Review on Agriculture and Rural Development 2015 vol. 4 (1-2) ISSN 2063-4803

POSSIBILITIES FOR EXPLOITATION OF AGRICULTURAL WASTES AND BY-PRODUCTS IN SOUTH-EASTERN HUNGARY

JÓZSEF HORVÁTH

University of Szeged Faculty of Agriculture
H-6800 Hódmezővásárhely Andrássy Street 15., Hungary
horvath@mgk.u-szeged.hu

ABSTRACT
By 2030, the EU could be reducing its energy use by more than a third and generate almost half of the remainder from renewables. Renewable energy sources from farm products - energy from plants and animal materials - are becoming increasingly important in Hungarian energy systems, too. The wide variety of available biomass feedstocks, conversion technologies, and integration strategies offer a broad range of feasible bioenergy scenarios. The main objective of present study is to estimate the regional amount of agricultural biomass and assess the possibilities of the development of the utilization. In Hungary a small part of biomass from agricultural source is used for human consumption, 4.5-5 million tons. 16-17 million tons are used for feeding animals, and a 6-7 million tons are processed by industries. A great majority of biomass supplies the nutrients of the soils. Roots of plants and trees constitute a 7-8 million ton quantity, straws and stems of annual crops comprise 12-14 million tons and manures compose 5-6 million tons annually. At moment, a limited part of biomass from annual crops are utilised as energy source. The most primary products used for biofuels is maize, and in changeable extent, rapeseeds. Straw of cereals are produced 4-4.5 million tons from which animal husbandry and industry uses 1.6-1.7 million tons. The rest (2.4-2.8 million tons) could be utilised for renewable energy.

Keywords: bioenergy, agriculture, biomass, wastes, development

INTRODUCTION

By 2030, the EU could be reducing its energy use by more than a third and generate almost half of the remainder from renewables. Renewable energy sources from farm products - energy from plants and animal materials - are becoming increasingly important in Hungarian energy systems, too. The wide variety of available biomass feedstocks, conversion technologies, and integration strategies offer a broad range of feasible bioenergy scenarios.

The term sustainable agriculture means an integrated system of plant and animal production practices having a site-specific application that will, over the long term:

- satisfy human food and fibre needs;
- enhance environmental quality and the natural resource base upon which the agricultural economy depends;
- make the most efficient use of non-renewable resources as well as on-farm resources and integrate, where appropriate, natural biological cycles and controls;
- sustain the economic viability of farm operations; and
- enhance the quality of life for farmers and society as a whole (GOLD, 2007).

MATERIAL AND METHOD

The main objective of present study is to estimate the regional amount of agricultural biomass in Hungary and assess the possibilities of the development of the utilization. The preliminary research begins the assessment of statistical data from which some conclusions could be drawn. In order to propose a method to maximize energy production from agriculture the characteristics of the local environment like current land use, proportion of land usage and crop rotation.

RESULTS AND DISCUSSION

According to the forecasts of WWF ET AL. (2011) a fully renewable global energy system is possible worldwide: 95% sustainably sourced energy supply can be reached by 2050. There are upfront investments required to make this transition in the coming decades (1–2% of global GDP), but they will turn into a positive cash flow after 2035, leading to a positive annual result of 2% of GDP in 2050.

Oil demand in Europe has already decreased to its lowest value during the last twenty years after a six-year steady decline. While the average oil demand in Europe was 8.4 million barrels/day, it decreased to 7.6 million barrels/day in 2015 (YARDENI AND JOHNSON, 2015). This change is partly caused by the increasing energy efficiency and a switch to alternative forms of energy. At the same time in the United States some grain-ethanol and biodiesel producers have had to shut down operations for lack of sufficient revenue to cover variable costs. Reduced corn production resulting from drought conditions in 2011 and 2012 drove up prices for feedstock grain, and higher prices for fuel ethanol are not possible given stable petroleum prices. Similarly, the availability of low-cost methane from shale gas has significantly reduced margins for biogas producers. Existing bio-refiners would greatly benefit from expanding their options for feedstock being able to be processed beyond just corn and soybean oil, to other readily available, lower-cost materials, such as lignocellulos ones. Although modern bio-refineries are very efficient, improvements in functional robustness and efficiencies could have significant impact on economic viability.

