Diversification of Agricultural Production by Implementation of Biomass Action Plan within the EU Energy Policy

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Abstract

Such as other sectors of industry, the agricultural sector has to find the way how to deal with new conditions within the world financial crisis. Other negatives which this sector has to deal are coming from the grant policy of EU, which creates different conditions in particular member countries. Financial crisis brought to agricultural industry new problems and challenges, which the private farms have to solve by the diversification of their business strategies. Some of the farms have already implemented new steps in their business plans by the growing of biomass for energetic purposes. Authors of the article are assessing the aim and scope of the action plan of biomass exploitation and its transformation to final energy in the farm PD Kapusany. This farm has close cooperation with the University of Economics Bratislava, Technical universities of Kosice and Zvolen. Result of this cooperation is the project of biomass exploitation in energetic sector. There was implemented new biogas station technology with the performance 180 kWh within the project.

Keywords: *agriculture, crisis, biomass, bioenergy, plants production*

JEL classification: Q16, Q27 or Q 29

Introduction

The modern civilization process is characterized by the fast development of research and science. This development brings the higher living standards, but on the other hands brings the negative effects. Results of these effects are damages of the ecological, biological and nature conditions, mainly in the industry areas with the high rate of emissions. People from the developed countries keep high importance to quality of produced and imported food and goods. We can use couple of ways to define the quality of food. One of the options is the control of biological substances, which are really important part of the water and gives us the information about the contents of foreign substances.

The contents of foreign substances show us the mirror of the society because reflect on all negatives which are connected with the industrialization and agricultural development. Every man, inhabitant of our planet, has the right to fulfil minimal needs, which guarantee the social and biological reproduction. The minimal need of man per day is 2l of water, 0,5kg of food and 15m3 of the air. We can guarantee these needs to every man, but it is difficult to guarantee these needs in the relevant quality.

We can consider the membership of Slovakia in EU as a very positive step for our country. Admission also means stabilization of business environment in agricultural sector. We have recorded positive results in 2006 and 2007. In 2008, there is a change of it because world financial crisis began. Crisis affected agricultural production by higher inputs and lower prices for its products like milk, corn and fatstock. At the end it means loss 100 – 130 mil € in the european agricultural sector. Farmers must to deal this fact and find new management strategy focused on utilization of regional potentials. One of these potential is potential of biomass as a source of energy. There are two possible ways how to exploit this source. First is direct burning in boilers and furnaces, second option is to use process of anaerobic digestion which produces biogas. The biogas is transformed to electricity and heat in biogas stations.

European Union comes with action program of biomass exploitation in energetics. It is a very good motivation tool not just for Slovakian farmers. Action program contains important goals for near future in the field of amount of biomass in particular member countries as a contribution to common energetic system.

Energy type	Biomass potential / Mtoe*
Electricity	**32**
Heat	**24**
Transportation	**18**
Total	**74**
***Tonne of oil equivalent (toe)**	

Figure 1. Potential of biomass

Source: Green report 2008, available online:
http://www.land.gov.sk/sk/index.php?start&language=sk&navID=122&id=1280

Biomass should become very important energy source within EU countries and supply them with final energy. We are not talking about numbers but about principal targets. Common target is to reduce 20% of carbon dioxide production, 20% of energy consumption covered by bioenergy sources and 20% savings in energy consumption till 2020. The base year is 1990. Important note is that not the primary energy, but final energy was set as evaluative criterion. The reason is losses along the transformation process of primary energy to final.

Primary conditions are:

- Minimisation of energy losses within the transformation process,
- Maximization of energy production from 1ha,
- Cost minimisation.

We have to consider also these secondary conditions for biomass production:

- Competitiveness of european energy production sector,
- Higher reliability of energy sources deliveries from Russia and other countries,
- Higher utilization of regional potentials and worth,
- Secure food supply in coherence with biomass production,
- Rural development.

