

Prospects for Development of Biomass Production in Agricultural Holdings of North-Eastern Poland²

Adam Pawlewicz, Zbigniew Brodziński

University of Warmia and Mazury in Olsztyn, Poland

Abstract

The need to fulfil environmental commitments regarding the energy policy in the European Union has resulted in an increased interest in the use of renewable sources of agricultural origin. This necessitates re-orientating the Member States' energy policies. On the other hand, due to the increased demand for energy, and the intensification of trends such as an increase in prices in the fuel and energy market, it is extremely important to identify the prospects for the non-food use of biomass originating from agricultural holdings, including the intended use thereof for energy purposes. The aim of this paper is to present the prospects for development of biomass production in agricultural holdings for energy purposes. Opinions regarding the determination of the above-mentioned prospects were collected from an identified group of farmers engaged in cultivation of such crops. The research shows that agricultural holdings with the biomass production in Poland and North-Eastern Poland are very few. The research shows that the barriers to the development of production of agricultural biomass for energy purposes are mainly economic in nature, and result from, *inter alia*, the volatility of prices and the existing difficulties to sell raw materials (in the opinion of almost 60% of respondents), and the low level of prices which fail to guarantee profitability of production (in the opinion of almost 40% of respondents). Therefore, farmers are awaiting support, in particular in a form of crop area payments (in the opinion of almost 25% of respondents), which, in their opinion, may improve profitability of production and encourage other farmers to take it up at the same time. It is to be expected that in the short term of next several years, it will become an important profile of production for many agricultural holdings, but today it isn't popular the direction of production in Poland. However, a condition for the further development of such an activity is to solve the problem of the organisation of biomass processing, and to reconcile such type of production with food-related purposes of agriculture.

Introduction

A new challenge for the European Union Member States, including their agriculture, is the environmental commitment as regards the energy policy. The outlined quantitative targets concern the reduction in greenhouse gas emissions by 20% from 1990 levels, and the reduction in energy use by 20% as compared to the projected levels for the EU for 2020. One of the ways to achieve those objectives is to make use of renewable energy sources of agricultural origin for energy generation. For Poland, the share of energy from renewable sources (RES) in the total consumption thereof must increase to up to 15% in 2020, and to 20% in 2030. It is also planned to achieve in 2020 the 10% ceiling of share of biofuels in the biofuel market, which should result in an increase in the use, for transport purposes, of up to 10% of energy obtained from renewable sources (Polityka energetyczna..., 2009).

In view of the above-mentioned commitments, one of the principal paths of Poland's energy policy within a time span of several years to come will be pursuing an increase in the level of the use of renewable energy sources. On average, in the European Union in 2010, a total of 634 TWh of energy was obtained from renewable sources, which accounted for approx. 20% of the total amount of energy generated. Within the structure of the RES, water power accounted for over 50%, but other sources, e.g. wind (25%) and biomass (20%), also had a significant share (EU energy trends..., 2010). Long-term projections forecast rapid development of the sector of energy obtained from renewable energy sources (Urbański, Tarnowska, 2011). Although the energy obtained from renewable sources is not widely popularised in Poland, growing interest therein of both the potential producers and consumers thereof has been already noticeable for several years.

Due to the rapid development of demand for energy, and the intensification of trends such as an increase in prices in the fuel and energy market, the determination of a growing number of countries and their governments to implement the climate policy, the progressive liberalisation of the market, and the growing demand for information, it is important to identify the prospects for the non-food use of biomass originating from agricultural holdings, including the use thereof for energy purposes. This is an important problem because in Poland agricultural holdings involved in the production of biomass for energy purposes and information about them is not enough.

The aim of this paper is to present the prospects for development of biomass production in agricultural holdings, including the intended use thereof for energy purposes. Opinions regarding the determination of the above-mentioned prospects were collected from an identified group of farmers engaged in cultivation of such crops.

