

## Article

# Rural Economy and Bioethanol Production

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**Abstract:** Biofuels are considered part of the potential sources of mitigation for the serious threat of global warming, by reducing human reliance on oil imported from unsafe sources at ever increasing costs. For the classic fuel supplier countries, biofuels are a source for the future, as local materials are used in their production. They generate jobs for the local population and do not require the importation of costly equipment and relevant expertise. A pioneer in the use of biofuels, Brazil has eliminated all oil imports and become energy independent. Recognising the positive effects of biofuel use, the EU and other countries are rapidly developing potential sources of their own biofuels. One of these sources could be agricultural cultures that are able to be developed under optimum conditions by endorsing and using modern and sustainable means and techniques in the rural economy. The sustainable use of the resources and the maintenance of the ecosystems in a good working order claims both the protection of the environment itself and the success of the farmers via the provision of fertility and productivity of the agricultural ecosystems, which will give them the leverage of competitiveness on the market and food safety in the long term. The paper herein intends to point out at a sustainable manner of having the economy's engine function—i.e., agriculture—by means of advocating for the efficient use of the resources within the farms and their associations, along with the support for the transition to a low-carbon economy, thanks to the progress in the bioethanol production.

**Keywords:** bioethanol; environmental paradigms; employment; economic development; rural economy; community farms; community rural development policies

## 1. Introduction

“As we know from its beginnings, Community Supported Agriculture is not just a clever, new approach to marketing. Community farming is about the necessary renewal of agriculture through its healthy linkage with the human community that depends upon farming for survival” [1].

Competitiveness in the agricultural sector is a key aspect, both from the perspective of national economy and from the social-political viewpoint of any country. This is why the analysis of the current situation and the identification of any problems relating to such farms is extremely important and prevailing, in view of arguing about the transition to a more productive, more efficient agriculture, and, therefore, of a more viable rural space, in the economic, social and ecological perspectives [2].

Poor development of non-agricultural activities and the lack of diversification by multi-functionality in farming activities generate people's dependence on so-called subsistence agriculture. In terms of the structure of the work force in rural areas in countries transitioning to market economies, they are facing ageing and preponderance of available work force involvement in the subsistence and semi-subsistence farming. A potential solution to absorb the excess work force

might be the diversification of farming activities, such as the processing, packaging or promotion of the agricultural products.

People who care about farmland protection and conservation, who look after their health [3], and consume healthy food from the natural environment [4], are joining forces to build and support *community farms* in their vicinity. Some support the community groups who govern the farms, others want to get directly involved in farm activities and capitalize on the achievements of the community farm, while others are just content with eating healthy, fresh food from the farm or visiting the farm. Community groups have control over the development of the overall farm plan; as a rule, such documents describe the farm's characteristics and capacity to identify resources and opportunities, so as to build an economically successful community farm, with diverse farming, ecological and social activities.

*Community agriculture* provides multiple benefits, both to farmers willing to practice sustainable agriculture and to the communities wishing to eat healthy, fresh, locally produced food [5]. Thus, by encouraging and supporting community farms, the local communities invest directly in their food system, protect and preserve farmland for future years, thus securing healthy food sources by consuming fresh, locally produced food and consequently enjoy social, economic and environmental benefits.

This paper also emphasizes the role and actions of the EU, in its medium- and long-term community policies and strategies [6], corroborated with the importance of Member State involvement in enhancing the competitiveness of the agricultural sector and of the quality of life in rural areas, by allocating funds for the next programming period. The funds must aim and contribute to the fair and sustainable development of rural areas [7], to the promotion of efficient use of resources and to supporting transition to a low carbon and climate resilient economy in the agricultural, food and forestry sectors, as well as to the promotion of social inclusion, poverty alleviation [8] and economic development in rural areas.

This paper therefore grasps a potential way of merging the directions specific to the rural development through the social and economic strategy and of the environment's stipulated in the community legislation for the increase in the competitiveness of the agricultural sector and of the quality of life in the rural areas, as well as the real condition of the community farms in countries such as Romania or Bulgaria, aiming to have a progress in the production of biofuels. The solution of the biofuels, mainly bioethanol, can be a prospective one, provided that the agricultural process tends to be renewable, only with the condition of having a durable exploitation of the biomass; thus, agricultural cultures can serve as raw materials in producing bioethanol that, in turn, goes back into the agricultural circuit via a residue coming from the processing of the gaseous composite generated in the chemical process of obtaining bioethanol, where this residue will be used as a nutritional supplements to the agricultural soil and also by a less polluting doped fuel that can be used for the agricultural equipment run for agrarian work.

