

ALTERNATIVE SOLUTIONS FOR SUSTAINABLE DEVELOPMENT OF THE ROMANIAN RURAL AREA

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Abstract: One of the major deficiencies of the rural area is the missing of production diversification and the lack of compliance with Communitarian norms and with International Quality Management Systems. A reduced competitiveness of the processed products determines a trade balance deficit of the agro-food products for the majority traditional agricultural areas.

Based on these considerations and on the present tendency in the world economy management regarding the gradual reduction of the fossil fuels use by their replacement with bio-fuels, an applicative study has been elaborated. Its purpose is to support the rural areas sustainable development which has difficulties, by re-conversion of some of their activities towards agricultural crops used for bio-fuels production and the organization of their production in the area where raw materials can be obtained.

INTRODUCTION

Rural Development National Program 2007 – 2013 includes within the measures destined to restructure and develop the physical capital and to promote the innovation the followings:

- up-dating of the agricultural exploitations;
- increasing the added value of the agricultural and forestry products;
- improving the economic value of the forest;
- improving and development of the infrastructure linked to the agriculture and forestry development and adjustment.

1. Bio-fuels, a favorable alternative for the environment and for the rural economy

The limited hydrocarbon resources, the necessity of carbon oxides, sulphur and nitrogen emission reduction in the atmosphere in order to limit the greenhouse gas effect which is responsible for climate changes has led to strong concerns for the use of renewable clean energy forms.

One of the solutions which have favorable results consists in vegetal resources use, practically unlimited in order to obtain bio-fuels. Bio-fuels have a special ecologic advantage due to the fact they produce a quantity of carbon dioxide, during their burning, equivalent to that consumed for the growing of the vegetal mass used for bio-fuels production, so they do not determine the increase of the greenhouse gas effect in the atmosphere. We must have in view the carbon dioxide emissions during the bio-fuels production process and the raw material used.

By bio-energetic technologies, the bio-mass – defined as the initial material produced by photosynthesis- is used for heat, power or fuels production, which can replace the traditional

energy sources, based on fossil products (hydrocarbon, coals). Directive 30/2003 specifies the following main categories of bio-fuels:

- bio-ethanol (ethanol produced from bio-mass and domestic wastes);
- bio-diesel – a methide-ester obtained from vegetal or animal fat, compatible to diesel quality;
- bio-gas – gas obtained from bio-mass or degradable ratio of wastes, which can be purified to reach the gas quality parameters;
- bio-methanol – methanol obtained from bio-mass;
- bio-dimethide – ether - dimethide-ether obtained from bio-mass;
- bio –ETBE (ethyl-third-butyl-ether) – ETBE obtained from bio-ethanol;
- bio-MTBE (methyl- third-butyl-ether) – fuel obtained from methanol;
- synthetic bio-fuels – synthetic hydrocarbon or mixtures of these, obtained from bio-mass.

Bio-diesel is used as fuel for internal-combustion engines or compression ignition engines, for boiler plants, as liquid fuel etc. It is perfectly mixable with Diesel oil and could be used alone or in combination with Diesel oil in any proportion. When is used as it is, bio-diesel is symbolized B100 and in combination with diesel oil is symbolized B 20, B40 etc, the numbers put next to B representing the ratio between bio-diesel and Diesel oil (i.e. B 20 is a mixture of 20 parts bio-diesel and 80 parts Diesel oil).

Bio-ethanol is a bio-fuel belonging to alcohols category which can be obtained from cellulose mass and is used as alternative fuel for spark ignition engines. The ethanol can replace gas/benzene and in a mixture with it can form new fuel categories: E 85 (mixture of 85% ethanol and 15% gas), E 50 (mixture of equal parts of ethanol and gas) etc.

As a result of the increasing demand of grain crops and oleaginous plants for human nourishment, for animals foddering and for bio-fuels production, cereals and oil stocks have decreased very much and their prices have grown leading to a chain increase of the agricultural products.

2. Bio-ethanol

The raw materials used for bio-ethanol production through fermentation process can be sorted as follows: carbon-hydrates easy fermentable which can be used as they are farina and other organic materials which have to be transformed in fermentable substances first and then be subjected to fermentation. These materials come from three major sources: agricultural crops, wood secondary products and industrial and agricultural residues.

2.1 Bio-ethanol production from cereals

In the case of cereals used as raw material for bio-ethanol production, the manufacturing process can be briefly presented by the following operations: milled cereals are mixed with water and heated, enzymes are added which transform the farina into saccharates, which, in their turn, are transformed in alcohol by yeasts. The alcohol is separated by distillation.

During the manufacturing process, important quantities of CO₂ are released into the atmosphere. Those quantities are added to the products resulted from coal combustion necessary for distillation process.

