GLL

EVALUATION OF POSSIBILITY TO USE TYPOLOGICAL PROCEDURE AND WROCŁAW TAXONOMY TO ANALYSE AGRICULTURE DEVELOPMENT CONDITIONS ON THE EXAMPLE OF THE FORMER KRAKÓW VOIVODESHIP COMMUNES

Barbara Prus, Marta Szylar

Summary

The paper presents comparative analysis of two methods: typological procedure and Wrocław taxonomy method. Possibilities of their usage to evaluate agriculture development conditions were also presented. Particular attention was paid to comparison of proceedings course, particular methods stages and also gained results. Chosen analysis methods allow to delimitate problem-areas for which the tested phenomenon has got complex character. Agriculture development conditions are influenced by numerous factors starting from variables of natural character, through demographic determinants economic factors in other words called socio-economic factors. Presented procedures allow to distinguish areas similar with regard to some features found as diagnostic ones, whereas these methods can be used to describe multipurpose phenomena because variables number accepted to the analysis is not restricted and the research area can be freely selected. The received result is helpful to estimate affiliation to extracted commune types. Analyses were performed in the area of the former Kraków Voivodeship excluding the municipal commune of Kraków. A commune was the field of the basic evaluation of performed research. Comparison of typological procedure and Wrocław taxonomy method allows to conclude about advantages and disadvantages of particular methods. The range of described methods applicability is also possible to define.

Keywords

typological procedure • Wrocław taxonomy • agriculture development conditions

1. Introduction

Performing development determinants analysis needs among others using of methods that enable to identify problems and delimit areas with compliance of a big number of research variables [Prus 2014, Leszczyńska 2010]. The main task of research evaluative methods is to systematize the set of elements with regard to chosen features [Kolenda 2006]. In spatial researches concerning territorial units, the main aim is both to system-

atize them and also to indicate possible links and dependences occurring between them [Frankowski 1991]. Thanks to procedure performed in such a way, assignation of similar types of units which fulfill uniformity requirements in the range of morphological, structural, functional and genetic features can be performed. So the effect of these researches is not only tested objects set taxonomy but also possible description of developmental processes and cause-and-effect connections [Śleszyński 2012]. Showing similarities or differences between chosen areas can have numerous practical applications. First of all, it enables evaluation of socio-economic conditions [Gawroński et al. 2014], development state of tested area or for instance land development and investment. Information about problematic grounds occurrence is useful while preparing local plans, regional programmes and development strategy [Wysocki 2010].

Both typological procedures and taxonomic methods are used in almost every science field [Domański 1964, Frankowski 1991]. Typology is most often used in such fields as botany or zoology, however, geography also uses that procedure in order to organize research units or spatial testing of phenomena arrangement. Typology fulfills various functions which can be written in three words: terminological, evaluative and heuristic. Terminological aim consists in introducing systematized and precise ideas in the range characteristic for a given scientific field. Evaluative objective is connected with need to systematize the set of elements such as things and phenomena that belong to the definite scientific field. However, heuristic aim results from necessity to describe the set of things and phenomena in the way which allows to compare it with definite types that in turn allows to reveal facts and regularities not noticed earlier [Domański 1964, Wysocki 2010].

Among area delimitation methods that enable to research multi-criterion phenomena, the typology procedure (that consists in separating similar areas which fulfill uniformity requirements in the range of representative features) and also the Wrocław taxonomy method (which allows to analyse phenomena of complex character on the basis of dendrites theory assumptions) can be distinguished [Kowalski 1977]. Typological procedure not only enables to systematize spatial units but also allows to value objects paying special attention to tested phenomena so it allows to define which of types chosen in that procedure has got the most favourable conditions. The Wrocław method being one of taxonomic procedures shows most of all connections between particular research units (e.g. communes). The Wrocław taxonomy is included in dendritic methods and is based on rules and definitions that come from the dendrites theory. It allows to construct a dendrite map which is a coherent and open one [Grabiński, Wydymus, Zeliaś 1989]. The basis to build a dendrite map is a distance between objects matrix. The dendrite map consists of vertexes that represent particular elements (territorial units) and linking edges the length of which depends on distances between units [Nowak 1990].

An article is based on the analysis of agriculture development conditions which served to delimit areas by means of two methods. Agriculture is one of the oldest forms of human activities and at the same time one of basic economy branches. Agriculture history includes millennia of transformations first connected with adaptation to local

natural conditions and later to economic and social changes. However, the goal was still the same – it was and is to produce food products by plants growing and animals breeding. But agriculture influence is much wider. It not only contains food economy but also shapes environment, changes landscape, delivers raw materials for the industry, creates worksites and influences regional politics [Bański 2007, Bański 2013]. Hence, agriculture development state evaluation should be based both on analysis that concerns actual situation of the particular region [Fogel 2010] and also study of effects that result from historical causations. Polish rustic lands still demonstrate considerable diversity both with regard to various natural and social conditions [Dudzińska M., Kocur-Bera K. 2014; Konieczna J., Trystuła A., 2014; Nowak M., Pawlewicz K., Szczepańska A. 2014], historical post-communist events [Kühne et al. 2015] as well as post-annexation ones [Hałasiewicz 2010]. The research of units spatial diversity state from the agriculture development conditions point of view is still very important especially because of occurring socio-economic and environmental transformations or changes connected with technical development [Bański 2013].

