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## **The Potential and Significance of Urban Agriculture on the Basis of the Ruhr Metropolis and the Upper Silesian Metropolis<sup>3</sup>**

**Abstract.** The paper attempts to evaluate the potential and importance of agriculture in the two largest (post)industrial metropolitan areas of Europe. It has been demonstrated that urban agriculture constitutes an important spatial component of studied urban organisms, as almost 40% of these consist of agricultural land. Analysis of chosen characteristics of agriculture in the researched metropolitan areas explicitly shows that their agricultural potential is comparable to the overall regions where they are located. This mainly concerns the average size of farms, the employment ratio and the intensity of both animal and plant production. The studies also led to the conclusion that, in spite of very similar natural environments, agriculture in the Ruhr Metropolis is characterized by significantly higher production potential than agriculture in the Upper Silesian Metropolis.

**Key words:** urban agriculture, production potential, Ruhr Metropolis, Upper Silesian Metropolis

### **Introduction**

Agricultural activities on land located within the administrative limits of towns or cities tend to be perceived as an obsolete form of economic activity, occurring in very strong regression [Krzyk et al. 2013]. Agricultural land in towns is also of marginal importance in spatial planning, while urban land, which is in shortage, is frequently treated as a reserve for other, more profitable activities [Petts 2001, Jiang et al. Giecewicz 2005]. This arises from the effect of (urban) land rent, a mechanism which was presented by von Thünen and then modified by Alonso and referenced to urban agglomerations [von Thünen 1826, Alonso 1964]. Both authors have proven that activities yielding higher economic rent push other economic activities away from cities. Although regression of agriculture and farm land is a natural process occurring in city centers or in highly urbanized areas, very large unoccupied areas in the outskirts of towns could or even should remain in agricultural usage. City land used for agricultural activities, apart from its production functions, has a number of additional functions which are extremely important, yet difficult to measure (in terms of economy), including recreational and health functions, or ecological functions [Wagner 2005].

Today, many researchers claim that the concept of “urban agriculture” can no longer be treated as an oxymoron [Mougeot 2010, Lohrberg and Timpe 2011, Tjeerd et al. 2001, Zasada 2011]. In many cities in Europe and worldwide, the proportion of agricultural land

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within cities, towns and metropolitan areas is higher than the share of areas occupied by such functions as housing, or transport infrastructure. This applies to Polish cities (Warsaw – 29.2% of agricultural land, Krakow - 47% of agricultural land) as well as to German cities (Hamburg 25% of agricultural land, Ruhr Metropolis 39% of agricultural land) and those in Canada (Vancouver - 14%) [Born and Pölling 2014, Sroka 2014]. Such a spatial relevance of agriculture derives from intensive urban expansion processes which began in highly developed countries in the second half of the 20th century and continue to the present day [Szymańska 2007, Bański 2008]. According to FAO [2007], in 1996 there were already as many as 800 million people worldwide who were engaged in various forms of urban agriculture (including allotment gardens).

Subject-matter literature states that in highly developed countries, (post)industrial cities should be recognized as a special case on the map of urban agriculture [Viljoen, Howe 2012, Colasanti et al. 2012, Kost 2015, Goldstein et al. 2011]. This is due to several factors: firstly, these cities expanded strongly in their best times and at the moment, they have relatively large areas of land that can be used for agricultural operations. Secondly, (post)industrial issues on the job market would often force the local inhabitants to seek alternative sources of income. In the United States, urban agriculture and urban allotment gardens began to grow rapidly in such cities as, for example, the (post)industrial crisis-ridden Cleveland, Detroit, or Philadelphia [Goldstein et al. 2011], while in Europe, this phenomenon mainly concerns the Ruhr Metropolis and the Upper Silesian Metropolis [Landwirtschaftskammer NRW, 2013, Sroka 2015].

Even though the issue of urban agriculture in Europe is flourishing, it is still barely recognized. In many countries, including Poland, it is widely, yet erroneously acclaimed that agriculture in highly industrialized areas is less important. This paper touches upon the hypothesis that the potential of agriculture in the Ruhr Metropolis and the Upper Silesian Metropolis is similar to the potential of regions where these two metropolitan areas are located.

