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Change in the Level of Agricultural Development in the Context of Public Institutions' Activities — A Case Study of the NASC Activities in Poland

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Abstract: Agricultural development is determined by various factors, such as environmental, economic, demographic, or social circumstances. In order to present the level of this development as com-prehensively as possible, a multidimensional analysis should be carried out with an appropriate methodology. In this article, a taxonomic approach known as the Hellwig's method was used to determine the level of agricultural development. The area of research was the territory of Poland, divided into voivodships, which are the main units of the administrative division of the country. The development of agriculture thus determined was correlated with activities pursued by the National Agricultural Support Centre (NASC), an institution responsible for the management of agricultural real estate owned by the State Treasury in Poland. The results showed that the NASC's activities are related to the level of agricultural development in every voivodship. The investigated model of rural space management was shown to be a rational one, performing well in today's market conditions. The proposed methodology could adapt to similar situations and can be used in similar research on rural areas.

Keywords: rural areas; agriculture development; Hellwig's method; correlation; NASC; sustainability; land

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1. Introduction

According to estimates, food provided by agriculture should feed 5.8 billion people, hence agricultural development is an important issue [1]. The Food and Agriculture Organization has declared to eliminate malnutrition and famine in the world by 2030 [2]. Foresight analyzed 40 projects and programs in 20 countries, between the years 1990 and 2000; 10.39 million farmers and their families benefited from this program. Attention was paid to the participation of government agencies and organizations supporting socio-economic and sustainability development (sustainability) [3].

Innovativeness is an important factor in agricultural development as it helps to achieve sustainable development. However, according to the to-date research, imple-mentation of innovative solutions depends on external and internal factors of agricul-tural development in a given country [4].

Another important element of agricultural policy is the impact of programs, agricultural reforms as well as policies on land markets and, more specifically, control over strategic land for food production [5]. Usually, agricultural policies do not consider the fact that farmers' ability to earn extra income is a determinant for maintaining sus-tainable land management. The possibility of securing land ownership and long-term renting, according to the research, has an impact on the economic growth [6]. It is therefore necessary to increase the efficiency of land use by preventing the allocation of agricultural and forestry land to non-productive purposes, which necessitates the es-tablishment of public

administration bodies with implemented agricultural develop-ment modeling systems [7]. Both agricultural development indicators and respect for the right of priority in the acquisition of land by local communities (especially the right to forests) are important elements in the protection of land and its rational use [8]. Re-search in each country should include systematic interpretation of these factors because changes in land use affect the agricultural system, food supply, and product prices; therefore, such changes should be monitored [9]. On the other hand, the crop subsidy policy should be supervised because the liquidation of subsidies may lead to the abandonment of some crops [10].

Sustainable land use requires monitoring of agricultural development characteris-tics with the use of indicators [11–13]. Census databases are considered to be the most reliable sources of information, hence the data collection and exchange systems in countries around the world must be unified when comparing the level of agricultural development [14]. Cartographic presentation of strategic data and selection of features are also problematic [15]. Analytical data to determine the level of agricultural devel-opment are important [16,17], although identification of the features that influence ag-ricultural development has been made more difficult due to substantial changed in-duced by subsidies from the European Common Agricultural Policy (e.g., subsidies to areas with unfavorable uses that have directly affected the development of agriculture in these territories) [17]. Agriculture is the production of food and goods through farming and forestry; for centuries, it was a key factor in the growth of human civiliza-tion [18]. The Agricultural Production Index [19] or Agricultural Production Space Quality Indicator [20,21] are agricultural statistical indices determined on the basis of agricultural census data or indicators of productivity and production [22]. However, the indices are not independent of each other; in fact, they influence each other both posi-tively and negatively, and therefore any statistical method applied to determine the level of agricultural development should include this aspect [23]. Such dependencies are taken into account in the Hellwig's method, and this approach enables one to use many data and achieve clear statistical interpretation [24,25]. It is important to realize that agricultural development is a system of links, and agricultural professionals are de-veloping models of agricultural systems because there is a need for a new generation of tools and methods of agricultural systems [26]. These models take into account many variables while being universal and comparable with different mechanisms of influence on agriculture, with particular emphasis on public sector activities in agricultural de-velopment [27].

Unlike in Western European countries, where most of the land is in the hands of private farmers, forms of socialist land ownership were used in post-communist coun-tries. After transition to market economy in these countries, public institutions were established to take over state agricultural land and to manage these resources. Examples of such institutions are the National Agricultural Support Centre (NASC) in Poland, National Land Service in Lithuania, and Land Service Latvia or State Property Agency in Romania. In Albania, Bulgaria, the Czech Republic, Slovakia, Slovenia, and Hungary, there are state institutions such as committees or land funds (banks). Moreover, agri-cultural support institutions are established in most EU countries to deal with any changes in the privatization of agriculture, new ways of financing, agricultural advisory services, or the integration of advisory institutions with research institutions. In Bel-gium, Greece, Luxembourg and Slovenia, Spain, Southern Germany, Portugal, Sweden, Italy, and Switzerland, central government organizations are responsible for advisory services, while in the Czech Republic, Estonia, Ireland, Norway, Poland, Slovakia, and Hungary, advisory services are provided by state organizations charging for certain services [28].

The NASC was established on 1 September 2017, as the successor of the Agri-cultural Property Agency (APA) and the Agricultural Market Agency. Among the many tasks that the NASC has been authorized to perform in the field of land management [29], the most important ones are listed in Figure 1.

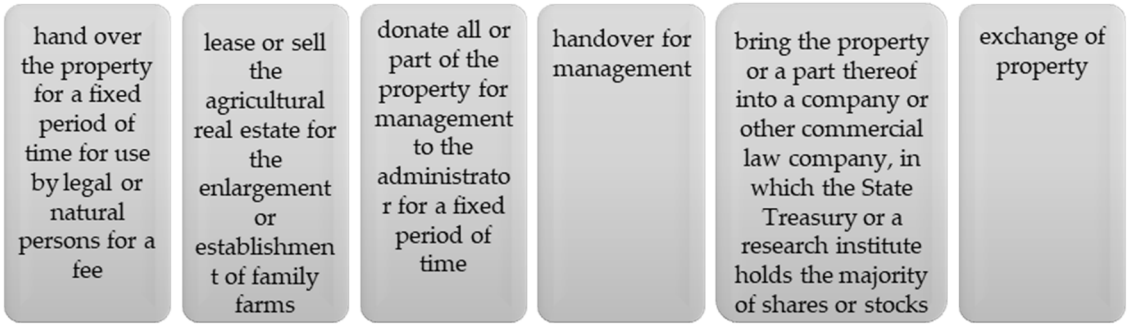

Figure 1. The state has authorized the National Agricultural Support Centre (NASC) to perform the tasks; source: [29].