Object and research methods

From the territorial perspective, the scope of the research covered individual agricultural holdings operating in Warmińsko-Mazurskie province. The sample consisted of 122 owners of holdings as registered by agricultural advisors of the Warmińsko-Mazurski Agricultural Advisory Centre (*W-MODR*) in Olsztyn as holdings cultivating crops to be used for biomass production. The group under research consisted of all persons identified as producers of biomass to be used for energy purposes. The field research, using the standardised interviewer questionnaire, was conducted in December 2012. Additionally, the participant observation was also employed, where the researcher becomes an

² The strategic program of the National (Polish) Centre for Research and Development (NCBiR): "Advanced Technologies for Energy Generation. Task 4: Elaboration of Integrated Technologies for the Production of Fuels and Energy from Biomass, Agricultural Waste and other Waste Materials."

observer and an accepted participant of the community under research. This allowed the author to verify certain disadvantages of the selected research method, in accordance with the principle of scientific objectivity and obtaining reliable information. The paper also made use of secondary data, i.e. information included in the relevant literature and source documents.

The average age of the respondents was almost 30 years. Men were predominant, and accounted for 80.33% of the group under research. Every second farmer (50.82%) has received higher education, while more than every third of them (36.07%) has obtained secondary schooling. The research participants mainly held university degrees and diplomas of agricultural schools.

The average area of holdings of the producers of biomass to be used for energy purposes amounted to 199.21 ha, including the average area of 180.10 ha for agricultural land (AL) (while the median of the total holding area of the group under research amounted to 93.5 ha (for AL, 83.5 ha)³. The minimum area of a holding under analysis amounted to 12.6 ha, while the maximum area was 1,988.0 ha. Table 1 presents the structure of the area under crops to be used for biomass production in 2012 in holdings of the farmers participating in the research. According to the information obtained from respondents, perennial energy crops were cultivated in 65% of holdings. That was the group in which the average acreage under those crops amounted to 30.05 ha (a median of 12.16 ha). The structure of the acreage planted (with a significant area under crops) also included cereals (24.59%, an average area of over 50 ha, a median of 20 ha) as well as rape and turnip rape (13.11%, on average almost 80 ha, a median of 67.75 ha). The remaining crops, i.e. papilionaceous plants with grasses, maize, and grasses, were of minor importance (Table 1).

Table 1. Structure of the area under crops to be used for biomass production in 2012 (ha)

Specification	Percent of indications	Number of indications	Average	Median	min	max
cereals	24.59	15	50.21	20	5.00	200.00
papilionaceous plants with grasses	4.92	3	26.00	25	5.00	48.00
maize	3.28	2	180.00	180	180.00	180.00
grasses	8.20	5	52.50	40.76	11.27	96.08
rape and turnip rape	13.11	8	79.43	67.75	6.00	277.70
energy crop	65.57	40	30.05	12.16	0.60	330.00

Source: own research

It should be noted that 72 % of the holdings were not engaged in animal production; moreover, products and residues from such an activity in the remaining holding were not intended to be used for energy generation.

Results of research

More than 65% of respondents concluded that within a time span of the next 2–3 years they intended to increase, in the structure of the acreage planted, the share of crops to be used for energy purposes; primarily, that includes crops such as cereals (21.31% of indications), common osier (16.39%), and rape (11.48%). The remaining farmers did not indicate such plans. According to the opinions of the farmers in that group, the discouragement was caused by problems such as low profitability, and absence of institutional support.

The growing demand for energy, and, at the same time, dwindling fossil resources, i.e. coal, crude oil and natural gas, along with the growing environmental degradation, result in the growing interest in energy from renewable sources, including biomass from agricultural holdings. According to Korycińska (2000): "most of the assessments of the biomass potential, as conducted so far, indicate that out of various types of biomass, it is the agricultural one that has the biggest energy potential". Under Directive 2009/28/EC on the promotion of the use of energy from renewable sources⁴, agriculture is considered to be, among other things, a producer of renewable energy. This is important as regards the agricultural resources in our country, since, as noted by, *inter alia*, Faber (2008): "Poland has approx. 0.41 ha of agricultural land per capita, while for the so-called "old" Union countries, the value concerned is only 0.19 ha. Therefore, Poland has always been seen as a country likely to provide a significant share in the production of biomass for energy purposes in the EU. According to estimates, Poland's potential for the cultivation of energy crops amounts to from 1.0 to 4.3 million ha by 2020". However, one also needs to remember the food-related purposes of agriculture. According to the experts of the Institute for Renewable Energy (IEO), provisions of the National Renewable Energy Action Plan (NREAP)⁵ concerning the areas to be brought under the cultivation of e.g. rape (which is a raw material for the production of biodiesel), indicate that the acreage of production of that crop for food and fuel purposes has been significantly exceeded (1.10 million ha)⁶. As a result, the experts expect that there will be a shortage of approx. 1 million ha for the production of rape, and Poland will be forced to import significant amounts of either raw

