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Agricultural Potential of Polish Voivodships in the Context of Sustainable Development

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Abstract

The paper focuses on the issue of the agricultural potential of Polish voivodships in the context of sustainable development. The overall objective is to measure the potential of individual voivodship markets in 2005 and 2015 and to identify those voivodships where the development potential is the biggest, based on the changes that took place over the decade between 2005 and 2015. The authors examined the agricultural potential of individual voivodships, concentrating not only on the agricultural land resources and quality, but also on the supporting infrastructure and socio-demographic factors in the environment of this property market segment. Detailed analyses covered 7 groups of diagnostic variables: geodesic areas, agricultural land, demographic variables, population incomes, agricultural production, ecology and infrastructure. The data came from the Central Statistical Office of Poland. The authors ranked the voivodships by means of a synthetic measure which took into account the groups of variables that characterized the phenomenon under study.

Keywords: agriculture potential, sustainable development, market analysis, Polish regions

JEL: R30

Introduction

According to the Eurostat data, rural areas cover about 90% of Poland's territory and are inhabited by one in three Polish residents.[1] The dominance of rural areas determines their great importance to the quality of life in Polish society. These lands cumulate plenty of public goods that are highly valuable socially, economically and environmentally (Woś and Zegar 2002, 48). The fundamental agricultural production factors are: land, labor and capital (Adamowski 1981, 675). The principal indicator of the agricultural potential is land—the farming production space. The resources of labor and capital—i.e., the economic and organizational conditions, have an influence on how this potential is utilized.[2] The degree of utilization of the potential productivity of the land in Poland differs regionally (Fotyma and Krasowicz 2001). Some voivodships are regions of large agricultural capacity but with a relatively low degree of its utilization (Nowak, Kaminska, and Krukowski 2015; Pawlewicz, Pawlewicz, and Cieslak 2016). The gaps in local market potential are the reason for the migration of capital and people to markets with larger development prospects. The bigger the

1. See: CAP context indicators, [@:] https://ec.europa.eu/agriculture/cap-indicators/context_en.

2. See: Waloryzacja rolniczej przestrzeni produkcyjnej. Biuletyn Informacyjny IUNG nr 12, Instytut Uprawy Nawożenia i Gleboznawstwa, Puławy 2000, pages 5–16.

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development gaps, the more energy is needed to reduce imbalances (Foryś 2011). This correlation has become the reason for undertaking a study.

The study aimed at evaluating the agriculture potential of individual voivodship markets in 2005 and 2015 as well as at indicating the voivodships with the highest development capacity, based on the changes over the 2005–2015 decade. Additionally, the quality of rural lands is closely associated with their residents' quality of life and with local sustainable development. Therefore, the authors also examined the agricultural potential of individual voivodships, focusing not only on the soil quality, its resources and infrastructural support, but also on socio-demographic factors in the environment of this property market segment. To this end the authors applied the method of ranking the voivodships by means of a synthetic measure that took into consideration groups of variables characterizing the examined phenomenon (Zeliaś 2000). The article uses data from a public statistics resource — Local Data Bank website of the Central Statistical Office of Poland. The study also includes a literature review of other research published in scientific journals.

1 Concept of Sustainable Development of Rural Areas

In the European Union the principles of sustainable development in all aspects of economic, social and environmental life have been in force since the announcement of the Action Programme – Agenda 21 (i.e., since the early 1990s).[3] Sustainable development is that which satisfies the fundamental needs of all people while at the same time ensuring the protection, conservation, rehabilitation and integrity of the Earth's ecosystems without compromising the needs of future generations and crossing the limits of the "carrying capacity" of our planet (Kutkowska 2009, 89). The overarching objective of sustainable development is to integrate economic, social and environmental policies at the local, regional and global levels (Fiedor 2013, 10–11; Ghosh and Goswami 2014). The basis of the concept of development sustainability is the interaction between anthropogenic and natural elements in the economic, environmental, social and institutional aspects of functioning, which link with one another, and thus contribute, through complex processes, to the durability of development (Gobattoni et al. 2015; Valentin and Spangenberg 2000).