The CO₂ produced during the raw material production is added to the CO₂ volume released during bio-ethanol manufacturing process. The cereals production using specific crop technologies determines the releasing into the atmosphere of the CO₂ resulted from diesel agricultural machines run, from the organic matter break-up in soil and from chemical fertilizers production.

Almost all ethanol consumed in USA is obtained from food corn grains, its price being of 0.29 USD/liter. A hectare of corn produces about 2500 liters of ethanol/year.

The retail price of the ethanol obtained in USA is 0.69USD/liter and the gas price is 0.80 USD/liter.

The greenhouse gas emissions are 22% lower for the ethanol obtained from corn than the gas; with 1 liter of ethanol a smaller distance with 30% is covered than using 1 liter of gas.

2.2 Bio-ethanol production from sugar beet

Sugar beet, crop with a much extended favorable ecological area in Romania, can be processed, like sugar cane, for ethanol obtaining. Having Brazilian experience, where sugar cane crop produces between 5700 and 7600 l of ethanol /hectare, with a high transforming efficiency because the plant contents 20% saccharates in the stem, which ferments easily and the residues are used for heat and energy production.

It is appreciated that the production and consumption of ethanol, from sugar cane, released 56% less CO₂ into the atmosphere than gas.

Ethanol cost price (obtained from sugar cane) in Brazil is of 0.23 USD/liter and the retail price is 0.77USD/liter, while the gas price is of 1.30USD/liter.

2.3 Bio-ethanol production from cellulose raw material

The secondary agricultural products (corn cob, straw etc.) or some wastes from wood industry and even some domestic wastes content big quantities of cellulose formed from resistant chains of sugar molecules by which breaking and fermentation bio-fuels can be obtained without being in competition with agricultural products destined for food.

It is considered that the bio-ethanol obtained from cellulose determines the reduction of CO₂ volume resulted from the manufacturing process and from its use with 91% than gas.

An original method for bio-ethanol production from secondary agricultural products (corn cob, straw etc.) has been developed in the Research Center for Macro-molecular Materials and Diaphragms S.A. Bucharest, in the frame of a research contract financed by CNMP in CEEX Program.

3. Bio-diesel

Bio-carbonate, the most used in the world, known as bio-diesel name, contents >96, 5% methyl-esters of the fat acids, being obtained by trans-etherification of triglycerides from vegetal oils. The raw material, renewable, used for bio-diesel production is the oil obtained from soy beans, rape seed, cotton etc.

In bio-diesel processing it is recommended to use oils with iodine index less than 120 in order to obtain a fuel with an adequate greasing capacity, like rape seed oil is and sunflower oil could be, not yet used in Romania as raw material.

Bio-diesel properties and performances

Bio-diesel is like a liquid with a variable color between gold yellow and dark brown, depending on the raw material used, being unmixable with water.

Bio-diesel is the only diesel fuel which can be used directly in existent diesel engines, without any modifications to these engines. Having similar properties with diesel oil, bio-diesel can be mixed in any proportion with diesel oil, the resulted mixture being a reliable fuel.

It is to be mentioned that alternative fuels successfully fulfill the energetic and environment safety criteria without affecting the operation performances. Bio-diesel acts very similar with poor content in sulphides diesel oil, both regarding the engine power and moment of couple without any changes of the engine or of the infrastructure.

Pure bio-diesel combustion (B 100) determines 90% reduction of the non-burning hydrocarbons, 80% reduction of CO₂ emissions and 100% reduction of SO₂. In the mixture, a slow increase of nitrogen oxides comes out. The solid particles emissions, injurious for human health, are reduced with 30%. Bio-diesel offers power similar with that produced by conventional diesel oil, having the cetane number higher (40 in USA, 48-49 in Europe) than diesel oil.

Bio-diesel confers a significant better greasing in comparison with diesel oil, even in case of mixtures (B20).

Economic effects. It is considered that bio-diesel industry can have a special favorable economic impact due to the following elements:

- increasing the tendency of property formation, as producers associations or the land undertaking by individual investors, in order to form agricultural exploitations orientated to technical plants;
- mechanization of agricultural works and, implicitly, increasing of work productivity;
- increasing of occupation rate in activities which generate plus value in the secondary and tertiary rural economy sector, in the same time with the reduction of the occupied people in subsistent agriculture;
- providing the optimal frame for innovation development, in accordance with Lisbon Strategy objectives;
- increasing authorities income by taxes, as a result of new economic enterprise activities;
- improvement of the trade balance as a result of the oil products import reduction;
- greenhouse gas emission reduction.