³ When the median is less than the arithmetic mean, it means that the value of that feature in most statistical units is less than the arithmetic mean.

⁴ Directive 2009/28/EC 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, *OJL 140*, 5.6.2009.

⁵ National Renewable Energy Action Plan, Minister of Economy, Warszawa, 2010.

⁶ The limit value as provided should not be exceeded for phytosanitary reasons.

material or oil, if the intended purpose of biodiesel production is achieved. On the other hand, the demand for cereals for the purpose of bioethanol production, as indicated in the NREAP, may be fully met (Określenie potencjału..., 2011).

In agricultural holdings, the main sources of biomass resources are as follows:

- crops cultivated on the so-called surplus agricultural land – the biomass may be sourced in a situation where demand for food and feed is met;
- crops cultivated on degraded land – biomass may be produced on the formerly afforested areas or areas otherwise degraded or peripheral, which are still suitable for being re-used for energy purposes;
- agricultural residues – residues from agricultural production and agro-food processing;
- solid animal waste (Hoogwijk, 2004).

The cultivation of biomass for energy purposes may, in a long term, be sustainable in relation to the scale of energy generation and energy needs, and it also may become a source of additional income and lead to an increase in employment in rural areas. It is also believed that it may contribute to the efficient use of environmental resources. That opinion is confirmed by the research results as obtained. According to the respondents, energy originating from biomass (being one step behind the solar energy in the rank) is one of the key development directions for measures associated with the demand for energy. In the opinions of farmers participating in the survey, the remaining trends of the demand for energy from renewable sources are, in descending order and in terms of significance: wind, water, geothermal and biogas energy. On the other hand, they are of the opinion that the use of crude oil, coal and lignite resources is, from the perspective of power industry development, becoming less and less significant (Fig. 1). It needs to be noted that according to the Central Statistical Office (GUS) data, in Poland, in the years 2006–2011, it was the energy from solid biomass that accounted for the biggest item of the balance of renewable energy. The share of biomass in the renewable energy carriers in the total sourcing of energy from renewable sources in 2011 amounted to approx. 85%, while the solar energy amounted to only 0.13%, and the water power to 2.58%. Furthermore, account must be taken of the public statistical data which indicates that the share of energy from renewable sources in the total sourcing of primary energy in the EU accounts for the average of 20% (EU energy trends..., 2010), while in Poland for 11%, with an upward trend both in our country and throughout the Community (Energia ze źródeł..., 2012).

