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CLASSIFICATION OF COMMUNES OF THE MAŁOPOLSKIE VOIVODESHIP AS REGARDS SELECTED FACTORS OF LOCAL DEVELOPMENT

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Summary

The study is an attempt at classification of 182 communes (*gminy*) of the Małopolskie voivodeship from the point of view of chosen factors influencing their local development. The adopted set of variables included 5 thematic categories: demography, economy, infrastructure, environmental management and land management. The scope of the variables is related to availability of statistical material. The data were acquired form public statistical sources – CSO (GUS) Local Data Bank for 2013–2014. The classification was carried out by Ward's hierarchical clustering method. The analysis led to isolation of factors shaping local development of a group of communes. It was demonstrated that in prevailing part of the studied area one main factor determines local development of these communes, namely environmental management.

Keywords

classification of communes • local development • Małopolskie voivodeship • Wards' method • multivariate objects • study of communes

1. Introduction

Local development, depending on factors that shape it, is a process of diverse changes taking place in a studied territory. It is most frequently characterized by desirable and positive transformations of quantitative, qualitative and structural characteristic of a given arrangement [Sztando 1998]. If the arrangement is a singled-out socio-territorial composition, having a set of characteristic economic, land and cultural features expressing its own needs and hierarchy of values, then the development has a local [Sztando 1998] or a regional scale. The concept of local development is also defined as a particular form of regional development, in which endogenous factors play a central role [Coffey et al. 2005]. In local government practice local development refers to territorial units of lower administrative levels – communes and districts, whereas regional development indicates units of higher level – voivodeships. Local development is also regarded as a harmonized and systematic effort of local community, local authorities and other entities functioning in a commune, aiming at creation of new and improve-

ment of existing utility values of the commune, designing favourable conditions for local management and ensuring spatial and environmental order [Brol 1996].

Commune is a principal unit of state's territorial or administrative subdivisions and a basic local government unit, comprising local government community and a territory it occupies. Commune possess adequate material resources, official bodies and appropriate competences that allow it to fulfil public tasks of local significance [Brunka et al. 2003].

Considering the issue of defining and choice of factors determining the development potential of studied communes, the attention has been paid to processes of local development, described in literature, that are the result of combining economic, socio-cultural and political phenomena [Hryniewicz 2000]. Therefore local factor should reflect commonly accepted goals of local development, encompassing features like: natural utility values and material values, products of human activity, labour force, local economic traditions, institutions specializing in promoting the area etc. [Wojtasiewicz 1997]. Another set of factors determining local development can include: natural resources, labour resources, capital, local and external companies, productive and service potential, transport and communication management, technologies and values of natural environment [Szymla 2005]. One can look at local development from the perspective of many different factors that shape it.

Having in mind the above considerations related to a theoretical aspect of the idea of local development, an attempt has been made to classify communes in the Małopolskie voivodeship according to factors determining their local development. On the basis of chosen features and measures and with help of taxonomic, combinatorial agglomerative Ward's method [Ward 1963], groups of communes have been singled out that were homogeneous with respect to factors (segments) that shape their local development. Moreover, spatial classification of analysed areas (location map of homogeneous types of communes as regards analysed factors determining their local development) has been made.

2. Research object and methods

The study covered smallest units of administrative subdivisions, that is 182 communes located within the Małopolskie voivodeship. The chosen areas are multivariate, which is a result of manifold character, state, function, status and spatial development of the communes. These features have diverse influence on local development. To determine diverse state of local development in particular communes according to factors that influence it, adequately chosen indicators were used as research tools. As a substantive criterion a principle was established that ultimate set of features will contain variables (measures) representing current state of a commune and domains influencing their development. The choice and measures of adequacy of used indicators were conditioned by the availability of data. The set of variables that allows for differentiation between factors influencing development of communes was acquired from public statistical sources – CSO (GUS) Local Data Bank for years 2013–2014.

As a result of the substantive analysis, five groups of factors influencing conditions and state of local development of communes have been determined (Tables 1–5). The first segment included social factors (changes in population and demographic structure, standard of living). The second segment comprised factors characterizing size of market of goods and services and financial state. The third segment consisted of factors of state and quality of infrastructure. The fourth one – factors related to environmental management together with state and protection of environment and tools for shaping environmental order. The fifth segment encompassed factors representing land management, including functional, territorial and structural state of a commune.

Table 1. Demographic segment. Description of features and their metrics

Population	Density of population [person · 1 km^{-2}]; share of people at: pre-working age, working age, retirement age [%]
Registered unemployment	Total registered unemployed by sex [persons]
Number of people using sewage treatment plant	Total population using sewage treatment plant [person]
Percentage of people using systems	Total population using water supply system, sewage system, gas supply system [%]

Table 2. Economic segment. Description of features and their measures

Revenue and expenditure of communes' budgets	Total budget revenues; total budget expenditures [zł]
Purchase of water	Purchase of water: total; from municipal waterworks for production purposes [dam^{-3}]
Expenditures on waste management	Expenditures on: collection of waste and its transportation; collection of municipal waste and its transportation; neutralizing and removal of dangerous wastes; neutralizing and removal of non-dangerous wastes; neutralizing and removal of dangerous of other wastes than dangerously stored; recycling of wastes; rehabilitation of slag heaps, tailing ponds and landfills and other devastated areas and degraded [thousand of zł]
Expenditures on fixed assets for water management	Expenditures on: intakes and supply of water; construction and modernization of water treatment plants; reservoir and barrages; regulation and reinforcement of mountain rivers and streams; flood embankments; pump stations in caves-in and depressions [thousand zł]
Expenditures on sewage management	Expenditures on: sewage networks; networks for discharging precipitation water; industrial wastewater treatment; treatment of municipal wastes [thousand zł]