Research area presented in the paper contains the part of Małopolskie Voivodeship within the administrative borders of the former Kraków Voivodeship. Kraków Voivodeship existed in the years 1975–1998 as the one of 49 voivodeships. It came into existence by virtue of the Act from 28th May 1975 about two-stage administrative division of the country and about the change of the Act about national councils. The voivodeship's area included about 3,254 km^2 inhabited by over 1.2M people. Rural economy of the former Kraków Voivodeship was characterized by flaked territorial structure of individual farms which was distinguished by crops mosaic [Baran-Zgłobicka, Zgłobicki 2012], diverse structure of possession and also decrease of arable lands area in favour of non-agricultural usage [Bański 1997, Salata et al. 2015, Prus 2012].

The aim of the paper is to evaluate possibilities of using the Wrocław taxonomy method as well as typological procedure to study research units spatial diversity degree paying special attention to agriculture development conditions. Methods presented in the paper: the typological procedure and the Wrocław taxonomy method served to delimit communes of the former Kraków Voivodeship in order to reveal similarities between these administrative units considering agriculture development conditions. They also allowed to classify lands with the most and the least favourable conditions of agriculture development. The basic assumption was to predicate researches on the same output set of variables. The types of communes which in terms of chosen representative features are the most similar from the point of view of set aim were scheduled within the frames of researches. Most often, procedures of such type concern units of the basic territorial division of the country [Śleszyński 2013].

2. Material and methods

Data for the tested area of communes of former Kraków Voivodeship were gained from sources of public statistics (GUS, Puławy PIB IUNG data). Base set of variables

included 6 example features the discrete values of which collected for 38 communes were combined in Table 1. Kraków urban commune's area was excluded from analyses with regard to its non- agricultural character. Features with demographic character ie. percentage of people who make the living by working in agriculture, with natural character: quality of natural environment expressed by point indicator of agricultural valorization of productive space given by IUNG in Puławy were assumed towards the needs of the present study. Socio-economic features assumed to analyses describe: mean farms size in particular communes [ha UR], farm equipment value [100 thousand PLN · ha⁻¹], area percentage of arable lands in communes general area [ha] and also farm animals stock [SF/100 ha UR]. It was accepted that these features in a simplified way are representative for relative variables influencing widely understood agriculture development conditions. Base set of variables was the research basis both in the typological procedure and in the Wrocław taxonomy method.

Table 1. Base set of variables accepted for researches that describe socio-economical development level and also natural conditions of farm production in communes of former Kraków Voivodeship

No.	Commune	Population living on work in agriculture [%]	Mean size of a farm [ha UR]	Value of farm equipment [100,000 PLN · ha⁻¹]	Farm animals stock [SF/100 ha UR]	Arable lands in general area [%]	Natural environment quality [points]
		x_1	x_2	x_3	x_4	x_5	x_6
1	Alwernia	34.2	1.37	2.8	65.1	60.8	72.3
2	Biskupice	36.7	1.84	2.8	67.4	85.1	86.7
3	Czernichów	44.6	1.72	2.8	75.8	73.4	76.4
4	Dobczyce	49.1	1.88	2.3	79.1	65.0	74.2
5	Drwinia	53.0	2.77	4.5	74.8	47.4	84.1
6	Gdów	49.5	2.27	2.7	74.3	79.1	87.7
7	Gołcza	68.5	2.91	5.9	74.8	86.4	88.9
8	Igołomnia-Wawrzeńczyce	73.6	2.40	6.7	60.1	90.4	97.9
9	Iwanowice	61.6	3.07	5.9	83.8	90.4	97.0
10	Jerzmanowice Przeginia	43.4	2.55	3.5	74.5	85.5	78.1
11	Kłaj	31.5	1.25	2.9	80.7	41.4	86.8
12	Kocmyrzów Luborzyca	45.1	2.01	7.2	61.3	84.9	100.9
13	Koniusze	80.4	3.50	7.9	72.1	92.9	101.2
14	Krzeszowice	34.7	0.98	2.6	59.3	54.2	77.8

15	Liszki	37.7	1.97	3.2	71.6	81.5	85.1
16	Michałowice	61.7	2.85	6.8	80.7	88.7	95.2
17	Mogilany	35.7	1.61	1.6	70.7	78.0	79.6
18	Myślenice	42.0	1.83	2.3	86.5	57.5	69.4
19	Niepołomice	35.9	1.50	2.3	78.5	72.6	83.6
20	Nowe Brzesko	71.2	2.37	6.5	60.6	83.9	98.2
21	Pcim	47.1	2.42	1.5	88.9	42.6	46.9
22	Proszowice	74.9	2.31	7.9	69.9	88.6	102.3
23	Raciechowice	73.6	3.14	5.8	77.8	67.9	70.6
24	Radziemice	80.6	3.89	7.7	69.6	92.0	99.8
25	Siepraw	39.9	1.36	1.5	87.2	74.8	73.6
26	Skała	50.3	2.22	4.8	74.8	73.9	92.8
27	Skawina	32.8	1.41	2.4	79.3	67.7	84.0
28	Słomniki	65.7	3.14	6.9	75.7	83.4	95.1
29	Sułkowice	38.2	1.62	2.8	83.6	56.2	72.6
30	Sułoszowa	68.2	2.21	6.4	77.8	89.8	77.9
31	Świątniki Górne	25.7	0.89	1.3	60.7	78.6	79.3
32	Tokarnia	58.6	2.80	2.5	100.5	46.1	41.0
33	Trzyciąż	65.1	3.81	6.3	79.6	77.9	78.9
34	Wieliczka	31.7	0.89	1.5	56.2	78.6	81.6
35	Wielka Wieś	38.6	2.35	3.7	64.8	83.9	87.2
36	Wiśniowa	65.2	3.20	6.0	99.8	56.0	49.2
37	Zabierzów	34.6	1.20	1.3	49.9	66.5	87.3
38	Zielonki	42.2	1.73	4.4	60.6	91.2	96.6

