

ENVIRONMENTAL CHANGES IN THE POLISH AGRICULTURE - TOWARD THE BIO-ECONOMY

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Abstract. This paper attempts to provide an interdisciplinary concept of the bio-economy in the context of environmental changes in the Polish agriculture. Various definitions of bio-economy have been presented and its place in the sustainable development theory have been described. The aim of this paper is to present the environmental changes in Polish agriculture in the context of the bio-economy. For this purpose uses the information published by the Central Statistical Office and Eurostat. To showcase and presentation methods were used descriptive and tabular. The empirical part presents changes of the essential elements characterising the agricultural sector, in particular, in terms of its impact on the natural environment. An attempt has been made to discuss the changes in the context of the implementation of the principles of sustainable development as well as development of bio-economy in the agricultural sector.

Keywords: bio-economy, sustainable development of agriculture, environment.

JEL code: Q56, Q57

Introduction

The assumptions of the concept of sustainable development have become nowadays essential to every area of the national economy. There is no question of taking any action related to the functioning of the state and development of any individual sector without taking into account these principles. But it is not easy to take measures, which would bring simultaneously the benefits in three different aspects considered in sustainable development, i.e. its economic, social and environmental aspect. Particular emphasis in the assumptions of sustainable development is put on activities in the agricultural sector, mainly because of its specific nature associated with production of food. Increasing¹ production of high-quality agricultural raw materials, while ensuring the economic viability of farms, preserving natural environment from the negative effects of farming and ensuring decent social conditions to the rural population, are big challenges. An agreement between the economic, social and environmental dimensions is possible through interdisciplinary concept of bio-economy,

which with its assumptions is in line with the theory of sustainable development.

The aim of this article is to present of environmental changes in Polish agriculture, through the analysis of the data contained in public databases like the Central Statistical Office and Eurostat. Discussion on the values discussed was directed towards a new and popular theory bioeconomy. An attempt was made to discuss the changes in Polish agriculture on the example of the specific data in the context of the theory of bio-economy. Research tasks in the article are to show changes in the main areas of agricultural activities which have the greatest impact on the environment. This is to show the changes taking place in agriculture in the context of environmental

Research materials and research method

The article presents the changes in Polish agriculture in terms of the impact on the environment. Considered the data presented in the context of a developing trend bio-economy. Different approaches to defining the problem being the subject of the paper based on literature on the subject have been discussed.

The empirical part focuses on various aspects of activity of the Polish agricultural sector in terms of impact on the natural environment.

¹ Increasing agricultural production on the global scale is inevitable due to the growing population, and, as a consequence, higher and higher demand for food.

Research objects were Polish farms characterized by national statistics. Farm is defined as a unit separate from the technical and economical, having a separate management (user or manager) and an agricultural activity (Charakterystyka gospodarstw...2014). The information related to changes in the structure of agricultural land in Poland, pollutants emitted into the atmosphere and use of mineral and lime fertilisers as well as plant protection products by agricultural sector has been used. The data published by the Central Statistical Office (GUS) and Eurostat have been used as the research materials. In the analysis, a descriptive method has been applied and the results have been shown in tabular and graphical form.

Bio-economy in agriculture

There are many definitions of the essence of bio-economy. It should be noted, however, that despite the differences in the approach to this issue, all the authors emphasise that the primary differentiator is the use of natural resources in the production process while preserving the original environment (Pajewski T., 2014). Indeed, this concept is in line with the assumptions of development of sustainable agriculture, which according to Krasowicz, are characterised by *"rational use of agricultural production environment and maintenance of production potential of soil, which ensures food self-sufficiency of the country and safe food. In addition, they are characterised by production of raw materials with desired quality parameters expected by the consumers and the industry, at the same time reducing or eliminating the threats to the environment. In the effect carrying out sustainable agricultural production would make it possible for agriculture to bring profitability comparable to other sectors of the economy and provide funds for modernisation and development"* (Krasowicz S., 2005).