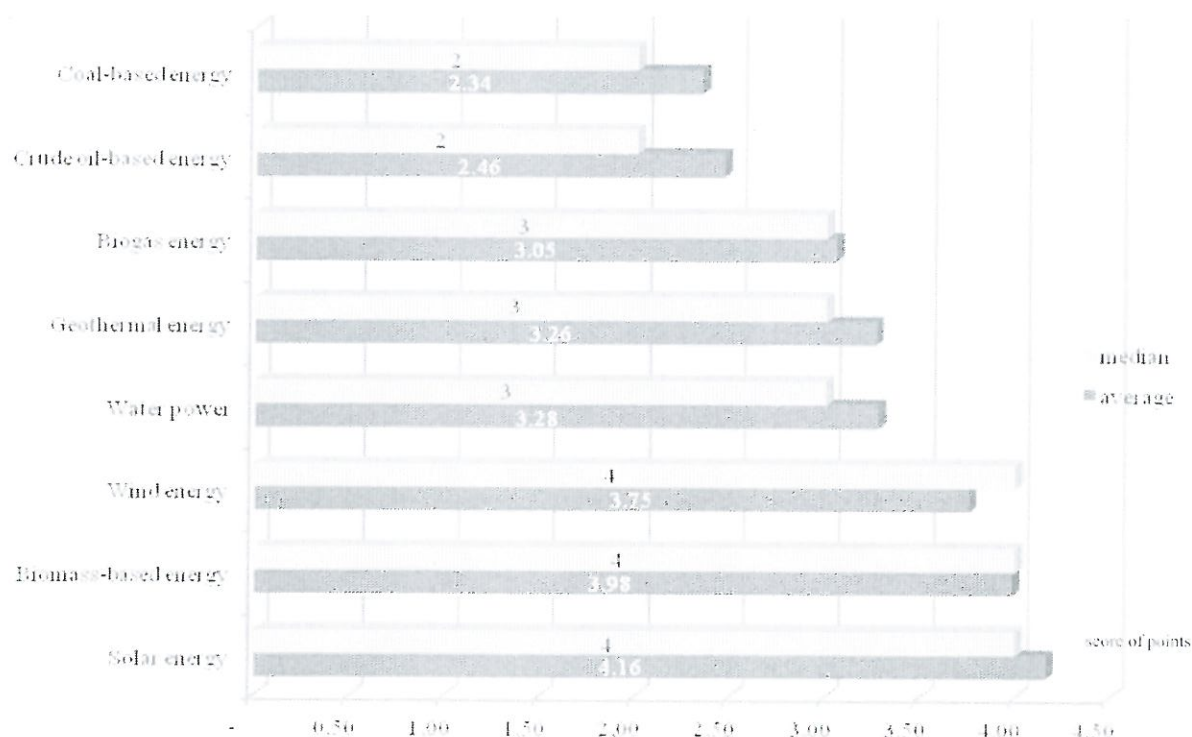


Figure 1. Trends in the demand for energy from renewable sources within a time span of the next several years, in the respondents' opinions (based on a score of 1 to 5, with 5 being the maximum)
Source: own research.

Numerous restrictions to the development of the entire RES industry include the economic, technical, logistical, environmental, social, cognitive, legal and commercial problems, as well as the problems associated with the availability and ownership of land, the danger of deforestation in certain areas, disequilibrium in the energy balance, increasing conflicts, or the competitiveness of that direction of farmers' economic activity with the production of agricultural raw materials intended for food purposes.

While identifying the determinants of the development of biomass production for energy purposes in agricultural holdings, the respondents primarily indicated the volatility of prices in the market (approx. 60% of

indications) as well as the need for ensuring such prices of the raw material that would guarantee profitability of production (39.34%). Those claims result from, *inter alia*, the actual low level of the organisation of entities engaged in biomass processing for energy purposes. Such circumstances interfere with striking the balance between the demand for and supply of biomass.

The fact that the organisation of modern technological chains of biomass processing requires significant capital expenditure still makes the conventional carriers a very attractive source of raw materials. Therefore, while fulfilling the objectives of the adopted EU energy and climate strategy, the measures aimed at promoting the use of energy from renewable sources through applying appropriate economic mechanisms are of particular importance (Energia w gospodarstwie... 2011). In the opinion of every fourth agricultural producer participating in the research, it is the absence of direct payments to such crops that is the main barrier to the development of this type of production. The relatively high expenditure associated with the production of crops for biomass, in a situation of either low or even negative profitability of cultivating other agricultural crops, restricts the agricultural producers' interest in that particular profile of production. Such circumstances lead to the situation where farmers are awaiting for appropriate mechanisms of financial support in a form of, for instance, area payments to the production, which would provide compensation for the low economic efficiency of cultivating crops intended for energy purposes. The form of support being discussed here seems a sufficient argument for the farmers' interest in the cultivation of such crops. Although there are other possibilities for financial support to the use of RES in rural areas, they mainly apply to the development of infrastructure and processing, and not to the direct support to the crops. Another factor as found important by 18% of respondents, which determines the development of biomass production for energy purposes in agricultural holdings, is the appropriate State policy along with regulations. That is an issue of the efficient development of the power industry with the use of RES, since the current status of legal solutions is considered, in the group of biomass producers under analysis, to have an adverse effect on the increase in the share of the RES energy. The remaining determinants as indicated by the farmers were associated with the following issues: appropriate systems of cultivation and harvesting, and the distance from the outlets. Account should be taken of the fact that the respondents, in their assessments, did not attach a particular value to issues such as an increase in prices in the market of alternative raw materials (e.g. crude oil) as compared to biomass, and the need to protect the environment being degraded through the sourcing of minerals (Fig. 2).