Table 3. The infrastructure segment. Description of features and their measures

Sewage treatment plants	Industrial sewage treatment plants: mechanical; chemical; biological; with enhanced removal of biogenic compounds [items]
Flow capacity of sewage treatment plant	Designed flow capacity of sewage treatment plant: mechanical; chemical; biological; with enhanced removal of biogenic compounds [$m^{-3} \cdot$ day]
Mains ramification network	network: water supply; sewerage (total); natural gas (total) [km]
Roads	Roads with paved surfaces; paved improved ones; unpaved ones [km]
Infrastructure	Cesspools; household-level treatment plants; sewage stations [items]

Table 4. The environmental management segment. Description of features and their measures

Atmospheric emissions	Pollutant emissions: dust; gas (total) [t per year]
Sediments	Sediments: from industrial sewage treatment plants, total amount produced per year; stored until now (accumulated); used from hitherto stored (accumulated); used in agriculture; used in land reclamation, including lands for agricultural purposes; used for cultivation of plants intended for production of compost; thermally transformed; stored jointly; stored temporarily [t]
Industrial waste water	sewage: discharged to sewerage network; discharged directly to waters and ground; discharged directly to waters and ground – cooling waters (that do not require treatment); containing substances particularly harmful to water environment; discharged directly to waters or ground and requiring treatment; treated (total); treated mechanically; treated chemically; biologically; treated with enhanced removal of biogenic compounds; not-treated; recycled [dam^3]; share of treated waste in waste requiring treatment [%]; loads of pollution: BOD_5; COD; suspended solids; volatile phenols; nitrate; phosphorus in waste discharged to waters or ground [kg per year]; sum of chloride and sulfate ions in waste discharged to waters or ground [kg per year]; saline waters (total) [dam^3]; waste treated together with seepage waters and delivered waste [dam^3]
Consumption of water	Consumption of water for industrial purposes; consumption of water: underground water; surface water [dam3]; water from draining mines and construction works (used for production or sold) [dam^3]; consumption of water for agriculture and forestry [dam^3]
Wastes	Waste subjected to: recycling; recycling – composting ; neutralized (total); thermally; in another way [thousand t]; waste: temporarily stored [thousand t]; share of stored waste in waste produced [%]; stored up to now (accumulated) in own waste stockpiles; handed over to other entities [thousand t]; mixed collected in a year form households [t]; units taking away waste by area of activity [item]; municipal waste collected during liquidation of illegal landfills [t]
Ilegal landfills	Area of existing illegal landfills; existing illegal landfills [m^2]; liquidated illegal landfills; illegal landfills per 100 km2 (total) [item]; area of illegal landfills per 100 km^2 (total) [m^2]

Expenditures on environmental protection:	Expenditures on: air protection and climate protection; protection and restoring soil, protection of underground and surface water; on reducing noise and vibrations; protection of biodiversity and landscape; protection from ionizing radiation; research and development activity; other activity related to environmental protection; energy saving; protection of waters; devices for reducing air pollution; new technologies of combustion of fuels and modernization of heating systems; protection of land surface; removal, use and neutralizing of industrial and municipal waste; construction and arranging landfill sites for industrial and municipal waste; expenditure on: refurbishment of waste heaps, tailing ponds and landfills and other degraded and devastated areas; protection of environmental and landscape and biodiversity; protection from noise; protection from radiation [thousand zł]

Table 5. The land management segment. Description of features and their measures

Wooded areas	Wooded areas: public (total); private [ha]
Forests	Forests: public (total); private (total) [ha]; woodiness [%]
Non-wooded areas intended for forestation	Forestation: public forests (total); private (total) [ha]; forestation [%] area (total) [%]
Areas protected by legislation	National parks; nature reserves [ha]; landscape parks (total); reserves and other forms of nature protection in landscape parks; protected landscape areas (total); reserves and other forms of protected landscape areas; ecological lands [ha]; documentary sites; nature and landscape complexes [ha]; nature monuments [items]
Agricultural land	Arable lands; orchards; permanent meadows; permanent pastures; lands: agricultural developed; under ponds; under ditches [ha]
Submerged lands	Lands under waters: internal sea waters; surface flowing waters; surface standing waters [ha]
Developed and urbanized lands	Developed and urbanized lands; residential areas; industrial areas; other developed areas; urbanized non-developed; recreational and leisure; transport: roads, railroad, other; developed and urbanized lands – fossil lands [ha]
Croplands, wastelands, various lands	Ecological lands; wastelands; various lands [ha]
Green areas	Share of green areas in total area [%]

Basic statistical features of variables juxtaposed in five thematic segments for 182 communes of the Małopolskie voivodeship have been calculated. Then multivariate space was reduced by a point method (using normalization of variables' values by a standardization method). The standardization was applied to transform different variables (with incomparable measures) into one comparable statistical measure. The data presented this way were then used to determine synthetic developmental indicator for all 182 communes according to five thematic groups (Table 6). The constructed synthetic indicators, also called meta-features or meta-indicators, allowed for organizing multivariate objects, or for aggregation of possessed information. The essence of aggregation was to construct one synthetic meta-feature in a studied group of spatial

units, based on standardized values. The higher the values of an independent variable, the higher the values of a synthetic indicator. Their interpretation consisted in the assessment of the level of phenomena described by independent values [Nowak 2004]. The use of synthetic indicators allowed for presentation of large set of data in the form of one value [Dziechciaż 2006]. As a developmental measure of synthetic meta-features composed into five thematic segments, an arithmetical mean of normalized values of statistical variables was adopted in analysing the phenomenon of local development.

