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SUSTAINABLE DEVELOPMENT AND FORESTATION RATE IN SELECTED VOIVODSHIPS IN POLAND

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ABSTRACT: This paper is an attempt to find interdependencies between selected variables of sustainable development and forestation rate. The scope of paper included 16 Polish Voivodships in the period 2004-2016. The descriptive method supplemented by tools of descriptive statistics has been used (Pearson Correlation Coefficient). Research results indicated above all high interdependency between forestation rate and EU funds for EU programmes and projects in Podlaskie, Śląskie and Warmińsko-Mazurskie Voivodships. Moreover, Voivodeships received support for afforestation in accordance with the arable land available for afforestation (land of lass V and VI). Voivodeships in which land of classes V and VI constituted about 20% of their area (Dolnośląskie, Lubuskie, Śląskie, Warmińsko-Mazurskie, and Zachodniopomorskie) received significant financial resources from the European Union for afforestation.

KEY WORDS: sustainable development, forestation rate, Voivodships in Poland

Introduction

The concept of sustainable development is rooted in forestry. It was introduced by a Saxon staroste Hans Carl von Carlowitz (Lasy Państwowe, 2013), who in 1713 ordered a restoration of forests under his rule and introduced a rule of a regulated and future use of natural resources. A model of sustainable development was adopted not only in forestry throughout Germany, but also became an example worldwide, which is indicated by above all a review of strategies of European Union (EU) for the benefit of the forest sector, which focus in particular on sustainable management of forests (Parlament Europejski, 2017). The assumptions of EU 2020 strategy highlight a sensible, sustainable and global development as a manner to overcome structural faults of European economy and at the same improvement of competitiveness, productivity, and support of sustainable social market economy (Strategia Europa 2020, 2010).

A number of legal documents point to the introduction of sustainable development. They draw attention above all to reduction of greenhouse gas emissions by supporting sustainable development (Protokół z Kioto, Journal of Laws 2005 no. 203, item 1684), or a change in energy policy in line with the rule of sustainable development (Art. 15.1 of the Law Amending the Energy Law and the Environmental Protection Law), as well as on adopting the rule of sustainable development in environmental protection (Art. 5 of the Polish constitution). Educational strategies for sustainable development are appreciated not only in environmental domain (natural resources, climate change, development of agriculture), but also socio-cultural (peace and safety, health protection, gender equality) and economic domains (market economy, corporate responsibility) (Raport Światowej Komisji Środowiska i Rozwoju ONZ, 1987).

In EU, the forests area amounts 161 million hectares (4% of forested area in the world) (Parlament Europejski, 2017), which constitutes 38% of the total EU area. Poland and the following countries: Spain, Finland, France, Germany and Sweden account for 2/3 of European forested area. In Poland the forestation rate (as an indicator is the participation of the area of forest in total geodetic area of a country) has been increasing since 2000 (GUS, 2016). In 2015 it was 29.5% (9214.9 thousand hectares) – an increase of 1.1% compared to 2000 (GUS, 2016).

An overview of literature

In Poland, within 70 years, the dominant types of land use changes have been the changes in the area of forest distribution, which has been the result of complex historical, social and economic processes. The contemporary spatial image of forests has also been significantly influenced by structural changes associated with political changes in Poland (Poławski, 2006). The forest composition in Poland in 2015 has been dominated by public forests – 80.8%, whereas the private forests have occupied 19.2% (Lasy Państwowe, 2016). Increasing forestation in Poland is an important element of the country's ecological and forestry policy. It contributes to increasing the efficiency in the management of agricultural space. Changes in the rural area of forests in Poland are the result of the afforestation of land used for agriculture or at a wasteland (Polna, 2017). According to Adamowicz (2005), the intensification of works aimed at afforestation of land should take place mainly in Voivodeships with a large wasteland area, such as Zachodniopomorskie, Warmińsko-Mazurskie and Podlaskie. The guides given in the analyzed literature of the subject were confirmed by the authors of the article. Based on the results of the Pearson correlation coefficient, very high correlations were estimated between total afforestation and total forestation in Poland in 2004-2006 and 2014-2016 in such Voivdeships: Podkarpackie, Podlaskie, Świętokrzyskie and Warmińsko-Mazurskie. However, in 2007-2013, high correlation between total afforestation and forestation was confirmed in the following Voivodeships: Dolnośląskie, Małopolskie, Wielkopolskie and Zachodniopomorskie. However, on the basis of data from GUS (2017) and The Agency for Restructuring and Modernisation (ARiMR) (2017) on the total agricultural land of the V and VI valuation class, average support for one-time afforestation and forestation in 2015, it should be concluded that the voivodeships received support for afforestation in accordance with the arable land available for afforestation (land of lass V and VI). Voivodeships in which land of classes V and VI constituted about 20% of their area (Voivodeships: Dolnośląskie, Lubuskie, Śląskie, Warmińsko-Mazurskie, and Zachodniopomorskie) received significant financial resources from the European Union for afforestation.