As a policy implication, energy policies which improve the biomass energy infrastructure and biomass supply are the appropriate options for G7 countries since biomass energy consumption increases the economic growth (BILGILI AND OZTURK, 2015).

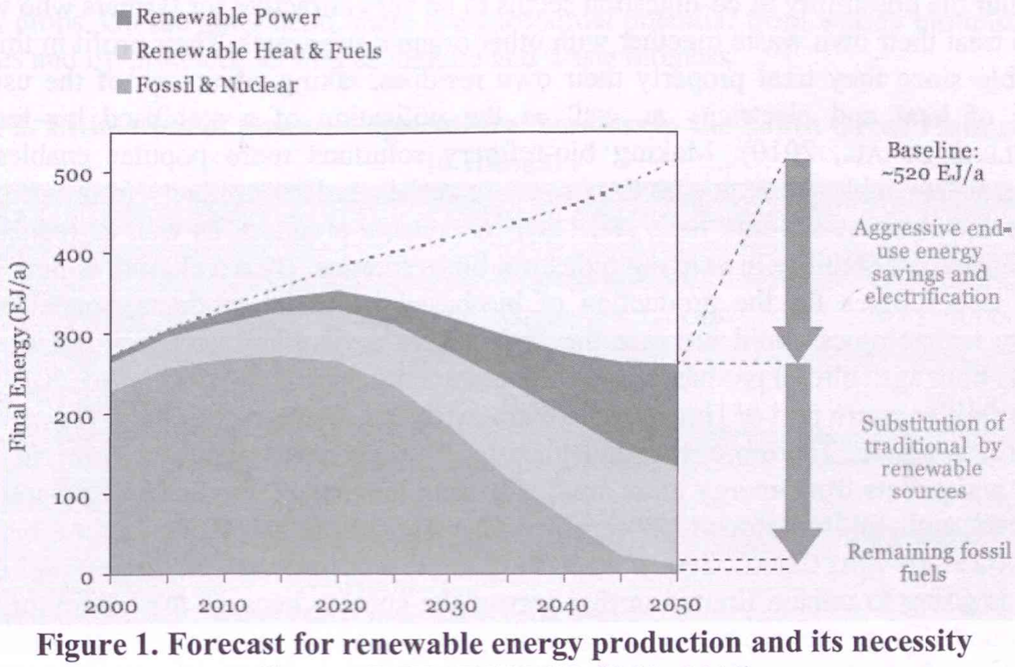

Figure 1. Forecast for renewable energy production and its necessity
(Source: WWF-ECOFYS-OMA, 2011)

One form of operational support instruments in Hungary is the feed-in tariff system. This system supports renewable electricity production and waste-to-energy. The main goal is to eliminate the competitive disadvantage of these forms of electricity production in comparison to the other, mainly fossil based generation technologies. In the feed-in tariff system, eligible electricity producers get pre-defined feed-in tariffs by law for the generated electricity sold in the feed-in tariff system. These tariffs are higher than the electricity market price (except for large hydro power installations above 5 MW installed capacity). On the other hand the responsible party has to buy this electricity at the pre-defined feed-in tariffs. This subsidy form means that the supported producers are segregated and protected from the free electricity market (KLEIN ET AL., 2010).

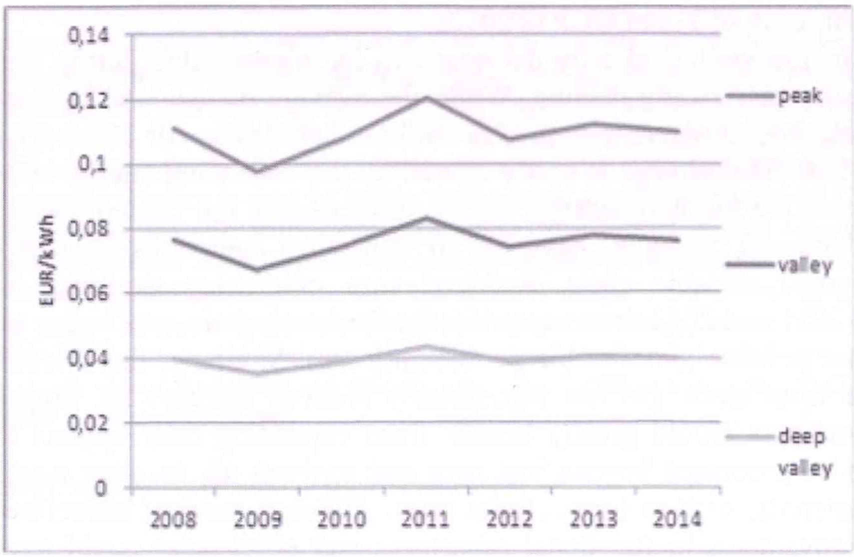

Figure 2. Change of feed-in tariffs in Hungary
(Source: own calculation)

