

CHANGES IN THE SCALE AND STRUCTURE OF FARM PRODUCTION IN METROPOLITAN AREAS IN POLAND

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ABSTRACT

The aim of this analyses was to assess the changes in the organisation and scale of plant production of commercial farms located within varying distances from the core of metropolitan areas. The analysis covered a total of 1,854 commercial farms from Pomorskie, Wielkopolskie, Mazowieckie, Lubelskie, Dolnośląskie and Małopolskie voivodeships that participated in the FADN system over an uninterrupted period between 2004 and 2016. In the study population, entities engaged in production in various functional zones of metropolitan areas (MA) were identified. The study found that in the commercial farms operating in the inner zone of MAs, field cropping and horticulture are gaining importance while livestock production is subject to marginalisation.

Key words: metropolitan area, location theories, agricultural farm, plant production, Poland

JEL codes: Q10

INTRODUCTION

Modern-day analyses of the distribution of agricultural production around urban centres in European cities do not show clear trends. Social, economic and environmental factors overlap with the location factor, making the process of inference much more difficult. The attempts to develop a coherent theory and to zone agricultural production in relation to large urban centres must take into account, in addition to the factor of distance and derivatives of transport costs, the quality and fitness of a given area for agricultural production, the size and economic impact of the urban centre, distance from other economic centres and the level of infrastructural development of the area under study, including, in particular, the functionality of the existing transportation networks [Wojewodzic 2017].

Land, due to its specific qualities (i.e. it cannot be multiplied, is rare, has fixed location, is indestructible), attracts the interest of many economic entities [Szymańska 2015]. It is a fundamental means of production, necessary in each area of human activity. Used for food production, it plays a double role in agriculture, being both the place and means of production. In the age of globalisation, advanced industry and its infrastructure, land as a means of production becomes a desirable good, for which demand is systematically growing [Deng et al. 2015]. Land is increasingly used to locate human and industrial settlements, transportation routes and recreation centres [Górska and Michna 2010]. One of the main negative effects of the development of society and urbanisation is loss of arable land [Liu et al. 2014].

Therefore, the resources of agricultural land¹, which shrink as a result of being converted to non-

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agricultural purposes, should be rationally used by situating agricultural production in an appropriate way. The taking over of land by other sectors, as well as the ineffective use of agricultural land in Poland in the early 1990s, led to a significant reduction in the size of agricultural area, reducing the production capacity of national agriculture [Szymańska 2015]. Effective management of land (and the use of other means of production) is becoming more difficult, as it is determined by a range of factors, both micro- and macro-economic, including environmental issues (connected, among other things, with the quality of soil and climatic conditions), financial issues (which take into account the distance from sales market translated into transportation costs) and social issues (connected with expectations of local residents as to the provision of a clean environment, neutralisation of odours or elimination of the noise accompanying agricultural production).

The rationale of gainful activities dictates that every entity, including agricultural farms, should take into account the location of its activity, as well as identify and establish the criteria for choosing the location [Lange 1959]. The relation between the costs of production, price, the level of profit and the location of production as well as the socio-economic effects of a certain location of production are the subjects of widespread interest in economics. Many studies attempt to explain the mechanism of locating activity – production – in specific geographic areas and, simultaneously, to provide an answer to the essential question of rational management: how and using what criteria should we choose the most economically efficient location? [Boroń 1962]. The above issues have provided the basis for attempts to address the problem of linking agricultural activity with location, and to find out whether there are changes in these linkages and if so, in what direction.

MATERIAL AND METHODS

The aim of the research was to identify and assess the changes in the organisation and scale of plant production of commercial farms located within varying distances from the core of metropolitan areas (MA). Metropolitan area is not defined in a consistent way in either the literature or the Polish system of law, which gives some variability in the interpretation of this term [Sroka et al. 2018]. For the purpose of meeting the aims of the project, the paper uses the definition of MA presented in the National Spatial Management Concept 2030² [MRR 2011], according to which a metropolitan area is the area of a large city (with over 300 thousand inhabitants) along with its functionally connected direct environment.