Studies carried out in USA indicate a specific consumption of fuel of 82 l/ha for crop obtaining , while a hectare of rape can produce 1029 l/ha at an average production or 1356 l of fuel/ha at a high production. The rate inlet/outlet in this case is 1:12.5 till 1:16.5

4. Technological recommendations for agricultural crops used as raw material in bio-diesel production

In vegetal world, a great number of species store, in different organs, important quantities of fat as reserve substances. At some plants, the fat are in so big quantities (20%-70%) that can be easily extracted using economic procedures (table no. 1)

Vegetal oils are esters of fat acids with glycerin, in which molecule 75-79% carbon is found, 11-13% glycerin and 10-12% oxygen.

Sunflower is on the third place in the world between oleaginous plants, which fruits contain around 50% oil with special feed qualities and high degree of preservation, used as food – directly or processed- and in bio-fuels industry.

The average production obtained in Romania during 1995-2007 varies between 1735 kg/ha (2004) and 627 kg/ha (2007).

The very favorable area for this crop, on deep black earth, includes Romanian Plain, South Dobrogea and Oltenia Plain., where the use of the below mentioned hybrids is recommended. (table no. 2).

Rape beans is one of the most important oleaginous crops taking into consideration the weight it occupies worldwide. The importance of the crop is due to the beans which contain 43%-48% oil and 20%-24% proteins.

In the last decades of the past century, new sort of rape were created, with a minimum content of erucic acid, considered to have negative effects on human health, sort called “canola” with 64% oleic acid content and 21% linoleic acid content. By processing one tone of raw oil and 100 kg of methanol, 1 tone of bio-diesel and 100 kg of glycerin are obtained.

The optimal ecological favorability of the crop is achieved in the east and west part of the country, with a rainfall regime of 450-650mm/year, on pervious, deep, with medium texture, rich in organic matter and calcium, pH 7 soils.

At a price of 300 euro/tone for rape beans, bio-diesel processing is profitable if the price of oil barrel overcomes 65 USD.

Soy is one of the most important crop plant with multiple uses as vegetable, fodder, oil source or protein, raw material for modern agro-food products, important compound in crop rotation, energetic destination crop.

By soy seeds processing the obtained flour is used in food industry (milk, cheese, substitutes of meat etc.) oil and for bio-fuels, and the remaining products are used for animals feed.

The crop zoning has on its basis plant specific requirements regarding the day duration, the thermal regime and area water sources. The soy crops have the optimal favorability in the plain of the southern part of the country and in Dobrogea, where the sum of the active temperatures ($>10^{\circ}\text{C}$) is of minimum 1600 $^{\circ}\text{C}$, on lands with underground water gain or on irrigated lands.

In this area, the following sorts are recommended to be used: Triumf, Lena, Victoria, Danubian, Elisir, Valkir, Agat, Atlas, Columna, AG0801 RR etc., and half early sorts: Columna, Stil, Zafir and 1484 RR. In a small measure, late sorts can be cultivated like Stil 2250 and S 2254 RR.

During 1995-2007, in Romania, a variable surface of 44800 ha (2001) and 143100 ha (2005) was cultivated and an average production of 594 kg/ha (2000) – 2452 kg/ha (2004) was obtained, depending on the technology applied. A hectare of soy can produce about 560 l of bio-diesel/year.

CONCLUSIONS

Interested in greenhouse gas emissions reduction and in economic updating of the rural area, Romania approached the bio-fuels production matter as a basic element of the energy policy based on renewable resources.

The assimilation of these new type of fuels is done gradually, so till 2010, in European Union, 5.75% of the fuel at gas stations to be bio-fuels. In Romania, 4% of the fuels must be obtained from biological resources, until 1.07.2009.

In accordance with the estimations, till 2010, Romania have to assure a quantity of 300000t/year of bio-fuels, a reachable indicator taking into account the fact Romania has a vegetal oil production capacity (sunflower, rape, soy) of about 550000 t/year.

On Romanian market, there are bio-diesel producers, having a production capacity estimated at about 400000 t/year for 2008 and bio-ethanol suppliers, so there premises to accomplish the European requirements for 2008. It is to be mentioned that since 2006, the Romanian production of bio-diesel was over 3200 tones.

The existent and potential production of bio-fuels in Romania is supported by agricultural resources, especially rape, the harvested quantity being of 180000 tones during 2005-2006, soy, with a production of 300000 tones in the same period and sunflower, 1.6 million tones, qualitative comparable with rape from energy point of view.

The extended use of bio-fuels creates the premises for a global sustainable development by saving the natural non-renewable resources, by greenhouse gas emission reduction in comparison with traditional fuels, by economic development of the area etc.

In the same time, it should be taken into consideration that the vegetal raw material used nowadays for bio-fuels production, obtained from arable lands, diminish the raw material volume for food industry, fact that could affect the people food safety, which is already precarious in the world.

In order to be sustainable, the agriculture have to assure a sufficient volume of food, qualitative adequate and raw materials for different industries, including bio-energy, a very well defined balance being necessary to exist between the distribution directions (main and secondary directions) of agricultural production.

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