In time, the benefits of job creation in the rural areas, and facilitation of agricultural work through the use of high performance, less polluting equipment will thereby be conducive not only to better living standards for the local residents and environmental protection, but also to improved quality of the generated food products.

## 2. Description of the Study Area

### 2.1. A Brief Review of Literature

The restructuring of agriculture and the reactivation of the rural economy can turn into important levers of development for any country.

The traditional agriculture has grown along with the humans, adjusting itself to the geographical and weather conditions. With a positive impact upon the biodiversity, the traditional agriculture endorses the connection between agriculture and mainly between the forms of the traditional

agriculture and the management of the agricultural lands and the biodiversity preservation. The list of benefits of a sustainable agriculture for companies, community and individuals includes reduction of the negative impact upon the environment, biodiversity preservation, landscape aesthetics, conservation of genetic diversity in the vegetal culture and animal species, low risks for business and attenuation of greenhouse gas emissions.

In full swing, the market of the biofuels has the potential to change the current structure of the agricultural cultures. The biofuels provide a source for the future, since they are viewed as prospective sources that could mitigate the severe threats of the global warming. Local materials are used for their production, jobs are created for the local population and it is not required to import expensive equipment and pertinent expertise.

Some of the popular biofuels are called *bioethanol* (or simply *ethanol*) and *biodiesel*. One of their uses is mixing with petrol, as a low emission fuel additive [9].

The plant-based fuels come from renewable sources that can be grown anywhere and generate lower carbon emissions, compared to fossil fuels. Such sources may include: wheat, maize, soybean and sugar cane crops.

The conventional bioethanol obtained from starch (e.g., maize or wheat) and sugar crops (e.g., sugar cane and sugar beet) is the greatest contributor to the total biofuel production and is, therefore, the renewable source with the highest contribution to transport. The following are sources of raw material [10].

- Food source: Ethanol may be obtained from any plant crop containing high sugars or components to be turned into sugars, such as starch or cellulose, for example sugar beet and cane, containing natural sugar. Crops such as maize, wheat and barley contain starch that can be easily turned into sugar. Most trees and grasses contain cellulose, which can also be turned into sugar, although not as easily as starch.

The entire process of obtaining ethanol includes four stages the first of which is selecting the raw material (crops or plants), followed by the conversion of starch or cellulose into sugar or the conversion of sugar cane or other into ethanol and carbon dioxide, ethanol and carbon dioxide separation as by-products, and lastly by ethanol purification to a suitable rate.

However, there are many large ethanol producers who use a moist-dry process in ethanol production. The by-products of this process include: fructose-rich maize syrup, used as a sweetener in many processed foods.

- Wood cellulose: Another raw material in the manufacturing of ethanol and carbohydrates, obtained in the acid hydrolysis of cellulose from wood scrap, reeds, etc., are equally used in obtaining alcohol, which comes out in small quantities of methanol contamination. The use of bisulphite leaches from the cellulose industry was also attempted in obtaining ethanol.

Bioethanol is thus a fermentation alcohol, i.e., the ethylic alcohol produced in microbial fermentation processes, unlike the synthetic ethanol obtained from petrochemical sources. The fermentation takes place in an aqueous solution and the solution resulting afterwards has an alcohol content of about 15%. The ethanol is then isolated and purified in a combination of absorption and distillation techniques. The purification requires high energy consumption [10].

