Dr Dariusz Koreleski

Instytut Ekonomiczno-Społeczny
Institute of Economics and Social Sciences
Uniwersytet Rolniczy w Krakowie
University of Agriculture in Cracow

Regional Differentiation and Sustainable Development

INTRODUCTION

The issue of sustainability with regard to the development, especially in rural areas, has been widely elaborated by many scientists, who are constantly trying to find original ways of dealing with this problem, stressing individual factors as intrinsic elements in this subject. The problem of determinants of sustainable development is also of considerable importance. One of the major elements concerning this problem seems to be the effect of differentiation. There are also different phenomena referring to the layout and, consequently, to the polarization level.

The current paper tries to combine together two important problems of each region: the sustainable development issue and the question of differentiation referring to its aspects and positive or negative thresholds. It is also relevant to understand, among others, such phenomena as: diversification, disparities, amplitude (range, span), polarization concerning the layout, the Extreme Rate of Differentiation (ERD), Polarization Quotient (PQ), Polarization Index (PI) and polarization circles.

SUSTAINABLE, PERMANENT AND ECO- DEVELOPMENT

The formal definition of Sustainable Regional Development maintains, that it is a traditional objective of the state regional policy in many countries in Europe. Such policy should counteract the distinct disparities within a region. The realization of the guidelines ought to optimize the use of space and other resources of the country or region [Kienzler I., 2003].

However, the notions of sustainable, permanent and eco- development are sometimes used interchangeably. In fact there are certain differences between

them which should be pointed out. First of all, sustainable development is an economic notion which earlier did not take into consideration the ecological elements. In the current understanding, we should rather say: the ecological sustainable development which contains the ecological elements. The reason for the present meaning of sustainable development is the existence of eco-development which stressed the role of ecology in the development. Thus, establishing the sequence of events we would have the following order:

1. Sustainable development entailing mostly economic factors (UN Conference – Stockholm 1972);
2. Eco-development underlining the formerly neglected role of ecological elements (UN Environmental Programme 1975);
3. Permanent sustainable development which entails all possible economic, ecological, spatial, social, etc. elements (UN – World Conservation Strategy, 1980s).

The permanence refers to the constant longing for the equilibrium of all kinds of elements which constitute the development. In 1987 the UN Commission of Ms. G.H. Brundtland, preparing the report: "Our Common Future", states that the concept of sustainable development should entail the following aspects: ecological, economic, political, organizational, welfare and technological.

According to K. Koreleski [1999], eco-development consists of three interacting elements: economic (economic efficiency), social (social acceptance) and environmental (ecological balance). The implementation of the eco-development is accomplished with the use of the following instruments: law, market, research and progress, and financial support.

Sustainable development should satisfy the present needs without sacrificing the abilities of future generations to meet their needs. There are certain laws concerning sustainable development:

1. Law of objective, i.e. the proper objective should be stated in economic strategy considering economic criteria, as well as ecological ones;
2. Law of scale, i.e. the range of the permissible environmental pollution and exploitation should be definite pointing out the qualitative and quantitative barriers of natural resources exploitation;
3. Law of region, i.e. every area needs to develop depending on natural conditionings and on the will of its inhabitants. This law entails not only the economic, natural and social aspects but also the historical-cultural sphere;
4. Law of continuity, i.e. each area should develop in a synchronized way with auto- regulative elements which could guard this process by buffer actions providing simultaneously the feeling of security.

Summing up, one may say that the present notion of sustainable development combines together the economic, spatial, social, etc. equilibrium with eco-

logical balance forming a permanent, cohesive structure. It is also of intrinsic importance here to mention the role and position of an integrated order entailing such developmental aspects as: social, ecological, spatial and economic. The laws of: minimum (by Liebig) and tolerance (by Shelford and next Thienemann) referring to the balance of nature (quality and quantity of biotic and non-biotic elements) may also be treated as examples of natural sustainable development, according to the old Latin maxim: "*Aequilibrium – magister vitae et naturae optimus est*" [cf. Koreleski D., 2001].