The National Agricultural Support Centre implements the state policy in the following areas: creation and improvement of the area structure of family farms and development of strategic companies of the Treasury, implementation of innovations in agriculture and agri-food industry, stabilization of agricultural markets, and promotion of Polish agri-food products. Apart from statutory tasks, it also performs other delegated tasks. The main objective of the National Agricultural Support Centre is to implement tasks resulting from the state policy, in particular in the scope of the implementation and application of agricultural support instruments, active agricultural policy and rural development. The thematic scope of activities of the National Agricultural Support Centre is presented in Figure 2.

Figure 2. Thematic scope of activities of the National Agricultural Support Centre.

The main objective of the study was to determine the level of agricultural development in Poland. In Poland, activities associated with the management of the Agricultural Property Stock of the State Treasury are carried out by the public institution called the National Agricultural Support Centre (NASC). Therefore, the authors additionally studied the relationship between changes in the level of agricultural development between 2006 and 2018 and activities of the NASC. Based on the review of the literature [7,30–38], it can be concluded that advancement in agriculture entails elements concerning land use, socio-demographic factors, economic factors describing agriculture, and factors determining the level of agricultural production. Following the perusal of the literature, the authors determined which features would be reliable and usable in the study. These are integral environmental, social, and economic impacts on agriculture. However, there is no single set of characteristics to be derived from the literature that would be able to describe the development of agriculture; instead, there are merely indicators based on environmental, social, and economic impacts on agriculture, which must be reliable.

2. Materials and Methods

The level of agricultural development was determined using the Hellwig's taxonomic method, and the NASC activities were determined based on the NASC statutory tasks and on quantified based on data from annual reports published by the NASC. The area of the research consisted of the voivodships of Poland, which are the main units of the country's administrative division. To determine the level of agricultural development, the authors used all available data from the agricultural censuses, which are a reliable source of information because they are prepared by Statistics Poland (GUS). The GUS is the central office of government administration dealing with the collection and dissemination of statistical information on most areas of public life and some areas of private life. The data are required to be provided by the relevant legal regulations (the Act on Public Statistics and the Statistical Research Program announced annually). The choice of diagnostic variables that would allow us to provide the most complete presentation of the level of agricultural development was guided by two factors. Firstly, a literature analysis was carried out and variables that met the requirement of being usable in in taxonomic methods were selected [39,40]. Secondly, the decision was also influenced by data availability. Information that can be obtained from Statistics Poland is aggregated for different administrative levels. Most data can be found for the whole country; less information is available pertaining to single voivodships (which is the level analyzed in this study). Not all data were available for the year 2006, which was chosen as the first year of analysis. However, it was possible to collect data for 43 diagnostic variables, which refer as widely as possible to different aspects of agricultural development and simultaneously meet the condition of a variable that can be used in taxonomic methods. The list of diagnostic variables accepted for the analysis is presented in Table 1.

Table 1. Diagnostic variables used in the research.

Symbol	Diagnostic Variables (Expressed as Indicators)
X1	Share of agricultural land in the voivodship (%).
X2	Land requiring reclamation per 100 ha of agricultural land (ha)
X3	Non-use area per 100 ha of agricultural land (ha]
X4	Population density in rural areas per 1 km^2
X5	Rural population of working age in % of total population
X6	Registered unemployed persons living in rural areas per 1000 people
X7	Balance of migration in rural areas
X8	Working in agriculture per 100 ha of farmland
X9	Investment outlays in agriculture per 1 ha of farmland (PLN)
X10	Gross value of fixed assets in agriculture (PLN million)
X11	Agricultural producers entered in the producers' register
X12	Number of tractors in agriculture
X13	Agricultural land area per 1 tractor (ha)
X14	Farm buildings put into use
X15	Consumption of mineral or chemical fertilizers (NPK) per pure component (tons)
X16	Structure of global agricultural production (Poland - 100%) (%)
X17	Structure of agricultural commodity production (Poland - 100%) (%)
X18	Structure of agricultural output - crop production (Poland 100%) (%)
X19	Structure of agricultural output - animal production (Poland 100%) (%)
X20	Structure of agricultural commodity production - plant production (Poland 100%) (%)
X21	Structure of agricultural commodity production - animal production (Poland 100%) (%)
X22	Area sown (thousand ha)
X23	Area of grain sown (thousand ha)
X24	Area of rape and colza seeding (thousand ha)
X25	Potato cultivation area (thousand ha)
X26	Sugar beet cultivation area (thousand ha)
X27	Harvest of cereals (thousand tons)
X28	Rape and colza harvest (thousand tons)
X29	Potato harvest (thousand tons)
X30	Sugar beet harvest (thousand tons)

Table 1. *Cont.*

Symbol	Diagnostic Variables (Expressed as Indicators)
X31	Area of ground vegetable crops (thousand ha)
X32	Harvest of ground vegetables (thousand tons)
X33	Fruit tree cultivation area (thousand ha)
X34	Fruit harvests from trees (thousand tons)
X35	Slaughterhouse livestock production per 1 ha of farmland (kg)
X36	Cow's milk production per 1 ha of farmland (liters)
X37	Production of hens' eggs per 1 ha of farmland (units)
X38	Purchase value of agricultural products - plant products [million PLN]
X39	Purchase value of agricultural products - animal products [million PLN]
X40	Total purchase value of agricultural products per 1 ha of agricultural land [PLN]
X41	Purchase of agricultural products converted into grain units per 1 ha of agricultural land [dt]
X42	Revenue of local government budgets from agricultural tax [PLN million]
X43	Amount of realized payments within the framework of direct payments to agricultural land [thousand PLN]

Our review of the literature indicated that linear ordering methods are most often used in studies similar to ours. As a result, the Hellwig's method, an approach proposed in 1968 by the Polish scientist Zdzisław Hellwig, was chosen for this study. This method is common in such type of research [25,30,41–50]. The Hellwig's method is based on the calculation of a synthetic development index which allows the user to present a situation of diversity in the level of the phenomenon studied, covering many categories, e.g., economic, social, ecological, and spatial ones [51,52]. The adopted research methodology is characterized by great transparency, as the results can be presented with a single numerical value. This is a great advantage of this method and a premise for its selection [53]. The construction of a synthetic developmental index requires several stages, starting from the selection of a set of objects and diagnostic variables, through normalization of features, determination of stimulants and destimulants, to the calculation of the index value as a distance from the constructed developmental index.

