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Development of energy crops cultivation for biomass production in Poland

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ABSTRACT

As a member of the European Union, Poland pledged to increase the share of energy generated from renewable resources up to 7.5% by 2010 and to 14% by 2020. These goals can be achieved through the production of biomass. Poland's biomass potential is among the highest in Europe and is 895 PJ. A major role in the production of biomass for energy purposes in Poland is played by the cultivation of fast-growing annual and perennial energy plants. The main objective of this research was the spatial analysis and evaluation of the development of energy crops in Poland based on historical, urbanisation and natural conditions.

The studies showed that in 2010 the surface area taken by energy crops in Poland was 154,100 ha, which accounted for 0.9% of the total agricultural land. The structure of energy crops is dominated by energy trees and shrubs; on forest land their share accounted for 88.9%. The share of energy crops on arable land accounted for 11.1%. The largest surface area taken by energy crops occurred in the poviats with medium environmental conditions. This is due to the need to use the best arable land for the cultivation for alimentation purposes. However, an intensive use of poor soils for the cultivation of energy crops was not noticed, although they are the first to be used for this purpose. In the structure of energy crops it is noted that the largest areas taken by perennial crops occurred in the poviats in the heavily urbanised areas, which is related to the profitability of production, and predominantly to the market demand. The analysis has shown that Poland has good natural conditions for the development of energy crops, but they are not yet fully utilised.

Contents

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1. Introduction

Poland, like all the member states of the European Union, must reduce the emission of greenhouse gases into the atmosphere, especially the CO_2. These gases cause systematic global warming, which in turn brings economic damage. One of the most important ways to accomplishing this task is to replace part of the traditional transport fuels with biofuels, and coal with biomass [1,2]. The European Commission's Directive 28/2009/EC assumes an increase in the share of renewable energy resources in the final energy consumption at the level of 20% for the entire EU. For individual Member States the target was set at a various level [3]. According to the Accession Treaty signed with the European Union in 2004, Poland has declared to increase the share of energy generated from renewable resources to 7.5% in 2010 and to 14% in 2020. Biomass production can therefore be a major factor contributing to the achievement of those objectives. Currently 4% of energy in the European Union is derived from biomass (190 million tons of biomass a year). By 2020 the use of biomass should increase up to 8% (360 million tonnes biomass a year) [4]. It is believed that Poland's potential of biomass is among the highest in Europe and is at 895 PJ [5]. The projected demand by professional energy suppliers in Poland is 8.3 million tonnes of dry biomass in 2020 and 10.6 million tonnes of dry biomass in 2030. At the same time, in accordance with the Regulation of the Minister of Economy (dated 14.08.2008), in the years 2015–2017 it will not be possible to use forest biomass for co-burning (Journal of Laws No. 156, item 969). Therefore, an important part of the production of biomass for energy purposes in Poland will be the cultivation of fast-growing annual and perennial energy plants through plantations.

The term ‘energy crops’ is used for both annual and perennial crops on agricultural land intended solely for energy purposes. Plant biomass obtained from energy crops can provide the raw material as a solid fuel or substrate for the production of biogas. It can also be used as the extract for the production of liquid fuels [6]. At the same time, the growth of plantations of energy crops in Poland is an opportunity to diversify farm production and to increase the income of farmers. An important element in the development of energy crops is also an increase in the economic activation of rural areas in accordance with the principles of sustainable development.

The main objective of this research was the spatial analysis and evaluation of the development of energy crops in Poland, taking into consideration natural, historical and socio-economic conditions. The paper also considers legal aspects of energy crops in Poland as well as payment unit to crops, mainly from the European Union (until 2010).

2. Materials and research methods

The study area was based on the administrative units within the rural and urban poviats. In total 314 poviats were analysed. The basis of the analysis was a matrix of spatial information including the recent Agricultural Census of 2010, as well as the Eurostat data. When analysing the spatial distribution of energy crops, the following external conditions of agricultural development were considered: natural, historical and urban characteristics, as well as inner qualities, namely: agricultural land use, and the size and structure of agricultural production. For each group of features, different types of areas were delimited. Within each group several types of areas were delimited depending on the intensity of the tested element. More details on this issue are given in the individual sections, which results from the nature of the analysed groups of conditions for the development of energy crops.

The adoption of the above-mentioned characteristics to evaluate the development of energy crops in Poland enabled a thorough explanation of the relation of spatial concentration of specific energy crops, as well as the delimitation of the areas of strong and weak concentration of such crops. The study used a comparative analysis of the level of development of energy crops in Poland with the EU's leading countries in the production of biomass, i.e. Germany, United Kingdom, France and Spain.

3. Results and discussion

3.1. Conditions of the development of the energy crops production

3.1.1. Historical conditions

A historical factor associated with the specific political and economic past plays an important role in the development of the Polish agriculture. The current shape of Poland's national borders formed only after World War II. The former state borders and administrative divisions are noticeable in the contemporary rural landscape (settlement system), in the agrarian structure (size of farms), as well as in farming culture and mentality of the society [7,8]. For the purposes of this study, four types of historical-political areas were delimited within the present territory of Poland:

1. Type 1 – the lands of the former Austrian partition, in Poland in the interwar period. These areas were located within the province of the Austro-Hungarian Empire, and were characterised by a strong agrarian overpopulation and high fragmentation of farmland (farms unable to sustain their owners).
2. Type 2 – the lands of the former Prussian partition, within Poland in the interwar period. These are the areas which historically belonged to the Kingdom of Prussia, where the emancipation of peasants from serfdom (enfranchisement) occurred as early as 1811–1850. They were characterised by dynamic processes of industrialisation and urbanisation, and a high productivity of agriculture.
3. Type 3 – the lands of the former Russian partition, within Poland in the interwar period. The enfranchisement processes occurred only in the years 1861–1884. This historical legacy is reflected in the current low productivity of agriculture, highly fragmented farmland and rural overpopulation. The area showed a slower rate of development in agriculture, due to the general socio-economic backwardness of the then Russia.
4. Type 4 – the lands of the former Prussian partition, within Germany in the interwar period. After World War II, these areas had a high proportion of large-scale farms, which were converted into state farms. After 1989, these areas underwent rapid privatisation in agriculture (Fig. 1).

3.1.2. Urbanisation conditions

In the analysis of the spatial differentiation of energy crops, the issue of the impact of urbanisation was taken into account. According to the theory of agricultural location proposed by Thünen, the production intensity decreases with the increasing distance from the market, i.e. the urban centre [9]. In addition, farms situated in the zones influenced by cities, i.e. in close proximity to potential customers demanding biomass, such as incinerators, have more favourable conditions for the production for energy purposes [10].

For the purpose of this research, three types of urbanisation were delimited (taking into account the demographic aspect of urbanisation):