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УСЛОВИЯ НА ДИВЕРСИФИКАЦИЯ НА ЕНЕРГИЙНИ ИЗТОЧНИЦИ И УРАВНОВЕСЯВАНЕ НА ЗЕМЕДЕЛИЕТО
PREMISES FOR DIVERSIFICATION OF ENERGY SOURCES VERSUS SUSTAINABILITY OF AGRICULTURE

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Abstract

The article deals with a dilemma concerning the use of agricultural biomass in the production of renewable energy, including biofuels. It discussed the premises for diversification of energy sources in the context of sustainable agriculture, which provided grounds for specifying the role of agriculture and rural areas when it comes to the share in renewable energy production.

Key words: biomass, bioenergy, sustainable agriculture

INTRODUCTION

Today, agriculture has to face new challenges. On the one hand, agriculture as a supplier of raw materials for food production should satisfy the increased demand for food, on the other, it is expected that the share of agriculture in the production of raw materials for renewable energy will grow. However, both of these directions or functions[1] of agriculture exert pressure on resources used for production. What we mean is the fact that these resources are both limited and non-renewable as well as the fact that agricultural production generates adverse external effects. Land resources and use of water[2] and energy from non-renewable

[1] The most important function of agriculture consists in manufacturing products for alimentary purposes, followed by an ever more important function of providing raw materials for non-alimentary sectors of the economy, such as the following industries: chemical, pharmaceutical, textile as well as fuel and energy (other functions include social and cultural and that related to nature).

[2] Agriculture uses the largest amounts of water: it makes up 70%, and over 95% of it falls to developing countries. In Europe the amount is 32.4%. According to FAO calculation, to obtain 1 kg of cereals 1-3 tons of water is needed. (*Water at a Glance. The relationship*

sources (for the production of fuel and chemical fertilisers) are important at this point. Land as a limited supply – following Floriańczyk and Buks [2013] – is one of the main barriers for agricultural production growth, while competitiveness of its non-agricultural uses grows along with economic development. We need to stress that both the production of food and raw materials for energy purposes are subject to requirements concerning sustainability in all of its spheres (economic, environmental and social). Due to the fact that agriculture generates external effects, both positive and negative, state involvement for the sake of inspecting whether certain standards are observed and supporting positive impact of agriculture on the environment is necessary[3]. It is also important to properly channel the development of agriculture and its role in energy production. The role of individual countries' governments in this regard is to determine medium and long-term objectives of energy and climate policy as well as to specify instruments used to fulfil these objectives. It is significant because it creates a framework for making long-term business and investment decisions. Moreover, it is believed that the use of renewable energy is an important component of sustainable development, bringing about measurable effects in the field of ecology and energy [Holger, 2010]. Similar, the diversification of management forms in agriculture, i.e. production of food and production of raw materials for renewable energy, is perceived as one of the elements of sustainable agriculture [Floriańczyk, Buks, Kunikowski, 2012].

Agriculture as a biomass producer[4] satisfying alimentary needs of the society is a producer of raw materials which can be used for the production of energy as well. Due to the fact that energy obtained this way – which is important – at current technological levels, is the main renewable energy source (RES[5]), the role of agriculture in this regard is perceived as significant [Faber, 2008].

Many European Union Member States are largely dependent on the imports of energy materials. European Union Member States are capable of satisfying only 19% of the demand for oil, 48% for natural gas and 61% for coal from their own resources. As far as Poland is concerned, 95% of oil and ca. 2/3 of natural gas is imported, and the majority of these resources is imported from one supplier –

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between water, agriculture, food security and poverty.
http://www.fao.org/docrep/016/ap505e/ap505e.pdf)

[3] Being granted payment under Single Payment Scheme depends on meeting a number of requirements by a farmer, e.g. maintaining land within the holding in Good Agricultural and Environmental Conditions, specified in Annex III to the Council Regulation No 73/2009. This requirement is one of the mechanisms under the common name cross compliance.

[4] According to Directive 2009/28/EC of the European Parliament and of the Council, biomass means: *the biodegradable fraction of products, waste and residues from biological origin from agriculture (including vegetal and animal substances), forestry and related industries including fisheries and aquaculture, as well as the biodegradable fraction of industrial and municipal waste.*

[5] According to the definition included in the Directive 2009/28/EC of the European Parliament and of the Council energy from renewable sources (RES) means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.