The numerical description of the set of objects can be presented in the form of an observation matrix

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1m} \\ \vdots & \ddots & \vdots \\ x_{n1} & \cdots & x_{nm} \end{bmatrix}, \quad (1)$$

where x_{ij} means the value of the j-th variable for the i-th object ($i = 1, 2, \ldots, n$; $j = 1, 2, \ldots, m$).

For the collected diagnostic variables, it should be examined whether these variables are characterized by sufficiently high variability by eliminating quasi-constant variables. For this purpose, the coefficient of variation V can be calculated for each j-th variable. Its value is a relative measure of dispersion, and it is calculated by using Equation (2) below.

$$V_j = \frac{S_j}{\overline{x}_j}, \ (j = 1, \ldots, m), \quad (2)$$

where: $\overline{x}_j$—the arithmetic mean of the j-th variable (3), S_j—standard deviation for the j-th variable (3)

$$\overline{x}_j = n^{-1} \sum_{i=1}^{n} x_{ij}, \ (i = 1, \ldots, n); \ S_j = \sqrt{n^{-1} \sum_{i=1}^{n} (x_{ij} - \overline{x}_j)^2}, \quad (3)$$

From the set of variables, unequal variables can be eliminated.

$$|V_j| \leq V^* \quad (4)$$

where V^* is the critical value of the variation coefficient. The value of V^* was arbitrarily set at 0.10.

Afterwards, the strength of the relationship between the other variables should be tested. For this purpose, the correlation between variables must be determined with the value of the Pearson coefficient. Highly correlated variables are removed from the data set (Pearson's coefficient > 0.9) [54].

The Hellwig's method requires the linearity of diagnostic variables. Therefore, covariance should be calculated, which is a measure of the joint variability of two random variables. The covariance of variables shows how variables are linearly related to each other. Positive covariance indicates a positive linear relationship between variables, while negative covariance indicates the opposite. If the variables are not linearly related, the covariance value is close to zero. The covariances must be calculated for the analyzed variables.

In the next step, the variables must be unified. To unify variables, the characteristics should be normalized by standardizing it, according to Equations (2) and (4).

$$Z_{ij} = \frac{(x_{ij} - \overline{x}_j)}{S_j}\ ,\ (j = 1, \ldots, m), \tag{5}$$

where: $\overline{x}_j$ is the arithmetic mean of j-th variable (3) and S_j is the standard deviation for the j-th variable (3). This way, a matrix of standard values of the Z characteristics is obtained in Equation (6) below.

$$\mathrm{Z} = \begin{bmatrix} z_{11} & \cdots & z_{1m} \\ \vdots & \ddots & \vdots \\ z_{n1} & \cdots & z_{nm} \end{bmatrix}, \tag{6}$$

where z_{ij} is a standardized value of x_{ij}.

The matrix (6) formed is the basis for determining the reference object P0. It is an abstract object (e.g., a city) with standardized values $z_{01}, z_{02}, \ldots, z_{0j}$, where:

$$\begin{pmatrix} z_{0j} = \max\limits_i z_{ij}, \text{ when } \mathrm{X_j} \text{ is a stimulant} \\ z_{0j} = \min\limits_i z_{ij}, \text{ when } \mathrm{X_j} \text{ is a destimulant} \end{pmatrix} \tag{7}$$

The P0 object obtained in this way is treated as a development pattern.

In the next step, the Euclidean distances of the tested objects from the determined pattern should be calculated. This can be completed based on Equation (8).

$$D_{i0} = \sqrt{\sum_{j=1}^{m} (z_{ij} - z_{0j})^2}, \tag{8}$$

For the $D_{10}, D_{20}, \ldots, D_{n0}$ distance values obtained in this way, the average value should be calculated (9).

$$\overline{D}_0 = n^{-1} \sum_{i=1}^{n} D_{i0} \tag{9}$$

As well as standard deviation (Equation (10)):

$$S_0 = \sqrt{n^{-1} \sum_{i=1}^{n} (D_{i0} - \overline{D}_0)^2} \tag{10}$$

The level of sustainable development is obtained from Equation (11) below.

$$d_i = 1 - \frac{D_{i0}}{D_0}\ , \tag{11}$$

where:

$$D_0 = \overline{D}_0 + 2S_0, \tag{12}$$

A string of $d_1, d_2, \ldots, d_n$ values is obtained in this way, using the range (0,1).

The higher the measure of the di value of the tested object (i.e., its values are close to the pattern), the higher its level of agricultural development is. The lower the di value is (i.e., the values of the tested object are further away from the pattern), the lower its level of agricultural development.

Two parameters of the taxonomic measure can be used to classify the examined objects, according to the level of agricultural development: a geometric mean (d_i) and standard deviation (S_{di}). Six agricultural development classes of voivodships can be distinguished in this way, depending on the value of d_i:

- 6th class (the lowest level of agricultural development): $d_i < d_i - 2S_{di}$
- 5th class (low level of agricultural development): $d_i - 2S_{di} \leq d_i < d_i - S_{di}$
- 4th class (medium level of agricultural development): $d_i - S_{di} \leq d_i < d_i$
- 3rd class (medium-high level of agricultural development): $d_i \leq d_i < d_i + S_{di}$
- 2nd class (high level of agricultural development): $d_i + S_{di} \leq d_i < d_i + 2Sdi$
- 1st class (the highest level of agricultural development): $d_i \geq d_i + 2S_{di}$

The measure of the relationship between variables in statistics is correlation. It is determined by the correlation coefficient. Strength of correlations or strength of the relationship between two variables interpreted according to J.Guilford Classification [54]:

- level 0—$|r| = 0$—no correlation
- level I—$0.0 < |r| \leq 0.1$—weak correlation (practically no relation)
- level II—$0.1 < |r| \leq 0.3$—low correlation (clear relation)
- level III—$0.3 < |r| \leq 0.5$— moderate correlation (significant dependence)
- level IV—$00{,}5 < |r| \leq 0{,}7$—high correlation (significant relationship)
- level V—$00.7 < |r| \leq 0.9$—correlation very high (very high dependence)
- level VI $0.9 < |r| < 1.0$—correlation almost complete
- level VII—$|r| = 1$—full dependence

This article will examine the strength of correlations between the NASC's activities and data on the socio-economic level of voivodships.

To determine the impact of the activities pursued by the NASC on the development of agriculture, the authors used the NASC source data published for public scrutiny in the NASC annual reports.

Table 2 contains data on the activities of the NASC in the field of land management of the land owned by the State Treasury until 2006 and Table 2 contains activities until 2018.