Research methods

The aim of the paper is to determine a significant relation between forestation rate and selected variables of sustainable development (socioeconomic and environmental ones) in all Voivodships of Poland, taking into account the following periods: 2004-2006, 2007-2013, 2014-2016[1]. The descriptive method supplemented by the calculation of Pearson's coefficient (ranges from -1 to 1, the degree of correlation is determined in the following manner: $0,4 \leq rxy < 0,7$; $-0,4 \leq rxy < -0,7$ – average correlation, $0,7 \leq rxy < 0,9$; $-0,7 \leq rxy < -0,9$ – high correlation, $0,9 \leq rxy < 1$; $-0,9 \leq rxy < -1$ – very high correlation (Cohen, 1998)) between forest cover (Y) and 14 variables selected in a purposeful manner has been used. The selection of variables for the model has been made on the basis of literature review (for instance: GUS, Grabowska, Poskrobko, Leichenko in references) and substantive conditions. As a model, there have b een used, inter alia, sustainable development indicators registered in the issues of social order, environmental order and economic order (GUS, 2011). To the environmental order indicator - land use - have been registered variables: the forest cover (Y), the surface area of non-forestry lands to be afforested (X1), the total surface area of private forests (X2), the surface area of usable agricultural land (X3), afforestation of private forests (X4) in general, afforestation of public forests (X5) in general; to the social order indicator - economic development and employment indicator – have been registered variables: total income of communes (X6), income per capita (X7), EU funds for funding EU projects (X8) (http://swaid.stat.gov.pl [27-11-2017]), expenditures per capita (X9), female employment in forestry (X13), male employment in forestry (X14), however, to the social order indicator - demographic changes and public health - have been registered variables: average life expectancy of women (X10), average life expectancy of men (X11), medical centres (X12). The variables apart from the forestation, do not perfectly correspond to the names of indicators, however, they still relate to their meaning. Moreover, there has been taken into account a variable afforestation of private forests (X4) in general and income per capita (X7) (Woźniak, 2011) on the basis of the work of Grabowska (2001) who deals with issues related to sustainable treatment of social, economic and ecological issues as essence of the sustainable development regarding ecological and economic issues. "27 rules of sustainable development" were specified in

[1] Funding from EU funds according to the Regulation (EU) No. 1305/2013 of the European Parliament and of the Council of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) repealing the Regulation of Council (EC) no. 1698/2005 and according to the Act on support for rural development co-financed by the European Agricultural Fund for Rural Development for the period 2014-2020.

Rio de Janeiro in 1992, which are specified in The Preamble to the United Nations Conference on Environment and Development. Despite of the fact that these rules mainly refer to the environment, they also specify the social section in frame of which the sustainable environment should be understood. The first rule specifies the health as the centre (in the model a variable average life expectancy of women (X10) and average life expectancy of men (X11)), the fifth specifies the need to decrease the disparities in standards of living (variable EU funds for funding EU projects (X8) and variable expenditures per capita (X9), the eleventh rules specifies the environmental standards (variable the total surface area of private forests(X2)) (http://old.ko.poznan.pl/pub/ftp/Edukacja_zrownowazonego_rozwoju/DEKLARACJA_Z_RIO_1992.pdf). In table 2 presented Pearson Correlation Coefficient between forest cover and selected variables, which are showed in sub-section 3.1 and 3.2. Moreover, an analysis of the potential of usable agricultural land (class V and VI) for afforestation in every Voivodship in reference to received one-off support for afforestation in the period from 2007 to 2013 was carried out (figure 1). Relevant literature, data from GUS BDL (the Local Data Bank of the Central Statistical Office) and the reports of ARiMR (Agency for Restructuring and Modernisation of Agriculture) have been used as a source material. The article presents selected research results.