## **Research goals and methodology**

The main aim of this paper is to assess the potential and significance of urban agriculture on the basis of two (post)industrial European metropolitan areas - the Ruhr Metropolis and the Upper Silesian Metropolis. This analysis touches mainly upon the comparison method. Characteristics of agriculture in the Ruhr Metropolis and the Upper Silesian Metropolis, which described their potential, were correlated not only with each other, but also with the pattern of agriculture in regions where the Ruhr Metropolis and the Upper Silesian Metropolis (North-Rhine Westphalia and Silesian Voivodeship respectively) are located. Apart from the comparison method, descriptive as well as quantitative methods, including analysis of dynamics and structure, were incorporated. Hence, the test procedure covered such stages as:

- definition of the research problem (aim of the research),
- selection of research subjects (explanation included),
- selection of features describing potential and significance of agriculture,
- indication of disparities not only in the potential of agriculture in the researched metropolitan areas and regions where they are located, but also in agriculture in the Ruhr Metropolis and the Upper Silesian Metropolis,

- evaluation of the results obtained from descriptive research.

The first stage of that research encompassed denotation of the spatial scope of research. It was established that the significance and potential of urban agriculture would be presented on the basis of the two biggest (post)industrial European metropolitan areas - the Ruhr Metropolis and the Upper Silesian Metropolis. These two regions constitute polycentric agglomerations and demonstrate quite a similar course of the processes of economic development [Mikołajec 2013]. Moreover, the structure of land usage, including 40% share of agricultural land, is comparable as well. It makes agriculture one of the most important elements in the urban area. Apart from the evident similarities between the Ruhr Metropolis and the Upper Silesian Metropolis it should also be pinpointed that agriculture in these regions, analogous to agriculture in Germany and Poland, over a span of several years developed under completely diverse political and industrial conditions. Delay in the restructuring process of the economy (including agriculture) in Upper Silesia is estimated at about 20-30 years [Mikołajec 2013]. Hence, this analysis is based foremost on a comparison of the potential of agriculture in the researched metropolitan areas and the regions where they are located. Correlation between Poland and Germany is aimed at demonstrating that agriculture in the Upper Silesian Metropolis is less developed than that in the Ruhr Metropolis.

According to source literature, urban agriculture includes the agricultural production which is used in cities and their functional areas [Mougeot, 2010, Lohrberg and Timpe 2011, 2010, Sroka 2014]. Thus, it is established in this analysis that the scope of research encompasses districts that form particular metropolitan areas. Apart from analyses of the whole area of both the Ruhr Metropolis and the Upper Silesian Metropolis, city counties (within those metropolitan areas) are distinctively analyzed. These cities are among the biggest and are characterized by high population density and by some of the highest pressures of the non-agricultural sector on agricultural production. The general description and explanation of the researched metropolitan areas is depicted in the following section.

The Ruhr Metropolis (German: Regionalverband Ruhr) is the biggest polycentric agglomeration in Germany. The origins of the Ruhr Metropolis, seen as a formalized union of districts, go back to 1920. Today, this Metropolis is comprised of 11 city counties (German: kreisfreie Stadt) and 4 rural counties (53 rural and urban communes altogether<sup>4</sup>). Together, they build a polycentric metropolitan area with more than five million inhabitants.

Contrary to its German counterpart, the Upper Silesian Metropolis tends to be delimited in various ways<sup>5</sup>. The *Metropolitan Association of Upper Silesia* was established in Upper Silesia in 2005, comprising 14 city counties that in fact constitute a single city organism, yet this area is not comparable to the Ruhr Metropolis. For the purposes of this paper, the delimitation defined by the Marshal's Office of the Silesian Voivodeship [UWMS 2012] was implemented, and the Upper Silesian Metropolis was considered to

<sup>4</sup> A detailed list of municipalities can be found in [Landwirtschaftskammer NRW 2013].

<sup>5</sup> Many attempts can be found in subject-matter literature at delimiting the Upper Silesian Metropolis properly. The most important of these include: [Runge, Krzysztofik 2011]; [Parysek 2008]; [UMWS 2012]. In addition, many problems are referenced in literature regarding the nomenclature of the area under consideration, which tends to be described as the Upper Silesian Conurbation, the Silesian Conurbation, the Upper Silesian Metropolitan Area, etc. In this paper, both the delimitation and the nomenclature of the metropolitan area was adopted as originally stated by the Marshal's Office of the Silesian Voivodeship.

comprise 23 core municipalities (of which 14 are city counties), as well as 29 communes within the functional area<sup>6</sup>.