The data from Tables 2 and 3 on land sold, transferred free of charge, contributed to the companies, and divested in other forms will be used to determine the correlation with the changes in the level of social and economic development in the voivodships of Poland, created with the Hellwig's method. The case of Poland is interesting because agricultural development in the post-communist countries was the responsibility of the State Agricultural Enterprises (SAE). After the political transformation in Poland, state agencies were established to take care of the land owned by the State Treasury. The agency preceding the NASC not only supervised the sale of agricultural land, but was also involved in the social activation of former state farm communities. Currently, the NASC plays an important role in agricultural land management. Due to legal constraints imposed on land sales (item in Tables 1 and 2), which protect farmers from uncontrolled land buyout and ensure the safety of food production for society, it mainly leases land (the activity is described as "divested in other forms" in Tables 1 and 2). However, it still has an important social impact as it has the possibility to transfer land free of charge for social purposes (item in Tables 2 and 3) or to transfer it as a contribution to companies (also item in Tables 2 and 3), which is one of its statutory tasks. This role of the NASC in agriculture should be correlated with social and economic development; these activities should have an impact on rural development.

Table 2. Activities of the National Agricultural Support Centre in the field of land management of the land owned by State Treasury until 2006.

Voivodship	Admitted to the State Treasury	Sold	Transferred Free of Charge	Contributed to Companies	Divested in other Forms	Rest of the Land Owned by the State Treasury
Dolnośląskie	495 378	157 316	27 348	2 745	2 844	305 125
Kujawsko-pomorskie	274 846	79 183	28 738	1 135	17 120	148 670
Lubelskie	189 979	90 494	12 780	179	1 131	85 395
Lubuskie	354 085	115 420	25 980	293	1 286	211 106
Łódzkie	79 607	39 813	2 395	505	31	36 863
Małopolskie	39 228	14 324	3 523	564	52	20 765
Mazowieckie	117 720	53 364	6 229	615	1 292	56 220
Opolskie	179 927	52 544	5 425	520	133	121 305
Podkarparckie	152 525	75 287	19 692	254	516	56 776
Podlaskie	127 983	41 986	13 119	106	4 125	68 647
Pomorskie	432 053	188 597	24 383	1 034	5 555	212 484
Śląskie	86 292	23 727	4 815	191	33	57 526
Świętokrzyskie	50 164	22 350	1 906	49	158	25 701
Warmińsko-mazurskie	818 065	334 116	42 712	1 719	4 535	434 983
Wielkopolskie	499 543	147 594	38 519	4 942	1 390	307 098
Zachodniopomorskie	820 545	257 869	47 675	934	23 294	490 773
Total	4 717 940	1 693 984	305 239	15 785	63 495	2 639 437

Table 3. Activities of the National Agricultural Support Centre in the field of land management of the land owned by the State Treasury until 2018.

Voivodship	Admitted to the State Treasury	Sold	Transferred Free of Charge	Contributed to Companies	Divested in other Forms	Rest of the Land Owned by the State Treasury
Dolnośląskie	508 872	262 450	37 539	10 564	4 514	193 805
Kujawsko-pomorskie	276 025	132 994	33 078	1 198	25 782	82 973
Lubelskie	189 656	132 842	15 349	213	4 288	36 964
Lubuskie	354 920	215 401	29 697	352	10 632	98 838
Łódzkie	79 727	55 729	3 777	505	1 103	18 613
Małopolskie	39 286	18 834	5 244	569	661	13 978
Mazowieckie	118 791	78 616	7 999	635	2 687	28 854
Opolskie	181 662	103 521	10 148	607	618	66 768
Podkarparckie	153 824	104 429	21 730	258	1 080	26 327
Podlaskie	128 430	65 635	14 726	113	16 089	31 867
Pomorskie	431 559	278 909	30 163	1 041	29 611	91 835
Śląskie	87 117	41 338	9 287	207	526	35 759
Świętokrzyskie	50 563	37 141	2 631	56	624	10 111
Warmińsko-mazurskie	822 192	508 395	47 709	1 748	115 249	149 091
Wielkopolskie	499 971	235 187	43 687	5 470	10 501	205 126
Zachodniopomorskie	821 433	440 879	53 691	943	47 896	278 024
Total	4 744 028	2 712 300	366 455	24 479	271 861	1 368 933

3. Results and Discussion

Following the methodology presented in the previous chapter, to achieve the research objectives set in the article, the first step was to determine the level of agricultural development and its changes in the years 2006–2018 in each of the 16 voivodships in Poland.

The process of verifying the indicators for usefulness and usability in the Hellwig's method, described in Section 2, involves the rejection of indicators based on the requirements of the method and consists of three stages:

- Rejection of indicators with a low variation coefficient; for the year 2006—1 rejected indicator (X5); for the year 2018—1 rejected indicator (X5)
- Rejection of indicators with a high level of correlation—the Pearson's linear correlation analysis for the year 2006—8 rejected indicators (X15–X20, X22, X23); for the year 2018—9 rejected indicators (X14–X20, X22, X23)
- Verification of linearity of diagnostic variables—covariance analysis; for the year 2006—1 rejected indicator (X2); for the year 2018—1 rejected indicator (X2)

The results obtained from the calculations are presented in Figure 4 and Table 4.

It is surprising that the Hellwig's classes in both 2006 and 2018 are the same. Two voivodships, Wielkopolskie and Mazowieckie, are in the first, best class distinguished according to the Hellwig's classification. There is no voivodship in the second class, while Kujawsko-Pomorskie, Lubelskie, and Łódzkie are in the third class. Lubuskie is in the fifth class, and the other voivodships fall in the fourth class. The authors established a ranking based on the parameters described above in order to compare changes in the level of agriculture. There are some evident shifts, for example Pomorskie Voivodship dropped by five classes or Podkarpackie Voivodship rose by five classes. No such spectacular changes occurred regarding the position of the other voivodships. The classification of Lubuskie, Podlaskie, and Zachodniopomorskie remained unchanged.

The second step was to determine the NASC's activities that may be related to the level of agriculture. Data from Tables 2 and 4 were used to create Figure 3, displaying land management activities in the years 2006-2018.

The largest sale of land occurred in Warmińsko-Mazurskie and Zachodniopomorskie Voivodships, with over 170 thousand hectares sold. A moderate level of sales was achieved by Wielkopolskie, Pomorskie, and Dolnośląskie Voivodships, where between 90 and 105 thousand hectares were sold; the remaining voivodships did not sell more than 55 thousand hectares each. With land transferred free of charge to municipalities, mainly for social purposes, most of the land was given away in Dolnośląskie Voivodship, whereas the remaining voivodships most often donated above 1 thousand hectares, not exceeding 6 thousand ha, except Świętokrzyskie Voivodship, where only 725 hectares were transferred. Land "contributed to companies" is the group of activities where the least land was transferred, except Dolnośląskie Voivodship (7819 hectares) and Wielkopolskie Voivodship (528 hectares). The level of support to companies did not exceed 65 hectares donated to a company, and no land was transferred under this category in Łódzkie Voivodship. With respect to land permanently disposed of in other forms, more than 100,000 hectares of land were transferred in Warmińsko-Mazurskie Voivodship, which can be considered an exceptional case.