THE DIFFERENTIATION – ISSUE AND PROBLEM

The issue of differentiation is of a very complex character. It concerns the positive, as well as negative aspects, depending on cohesion forces and the level of ordering resulting in the layout. In case of cohesion forces, they act in such a way as to stick together the data of the set as close as possible to the middle of the set. The higher the amplitude, the weaker the central cohesion forces resulting in disparities. But the real negative aspect of differentiation refers to its layout. In case of a negative one we are dealing with the high level of polarization, marked by the Extreme Rate of Differentiation (ERD), the Polarization Quotient (PQ) and Polarization Index (PI).
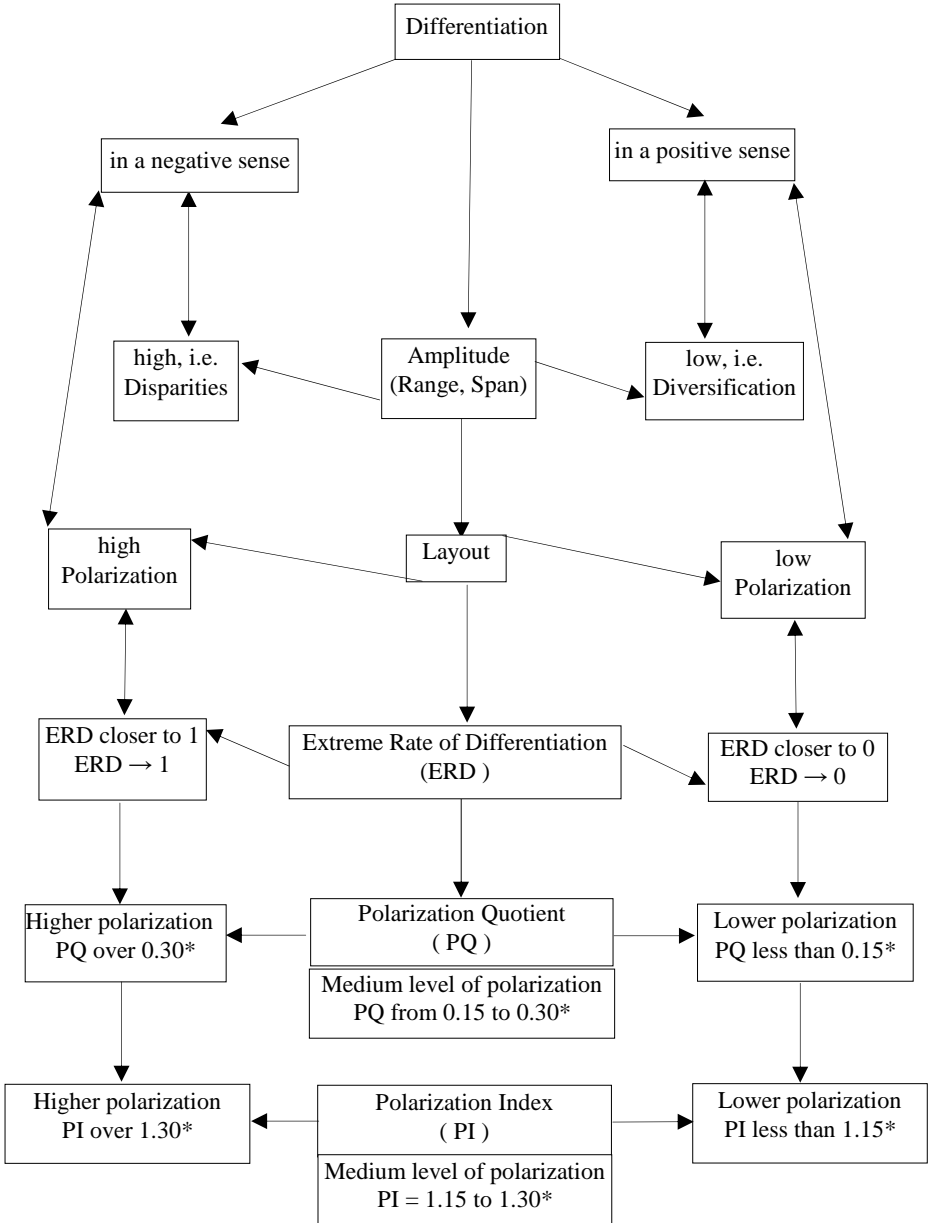
The differentiation may be positive or negative but is inevitable, the amplitude index – even higher – is difficult but seems to be bearable (however not advantageous), but polarization (especially high) is negative. The amplitude index shows the range (scale, span or distance), but polarization relies on the accumulation of extreme values, i.e. grouping them at opposite poles (layout).

The problem of differentiation is mostly of spatial character and is destimulative, i.e. the higher the level of differentiation, the higher the probability of encountering disparities, etc. But there are also positive aspects of differentiation leading to the diversification concept. This concept is based on a balanced differentiation, not exceeding definite thresholds, presenting diversity in a complementary sense.