Table 6. Meta-synthetic indicators

Communes / meta-features	D	E	I	EM	LM
Bochnia (1)	35.02	52.45	40.78	349.72	66.75
Bochnia (2)	19.91	21.22	16.12	8.78	63.98
Drwinia (2)	11.91	6.72	7.54	68.74	60.26
Lipnica M. (2)	12.66	8.58	6.84	20.45	30.80
Łapanów (2)	14.70	21.18	19.91	4.72	31.07
Nowy W. (3)	14.87	12.95	12.93	11.30	46.73
Rzezawa (2)	17.17	10.55	15.38	19.50	41.90
Trzciana (2)	12.88	3.53	14.69	4.12	24.36
Żegocina (2)	16.35	10.30	14.65	3.06	16.27
Borzęcin (2)	11.83	6.99	9.67	20.78	55.33
Brzesko (3)	26.26	23.40	152.15	476.61	68.06
Czchów (3)	15.01	6.52	19.42	3.95	45.14
Dębno (2)	19.42	8.66	22.97	9.03	36.97
Gnojnik (2)	12.71	4.42	13.42	53.88	26.61
Iwkowa (2)	11.06	5.81	8.71	74.24	23.58
Szczurowa (2)	12.28	277.77	12.39	14.36	83.60
Alwernia (3)	17.68	34.14	96.21	258.59	55.54
Babice (2)	14.82	1.85	16.52	2.16	40.17
Chrzanów (3)	36.53	49.12	47.00	185.48	111.27
Libiąż (3)	23.86	46.74	56.06	970.48	241.29
Trzebinia (3)	28.71	852.13	51.10	649.43	160.05
Bolesław (2)	14.98	5.33	12.96	10.49	15.66
Dąbrowa Tarn. (3)	23.73	329.59	16.90	17.68	49.10
Gręboszów (2)	11.33	10.05	12.35	1.48	18.27
Mędrzechów (2)	13.28	8.70	11.02	1.59	28.30
Olesno (2)	16.02	11.84	16.54	3.91	35.10
Radgoszcz (2)	15.45	8.29	14.39	2.80	29.55

Szczucin (3)	16.56	2.55	10.00	6.71	67.89
Gorlice (1)	38.07	93.83	81.20	219.16	47.01
Biecz (3)	15.77	3.77	15.79	6.34	36.02
Bobowa (3)	14.49	1.85	10.00	3.85	19.43
Gorlice (2)	17.68	24.59	27.16	4.46	44.59
Lipinki (2)	14.13	5.57	17.16	7.10	27.61
Łużna (2)	11.00	5.83	9.90	3.62	23.28
Moszczenica (2)	14.22	5.47	15.26	3.21	11.01
Ropa (2)	9.80	11.25	8.75	1.16	23.93
Sękowa (2)	13.95	3.80	19.77	2.90	83.87
Uście Gorlickie (2)	11.11	14.45	13.65	8.10	119.82
Czernichów (2)	14.71	31.33	14.69	9.52	43.33
Igołomia-Wawrz. (2)	11.59	10.69	12.33	1.96	27.90
Iwanowice (2)	12.73	1.31	14.58	3.44	27.04
Jerzman.-Przeg. (2)	16.53	1.67	16.83	52.94	30.41
Kocmyrzów-Lub. (2)	15.17	4.87	24.57	16.50	29.40
Krzeszowice (3)	23.34	10.69	73.22	261.37	244.25
Liszki (2)	18.64	15.92	32.65	34.56	72.46
Michałowice (2)	15.36	1.98	23.36	3.96	25.22
Mogilany (2)	18.78	11.47	24.00	9.00	24.18
Skała (3)	17.68	5.71	42.63	107.42	32.55
Skawina (3)	28.15	73.39	111.91	1758.00	94.47
Słomniki (3)	13.41	3.44	15.26	34.41	35.11
Sułoszowa (2)	15.17	14.76	13.22	2.55	15.90
Świątniki Górne (3)	17.94	5.93	22.62	108.47	10.21
Wielka Wieś (2)	19.04	3.96	18.74	13.03	36.36
Zabierzów (2)	24.09	15.60	29.35	170.92	138.12
Zielonki (2)	22.92	16.62	30.40	71.49	33.50
Limanowa (1)	28.12	5.62	29.41	35.91	31.93
Mszana Dolna (1)	19.04	9.38	13.49	21.72	19.91
Dobra (2)	12.77	15.10	18.13	3.48	61.18
Jodłownik (2)	12.00	30.73	11.18	3.80	35.77
Kamienica (2)	11.36	3.80	10.83	2.81	50.42
Laskowa (2)	13.77	15.95	9.25	3.41	32.19
Limanowa (2)	17.75	9.80	29.25	19.29	71.08
Łukowica (2)	11.34	23.46	27.20	1.13	35.92

Table 6. cont.

