PROSPECTS FOR THE DEVELOPMENT OF RENEWABLE ENERGY IN AGRICULTURAL ENTERPRISES FROM THE KUJAWSKO-POMORSKIE PROVINCE

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Summary: Over the past few years, the need for the growth of innovation as an engine for the economic development had become a crucial issue. The global financial and economic crisis has not spared the agricultural sector, moreover the crisis has highlighted the urgent need and the potential for developing sustainable agricultural system based on innovation. The development of innovation had become an important aspect of the EU countries policy, including the Common Agricultural Policy in the future. One of the most important aspects of the agricultural innovation development are the investments in renewable energy sources. The analysis was carried out in large agricultural enterprises in Kujawsko-Pomorskie province. Questionnaires were sent to the managers and owners of those companies. Questionnaire survey consisted of two parts and specifications. The obtained results related to the experience of implementing innovation in large agricultural enterprises from the Kujawsko-Pomorskie province. The article includes information on their experience, interests, and capabilities to carry out investments in renewable energy. Integration of renewable energy sector in agriculture, may result in significant benefits for farmers and society. After analyzing data from the questionnaires the large potential for innovation in the development of renewable energy from agriculture can be noticed, including the use of residues from agricultural production for energy purposes or the advantages of the location potential of the farms.

Keywords: agricultural enterprises, innovation, investments, renewable energy sources, sustainable development

1. Introduction

Over the past few years, the need for the growth of innovation as an engine for the economic development had become a crucial issue. The development of innovation had become an important aspect of the EU countries policy, including the Common Agricultural Policy in the future. One of the agricultural strategic innovation priority action area is implementation of environmental projects, especially investments using renewable energy sources. Currently, a widespread discussion is taking place on the subject of the costs of switching to clean energy sources, which is connected with high investment outlays, expensive mechanisms of Renewable Energy Sources (RES) technologies support systems, and the conflict involved in fulfilment of food and energy needs versus cultivation of energy providing plants. The supporters of RES point out that, with the same outlay, it is possible to obtain a similar amount of energy, by building either large coal power plants or small local (the so called scattered) plants which use renewable energy sources. It is especially important for the local population as this solution can provide new workplaces for the local people. It also enables reduction of energy losses connected with its

transmission over long distances [5, 11], as well as transport costs [2]. Thus, a more widespread use of RES can be considered as a factor accelerating sustainable economic and social development with special emphasis on rural areas [6] .

Agricultural enterprises are the economic entities, which in the context presented above appear to be mostly interested in the implementation and use of renewable energy sources. Additionally, it shall be pointed out that this phenomenon can manifest itself in many different activities pursued by these entities, such as: the production of energy for the renewable energy sector, the supply of residues from agricultural production for the renewable energy sector, diversification into non-agricultural activities but related to renewable energy industry, investing in new technologies using renewable energy and reducing the cost of the enterprise.

Many authors stress the fact that in the Polish geographical-climatic conditions biomass appears to be the most profitable of all available RES [7, 13] and its utilization is predicted to be increasing [1, 3, 10]. The biomass that comes from the forest and agriculture is of key importance. Despite optimistic prognosis, the role of energy plants in biomass production is still too small [4]. Biomass is used for energy production purposes in the process of direct combustion (wood, straw, energy plants), it can also be reused to produce liquid fuels (e.g. esters of rape oil, alcohol) or gaseous (e.g. agricultural biogas) [9]. And those who choose mentioned above production are the agricultural producers who has the greatest access to the biomass from agricultural cultivation. On the other hand the location in rural areas and often the availability of vacant farm outbuildings are the conditions that can also lead to the use of other renewable resources such as wind and sun. Moreover, in Poland there are widespread mechanisms supporting the development of renewable energy which are mostly directed to the agricultural sector. In this context, it seems to be crucial to know the opinions of the agricultural producers on the development of renewable energy sources and their possible interest in the available opportunities given by this type of investment.

2. Materials and Methods

The purpose of the questionnaire survey was to collect information about people's views and opinions on their interest in and ability to implement renewable energy technologies in agricultural enterprises in the Kujawsko-Pomorskie province. The research was conducted and information was collected using Computer-Assisted Web Interviewing method (CAWI method), for the purposes of research an online questionnaire was made in a program creating web interviews and the interviewees followed a script provided in a website using a computer or any other device connected to the Internet.