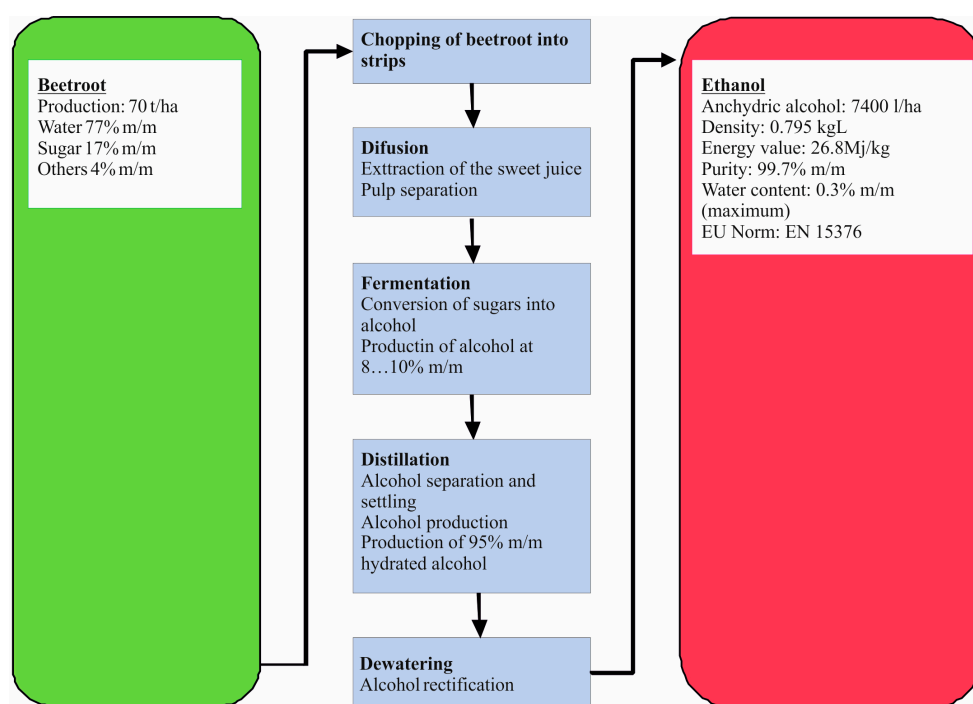
As a result, the industrial preparation of ethanol consists of a number of operations using cereals or potatoes as raw materials, based on their high starch content. Cereals or potatoes are crushed before mixing with water at 60 °C, and preferably under a pressure of about 3 atm., until a cake is obtained. Independent from this chemical procedure, the malt is prepared by germinating barley. The mashed malt is mixed with the starch cake in a saccharifier, a device provided with an agitator and a cooling serpentine. The temperature should not exceed 60 °C, otherwise the amylase is destroyed. The mixture in the saccharifier converts to a thin sweet tasting liquid after circa an hour, when most of the starch had already turned to maltose [10].

The liquid thus obtained is cooled down to 15–20 °C, then yeast is added to it. This multiplies and, after a while, the energetic fermentation starts. The alcoholic fermentation lasts for 2–3 days. The vessels used for fermentation need cooling, as the digestion of each kg of sugar releases 133 kcal. The carbon dioxide thus formed can be collected. Alcoholic fermentation produces a liquid, known as leaven, containing up to 18% alcohol, while the rest is water, small amounts of glycerine, propyl, butyl, amyl alcohols, etc. This liquid is subjected to primary distillation, resulting in raw, 90% proof alcohol. The distillation residue is known as marc and is used as livestock feed, since it contains proteins, fats, etc. [10].

The raw alcohol is subject to rectification, in a rectification column, the distillate being 95.6% pure alcohol, and the distillation residue glycerine and fusel an oily liquid formed of higher alcohols (propyl, butyl, amyl). Ninety five point six per cent alcohol is an azeotrope mix, with the boiling point at 78.15 °C; this is why obtaining pure alcohol (absolute alcohol) in a further distillation is not possible, but rather special methods need to be applied, such as treatment with substances that easily combine with water (calcium oxide, calcined calcium sulphate, etc.), followed by the distillation process [10].

The industrial scheme contains (see Figure 1):

- (1) Heat exchanger
- (2) Agitator
- (3) Synthesis column (hydractor)-reactor
- (4) Condenser
- (5) Gas separator



**Figure 1.** Schematic technological flow in obtaining biopetrol from sugar beetroot (Source: [10]).

Despite the fact that Romania does not have a significant production of biofuel, the status of EU Member State brings community regulations concerning a minimum use of the biofuels at the national level. Within realm of possibility to increase the internal rapini and soy production and given the present capacity of processing, Romania attracts more and more interest from foreign investors in this sector. First-hand sources point to the fact that in Romania the necessary of biofuels was 5.75% of the total consumption of classical fuels until the end of 2010, which means circa 330,000 tons of biodiesel and bioethanol per year. According to the European Union legislation, the mandatory minimum

objective for 2020 is 10% biofuel contribution in the consumption of gas and Diesel fuel used for transport, which means 600,000 tons of biofuels per year. The MARD (Ministry of Agriculture and Rural Development) data for Romania have shown that there are circa 31 economic agents on the market of biofuels, with a total production capacity of 280,000–300,000 tons every year [11].

In 2006, an Environment European Agency (EEA) study considered that 15% of the European demand for energy that is estimated for 2030 could be covered by bioenergy obtained from agricultural, forest and waste products, coming from only European resources. This estimation is called “biomass potential” of Europe. The study has also commanded a series of conditions to protect biodiversity and lower to the minimum the waste production so that the “biomass potential” does not affect the environment [12].