Results of the research

The economic aspect

Since May 1 2004 the tools of the EU Common Agriculture Policy (CAP) have been applied in Poland. The main source of funding of support for agriculture and rural areas in the Member States of EU is the European Agricultural Guidance and Guarantee Fund (EAGGF, contribution of funds amounting to 80% between 2004 and 2006). The Agency for Restructuring and Modernisation of Agriculture supports afforestation of usable agricultural lands and agricultural land that is not arable. Between 2004 and 2006 (Action 5. Afforestation of agricultural land), as part of PROW (RDP) 94,6 million EURO was paid out to 8066 beneficiaries from the RDP budget (ARiMR, 2015). As far as the period from 2007-2013 is concerned (Action 221, 223 Afforestation of agricultural and non-agricultural land) 128 million EURO was paid out to 10058 beneficiaries as part of the budget of RDP for the period 2007-2013 (ARiMR, 2015). In 2014, 17894 decisions granting support for afforestation for the amount of 5,4 million EURO were issued, 33,7 million EURO was paid out, including: 21,5 million EURO paid out to 8043 beneficiaries as part of the budget of RDP for the period 2007-2013 and 12,1 million EURO

paid out to 7326 beneficiaries as part of the budget of RDP for the period 2004-2006 (ARiMR, 2017). According to the report of ARiMR (2017) 301 million EURO has been included in the budget of RDP for the period 2014-2020 for afforestation and establishment of forest areas. Taking into account the average support for afforestation per hectare (1445,7 EURO) and the planned budged of RDP for the period 2014-2020 for afforestation (286 million EURO), 197.9 thousand hectares can be afforested (calculated on the basis of incomplete data for each Voivodship) (ARiMR, 2017). Table 1 presents subsidy figures for afforestation in selected years.

Table 1. Subsidies for afforestation for time periods 2004-2006, 2007-2013, and 2014-2020 [euro]

Subsidy	Amount in EURO for the period		
	2004-2006	2007-2013	2014-2020
One time payment	1022-1402	989-1487	1184-1707
Fencing of reforested area:			
- One time payment	-	615	-
- Fence, per meter	-	1,54	2,10
Tree staking, per planted tree	-	-	1132
Annual payment for cultural practices paid for 5 years	100-261	231-323	189-387

Source: author's own work based on the data from ARiMR (2015) and on research Klepacka et al. (2017).

Correlations between EU funds and forestation rate in the period 2010-2016 (no data prior to 2010) have shown high interdependencies in Warmińsko-Mazurskie Voivodship (private forests constituted 3% of geodetic area of the Voivodship in 2016 and 3.45% of private forests in Poland in general) and high interdependencies in the following Voivodships: Lubelskie, Mazowieckie, Podkarpackie, Podlaskie, Śląskie, Świętokrzyskie (average interdependencies in Łódzkie and Wielkopolskie Voivodship) (table 2).

Table 2. Values of the Pearson Correlation Coefficient between forestation and selected economic and environmental variables, 2004-2016

Selected Pearson Correlation Coefficient	Pearson Correlation Coefficient between forestation and EU funds		Pearson Correlation Coefficient between forestation and afforestation			Pearson Correlation Coefficient between forestation and surface area of private forest in general		
Voivodships/In years	2010-2013	2014-2016	2004-2006	2007-2013	2014-2016	2004-2006	2007-2013	2014-2016
Dolnośląskie	0,29	-0,91	-0,87	-0,95	-0,70	0,83	0,99	0,87
Kujawsko-pomorskie	0,26	-0,89	0,92	-0,55	-0,97	1,00	1,00	0,98
Lubelskie	-0,87	-0,48	0,43	-0,14	-0,70	1,00	0,99	1,00
Lubuskie	0,13	-0,77	0,53	-0,77	0,10	-0,30	1,00	0,95
Łódzkie	-0,71	-0,46	0,66	0,12	-0,80	1,00	1,00	1,00
Małopolskie	0,71	-0,68	0,37	-0,97	-0,94	1,00	0,97	1,00
Mazowieckie	-0,93	-0,09	0,98	-0,03	-0,91	1,00	1,00	1,00
Opolskie	-1,00	-0,99	-0,13	-0,86	-0,10	0,99	0,93	0,94
Podkarpackie	-0,82	-1,00	0,92	-0,79	-0,94	0,99	1,00	1,00
Podlaskie	-0,90	0,84	1,00	-0,55	-1,00	0,99	1,00	0,99
Pomorskie	0,52	-0,58	0,86	-0,79	-0,30	1,00	1,00	1,00
Śląskie	-0,95	-0,61	0,41	-0,18	-0,36	0,48	0,81	-0,89
Świętokrzyskie	-0,83	0,39	0,93	-0,54	-0,99	1,00	0,99	0,98
Warmińsko-mazurskie	-0,98	-0,87	0,97	-0,85	-1,00	0,99	1,00	1,00
Wielkopolskie	0,26	-0,58	-0,2	-0,84	-0,97	1,00	0,99	0,97
Zachodniopomorskie	0,98	-0,21	-0,96	-0,87	-0,61	1,00	0,99	0,99