Russia. We can speculate that in the future, following the growing demand for primary energy carriers as a result of development, the EU will have to increase its dependency on other regions of the world in this scope. It only confirms the need to diversify energy sources.

A premise for diversification of energy sources and, at the same time, for dedicating an ever growing amount of biomass for alimentary purposes is the expected growth in human population. It is estimated that by 2050 the human population will have reached 8-10.4 billion, on average it will be 9.1 billion [ESA, 2011]. It is expected that as soon as by 2030 the growth of human population and economic growth will have contributed to the global increase in the demand for energy and water by 40% [IEA, 2010], while demand for food will have increased by 50%, which can be satisfied only by increasing the volume of crops. FAO estimates that in order to satisfy the demand for food until 2050 agricultural production will have to grow globally by 70% and by 100% in developing countries (excluding an increasing demand for raw materials for the production of biofuels [*Save and grow*... 2011]. Additionally, satisfying these demands is hampered by climate change, limited availability of arable land and a threat of natural resources depletion.

Another premise is dependence of agriculture on non-renewable energy sources. It is related to progress in agriculture which has taken place for several dozen years now. The increase in agricultural production, starting from the 1960s (the Green Revolution) was mainly based on the intensification, mechanisation, increased use of chemical fertilisers and plant protection products as well as cheap energy. Dependence of agriculture on fossil fuels reflects the relationship between energy input and volume of agricultural production. In developed countries, on average, two units of energy obtained from fossil fuels translate into one energy unit of produced food, whereas in developing countries this relation is opposite and one energy unit generates two energy units of food (not including transport and food preparation) [White, 2012]. This means that agricultural production in developed countries is more expensive and less efficient in terms of energy. Continued intense agricultural development based on non-renewable energy sources also encountered a fundamental obstacle in the form of the environmental capacity and limited renewable energy sources. As expressed by numerous expert opinions, coal, oil and gas deposits are subject to gradual exhaustion [Singh, Singh, 2012]. It is estimated that global coal deposits will have been exhausted in ca. 200 years, while oil and gas deposits in ca. 100 years [White, 2012].W Polish operational resources of coal present in exploitable beds, at annual extraction of 70 million tons, will suffice for 30 years. When it comes to lignite, it is estimated that in nearly 30 years its deposits will have been exhausted [Nowicki, 2012]. Limited environmental capacity means that intense development based on chemisation, non-renewable energy sources, policy of plundering ever greater amounts of hectares under cultivation thereby violating the natural balance, has contributed to disrupting the balance in the entire environment and thus - to the greenhouse effect. As provided by FAO, basic agricultural production and fisheries are responsible for about 1/5 of the total energy consumption in the process of food production and for 2/3 of greenhouse gas emissions. The abovementioned

premises speak in favour of seeking solutions and satisfying the demand on energy with the use of renewable raw materials and indicate the need to work for sustainability of agricultural production. A response to such state of affairs is not only a diversification of energy sources, but also a change in cultivation methods aimed at sustainability. It will particularly contribute to the reduced level of dependence on fossil fuels and will provide safe food meeting the expectations of the customer. Dependence of agriculture on non-renewable energy sources also poses a serious threat to food security [Food Security, 2011]. Recently, the so-called "sustainable intensification" has been a real challenge for agriculture, defined by FAO [*Save and Grow*... 2011] as „producing more from the same area of land while conserving resources, reducing negative impacts on the environment and enhancing natural capital and the flow of ecosystem services".

From the point of view of agriculture, productivity and, consequently, food security will be influenced by climate change, caused by greenhouse gas emissions. This is because agriculture is characterised by very slow and long process of adapting itself to climate change. Weather shocks caused by climate change (floods, droughts) bring about global consequences as they influence food prices. Largest amounts of greenhouse gases are emitted at fossil fuel incineration - 57%; additional 17% of emissions is caused by deforestation, organic matter and peat decomposition [*Climate Change... 2007*]. In this regard an initiative counteracting climate change has been undertaken. What is meant here are the obligations resulting from international arrangements from 1997, known as the Kyoto Protocol [*Kyoto Protocol*, 1997]. On the basis of this document signatory countries committed themselves to reduce greenhouse gas emissions by at least 5% below the emission level from 1990 in the 2008-2012 period. The instrument for meeting this objective was the production of renewable energy and improved energetic efficiency, including the production of energy from solid agricultural biomass.