Anaerobic digestion is a very promising solution for the treatment of agricultural by-products and waste, preventing pollution and leading to efficient energy production. In particular the possibility of co-digestion seems to be very attractive for farmers who will be able to treat their own waste together with other organic substrates. Their profit in this case is double since they treat properly their own residues, taking advantage of the using or selling of heat and electricity as well as the utilisation of a stabilised bio-fertilizer (KARELLAS ET AL., 2010). Making bio-refinery solutions more popular enables new commercially-viable technologies to convert materials and by-products from agriculture and for food production into fuels and other marketable products, as well as reduce risks and increase profitability in existing industrial bio-refineries. By developing commercially viable technologies for the production of bio-based industrial products, spread of bio-refinery technologies could increase the demand for agricultural products and therefore benefits both agricultural producers and rural communities (REE AND ZEELAND, 2014).
On the south-eastern part of Hungary there are extensive rural territories and the main land use form is arable. Therefore, the main feedstock for pellets is agricultural origin. Straw pellets and pellets from energy grass are dominating the market. Several agricultural pellet producers with limited production capacity operate with ad-hoc working time based on orders (GYURIS AND CSEKŐ, 2009). According to several forecasts the territory of energy plants is going to remain limited in that part of the country because the quality of soil is quite good. Thus, the production of energy plants cannot generate as high income as cereals or industrial plants, especially on those areas where irrigation is established.

Review on Agriculture and Rural Development 2015 vol. 4 (1-2) ISSN 2063-4803

Ruminants have served and will continue to serve a valuable role in sustainable agricultural systems. They are particularly useful in converting vast renewable resources from rangeland, pasture, and crop residues or other by-products into food edible for humans. With ruminants, land that is too poor or too erodible to cultivate becomes productive. Also, nutrients in by- products are utilized and do not become a waste-disposal problem. The need to maintain ruminants to utilize these humanly inedible foodstuffs and convert them into high-quality foods for human consumption has been a characteristic of advanced societies for several thousand years (OLTJEN AND BECKETT, 1996).

In order to start thinking about alternative energy production of a certain region at first we should estimate the potential of agricultural biomass, by-products and residues. Six biomass resource categories for energy are identified: energy crops on surplus cropland, energy crops on degraded land, agricultural residues, forest residues, animal manure and organic wastes (HOOGWIJK ET AL., 2003). In Hungary, a significant biomass potential could be economically and competitively harvested (*Table 1*).

Table 1. Quantity and heating value of annual agricultural and forestry by-products in Hungary

By-product	Quantity produced (million ton/year)	Consumable quantity (million ton/year)	Heating value MJ/kg
Baled staw	4.5-7.5	1.5-2.0	13.5
Corn stalk	10.0-13.0	3.0-4.0	13
Corn cob	1.0-1.2	0.4-0.6	13.5
Sunflower stalk	0.4-1.0	0.3-0.4	11.5
Loppings, vine	1.0-1.5	0.5-0.7	14.8
Timber waste	1.0-1.5	0.5-0.7	15

(Source: own calculation)

The quantity of by-products, side products and residues are rarely measured exactly but it can be estimated on the basis of the quantity of main products. According to our calculations, there is currently no sustainable potential for agricultural biomass, such as energy crops. On the other hand, there is a substantial potential from woody biomass, crop residues and by-products, as well as manure and waste biomass.

