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ECONOMIC EVALUATION OF BIOMASS AS A SOURCE OF ENERGY IN VOJVODINA

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Abstract

World trends in the area of utilization of renewable sources of energy indicate that all developed countries are rapidly orienting towards intensive utilization of the renewable sources of energy. The fact that our country has relatively high rate of growth of energy consumption (6 – 7% annually) and that our reserves of primary energy are six times weaker in relation to the world's average, strongly directs us to rational utilization of even the smallest volumes of disposable fuels. According to the way in which the biomass has been utilized so far in Vojvodina, it was estimated that 30 - 50% of the total biomass volumes can be used for energy purposes. During the previous period, the biggest part of this potential was being burned, other part was used as a floor covering in livestock production and insignificant part was ploughed in. Utilization for other purposes is quite rare. This potential of the biomass can be exploited for the production of thermal and electric energy, as well as for the insulation in civil engineering, and other purposes as well.

Key words: biomass, crop production, potentials

Introduction

Using renewable energy as an alternative to conventional fuels (oil, coal, wood) is a target pursued by our country and the EU countries, where the "work paper on renewable energy" was adopted, on January 16th 2007, by the Brussels United Union Board, which stated that 20% rise in renewable energy production inside the UE energy sector by 2020. In conformity with the CE Legislation and HG 1844/2005, "biomass is a biodegradable fraction of agricultural waste and residue products, forestry domain and the similar industries, as well as the biodegradable fraction from the municipal and industrial waste". According to some estimation, the total annual production of biomass in Vojvodina is 10.75 million tons or 30 - 40% less, as compared to earlier periods (Brkic, Janic, 2010). Agriculture, forestry, wood industry and communal business produce large quantities of biomass, and/or organic matter, production residues or waste. Those quantities are approximately the same each year. Even 30 years ago, it was estimated that 9 million tons of biomass was produced by agricultural industry of Vojvodina only (Brkic at all, 1979). Since one part of this quantity of the organic matter can be utilized as an alternative fuel or as a raw material for production of fuel, it is also called renewable source of energy (or abb. RSE). Research activities of other authors (Zekic, Tica, 2010) are also in conformity with previous quotations. The potentials of crop residues of the basic field cultures is over 5,5 million tons in Vojvodina, annually, and/or over 9 million tons in Serbia. Regardless the significant potential we should have on mind that only one part of biomass can be utilized in energy purposes or some other purposes. Namely, in order to preserve the fertility of the soil, crop residues should be ploughed in, which increases the level of humus in soil and preserves its fertility. Much better way to preserve the soil is to use crop residues as a floor covering on animal farms. In this way, the produced dung can be used for soil preservation. Development of the energy crisis stimulates the opinion that great volumes of the biomass can be utilized for combustion and the production of thermal and electric energy. Namely, it is well known that significant volumes of biomass are needlessly burnt on fields, because it is

difficult to plough it in. In order to plough the biomass in, it is necessary to cut it up previously, which requires additional energy. Besides, livestock fund in Serbia was significantly reduced during the previous period, the technology of animal breeding was changed, and necessary floor coverings for animals were minimized. Due to the aforesaid, it is possible to use only 30 - 50% of the total estimated volumes of crop residues for the production of thermal and electric energy, each year.

Material and Method

Information about the types and volumes of the biomass was collected from the statistical records for most important agricultural crops. Specific features of the performed estimations required the use of technical literature and practical experience. Because the official statistics do not make records of the volumes of crop residues and other side-products, grain mass versus straw mass ratio had to be defined (Brkic, Janic, 1998, 2000; Alimpic, 1983). The obtained mass ratio relates balance (or storage) degree of humidity in certain products. The total potential was calculated into energy-equivalent volumes of lignite. Economic estimation of the aforesaid potential was executed in accordance with the market price of lignite in Serbia.

Results and discussion

Calculation presented in the following table provides the data relating average annual production of the biomass in Vojvodina, relating the period of 5 years (2003 - 2007). If this data is compared to previously executed research activities it is possible to conclude that the quantity of biomass originating from crop production in Vojvodina was reduced for 32,3%. Estimation of the annual potential is 12,6 million tons of biomass in Serbia, whereas nowadays, only 9,97 million of tons are being produced. In Vojvodina, this drop is even more intensive. The total production used to be around 9 million tons, whereas today it is 6.1 million of tones (Brkic, Janic, 2010), and only 5 million of tones of biomass for the observed crops.
This change is also noticeable in the very types of biomass. The production of hop is insignificant, domestic seed products and oilseed rapes are gradually being reduced. The production of wheat is halved, and the quantity of corn is three times lower. The following table presents the calculation of the available crop residues, equivalent volumes of coal and estimated values of this potential.