When it comes to agriculture and rural areas in the strict sense, the development of RES was perceived as a tool for increasing the number of jobs directly or indirectly related to the "green energy." This benefit can be treated as a successful integration of economic, social and ecological objectives. They are all in accord with sustainable development principles. Another significant issue is the increased income in the agricultural sector, resulting from enhancing agricultural production for energy purposes, which is compliant with one of CAP assumptions, namely the provision of appropriate level of income in the agricultural sector. We need to bear in mind that the sole production of raw materials for energy purposes is not the only possibility to involve agriculture and rural areas in the development of RES. Expected development of energy processing installations, such as biogas plants, wind power plants and briquette plants constitutes another chance for economic stimulation of agriculture and rural areas [Matyka, 2011]. The expected development of rural areas owing to numerous investments in these areas, namely development of technical infrastructure, should not be underestimated. These premises have made the use and support of RES development in the energy sector one of the priorities of state policies. The involvement of agricultural resources in the production of RES is also inscribed in the concept of

multifunctional development of rural areas, presented in a governmental document entitled *Outline of directions for rural development* [*Outline of directions... 2009*].It assumed that in the case of agriculture, a social and economic function of rural areas is not equated solely with the production of food and providing space for such production any longer. In particular, it is expected that agriculture will provide other goods and execute other functions of social significance to a greater extent, which corresponds to the production of biomass for energy purposes. Taking the abovementioned phenomena, mutual influence and relationships into account, as well as the expected development of agriculture on the basis of RES, diversification of energy sources seems indispensable. The role played or to be played by agriculture as regards RES is determined by energy, environmental and agricultural policy. The EU's involvement in the development of RES consists in gradual increase in the share of renewable energy sources in energy from fossil fuels from 10.4% in 2002 to 20% in 2020.

It is important to make the production of agricultural biomass meet the sustainable development criteria. Meeting sustainable development criteria means that raw materials used for production cannot originate either from areas that are valuable for their biodiversity, such as protected areas, or areas binding large amounts of carbon (peatlands, forests). Article 17 is a particularly important element of the applicable Directive 2009/28/EC – it specifies sustainable criteria for biofuels and bioliquids. In the light of the Directive in force, a basic sustainable development criterion for RES is the reduction of greenhouse gas emissions by means of biofuels and bioliquids by 35% to 01.04.2013, at least by 50% to 01.01.2017 and by 60% to 2018 for new installations that will start operating from the beginning of 2017. The entire process of greenhouse gas emissions will be analysed for the complete biomass production cycle, in accordance with a methodology specified in the Directive. Additionally, for a fuel to be recognised as renewable, it cannot originate from naturally valuable areas with high degree of biodiversity or carbon-rich soils.

With time, the interest in 1st generation biofuels switched to 2nd generation biofuels. The need to evaluate the influence of biofuel production on food production is emphasised, same as the need to consistently monitor the influence of production and use of biofuels on the environmental and social aspects. The Directive draws attention to the use and development of 2nd and 3rd generation biofuels in the Community and around the world, at the same time, undertaking measures that support sustainable agriculture criteria related to the above and promote research in this area. It was achieved through highlighting benefits for agriculture arising from the use of agricultural raw materials, such as animal manure and organic waste, i.e. materials not directly linked to the production of food in the process of biogas and biofuel production. These benefits relate to the impact on sustainable rural development and the improvement of material status of farmers. When it comes to costs of energy production, the Directive expresses the need for energy price to reflect internal costs of production and use as well as environmental, social and health care costs. Due to the fact that energy prices do not include the abovementioned costs, there is a need for public support of renewable energy production.

Summing up, one has to refer to the need for using RES in the energy sector. The first premise was the increase in greenhouse gas emissions to the atmosphere, caused by incinerating conventional energy sources and the threat of exhaustion of fossil fuels. The use of RES in the energy sector has become a method of limiting the dependency on fossil fuels. At the same time, achieving the energy security of Member States has become significant. The use of RES has always depended on sustainability of environment as well as social and economic sphere. As regards the social sphere of sustainability, a positive impact of the introduction of RES was emphasised due to the diversification of income in agriculture, employment growth and rural development. Profitability of RES production was not that important since it satisfied other demands: environmental and social. Therefore the need to support the development of this energy production sector. Along with its development, various studies had been carried out, whose results undermined environmental sustainability and highlighted adverse impact of the use of biomass based on food raw materials on security of food supply. Therefore the change in the energy policy towards subsequent generations of biofuels and a simultaneous increase in quantitative objectives related to the share of renewable energy. Technological development aimed at making agricultural food production and agricultural biomass and energy production sustainable is of key importance as well.