The primary data source comprises the results of the agricultural censuses conducted in 2010, information available from the Polish Central Statistical Office (GUS) and the Statistical Authority of the German federal state of North Rhine-Westphalia (IT.NRW), data published by the German Agricultural Chamber seated in Münster/Bonn (Landwirtschaftskammer NRW 2012), and subject-matter literature.

### General characteristics of the compared regions

Ruhr Metropolis is located at the Northwest of Germany in the federal state of North Rhine-Westphalia and is among the largest metropolitan areas in Europe in terms of population size (Table 1). The region is characterized by a very convenient geographic location, and well-developed infrastructure of both roads and waterways. The region occupies in total of nearly 4,500 km<sup>2</sup> [Wuppertal Institut für Klima, Umwelt, Energie 2013]. The Upper Silesian Metropolis is located in the south of Poland, in the central part of the Silesian Voivodeship. The total area, including the functional surrounding municipalities, is approximately 3,500 km<sup>2</sup>, which is approx. 20% smaller than its German counterpart. Like Ruhr Metropolis, it has very well developed road infrastructure (A-4 and A-1 motorways cross the center of the metropolitan area) and is the largest cluster of population and heavy industry in Poland [Runge, Krzysztofik 2013]. Both metropolitan areas are characterized by very high population density and are primarily formed by municipalities with a town status (a city county). City counties also have a very significant share in the overall area. Across the Ruhr Metropolis, these occupy as much as 37.9% of the total area, compared to 34.7% for the Upper Silesian Metropolis.

Table 1. Characteristics of the Metropolitan Areas under comparison (2013)

Specification	No. of municipalities	Area (km <sup>2</sup> )	Population (thousand)	Population density (person per km <sup>2</sup> )
Ruhr Metropolis	53	4 435.3	5 150.1	1 161
City counties in the Ruhr Metropolis	11	1 681.4	3 309.2	1 968
North-Rhine Westphalia	396	34 110.4	17 553.0	515
Upper Silesian Metropolis	52	3 508.2	2 513.7	716
City counties in the Upper Silesian Metropolis	14	1 216.2	1 917.5	1 576
Silesian Voivodeship	169	12 333.0	4 599.4	373

Source: authors' research, based on data from: BDL GUS and IT.NRW

Both the Ruhr Metropolis and the Upper Silesian Metropolis are located within densely populated regions. The current structure and growth potential of both the metropolitan areas and the regions as a whole (the North-Rhine Westphalia and the Silesian

<sup>6</sup> A detailed list of municipalities included in the Upper Silesian Metropolitan Area and its functional areas can be found in: [UMWS 2012].

Voivodeship) under comparison are largely dependent on (partially shared) historical background.

The Ruhr Metropolis and most of the Upper Silesian Metropolis were established and continued to develop during a certain time within a single State organism, i.e. in Prussia, and in Germany as of 1871 [Mikołajec 2013]. Both conurbations flourished mainly through exploration of hard coal (as well as silver, zinc ores in Upper Silesia), followed by growth of heavy industry afterwards. Coal mining in the Ruhr Metropolis began as early as the Middle Ages, and significantly later in the Upper Silesia – only in the 18th century [Pudlik, Garus 2009]. During the following years, the metropolitan areas were developing according to a similar model, with Upper Silesia's economic backwardness continuing throughout that time. Its peripheral location, compared to the core of European growth (England, Germany), as well as various other turbulences (divisions of Silesia, polls, change of the political system of the State), led to the studied conurbations following their consecutive phases of emergence, flourishing and restructuring at different times. Subject-matter literature even mentions the existence of an absolute law of delayed development and decline of mining districts, which is the more prevalent the further to the east the district is located [Mikołajec 2013]. The period of greatest flourish of the industry (and mining) for the Ruhr Metropolis was the 1950s, while the processes of restructuring the economy commenced in the 1970s and continue till the present day [Lageman et al. 2005, Heinze 2013]. The prosperity period for Upper Silesia ended in the late 1970s, and the first attempts at restructuring the mining industry were made during 1998-2001 [Walewski 1999, Pudlik, Garus 2009]. These undertakings have not yielded the desired effects, while the financial and materials crisis still aggravates the issues of Upper Silesian mining and at the same time the entire economy of the region. The proposed objectives of the EU energy policy suggest that the presented “delay theory” will continue to measure up, and in 20-30 years the Upper Silesian economy will, like in the Ruhr Metropolis, cease to be based on coal mining.