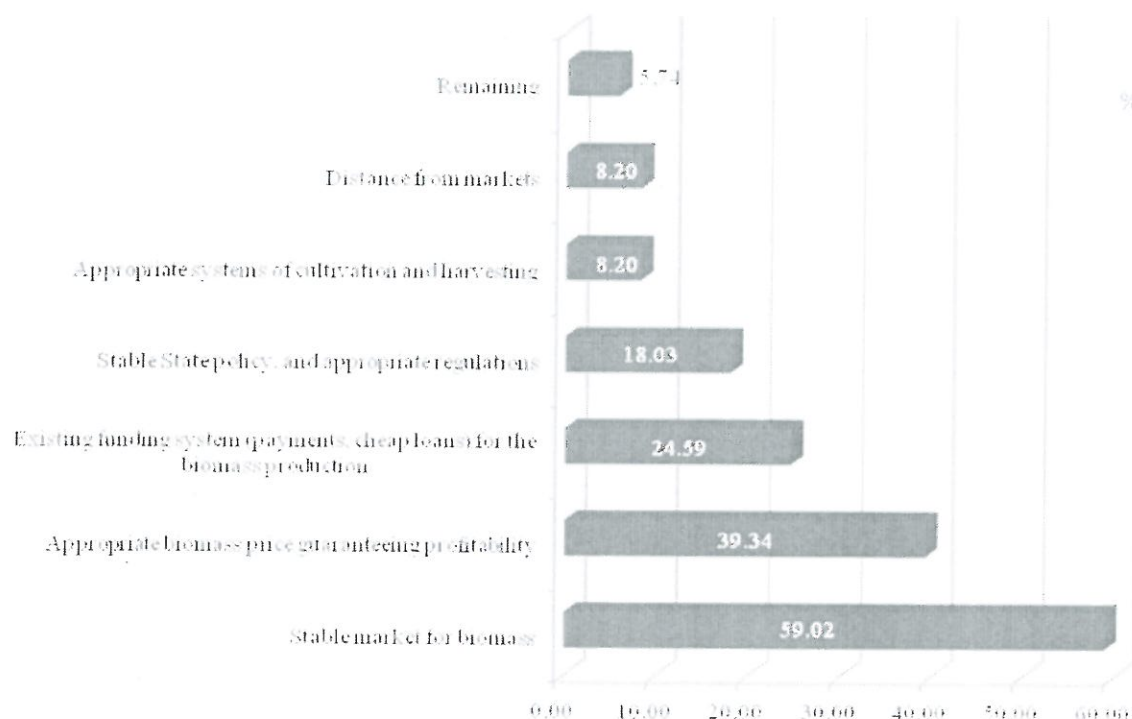


Figure 2. The factors which, in the respondents' opinions, determine the development of biomass production for energy purposes in agricultural holdings (% of respondents). The remaining ones include: high price of crude oil; environmental protection – RES being in vogue; restricted access to the sources of knowledge on the possibilities for production and use of biomass for energy purposes; technical infrastructure; and the possibility for development of problematic areas. Source: own research