Source: authors' study based on GUS and Puławy PIB IUNG data

In the first stage of both methods, from among features that describe agriculture development conditions, diagnostic features were selected according to the assumptions that representative features should be: essential with reference to the tested phenomenon and corresponding to issues of performed analysis, characterized by great variability and consequently in significant degree diversify tested objects as well as be poorly correlated with the other diagnostic features and strongly correlated with these not approved as diagnostic [Wojnar 2008].

For further analyses, diagnostic features for every informative group were accepted including groups of demographic character with x_1 one – population living on work in agriculture [%], for socio-economic group x_4 one – farm animals stock [SF/100 ha UR] and for natural features x_6 one – natural environment quality [points]. It can be

observed that spatial variability of analysed features on the tested area is significantly diverse. The last and common for both procedures stage was standardisation of diagnostic features depending on commission to mutual direct comparability of features described with help of different units.

Table 2. Matrix of correlation features between variables accepted to the analyses

Variables	Population living on work in agriculture [%]	Mean size of a farm [ha UR]	Value of farm equipment [100,000 PLN · ha^{-1}]	Farm animals stock [SF/100 ha UR]	Arable lands in general area [ha]	Natural environment quality [points]
	x_1	x_2	x_3	x_4	x_5	x_6
x_1	1	0.848	0.861	0.202	0.378	0.230
x_2	0.848	1	0.748	0.373	0.273	0.090
x_3	0.861	0.748	1	−0.013	0.534	0.519
x_4	0.202	0.373	−0.013	1	−0.429	−0.619
x_5	0.378	0.273	0.534	−0.429	1	0.720
x_6	0.230	0.090	0.519	−0.619	0.720	1

Standardisation was performed by means of zero unitarisation as well as features distinction to stimulants and destimulants. Formulas for standardisation took the forms (1) and (2):

– for stimulants:
$$S = \frac{x_i - x_{min}}{x_{max} - x_{min}} \qquad (1)$$

– for destimulants:
$$S = \frac{x_{max} - x_i}{x_{max} - x_{min}} \qquad (2)$$

Calculations were performed by means of Excel 2007 sheet, Numerical Taxonomy programme, whereas the result of spatial arrangement of objects was presented in QGIS programme.

3. Research results

Typological procedure

The typological procedure led to allocation of characteristic formations of territorial units (types) complying with requirements of uniformity (similarity) in the range of some features considered as diagnostic ones.

By means of point method, there were performed: reduction of multi-feature space, estimation of synthetic factor (Ws) which is the sum of standardized diagnostic features

(Table 3) and then gathering units by an analytic method (analysis of values distribution on coordinates axis) with separating types which are located in the following class ranges:

- type I: $Ws \in < 1,16; 1,36)$
- type II: $Ws \in < 1,36; 1,83)$
- type III: $Ws \in < 1,83; 2,00)$
- type IV: $Ws \in < 2,00; 2,25 >$

Table 3. Values of synthetic factor describing agriculture development conditions in communes of the former Kraków Voivodeship

No.	Commune's name	Synthetic factor's value Ws	No.	Commune's name	Synthetic factor's value Ws
1	Alwernia	1.66	20	Nowe Brzesko	1.32
2	Biskupice	1.89	21	Pcim	1.48
3	Czernichów	1.75	22	Proszowice	1.50
4	Dobczyce	1.69	23	Raciechowice	1.16
5	Drwinia	1.70	24	Radziemice	1.35
6	Gdów	1.81	25	Siepraw	2.01
7	Gołcza	1.49	26	Skała	1.89
8	Igołomnia-Wawrzeńczyce	1.26	27	Skawina	2.15
9	Iwanowice	1.93	28	Słomniki	1.66
10	Jerzmanowice Przeginia	1.77	29	Sułkowice	1.95
11	Kłaj	2.25	30	Sułoszowa	1.38
12	Kocmyrzów Luborzyca	1.85	31	Świątniki Górne	1.84
13	Koniusze	1.42	32	Tokarnia	1.40
14	Krzeszowice	1.62	33	Trzyciąż	1.49
15	Liszki	1.93	34	Wieliczka	1.68
16	Michałowice	1.84	35	Wielka Wieś	1.81
17	Mogilany	1.86	36	Wiśniowa	1.40
18	Myślenice	1.89	37	Zabierzów	1.59
19	Niepołomice	2.07	38	Zielonki	1.82

Division was performed taking assumption about as big as possible intra-group coherence into consideration. Presented ranges guarantee the biggest types similarity described by the lowest values of coefficient variations in the groups.