Table 1. Potentials of the biomass in crop production in Vojvodina

No	Culture	Mass of grain (t/ha)	Mass of relations (t/t)	Mass of straw (t/god)	Energy-equivalent quantity of coal (t/god)	Estimated value (€)
1	Wheat	1.062.949	1:1	1.062.949	982.864	20.640.140
2	Corn	2.283.398	1:1	2.283.398	2.189.560	45.980.754
3	Corncob	0	1:0,2	456.680	437.912	9.196.151
4	Sunflower	337.361	1:2	674.722	716.314	15.042.603
5	Shell	0	1:0,3	101.208	107.447	2.256.391
6	Soybean	260.550	1:2	521.100	560.361	11.767.580
	Total	**3.944.258**		**5.100.057**	**4.994.458**	**104.883.619**

Establishment of energy-equivalent quantities of coal is based on minimal energy value of lignite, which is 14.6 MJ/kg[17]. This value is relatively high, considering the fact that the thermal value of raw lignite from the Kovin mine is roughly 10,54 MJ/kg[18]. Energy values of some types of crop residues were calculated in conformity with the previously performed research activities (Zubac,

[17] http://hypertextbook.com/facts/Energy Density of Coal.htm
[18] Energy balance of the Autonomous Province of Vojvodina - Plan for 2011. year

Bubalo, 1995) although, in real exploitation conditions, these values are generally lower. The total energy value of side-products of crop production is 1,741 M toe, which makes 59,25% of the total final production of energy in AP Vojvodina, according to the plan for the year 2011.
Calculation of the economic value was made on the basis of the price of lignite in Serbia. In all that, it included the minimal price of raw coal, and which is 21 €/t, on average. If we take into consideration previously quoted utilization of this potential, which is 30%, it is possible to talk about the potential whose value goes to 31 million € annually, where its utilization could satisfy 17,7% of the final energy consumption in AP Vojvodina.

Conclusion

According to the research, it was concluded that in Vojvodina, more than 5 million tons of crop residues are produced each year, all originating from crop production (the rest is grain production). It is estimated that this quantity of biomass can be utilized for the production of thermal energy and electric energy, in the percentage of 30 – 50 %. The rest could be directed to increase the soil fertility, it could be used in livestock breeding, vegetable production, insulation in civil engineering, fodder cropping, and etc. Tendencies of trends in production of certain crops indicate to reduction in share of wheat and grains, in the seeding structure. It is assumed that this trend will continue in the following period as well, and/or that the crop production will reach production substitution of grains with industrial crops. The assumption of further spreading of the areas seeded with industrial crops comes out of the expected improvement of the economic position of the agriculture, and in accordance with that, increased investments into production which should result in preferring of the capitally intensified cultivations, for example, cultivations utilized in industrial production. With further development of biological potentials of cultivations, the real assumption is that available quantities of crop residues will be reduced. Namely, it is obvious that as the sorts are being improved, and/or as new sorts and hybrids are being cultivated, the ratio straw-grain will be changing in favour of grain. In future, this tendency will reduce available quantities of side-products, in crop production. On the other hand, if we analyse the quality of available volumes of the biomass, we must, first of all, take care of humidity of straw of certain cultivations, at harvest time. Namely, straw from wheat and other corns, at harvest time, has 15 - 20% of humidity. The quoted value is appropriate for energetic application. This circumstance makes the straw from grains the basic potential source of energy in analyzed sector. As different to the straw from grains, the research indicates that the cornstalk in October, and/or at harvest time, has up to 48% of humidity. This makes cornstalk inconvenient for baling, so its preparation is done in the form of stacks. Although our practice includes mechanization for mechanical preparation of the cornstalk, this way of preparation is very extensive and is not convenient for large energetic exploitation. The quoted statement relates production of commodities, which is organized on large properties. In case of small individual sectors, due to latent unemployment and low level of commodity production, exploitation of crop residues has more perspective. The same frames and contributors refer to crop residues of the sunflower. It does not include the sunflower coat, which, as a potential source of energy and the very technology of sunflower processing, is concentrated in oil plants. In this way, the total issue of its utilization is brought down to adaptation of combustion boilers or the process of briquetting, which make this, almost conventional energy substance, the matter of market sales. Besides, we should not forget the possibility of production of the biomass for combustion, as the main cultivation on less productive soils.

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