12200	129,8
Gross value added total (mln euro, current prices)	318291	410256	128,9
Gross value added in agriculture, forestry and fishing (mln euro, current prices)	9284	10740	115,7

The agricultural sector in Poland plays an important role in the economy, although it produces only 2.6% of gross value added. It is worth noting that every eight Poles work in the agricultural sector, and it still happens that there are no people willing to harvest fruit and vegetables. On the basis of the quoted data, Poland should be included in agricultural countries, the Czech Rep. – for industrial. The information published in the Competitive Industrial Performance Report 2014 shows that the Czech Republic occupies the 18th position among the most competitive industrialized economies in the world, Poland - 23 [10].

## 4 Farms in Poland and the Czech Republic

The functioning of agriculture and the profitability of agricultural production depend to a large extent on the agrarian structure [2]. In 2016, a periodic survey of the structure of farms was carried out in EU countries. On the basis of its results, it can be concluded that utilized agricultural area (UAA) has a similar share in the total area in the discussed countries. In the Czech Rep. they occupied 43.8%, in Poland - 46.1%.

In the Czech Rep. there were 22.8 thous. farms operating in the area of 3455,4 thous. ha UAA (Tab. 2). In comparison with 2010 decreased: the number of farms (by 3.7 thous., ie by 13.8%) and the area of land used by them (by 28.1 thous. ha, ie by 0.8%). These disproportionate changes in the number and area of farms caused that the average area of the farm in the Czech Rep. grew from 131.3 ha to 151.2 ha.

**Table 2.** Selected data on farms in the Czech Republic and in Poland [3].

Specification	2010	2016	2010=100
<b>Czech Republic</b>			
Number of farms (thous.)	26,5	22,8	86,2
Utilised agricultural area – UAA (thous. ha)	3483,5	3455,4	99,2
UAA belonging to natural persons (thous. ha)	1013,3	1039,7	102,6
Labour force directly employed (thous. AWU)	108,0	103,3	95,6
Standard output (mln euro)	3852,2	5081,9	131,9
Number of farms whose household consumes more than 50% of the final production (thous.)	4,1	2,2	53,4
<b>Poland</b>			
Number of farms (thous.)	1506,6	1410,7	93,6
Utilised agricultural area – UAA (thous. ha)	14447,3	14405,7	99,7
UAA belonging to natural persons (thous. ha)	12900,0	13183,0	102,2
Labour force directly employed (thous. AWU)	1897,2	1649,4	86,9
Standard output (mln euro)	18987,1	25005,6	131,7
Number of farms whose household consumes more than 50% of the final production (thous.)	510,8	259,0	50,7

In Poland, the agrarian structure is definitely less favorable. There is a huge fragmentation of farms. In 2016, there were 1410.7 thous. of them (by 95.9 thous. less than 6 years earlier). They occupied an area of 1,4405.7 thous. ha. In the years 2010-2016, the area of UAA decreased by 41.6 thous. ha, i.e. by 0.3%. The average area of the farm increased from 9.6 ha to 10.2 ha during this time.

Differences in the size of farms in both countries result from the agricultural systems prevailing there. In Poland, 91.5% of UAA is owned by private persons, while in the Czech Rep. – 30.1%. The remaining part of agricultural land belongs to legal persons (mostly commercial law companies, created in place of socialist agricultural cooperatives). Moreover, there is a large discrepancy in the Czech Republic between

the ownership of agricultural land and its use. Large agricultural entities use land leased from many owners. [1]

The total output standard of Czech farms in 2016 amounted to 5081,9 million euros. The number of people employed in them reached 103.3 thousand. AWU. Of the total number of farms, 15,5% consume over 50% of the final production in their own household. Polish farms worked out in total 2,500.6 million euros with employment at the level of 1649.9 thous. AWU. Farms producing mainly for their own needs accounted for 18.4%. Thus, the value of Polish agricultural production was nearly 5 times higher than in the Czech Republic, and employment was 16 times higher.

It is not difficult to notice that unit productivity of agricultural production in the Czech Republic is much higher than in Poland. In Czech Rep. in 2016 there was an average of EUR 222.9 thous. of standard output on one farm. Calculated per 1 ha, it was EUR 4,887.7. The Polish agricultural holding was able to produce an average of EUR 17.7 thous. per year. For 1 ha there was EUR 1,735.8 of standard output.