Table 4. Results list of analyses performed according to typological procedure assumptions

Type's name	Communes qualified to types
Type I – with weak values of agriculture development	Igołomia-Wawrzeńczyce, Nowe Brzesko, Raciechowice, Radziemice
Type II – with average values of agriculture development	Alwernia, Czernichów, Dobczyce, Drwinia, Gdów, Gołcza, Jerzmanowice Przeginia, Koniusze, Krzeszowice, Pcim, Proszowice, Słomniki, Sułoszowa, Tokarnia, Trzyciąż, Wieliczka, Wielka Wieś, Wiśniowa, Zabierzów, Zielonki
Type III – with good values of agriculture development	Biskupice, Iwanowice, Kocmyrzów Luborzyca, Liszki, Michałowice, Mogilany, Myślenice, Skała, Sułkowice, Świątniki Górne
Type IV – with very good values of agriculture development	Kłaj, Niepołomice, Siepraw, Skawina

Communes with the most similar agriculture development conditions were put together in grouped types. Moreover, values of reduced factor Ws allow to conclude that the most favourable conditions of agriculture development are characterized by type IV. 4 of 38 communes were qualified to type I, in the most numerous type II as much as 20 communes appeared. Type III concentrates 10 communes, whereas in the best type there are also 4 ones.

Wrocław taxonomy

As basis of objects division into groups in the Wrocław taxonomy method, matrix of Euclidean distance was taken. Distance matrix was calculated on the basis of standardized diagnostic features. Next, probability between units was determined preparing a disconnected dendrite map assuming that the greatest probability between units is marked by the smallest value of calculated Euclidean distance. The units which are mostly similar to each other considering agriculture development conditions were put together in sequence.

Table 5. Specification of communes with their closest neighbours on the basis of the matrix of Euclidean distance

Commune No.	The smallest distance	The closest neighbour	Commune No.	The smallest distance	The closest neighbour
1	0.146	14	20	0.045	8
2	0.062	35	21	0.325	32
3	0.044	10	22	0.111	13
4	0.111	3	23	0.154	30
5	0.087	6	24	0.055	13
6	0.085	26	25	0.079	29
7	0.115	28	26	0.085	6
8	0.045	20	27	0.058	11

9	0.068	16	28	0.115	7
10	0.044	3	29	0.079	25
11	0.058	27	30	0.069	33
12	0.089	38	31	0.146	34
13	0.055	24	32	0.180	36
14	0.103	34	33	0.069	30
15	0.089	2	34	0.103	14
16	0.068	9	35	0.062	2
17	0.098	15	36	0.180	32
18	0.080	25	37	0.164	34
19	0.059	27	38	0.089	12

A disconnected dendrite map was created next (Fig. 1).
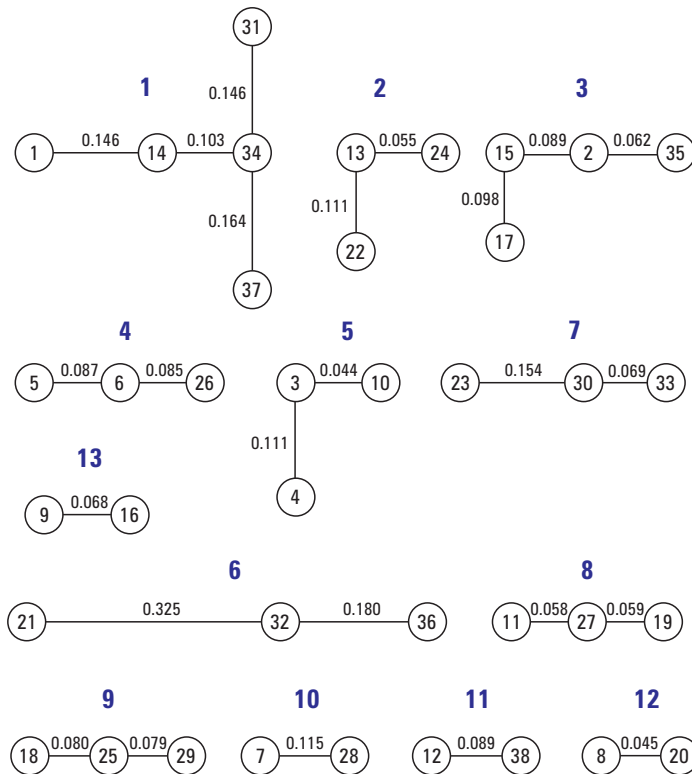
Source: authors' study

Fig. 1. Disconnected dendrite map of 1–13 clusters

Table 6. The smallest distance between 1 and 2 clusters objects

Object from cluster 1	The closest neighbour from cluster 2	Distance between objects
1	13	0.5126
14	13	0.4236
31	13	0.6505
34	13	0.2622
37	13	0.0889

Table 7. The smallest distance between 2 and 3 clusters objects

Object from cluster 2	The closest neighbour from cluster 3	Distance between objects
13	35	0.8079
22	35	0.7128
24	35	0.7978

Table 8. The smallest distance between 3 and 4 clusters objects

Object from cluster 3	The closest neighbour from cluster 4	Distance between objects
2	6	0.2706
15	6	0.2255
17	6	0.2928
35	6	0.2734

Table 9. The smallest distance between 4 and 5 clusters objects

Object from cluster 4	The closest neighbour from cluster 5	Distance between objects
5	3	0.1989
6	10	0.1921
26	10	0.2708

Table 10. The smallest distance between 5 and 6 clusters objects

Object from cluster 5	The closest neighbour from cluster 6	Distance between objects
3	21	0.5484
4	21	0.4870
10	21	0.5870

Table 11. The smallest distance between 6 and 7 clusters objects

Object from cluster 6	The closest neighbour from cluster 7	Distance between objects
21	33	0.6433
32	23	0.7135
36	23	0.5782