A request to fulfil a questionnaire was sent to about 100 agricultural enterprises from the Kujawsko-Pomorskie province, including the entities affiliated with the Association of Employers-Leaseholders and Agricultural Owners, as well as to the others who had previously cooperated with the Faculty of Agriculture and Biotechnology or the Faculty of Management at University of Technology and Life Sciences. The questionnaire was directed to the managers and owners of the large agricultural enterprises. The questionnaire consisted of twelve closed questions concerning, among others, previous experience with the use of RES, opinions on the support for renewable energy development, the possibility of future investment in renewable energy technologies, as well as the factors that limit the development of renewable energy sources. The survey was anonymous.

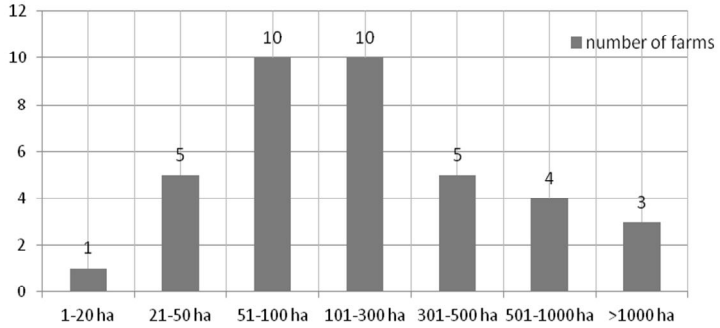

Figure 1. Size structure of the analyzed agricultural enterprises (Source: own reaserch)

The questionnaires were sent to the selected agricultural enterprises in the first half of September 2013 and was completed by 38 respondents. Chosen group of companies was not homogeneous. In 26 cases, the farms were focused on crop production, next four concerned themselves as animal breeding companies and eight of them identified themselves as mixed farms with agricultural production. Among the examined enterprises specializing in crop production the following crops production was indicated: cereals (92 % of respondents), rape (47 % of respondents) and corn (42 %). In animal production it was mainly: pigs (13 % of respondents), dairy cattle (11 % of respondents) and cattle for slaughter (11 % of respondents). In terms of the average surface area of the agricultural enterprises taking part in the questionnaire survey there were also significant differences. The detailed profile of the tested group are given in Figure 1 and Table 1.

Table 1. The structure of agricultural production in the analyzed agricultural enterprises

Types of crops with the highest economic importance in analysed agricultural companies	%	Number of responses
cereals	92,11	35
rape and turnip rape	47,37	18
corn	42,11	16
sugar beet	26,32	10
potatoes	15,79	6
orchards	15,79	6
permanent pasture	10,53	4
fodder plants	5,26	2
lack of crop production	2,63	1
Types of livestock production with the highest economic importance in analysed agricultural companies:	%	Number of responses
no livestock	68,42	26
pigs	13,16	5
cattle for slaughter	10,53	4
dairy cattle	10,53	4
laying poultry	2,63	1
Other (please specify) geese	2,63	1

Source: own reaserch

3. Results

The first part of the research consisted of a series of questions for the purpose of gathering information from respondents about their opinion on three statements: that Poland has high potential for development of renewable energy sources in the agriculture, the possible positive impact of renewable energy for rural development and the purposefulness of further promotion of the use of renewable energy sources by the EU and the domestic policy in Poland. Detailed results of the carried out survey are presented in Table 2. Given answers were consistent with each other and respondents agreed on the validity of supporting the development of renewable energy sources by the Polish government and the EU. 95 % of respondents agreed with the first statement, and the other 90 % with the second one. In this part of the research, there had been no negative answers, what emphasizes and indicates that the respondents support renewable energy sources development and are aware of the positive aspects of an increase in their use.

Table 2. The structure of responses from the survey

	I do not agree		I have no opinion		I agree	
Questions	**%**	Responses	%	Responses	%	Responses
In the agricultural sector in Poland there is a great potential for the development of renewable energy sources	0.00	0	5.26	2	94.74	36
Development of renewable energy sources in Poland promotes rural development.	0.00	0	10.53	4	89.47	34
The use of renewable energy sources in Poland should be supported by the state and the European Union.	0.00	0	0.00	0	100.00	38

Source: own reaserch

When asked if they have considered a possibility of investing in renewable energy sources earlier only 21% of respondents answered no. The vast majority of surveyed enterprises have agreed upon having previously initial interest about such activities. Among the most commonly considered investments were wind power plants (33 % of responses) and the production of pellets or briquettes from biomass (23 % of responses). The detailed specification of different RES technologies mentioned by respondents are presented in Table 3.