## **5 The Agrarian Structure of Horticultural Farms**

Vegetables are grown in horticultural farms and home gardens. According to the data of the national statistical offices of Poland and the Czech Republic, the area of backyard garden amounted in 2017 respectively 7.6 thous. ha i 4.0 thous. ha. In Poland, they accounted for 4.4% of the total vegetable crop area, in the Czech Rep. – 28,2% [5, 8].

The article assumes that production taking place in horticultural farms is of key importance for the economy. The rest of the article will be devoted to such farms.

The Eurostat methodology distinguishes three groups of horticultural farms:

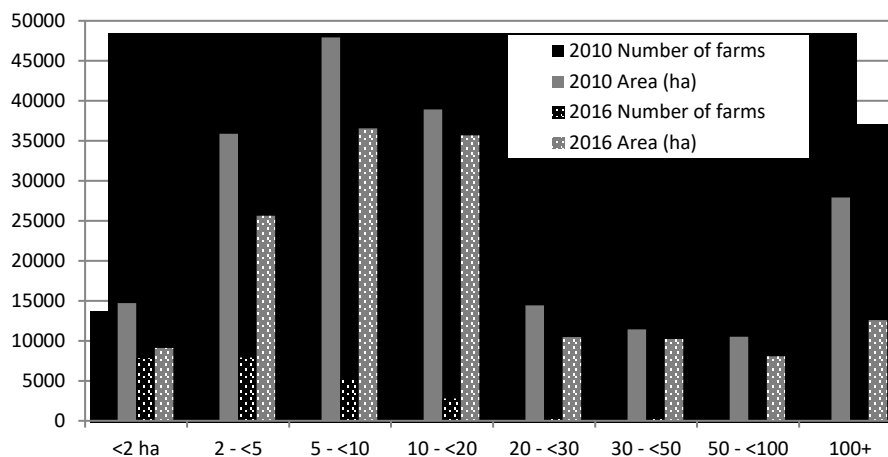
- specialist horticulture indoor,
- specialist horticulture outdoor,
- other horticulture.

### **5.1 Horticultural Farms in Poland**

In Poland in 2016 there were a total of 24.6 thous. horticultural holdings, of which 38.3% were farms specialized in crop production under cover. In comparison to 2010, the total number of farms decreased by 30.3%. In turn, the number of farms specializing in production under cover was lower by 13.8% [3]. The structure of the number and area of total horticultural holdings is presented in Fig. 1.

In 2010, horticultural farms occupied a total of 201.8 thous. ha. The vast majority, 88.3% of the number of all these farms, constituted units up to 10 ha. Such farms used 48.8% of the area occupied by all horticultural farms.

The largest group were farms with the smallest area (up to 2 ha). In 2010, there were 13.2 thous. of them in Poland. It is 37.5% of all gardening farms. The area occupied by them totaled 14,7 thous. ha, ie 7.3% of the total area of horticultural farms. The average area of a farm in this area group was only 1.1 ha.



**Fig. 1.** The agrarian structure of all horticultural farms in Poland in 2010 and 2016 with division into area groups [3].

The largest share in the total area of horticultural farms (23.8%) had in 2010 units from the area group of 5 - <10 ha. They occupied 47,9 thous. ha. There were 6.8 thous. of them, ie 19.3% of all horticultural farms.

In 2016, the total area of horticultural farms decreased in comparison with 2010 by 53.4 thousand. ha, i.e. by 26.5%. In each area group decreased: the number of farms and the area of crops. The largest dynamics of changes was recorded in the biggest farms, the area of which amounted to 100 ha and more. Their number decreased by 58.3%, and their area decreased by 54.9%. In 2016, there were 50 such farms operating on 12.6 thous. ha. The average area of a farm in this area group increased from 222.5 ha in 2010 to 251.6 ha in 2016. Their share in the total area of horticultural farms decreased in these years from 13.8% to 8.5%.

High dynamics of changes was also observed among the smallest horticultural farms (up to 2 ha). Their number decreased by 40.6%, and the area was lower by 38.2%. In 2016, there remained 7.9 thous. of the smallest gardening farms. They used a total of 9.1 thous. ha. Their share in the surface structure decreased in 2010-2016 to 6.1%.

The smallest dynamics of changes in the discussed period was characteristic for medium-sized farms (10 - <20 ha). Their number decreased by 5.8%, and the area was less by 8.3%. The most stable situation among this group of farms caused that their share in the total area of horticultural farms increased from 19.3% to 24.1%, and the share in the number of farms increased from 8.3% to 11.3%.

Farms up to 10 ha still accounted for the vast majority, but their share in the total number of horticultural farms decreased to 85.2%, and their share in the area of these farms decreased to 48.0%.