Along with the process of progressive diversification of energy sources, an important factor of the development of crops with the intended use of biomass for energy purposes is the support provided by a variety of institutions. Another serious problem has been the rudimentary system of information flow, and the relatively low level of the farmers' knowledge on the issues of crop selection, cultivating crops, or the possibilities for and forms of the sales of

biomass (however, that particular issue was noted by only one respondent – Fig. 2). In the opinions of 73% of the farmers participating in the survey, the major role in the transfer of knowledge on the development of biomass production should be played by the provincial Agricultural Advisory Centres (*WODR*), while in the view of 47.5% of respondents, by the ARMA (Agency for Restructuring and Modernisation of Agriculture) and AMA (Agricultural Market Agency)⁷. A similar number of respondents (44.26%) indicated the important role in that regard of local governments, especially as the local government sector frequently benefits from EU funds which may be designed to be used for the development of infrastructure associated with the organisation of the system of sourcing energy from renewable sources (Fig. 3).

In general, the need for support through specially established institutions dealing with the RES issues was indicated by every third respondent, while every fifth farmer under the research noted that it is the Agricultural Chamber that is an important element of the system of transfer of knowledge on the production of biomass for energy purposes, and the processing thereof (Fig. 3). It may be concluded that biomass producers most frequently seek for support to their actions in the immediate vicinity.

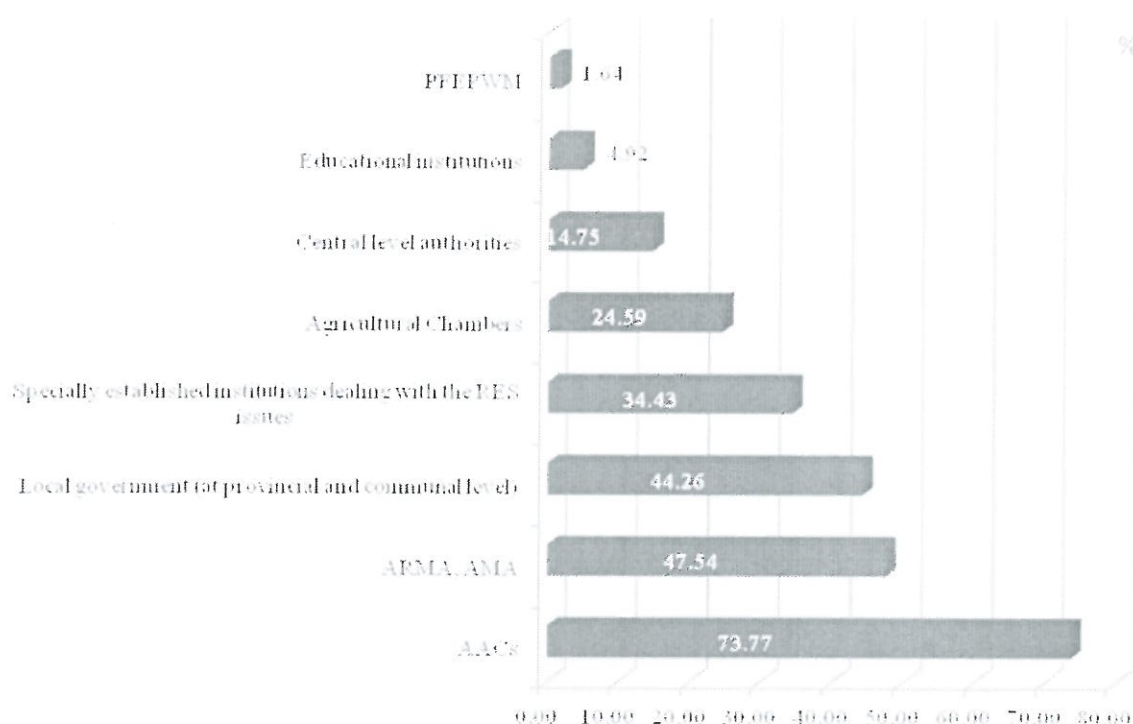


Figure 3. Institutions and organisations which, in the biomass producers' opinions, should support measures aimed at propagating the use thereof for energy purposes (% of respondents, abbreviations: AAC – Agricultural Advisory Centre (*ODR*); ARMA – Agency for Restructuring and Modernisation of Agriculture (*IRiMR*); AMA – Agricultural Market Agency (*ARR*); PFI, PVM – Provincial Fund for Environmental Protection and Water Management (*WFOŚiGW*)). Source: own research