Table 2. Estimation of potential agricultural biomass in the South Great Plain region in Hungary

Product	Quantity (ton)	Product	Quantity (ton)
Winter wheat	790000	Fruit plantations	59000
Barley	215000	Grape plantations	116000
Sunflower	241000	Pig	553000
Sugar beet	83000	Beef cattle	81000
Rapeseed	496000	Sheep	19000
Corn	1365000	Poultry	650000
Corn silage	469000	Egg	172148
Alfalfa	163000	Cow milk	1641000
Vegetables	719000		

(Source: own calculation based on data 2015 of Central Statistical Office in Hungary)

The main products are used for human or animal nutrition and industrial purposes. At the same time the side- and by-products cause transportation and placement costs, in some cases require the application of serious treatment technologies which needs setting of non-productive infrastructure. If we are aware of the volume of the available row products, we can estimate the quantity of the side- and by-products, as well as waste. Some kinds of products are appropriate to be handled on enterprise level, while others should be collected and utilized in larger scale. Seeing that some biogas plants operate with more or less serious difficulties, it must be highlighted that beyond the economic and technological planning of the given plant, the main criteria of sustainability should also be analysed thoroughly. Such criteria are for instance the prospective changes of land use structure in the region and the changes of the agricultural and rural development subsidy system. Consequently, the local producers and stakeholders should ensure the continuous supply in the sufficient quantity of raw materials for fermentation.

CONCLUSIONS

In Hungary, a small part of biomass from agricultural source is used for human consumption, a mere 4.5-5 million tons. 16-17 million tons are used for feeding animals, and 6-7 million tons are processed by industries. A great majority of biomass supplies the nutrients of the soils. Roots of plants and trees constitute a 7-8 million ton quantity, straws and stems of annual crops comprise 12-14 million tons and manures compose 5-6 million tons annually. At moment, a limited part of biomass from annual crops are utilised as energy source. The most primary products used for biofuels are maize and, in changeable extent, rapeseeds. Straw of cereals are produced 4-4.5 million tons from which animal husbandry and industry use 1.6-1.7 million tons. The rest (2.4-2.8 million tons) could be utilised for renewable energy.

REFERENCES

BILGILI, F., OZTURK, I. (2015): Biogas Energy and Economic Growth Nexus in G7 Countries: Evidence from Primary Panel Data. Renewable and Sustainable Energy Reviews 14: 132-138.

GOLD, M. V. (2007): Sustainable Agriculture: Definitions and Terms, National Agricultural Library - U.S. Department of Agriculture, Beltsville

GYURIS, P., CSEKŐ, A. (2009): Development and Promotion of a Transparent European Pellets Market Creation of a European Real-time Pellets Atlas – Pellet Market Country Report Hungary. Geonardo Ltd., Budapest.

HOOGWIJK, M., FAAIJ, A., BROEK, R., BERNDES, G., GIELEN, D., TURKENBURG, W. (2003): Exploration of the Ranges of the Global Potential of Biomass for Energy. Biomass and Bioenergy 25(2): 119-133.

KARELLAS, S., BOUKIS, I., KONTOPOULOS, G. (2010): Development of an Investment Decision Tool for Biogas Production from Agricultural Waste. Renewable and Sustainable Energy Reviews 14(4): 1273-1282.

KLEIN, A., MERKEL, E., PFLUGER, B., HELD A., RAGWITZ, M., RESCH, G., BUSCH, S. (2010): Evaluation of Different Feed-in Tariff Design Options – Best Practice Paper for the International Feed-in Cooperation. Energy Economics Group, 3rd edition, update by December 2010

CSO (2015): A hazai mezőgazdaság teljesítménye 2014-ben. Statisztikai Tükör 2015/77. Központi Statisztikai Hivatal, Budapest, 7 p.

OLTJEN, J.W., BECKETT, J.L. (1996): Role of Ruminant Livestock in Sustainable Agricultural Systems. Journal of Animal Science 74: 1406-1409.

REE, R., ZEELAND, A. (2014): Sustainable and Synergetic Processing of Biomass into Marketable Food & Feed Ingredients, Products (Chemicals, Materials) and Energy (Fuels, Power, Heat). IEA Bioenergy Task42 Secretariat, Wageningen, 63 p.

YARDENI, E., JOHNSON, D. (2015): Energy Briefing: Global Crude Oil Demand & Supply, Yardeni Research, Inc.

WWF INTERNATIONAL, ECOFYS, OMA (2011): The Energy Report – 100% Renewable Energy by 2050. ISBN 978-2-940443-26-0, Gland