Communes / meta-features	D	E	I	EM	LM
Mszana Dolna (2)	16.17	9.61	7.82	7.79	78.04
Niedźwiedź (2)	12.30	7.22	9.03	4.17	43.68
Słopnice (2)	13.75	25.69	6.82	1.52	29.68
Tymbark (2)	15.41	28.40	70.32	145.92	20.34
Charsznica (2)	13.07	3.43	38.09	8.34	36.60
Gołcza (2)	12.07	2.48	39.53	44.92	20.16
Kozłów (2)	9.44	1.72	6.66	1.33	51.53
Książ Wielki (2)	10.77	27.39	18.96	23.05	58.92
Miechów (3)	17.50	19.09	20.74	42.19	60.48
Racławice (2)	9.39	1.08	23.47	1.10	20.42
Słaboszów (2)	9.38	1.33	15.90	6.68	31.06
Dobczyce (3)	18.77	46.31	17.49	18.68	47.74
Lubień (2)	15.42	5.82	8.30	5.50	29.36
Myślenice (3)	27.51	134.58	22.21	120.46	80.49
Pcim (2)	11.71	2.75	8.89	42.01	36.15
Raciechowice (2)	9.72	8.00	9.71	2.52	30.37
Siepraw (2)	16.93	7.17	23.10	9.71	15.46
Sułkowice (3)	17.20	56.82	15.52	27.97	40.09
Tokarnia (2)	11.21	1.01	5.52	3.10	26.78
Wiśniowa (2)	11.70	6.93	9.71	4.35	30.50
Grybów (1)	18.33	3.89	13.89	4.64	16.57
Chełmiec (2)	18.40	21.64	52.47	68.15	69.95
Gródek nad D. (2)	13.19	12.40	30.76	85.14	106.09
Grybów (2)	15.72	136.73	32.09	22.30	63.12
Kamionka Wielka (2)	15.35	9.39	12.61	1.70	30.90
Korzenna (2)	12.20	14.01	24.10	28.57	46.01
Krynica-Zdrój (3)	22.82	16.13	17.57	34.58	86.17
Łabowa (2)	10.52	17.61	22.71	2.09	70.67
Łącko (2)	12.99	16.26	17.19	5.10	90.74
Łososina Dolna (2)	12.79	8.90	33.47	26.71	135.08
Muszyna (3)	18.56	19.63	17.98	50.29	104.96
Nawojowa (2)	12.05	3.87	7.73	1.48	28.07
Piwniczna-Zdrój (3)	12.02	10.32	28.51	230.14	97.12
Podegrodzie (2)	12.20	39.77	25.87	13.34	41.12

Rytro (2)	12.02	3.35	5.94	2.99	42.94
Stary Sącz (3)	18.15	63.56	40.63	49.80	59.20
Nowy Targ (1)	30.34	101.66	24.61	224.69	177.31
Szczawnica (3)	14.76	2.03	10.00	18.94	90.14
Czarny Dunajec (2)	11.35	9.96	13.39	14.22	112.45
Czorsztyn (2)	16.61	4.44	11.33	13.31	53.06
Jabłonka (2)	15.80	11.43	15.07	18.42	93.20
Krościenko nad D. (2)	13.35	29.33	8.43	8.68	32.73
Lipnica Wielka (2)	11.44	17.11	4.90	5.77	40.14
Łapsze Niżne (2)	13.94	5.02	10.43	25.18	72.53
Nowy Targ (2)	15.20	22.58	19.31	46.46	107.21
Ochotnica Dolna (2)	12.23	3.00	7.95	13.18	75.71
Raba Wyżna (2)	12.67	4.05	12.19	7.98	54.36
Rabka-Zdrój (3)	18.32	31.07	10.83	33.09	40.33
Spytkowice (2)	13.95	2.81	19.73	3.17	11.88
Szaflary (2)	11.68	2.36	10.84	6.00	27.99
Bukowno (1)	20.05	98.87	597.32	1846.34	106.37
Bolesław (2)	16.73	2.51	12.18	431.42	59.95
Klucze (2)	18.46	82.67	74.61	352.24	534.03
Olkusz (3)	33.33	79.67	26.19	493.72	118.90
Trzyciąż (2)	12.57	9.38	20.62	3.50	29.46
Wolbrom (3)	19.31	3.10	25.35	61.88	63.21
Oświęcim (1)	41.88	143.73	572.11	2183.67	255.42
Brzeszcze (3)	24.68	369.06	20.67	948.55	86.67
Chełmek (3)	21.59	22.95	17.72	14.51	38.81
Kęty (3)	27.89	131.19	222.80	560.80	71.14
Osiek (2)	16.58	1.52	14.95	73.75	39.85
Oświęcim (2)	18.26	67.18	34.58	89.84	153.87
Polanka Wielka (2)	14.77	0.59	7.24	6.21	14.06
Przeciszów (2)	16.81	10.70	12.89	26.04	44.28
Zator (3)	19.77	129.14	17.05	104.36	135.78
Koniusza (2)	14.08	1.42	24.47	4.84	23.11
Koszyce (2)	12.38	3.54	11.48	7.28	32.08
Nowe Brzesko (3)	11.43	1.29	10.00	42.76	25.16
Pałecznica (2)	10.78	1.67	10.48	1.16	9.36
Proszowice (3)	15.89	112.85	16.18	18.59	39.24

Table 6. cont.