The example of Ruhr Metropolis shows that land development and creation of a sustainable urban landscape are among the key tasks faced by (post)industrial metropolitan areas, including the Upper Silesian Metropolis. In the Ruhr, attention was drawn to the fact that the region grew and developed on the basis of hard coal exploitation, yet agriculture used to prevail in the region by the 18th century. Development and support of urban agriculture is currently perceived as one of the major landscape revitalization directions, including development of (post)industrial land and building an image of a green city, friendly to its inhabitants. Hence, it should be unambiguously depicted that there are reasons to carry out comparative studies and the Ruhr Metropolis may be seen as an example for agriculture development in the Upper Silesian Metropolis.

### **The potential and significance of agriculture in the (post)industrial Ruhr Metropolis and the Upper Silesian Metropolis**

In subject-matter literature, there are only few comparative studies concerning urban agriculture in countries with developed economies. According to Danso et al. [2003], few research projects are based mainly on case studies and they are often focused on developing countries where the growth potential of agriculture is compared primarily to the ability to satisfy the nutritional needs of the urban poor. There are also relatively frequent studies on

microeconomic level (case studies), analyzing such factors as profitability, competitiveness, productivity, etc. [Nugent 2001]

In economic studies, growth potential of agriculture can be interpreted and defined in different ways [Pawlak, Poczta 2010]. The word 'potential', derived from Latin *potentia*, means strength, power, but also productive capacity inherent in something or somebody. This is a certain state, which can be judged and evaluated. In cities, agricultural growth potential is determined by such factors as, inter alia, natural conditions, availability of the land element, economic conditions (production size, size of farms, relationship to the market, etc.), socio-cultural conditions (qualities of farm managers and users, their education, motives for working in agriculture, etc.) [Indraprahasta 2013, Abdalla 2012, Van Veenhuizen and Danso 2007, Egyir, Beinpuo 2009]. Furthermore, one of the most essential variables determining the potential and ways of agricultural development are both the condition and the structure of economy, including the unemployment rate, the number and structure of enterprises, demographical or legal conditions (e.g., concerning land management, plans of spatial planning, etc.). Hence, this analysis touches only upon the comparison of chosen indexes concerning the condition of agriculture.

Natural environment should be considered primary for determining the production potential of agriculture. For the regions under comparison, both the climate conditions and soil conditions are quite similar. Since the climate in the Ruhr Metropolis and the North-Rhine Westphalia is more favourable than the climate in the Upper Silesian Metropolis and the Silesian Voivodeship, the vegetation period is prolonged [Witek, Górski 1977].

In the case of soil quality and fitness for agricultural production, there are very significant differences between the soils of the two studied conurbations, but their structure in terms of quality is similar. The best soils in the Ruhr Metropolis are located in the central part of the region, along the east-west axis. Good quality sandy loessial soils stretch from the southern part of the town of Hamm, through the district of Unna, the towns of Dortmund, Bochum, Essen and Mülheim. The soils in that region are characterized by good hydration and high availability of nutrients [Landwirtschaftskammer 2012]. There is also a stretch of good soil in the Upper Silesian Metropolis, located in the central part of the region, from the south-west (Knurów) towards the north-east (to Piekary Śląskie). Of all the largest cities of Upper Silesia, very good soils can be observed in such towns as: Gliwice, Chorzów, Zabrze, Bytom, Świętochłowice, and Piekary Śląskie [Witek 1981]. Despite the local fragments of good soils, the prevailing proportion of soils, both in the Upper Silesian Metropolis and Ruhr Metropolis covers relatively low quality spodic soils and podzols. In the Ruhr, these are located mainly in the northern part, while in the Upper Silesian Metropolis - in the north and south [Landwirtschaftskammer 2012, Witek 1981]. Summing up, it should be concluded that the natural conditions for development of agriculture are similar in both conurbations and they exhibit average natural potential.