Looking at the Diagram above, besides the links between different elements, we may notice certain differentiation thresholds indicating different levels of polarization, which have been assumed in this paper. Finally, we may state that the issue of differentiation may be treated as a problem – in a negative sense (disparities, high amplitude, high polarization), and as a phenomenon – in a positive meaning (diversification, low amplitude, low polarization).

The detailed differentiation model is presented in Diagram 1.

Diagram 1. Model of differentiation

Differentiation

in a negative sense

in a positive sense

high, i.e.
Disparities

Amplitude
(Range, Span)

low, i.e.
Diversification

high
Polarization

Layout

low
Polarization

ERD closer to 1
ERD → 1

Extreme Rate of Differentiation
(ERD)

ERD closer to 0
ERD → 0

Higher polarization
PQ over 0.30*

Polarization Quotient
(PQ)

Medium level of polarization
PQ from 0.15 to 0.30*

Lower polarization
PQ less than 0.15*

Higher polarization
PI over 1.30*

Polarization Index
(PI)

Medium level of polarization
PI = 1.15 to 1.30*

Lower polarization
PI less than 1.15*

Source: own elaboration
Remarks:
*presumed experimentally.

EXTREME RATE OF DIFFERENTIATION (ERD), POLARIZATION QUOTIENT (PQ) AND POLARIZATION INDEX (PI)

The ERD (Extreme Rate of Differentiation) determines the pace of approaching the middle of the set, i.e. the median value. Hence, the lower the ERD the faster we approach the middle of the set, i.e. the polarization is lower. The higher the ERD, the more slowly we reach the middle of the set, i.e. the polarization is higher. The ERD helps to answer the following questions:

1. How fast do we approach the middle of the set?
2. How concentrated are the polar values?, i.e. how concentrated are the data at the poles?
3. How high is the level of polarization of the data in the set?

The ERD is also useful for finding out the proportions of the layout concerning the polar values, the middle of the set and thresholds.

The ERD has been created so as to measure the differentiation for the evaluation of the degree (level) of polarization.

The ERD determines the pace of approaching the middle of the set, e.g. the median value. The ERD should belong to the $<0, 1>$ set. If ERD = 0 then it would mean that we are dealing with modal values. If ERD is close to 1 (e.g. at the beginning of the analysis), it means that we are dealing with clear polarization of the set (extreme values are grouped at two polar opposites). If ERD is lower through some stages, it means that the polarization is of sporadic character.

Summing up, in our case, we may presume that the lower the ERD the better, because it means smaller effect of regional polarization within differentiation; the higher the ERD the worse, due to higher danger of polarization within differentiation. Therefore we may state that the ERD is of destimulative character, i.e. may be treated as a statistical destimulant. Data analysis helps distinguish the following levels of polarization:

− higher level of polarization for ERDx (mean) over 0.85;
− medium level of polarization for ERDx (mean) between 0.70 and 0.85;
− lower level of polarization for ERDx (mean) less than 0.70.

The method regarding ERD relies on the comparison of extreme values (in this case 3 best and 3 worst) in such a way that we compare the 1st best with the 1st worst and then the 2nd best with the 2nd worst, a.s.o. In such a way are calculated the distances (d) which show the amplitudes. Obviously these distances (d) should be decreasing i.e. $d_1 > d_2 > d_3$ etc. Next ERD is calculated on the basis of distances (d) according to the formula: $ERD = d_2 / d_1$, next $ERD = d_3 / d_2$ a.s.o. Thus, ERD will show us the decreasing amplitude index of differentiation. The force of the change will be shown by ERD value [cf. Koreleski D., 2005a].

The Polarization Quotient (PQ) refers to the relation between two polar circular spheres (with a radius ranging up to 10% from each pole, i.e. polarization

circles) and the rest of the set. The Polarization Index (PI) concerns mostly the distance between PQ and polarization circles.

THE ISSUE OF POLARIZATION ON THE CASE OF THE MAŁOPOLSKA PROVINCE

The problem of polarization has been shown on the example of the Małopolska Province, concerning mostly the rural areas. Hence, it refers to the regional level NUTS 2 treated as a whole, but especially to its components, i.e. the NUTS 4 level of land-districts (*powiats*) – since 2003 called the LAU 1 level (Local Administrative Unit).