Action plan implementation in practise

Although the universities should keep some kind of conservatism, present globalization and problems of world economy offer to universities a great chance to flexible react on innovations within the frame of contents and quality of education. World financial crisis offers probably the best laboratory and research environment for searching the new solutions of the problems. It is really important to flexibly react on the needs of enterprises, but it is also really important to keep all the rules and principles in particular industries and regions. It is no more accepted still manage people in the all ways, which are already out of date. All the changes in educational process should be focused just on the flexibility and new trends in the industries.

The reality is that future managers have lack of skills, habits and resistance to impotence and stress. Firms and its employers do not have enough time and money to retraining the graduates of universities and teach them how to use the marketing tools in practise and how to manage the skills and businesses successfully. Just that is the main problem which we have to solve, because our students can not to try or use gained knowledge in reality. Our universities need to make the firms more than sure, that the cooperation between these two institutions is more really necessary and can brings a big progress in educational process. The firms can save their costs which are spent for the graduates. Our knowledge is in this way more than explicit. That is the reason why we have prepared and realized in cooperation with firms construction of "Research, development and information centre of bioenergy", which is connected with the practise. The research centre is focused on research of renewable resources of energy, presentations of particular alternative sources, production, processing and fermentation of biomass and for the preparation of new professionals and specialists. The research centre will be equipped with the most modern technology, measuring and laboratory equipment.

The area under cultivation of our partner in this project the PD Kapušany farm has surface 3050 ha. 1090 ha represents ploughland, 1200 ha meadowland

and 760 ha of pasture lands. Farm is oriented on plats and livestock production. Structure and the results are shown in figures 2 and 3 below.

Plant	Surface/ha	Yield t/ha	Price 1t/ha
Wheat	346,54	3,23	90
Barley	75	2,66	80
Oat	10	2,45	65
colza	160,54	1,46	260
charlock	24,97	0	320
Maize for silage	189,87	20,32	25,3
Maize for silage (energetic)	139,03	29,23	23,3
hay	1200	14,3	16,4

Figure 2. Plant production – structure and yields

Source: internal documents of the farm PD Kapušany

Animal category	Number/pcs.	Note
Beef cattle - total	**1138**	
Calf (< 6 months)	313	
Heifer (< 1 year)	156	
Heifer(< 2 years)	19	
Fattening (beef cattle)	20	
Heifer in higher degree of gravidity	59	
Dairy cattles	501	Annual milk production: 2 577 480 l
Bulls	69	
Stock bull	1	
Sheeps - total	**1448**	
Young sheeps	905	
Ewes	520	
Rams	23	

Figure 3. Livestock production -main indicators

Source: internal documents of the farm PD Kapušany

Annual production of barnyard manure is 12 745 tons and 13 166 hl. of dung water.

Plants production

Because of lower prices of cereals and colza the management of the farm PD Kapušany needed to find how to diversify plant production. Since 2005, the farm started to grow energetic maize for silage. In the same year PD Kapušany has built a biogas station with the performance 100 kWh. After the connection to

public electricity network farm started to produce electricity within the processes of fermentation based on maize, barnyard manure and dung water.

Annually PD Kapušany uses for energic purposes 3200 – 3400 tons of maize for silage, 600 – 800 tons of barnyard manure and 1100 hl of dung water. The farm with 100 kWh biogas station technology with continuous operation (7200 hours per year) has produced 720 000 kWh of electricity and 920 000 kWh of heat per year. Price for 1 kW of electricity is 0, 12 €, because for other supporting grants. With this price could PD Kapušany generate a gross profit 81 259 € just for the electricity. 40 % of produced heat was used for fermentation processes, 20 – 30% was used for heating of farm building complex and 20 – 30% was released to the air.

In 2007, there was prepared the project of applied research APV 4/0046/2007 with the title Research and development centre of bioenergy, which includes the innovation of biogas station technology and construction of education centre. The project finished in 2009 and the bioenergy centre was opened on 3rd of April 2009.