When comparing the quality of soils in the Ruhr Metropolis with the regional conditions it should be noted that there are slightly better soils in the North-Rhine Westphalia. While fertile brown earth predominate in these regions, in the northern part poor podzols can be found [Geologischer Dienst NRW 2011]. The opposite situation is found in the Upper Silesian Metropolis where the soils are better than on average in the Silesian Voivodeship. The Silesian Voivodeship is diverse in terms of environmental conditions of agricultural production because the southern part is largely mountainous with poor podzols while the northern part is dominated mainly by sandy soils. It should be

highlighted that quite good soil conditions are visible foremost in the central part of this Voivodeship [Witek 1981].

In urban conditions, availability of land is one of the most important variables, determining the actual growth potential of agriculture. Very high competition for land means that agriculture is pushed away from towns and land is taken over for different types of activities. However, research shows that within the studied metropolitan areas, agricultural land occupies relatively large portions. As much as 39.2% of the total area of the Ruhr Metropolis is occupied by agricultural land (Table 2). In the Upper Silesian Metropolis, this proportion is even higher - it amounts to 42.7%. It is worth mentioning that in both conurbations, even in city counties, over one quarter of the land is dedicated as agricultural land<sup>7</sup>. The share of agricultural land in the total surface of the Silesian Voivodeship is 49.6% while in the North-Rhine Westphalia it amounts to ca. 48.5%.

Table 2. Selected characteristics of agriculture in the Upper Silesian Metropolis Area and Ruhr Metropolis (2010)

Specification	Share of agricultural land in total area* (%)	Share of agricultural lands managed by farms in total area (%)	Average agricultural land area of farms over 1 ha** (ha)	Labour resources AWU <sup>8</sup> /100 ha of agricultural land	Percentage of farms earning more than 50% of their incomes from agricultural activities (%)
Ruhr Metropolis	39.2	32.7	40.0	4.6	55.4
City counties in the Ruhr Metropolis	24.7	19.2	39.6	5.2	53.0
North-Rhine Westphalia	48.5	42.9	40.9	4.3	53.7
Upper Silesian Metropolis	42.7	29.6	10.1	11.5	11.0
City counties in the Upper Silesian Metropolis	33.3	12.3	6.6	16.3	8.6
Silesian Voivodeship	49.6	35.3	7.1	13.8	10.7

\*The data concerns area measured for geodesic purposes

\*\*In Germany, an entity will be considered a farm if its size exceeds 5 hectares, or if it holds an appropriate quantity of livestock (e.g. 10 cattle). In Poland, agricultural farm is an establishment at least 0.1 hectare in size, or having an appropriate quantity of livestock (e.g. 1 cattle).

Source: authors' research, based on data from: LDB GUS and IT.NRW

Nevertheless, only some of the agricultural land presented in geodesic registers belongs to farms. In the towns of the Upper Silesian Metropolis, only 12.3% of land represents agricultural land of farms, while the same ratio for Ruhr Metropolis is at 19.2%. Taking the share of agricultural land managed by farms into account, it should be highlighted that agriculture in the researched metropolitan areas, especially in the city counties, has less importance than in the North-Rhine Westphalia and the Silesian Voivodeship.

<sup>7</sup> These differences arise from the different method of defining agricultural land for the purposes of agricultural censuses and land registry. In addition, some agricultural land may be held by parties other than farms (e.g. businesses, municipalities, etc.).

<sup>8</sup> AWU – Annual Work Unit - The work performed by one person who is occupied in farms on a full-time basis. Persons with a minimum working time of 1,800 hours annually are considered as full-time workers and count as one AWU.

The development potential of agriculture in the given area is not only determined by the available land resources but also by their organization. Only with the right scale and concentration of production is it possible to earn parity incomes and to achieve growth of farms [Ziętara 2009]. Research has shown that the average area of agricultural land in farms in the Upper Silesia is ca. 10 hectares, and is even lower in city counties, at 6.6 hectares. Moreover, only 70% of all agricultural land is available to farms with the area exceeding 10 hectares. These values are significantly lower than in the Ruhr Metropolis, yet higher than the average for the Silesian Voivodeship, where the average size of agricultural land per farms is ca. 7.1 hectares. The proximity of town centers has a positive effect on structural transformations, while in Polish towns and suburbs, the processes of increasing the average area per farm proceed much faster than the Polish average for at least 10 years [Sroka 2014]. Comparing the studied characteristics of the structure of agriculture by farm size between the Upper Silesian Metropolis and Ruhr Metropolis, we should emphasize that farming in the Ruhr is characterized by much more positive values because the average farm has approximately 40 hectares of agricultural land, while 97% of all agricultural land in the area is available to farms larger than 10 hectares. These indexes are comparable to the data applicable for the entire North-Rhine Westphalia.