The idea of sustainable development is also regarded as a concept addressing the development of rural areas because its rules apply to rational management of these areas, thus offering improved quality of life prospects to present and future residents (Kołodziejczyk 2015, 77–78). According to the UN FAO agency's definition, sustainable agriculture, being a pivotal element of the sustainable development of rural areas, consists in the management and conservation of the natural resource base to ensure the attainment and continued satisfaction of human needs for present and future generations. Creating sustainable agriculture does not lead to the natural environment degradation but to the promotion of adequate technology as well as to the protection of soil, water resources, plants and animals. This type of growth confers economic viability and social acceptance on agriculture while simultaneously allowing it to implement production and environmental targets. For the first time the concept of sustainable development of agriculture and rural areas was articulated in the Cork Declaration issued at the rural development conference in 1996. The Cork Declaration stated the principles of European Union's rural development (Marsden and Sonnino 2008, 422). The common elements of the European Union policy in this field are: rational use of production factors, including land; curbing harmful impact of agriculture on the natural environment; implementing management and technological systems that are safe for human and animal health while being economically effective. Other priorities are: the improved quality of life of rural area residents and increased use of renewable energies (Heller 2003). All the above characteristics are connected with the use of the agricultural production environment (Krasowicz and Kopiński 2006).

Today, the generally acknowledged concept of sustainable rural development combines the major sustainable development theories from the 1980s with new ideas on rural development being the effect of widespread criticism of modernization that farming underwent in the second half of the 20th

3. Agenda 21 is a programme document adopted at the 2nd United Nations Conference on Environment and Development in Rio de Janeiro in 1992 which described the ways of developing and implementing local programmes of sustainable development.

century (Pugliese 2001, 112–113) and which is considered incoherent with the concept of sustainable development and has brought adverse effects all over the world, mainly: unequal distribution of benefits, worsened socio-economic conditions for farmers, considerable degradation of the natural environment (Pretty 1995, 59–91). A new paradigm of rural development introduces a systemic approach by seeing 'the countryside' as a complex, dynamic and open system which encloses subsystems, such as the social, economic, natural and cultural, that are subject to co-evolution. The system is open to the exchange of people, goods, money, services or information with its environment (Allanson et al. 1994; Clark and Lowe 1992). Sustainable rural development is regarded as a joint outcome of targeted processes of changes taking place in several dimensions. In scientific research its three aspects are usually investigated: the social, economic and environmental, but some researchers approach it in a broader sense. They point out that sustainable development is a concept that focuses attention on the quality of human life and health. It is possible to reach its desired standard provided five categories of capital: natural, economic, human, social and the one integrating these four so that they are adequately managed (Adamowicz and Dresler 2006). The management of all the capital categories should be performed in agreement with the fundamentals of, respectively, the ecological, economic, social, institutional and land use governance (fig. 1).

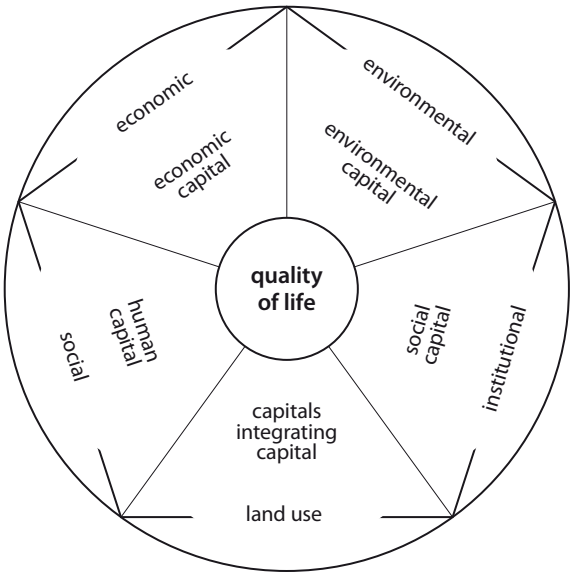

Fig. 1. Sustainable development by categories of capital and governance

Source: Adamowicz, Dresler (2006)