Farms from the range of 5 - <10 ha still occupied the largest area. It was 36.6 thous. ha, which accounted for 24.6% of the total area of horticultural holdings.

Concentration coefficient K for horticultural holdings decreased in 2010-2016 from 0.43 to 0.39. This means greater uniformity in the distribution of land between

horticultural farms and smaller polarization of farms towards the largest and smallest ones.

In 2016, there were 9,400 farms with crops under cover registered in Poland. The total area of their cultivation amounted to 42.2 thous. ha and decreased compared to 2010 by 9.7%. The quantitative and area structure of farms with crops under cover was similar to the total number of horticultural holdings. The largest share in the number of greenhouse holdings had entities up to 2 ha (37.1%). Their share in the area of these farms was 7.2%. In the six analyzed years, the number and area in this group of households decreased the most, respectively by 22.8% and 29.3%.

Both in 2010 and in 2016, the largest area was occupied by entities with the size of 5 - <10 ha. It was respectively 15.8 thous. ha and 14.7 thous. ha. Although the area of these farms decreased, their share in the total area of crops under cover increased from 33.9% to 34.8%.

The largest importance among specialist horticultural farms still have units up to 10 ha. It is worth noting, however, that in 2010-2016 their share in the total number of greenhouse farms decreased from 92.0% to 90.8%. Decreased also share in their area from 66.1% to 65.6%.

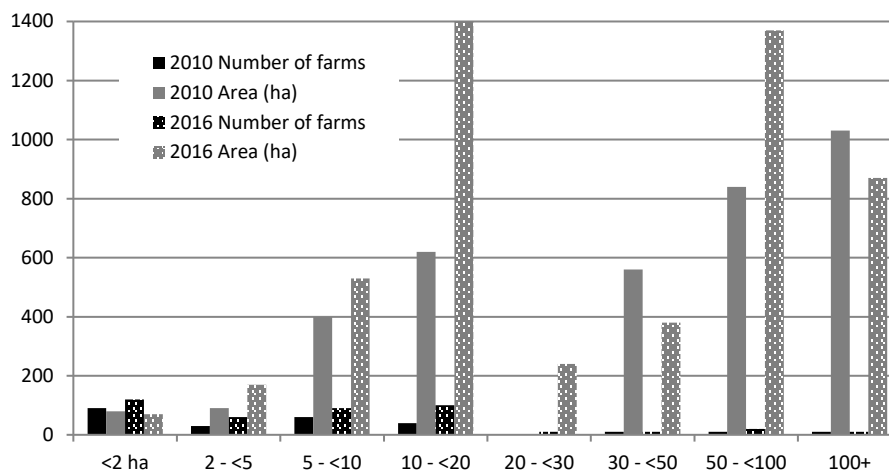
The study of the dynamics of changes in the number and area of greenhouse farms in units of 20 ha and more gave different results than the study of all horticultural farms. In all groups of larger greenhouse holdings there were increases in their number and area of UAA use by them. The area increased the most in the group of 20 - <30 ha (by 73.3%), and the number of such entities increased by 57.1%.

Among farms under cover, the concentration coefficient  $K_c$  was calculated. In 2010-2016 its value decreased from 0.32 to 0.30. The results show a decreasing concentration of land in greenhouse farms. It is also seen that the stock of agricultural land is more evenly distributed between greenhouse farms than between all horticultural farms.

## **5.2 Horticultural Farms in the Czech Republic**

Number of specialist horticultural farms in the Czech Republic amounted to 420 in 2016 and increased by 68% compared to 2010. They occupied a total of 5030 ha, ie 39% more than 6 years earlier. The average area of such a farm in 2016 was 12.0 ha. Eurostat data shows that in the Czech Rep. has no specialist indoor horticulture.

In 2016, the largest number, because 120, were the smallest horticultural farms up to 2 ha (Fig. 2). In comparison to 2010, their number increased by 33.3%, but their area decreased by 12.5%. The largest area in 2016 was occupied by horticultural farms from the area group of 10 - <20 ha, and then 50 - <100 ha. It was respectively 1400 and 1370 ha. The highest dynamics of changes was observed in farms from the group of 10 - <20 ha. In 6 years, their number increased by 150%, and the area increased by 125.8%.



**Fig. 2.** The agrarian structure of all horticultural farms in the Czech Republic in 2010 and 2016 divided into area groups [3].