Source: author's own work based on the data from GUS (2017).

The environmental aspect

Intensification of the increase of forestation (in which a forest is established in a non-forest area (Heze, 2012)) started after the Polish accession to European Union. The document adopted by the Council of European Union aimed to support the development of rural areas by the European Agricultural Fund for Rural Development. Attention was paid to relations between agriculture and forestry, namely between manners in which usable agricultural land is used and the state of natural environment (Skolud, 2008). Afforestation contributes to the improvement of the environment state, strengthen ecological stability of forest areas by decreasing fragmentation of forest complex and establishment of ecological corridors (Polna, Szczepański, 2010). In line with the National Programme for the Augmentation of Forestation Rate (Krajowy Program Zwiększania Lesistości (KPZL)), after 2050 forestation rate should arrived to 33% (Kwiecień et al., 2002; Bułkowka, Chmurzyńska, 2007). By increasing forestation rate Poland achieves a higher level of sustainable development, which was highlighted in Rural Development Plans (RDP) for the period 2004-2006. Forests have important production and social functions. According to the GUS (2015), there are large needs and opportunities to increase forestation of the country by afforestation of productively ineffective or undeveloped arable land (Wskaźniki Zrównoważonego Rozwoju Polski 2015). In the period 2004-2006 and 2014-2016, the process of afforestation related to forestation rate in general indicated correlations in the following Voivodships: Podkarpackie, Podlaskie, Świętokrzyskie, Warmińsko-Mazurskie (high correlations were also found in period 2004-2006 in Voivodships: Dolnośląskie, Zachodniopomorskie, and in period 2014-2016 in Kujawsko-Pomorskie Voivodship) as well as in the following Voivodships in the period 2007-2013: Dolnośląskie, Małopolskie, Wielkopolskie and Zachodniopomorskie (table 2). As part of RDP for the period 2004-2006, 39736.99 ha of usable agricultural land („Afforestation of agricultural land" – Action 5 RDP for the period 2004-2006) in total was afforested and average forestation rate increased by 0.12 percentage point (Konsorcjum, 2009). As part of RDP for the period 2007-2013 on the other hand, 32216.65 ha of usable agricultural land (only 50% of planned area) was afforested. A significant interdependency was found in case of forestation rate and surface area of private forests in general for the period 2004-2006, while for the period 2014-2016 high correlations were found in the majority of Voivodships in Poland (except for Lubuskie, Małopolskie, Opolskie, Śląskie and Wielkopolskie as well as in the period 2004-2006 also in Kujawsko-Pomorskie Voivodship and in the period 2014-2016 in Dolnośląskie, Pomorskie and Świętokrzystkie Voivodship). For data from the period 2007-2013 a high correlation was found only in case of Kujawsko-Pomorskie

and Wielkopolskie Voivodships (average correlation in case of 7 Voivodships: Małopolskie, Opolskie, Podlaskie, Pomorskie, Śląskie, Świętokrzyskie, Zachodniopomorskie out of 16 Voivodships or no correlation in case of the remaining 7 Voivodships: Dolnośląskie, Lubelskie, Lubuskie, Łódzkie, Mazowieckie, Podkarpackie, Warmińsko-Mazurskie) (table 2). According to the FADN data (Klepacka et al., 2017), a potentially forested area (a private forest in particular) in Poland corresponds to approximately 27% out of 159.3 thousand ha of land in the period from 2001-2014.