Following the studies conducted for Romania, biomass is one of the main resources of renewable energy herein and its exploitation is gaining more ground in this country, as well. The potential in the green energy production is thus 65% biomass, 17% wind energy, 12% solar energy, 4% micro hydroelectric power plant and 2% voltaic and geothermal, an increased energetic biomass potential, circa 7594 tep (million tons of oil equivalent)/year, which is a real opportunity for the durable development of the rural economy. Out of the raw material used for producing energy from biomass, 15.5% is waste from lumbering and fire wood, 6.4% sawdust and other wood leftovers, 63.2% agricultural waste, 7.2% residential waste and 7.7% biogas. In Romania, biomass can easily provide over 20% of the energetic necessities of the country; in other words, the current territorial resources and the infrastructure of the agrarian sector allow a complete replacement of all the atomic stations, with no effect upon the prices of the food products. The use of biomass for producing ethanol can also decrease the oil import by 50% [13].

The Romanian rural space described by natural resources in a good preservation condition, thanks to a high level of biodiversity, associated with a variety of habitats and ecosystems, of forests and valuable agricultural landscape, is vulnerable to the major changes that are to happen in the immediate future, similar with the ones brought about by measures such as maintenance of these natural values and fight against the climate changes.

In recent years, the performance in the rural environment and the Romanian agriculture seem to be less and less stable. This derives from both the frequency and the surging harshness of extreme phenomena, namely heat/cold waves, drought, flooding and disease incidence in animals.

- One reason reflects the impact of the weather changes upon the Romanian agriculture and the improper infrastructure in order to counterattack the related risks. In this context, the *weather changes* represent a challenge in terms of the stability of crops and provision of the food security.
- Another reason lies in the general trend of extending the cultivated areas and low usage of the chemical products in agriculture, when a number of agricultural lands were affected by *the incorrect use of the chemical fertilizers and pesticides, irrigations, drainage or the implementation of certain inadequate mechanical works*, thus generating a strong degradation of the environment components (mainly soil and water) on small surfaces.
- Similarly, the *abandonment of the agricultural activities and the defective agricultural practices* emerged from the lack of pertinent knowledge or limited financial resources had a negative impact upon biodiversity and triggered the emergence or the accentuation of the soil erosion phenomenon.
- In default of concrete data to be examined, it becomes difficult to estimate the percentage of the abandoned agricultural land that was meant to accommodate agrarian works but it can be pinpointed those areas where the phenomenon is more intense. The abandonment affects Romania in the areas with a higher poverty line that is characterized by an increased emigration and on the outskirts of the large cities, where certain agricultural lands are pulled off their expected use in order to serve to the projects of extending the residential or commercial areas.

For the same purpose, the Romanian rural economy features significant differences in dependence on the regions, the specific demographic qualities, social and economic. This differentiation is visible

in what poverty means in the Romanian rural space, reflected in a low standard of living for the population and in the lack of sources of alternative income.

The intensification of the agricultural activity via the sustainable development of farms and of their associations provides a better land management and also an efficient promotion of the agricultural products, against the implementation of certain measures aiming the protection of the environment and the business development in the rural area.

A farm can be owned by an individual, family, community, corporation or company and it can produce one or more types of goods, while ranging from the smallest size to several thousand hectares. This could function on a system of mono-crop or multiple crops that may occur separately or in parallel with livestock breeding. Specialist farms are often designated as such. There are also farms primarily established for research or educational purposes [14].

The *community farm* support schemes consider that a farm is eligible to receive assistance if it meets the following conditions:

- the farmland is held “in trust” for the community;
- the farm is managed by a community group or cooperative;
- the farmers are involved on a long term, residing on or near the farmland;
- the farm production is focused on local foods obtained through sustainable farming practices;
- multiple activities are conducted to complement food production; and
- the property owners, the farmland supervisors, the farmers and working partners of the community farm are bound by an agreement [15].

The influence of Austrian philosopher Rudolf Steiner’s ideas about the biodynamic agriculture was felt and launched as the concept of *community-supported agriculture* (CSA) to use in north-eastern USA in the 1980s. Prior to that, Japan had developed a model called *teiki* in the early 1970s. Today, the CSA seems to be associated with a higher awareness towards the ecologist movement in the USA [16].

Since the production of high quality foods for the local community is its main focus, the common practice for CSA is the methods that are specific to organic or biodynamic farming, and a shared risk membership–marketing structure.

This type of agriculture requires an increased level of involvement from the participants in the process, which leads to strong relations among them.

The plan follows a certain scheme, including the creation of a coherent consumer group that will be willing to fund the process for the entire season, aiming for the high quality food. There are several alternative ways of this financial assistance for the farm budget, farmers and delivery of the products.