Biogas station after innovation (expenses 250 000 €):
Fermenter capacity: 1600 m^3
Digestion period: 21 - 32 days
Temperature of substratum in fermenter: 40 - 42 ^{0}C
Amount of substratum: 21tons /24h
Amount of produced biogas: 80 - 90 m^3/h
Volume of methane: 52 – 72%
Performance of biogas station: Rated output 180 kWh
Actual output: 130 – 142 kWh of electricity
170 – 180 kWh of heat

After the installation of new technology we had many problems to start running it. First problem was low pressure in the pipes, or low pressure of biogas. We had to change the pipes and implement the blower which helped us to keep pressure higher. Another problem was very law quality of substratum. Result was outage of our technology and losses in produced amount of electricity. We decided to clean up the fermenter and start the fermentation process from the beginning. After that, the quality of biogas has risen and we could start to transform the biogas to electricity after 36 days long digestion of die. Despite of these facts, **the losses have reached quite high level. It represents 20 – 30% share because of insufficient pre-treatment (homogenization) of substratum before fermentation process.** That is the reason why will be in the next phase of innovation implemented new technology for substratum homogenization and automatic regulation of processes of fermentation. Modernization will contain:

- Building up of homogenous reactor with the capacity 150m^3 and technology for modification, mixing and pumping of substratum,
- Visualization system,

- Controls of heating of fermenter,
- Control of biogas station operations regarding to biogas production in fermenter,
- Visualization of technological processes,
- Monitoring and measurement of liquid for fermentation processes,
- Weighting and measurement of input material,
- Monitoring and control of pressure, level and temperature in the gasholder.

Rentability of energy production with biogas station

Rentability highly depends on the amount and quality of input material. Very important is to have optimized processes of fermentation. Least but not the last is needful to monitor temperature of substratum and keep the period of digestion in the range 21 – 32 days.

In our case, we used for fermentation maize for silage, barnyard manure and dung water in the amount of 21 tons/24h. Parameters of performance and effectiveness are shown in figure 4. In monitored period from 1.1 – 30.10.2009 was produced 698 000 kWh of electricity. We used for these production 2866 tons of biomass. Costs were 51 255, 60 € and income for sold electricity was 83 760 €. Income for heat represents 16 450 €. Net income after income tax was 38 954, 40 €.

Running hours	**7 200/year**
Produced electricity	698 000 kWh (price per kW 0,12 €)
Usage of substratum	2 866 t (price 16,60 €/t)
Expenses for production	44 275,60 €
Transportation cost of substratum after digestion	0,01 €/ kWh = 6 980 €
Total costs	51 255,60 €
Income for electricity production	698 000 x 0,12 = 83 760 €
Income for heat production	16 450 €
Total income	**90 210 €**
Net Income	**38 954,40 €**

Figure 4. Rentability of energy production after the innovation of biogas station technology

Source: internal documents of the farm PD Kapušany

Conclusion

For biomass growing is in use 140 ha of soil. Calculations has shown that the income from 1 ha of soil used for energic purposes is 65, 4 € without heat and substratum, which the farm use for fertilization. If we keep in mind the fact that the biogas station potential is used just on 60% and we had many incidents when we had to stop the technology, the attained economic results are very promising. After the complex innovation process we expect to produce 1 220 000 kWh of electricity and 1 500 000 kWh of heat. After the calculation it means the income 140 – 160 €/ha for produced energy. If we take into consideration lower prices of cereals and colza, bioenergy production could be the way how to exceed losses from this price decrease. Bioenergy production could also at least partially eliminate lower income from plants and livestock production. Secondary benefits are utilization of biomass and lower production of carbon dioxide.

The topic „Bioenergy“ is getting popular and actual at current days. Because of very high dependency on fossil fuel, the European Union and Slovakia needs to find alternative sources of energy. One of the possible is just biomass with its high potential in Slovakia, where more than 40 % of the surface represents forestry. The need of educational activities are quite connected and very important for this issue. Just this is the aim of R&D and information centre of bioenergy in Kapušany, which will also provided educational and consultancy services.

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