Communes / meta-features	D	E	I	EM	LM
Radziemice (2)	10.42	0.56	17.56	1.76	10.17
Jordanów (1)	14.38	3.90	8.84	5.32	24.60
Sucha Beskidzka (1)	18.34	8.12	15.46	51.39	27.53
Budzów (2)	8.22	2.63	8.36	1.25	25.10
Bystra-Sidzina (2)	8.81	1.71	2.78	1.34	48.00
Jordanów (2)	11.64	1.84	33.59	7.00	40.53
Maków Podh. (3)	12.54	9.19	33.92	85.46	48.15
Stryszawa (2)	10.93	7.06	8.19	5.08	44.38
Zawoja (2)	9.34	3.28	7.34	1.84	63.49
Zembrzyce (2)	13.42	1.93	10.09	2.27	39.77
Ciężkowice (3)	12.38	6.97	18.15	25.27	79.09
Gromnik (2)	13.19	3.12	10.29	6.43	46.00
Lisia Góra (2)	20.20	6.39	17.30	19.55	181.04
Pleśna (2)	15.24	16.60	21.59	16.72	59.32
Radłów (3)	15.60	1.37	10.00	11.84	55.52
Ryglice (3)	11.89	1.76	11.88	1.77	114.67
Rzepiennik Strzyż. (2)	10.15	3.87	17.69	1.04	366.08
Skrzyszów (2)	17.80	17.87	63.38	33.71	31.91
Tarnów (2)	24.33	18.44	53.11	56.98	47.87
Tuchów (3)	17.37	8.07	26.24	18.42	47.21
Wierzchosławice (2)	19.98	13.30	13.15	25.01	92.21
Wietrzychowice (2)	14.90	32.55	19.62	126.11	36.92
Wojnicz (3)	15.37	1.69	10.00	3.09	66.93
Zakliczyn (3)	12.67	2.31	10.00	15.14	71.38
Żabno (3)	20.33	27.49	18.05	51.67	75.04
Szerzyny (2)	15.33	1.51	9.64	2.12	30.28
Zakopane (1)	26.17	188.05	218.29	659.48	121.43
Biały Dunajec (2)	13.10	2.28	6.01	3.35	16.31
Bukowina Tatrz. (2)	12.69	4.82	32.69	21.80	98.89
Kościelisko (2)	12.75	3.33	7.64	6.03	165.04
Poronin (2)	15.04	8.57	12.54	5.67	51.77
Andrychów (3)	31.43	22.92	27.50	114.75	72.75
Brzeźnica (2)	14.43	96.17	21.72	8.81	37.71
Kalwaria Zebrz. (3)	15.19	56.72	23.85	75.76	52.85
Lanckorona (2)	11.51	1.74	24.38	34.84	16.40

Mucharz (2)	14.34	43.26	12.98	2.01	123.34
Spytkowice (2)	15.84	23.62	13.46	36.49	61.22
Stryszów (2)	13.98	1.16	12.68	5.79	36.88
Tomice (2)	14.93	3.56	18.48	2.43	31.77
Wadowice (3)	26.86	44.08	22.38	169.97	79.54
Wieprz (2)	14.33	4.22	34.26	23.91	45.80
Biskupice (2)	14.05	4.70	15.56	24.85	17.14
Gdów (2)	16.09	16.83	24.29	10.39	196.76
Kłaj (2)	18.74	7.15	18.15	44.49	43.04
Niepołomice (3)	24.54	58.90	52.75	346.13	77.28
Wieliczka (3)	28.10	54.38	78.27	52.07	141.89
Kraków (1)	222.38	1415.79	357.36	4999.30	1001.57
Nowy Sącz (1)	54.83	207.92	83.90	298.33	103.26
Tarnów (1)	65.67	501.23	213.87	1011.82	176.93

Explanations:
D – demography, E – economy, I – infrastructure, EM – environmental management, LM – land management

The objects of research described by the indicators presented above can be compared only after defining the measure of similarity between them. Therefore as a measure of taxonomic distance between objects, Euclidean distance was adopted. The matrix of Euclidean distances was created on the basis of five constructed meta-features (matrix of metadata). The measure of similarity, expressed by Euclidean distance, is presented in the following formula:

$$d_{io} = \sqrt{\sum_{j=1}^{n} (z_{ij} - z_{oj})^2}$$

where:
   z_{ij} – normalized value of a 'j' feature in an object 'i',
   z_{oj} – normalized features' values of a standard object,

Classification of communes as regards factors influencing their local development was carried out by Ward's hierarchical clustering method, which is agglomerative combinatorial method for grouping and arranging objects. It uses an analysis of variance in order to assess distances between clusters [Ward 1963]. Ward's method is aimed at obtaining small clusters and is regarded as highly effective [Nowak 1980]. It assumes that at the beginning of a calculation procedure each object is initially a separate group, then the number of group is gradually reduced by joining into groups of higher order. The process of joining itself was completed at the moment when one group consisting of set of all objects was obtained [Kolenda 2006]. The essence of the agglomeration of clusters by Ward's method consisted in organizing objects according to an adopted criterion, which was meeting the

condition of homogeneity of communes with regard to factors (segments) adopted in the analysis. The results were obtained in the form of dendrogram (hierarchical tree). Then classes of communes singled out by Ward's method were juxtaposed and averages and standard deviations were calculated of meta-features collated into five thematic segments of an adopted classification. Spatial analysis of the results was carried out. The territorial distribution of types of communes homogeneous with respect to studied factors shaping communes' local development was presented.

3. Results

The synthetic indicators of component factors of local development, obtained as a result, became a basis for grouping communes into homogeneous types with respect to anatomical similarity of their structure.

As a result of applying Ward's method a diagram of connections was obtained and it is presented in the form of dendrogram in Figure 1.

By using Ward's method classes of communes were singled out and on this basis ten group of communes were obtained (A–J) and juxtaposed in Table 7.