This study covers commercial farms located within six voivodeships, i.e.: Pomorskie, Wielkopolskie, Mazowieckie, Lubelskie, Dolnośląskie and Małopolskie. These regions were selected to reflect the huge diversity of the environmental and economic conditions in Poland. Based on planning documents (i.e. plans or studies of spatial management), in each of the selected voivodeships three locational study zones were distinguished: ‘inner zone of MA’ (i.e. municipalities directly bordering the core), ‘outer zone of MA’ (the remaining municipalities within MA that do not directly border the core) and the part of a voivodeship outside of a metropolitan area referred to as ‘outside of MA’ [Sroka et al. 2018].

The source material was numerical data obtained from the database of the Polish FADN (Farm Accountancy Data Network). Of the 3,508 farms that participated in the FADN system for an uninterrupted period between 2004 and 2016, entities carrying on agricultural activity in the voivodeships selected for the study were identified, i.e.: 1,854 commercial farms, 46 of which functioned in inner zones of MA, and 143 in

¹ The literature stresses the negative impact of the dynamic pace of the cessation of using land for agricultural purposes on Poland’s food security. Wilkin [2011] stresses that this pace is twice as fast as the average for the OECD countries. More on the reduction of agricultural land in Szymańska [2015].

² The National Spatial Management Concept 2030 is the most important national strategic document concerning national spatial management. It was created in compliance with the provisions of the Law of 27 March 2003 on spatial planning and management.

outer zones. For the identified groups of farms, a comparative analysis was conducted, taking into account changes in the cultivation area, structure of the value of production and production type (dominant direction of production).

The discussion presented in this paper uses the terminology of the FADN system. According to the Community typology for agricultural holdings, there are, depending on the amount of detail required, 8 general types, 21 principal types and 61 particular types of farming. Due to the relatively small number of farms located in the metropolitan areas covered by the analysis, part of the discussion was limited to changes in the general type of farming. The adoption of a higher level of data aggregation was also connected with the methodological changes made in 2010. As the criterion of the assessment of a farm's economic size and assessment of the type of farming, standard gross margin (SGM) was replaced by standard output (SO). Thus, the type of farming is determined by the contribution of the standard output of the different groups of a farm's activity to the total value of SO. Based on that, in accordance with the Community typology for agricultural holdings, the following general types of farming were distinguished: field cropping, horticulture and permanent crops. The analyses were extended to include the so-called mixed type, which refers to farms focused, to a similar extent, on both mixed cropping and livestock.

The dynamic analysis of production value took into account changes in the time value of money, adjusting the nominal values by yearly price indices of consumer goods and services adopted based on the announcements of Statistics Poland [GUS n.d.].

THEORIES OF AGRICULTURAL PRODUCTION LOCATION

Spatial economics gives a lot of attention to the factors determining decision-making by economic entities functioning in a given area. This allows studies of metropolitan areas to draw on the achievements of location theory and rent theory, the dynamic development of which was initiated in the early 19th century by representatives of classical economy, such as Smith [(1776), 1954] or the continuator of his

thought, Ricardo [(1817) 1957], as well as the creator of the first theory of spatial location, von Thünen [1826], the precursor of the theory of the optimal location of an enterprise, Weber [1909], and Lösch [1954], who is considered to be the father of spatial management. They pointed out that economic activity can generate various costs and bring various benefits depending on where it is carried out. They often used agriculture and agricultural markets to conduct their observations.

However, in terms of the subject addressed in this paper, more significant are various location (geographical) rents, first explored by von Thünen [1826]. In the model he developed, the central place was occupied by a city, which constituted the only agricultural market for the products produced in its environment. The area within reach of the city's impact was by definition homogeneous in terms of the quality of land and transportation conditions, and the produced agricultural products could be transported directly to the city. Assuming that the costs of transportation are proportional to the distance and there is free competition between sellers, four concentric zones (rings) around the urban centre were identified. Thünen [1826] pointed out that intensive production of vegetables and milk should be located in the first ring, which directly borders the city, followed by forestry production (firewood), cereal and potato production in the next rings, and fodder plant production and livestock farming in the fourth ring. In his works, he showed that the owners of land and labour (the so-called fixed factors of production) located outside of the centre must incur the costs of transport and communication by themselves in order to survive on the market. This put them at a disadvantage in relation to those carrying on their activity in the centre. Thünen also noted that the spatial variation in the remuneration of capital and technological knowledge (the so-called variable factors of production) would lead to relocation of the activity from places generating lower income to places where the income could be higher [Kasper 2014].