Conclusions

The prospects for the development of cultivation of crops with the intended use for energy purposes depend on numerous factors, both internal (associated with the current organisational level of the agricultural sector) and external conditions, including the legal solutions. The research shows that agricultural holdings with the biomass production in Poland and North-Eastern Poland are very few. In the farmers' opinions, the barriers to development of agricultural production of raw materials for energy purposes are mainly economic in nature, and result from, *inter alia*, the volatility of prices, the existing difficulties to sell raw materials (in the opinion of almost 60% of respondents), and the low level of prices which fail to guarantee profitability of production (in the opinion of almost 40% of respondents). Therefore, farmers are awaiting support, including, in particular, in a form of crop area payments (in the opinion of almost 25% of respondents), which, in their opinion, may improve profitability of production and encourage other farmers to take it up at the same time. Certainly, the important factor affecting the further development of the production profile in question are the clearly defined objectives of the energy and agricultural policy, and the fulfilling thereof to the satisfaction of biomass producers (in the opinion of almost 20% of the respondents).

⁷ In the years 2007–2009, ARMA provided financial support to farmers for the cultivation of crops to be used for energy purposes. The authority responsible for supervising the processing of the above-mentioned crops to final energy products was AMA.

Furthermore, account should be taken of the fact that the EU under the CAP, despite having previously adopted payments to the energy crops, has withdrawn from that type of support. It can be assumed that obtaining new, renewable energy sources requires both the appropriate policy governing those markets, and the introduction of economic incentives, and, primarily, the establishment of an efficient system of the flow of information and knowledge on the RES. Out of the institutions supporting the entities within the chain of biomass production and processing for energy purposes, the most frequently indicated ones include the Provincial Agricultural Advisory Centres and State Agencies supporting the development of agriculture and rural areas (e.g. ARMA and AMA), and the local governments and the Agricultural Chamber.

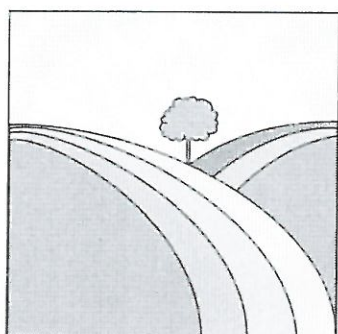
As may be seen, the objectives of the European Union's energy policy are clearly defined. However, the requirement for an increase in the use of the "green energy" within a time span of the next two decades results in problems with the fulfilling thereof, which arise in many countries. One of the ways to fulfil those commitments is to use biomass, and one of the main sectors of economy supplying that particular raw material is agriculture. In conclusion, it must be concluded that currently biomass, as a renewable energy source, is used to a small extent, despite the actual significant potential thereof. It is to be expected that in the short term of next several years, it will become an important profile of production for many agricultural holdings. However, a condition for the further development of such an activity is to solve the problem of the organisation of biomass processing, and to reconcile such type of production with the field of food production.