Table 7. Classes of communes obtained by Ward's method

Group of communes	Commune	No. of communes
A	Trzebinia (3)	1
B	Kraków (1)	1
C	Libiąż (3), Brzeszcze (3), Tarnów (1)	3
D	Skawina (3), Bukowno (1), Oświęcim (1)	3
E	Myślenice (3), Dąbrowa Tarnowska (3), Szczurowa (2), Grybów (2), Brzeźnica (2), Proszowice (3), Zator (3)	7
F	Bolesław (2), Olkusz (3), Bochnia (1), Brzesko (3), Niepołomice (3), Nowy Sącz (1), Kęty (3), Zakopane (1)	8
G	Krzeszowice (3), Zabierzów (2), Gorlice (1), Alwernia (3), Chrzanów (3), Rzepiennik Strzyżewski (2), Wadowice (3), Klucze (2), Piwniczna Zdrój (3), Nowy Targ (1)	10
H	Muszyna (3), Łososina Dolna (2), Szczawnica (3), Jabłonka (2), Czarny Dunajec (2), Uście Gorlickie (2), Sękowa (2), Gródek nad Dunajcem (2), Łącko (2), Krynica Zdrój (3), Kościelisko (2), Bukowina Tatrzańska (2), Mucharz (2), Wieliczka (3), Gdów (2), Oświęcim (2), Nowy Targ (2), Lisia Góra (2), Wierzchosławice (2), Ryglice (3)	20
I	Mszana Dolna (1), Limanowa (2), Zielonki (2), Limanowa (1), Miechów (3), Pcim (2), Tymbark (2), Gołcza (2), Świątniki Górne (3), Gnojnik (2), Iwkowa (2), Drwinia (2), Lipnica Murowana (2), Skała (3), Słomniki (3), Jerzmanowice-Przeginia (3), Liszki (2), Andrychów (3), Kalwaria Zebrzydowska (3), Wietrzychowice (2), Żabno (3), Biskupice (2), Kłaj (2), Lanckorona (2), Spytkowice (2), Tarnów (2), Wolbrom (3), Osiek (2), Chełmiec (2), Stary Sącz (3), Maków Podhalański (3), Skrzyszów (2), Nowe Brzesko (3), Sucha Beskidzka (1)	34
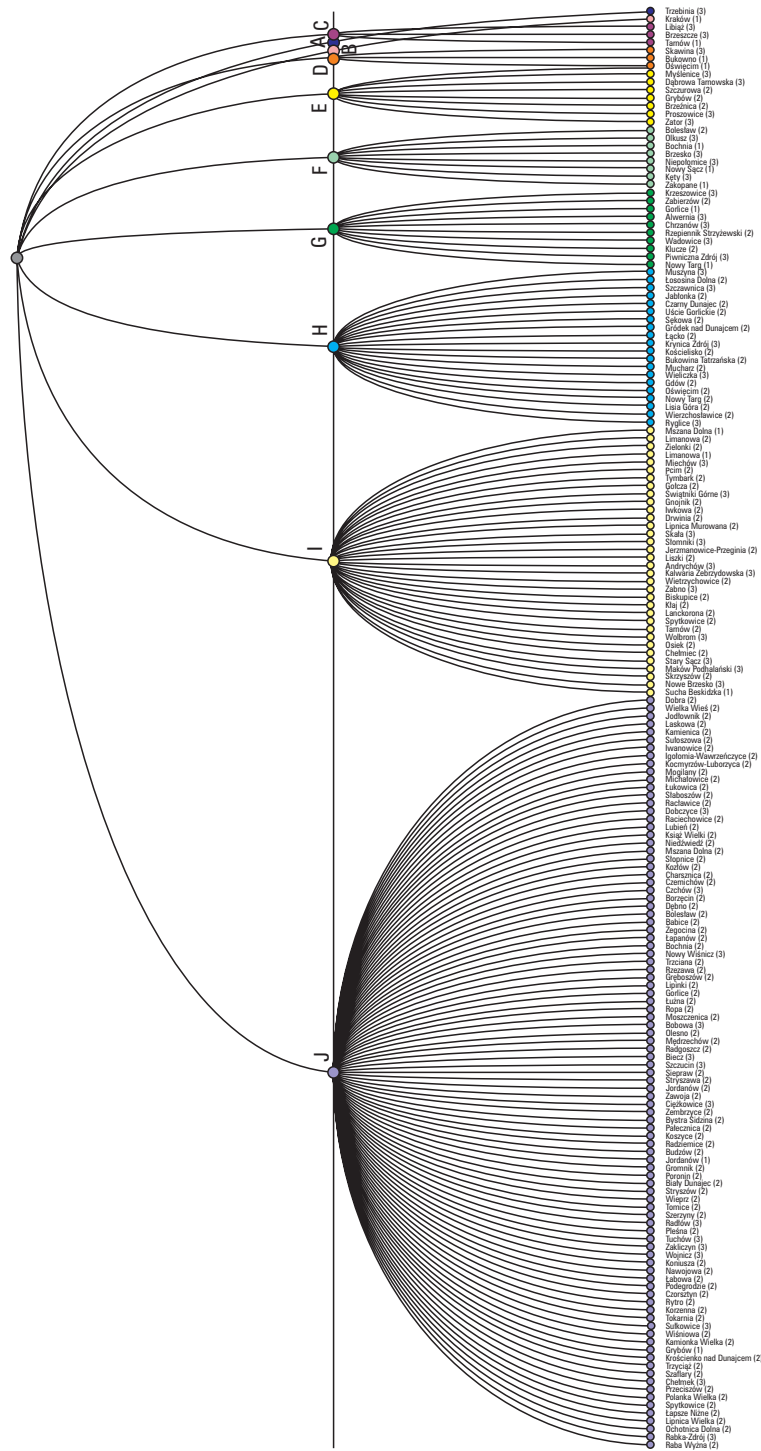
Source: author's study

Fig. 1. Tree diagram for 182 communes of the Małopolskie voivodeship, obtained by Ward's method

Table 7. cont.