Based on conducted analysis of the potential of usable agricultural land (Skłodowski, Bielska, 2009) it has been found that by afforesting 77.15 thousand ha (afforested area on account of actual location of a forest) as part of RDP for the period 2007-2013 all Voivodships received a total of 95 million EURO (including 76.4 million EURO from EU funds) and they could receive a total of 12.7 billion EURO by maximizing the use of usable agricultural land (V and VI soil quality class) – 10233 thousand ha to be afforested in total (own research on the basis of the data from the report by ARiMR, 2015). As a result, forestation rate in Poland would almost double. The figure below is a graphic display of total usable agricultural land, V and VI soil quality class, an on-off average support for afforestation and forestation rate in 2015.

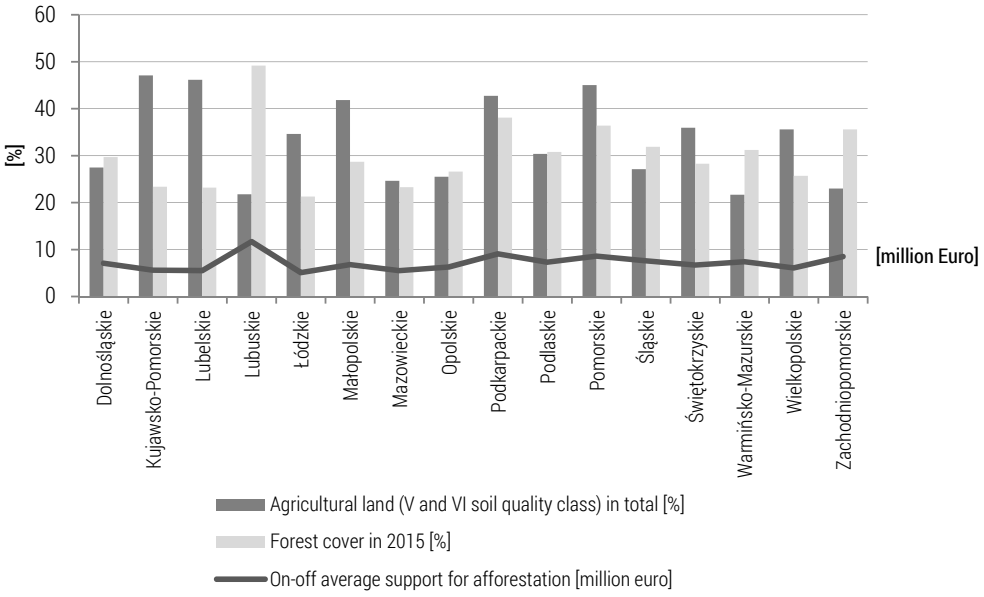

Figure 1. Support for afforestation and usable agricultural land to be afforested by Voivodship

Source: author's own work based on the data from GUS (2015) and ARiMR (2015).

On the basis of the data (figure 1) it should be concluded that the level of forestation is correlated with the average support for one-time afforestation. The level of subsidies from the European Union is highest in Lubuskie Voivodeship, where the level of forestation is highest in Poland, whereas in Łódzkie Voivodeship the lowest forestation has been recorded, with the lowest support of fund for afforestation from the European Union. Moreover, in Lubuskie Voivodeship, the percentage of agricultural land in the V and VI class is one of the lowest in Poland – 21.8% (the lowest in Warmińsko-Mazurskie Voivodeship – 21.7%), whereas Łódzkie Voivodeship takes sixth position amongst 16 Voivodeships. This situation shows the limited possibilities of afforestation of agricultural land in Lubuskie Voivodeship. In 9 Voivodeships in Poland, the level of agricultural land of V and VI class is higher than the level of forestation, whereas in case of Podlaskie Voivodeship the values in both cases are very similar, which creates opportunities for increasing their forestation.

Conclusions

Research results have shown a link between economic and environmental variables and forestation rate is significant. Forestation rate in Poland is an indicator which, starting from 1945 (when it amounted to 21% of the country's area), has been steadily increasing, enabling the implementation of sustainable development of rural areas (GUS, 2015). The sequence of the development of forestation rate, confirmed by research results and observed at a Voivodship level, exerts influence on the provision of benefits of financial support for sustainable development. Additionally, the conducted analysis has shown that there is an interdependency between forestation rate and the surface area of usable agricultural land of V and VI soil quality class, and the averaged level of on-off support for afforestation in all investigated Voivodships, in particular in those with the greatest number of private forests such as Mazowieckie or Podlaskie Voivodship.

The contribution of the authors

Anna M. Klepacka – 50% (conception of framework, literature review, analysis and interpretation of data)

Patrycja Szmulewicz- 50% (literature review, data collecting, analysis and interpretation of data)

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