Pomorskie and Zachodniopomorskie Voivodships each donated 24 thousand hectares and Podlaskie, Lubuskie, Wielkopolskie, and Kujawsko-Pomorskie Voivodship each donated between 8 and 9 thousand hectares; in the remaining voivodships, less than 1.5 thousand hectares were donated, with the exception of Lubelskie Voivodship, where 3 thousand hectares were donated. Between 2006 and 2018, most land was sold in Zachodniopomorskie and Warmińsko-Mazurskie Voivodships, while most land free of charge was transferred in Dolnośląskie Voivodship. As for the category "contributed to companies," most land was transferred in Dolnośląskie Voivodship, and most "divested of in other forms" (usually lease) land was recorded in Warmińsko-Mazurskie Voivodship.

Table 4. Results of the research.

	Voivodship	d_i for 2006	Class for 2006	Ranking for 2006	d_i for 2018	Class for 2018	Ranking for 2018	Change in the Ranking
1	Dolnośląskie	0.246602	4	7	0.26522	4	6	−1
2	Kujawsko-pomorskie	0.365493	3	4	0.341738	3	5	1
3	Lubelskie	0.345213	3	5	0.364582	3	3	−2
4	Lubuskie	0.080361	5	16	0.08352	5	16	0
5	Łódzkie	0.366992	3	3	0.349937	3	4	1
6	Małopolskie	0.257784	4	6	0.248545	4	8	2
7	Mazowieckie	0.525859	1	2	0.598584	1	1	−1
8	Opolskie	0.187966	4	10	0.223452	4	9	−1
9	Podkarpackie	0.196794	4	9	0.167044	4	14	5
10	Podlaskie	0.179418	4	11	0.206057	4	11	0
11	Pomorskie	0.177769	4	12	0.260416	4	7	−5
12	Śląskie	0.172095	4	13	0.190522	4	12	−1
13	Świętokrzyskie	0.200894	4	8	0.215168	4	10	2
14	Warmińsko-mazurskie	0.146445	4	14	0.186128	4	13	−1
15	Wielkopolskie	0.531171	1	1	0.579058	1	2	1
16	Zachodniopomorskie	0.145661	4	15	0.148826	4	15	0

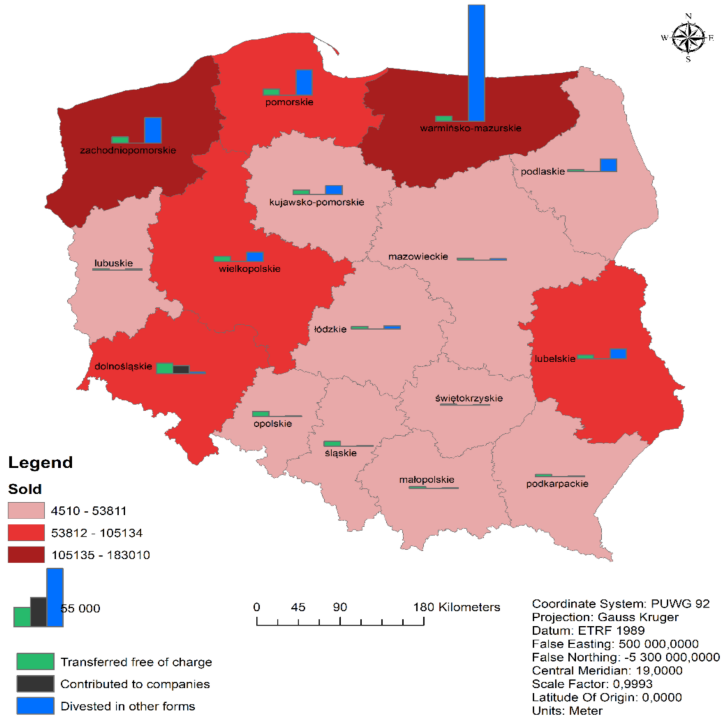

Figure 3. Management of agricultural land by the NASC in Poland, divided into voivodships, between 2006 and 2018.

If we sum up all the activities from 2006 to 2018, the NASC Field Branch in Olsztyn generated the largest amount of trade in agricultural land, involving more than 290 thousand hectares. Field branches in Szczecin and Koszalin, which manage the land in Zachodniopomorskie Voivodship, traded 213 thousand hectares. The field branches in Pruszcz Gdański, Gorzów Wielkopolski, Poznań, and Wrocław achieved a transfer of just over 100 thousand hectares. The remaining field branches were below this figure.

Comparing the statistical data of agricultural land transfer from individual voivodships (Tables 2 and 3) regulated by the NASC with the data on agricultural development in these areas obtained by the Hellwig's method (Table 4), the following results were obtained (also illustrated in Figure 4).

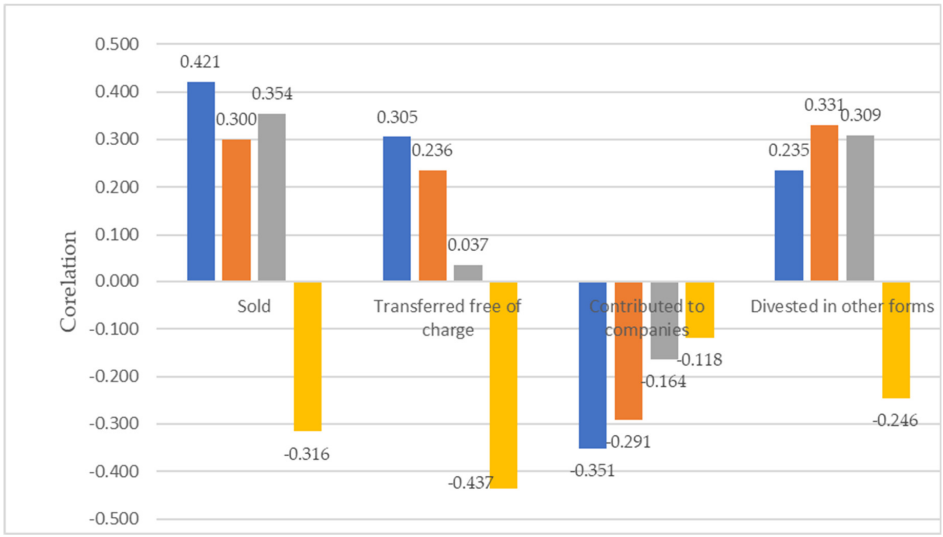

Figure 4. Correlation of the level of agricultural development determined by the Hellwig's method with the NASC activities. Source: the authors.