Among the surveyed agricultural enterprises, only 8 are using renewable energy for their own needs. They most commonly use biomass of agricultural origin, mainly chips from energy crops and crop residues such as straw surplus, for combustion of biomass for thermal energy purposes. The two of the respondents had installed solar panels in their enterprises. Among the interviewees were those who had already expanded their agricultural activity on technologies related to renewable energy industry. It mainly included production of esters and ethanol used as an additive to transport fuels, as well as the production of pellets or briquettes, fuel obtained from the compressed biomass. In addition, approximately 36 % of the surveyed companies increased their financial income

Table 3. The structure of responses from the survey

Were you interested in investing in renewable energy sources?	%	Responses
no	21.05	8
yes	78.95	30
If yes, what kind?	%	Responses
wind power plants	33.33	10
production of pellets / briquettes	23.33	7
farm biogas plants	20.00	6
biomass heat and/or power plants	20.00	6
photovoltaic systems	16.67	5
production of biofuels	13.33	4
solar collectors	6.67	2

Source: own reaserch

by selling straw to the companies involved in the production of briquettes or pellets or for small local plants. Moreover, 18 % of enterprises cultivate energy crops, which as well as straw surplus are being sold for widely understood agro energy purposes. On the other hand, over 42 % of companies do not use the given possibilities of using biomass for energy (see Table 4).

Table 4. The structure of responses from the survey

Do you use the energy from renewable sources in an agricultural company?	%	Responses
no	78.95	30
yes	21.05	8
If yes, what kind?	%	Responses
burning straw	7.89	3
solar collectors	5.26	2
burning willow	5.26	2
burning pellets	2.63	1
What are the experiences in the enterprise related to the use of agricultural biomass for energy purposes?	%	Responses
There is no experience with the use of agricultural biomass for energy purposes	42.11	16
Sales to companies producing straw pellets / briquettes or local power plants	36.84	14
Production and sale of energy crops	18.42	7
Burning straw / energy crops for their own use	13.16	5
Other (please specify) Production of esters Production and sales of agricultural distillate to produce biofuels	5.26	2
Production of pellets / briquettes from straw and energy crops	2.63	1
Sales of agricultural biomass to biogas plants	0.00	0

Source: own reaserch

The second part of the research, included gathering information about the agricultural enterprises possible interests in carrying out investments in renewable energy sources in the future. The questionnaire contained three questions about interest in this matter and the type of renewable energy technologies, which could be taken under consideration. In addition,

respondents were asked to indicate the factors which, according to them, mostly limits their capacity of investing in renewable energy sources (the question had limited number of responses to a maximum of three factors). The main factors pointed out by the enterprisers were: unstable renewable energy market in Poland, the high investment costs, uncertain cost-effectiveness and lack of a coherent and consistent policy of the governments towards RES. Surprisingly, companies do not consider technological problems as those that could limit their future possibility to invest in renewable energy sources. The results of this part of the study are provided in Table 5.

Table 5. The structure of responses from the survey

Do you consider the possibility of investing in renewable energy sources?	%	Number of responses
no	0.00	0
yes	100.00	38
If yes, what kind?:		
the heat pump	42.11	16
photovoltaic systems	36.84	14
wind power plant	36.84	14
solar collectors	31.58	12
biomass heating system	26.32	10
biogas plant	26.32	10
production of briquettes or pellets	10.53	4
Other (please specify)	0.00	0
Please identify the most important factors which limit the interest in investing in renewable energy sources (select up to three factors)	%	Number of responses
Unstable RES market in Poland.	73.68	28
High investment costs.	68.42	26
Lack of a coherent, long-term renewable energy development policy.	55.26	21
The uncertain return on investment.	52.63	20
Technical problems related to renewable energy technologies	0.00	0
Other (please specify)	0.00	0

Source: own reaserch

4. Conclusions

Integration of renewable energy sector in agriculture, may result in significant benefits for farmers and society. In the studied agricultural enterprises from Kujawsko-Pomorskie province a large potential for innovation in the development of renewable energy from agriculture can be noticed, including possible use of residues from agricultural production for energy purposes or taking advantages of the farm location and future investments in wind or solar energy plants. A wide range of interests in the possibility of investment in RES is noticeable. On the basis of the conducted survey, it can be concluded that agricultural entrepreneurs are strong supporters of to the development of renewable energy sources and they see in it a opportunity for their own future economic development. They see the possibility of combining their traditional farming activities with the use of renewable energy sources, which can manifest itself in many areas such as: planned investments, expanding the range of production, or farm diversification in the direction of

non-agricultural production, the introduction of modern technology or providing raw materials for the renewable energy industry. This kind of phenomenon in relation to the agricultural industry are innovation, they can add value and have impact on the competitiveness of these companies. To conclude, this innovative aspect of the integration of agriculture sector and renewable energy sources on the basis of cooperation, rather than mutual competition, is the principle rule of sustainable development.

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