The CSA Theory [16] claims to meet three major objectives:

- New forms of ownership: The land should be shared in proprietorship by a community under a legal trust that will then give it to the farmers on a rental agreement.
- New forms of cooperation: A network of human relationships should replace the traditional system of employers and employees.
- New forms of economy: The real needs of the people and land should be put in place of the profit and growth criteria of the economy.

A challenge facing the CSAs is the overproduction. The CSA farms often sell their produce on local farmer markets, to restaurants, while applying retail at the farm, as well as wholesale in natural food stores [16].

Specialist references also highlight potentially important roles of small and semi-subsistence farms, such as supply of public environmental goods, supply of specialist food products, and conservation of local and cultural traditions; however, to date, there is very limited research in support of these roles [17].

The literature in review does not contain any clear definitions of subsistence farms. However, three different approaches can be identified and they can help trace an image of this type of farms in



the context of agricultural operations. Based on the physical size, farms of less than one hectare or two or five, respectively, are considered subsistence farms. In several cases, operations of less than one hectare are not even considered to be farms. Based on the market orientation, a basic feature of subsistence farms is that they produce for their own final consumption or sell very few of their goods, on the one hand, while buying very few goods for use in agriculture or for their own consumption, on the other hand (see Figure 2).

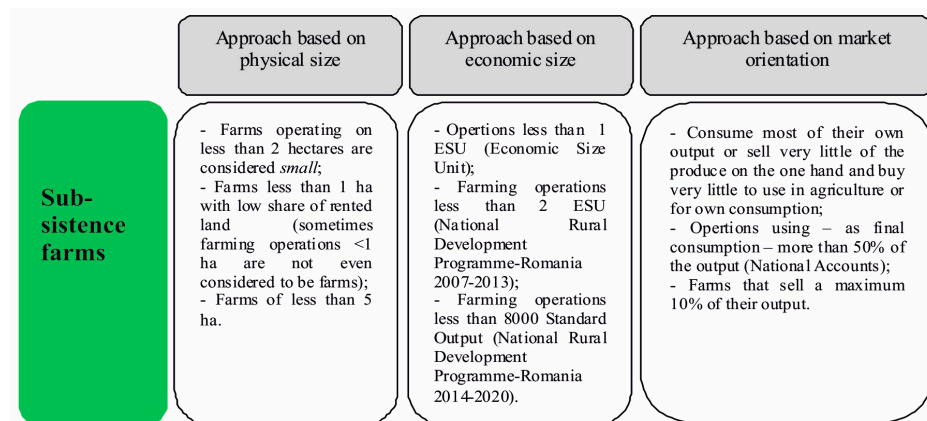


Figure 2. Conceptual framework in defining subsistence farms (Source: [18]).

In light of the international specialist literature, farms of 0.5 to 5 ha or between 1 and 5 ha, are considered to be semi-subsistence farms. However, the Romanian specialist literature [19] defines the lower threshold for this type of farms as being 5 ha.

Based on their market orientation, the farms that primarily produce for their own consumption, but sell part of their output are considered to be semi-subsistence farms (Reg. EC 1698/2005). The international literature in review calls the semi-subsistence type of farms those that sell some, but less than 50% of their output [20]. The agricultural estates that sell 10%–90% of their production are considered “transitional farms” [21].

Research by Fritzsche et al. (2011) [22] shows that semi-subsistence farms do not come as a consistent group. Four types of households are identified within the semi-subsistence farms: diversifiers, pensioners, farmers and job-starters. These groups have different combinations of income, human capital, different size farms, production and consumption structures, respectively, and balances in their annual credits [2] (see Figure 3).

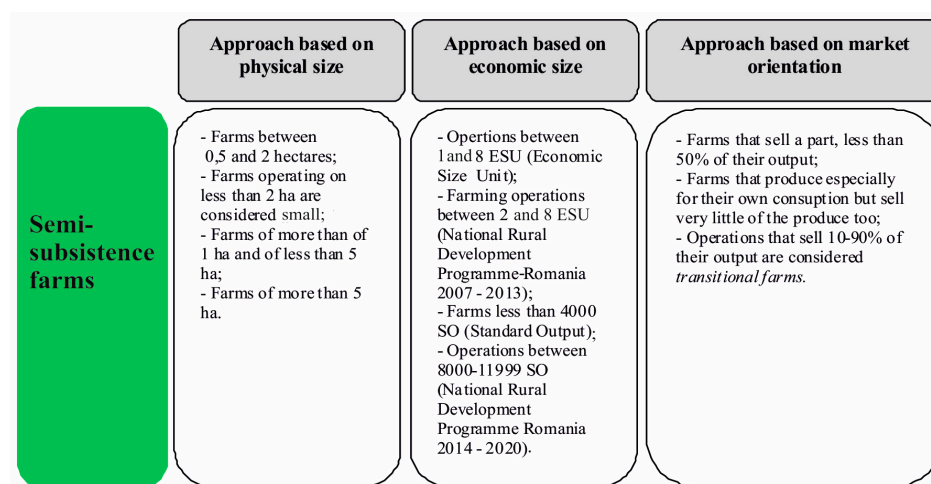


Figure 3. Conceptual framework in defining semi-subsistence farms (Source: [18]).