Golebiewski describes bio-economy as set of sectors of the national economy, which deal with

the biological origin. In defining this term, he highlights the issue of sustainable use of resources. According to Golebiewski, the term *"bio-economy"* means sustainable production and conversion of biomass in relation to food, health, fibres, industrial products and energy, where the renewable resources of biomass include any biological resource, which can be used as a raw material. Bio-economy sector includes agriculture, forestry, food industry, fishing and fisheries, chemical, pharmaceutical, cosmetic and textile industries and energy production based on use of biomass as the main raw material (Golebiewski, 2013). The holistic nature of bio-economy in the context of the national economy is also described by Chylek. The author underlines that bio-economy covers virtually all sectors of the economy and the related services, which produce, process or make use of biological resources in any form. For the author, in addition to business and production aspects, also a theoretical aspect is important, because it makes it possible to define and implement innovative solutions. According to Chylek, bio-economy combines intensive research in many fields of science with innovative and comprehensive use of renewable raw materials, which come from the world of plants, animals and micro-organisms. In addition, bio-economy constitutes a strategic, trans-sectoral, integrating activity having an influence on economic development, which is in line with multidisciplinary approach to the rules of research funding (Chylek E. K., 2012).

A synthetic definition of bio-economy can be found in the report "The Knowledge Based Bio-Economy (KBBE) in Europe: Achievements and Challenges. Full report. 2010). The concept of bio-economy is described there as sustainable production and use of renewable biomass for food production, health, production of dietary fibre, industrial products and energy. Renewable biomass is defined here as any biological

resource that can be used as a raw material (The Knowledge...2010).

It can be noted that in the presented definitions the concept of bio-economy is based on the interdisciplinary approach of the representatives of the academic, business and administration environment² used in creating solutions, which, if developed, allow for the implementation of the objectives of sustainable development of the economy. A foundation of bio-economy is efficient use of natural resources to meet the needs of the population without affecting the environment. Therefore, we can see how important the agricultural sector and the conservation of resources should be in discussion of implementation of the bio-economy concept. Agriculture is a key sector of the economy due to the produced raw materials and the use of natural resources, thus, their more efficient use in terms of environment protection is currently the subject of lively debate both in the European Union and globally.

The specifics of the agricultural sector are emphasised by Walenia who highlights direct and strong ties of the agriculture with natural environment due to the use of living organisms of plants and animals in the production process and due to shaping the natural environment. He sees its uniqueness also in constant evolution consisting in systematic search of such a farming model, which fills its basic function, which is the production of agricultural products intended directly for consumption or for processing within the agri-food industry, and is well harmonised with the whole economy, at the same time following the principles of environmental protection, the principles of sustainable development. This phenomenon can also be seen in the emerging new functions of this sector. It is worth mentioning here production of biomass for production of renewable energy, protecting the environment and biodiversity as well as

² Cooperation in the area of science, business, administration is called the triple helix model

increasing landscape values (Walenia A., 2009).

New functions of the agriculture stem from many factors; nonetheless it seems that a primary one is growing awareness of the public as to the value of the natural environment and as to the related phenomena, which are characterised by the society-environment relationship.

Environmental protection depends to a large extent on the policy of the State. The policy specifies the framework, which agricultural producers should move within, when it comes to introducing agents mainly of chemical origin into the ecosystem. The importance of creating a policy promoting transition into low carbon economy is underlined by Bienkowski, Jankowiak, Holka. According to the authors, the most important role in the actions related to environmental protection both in Poland and globally is played by economic policies, which are intended for development of the low-carbon economy. Understanding the threats of degradation of ecosystems causes gradual changes in production systems, combining production, economic and social objectives. Currently, a primary research issue is to determine the future development of the society and economic conditions in order to reduce the pressure exerted on ecosystems by development of civilisation (Bienkowski J. F., Jankowiak J., Holka M., Dabrowicz R., 2014).

Environmental changes in the Polish agriculture

Agricultural production activities affect the natural environment. The classic division of agriculture into extensive and intensive suggests how the resources, particularly of natural origin (the environment), are used in production. However, analysing the impact of every activity on the environment is very difficult and perhaps even impossible, simply due to the fact that some effects of agricultural activity are hardly measurable or even completely immeasurable. Economic theory of externalities is applied here,

which depicts the relationships between the parties arising out of the unintended activities, which are not shown in market processes in terms of fees for these activities.

Changes in agriculture in relation to the natural environment can be seen from the perspective of the entire sector with the use of aggregated data. Table 1 shows changes in use of agricultural area in Poland in the years 2005, 2010 and 2014. It can be noted that during the considered period the total agricultural area decreased by about 2 %. In the years 2005-2014, within the agricultural land the areas used for development and ponds increased. A decrease of the utilised agricultural area is caused by many factors. Most often this is a result of conversion of agricultural land into residential area or other non-agricultural developments. Some agricultural areas are assigned for afforestation in relation to afforestation of agricultural land (RDP, Measure 5). The objectives of afforestation of agricultural land under Measure 5 of the RDP are:

- 1) extending forested areas in line with the National Woodland Extension Programme;
- 2) afforestation of agricultural land with low usefulness for agriculture and susceptible to degradation (erosion, soil fatigue, penetration of pollutants into groundwater);
- 3) strengthening the ecological functions of afforested areas by restoring the old and creating new connections between existing forests to maintain the migratory routes of animals and ecological corridors;
- 4) increasing the share of forests in the global carbon balance, by increasing the absorption of CO₂ by tree vegetation in Poland. Afforestation helps mitigate the "greenhouse effect" responsible for global warming on

Earth (11. Zalesianie gruntów rolnych. Przewodnik. MRiRW, p. 6).