Since the agricultural level classes did not change between 2006 and 2018, the ranking of the voivodships in 2006, 2018, between 2006 and 2018, as well as changes in the ranking were based on raw "di" data. "Contribution to companies" always negatively correlated and the other NASC activities always positively correlated, except for the change in the ranking. "Contribution to companies" is the least active way of land management and, therefore, its impact on the level of agricultural development is not demonstrable. However, the impact of the sale, lease or free transfer of land is visible. When the rankings are compared, it emerges that as the NASC activity increases, so does the level of agriculture in a given voivodship.

However, while comparing changes in the rankings, the correlation proves to be inversely proportional, which means that the NASC activities were conducted mainly in areas where the level of agriculture was the lowest. This proves that the measures were addressed mainly to the weakest voivodships and have been implemented consistently; therefore, the position in the rankings of voivodships where there is a large range of land transfer is improving. According to J. Guilford's scale, the 2006 ranking was at level III, i.e., moderate correlation (significant dependence), except for paid transfers in other forms, where the correlations with the 2006 ranking reached level II, i.e., low correlation (clear relation). In the 2018 ranking with free contributions to companies, it is at level II, i.e., low correlation (clear relation). Land sold and transferred in other non-free forms reached level III, i.e., moderate correlation (significant relation). If we compare the data on agricultural development with the data from the 2006–2018 ranking, we observe level III of correlation, i.e., moderate correlation (significant dependence), except for contribution to companies, which is at level II of correlation (clear relation). If we compare it with a change in the ranking, all the features will be at correlation level II, except for transfer free of charge, which was at correlation level III, i.e., a significant correlation. However, if we use the scale described by Cohen [55], the correlation for transfer free of charge will even reach level four, i.e., 0.43, which is a high correlation (significant relationship).

4. Conclusions

The methodology used in the research is applied to determine the level of agricultural growth [56–59] (used the findings from these studies to build the matrix of diagnostic features used—tab 1), although it is also useful to study the level of social and economic development [30], and the level of sustainable development [30,56]. The National Agricultural Support Centre may have an impact on the level of agriculture achieved [60–67]. The conducted research justifies the following final conclusions, where the results obtained are summarized:

- The proposed methodology can be used in similar research on rural areas. The conducted research confirmed the suitability of the Hellwig's method for determination of the level of agricultural development in a given voivodship. This method can also be used to assess the level of development of any administrative unit (e.g., in Poland, these are municipalities, districts, and voivodships). It can be also used to determine and compare the level of development of different countries. By changing the range of diagnostic variables, it is also possible to assess the level of social, economic, or sustainable development using the Hellwig's method. It is only necessary to select an appropriate range of variables in each case. The level of development obtained in this way can be correlated with the activities of various institutions or organizations (a given country, the EU, or local authorities) in order to determine the relationship between such activities and a particular level of development.
- The results obtained in this study showed that the NASC's activities are related to the level of agriculture development in individual voivodships. It was shown that such a model of land management is reasonable and performs well in today's market conditions.
- Agricultural development level indicators should be correlated with institutional public actions. This justifies and confirms the validity of the activities conducted by

such public institutions. The results obtained in the research can be used by public institutions, e.g., when reporting their activities and applying for funds for the next years of their activity.

- The NASC activities have an impact on the level of agriculture development in Poland. The results obtained indicate that the voivodships with higher NASC activity are better evaluated in terms of agricultural development.
- The impact of programs, reforms, and agricultural policies on the land markets is visible because legal changes in Poland have given preference to land lease over land sale.
- The right of priority and the right of pre-emption enables the NASC to acquire strategic land, owing to which the NASC is in control of strategic land for food production, maintenance of sustainable land management, securing land ownership and the possibility of its long-term use in a specific way, combating climate change, ensuring food safety, or preventing environmental degradation, which can all be seen as thoughtful measures undertaken to reduce the risk of abandonment of business activity. The concept of multifunctional land use supports the NASC's modeling system through economic and social monitoring.

Determination of the level of agricultural development and identification of factors influencing the dynamics of change are important for the proper functioning of any country. Agricultural land management systems are supported by the activities of various state institutions. The proposed research methodology can be used to study relationships between the activities of state institutions and the level of agricultural development. The proposed methodology could adapt to similar situations and can be used in similar research on rural areas, so the authors plan further experiments to confirm this hypothesis in future work.

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References

1. Garrett, K. Sustainable agriculture. In *Environmental Management in Practice: Compartments, Stressors and Sectors*; Psychology Press: East Sussex, UK, 2013; ISBN 9780203023204.
2. Food and Agriculture Organization. *Food Security and Nutrition in the World*; Food and Agriculture Organization: Rome, Italy, 2019; ISBN 978-92-5-109888-2.
3. Pretty, J.; Toulmin, C.; Williams, S. Sustainable intensification in African agriculture. *Int. J. Agric. Sustain.* **2011**. [CrossRef]
4. Meijer, S.S.; Catacutan, D.; Ajayi, O.C.; Sileshi, G.W.; Nieuwenhuis, M. The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa. *Int. J. Agric. Sustain.* **2015**. [CrossRef]
5. *Sustainable Agricultural Development*; Springer: Dordrecht, The Netherlands, 2011.
6. Kassie, G.W.; Kim, S.; Fellizar, F.P. Determinant factors of livelihood diversification: Evidence from Ethiopia. *Cogent Soc. Sci.* **2017**. [CrossRef]
7. Lambin, E.F.; Meyfroidt, P. Global land use change, economic globalization, and the looming land scarcity. *Proc. Natl. Acad. Sci. USA* **2011**, *108*, 3465–3472. [CrossRef]
8. Graziano Ceddia, M.; Gunter, U.; Corriveau-Bourque, A. Land tenure and agricultural expansion in Latin America: The role of Indigenous Peoples' and local communities' forest rights. *Glob. Environ. Chang.* **2015**. [CrossRef]
9. Popp, A.; Calvin, K.; Fujimori, S.; Havlik, P.; Humpenöder, F.; Stehfest, E.; Bodirsky, B.L.; Dietrich, J.P.; Doelmann, J.C.; Gusti, M.; et al. Land-use futures in the shared socio-economic pathways. *Glob. Environ. Chang.* **2017**. [CrossRef]
10. Renwick, A.; Jansson, T.; Verburg, P.H.; Revoredo-Giha, C.; Britz, W.; Gocht, A.; McCracken, D. Policy reform and agricultural land abandonment in the EU. *Land Use policy* **2013**. [CrossRef]
11. Awange, J. Land management. In *Environmental Science and Engineering (Subseries: Environmental Science)*; Springer: Berlin/Heidelberg, Germany, 2018.