For the above reasons sustainable rural development can be defined as a multidimensional process of changes that influences rural sub-systems (Polidori and Romano 1996, quoted in Pugliese 2001). The new paradigm of rural development manifests itself through the increased importance of endogenous factors and through the role of their correlations (Kołodziejczyk 2015, 77–78). The main objectives of sustainable development of rural areas are their economic development, better social environment as well as well-preserved natural environment. These objectives should be called forth by way of a bottom-up approach, through participation and sustainable use of local endogenous resources (natural environment, labor force, knowledge, production patterns, consumption and communication). Sustainable rural communities should be able to recognize and internalize their exogenous growth prospects (e.g., markets), policies, technological capabilities as well as to integrate them and use them to counterbalance the need to preserve and strengthen local specific features and diversity. Rural residents and local authorities, being key economic and social entities, are expected to play an active role in defining the development policy, controlling the development process and sustaining the benefits (Ploeg and Long 1994). The concept of sustainable rural development consists in integrating and maintaining accurate proportions among the production-economic, environmental, social, institutional and land-use objectives (Adamowicz and Dresler 2006; Kutkowska 2007).

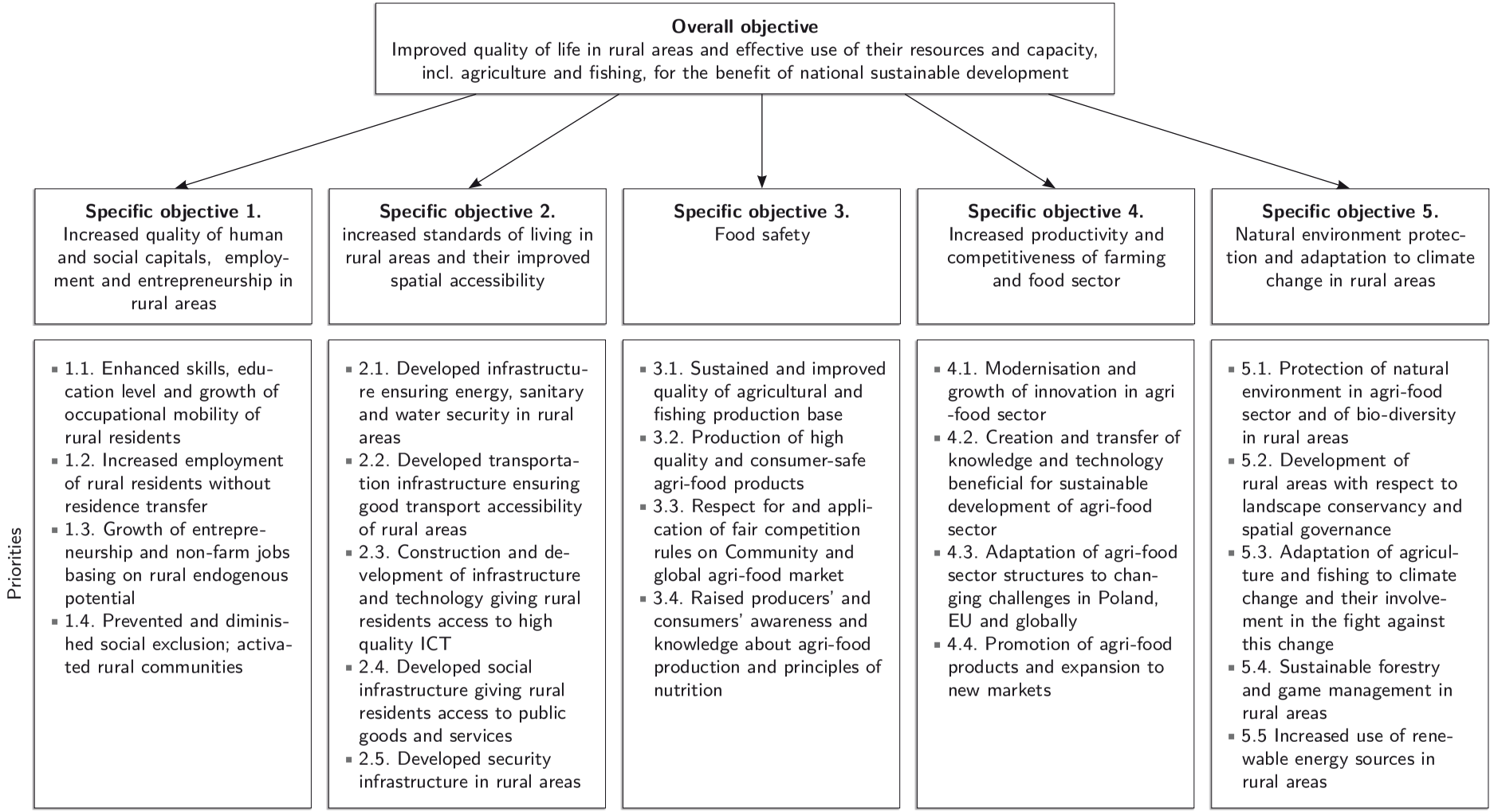

Fig. 2. Overall and specific objectives of the sustainable rural development strategy

Source: Uchwała Nr 163 Rady Ministrów..., op. cit. (see footnote 4, below)

As stated in the 2012–2020 Strategy of Sustainable Development of Rural Areas, Agriculture and Fishing Industry adopted by the Polish Council of Ministers in November 2012,[4] the overall objective of rural development in Poland is "to improve the quality of life in rural areas and effectively use their resources and potential, including agriculture and fishing, for the benefit of the sustainable development of the country" (fig. 2).

2 Research Method

In order to choose a synthetic development measure, the need arises to propose in groups a set of diagnostic variables that best describe the analyzed phenomenon. The selection of variables is conditioned by substantive reasons, expert knowledge as well as by the availability of data. The first step in the analysis is elimination of variables for which the inequality $V_j \leq 10\%$ is satisfied, where V_j ($j = 1, 2, ..., k$) denotes the coefficient of variation for the j-th variable. The