Highly distributed agrarian structure, including a large number of entities with a small area, usually involves excessive workforce resources. The Upper Silesian Metropolis, like the entire area of southern Poland (including the Silesian Voivodeship) is among the regions with high agrarian overpopulation, based on historical and economic factors [Musiał 2009]. On average 11.5 people work full time (AWU) at the farms in the Upper Silesia per 100 hectares of agricultural land, which is more than twice higher than the value for the Ruhr Metropolis, but lower than it is on average in the Silesian Voivodeship. In both conurbations, employment ratios at farms located in towns are slightly higher than in the remaining areas. The reason for this difference is the higher proportion of intensive cultivation (including vegetable plantations) in overall crop structure. In the Upper Silesian Metropolis, further reasons for this situation can be sought in the farms being more scattered. To evaluate the labour resources in agriculture, it must be emphasized that as a consequence of excessive AWU, incomes are reduced per one worker, which limits growth of the farms that lack adequate funding of investments. Thus, we should conclude that agriculture in the Upper Silesian Metropolis is characterized by less positive qualities of work resources.

The factor derived from low average area of farms and high levels of employment in the Upper Silesian Metropolis is the low proportion of farms that earn their incomes primarily from farming. In 2010, only 11% of individual owners of farms on average would earn over 50% of their income from agriculture. For comparison, all other farms in the Ruhr Metropolis can be defined as being dependent mainly on farming. Thus, it can be clearly concluded that agriculture in the Upper Silesia exhibits significantly lower earning potential. Nevertheless, both in the Ruhr Metropolis and Upper Silesian Metropolis the share of urban farms earning their income mainly from agriculture is higher in the North-Rhine Westphalia and the Silesian Voivodeship respectively.

The potential and importance of agriculture in any given territorial unit or country is not only determined by production resources but also by production volume. Moreover, production volume itself, and its scale and structure, indicates the actual utilization of production factors. One of the most important variables that illustrate the condition of plant production is the structure of agricultural land (Table 3). In both conurbations, the vast

majority of agricultural land (over 2/3) is occupied by crops, and in the city counties of the Upper Silesian Metropolis their share is over 16 percentage points (p.p.) lower than in the city counties of the Ruhr Metropolis. Similarly, there is less permanent pasture in Upper Silesian towns (by 8.6 p.p.). The relatively low share of crops and grassland is due to the high proportion of land excluded from agricultural production. In towns in particular, but across the entire Upper Silesian Metropolis as well, over 16% of all agricultural land is not maintained in good agricultural condition (wasteland). To this, we should add the large areas of permanent pasture which is not used for production (ca. 17% of total grassland). In fact, this data can be even slightly understated, as it does not include agricultural land in possession of farms. For comparison, agricultural land not maintained in good agricultural condition represents ca. 5.8% of total agricultural land in Poland, however outside the south of Poland which is a highly scattered territory in terms of agriculture, this ratio is below 3%.

Table 3. Structure of agricultural land of farms in the Upper Silesian Metropolis and Ruhr Metropolis (2010).

Specification	Percentage of crops in agricultural land (%)	Percentage of permanent pasture in agricultural land (%)	Percentage of permanent crops in agricultural land (%)	Percentage of other land in agricultural land (%)
Ruhr Metropolis	69.2	30.2	0.4	0.2
City counties in the Ruhr Metropolis	71.8	27.1	0.6	0.5
North-Rhine Westphalia	71.9	27.1	0.9	0.1
Upper Silesian Metropolis	67.3	15.5	0.9	16.3
City counties in the Upper Silesian Metropolis	55.5	18.5	1.5	24.5
Silesian Voivodeship	60.9	19.6	0.8	18.7

Source: authors' research, based on data from: LDB GUS and IT.NRW.