Table 12. The smallest distance between 7 and 8 clusters objects

Object from cluster 7	The closest neighbour from cluster 8	Distance between objects
23	19	0.7188
30	19	0.5958
33	19	0.5378

Table 13. The smallest distance between 8 and 9 clusters objects

Object from cluster 8	The closest neighbour from cluster 9	Distance between objects
11	29	0.2680
19	29	0.2100
27	29	0.2269

Table 14. The smallest distance between
9 and 10 clusters objects

| Object from cluster 9	The closest neighbour from cluster 10	Distance between objects
18	7	0.6226
25	7	0.6275
29	7	0.6368

Table 15. The smallest distance between
10 and 11 clusters objects

Object from cluster 10	The closest neighbour from cluster 11	Distance between objects
7	12	0.5396
28	12	0.4804

Table 16. The smallest distance between
11 and 12 clusters objects

Object from cluster 11	The closest neighbour from cluster 12	Distance between objects
12	28	0.4804
38	28	0.5224

Table 17. The smallest distance between
12 and 13 clusters objects

Object from cluster 12	The closest neighbour from cluster 13	Distance between objects
8	16	0.4633
20	16	0.4360

In order to create a connected dendrite map, the smallest distances between grouped clusters in the disconnected dendrite map were found. And to that end, it is necessary to find the smallest distance between objects for every pair of clusters. Considering the very big number of clusters and objects, presented in Tables 6–17, example pairs of chosen clusters were presented. On the basis of combination of the clusters nearest to each other and the nearest objects in these clusters (Table 18), the connected dendrite map was created (Fig. 2).

Table 18. Specification of the nearest connections between 1–13 clusters

Clusters' connection		Objects' connection		The smallest distance
Cluster	The closest neighbour	Objects	The closest neighbour	
1	2	37	13	0.0889
2	1	13	37	0.0889
3	8	15	19	0.1424
4	5	6	10	0.1921
5	3	10	17	0.1610
6	9	21	18	0.3816
7	10	30	7	0.1891
8	3	19	15	0.1424
9	5	29	3	0.2030
10	13	28	16	0.1228

Table 18. cont.

Clusters' connection		Objects' connection		The smallest distance
Cluster	The closest neighbour	Objects	The closest neighbour	
11	3	38	35	0.1863
12	2	20	22	0.2069
13	10	16	28	0.1228
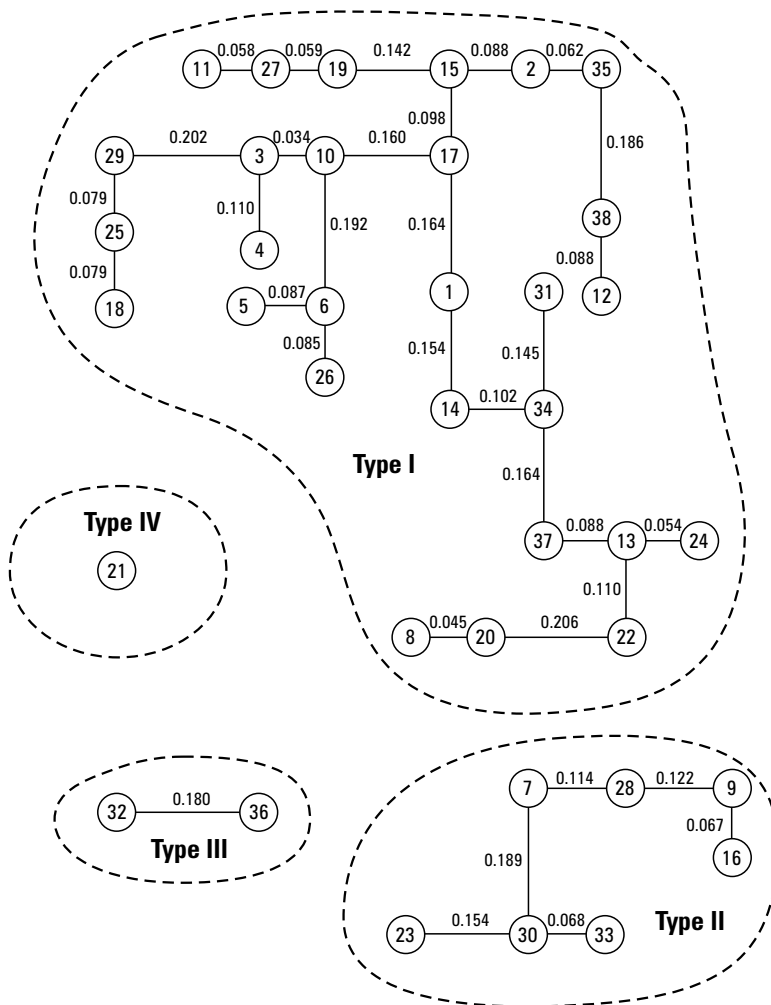
Source: authors' study

Fig. 2. Assigned typological groups

The obtained connected dendrite map grouped objects so that every tested object (a commune) would be joined with at least one other element. To group units in the Wrocław method which means gaining typological groups that bring together communes with similar agriculture development conditions, the longest connections between objects were removed. The amount of eliminated edges decided about the number of appointed typological groups. Like in typological procedure, 4 types of communes were fixed which means that 3 longest connections were removed:

- between Myślenice (18) and Pcim (21) the edge with length 0.381
- between Pcim (21) and Tokarnia (32) the edge with length 0.325
- between Proszowice (22) and Słomniki (28) the edge with length 0.234
  As a result of above actions, four typological groups were created (Table 19).