## 2.2. The Romanian Farming Structure vs. Needs/Shortages

The European Union undertook to create better and more work places. This commitment requires a strong partnership between the Member States, the regional and local authorities, the social partners, civil society and, especially, the European citizens. There are still a lot of things to achieve in important fields, such as research, innovation and within the knowledge-based society in order to create better and more jobs [20] in a continuously changing world. It is very important that the EU and each Member State invest in their most valuable resource: their citizens.

The Romanian farming structure is of an extreme dual character, with a high number of very small farms and a small number of very large farms, which farm distribution by physical and economic size is confirmed [2].

The financial support provided by the Common Agricultural Policy started to penetrate the Romanian national economy after 2007, when the country acceded to the European Union. As a result of the farmland restitution process under the Real Estate Law of 1991, the Romanian economy became bipolar, with many small and very small farms (some 2.7 million less than 1 hectare or lots of less than 0.3 ha—which are not eligible for the direct payment scheme) on the one hand, and a small number of large and very large farms using about 50% of the whole farmland area, on the other hand. The Romanian agricultural structure is extremely fragmented and polarised.

According to RGA (General Agricultural Census) data for 2010, 93% of the agricultural operations cover less than 5 ha, using only 30% of the total farmland, with the remaining 7% of the farms (category >5 ha, medium sized and large) operating on 70% of the Utilised Agricultural Area. Thus, subsistence and semi-subsistence agriculture is an essential feature of the Romanian rural areas in most counties and regions. From this perspective, cooperation of small farms would be a very important necessity.

As a result, the agricultural income in such farms cannot provide a decent livelihood for the farmers in most cases. Such small Romanian farms are fundamentally different from EU-15 small farms:

- most of them have almost no market relationship;
- the land farming structure in Romania has not changed significantly in the past decade, still remaining with the same extreme fragmentation and polarity, an important impediment to the increase of competitiveness in the sector [23]; and
- the farm consolidation process is very slow, with a slight increase in the average farm size of 0.3 ha: from 3.1 ha in 2002 to 3.4 ha in 2010 [24]. In this context, the product capitalisation process becomes very difficult.

In 2007, the small farms (of less than 5 ha) accounted for a share of 90% in Romania, while very small ones, less than 2 ha, accounted for 65%. This shows the size and persistency of the subsistence and semi-subsistence agriculture in Romania, chiefly caused by the implementation of the post-1990 agrarian reform and the demographic structure of the Romanian rural space [23].

Although small farms are not directly excluded from the group of direct payment beneficiaries, they either get no support under this scheme as they do not reach the minimum eligibility threshold, or they receive very small amounts, due to their physical size. According to the above-mentioned eligibility criteria, farms of a minimum 1 ha made up of lots of minimum 0.3 ha are eligible under the Single Area Payment Scheme. In Romania, some three million individual farms do not even meet one of the eligibility criteria [20]. The minimum eligibility threshold was established at 1 ha, based on considerations of farming efficiency and to avoid additional administrative burdens [25]. It is worth mentioning that, for the small farms not eligible under the SAPS (Single Area Payment Scheme), such direct assistance is an important contribution to the household income [2]. Therefore, the distribution of direct payments in Romania and the EU as of 2013, was unequally implemented, as a result of the dual structure of Romanian agriculture (see Figure 4): characterised by a large number of small and very small farms—in total using a very small part of the utilised farmland—and a small number of large farms using a relatively extensive farmland area; 76.41% of the beneficiaries—who received at least 500 euro/beneficiary—only received 18.62% of the total payments, and the remaining



81.38% of the direct payments going to 23.59% of all the beneficiary farmers. Those who received more than 5000 euro account for 1.21% [2].