Table 1 presents the data concerning the revenue of land-district budgets (*powiats*) in the Małopolska Province in 2003 comparing the 7 best data (for land-districts) with the 7 worst data (for land-districts) whereas the total amount of land-districts in the Małopolska region amounts to 19.

Table 1. Revenue of land-district budgets (powiats) in 2003*

Ordinal	Land district (*powiat*)	Revenue of land-district budgets per capita in PLN	Amplitudes (distances)	Extreme Rate of Differentiation (ERD)
1	Miechowski	581	355	0.70
2	Gorlicki	523		
3	Tatrzański	487	248	
4	Suski	478		0.82
5	Nowotarski	477	203	
6	Oświęcimski	475		
7	Olkuski	425	185	0.91
1	Wielicki	226		
2	Tarnowski	275	140	
3	Krakowski	284		0.76
4	Nowosądecki	293	112	
5	Chrzanowski	337		
6	Brzeski	363	48	0.80
7	Myślenicki	377		
X	Mean ERD value of the first three data = 0.81			
X	Mean ERD value of the next three data = 0.66			
X	Amplitude index** A = 2.57 ; Span (nominal amplitude) S = 355			0.43
X	Polarization Quotient PQ = 0.11 ; Polarization Index PI = 1.12			

Source: own elaboration on the basis of the data taken from the Statistical Yearbook of the Regions – Poland, GUS, Warsaw 2004.

Remarks:

*per capita in PLN.

**calculated as max value/min value of the set.

Looking at Table 1, we notice the phenomenon of rather medium polarization (with certain trends even to the lower level), which is shown by medium mean ERD values for the first three data, while later, the mean ERD value of the next three data seems to direct the set towards the lower level. The lower level of polarization is also indicated by lower PQ and PI (see Diagram 1).

Calculating PQ value we consider the number of districts fluctuating around both poles +/- 10% (polarization circles) in comparison to the total population of the set (all land-districts of the Małopolska Province) which in this case equals 19 – including the middle of the set, i.e. also five land districts not mentioned in the table. Thus, counting the semicircles around the poles we must consider the Span (nominal amplitude) value. In our case we have the calculation: 2/19 = 0.11. In turn, Polarization Index (PI) is calculated as 1/(1-PQ) which gives the value of 1.12. Thus, one may say that the Polarization Quotient (PQ) equals 0.11, whereas Polarization Index = 1.12.

Table 2 presents the revenue of land-district budgets in the Małopolska Province five years later, i.e. in 2008.

Table 2. Revenue of land-district budgets (powiats) in 2008*

Ordinal	Land district (*powiat*)	Revenue of land-district budgets per capita in PLN	Amplitudes (distances)	Extreme Rate of Differentiation (ERD)
1	Miechowski	896	447	0.83
2	Tatrzański	848		
3	Gorlicki	826	373	
4	Oświęcimski	811		0.86
5	Suski	790	322	
6	Nowotarski	736		
7	Limanowski	724	300	
1	Wielicki	449		0.93
2	Krakowski	475	240	
3	Tarnowski	504		
4	Nowosądecki	511	151	0.80
5	Chrzanowski	550		
6	Dąbrowski	585	103	
7	Myślenicki	621		0.63
X	Mean ERD value of the first three data = 0.87			
X	Mean ERD value of the next three data = 0.70			
X	Amplitude index** A = 2.00 ; Span (nominal amplitude) S = 447			0.68
X	Polarization Quotient PQ = 0.16 ; Polarization Index PI = 1.19			

Source: own elaboration on the basis of the data taken from the Statistical Yearbook of the Regions – Poland, GUS, Warsaw 2009.

Remarks:
*per capita in PLN.
**calculated as max value/min value of the set.

In case of Table 2, the phenomenon of polarization is higher in comparison with the situation from Table 1. It refers especially to the Polarization Quotient PQ = 0.16 and Polarization Index PI = 1.19 which indicates the medium level of polarization. The mean ERD value of the first three data presents even the higher level of polarization, whereas the mean ERD value of the next three data stabilizes at the medium level. Comparing the data from Tables 1 and 2 we may notice, during five years (2003–2008), the increase of polarization which may point to the determinant of differentiated level of entrepreneurship in land-districts, which presumably has been reinforced by the accession of Poland to the European Union structures, but still the changes proceed in a rather sustainable way (not extreme).