Table 19. Results specification of analyses performed by means of Wrocław taxonomy method

Type's name	Communes qualified to the types
Type I	Alwernia, Biskupice, Czernichów, Dobczyce, Drwinia, Gdów, Igołomnia-Wawrzeńczyce, Jerzmanowice Przeginia, Kłaj, Kocmyrzów Luborzyca, Koniusze, Krzeszowice, Liszki, Mogilany, Myślenice, Niepołomice, Nowe Brzesko, Proszowice, Radziemice, Siepraw, Skała, Skawina, Sułkowice, Świątniki Górne, Wieliczka, Wielka Wieś, Zabierzów, Zielonki
Type II	Gołcza, Iwanowice, Michałowice, Raciechowice, Słomniki, Sułoszowa, Trzyciąż
Type III	Tokarnia, Wiśniowa
Type IV	Pcim

It should be remembered that the Wrocław taxonomy does not allow to evaluate fixed areas paying special attention to their assessment (advantageous – little advantageous). Division enabled only to assign types with similar agriculture development conditions. Like in typological method, four types of communes were obtained. However, in this method the type does not decide which of the communes has got the most favourable conditions and which one – the least. Type I concentrates up to 28 communes. Seven ones were matched to type II, two – to type III and one – to type IV.

Comparison of typological procedure with Wrocław taxonomy method

Comparing course of action it can be noticed that calculations in both tested methods can be done simultaneously to the moment of standardisation of diagnostic features. Next, the typological procedure provides multi-feature space reduction and then grouping of diagnostic features on the basis of calculated reduced factor, whereas the Wrocław taxonomy method needs to perform a number of partial analyses that enable to identify single connections between units accepted for research until the moment of creating of so called connected dendrite map.

Comparison of results obtained after performing both procedures (Fig. 3) can lead to conclusion that direct spatial comparison of research results is not possible. The

further statistical analyses should be performed to state which of fixed types can be classified as the one with the most favourable conditions of agriculture development. It can be observed how much the results of both procedures differ from each other. Division of the same space to uniform types does not basically agree. The typological procedure diversifies area of the former Kraków Voivodeship absolutely more, taking agriculture development conditions into consideration. Its usage also helps to determine which of particular communes belong to the types of the most and the least favourable conditions of agriculture development. Higher synthetic factor's value (Ws) allows to classify a commune as the better one from the established aim's point of view. Such possibility is not provided by the Wrocław taxonomy where – by means of a dendrite map – similarity between discussed areas is presented. Division to particular types does not result from the statement in which units more favourable conditions of agriculture development occur but only from resemblance of these conditions in particular communes. As it can be observed in picture 7, the Wrocław taxonomy to a small extent diversifies units in respect of accepted criterion.
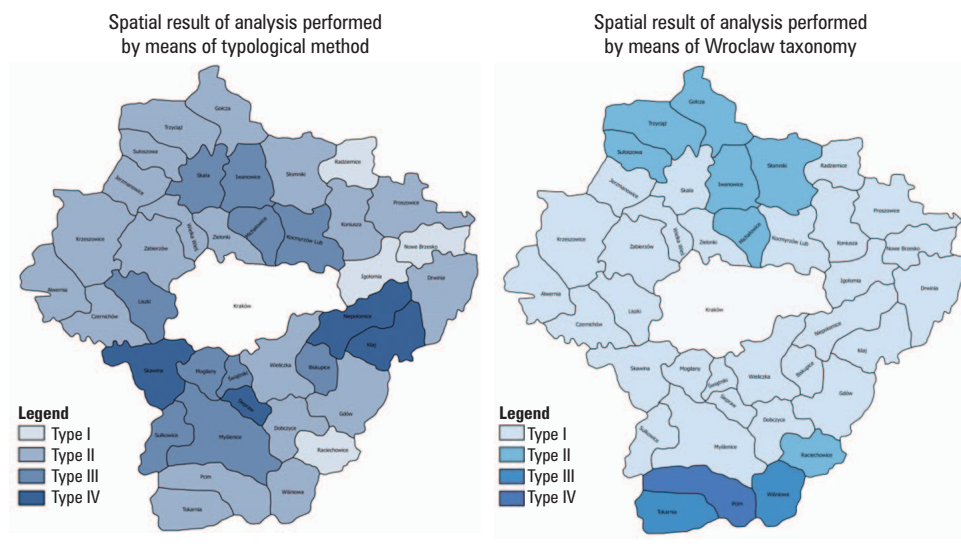

Fig. 3. Comparison of spatial distribution of obtained results

On the basis of presented analysis of agriculture development conditions in the area of the former Kraków Voivodeship, some conclusions concerning the methods themselves can be drawn. The typological procedure and the Wrocław taxonomy were compared by means of 10 aspects (Table 20).