References

1. Directive 2009/28/EC 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, OJ L 140, 5.6.2009.
2. Energia w gospodarstwie rolnym (*Energy in an Agricultural Holding*). (2011). Fundacja Instytut na rzecz Ekorozwoju (*Foundation Institute for Sustainable Development*). Warszawa, 2011, pp. 32.
3. Energia ze źródeł odnawialnych w 2011 roku (*Energy from Renewable Sources in 2011*). (2012). Informacje i opracowania statystyczne (*Statistical Information and Elaborations*), GUS, Warszawa, pp. 83.
4. EU energy trends to 2030, Update 2009, (2010). Luxembourg: Publications Office of the European Union, pp. 182.
5. EU energy trends to 2030, Update 2009, Luxembourg: Publications Office of the European Union, 2010, pp. 182.
6. Faber A. 2008. Potencjał i konsekwencje rolnej produkcji biomasy dla energetyki (*The Potential and Consequences of Agricultural Biomass Production to the Power Industry*). (2008). Available at http://www.cira.pl/pokaz-pdf-%252Fplik%252F2%252Fpotene_konsekwencje_.pdf, pp. 21.
7. Hoogwijk M.M. (2004). On the global and regional potential of renewable energy sources. Utrecht: Universiteit Utrecht, Faculteit Scheikunde, pp. 256.
8. Korycińska A. (2009). Stan rozwoju sektora bioenergii. Odnawialne źródła energii nowym wyzwaniem dla obszarów wiejskich w Polsce (*Development Status of the Bioenergy Sector: Renewable Energy Sources as a New Challenge to the Rural Areas in Poland*). Foundation of Assistance Programmes for Agriculture FAPA, Warszawa, pp. 6–16.
9. Krajowy Plan Działania w zakresie energii ze źródeł odnawialnych (*National Renewable Energy Action Plan*). (2010). Minister of Economy, Warszawa, pp. 203.
10. Określenie potencjału energetycznego regionów Polski w zakresie odnawialnych źródeł energii – wnioski dla Regionalnych Programów Operacyjnych na okres programowania 2014-2020 (*Identification of the Energy Potential of Poland's Regions in Terms of Renewable Energy Sources – Conclusions for the Regional Operational Programmes for the Programming Period 2014-2020*). Ministry of Regional Development, Warszawa, 2011, pp. 146.
11. Polityka energetyczna Polski do 2030 roku (*Energy Policy of Poland until 2030*). Ministry of Economy, Warszawa, 10 November 2009.
12. Urbanski M., Tarnowska A. (2011). Energetyka w Polsce i na świecie – tendencje i wyzwania. Ludzie, zarządzanie, gospodarka. Studia i Materiały (*Power Industry in Poland and Worldwide – Trends and Challenges. People, Management, Economy, Studies and Materials*). Miscellanea Oeconomicae, Year 15, No 2, Faculty of Management and Administration of the Jan Kochanowski University in Kielce, pp. 264–277.

Adam PAWLEWICZ, PhD, Department of Agribusiness and Environmental Economics, University of Warmia and Mazury in Olsztyn, Plac Łódzki 2, 10-727, Olsztyn, Poland, adampawl@uwm.edu.pl, phone: +48895233313, fax: +48895233735, scientific specialities: agribusiness, environmental economics, regional development

Zbigniew BRODZIŃSKI, Assistant Professor, Department of Agribusiness and Environmental Economics, University of Warmia and Mazury in Olsztyn, Plac Łódzki 2, 10-727, Olsztyn, Poland, zbr@uwm.edu.pl, phone: +48895233822, fax: +48895233735, scientific specialities: agribusiness, advisory, the local economy, regional development



THE SIXTH INTERNATIONAL SCIENTIFIC CONFERENCE

RURAL DEVELOPMENT 2013

PROCEEDINGS

28–29 November, 2013,
Aleksandras Stulginskis University
Akademija, Kaunas district, Lithuania
www.asu.lt/rural_development/lt

AKADEMIJA, 2013

ALEKSANDRAS STULGINSKIS UNIVERSITY



THE SIXTH INTERNATIONAL SCIENTIFIC CONFERENCE

RURAL DEVELOPMENT 2013

PROCEEDINGS

Volume 6, Book 3

28–29 November, 2013
Akademija

RURAL DEVELOPMENT 2013
THE SIXTH INTERNATIONAL SCIENTIFIC CONFERENCE PROCEEDINGS
Volume 6, Book 3

Aleksandras Stulginskis University
Akademija, Kaunas district, Lithuania

ISSN 2345-0916

© Aleksandras Stulginskis University, 2013

Proceedings of the International Scientific conference "Rural Development'2013: Innovations and Sustainability" are indexed and abstracted in the international databases: Thomson Reuters ISI Web of Science (Conference Proceedings Citation Index), Academic Search Complete (EBSCO).

All papers published in the Proceedings of the International Scientific conference "Rural Development 2013: Innovations and Sustainability" have been peer reviewed by two experts in the field.

Conference website: http://www.asu.lt/rural_development/en