Thünen's observations were developed by other scholars such as: Jonasson [1925] and Sinclair [1967], who addressed the subject of creating rational feeding zones around ever more dynamically growing large cities. Swedish geographer Jonasson, taking into

account transportation costs, indicated the validity of locating activity characterised by higher intensity near the city. According to his findings, horticulture should be located in immediate proximity to the centre, while in the next rings: milk production, less intensive plant production and livestock farming, and forestry furthest from the centre.

The 19th and 20th centuries saw expansion of large cities, which, seeking space for quickly developing industry and increasing population, absorbed the neighbouring agricultural areas and covered them with a dense network of technical infrastructure, which led scholars to change their approach to the theory of location. Developing the theory of central market, Sinclair [1967] formulated the so-called theory of reversed Thünen's rings, according to which production performance and production per unit of area grow with the distance from the urban centre. Changes in the distribution of agricultural production are mainly explained by the impact of urbanisation on the prices of agricultural land. According to this theory, urban agriculture and temporarily used land are located nearest the urban centre (large city), while the next rings are occupied by cereal and milk production, fruit cultivation and horticulture.

RESULTS AND DISCUSSION

The scale and structure of plant production is significantly impacted by environmental and climatic conditions. An increasingly important role in the selection of arable crops and production technology is played by economic and social factors, including, among other things, the amount of land, labour and capital, location relative to the markets, level of prices, legal regulations impacting the level of prices and costs, and possibility of benefiting from institutional rents, including production-related payments. The exact location of a farm has a significant impact on the level of income earned by the farmer and economic viability of his/her production.

The impacts of the above-listed factors shaping the structure of agricultural production overlap. The analyses showed that irrespective of a farm's location relative to the core of the metropolitan area, there was a clear increase in the average size of agricul-

tural area, which indicates that the analysed groups of farms tend to increase their production capacity. A factor that significantly limits the development potential of commercial farms is the supply of land. The willingness to sell land is mainly reported by small-size farms resigning from agricultural production [Wojewodzic 2017]. Higher capacity of labour markets within metropolitan areas facilitates the abandonment of processes of agricultural production by farm owners. However, with a highly stable situation in terms of land management, i.e. an almost complete lack of transactions of land purchase and sale, especially in the southern part of Poland, one can surmise that it is usually the smallest and most remote plots that are subject to the abandonment of cultivation [Musiał and Płonka 2012].

In the analysed selection of commercial farms, it was found that an increase in the average size of agricultural land was higher in the 'outer zone of MA' (by 40.3%) than in the 'inner zone of MA' (by 8.6%). One cause may be the fact that in close proximity to cities and transportation routes, the land of agricultural farms that are closed down is captured for non-agricultural uses (residential and infrastructural), which is mainly determined by land prices. In the outer zones of metropolitan areas, there is less pressure towards changing the use of land, as the possibilities for using land that has been freed up for non-agricultural purposes are more limited, and so this land is usually taken over by agricultural farms. Outside of metropolitan areas, agriculture often constitutes the main sphere of economic activity. There is a relatively low demand for labour in non-agricultural sectors in these areas, which leads to a smaller number of farmers resigning from agricultural activity [Satoła et al. 2018]. Also, the average size of the analysed commercial farms was smaller than it was near cities (Table 1).