Table 20. Comparison of typological procedure and Wrocław taxonomy

	Typological procedure	Wrocław taxonomy
Base of analysis	Synthetic factor	Distance matrix
Algorithm difficulty degree	Very easy	Easy
Work consumption	Mean	High
Base of division of objects to groups	Analysis of values distribution of synthetic factor on numerical axis	Removal of the longest edges of a connected dendrite map
Way of presenting results	Choropleth, table	Dendrite map – coherent and open one
Simplicity of results interpretation	Easy – colours or hatches scale on a choropleth	Easy – rules and concepts from dendrite maps theory
Differentiation of research area in terms of accepted analysis aim	Considerable	Slight
Evaluating objects paying attention to determined phenomenon	Yes	No
Advantages	• very easy calculations; • legible imaging of results which allows to study spatial phenomena diversity; • method's little work consumption; • possibility to assess objects paying special attention to studied phenomenon	• possibility to picture even very complicated connections between objects; • exceptionally legible expression of classification results
Limitations and difficulties	• lack of ambiguity when choosing diagnostic features; • difficulties in determining divisions of synthetic factor (division into types)	• work consumption of calculations in case of a bigger (>30) number of objects; • technical limitations connected with presenting results in case of great amount of data; • lack of possibility to assess objects (it only shows similarities)

Despite some similarities connected with preliminary preparing of data (diagnostic features choice, standardisation), the basis of analysis for both procedures is different. In typology, a reduced factor which is a sum of diagnostic features after standardisation values is determined. In case of the Wrocław taxonomy, the basis as in many taxonomic methods is a distance matrix. When it comes to algorithm difficulty degree, both procedures are similar – in both cases calculations do not cause problems. Both algorithms are transparent. Much bigger differences concern methods' work consuming. Taking this aspect into consideration, the typological procedure turns out to be much

better. In the Wrocław taxonomy, calculations, though not difficult, need many tables and sheets to be prepared on the basis of which the following objects can be joined with each other. Additionally, to obtain a connected dendrite map, the procedure should be performed several times joining firstly singular objects and then clusters. Methods' diversity can also be noticed in the way of determining final, homogenous groups. In typology, groups are determined on the basis of synthetic factor's value. These values' distribution is analysed. The factor's ranges are defined considering the most similarity of objects in the group so the closest values of the reduced factor. In the Wrocław taxonomy, a connected dendrite map that joins all objects with each other is created first of all. Division to types is performed by removing the longest edges from the dendrite map so separating the most distant (the least similar) objects. Both the typological procedure and Wrocław taxonomy do well in terms of results' presentation and interpretation. In the typological procedure results can be presented in the table, however, the choropleth that illustrates phenomenon's spatial diversity is most often used. On the basis of colours scale and hatching difference it is easy to determine location of objects of the same type. The Wrocław taxonomy belongs to taxonomic dendrite methods so the name indicates the way of analysis results' presentation. A dendrite map allows to interpret results easily and also enables to illustrate very complicated connections between particular objects and their groups. Additionally, rules and concepts from dendrites' theory become helpful in results interpretation. Taking diversity of tested area and also possibility to assess objects with regard to agriculture development conditions into consideration, the typological procedure did much better. Every type extracted in that procedure includes at least a few communes. In division made by means of the Wrocław taxonomy, most of communes is located in the first group. One type is represented by just one element and the other – by two ones. Analizing results gained in that procedure, the conclusion can be drawn that agriculture development conditions in the area of the former Kraków Voivodeship are little diverse. However, spatial diversity of particular features accepted to the analysis and diagnostic features in particular indicates completely different conclusions.

Last two verses of the table (Table 20) are specific recapitulation of presented comparison. The main advantages as well as appearing difficulties and limitations while using both methods were collated. Synthetic factor's calculations simplicity and also legible illustrating results by means of the choropleth belong to benefits of the typological procedure. It is not very work-consuming, diversifies objects well with regard to analysed phenomenon and makes possible its assessment. Lack of ambiguity when choosing diagnostic features made on the basis of correlation matrix and units grouping rules can be included in its disadvantages. Among virtues of the Wrocław taxonomy, possibility to illustrate even very complicated connections between objects with dendrite map's help and also easy and intuitive interpretation can be underlined. However, this method has got some defects. Most of all, great difficulties appear together with increasing number of objects – both in calculations and in constructing and presenting the dendrite map.

4. Conclusions

Performed typological procedure allowed to divide the area of the former Kraków Voivodeship to commune's types with good, very good, average and the weakest conditions of agriculture development. A few communes appeared in every type. Comparing spatial arrangement of types with spatial diversity of diagnostic features, it is easy to find relationship between demographic, economic and natural conditions and determined conditions of development.

The Wrocław taxonomy by means of the dendrite map illustrates similarity of conditions prevalent in particular communes. It can be determined in an easy and simple way which of the communes are the most and least similar to each other with regard to the tested phenomenon. So the dendrite map presents a specific map of likeness. However, taxonomic procedure did not allow to diversify this area significantly with regard to agriculture development conditions. What is equally important, it cannot be determined on the basis of the dendrite map and without performing additional statistic analysis in which communes conditions are more and less favourable.

Conclusions that result from comparing of both procedures come to mind by themselves. The typological procedure is for sure less time-consuming than the Wrocław taxonomy. Moreover, on the basis of its results, grouped types can be clearly characterized with respect to its own merits. It diversifies analysed space in a better way. The Wrocław taxonomy does not enable substantial characteristics. It only shows objects' similarity. Apart from that, this is a very time-consuming procedure. It is necessary to perform many combinations in order to choose the shortest possible connections so as the dendrite map could group tested objects in the most uniform types. Although the dendrite map being a picture of a performed procedure's result is easy to interpret and shows objects' similarity in a simple way, it is difficult to prepare. The greater amount of analysed elements, the higher the level of difficulty.

Summing up, it can be stated that performing researches of phenomena that are possible to be characterized by means of variables set, the typological procedure seems to be more favourable. However, if the aim of analyses is to show similarities between tested units, the Wrocław taxonomy can be used providing that the number of tested elements in the set is not very big.