There are different phenomena referring to the layout and, consequently, to the polarization level. Of course here we are dealing with nominal values which have the tendency to be higher and more differentiated, being simultaneously less polarized, while if we compared the relative values we would probably experience more polarized set due to certain statistical inclination for lower differences.

THE AMPLITUDE VERSUS POLARIZATION

Both phenomena: amplitude and polarization are derivatives of differentiation. The amplitude refers to the central forces of cohesion (the attraction of the middle of the set), while the polarization concerns the problem of the layout of the set.

The combinations of different situations with the use of positive or negative aspects of amplitude and layout, i.e. polarization are presented in Table 3.

Table 3. The Amplitude/Polarization (AP) matrix

Amplitude / Polarization*	High A+	Low A-
High P+	The danger of negative synergy (1)	The pole accumulation hazard (2)
Low P-	The span hazard (3)	The opportunity for diversification and positive cooperation (4)

Source: own elaboration

Remarks:
*entails both ERD, PQ, as well as PI indexes.

There are 4 situations of the co-acting between the polarization and the amplitude factors:
1. The danger of negative synergy means the threat of the accumulation of negative phenomena resulting in a negative added value.

2. The pole accumulation hazard denotes the negative layout and danger in perspective of the situation N^o1.

3. The span hazard seems to be less dangerous than the first two options, but requires caution with regard to the range trends, in order not to overcome certain thresholds in the future.

4. The opportunity for diversification and positive cooperation is a distinctly positive option, which enables to show the positive aspects of differentiation.

In Table 3 we may deal with the positive, as well as negative synchrony effects, which point out the problems co-existence. It means that in a certain area different phenomena and problems exist at the same time, simultaneously. The second group of effects is called the positive or negative effects of synergy, which indicate positive or negative cooperation of the phenomena or problems. It means that two existing phenomena or problems co-operate with each other in a positive or negative way, which causes the positive or negative synergy that relies on a bigger positive or negative effect, as if these two phenomena or problems were treated separately. It forms the so called positive or negative added value which may be shown in the difference between: $[a+b = $ a+b and $a+b >$ a+b or (-a-b) = $(-a-b)$ and (-a-b) > $(-a-b)]$. Both positive or negative synchrony effects and positive or negative effects of synergy lead to the positive or negative accumulation effects. Both positive or negative synchrony effects together with positive or negative effects of synergy lead also to the positive or negative intensification effects, thus pointing out the depth of the phenomenon or problem intensification. Basing on that, in recapitulation we could state two codas:

Coda 1: disturbed equilibrium of rural areas leads to their differentiation;

Coda 2: synchrony and synergy positive or negative effects lead to the phenomenon of multi-problem cases [cf. Koreleski D., 2005b].

SUMMING UP AND CONCLUSION

The issue of sustainable development is of complex character. The ecological elements are still very often stressed: e.g. C. Wood [1995] lists two general environmental aims of sustainable development: sustaining natural resource base and enhancing environmental quality. On the other hand, one must not forget about the socio-economic elements and hence, M. Finger & J. Kilcoyne [1995] emphasize the socio-economic aims of rural sustainable development, mentioning: sustaining economic viability of farm operations and promoting social sustainability of rural community. Some authors stress the spatial context of sustainable development. Thus H. v. Meyer [1996] proposed two approaches to sustainable development of rural areas:

1. Territorial approach concerning spatial differentiation;

2. Multifunctional approach referring to the wide range of rural space aspects concentrating, among others, on demographic, economic, social and environmental problems.

According to Hadryjańska [2005] sustainable development should be treated as a process which requires institutional changes, as well as defining the technical progress and changes in the model of consumption and behaviour. Sustainable development denotes, on the one hand, providing the proper level of socio-economic welfare and, on the other hand, guaranteeing natural environment protection. A visible prove of the implementation of this concept in the EU countries is a gradual turning away from rural policy towards the complex policy of the development of rural areas.

As we may see above, there are various approaches to the sustainable development issue. One of the main objectives of the paper was to show the links between the sustainable development issue and the problem of differentiation in a region. The thesis is that differentiation does influence the sustainability of the development in a relevant way. The diversification or disparities form the positive or negative background, stressing either the positive spatial equilibrium or negative, threatening spatial imbalance. Hence, the spatial layout has the influence on the level of the spatial polarization within the region. The problem of high polarization is a real danger for sustainability of the development, which distinctly disturbs achieving the socio-economic-environmental equilibrium in a given area.