As we evaluate the scale of exclusion of land from agricultural production in the Upper Silesian Metropolis, it should be considered even three times higher than in other regions of Poland, but lower than it is on average in the Silesian Voivodeship. A large share of agricultural land that is not maintained in good agricultural condition is depicted only in city counties. In Ruhr Metropolis cities, wasteland constitutes a very small proportion of land owned by farms, and is usually only temporary (due to greening processes). The German legal solutions seem to be more effective in protecting the market of agricultural land from undesired activities, particularly speculative activities that can be enhanced around towns. Trading in agricultural land, including the processes of splitting or withdrawal of agricultural status, tends to be very carefully monitored and evaluated by the agricultural chambers, *inter alia* [Sroka and Ender 2011]. High percentages of land excluded from agricultural production in the Upper Silesian Metropolis can be partially explained by the different method of defining farms. Nevertheless, it should be expressly stated that the production potential of agriculture in Upper Silesia is not fully utilized. There are invasive plants or shrubbery frequently prevailing on set-aside land, which significantly limits the possibility of returning land to productive use in the future.

Land is the primary production factor in agriculture, and land resources constitute only a dormant potential. The intensity of agriculture organization is important as well, including

the structure of crops and intensity of animal production. Within the studied metropolitan areas, the structure of crops is dominated by cereals, mainly wheat and barley (Table 4). Still, certain major differences can be noticed here, as the percentage of cereals in the Ruhr Metropolis is almost 20 p.p. lower than in the Upper Silesian Metropolis. It turns out that cereals often give way to plants grown for industrial purposes there (oily plants) and fodder plants (e.g. corn, leguminous plants for forage). The latter constitute over 20% of crops and are located mainly in regions with high intensity animal production. Similar structure of crops is prevalent also in the North-Rhine Westphalia.

Farming in the Upper Silesian Metropolis is quite clearly no match for farming in the Ruhr Metropolis in terms of the share of vegetables in the overall area of crops. There, the percentage of land occupied by vegetables is ca. 2.5%, yet as many as 12% of all farms in Ruhr Metropolis are engaged in growing vegetables [Pölling, Born 2015]. This percentage is twice as high as the average for North Rhine-Westphalia, and more than 20 times higher than in the Upper Silesian Metropolis.

Table 4. Selected characteristics of the production potential of agriculture in the Upper Silesian Metropolis and Ruhr Metropolis (2010)

Specification	Percentage of cereals in crops area (%)	Percentage of vegetables in crops area (%)	Percentage of farms with animals (%)*	Stocking density (LSU per 100 hectares of agricultural land)
Ruhr Metropolis	61.1	2.5	79.7	122.6
City counties in the Ruhr Metropolis	65.7	2.6	72.9	88.7
North-Rhine Westphalia	61.3	1.9	77.5	120.7
Upper Silesian Metropolis	80.1	0.8	45.7	73.2
City counties in the Upper Silesian Metropolis	76.6	2.1	36.8	63.7
Silesian Voivodeship	79.5	0.6	49.3	69.5

\*Farms over 1 ha are used as a basis for calculations

Source: authors' research, based on data from: LDB GUS and IT.NRW.

The relatively high proportion of vegetable crops in city counties, both in Ruhr Metropolis and the Upper Silesian Metropolis, is worth emphasizing. This index outnumbers average indexes for the Silesian Voivodeship and the North-Rhine Westphalia.

The interest of urban farmers in growing vegetables is a product of the mechanism of land rents. Specifically, in urban conditions where alternative forms of development of agricultural land are relatively highly available, agricultural producers will decide to cultivate the land only if it brings higher benefits than the other types of activities. This is often only possible in the case of high intensity crops, such as vegetables, potatoes, and permanent crops. High levels of interest among the Ruhr farmers in vegetable production is also due to the increasing demand for regional products, i.e. those produced as close as possible to the point of sale [Banik et al. 2007].

Another very important division of agricultural production is animal production. In highly urbanized areas, particularly in close proximity to large populations, animal production is often not permitted, due to disease hazards, or risk of water contamination [Schulz et al. 2013]. Another reason for prohibition to set up new farms in urban zoning plants, particularly farms with animals, is the unpleasant odor [Tokajuk 2011]. Nevertheless, despite the potential conflicts between animal production and towns, there are

still numerous farms at the outskirts of town that breed cattle, swine and horses. As many as 73% of all farms in Ruhr Metropolis have animals, and some of them (ca. 30% of all farms) keep horses that are used for riding. There are as many as 10 horses per 100 hectares of agricultural land, which is five times higher than for the Upper Silesian Metropolis. The regions being compared exhibit relatively significant differences in terms of animal production intensity: livestock density in the Ruhr Metropolis exceeds 122 LSU per 100 hectares of agricultural land, while in the Upper Silesia it is at 73.2 LSU per 100 hectares of agricultural land. These two cases show that the values are higher than they are, on average, in regions where these metropolitan areas are located.