Group of communes	Commune	No. of communes
J	Dobra (2), Wielka Wieś (2), Jodłownik (2), Laskowa (2), Kamienica (2), Sułoszowa (2), Iwanowice (2), Igołomia-Wawrzeńczyce (2), Kocmyrzów-Luborzyca (2), Mogilany (2), Michałowice (2), Łukowica (2), Słaboszów (2), Racławice (2), Dobczyce (3), Raciechowice (2), Lubień (2), Książ Wielki (2), Niedźwiedź (2), Mszana Dolna (2), Słopnice (2), Kozłów (2), Charsznica (2), Czernichów (2), Czchów (3), Borzęcin (2), Dębno (2), Bolesław (2), Babice (2), Żegocina (2), Łapanów (2), Bochnia (2), Nowy Wiśnicz (3), Trzciana (2), Rzezawa (2), Gręboszów (2), Lipinki (2), Gorlice (2), Łużna (2), Ropa (2), Moszczenica (2), Bobowa (3), Olesno (2), Mędrzechów (2), Radgoszcz (2), Biecz (3), Szczucin (3), Siepraw (2), Stryszawa (2), Jordanów (2), Zawoja (2), Ciężkowice (3), Zembrzyce (2), Bystra Sidzina (2), Pałecznica (2), Koszyce (2), Radziemice (2), Budzów (2), Jordanów (1), Gromnik (2), Poronin (2), Biały Dunajec (2), Stryszów (2), Wieprz (2), Tomice (2), Szerzyny (2), Radłów (3), Pleśna (2), Tuchów (3), Zakliczyn (3), Wojnicz (3), Koniusza (2), Nawojowa (2), Łabowa (2), Podegrodzie (2), Czorsztyn (2), Rytro (2), Korzenna (2), Tokarnia (2), Sułkowice (3), Wiśniowa (2), Kamionka Wielka (2), Grybów (1), Krościenko nad Dunajcem (2), Trzyciąż (2), Szaflary (2), Chełmek (3), Przeciszów (2), Polanka Wielka (2), Spytkowice (2), Łapsze Niżne (2), Lipnica Wielka (2), Ochotnica Dolna (2), Rabka-Zdrój (3), Raba Wyżna (2)	95
Total number of studied communes		**182**

Legend: 1 – urban commune, 2 – rural commune, 3 – urban-rural communes

Table 8. Averages and standard deviations of diagnostic features in the classification

Group of communes	No. of communes in a group	Demography		Economy		Infrastructure		Environmental management		Land management	
		x	S	x	S	x	S	x	S	x	S
A	1	28.71	–	**852.13**	–	51.10	–	649.43	–	160.05	–
B	1	222.38	–	1415.79	–	357.36	–	**4999.30**	–	1001.57	–
C	3	38.07	23.91	305.67	233.78	96.87	102.86	**976.95**	32.13	168.30	77.67
D	3	30.03	11.04	105.33	35.61	427.11	273.27	**1929.34**	224.65	152.09	89.68
E	7	18.48	5.48	**173.83**	91.04	19.79	6.38	43.79	47.28	69.86	34.39
F	8	30.38	11.59	93.36	74.84	101.23	85.19	**399.41**	198.32	80.31	34.46
G	10	23.75	9.48	44.60	36.64	49.48	29.06	**207.36**	90.22	185.03	156.51
H	20	15.84	4.34	17.44	17.63	22.05	15.47	26.97	25.87	**119.87**	32.70
I	34	16.94	4.67	13.94	14.67	25.83	15.96	**59.16**	31.30	41.29	19.13
J	95	13.87	2.71	9.59	10.41	14.65	6.81	12.28	43.63	**38.45**	16.39
Studied community	182	18.00	16.94	42.00	134.66	33.71	70.81	**130.00**	463.77	69.00	92.62

The calculated averages and standard deviations of synthetic meta-features in groups of communes became a basis for determining the fundamental segments shaping local development of all studied communes in specific groups (Table 8).

Group A (1 commune) and group E (7 communes) are characterized by marked prevalence of economic factors over remaining analysed ones. The basic segment of local development is here an economic segment. Local economic development is determined by financial factors, such as fixed assets. Capital is a prerequisite for all investment processes and therefore the stress should be put on actions that generate local capital [Dobrodziej 2002].

Group B (1 commune), C (3 communes), D (3 communes), F (8 communes), G (10 communes), I (34 communes) are characterized by the prevalence of environmental factors. Local environmental development is determined by state and protection of environment and proper environmental policy. State and quality of environment becomes more and more frequently and with an ever higher degree a criterion for assessment of investment attractiveness. Low quality of environment not only can scare off people, but can also be an obstacle to using modern technologies [Dobrodziej 2002].

Groups H (20 communes) and J (95 communes) show clear prevalence of spatial factors. The basic segment of development of these communes is land management. Local development in this group is determined by usable space, basic resources necessary for proper development of local economy and meeting the needs of people. Utility values of the group can enhance or lower the attractiveness to potential investors. Local authorities can attract investors by creating favourable economic climate in their area, facilitating the development of existing companies and establishment of the new ones [Rosińska 2007].