The aim of sustainability regarding regional development is to find the balance between social, spatial, economic and environmental factors and to avoid the danger of disorder, as well as to overcome the hurdles created by the exceeding entropy. Sometimes it takes quite a lot of time to adjust the idea of sustainability to the present layout within differentiation. Both sustainable development and spatial differentiation are the processes which develop in time. The issue is to find a compromise (equilibrium or balance) between them, i.e. to let them adjust to one another at a certain level of mutual elasticity.

In conclusion we may state that:

1. Spatial differentiation of a region is a phenomenon that should be monitored;
2. Sustainable development idea (with its laws and principles) is to help in this monitoring of differentiation towards positive diversification phenomenon, stressing simultaneously the balanced complementarity;
3. The phenomenon of diversification forms a desired status of differentiation in a region, basing on sustainability of diversity and proper layout, i.e. proportionally low amplitude;
4. Combined sustainability of the development with developmental differentiation within a region should be co-acting in a synchronized, continuant and permanent process of improvement implementation;

5. Balance conditioning the sustainability should refer not only to the social, spatial, economic and environmental elements but also ought to stress the equilibrium of differentiation, i.e. avoiding disparities, high polarization and high amplitude but leading to the diversification concept.

REFERENCES

Finger M., Kilcoyne J., 1995, *Learning our Way out* [in:] *A Sustainable World. Defining and Measuring Sustainable Development,* Trzyzna T.C. (ed.), IUCN-World Conservation Union, California.

Hadryjańska B., 2005, *System gospodarki odpadami jako element zrównoważonego rozwoju obszarów wiejskich w Polsce,* wyd. SERiA – Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu tom VII, zeszyt 4, Warszawa-Poznań, s. 129–136.

Kienzler I., 2003, *Leksykon Unii Europejskiej,* Warszawa.

Koreleski D., 2001, *Zrównoważony rozwój obszarów wiejskich w województwie małopolskim,* Krakowskie Studia Małopolskie N°5/2001, Kraków, s. 147–160.

Koreleski D., 2005a, *Poland and the Ukraine – a Tentative Comparison of Social and Economic Effects of the Transformation Period,* wyd. SERiA – Annals of the Polish Association of Agricultural and Agribusiness Economists Vol. VII, No. 6, Warszawa–Poznań, pp. 65–71.

Koreleski D., 2005b, *An Integrated Approach to the Rural Problem Areas Issue,* Acta Agraria et Silvestria Vol. XLIV/2, PAN, Kraków, pp. 107–115.

Koreleski K., 1999, *Semantyczne, teoretyczne i praktyczne problemy rozwoju zrównoważonego – ekorozwoju,* Zesz. Nauk. AR w Krakowie N°359, Kraków, s. 61–68.

Meyer H. v., 1996, *The Environment and Sustainable Development In Rural Europe,* European Conference on Rural Development in Cork – "Rural Europe – Future Perspectives", European Commission, DG VI, Brussels.

Wood C., 1995, *Environmental Impact Assessment. A comparative Review,* Longman, Harlow.

Summary

The aim of the paper is to present the issue of sustainable development (mentioning also eco-development and balanced development) in the context of different aspects of differentiation which may be found in a region, resulting in positive diversification or negative disparities, i.e. high amplitude and, additionally, not advantageous layout which, in consequence, leads to high polarization. In order to measure the level of polarization of the data set, the Extreme Rate of Differentiation (ERD), Polarization Quotient (PQ) and Polarization Index (PI), as well as polarization circles have been introduced. The issue of differentiation and polarization has been shown on the example of the Małopolska Province and its land-districts in years 2003 and 2008.

Regionalne zróżnicowanie a zrównoważony rozwój

Streszczenie

Celem artykułu jest zaprezentowanie zagadnienia zrównoważonego i trwałego rozwoju w kontekście różnych aspektów zróżnicowania intra-regionalnego, które może w konsekwencji oznaczać pozytywną dywersyfikację lub negatywne dysparytety takie jak: wysoką amplitudę oraz niekorzystny rozkład prowadzący do wysokiej polaryzacji. W celu zmierzenia poziomu polaryzacji wprowadzono następujące pojęcia: krańcowej stopy zróżnicowania (ERD), współczynnika polaryzacji (PQ), wskaźnika polaryzacji (PI) oraz kręgów polaryzacji. Kwestię zróżnicowania i polaryzacji ukazano na przykładowych danych dla powiatów ziemskich województwa małopolskiego w latach 2003 i 2008.