variables that satisfy the above inequality should be regarded as quasi constant, not providing relevant information about the phenomenon under study and lacking discriminative abilities. Then the representatives of the selected groups are chosen out of the remaining variables that characterize these groups. To achieve this, the parametric method is used (Hellwig 1981). In this method, a starting point is to determine the matrix $\mathbf{R}$ of the coefficients of correlation between individual diagnostic variables. The variable classification criterion is a critical value of the correlation coefficient r^* at 0,5.[5] The diagnostic variables that are similar in terms of the correlation degree create clusters—i.e., such subsets where the minimum similarity between variables is lower than r^*. The clusters consist of one central and several satellite variables that constitute a set of diagnostic variables (Foryś 2011, 279). The variables should be standardized by transforming destimulants into stimulants. To this end, one can use a simple method of finding the inverse of diagnostic variables of a destimulant character. In the next stage of determining a synthetic development measure (SMR) the diagnostic variables are harmonized—i.e., the variables x_{ij} are subjected to standardization given by formula

$$x'_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j}, \tag{1}$$

where s_j is standard deviation of j-th variable. The aggregation of the variable values can be based on formulas with and without a "development pattern" and their use is limited by the measurement scale of variables (Zeliaś 1991, 86–87). In the development pattern methods the existence of a model (pattern) object is assumed, in relation to which the taxonomic distances of the remaining objects $q_i = \mathrm{d}(x_i, x_0)$ are calculated. These distances allow for ranking the objects from the most developed (the closest to the pattern) to the least developed (the farthest from the pattern). In the market potential studies, the maximum value for each variable can be used as the pattern value.

Usually, the distance of a given object from the development pattern (as a synthetic measure value) is measured with the use of Minkowski's metrics, the special example of which is the Euclidean distance

$$q_i = \sqrt{\sum_{j=1}^{m} \frac{1}{m}(x'_{ij} - x_{0j})^2}, \quad i = 1, 2, \ldots, n, \tag{2}$$

where x'_{ij} standardized values of j-th diagnostic variable for i-th object. The obtained values of the synthetic measure q_i are transformed giving a synthetic development measure q'_i for the i-th object:

$$q'_i = \frac{q_i}{\|Q\|}, \quad i = 1, 2, \ldots, n, \tag{3}$$

where $\|Q\|$ is a synthetic variable norm.