Natural environment is also affected by activities associated with the use of mineral fertilisers. Table 2 provides the information on consumption of mineral and lime fertilisers in the agricultural sector. It may be noted that in the analysed period there was a slight increase (about 3 %) in use of NPK fertilisers per 1 ha of agricultural land. In contrast, consumption of lime fertilisers fell by more than a half. Costs associated with the NPK fertilisation were the main cause of moderate changes in use of these fertilisers. A pragmatic approach of farmers to their business is demonstrated here, which is associated with the exact calculation of the costs of their activity.

Sales, or in fact consumption of plant protection products used by farmers also affects the natural environment, particularly the water reservoirs located near the land, where the chemicals are used. A noticeable increase in use of four out of the five presented groups of PPP (Figure 1) is associated with more and more popular ploughless tillage. Cultivating machines replacing the tillage significantly reduce production costs but contribute to the development of weeds, fungi and pests devastating crops.

Emission of various pollutants into the atmosphere is a relevant issue in the face of changing global climate. Emissions from agriculture are mainly associated with the production of methane as a result of enteric fermentation and formation of animal manure. On a global scale, agriculture is a sector emitting significant amounts of greenhouse gases into the atmosphere.

Changes in use of agricultural area in Poland

Item	2005	2010	2014	Changes from 2014 to 2005, %
	in thousand ha	in thousand ha	in thousand ha	
Arable land	14074	13969	13818	98
Orchards	296	292	285	96
Permanent meadows	2353	2293	2260	96
Permanent pastures	1695	1638	1613	95
Built-up agricultural land	527	530	529	100*
Land for ponds	51	70	79	155
Land for ditches	152	138	132	87
Total agricultural land	19148	18930	18716	98

* Non-visible percentage change is a result of rounding method

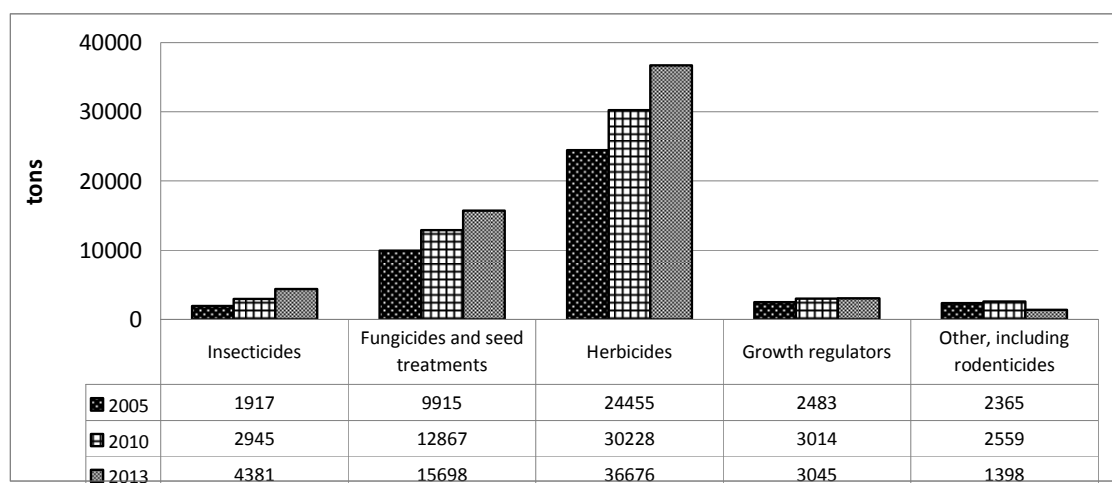
Source: author's calculations based on data provided by the Central Statistical Office (GUS), "Ochrona srodowiska 2014"

Table 2.