The totality of studied communes are characterized by the prevalence of environmental factors. Environmental management segment has been recognized as a fundamental one for local development in the Małopolskie voivodeship. The region is oriented mainly towards economy efficiently using natural resources. Around 52.1% of the voivodeship's area are nature sites and objects [Urząd Statystyczny… 2015]. It has a significant influence on maintaining sustainable development in the region. Local development of communes of the Małopolskie voivodeship is an integrated development, combining domains of demography, economy, infrastructure, environment and space. Local development should be an integrated one, so it should take place harmoniously in the following domains: social, economic, infrastructural, spatial and environmental [Majchrzak and Zalewski 2000].

Spatial distribution of homogeneous types of communes as to factors influencing local development of communes has been presented in Figure 2. Analysing it one can see that singled out types of communes are highly spatially diversified.

The communes where economic factors were prevailing (groups A and E) are located in the vicinity of big cities, industrial centres and by main communication roads (Trzebinia, Myślenice, Dąbrowa Tarnowska, Proszowice and Zator). They are highly active in the economic domain. Communes where environmental factors prevail (groups B, C, D, F, G, I) are located in different places, especially in north-western part of the country, usually in the vicinity of nature sites. They are highly active in the

domain of environmental policy and maintaining sustainable development towards an economy efficiently using natural resources. Most spatially diverse communes (groups H and J) take up around 85% of the voivodeship area. They are very active in implementing land policy and management. It is enormously important when it comes to managing space and using land in such way as to permit sustainable development.
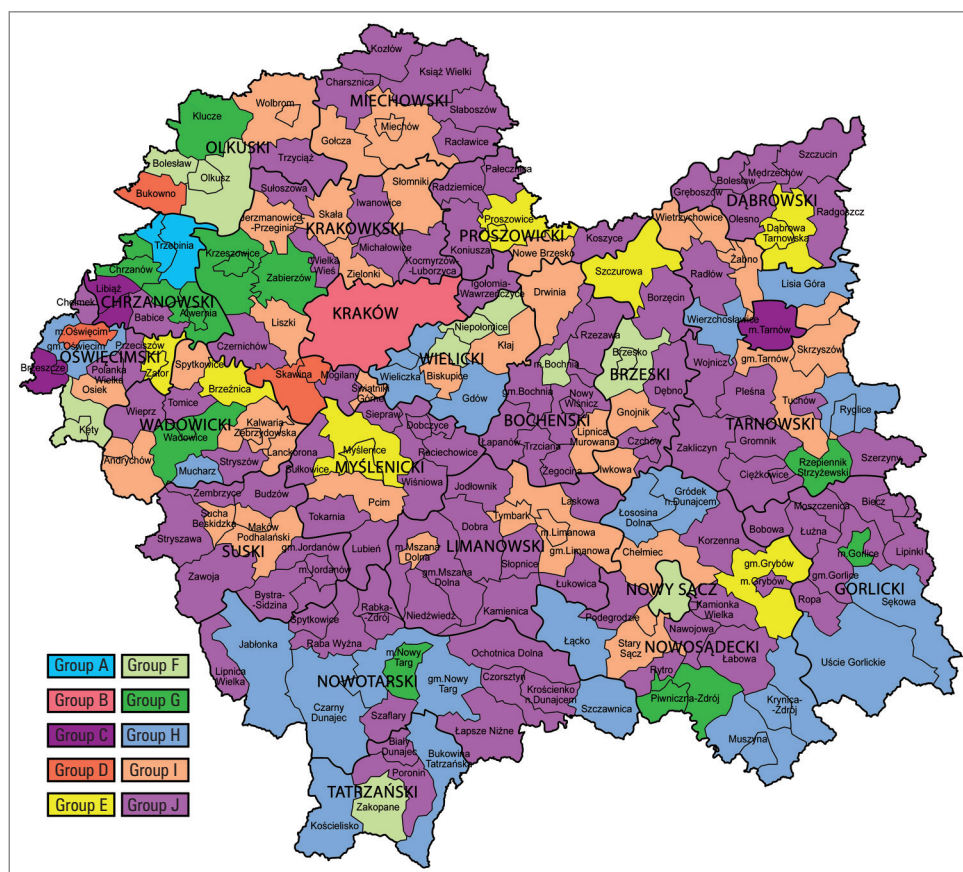
Source: author's study

Fig. 2. Spatial distribution of the homogeneous types of communes of the Małopolskie voivodeship

4. Recapitulation and conclusions

Using Ward's method allowed for classification of the Małopolskie voivodeship communes into 10 homogeneous groups as to factors of local development. The basis of this typology of communes was their classification according to adopted criteria: demographic, economic, infrastructural, environmental and spatial. Of great impor-

tance in the study was the choice of features and measures, which allowed to differentiate communes within 5 segments shaping their local development. The calculated averages and standard deviations of meta-features in singled out groups were the basis for selection and determination of basic indicators influencing local development. The analysis of spatial distribution of types of communes, carried out by Ward's method, showed high diversity of saturation in that respect. The kind of developmental factor depended on territorial location of a commune. The determining developmental factor in all studied communes proved to be a segment of environmental management, which shows positive activity of certain group of communes and their commitment to maintaining suitable state and protection of nature. Thanks to using synthetic indicators the analysis of large databases was possible in the study. Ward's method was used as a basic tool for grouping and analysis of acquired taxonomic collections. The above classification may be helpful in coping with tasks related to environmental policy of local or regional dimension.

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