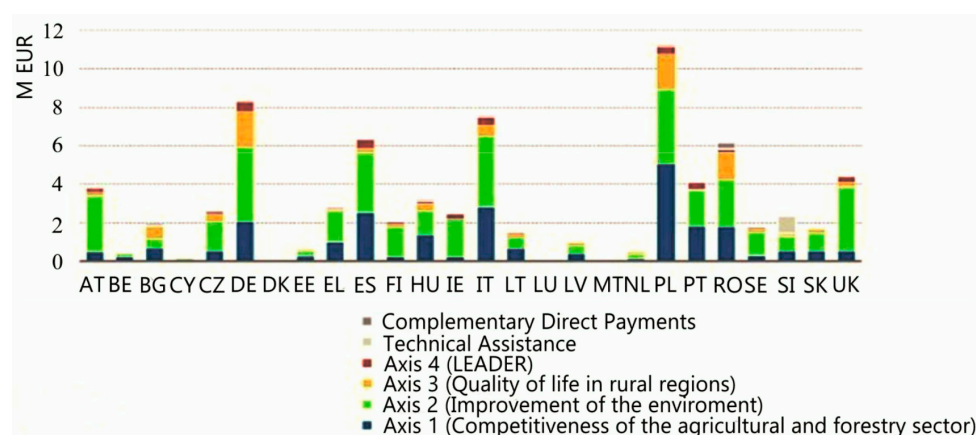


Figure 4. Distribution of direct payments in Romania and the EU, 2013 [26].

Between 2007 and 2013, there is a decrease in the total number of farms (see Table 1), i.e., from 13.8 million to 10.8 million farm holdings (−21.5%). For the Member States, they share the same trend, except for Ireland (+9%). Romania holds a first place in terms of the number of farms (3.6 Mio.), representing a third of EU28. Within EU-28, the farms lowered in number by −7.7% during the above-mentioned period. The strongest restructuring is visible in Slovakia, Bulgaria, Poland, Italy and Greece [27].

Table 1. Utilized agricultural area [ha], total number of farm holdings and average farm size (2007–2013) (Source: [26]).

	Utilized Agricultural Area		Total Number of Farm Holdings		Average Area Farm Size		Number of Farm Holdings					
							With Less Than 5 ha		With 5 ha–50 ha		With More Than 50 ha	
	2013 '000 ha	07/13 %	2013 '000 ha	07/13 %	2013 ha/Farm	07/13 %	2013 '000	07/13 %	2013 '000	07/13 %	2013 '000	07/13 %
<b>EU Total</b>	174,600	0.7	10,840	−21.5	16	28.3	7014	−26.1	2928	−13.8	899	−2.5
<b>EU-15</b>	124,600	0.1	4440	−20.6	28	26.0	2033	−31.4	1742	−11.0	665	−0.6
<b>EU-10</b>	30,800	−1.2	2360	−34.7	13	51.5	1379	−44.5	856	−13.9	125	−8.3
<b>Examples</b>												
<b>BG</b>	4700	52.5	250	−48.4	19	197.2	211	−53.7	24	27.1	19	7.4
<b>RO</b>	13,100	−5.1	3630	−7.7	4	2.8	3281	−4.9	262	−32.1	86	−8.2
<b>PL</b>	14,400	−6.9	1430	−40.2	10	55.3	770	−52.6	620	−15.1	39	13.1
<b>IT</b>	12,100	−5.1	1010	−39.8	12	58.5	592	−51.8	372	−8.9	46	10.8
<b>HU</b>	4700	10.1	490	−21.6	10	43.9	377	−24.5	62	−14.0	52	−27.6
<b>IE</b>	5000	19.8	140	8.9	36	13.2	10	19.3	105	7.8	25	9.7

For the same time window, the Utilised Agricultural Area (UAA) remained stable at the level of the EU, compared with the Member States' whose development counterbalanced the overall picture. In the large agricultural member states like Spain, Poland, Romania and Italy, UAA decreased by (−5%) to (−7%), whereas Bulgaria registered a sharp increase (+50%).

It is worth mentioning that the number of farm holdings followed a descendent path all over Europe, with (−21.5%). The small farm holdings with less than 5 ha were the most affected in EU-10 (−44.5%) due to their small structure. Generally speaking, the number of medium holdings with 5 ha–50 ha cut back throughout Europe, save for Hungary, Ireland, Czech Republic, Slovakia and Malta.

As a general comment, in regard to the structure of payments under the Common Agricultural Policy (CAP) made to the Romanian economy as of 2008, only one third entered as direct payments, more than half through CAP Pylon II—contracted projects in support of rural development—and the rest, a very small percentage, through the market measures. Istudor and Petrescu, (2009) [7] stress the importance of the public authorities and of the EU accession consulting companies, respectively, in accessing the rural development funds, since the predominantly rural, underdeveloped areas, the most suited to receive such aid show the poorest performance in point of absorption of small farm grants.