4. See: Uchwała Nr 163 Rady Ministrów z dnia 25 kwietnia 2012 r. w sprawie przyjęcia "Strategii zrównoważonego rozwoju wsi, rolnictwa i rybactwa" na lata 2012–2020. Monitor Polski 2012 poz. 839.

5. [In the journal European practice of number notation is followed—for example, 36 333,33 (European style) = 36 333.33 (Canadian style) = 36,333.33 (US and British style).—Ed.]

In practice the formula is transformed by solving $1 - q_i'$, which leads to changed variable preference (in the case of the stimulants the higher the values, the higher the level of the phenomenon under analysis). The norm $\|Q\|$ is usually the maximum value. Eventually, one can rank the tested objects from the best to the weakest in terms of the rural potential by setting the distances of the objects from the development pattern, and then compare the ordering in time.

3 Analysis of Attributes Characterizing Rural Potential of Regions

Market potential refers to the quality and supply of human, financial and property capital (Foryś 2011). As far as the agricultural property market is concerned, the market potential pertains to human capital, land and agricultural conditions. In this study the authors primarily adopted a wide range of variables of socio-economic character that directly influence the agriculture potential in regions (Foryś and Putek-Szeląg 2014). Voivodships were chosen as units under study—i.e., the study covers 16 objects (voivodships) Z_i, $i = 1, 2, ..., 16$, in 2015. The evidence base and the existing research into the analyzed segment of the property market confirm that its development is conditioned by current resources and their quality, by support infrastructure as well as by environmental and socio-economic factors. Hence the proposed initial set of seven groups of variables (G_1–G_7) representing the factors under study. For individual variables, selected for the analysis in seven groups of factors having impact on the agricultural property market, the coefficients of variation were determined, and the intra-group correlations were investigated. Finally, those variables were left for which the coefficient of variation was higher than 10% and which were poorly correlated with one another. As a result, the variables that were eventually included in the set of diagnostic variables and their effect on the phenomenon under analysis (nominants, stimulants or destimulants) are shown in table 1.

There is a group of voivodships where the proportion of ecological areas in the total of agricultural land (group G_1) was high. Those were: Lubuskie, Kujawsko-Pomorskie, and Zachodniopomorskie. Over the decade in the majority of voivodships the coefficient went up, the most considerable changes taking place in the Warmińsko-Mazurskie, Podlaskie, and Lubuskie. No change was recorded in Małopolskie and Świętokrzyskie whose agricultural value was the lowest (fig. 3). As far as demographic variables (group G_3) are concerned, it is important to note the growing rural population between 2005 and 2015. The most notable rise was seen in the Pomorskie, Wielkopolskie and Dolnośląskie voivodships (fig. 4). Nevertheless, in many voivodships the growth in rural population is a result of suburbanization and does not mean the increased human capital in agriculture (Foryś 2013). The market potential is also reflected by the economic potential of local residents that can be measured with average monthly disposable income per a member of a farming household. When comparing 2005 with 2015, one can see a negative change in the Lubuskie Voivodship (a drop