Consumption of mineral and lime fertilisers in Poland

Item	Consumption of mineral and lime fertilisers in pure component in the years			
	2004/ 2005	2010/ 2011	2012/ 2013	Change from 2004/2005 to 2010/2013, %
Total amount of NPK fertilisers in thousand tonnes	1628.4	1954.4	1943.4	119
NPK mineral fertilisers per 1 ha of agricultural land in kg	129.1	129.1	133.0	103
Total amount of lime fertilisers in thousand tonnes	1455.6	568.3	634.7	44
Lime fertilisers per 1 ha of agricultural land in kg	91.5	37.6	43.4	47

Source: author's calculations based on data provided by the Central Statistical Office (GUS), "Ochrona srodowiska 2014"



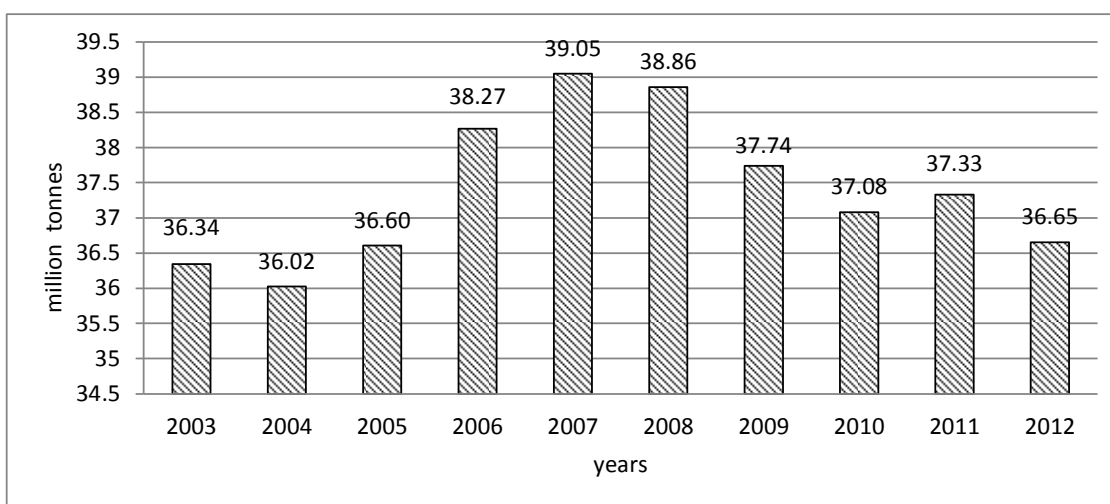
Source: author's calculations based on data provided by Central Statistical Office (GUS), "Ochrona srodowiska 2014"

Fig. 1. Sales of plant protection products (PPP) in Poland (all products admitted to trading)

As indicated by Steinfeld, "direct greenhouse gas emissions (GHG) associated with agricultural production account for about one-seventh of global emissions of this gas into the atmosphere. However, in connection with the emission resulting from the destruction of forest resources for further expansion of agricultural areas and the emissions from processes of production, packaging, distribution, transportation, disposal and other activities associated with food production and consumption, overall greenhouse gas emissions associated with agriculture and

consumption of food may exceed even 40 % of total global emissions" (Steinfeld H., 2006).

Greenhouse gas emissions from the Polish agriculture are shown in Figure 2. The emissions increased in the years 2004-2007 and over the subsequent years the discussed values decreased. This was a result of such factors as: the green policy of the European Union, introducing the principles of sustainable agriculture in the Polish rural areas and increasing farmers' awareness of the environmental protection issues.



Source: author's calculations based on Eurostat: <http://appsso.eurostat.ec.europa.eu/nui/show.do>

Fig. 2. Greenhouse gas emissions from Polish agriculture (CO₂ equivalent)

Economic development based on the assumptions of sustainable development and the theory of bio-economy is mainly based on employing a natural resources in an environmentally friendly manner. One of the elements characterizing the economy, whose development is based on these principles is the process of afforestation.

In Poland, increasing the area of forests is carried out mainly on the basis of the "National Programme of increasing forest cover" and the activities of the Agency for Restructuring and Modernisation of Agriculture (ARMA) in the framework of the program "Afforestation of agricultural and non-agricultural land" (www.arimr.gov.pl) which is part of the Rural Development Programme. Figure 3 shows the