In 2010, 12.0% of all horticultural farms in Rep. Czech Republic owned 67.1% of the total agricultural land used by such farms. Over 6 years, unevenness in the distribution of land between different area groups of farms has decreased. This is evidenced by the index K. Its value decreased from 0.62 to 0.53.

## 6 Vegetable Production in the Czech Republic and in Poland

Horticultural farms mainly specialize in the cultivation of ground vegetables and under covers. Vegetables neither in Poland nor in the Czech Republic have a large share in the area of agricultural crops. In Poland, they occupy less than 2% of the sown area, in the Czech Republic 0.2%.

According to FAOSTAT data [4] in the years 2010-2013, the production of vegetables in Czech Rep. amounted on average 187.5 thous. tonnes per year. This amount covered national demand in 23.8%. In Poland, the situation was much better. Domestic production in the corresponding years amounted 5502 thousand. tonnes per year and satisfied domestic demand in 108.7%.

Area of agricultural vegetable crops in the Czech Republic in the years 2010-2011 amounted to on average of 9.1 thous. ha. In the years 2016-2017, this area increased by on average of 12.4%. In the same years, the average annual production of vegetables also increased from 248.6 thous. tonnes to 305.0 thous. tonnes, ie by 22.9% [5, 8].

The structure of vegetable harvest in the Czech Rep. were dominated by cabbages, onions and carrots (Fig. 3). Their combined share in the harvest of vegetables in the years 2016-2017 was on average 47%.



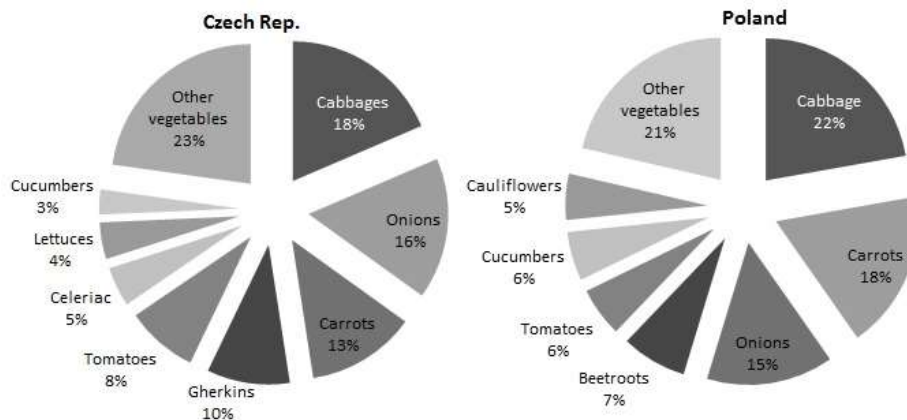


Fig. 3. The structure of vegetable harvest in the Czech Republic and Poland – average annual data from 2016-2017 [5, 8].

In Poland, the area of vegetable cultivation in 2010-2011 amounted to on average 168.8 thous. ha. In 2016-2017, it increased by an average of 5.5%. In analogous years, production increased by only 1.5% (from 4496.0 thous. tonnes to 4565.3 thous. tonnes). In the last analyzed period, the production of vegetables in Poland was nearly 15 times higher than in the Czech Rep.

The production structure is dominated by the same three vegetable species as in the Czech Rep.: cabbages, carrots and onions. Their combined share in the structure of harvest in the years 2016-2017 amounted to 55%.

## 7 Conclusion

Vegetables are a very important component of the diet especially in times of struggle against obesity and civilization diseases. Poland and the Czech Republic are characterized by similar climatic conditions but different terrain features. Poland has better natural conditions to conduct agricultural activities, but in the Czech Rep. agrarian structure is more favorable to achieving higher production results. It is based on large-area farms in which the unit production output is much higher than in very fragmented farms in Poland. The average area of a farm increases in both countries. In Poland, in the years 2010-2017, the average size of a horticultural farm also increased.

The future in the production of vegetables is specialist horticulture indoor. Such production is lacking in the Czech Rep. It is an activity that requires a lot of work and capital. There are many labor resources in agriculture in Poland and this may favor the development of vegetable farms. It was noted that in both countries the land concentration ratio in horticultural farms decreased. This means that there is a decrease in such farms among units from the smallest and largest area groups. It is to be expected that medium-sized farms (with an area of 5-20 ha) will dominate in the agrarian structure of horticultural farms.

Vegetable production in the Czech Republic does not cover domestic demand. Many Czechs run their own vegetable growing in home gardens. This is not conducive to the development of specialized horticultural farms in this country.

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