In the analysed period between 2004 and 2016, there were visible changes in the structure of sowings. All of the analysed groups of farms recorded a noticeable increase in the area covered by cultivation of cereals, but it was slower than the increase in the agricultural area, which resulted in a decline of this group of plants in the structure of sowings. At the same time, it was observed that the share of cereals

Table 1. Selected parameters of plant production in the analysed agricultural farms in 2004 and 2016

Specification		MA inner zone	MA outer zone	Outside of MA
Average area in a farm (ha)				
Total agricultural area	2004	38.4	29.8	27.0
	2016	41.7	41.8	32.9
Cereals	2004	26.9	19.4	17.3
	2016	27.2	24.7	18.6
Vegetables and flowers	2004	1.8	0.7	0.6
	2016	1.3	0.4	0.4
Permanent crops	2004	0.2	0.2	0.4
	2016	0.2	0.2	0.8
Legume crops	2004	2.1	5.3	4.9
	2016	1.4	8.5	6.6
Agricultural area excluded from production ^a	2004	0.1	0.1	0.2
	2016	0.3	0.7	0.4
Share of farms increasing (%)				
Agricultural area		56.5	71.3	59.6
Abandoned land		4.3	11.9	7.0
Fallow land		17.4	11.9	9.2
The area of the cultivation of vegetables and flowers		10.9	6.3	8.2
The area of permanent crops		4.3	4.2	8.5

^aSum of the area of abandoned land (SE072) and fallow land (SE073).

Source: authors' own survey on the basis of data of FADN.

in the structure of agricultural area decreased with the growing distance of farms from the centre of metropolitan areas. The simultaneous increase in the area of farms and decrease in the share of cereals in sowings suggest that intensification in the processes of production take place.

The average area of flower and vegetable cultivation in commercial farms classified to an inner zone of MA was almost three times bigger than in the case of entities located outside of metropolitan areas. However, both the area of crops and their share in the structure of sowings decreased significantly in all of the analysed groups of farms. In farms located outside of metropolitan areas, the area of permanent crops doubled, and the area of legume crops saw a significant increase. While in agricultural farms located in

an inner zone of MA the share of legume crops in agricultural area was 3.4% in 2016 and showed a declining trend, in the other two study areas it exceeded 20% and slowly increased.

Changes in the size of farms specialising in plant production, as well as changes in their organisation, impact changes in the value of production generated by farms. All of the analysed groups of commercial farms recorded an increase in the value of production between 2004 and 2016. The biggest increase in total output was observed in farms located in external zones of metropolitan areas. However, it was to a large extent due to an increase in the area of exploited land. Plant cultivation clearly dominated in the structure of total output in the farms located in municipalities directly bordering the core of MA. In entities operating

outside of metropolitan areas, the value of livestock production in 2016 was similar to that of plant production, with the value of plant production increasing faster (Table 2). The observed changes in the value of production show that livestock production is pushed from inner metropolitan areas to the areas further away from the central city, where the production can be carried out without protests from city residents.

The production structure of the commercial farms participating in the FADN system is indicated in a synthetic way by the ‘type of farming’, which reflects the level and direction of specialisation. The analysed population of farms specialising in crops was very diverse in terms of structure (Table 3). In the inner zone of metropolitan areas, there was a clear dominance of farms specialising in field cropping such as cereals, oil plants or legumes, among other things. In the outer zone of MA, just as outside of metropolitan areas, so-called

mixed farms without a clear dominance of any type of activities constituted the biggest group. Particularly interesting from the perspective of these studies were changes in the structure of the analysed farms. The inner zone of MA saw further increase in the number of farms specialising in field cropping, and the number of farms engaged in horticulture also grew. This is a result of the following polarisation of production activity. Some people, who also have off-farm jobs, simplify crop rotation by increasing the share of plants requiring less labour. The other group intensifies the use of land. For instance, by developing horticulture, they strive to achieve higher productivity (and profitability) from unit area. This is particularly important in situations where it is impossible to increase the area of a farm.

An interesting subject of observation is the directions of the changes of farms in the different groups under study. Farms specialising in field cropping

Table 2. Value of agricultural production in the farms analysed (in fixed prices from 2016) in the period 2004–2016

Specification	Years	MA inner zone	MA outer zone	Outside of MA
		On average in PLN 1 000 / 1 ha of AA		
Plant production	2004–2006	4.5	3.0	3.3
	2014–2016	5.8	3.1	3.8
Production in total	2004–2006	5.8	6.6	7.0
	2014–2016	6.4	6.9	7.7

Source: Authors’ own survey on the basis of data of FADN.