12. López-Ridaura, S.; Masera, O.; Astier, M. Evaluating the sustainability of complex socio-environmental systems. The MESMIS framework. *Ecol. Indic.* **2002**, *2*, 135–148. [CrossRef]
13. Haberl, H.; Fischer-Kowalski, M.; Krausmann, F.; Martinez-Alier, J.; Winiwarter, V. A socio-metabolic transition towards sustainability? Challenges for another Great Transformation. *Sustain. Dev.* **2011**. [CrossRef]
14. Lowder, S.K.; Skoet, J.; Raney, T. The Number, Size, and Distribution of Farms, Smallholder Farms, and Family Farms Worldwide. *World Dev.* **2016**. [CrossRef]
15. Ogryzek, M.; Ciski, M. Cartographic Methods of Presentation the Average Transaction Prices of the Undeveloped Land. *Civ. Environ. Eng. Rep.* **2018**, *28*, 85–100. [CrossRef]
16. Minten, B.; Barrett, C.B. Agricultural Technology, Productivity, and Poverty in Madagascar. *World Dev.* **2008**. [CrossRef]
17. Van Zanten, B.T.; Verburg, P.H.; Espinosa, M.; Gomez-Y-Paloma, S.; Galimberti, G.; Kantelhardt, J.; Kapfer, M.; Lefebvre, M.; Manrique, R.; Piorr, A.; et al. European agricultural landscapes, common agricultural policy and ecosystem services: A review. *Agron. Sustain. Dev.* **2014**, *34*, 309–325. [CrossRef]
18. Wager, F.C. *Agricultural Production*; Nova Science Publishers: Hauppauge, NY, USA, 2011; ISBN 9781616686956.
19. Suhara, M. Agriculture. In *Russian Economic Development over Three Centuries: New Data and Inferences*; Springer: Singapore, 2019; ISBN 9789811384295.
20. Harkot, W.; Lipińska, H.; Wyłupek, T. Kierunki zmian użytkowania ziemi na tle naturalnych warunków rolniczej przestrzeni produkcyjnej Lubelszczyzny. *Acta Sci. Pol. Adm. Locorum* **2011**, *10*, 5–16.
21. Tokarski, J. Valorization of agricultural production area in spatial planning of rural communities (Szczecin Province as and example). *Nowe Rolnictwo* **1978**, *27*, 14–16.
22. Dethier, J.J.; Effenberger, A. Agriculture and development: A brief review of the literature. *Econ. Syst.* **2012**. [CrossRef]
23. Kanter, D.R.; Musumba, M.; Wood, S.L.R.; Palm, C.; Antle, J.; Balvanera, P.; Dale, V.H.; Havlik, P.; Kline, K.L.; Scholes, R.J.; et al. Evaluating agricultural trade-offs in the age of sustainable development. *Agric. Syst.* **2018**, *163*, 73–88. [CrossRef]
24. Hellwig, Z. Zastosowanie metody taksonomicznej do typologicznego podziału krajów ze względu na poziom rozwoju i strukturę kwalifikowanych kadr. *Przegląd Stat.* **1968**, *4*, 307–326.
25. Stec, M. Analiza porównawcza rozwoju społeczno-gospodarczego powiatów województwa podkarpackiego. *Nierówności Społeczne A Wzrost Gospod.* **2012**, *25*, 180–190.
26. Jones, J.W.; Antle, J.M.; Basso, B.; Boote, K.J.; Conant, R.T.; Foster, I.; Godfray, H.C.J.; Herrero, M.; Howitt, R.E.; Janssen, S.; et al. Brief history of agricultural systems modeling. *Agric. Syst.* **2017**. [CrossRef] [PubMed]
27. Hallett, G.; Hayami, Y.; Rutton, V.W. Agricultural Development: An International Perspective. *Econ. J.* **1972**. [CrossRef]
28. Zadura, A.; Sikorska, A. *Zarzadzanie Gruntami Rolnymimw Krajach Europy Srodkowo-Wschodniej Gruntami Rolnymi W Krajach Europy*; Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej—Państwowy Instytut Badawczy: Warszawa, Poland, 2005; ISBN 838966612X.
29. Act of 19 October 1991 on the Management of Agricultural Real Estate of the State Treasury. Poland, 1991. Available online: http://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19911070464/U/D19910464Lj.pdf (accessed on 12 February 2021).
30. Rzasa, K.; Ogryzek, M.; Źróbek, R. The land transfer from the state treasury to local government units as a factor of social development of rural areas in Poland. *Land* **2019**. [CrossRef]
31. Pingali, P.L. Green revolution: Impacts, limits, andthe path ahead. *Proc. Natl. Acad. Sci. USA* **2012**, *109*, 12302–12308. [CrossRef]
32. Johnson, N.L.; Kovarik, C.; Meinzen-Dick, R.; Njuki, J.; Quisumbing, A. Gender, Assets, and Agricultural Development: Lessons from Eight Projects. *World Dev.* **2016**. [CrossRef]
33. Gallup, J.L.; Sachs, J.D.; Mellinger, A.D. Geography and economic development. *Int. Reg. Sci. Rev.* **1999**, *22*, 179–232. [CrossRef]
34. Schneider, U.A.; Havlík, P.; Schmid, E.; Valin, H.; Mosnier, A.; Obersteiner, M.; Böttcher, H.; Skalský, R.; Balkovič, J.; Sauer, T.; et al. Impacts of population growth, economic development, and technical change on global food production and consumption. *Agric. Syst.* **2011**. [CrossRef]
35. Muzari, W.; Gatsi, W.; Muvhunzi, S. The Impacts of Technology Adoption on Smallholder Agricultural Productivity in Sub-Saharan Africa: A Review. *J. Sustain. Dev.* **2012**. [CrossRef]
36. Hamidov, A.; Helming, K.; Balla, D. Impact of agricultural land use in Central Asia: A review. *Agron. Sustain. Dev.* **2016**, *36*, 6. [CrossRef]
37. Pereira, P.A.A.; Martha, G.B.; Santana, C.A.M.; Alves, E. The development of Brazilian agriculture: Future technological challenges and opportunities. *Agric. Food Secur.* **2012**, *1*, 1–12. [CrossRef]
38. Saysel, A.K.; Barlas, Y.; Yenigün, O. Environmental sustainability in an agricultural development project: A system dynamics approach. *J. Environ. Manag.* **2002**. [CrossRef] [PubMed]
39. Tarka, D. Własności cech diagnostycznych w badaniach typu taksonomicznego. *Ekonia Zarządzania* **2010**, *2*, 194–203.
40. Grabiński, T.; Wydymus, S.; Zeliaś, A. *Metody Taksonomii Numerycznej W Modelowaniu Zjawisk Społeczno-Gospodarczych*; PWN: Warsaw, Poland, 1989; ISBN 83-01-08596-7.
41. Salamon, J. Badania wielofunkcyjnego rozwoju obszarów wiejskich województwa świętokrzyskiego. *Infrastrukt. I Ekol. Teren. Wiej.* **2005**, *4*, 145–155.
42. Ziemiańczyk, U. Ocena poziomu rozwoju społeczno-gospodarczego gmin wiejskich i miejsko-wiejskich w województwie małopolskim. *Infrastrukt. I Ekol. Teren. Wiej.* **2010**, *14*, 31–40.