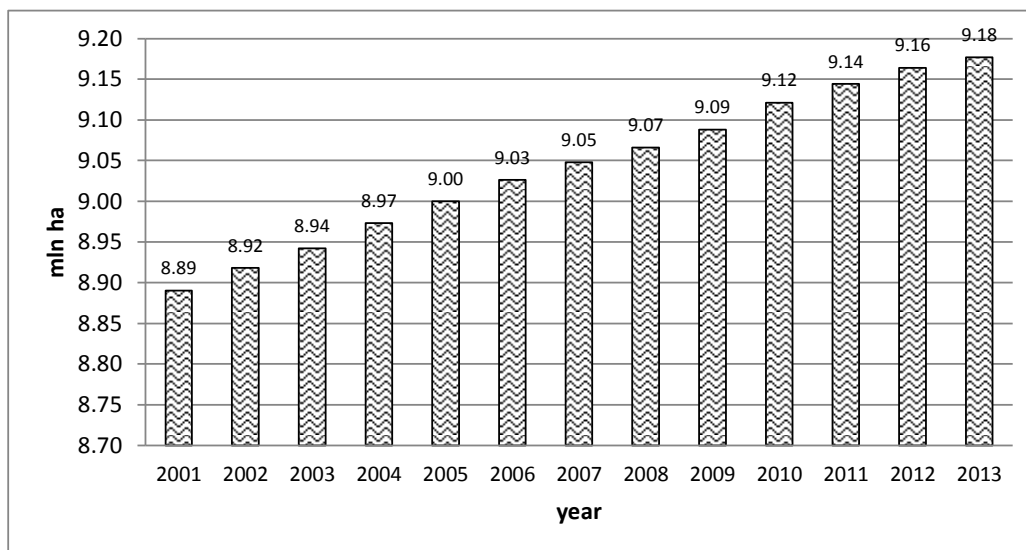
change of forested Polish territory in the period 2001-2013.

Figure 3 is visible larger area of forest in Poland in the years 2001-2013. The end of 2013. Polish territory occupied 9.18 million hectares of forests which corresponds to the forest cover at around 29.5 %. The per capita for about 0.24 ha of forest (Ministry for environment. Information2015).

To increase forest cover in Poland is influenced by many factors. There are activities here, such as the implementation of a national program to increase forest cover, ARMA activities related to the funding of afforestation of agricultural land - which encourages farmers to transform their land to the forest. From the point of view of bio-economy increase in forest area is

a desirable phenomenon. Convinces about Golebiewski representing sectors of forestry, agriculture, fishing and hunting as those that

produce raw materials essential for the development of the bio-economy (Golebiewski., 2013).



Source: Ministry for environment. Informacja o stanie lasów oraz o realizacji „Krajowego programu zwiększania lesistości” w 2013 r. Warszawa. 2015. p. 14

Fig. 3. Change of forest area in Poland in the years 2001-2013

Conclusions, proposals, recommendations

The concept of bio-economy covers almost all sectors of the economy. Its uniqueness is a result of an interdisciplinary approach for solving economic, social and environmental problems. The emphasis it puts on the smart use of environmental resources can be a basis for new innovative solutions, which in a long term will bring positive social, environmental and economic effects. Therefore, it is important that environmental policy adopted by the individual countries is aimed at pro-environment activities.

Changes in the Polish agriculture should also move towards protection of natural resources without ignoring challenge of ensuring adequate quality and quantity of food raw materials. Since 2005 in Poland the area of land used for agriculture has been reduced (by about 2 %) mainly due to non-agricultural (residential or industrial) construction projects. An important factor has also covered conversions of agricultural areas into forests under RDP. From the perspective of bio-economy a much better solution for use of agricultural land is

afforestation, because it brings specific environmental benefits to the society.

A small change (an increase of about 3 %) in use of mineral fertilisers also helps in achieving the assumption of both sustainable agriculture and bio-economy due to the conscious use of fertilisers of chemical origin. However, the information on the use of PPP, where a high increase has been noted. give cause for concern. Positive changes in relation to natural environment include reduction of greenhouse gases emitted into the atmosphere by the agriculture sector since 2007.

The objectives of sustainable agriculture and bio-economy, which are characterised by a pro-environment approach, are not easy to achieve. Because there will always be a conflict between the economic efficiency of agricultural activity, which implies exerting pressure on the environment, and the protection of the environmental values.

Presented in text the study do not reflect the characteristics of the sector as a whole bio-economy also defined as: " the knowledge-based

production and utilization of biological resources to provide products, processes and services in all sectors of trade and industry within the framework of a sustainable economic system"(German Bioeconomy...2015). The study does not reflect the definition of bio-economy comprised many aspects, but pay attention to some environmental trends in one of the main

sectors of the bio-economy - agriculture, which significantly affects the development of this new discipline. Satisfactory from the point of view of trends can be associated with reducing the negative environmental effects of agricultural activities especially in terms of GHG emissions, the insertion into the soil fertilizers or afforestation of land, including agricultural land.

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