References

Bański J. 2013. Polska wieś w perspektywie 2050 roku. Stud. Obsz. Wiej. (Rural Stud.), 33.
Bański J. 2007. Historia rozwoju gospodarki rolnej na ziemiach polskich. [In:] Geografia rolnictwa Polski, PWE, Warszawa.
Bański J. 1997. Przemiany rolniczego użytkowania ziemi w Polsce w latach 1975–1988. Prace Geogr., 168.
Baran-Zgłobicka B., Zgłobicki W. 2012. Mosaic landscape of SE Poland: should we preserve them? Agroforest Syst. 85, 351–365.
Domański R. 1964. Procedura typologiczna w badaniach ekonomiczno-geograficznych. [In:] Przegl. Geogr. 36, z. 4, 627–660.

Dudzińska M., Kocur-Bera K. (eds) 2014. Bariery i stymulanty rozwoju obszarów wiejskich, Wyd. UWM w Olsztynie.

Fogel P. Obszary problemowe rolnictwa w świetle planowania miejscowego. Studia i Raporty IUNG PIB, 19, 19–26.

Frankowski Z. 1991. Zastosowanie metod taksonomicznych w badaniach przestrzennych. Agencja Wyd. Instytutu Gospodarki Przestrzennej i Komunalnej, Warszawa.

G**awroński K., Prus B., Sołtysik S.** 2014. Analiza i ocena warunków rozwoju społeczno-gospodarczego województwa podkarpackiego. Infrastr. Ekol. Ter. Wiej. 4(2), 1241–1254.

Grabiński T., Wydymus S. Zeliaś A. 1989. Metody taksonomii numerycznej w modelowaniu zjawisk społeczno-gospodarczych, PWN, Warszawa

Hałasiewicz A. 2010. Rozwój obszarów wiejskich w kontekście zróżnicowań przestrzennych w Polsce i budowania spójności terytorialnej kraju. Ekspertyza wykonana na zlecenie MRR, www.mir.gov.pl [accessed: 24.04.2014]

Konieczna J., Trystuła A. (eds). 2014. Zrównoważony i wielofunkcyjny rozwój obszarów wiejskich. Wyd. UWM w Olsztynie.

Kolenda M. 2006. Taksonomia numeryczna. Klasyfikacja, porządkowanie i analiza obiektów wielocechowych. Wyd. AE we Wrocławiu, Wrocław.

Kowalski S. 1977. Charakterystyka niektórych metod taksonomicznych. PWN, Warszawa.

Kühne O., Gawroński K., Hernik J. (eds). 2015.Transformation und Landschaft. Die Folgen sozialer Wandlungsprozesse auf Landschaft. Springer VS, Wiesbaden.

Leszczyńska M. 2010. System wspomagania decyzji optymalizujących rozwój marginalnych obszarów wiejskich. Acta Sci. Pol. Geod. Desc. Terr. 9(4), 37–48.

Nowak E. 1990. Metody taksonomiczne w klasyfikacji obiektów społeczno-gospodarczych, PWE, Warszawa.

Nowak M., Pawlewicz K., Szczepańska A. 2014. Instrumenty kształtowania przestrzeni obszarów wiejskich. Wyd. UWM w Olsztynie.

Prus B. 2014. Wybrane przykłady zastosowania informacji przestrzennej na potrzeby identyfikacji obszarów problemowych. Infr. Ekol. Ter. Wiej. 1, 49–60.

Prus B. 2012. Kierunki zmian przeznaczenia gruntów rolnych i leśnych w Polsce. Acta Sci. Pol., Geod. Descr. Terr. 11(2), 27–40.

Salata T., Prus B., Janus J. Planning as trigger for land use changes. [In:] Engineering for rural development, Jelgava, 20–22.05.2015, 729–734.

Śleszyński P. 2013. Delimitacja miejskich obszarów funkcjonalnych stolic województw, Przeg. Geogr., 85(2).

Śleszyński P. 2012. Klasyfikacja gmin województwa mazowieckiego, Przeg. Geogr., 84 (4), 559–576.

Ustawa z dnia 28 maja 1975 r. o dwustopniowym podziale administracyjnym Państwa oraz o zmianie ustawy o radach narodowych (Dz. U. 1975, Nr 16, poz. 91).

Wojnar J. 2008. Zastosowanie metod taksonomicznych do klasyfikacji państw Unii Europejskiej. [Im:] Rola informatyki w naukach ekonomicznych i społecznych, Zesz. Nauk. 8(2), Wyższa Szkoła Handlowa im. Bolesława Markowskiego w Kielcach.

Wysocki F. 2010. Metody taksonomiczne w rozpoznawaniu typów ekonomicznych rolnictwa i obszarów wiejskich. Wydawnictwo Uniwersytetu Przyrodniczego w Poznaniu, Poznań.

Dr inż. Barbara Prus
Uniwersytet Rolniczy w Krakowie
Katedra Gospodarki Przestrzennej i Architektury Krajobrazu
30-149 Kraków, ul. Balicka 253c
e-mail: b.prus@ur.krakow.pl

Mgr inż. Marta Szylar
Uniwersytet Rolniczy w Krakowie
Katedra Gospodarki Przestrzennej i Architektury Krajobrazu
30-149 Kraków, ul. Balicka 253c
e-mail: szylarmarta@gmail.com