Table 3. Share of selected farming types in the different zones in 2004 and 2016

Specification (farming types)	Years	MA inner zone	MA outer zone	Outside of MA
		%		
Field cropping	2004	47.8	21.0	19.6
	2016	67.4	28.7	28.5
Horticulture	2004	4.3	0.0	2.9
	2016	8.7	0.7	3.9
Permanent crops	2004	2.2	1.4	3.6
	2016	0.0	2.1	4.6
Mixed	2004	32.6	42.7	43.6
	2016	17.4	33.6	32.1

Source: Authors’ own survey on the basis of data of FADN.

Table 4. Changes in the farming type of the analysed farms between 2004 and 2016

Specification (farming type)	Metropolitan areas			Outside of metropolitan areas		
	2004	type changing	preferred directions in type of changes ^a	2004	type changing	preferred directions of type changes (TF8) ^a
	number of farms			number of farms		
Field cropping	52	7	dairy cows horticulture mixed	327	81	mixed permanent crops horticulture
Horticulture	2	0	–	49	8	field cropping mixed
Permanent crops	3	1	horticulture	60	9	field cropping horticulture dairy cows
Mixed	76	36	field cropping dairy cows granivores	726	364	field cropping dairy cows other grazing livestock

^a Three most selected directions of changes arranged by prevalence.

Source: Authors' own survey on the basis of data of FADN.

changed production type relatively seldom (Table 4). In the metropolitan area, only 5.8% changed their profile to milk production, followed by horticulture and mixed production. Meanwhile, 12.8% of farms engaged in field cropping outside of metropolitan areas decided to convert the existing activity to mixed production, seeking opportunities in diversification of crops and kept groups of animals.

Analysis of the direction of changes in the other types of farms showed that these changes were very similar, which means that the location of farms relative to the core of the metropolitan area is less significant. The most common directions of change were an increase in the importance of field cropping, increase in milk production and diversification of activities (mixed types).

CONCLUSIONS

Also today, we can see variation in the scale and structure of production around regional centres of development. The analyses conducted in this paper confirm the phenomena known from economic theory. In the population of commercial farms operating in the inner zone of MA, there is a visible extension of agricultural production. The share of cereals in the structure of sowings remains at a high level, while

both the number of herds and the scale of livestock production have become reduced, which is evidenced by a smaller share of livestock production in the total value of production. The outer zone of metropolitan areas recorded a relatively fast increase in the area of farms, which facilitated an increase in the area of cereal and fodder plant cultivation. The group of farms located outside of metropolitan areas was characterised by a relatively high share of permanent crops and increasing importance of livestock production. The changes observed in the structure of agricultural production show that livestock production is pushed from inner metropolitan areas to zones further away from the core of a metropolitan area.

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ZMIANY W SKALI I STRUKTURZE PRODUKCJI TOWAROWYCH GOSPODARSTWACH ROLNYCH NA OBSZARACH METROPOLITALNYCH POLSKI

STRESZCZENIE

Celem podjętych analiz była ocena zmian w zakresie organizacji i skali produkcji roślinnej gospodarstw towarowych zlokalizowanych w różnej odległości od rdzeni obszarów metropolitalnych. Analizą objęto łącznie 1854 gospodarstwa towarowe z województw pomorskiego, wielkopolskiego, mazowieckiego, lubelskiego, dolnośląskiego i małopolskiego, które nieprzerwanie prowadziły rachunkowość rolną w ramach systemu FADN w latach 2004–2016. W badanej populacji wyodrębniono podmioty prowadzące produkcję w różnych strefach funkcjonalnych obszarów metropolitalnych (OM). Przeprowadzone badania wykazały, że w populacji gospodarstw towarowych prowadzących swą działalność w wewnętrznej strefie OM następuje wzrost znaczenia upraw polowych oraz produkcji ogrodniczej a marginalizacji podlega produkcja zwierzęca.

Słowa kluczowe: obszar metropolitalny, teorie lokalizacji, gospodarstwo rolne, produkcja roślinna, Polska