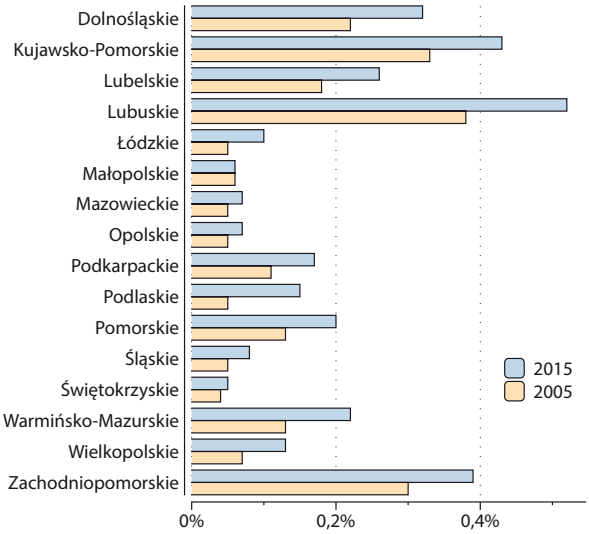

Fig. 3. Proportion of ecological areas in total agricultural land

Tab. 1. Tested set of diagnostic variables

Variable	Evaluation
G_1 — geodesic areas	
• agricultural land total (ha)	S
• agricultural land — land under ponds (ha)	N
• forested, wooded and bushy land — wooded and bushy land (ha)	S
• land under standing surface waters (ha)	N
• built — up and urbanized land — residential areas (ha)	D
• built — up and urbanized land — undeveloped urbanized areas (ha)	D
• built — up and urbanized land — mining grounds (ha)	D
• ecological areas (ha)	S
• wasteland (ha)	D
G_2 — agricultural land	
• arable land (ha)	S
• permanent crops (ha)	S
• fallow land (ha)	D
G_3 — demographic variables	
• population per 1 km^2	D
• migrations for permanent residence between voivodships — total	D
• rural population	S
G_4 — population income	
average monthly disposable income from paid employment per capita (PLN)	S
average monthly disposable income from private farm per capita (PLN)	S
average monthly disposable income from self-employed activity per capita (PLN)	S
total average monthly spending per capita (PLN)	D
G_5 — agricultural production	
global agricultural production per 1 ha of agricultural land (PLN)	
production of animals for slaughter — calves (PLN per 1 kg of live weight)	
price of agricultural land — total (PLN per 1 ha)	
G_6 — ecology	
• total consumpt. of mineral fertilizers (NPK) per 1 ha of agricult. land in private farms (kg)	D
• total consumpt. of nitrogen. fertilizers (NPK) per 1 ha of agricult. land in priv. farms (kg)	D
• total consumpt. of potassic fertilizers (NPK) per 1 ha of agricult. land in priv. farms (kg)	D
• consumption of low voltage electricity in rural areas per capita (kWh)	D
• consumption of water from supply network in rural areas per capita (m^3)	D
• consumption of gas from supply network in rural areas per capita (m^3)	D
G_7 — infrastructure	
• rural hard-surfaced roads per 10 thousand population (km)	D
• expressways and motorways per 10 thousand population (km)	D
• rural users of water supply networks (in %)	S
• rural users of sewer systems (in %)	S
• rural users of gas supply networks (in %)	S

Note: D — destimulants, S — stimulants, N — nominants

by 300%) with the biggest proportion of ecological areas. The most advantageous change took place in the Świętokrzyskie Voivodship where the share of ecological areas was one of the smallest and did not improve over the decade (fig. 5).

The last of the parameters indicates a worrying dependency between the average monthly disposable income per a member of a farming household, and the changing proportion of ecological areas to the total agricultural land over the decade between 2005 and 2015. Although in both years the Pearson correlation coefficient was positive, it was statistically insignificant and fell from 0,17 in 2005 to 0,09 in 2015.

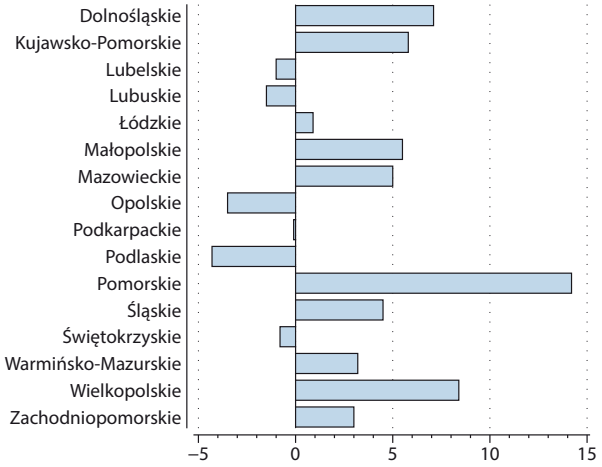

Fig. 4. Growth of rural population in 2015 (2005 = 100)