REFERENCES

Climate Change, Synthesis Report Summary for Policy Makers. Contributions of Working Groups I, II, III to the Fourth Assessment Report of the Intergovermental Panel on Climate Change, Intergovermental Panel on Climate Change, Core Writing Team Pachauri R. K., Reisinger A., Geneva IPCC 2007

Energia ze źródeł odnawialnych w 2011 r.[Renewable energy in 2011], Central Statistical Office, Warsaw 2012, p. 24.

Faber, A. 2008, Uprawa roślin energetycznych a wykorzystanie rolniczej przestrzeni produkcyjnej w Polsce [Cultivation of energy crops versus the use of agricultural production space in Poland], Studia i Raporty IUNG-PIB, z. 11, Puławy.

Floriańczyk, Z., Buks J., 2013, Produktywność gospodarstw potencjalnie zrównoważonych [Productivity of potentially sustainable farms]. J. Agribus. Rural Dev. Article in print.

Floriańczyk, Z., Buks J., Kunikowski G., 2012, Z badań nad rolnictwem społecznie zrównoważonym [16] Produktywność rolnictwa z perspektywy produkcji żywności i surowców dla energii odnawialnej [Research on socially sustainable agriculture. Productivity of agriculture from the perspective of production of food and renewable energy materials]. Multi-Annual Programme Report no. 51, IAFE-NRI, Warsaw

Food Security, Science 2011, vol. 327, no. 5967 (12 February) pp. 797-834.

Holger, R., 2010, Ekonomia zrównoważonego rozwoju [Economy of sustainable development]. Teoria i praktyka [Theory and Practice], Wyd. Zysk i S-ka, Poznań.

Matyka, M., 2011, Rolnictwo a odnawialne źródła energii-szanse i zagrożenia [Agriculture versus renewable energy sources – chances and threats, [in:] Z badań

nad rolnictwem społecznie zrównoważonym [11] [Research on socially sustainable agriculture], Multi-Annual Programme Report no. 3, IAFE-NRI, Warsaw.

Nowicki, M., 2012, Niewyczerpalna energia w świecie wyczerpywalnych kopalin [Non-exhaustible energy in the world of exhaustible fossil fuels], http://cse.ibngr.pl/niewyczerpalna_energia_w_swiecie_wyczerpywalnych_kopalin/

Kyoto Protocol to the United Nations Framework Convention on Climate Change, drawn up in Kyoto on 11 December 1997, OJ 05.203.1684.

Save and grow. A policymaker's guide to the sustainable intensification of smallholder crop production, Food and Agriculture Organization of the United Nations, Rome, 2011.

Singh Bharat Raj, Singh Onkar 2012, Global Trends of Fossil Fuel Reserves and Climate Change in the 21st Century, [in:] Khan S., Fossil Fuel and the Environment, InTech.

Water at a Glance. The relationship between water, agriculture, food security and poverty. http://www.fao.org/docrep/016/ap505e/ap505e.pdf

What Drives Crude Oil Prices?, Energy & Financial Markets, An analysis of 7 factors that influence oil markets, with chart data updated monthly and quarterly, U.S. Energy Information Administration EIA, EIA 2012, http://www.eia.gov/finance/markets/spot_prices.cfm

White, R. E. 2012, Fossil Fuel and Food Security, [in:] Khan S., Fossil Fuel and the Environment, InTech.

World Energy Outlook 2010, International Energy Agency, OECD/IEA, Paris, IEA, 2010, www.iea.org.

World Population Prospects: The 2010 Revision, Highlights and Advance Tables, Economic & Social Affairs, United Nations, New York, 2011, https://esa.un.org/unpp.

Directive of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

Zarys kierunków rozwoju obszarów wiejskich [Outline of directions for rural development], Ministry of Agriculture and Rural Development, Warsaw, 3.02.2009

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