Considerable difference should be noted when comparing the data of the researched metropolitan areas. There are 90 cattle per cattle-breeding farm on average in the Ruhr Metropolis (ca. 10 animals in the Upper Silesian Metropolis), and 590 swine per swine-breeding farm (ca. 90 animals in the Upper Silesian Metropolis). The analogous indexes for both the North-Rhine Westphalia and the Silesian Voivodeship are from several to a few hundred percentage points lower, but the greatest differences are evident in Poland. The average size of a herd of cattle in the Silesian Voivodeship, for example, consists of 30 head, which is 3 times smaller than in the Upper Silesian Metropolis. In contrast, in the North-Rhine Westphalia the average head of cattle amounts to 83 head, which is 9 head less than in the Ruhr Metropolis.

Analytic studies have confirmed that in city counties of the conurbations under comparison, livestock density is relatively low, at 88 LSU per 100 hectares of agricultural land in the Ruhr Metropolis and 63.7 LSU per 100 hectares of agricultural land in the Upper Silesian Metropolis. In the Ruhr, large animal stocks are mainly located in the "rural" part of the conurbation, i.e. in Wesel and Recklinghausen districts, where the natural conditions (poor soils) predispose these areas mainly from agricultural production, with the use of permanent pasture.

To sum up, it should be emphasized that both metropolitan areas indicate quite higher intensity of animal production than the regions where they are located. This is indicated both by higher density of livestock and by higher concentration and perhaps professional character of agricultural production.

## **Summary and conclusion**

The development conditions, and the importance and potential of urban agriculture in densely populated and urbanized regions of Europe seem to be insufficiently recognized. This is due to the decreasing importance of the agricultural sector and the seemingly antagonistic relation of towns to agriculture. Still, research shows that farming has been and will probably continue to be present even in the largest metropolitan areas of Europe. (Post)industrial agglomerations have a special place here, as they expanded strongly in their times of greatness, flooding the surrounding locales. Research has shown that despite the strong pressure on urbanization, there are still large agricultural land areas present there. Almost 40% of the total area, both in the Ruhr Metropolis and the Upper Silesian Metropolis, comprises land identified in the registers as agricultural land. Thus, it should be emphasized that in the studied metropolitan areas, agricultural land constitutes the key component of urban space in terms of the area it occupies.

Analysis of selected characteristics of agriculture of the Ruhr Metropolis and the Upper Silesian Metropolis has clearly proven that they are characterized by a quite similar potential than the regions where these metropolitan areas are located. The average size of the surface of farms in the Upper Silesian Metropolis is slightly higher than in the Silesian Voivodeship (in the Ruhr Metropolis it is lower than in the North-Rhine Westphalia). The researched metropolitan areas, especially city counties, are marked by a considerably higher share of vegetables in the structure of crops than it is on average in the analyzed regions. Even the intensity of animal production measured in terms of stock density is larger in the researched metropolitan areas than in the Silesian Voivodeship and North-Rhine Westphalia. The conducted research has shown that in city counties, namely big urban centers, the significance and potential of agriculture is slightly lower. Farms are smaller than in the entire metropolitan areas and the indexes of employment as well as the intensity of animal production are less beneficial.

Comparing the analyzed metropolitan areas it should be highlighted that the differences in the level of development of agriculture and of the entire economy of the Upper Silesian Metropolis and the Ruhr are the product of certain historical background, i.e. different conditions for development that prevailed during the last several hundred years. The Upper Silesian Metropolis indicates considerably lower potential of agriculture than the Ruhr Metropolis. This concerns almost all analyzed indexes. The main problem of the Silesian Voivodeship is seen in the huge acreage (above 16% of agricultural land) of land out of agricultural production and not maintained in good agricultural condition.

In order to sum up the conducted analyses, a positive verification of the hypothesis saying that the potential of urban agriculture in the Ruhr Metropolis and the Upper Silesian Metropolis is similar to the North-Rhine Westphalia and the Silesian Voivodeship respectively should be made.

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