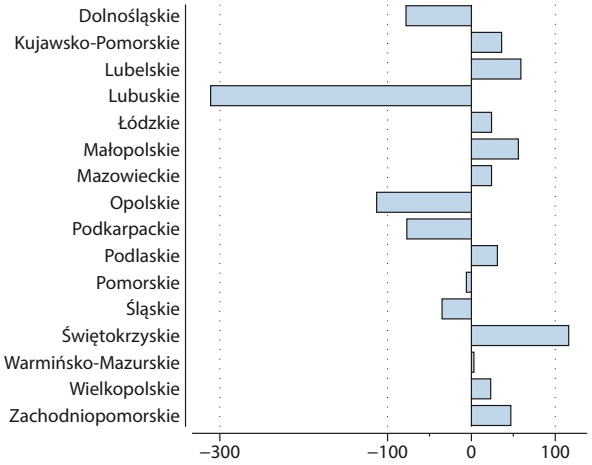

Fig. 5. Change in average monthly disposable income per one member of a farming household in 2015 (2005 = 100)

4 Multidimensional Ranking of Voivodships in Terms of Their Agricultural Potential

For the purpose of ordering the objects from the strongest to the weakest in terms of rural development the distance between the object and the pattern was calculated. Due to the study objective an object with coordinates that adopt maximum values of standardized diagnostic variables was used. As a result, the synthetic development measures SDM (tab. 2) were obtained, which allowed for ranking the voivodships from the strongest to the weakest in 2005 and 2015. In both years the three top positions were taken by the Lubuskie, Opolskie, and Łódzkie voivodships with the biggest development potential represented by the lowest SDM values (the lowest distance to pattern). Also, the ranking of objects by means of the synthetic development measure (SDM) made it possible to compare the changes in the ranking arrangement between both years under study. Both in 2005 and in 2015 Mazowieckie and Lubelskie reached the highest SDM values, which means that they had the smallest development potential in Poland. The Lubuskie, Opolskie, and Łódzkie voivodships had the biggest development potential (their distance from the development pattern was the farthest).

Conclusions

After 10 years there were no visible changes in the ranking of voivodships except for minor shifts in the neighboring positions. In 2015 the biggest potential was seen in those voivodships where the drops in disposable incomes in farming households were the most severe. The weakest development potential was seen in the Pomorskie Voivodship which had experienced the biggest rural population

Tab. 2. Ranking of voivodships by SDM in the years 2005 and 2015

2005		2015	
Lubuskie	0,553	Łódzkie	0,376
Opolskie	0,567	Opolskie	0,379
Łódzkie	0,588	Lubuskie	0,393
Śląskie	0,592	Dolnośląskie	0,395
Pomorskie	0,593	Kujawsko-Pomorskie	0,405
Zachodniopomorskie	0,594	Świętokrzyskie	0,411
Podlaskie	0,604	Podlaskie	0,419
Świętokrzyskie	0,607	Śląskie	0,421
Dolnośląskie	0,611	Warmińsko-Mazurskie	0,438
Podkarpackie	0,614	Wielkopolskie	0,441
Małopolskie	0,618	Podkarpackie	0,447
Kujawsko-Pomorskie	0,620	Zachodniopomorskie	0,457
Warmińsko-Mazurskie	0,625	Małopolskie	0,457
Wielkopolskie	0,632	Pomorskie	0,462
Mazowieckie	0,635	Lubelskie	0,479
Lubelskie	0,645	Mazowieckie	0,481

growth over the 2005–2015 decade. As noted above, both in 2005 and in 2015 Mazowieckie and Lubelskie reached the highest SDM values, which means that they had the smallest development potential in Poland. The Lubuskie, Opolskie, and Łódzkie voivodships had the biggest development potential (their distance from the development pattern was the farthest). In that case, it is recommended for local governments to regard agriculture as one of the areas of the rural economy and to initiate favorable conditions for policies encouraging non-agricultural economic functions and creating new jobs outside agriculture as well as to offer opportunities to withdraw from agriculture as a major source of income (Adamowicz and Smarzewska 2009, 252). Further studies on rural development potential should take into account lower levels of local government (e.g., counties, and include weights in the process of calculating the synthetic development measure).

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