43. Jaworska, M.; Luty, L. Ocena Rozwoju Spoàeczno-Gospodarczego Powiatów Województwa Maàopolskiego. *Acta Sci. Pol. Oecon.* **2009**, *8*, 37–44.
44. Malina, A. Analiza przestrzennego zróżnicowania poziomu rozwoju społeczno-gospodarczego województw Polski w latach 2005–2017. *Nierówności Społeczne A Wzrost Gospod.* **2020**, *61*, 138–155. [CrossRef]
45. Podstawka, M.; Suchodolski, B. Assessment of the level of economic and social development of regions using the Hellwig taxonomic development measure. In Proceedings of the VII International Scientific Conference Determinants of Regional Development, PIła, Poland, 12–13 April 2018; pp. 187–201. [CrossRef]
46. Dorożyński, T.; Dobrowolska, B.; Kuna-Marszałek, A. Institutional quality as a determinant of FDI inflow: The case of Central and Eastern European countries. *J. Manag. Financ. Sci.* **2019**, *36*, 103–122.
47. Pomianek, I. Poziom rozwoju społeczno-gospodarczego obszarów wiejskich województwa warmińsko-mazurskiego. *Acta Sci. Pol. Oecon.* **2010**, *9*, 227–239.
48. Katarzyna Łogwiniuk The use of taxonomic methods in the comparative analysis of the access to the ICT infrastructure by schoolchildren in Poland. *Econ. Manag.* **2011**, *1*, 7–23.
49. Sołek, K.; Sowa, B. Diversification of the Social Development of Podkarpackie Province Communes. *Econ. Reg. Stud./Stud. Ekon. I Reg.* **2019**, *12*, 45–55. [CrossRef]
50. Niemczyk, A. Poziom rozwoju społecznego w nowym układzie administracyjnym Polski. *Przegląd Stat.* **2001**, *48*, 289–300.
51. Nowak, E. *Metody Taksonomiczne w Klasyfikacji Obiektów Społeczno-Gospodarczych*; Państwowe Wydaw: Ekonomiczne, Poland, 1990; ISBN 8320806895, 9788320806892.
52. Ilnicki, D. Próba Określenia Zmienności Czasowej Zjawisk Przestrzennych Metodami Wzorcowymi—Przykład Metody Hellwiga. In *Możliwości I Ograniczenia Zastosowań Metod Badawczych W Geografii Społeczno-Ekonomicznej I Gospodarce Przestrzennej*; H. Rogacki, Ed.; Bogucki Wydawnictwo Naukowe: Poznań, Poland, 2002.
53. Schober, P.; Schwarte, L.A. Correlation coefficients: Appropriate use and interpretation. *Anesth. Analg.* **2018**, *126*, 1763–1768. [CrossRef]
54. Guliford, J.P. *Podstawowe Metody Statystyczne W Psychologii I Pedagogice*; PWN: Warsaw, Poland, 1960.
55. Cohen, J. *Statistical Power Analysis for the Behavioral Sciences*, Revised ed.; New York University: New York, NY, USA, 2013.
56. Nowak, A.; Janulewicz, P.; Krukowski, A.; Bujanowicz-Haraś, B. Diversification of the level of agricultural development in the member states of the European Union. *Cah. Agric.* **2016**. [CrossRef]
57. Reiff, M.; Surmanová, K.; Balcerzak, A.P.; Pietrzak, M.B. Multiple criteria analysis of European union agriculture. *J. Int. Stud.* **2016**. [CrossRef]
58. Ślusarz, G.; Cierpial-Wolan, M. Development of entrepreneurship in valuable natural rural areas. *Econ. Agro-Aliment.* **2019**. [CrossRef]
59. Krukowski, A.; Nowak, A.; Różańska-Boczula, M. Evaluation of Agriculture Development in the Member States of the European Union in the years 2007–2015. In Proceedings of the 31st International Business Information Management Association Conference, IBIMA 2018, Seville, Spain, 15–16 November 2018.
60. Walenia, A. Zmiany w administracji rolnej i ich wpływ na wdrażanie instrumentów wsparcia rolnictwa w Polsce. *Pr. Nauk. Uniw. Ekon. We Wrocławiu* **2019**, *63*, 185–198. [CrossRef]
61. Niewiadomski, A. Status prawny Krajowego Ośrodka Wsparcia Rolnictwa. *Stud. Iurid.* **2018**, *72*, 279–293. [CrossRef]
62. Bisaga, A.; Sokołowska, S. Barriers to the development of family farms in the opinion of their owners from the Opolskie Voivodeship. *Studia* **2018**. [CrossRef]
63. Bąk, M. Rola Nieruchomości Rolnych Skarbu Państwa W Kształtowaniu Struktury Agrarnej W Województwie Warmińsko-Mazurskim. *Acta Sci. Pol. Adm. Locorum* **2019**, *18*, 141–152.
64. Mickiewicz, B.; Mickiewicz, A. Role of Agricultural Property Agency in Process of Land Policy Implementation. *Ann. Pol. Assoc. Agric. Agribus. Econ.* **2017**, *XIX*, 110–115. [CrossRef]
65. Czechowski, P. Agencja Nieruchomości Rolnych-restrukturyzacja czy likwidacja? *Przegląd Prawa Rolnego* **2008**, *2*, 76–97.
66. Podgórski, B.; Witochowski, L. Gospodarowanie nieruchomościami *Zasobu* Własności Rolnej Skarbu Państwa. *Wieś I Rol.* **2014**, *20*, 173–188.
67. Foryś, I.; Putek-Szeląg, E. Przesłanki inwestowania w nieruchomości rolne na przykładzie zasobów AWRSP i ANR w zachodniopomorskim. *Stud. Mater. Tow. Nauk. Nieruchom.* **2008**, *16*, 37–47.