### 3. Economic Development and Community Policies of Rural Development

In support of the Romanian small farms during 2014–2020—the perspective under the PNDR 2014–2020—the Agency for Funding Rural Investments (AFIR) had paid more than 7.4 billion euro from the *National Rural Development Programme* (PNDR) 2007–2013 by 25 March 2015 for investment projects and direct payments to the Romanian farmers. With these payments, Romania achieved more than 83% absorption of the EU funding granted to agriculture and rural development. As payments for investment projects and multiannual commitments will continue to flow until the end of this year, it is thought that the absorption rate by the end of the programming period will come close to 100% [28].

The six priorities set under the EC Rural Development Regulation 1305/2013 for the programming period 2014–2020 are (Article 5/Reg. EC 1305/2013) [29]:

- P1. Fostering knowledge transfer and innovation in agriculture, forestry, and rural areas.
- P2. Enhancing farm viability and competitiveness of all types of agriculture in all regions and promoting innovative farm technologies and the sustainable management of forests.
- P3. Promoting food chain organisation, including processing and marketing of agricultural products, animal welfare and risk management in agriculture.
- P4. Restoring, preserving and enhancing ecosystems related to agriculture and forestry.
- P5. Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors.
- P6. Promoting social inclusion, poverty reduction and economic development in rural areas.

The above-mentioned priorities, transposed into practice by area of intervention under PNDR 2014–2020, facilitate the achievement of transversal objectives aiming for: innovation, environmental protection, mitigation of the negative impacts of global warming and adaptation to the climate change, respectively [30].

The same PNDR 2014–2020 identified a number of specific needs in agriculture and the Romanian rural areas, the following being those that (also) target the issues of small farms: need No. 004: Adequate level of capital and technology for modern farming activities; need No. 006: Rejuvenation of the farmer generations; need No. 007: Restructuring and modernisation of small farms into market-oriented farms; need No. 11: Easy access to financial instruments suitable for farmers, processors, and small entrepreneurs in rural areas [29].

A recent study, conducted in April 2016 by the Directorate-General for Internal Policies of the European Parliament in regard to the EU CAP in creating jobs in the rural areas—*Agriculture and Rural Development*, reviews the newest data for each of the Member States. Herein, Romania is featured in the categories of *dominant agriculture, rural, peripheral regions* and *traditional regions in transition* [26].

- Rural employment. In Romania, the numbers in this section registered a decreasing trend before 2011 and it was repeated after 2012. With no information to back up this statement, a possible cause has been hypothesized as the effect that the financial recession had on the business operations and general employment.

The number of people working in agriculture, forestry and fisheries slightly increased before 2012 but lowered two years afterwards. For the 2008–2014, statistics show that the employment rate in rural

areas shrunk in all age groups, with the mention that it was stronger in the younger categories (5% for people aged 25–34, and over 7% for those aged 15–24). There was an increase by about 20% (19.84%) in the number of salaried personnel in agriculture and forestry, which reached 18,843.

- CAP action and employment-related impacts. For 2008–2015, the monitoring instruments chosen to implement the system provided data to prove that the European Fund for Agriculture and Rural Development, more exactly via its national instrument the National Rural Development Programme, created an estimated number of 8723 jobs, targeting 54,288 work places.

A percentage of 69.52% real jobs resulted from the National Rural Development Programme is estimated, versus the reported percentage of 16.06% achieved for the targeted employment indicators alone.

For this reason, community policies and strategies for agriculture and related activities, compared to employment in the rural areas and the efforts to diversify rural economy, have proved to be efficient. However, it was found that there are no official data available to the general public in regard to the productivity of the new jobs, or any other relevant information on their qualifications and level of training/education, professional development needs or personal profile, age, and others.

For Romania, the study concludes that CAP support in developing the rural areas has been a *success story*, for the previous programming period, considering that the PNDR used all the working instruments and overpassed the structural programmes [26].

Similar with Romania, Bulgaria has also faced a fast depopulation of the rural areas in the past years, with the population density being in fast decline. Moreover, there is a lack of educated people and economically active population, and, of more concern, a decline in young families. This last factor also leads to closing schools and municipal hospitals, further reducing the quality of life in the rural areas. The rural areas are thus gradually losing their socio-economic development potential, as in place for many generations [31].

Further, as the country economy is small, it depends on the results of foreign trade, where economic recession has a negative impact, thus: foreign direct investment has dropped six times compared to pre-recession levels, thousands of small enterprises have been closed, more than 350,000 workers lost their jobs, gross foreign debt of the country reached 94%, national development of GDP in agriculture and the rural areas of Bulgaria in 2012, income inequality is rising, the purchasing power of poor families is declining, and the global consumption rate in Bulgaria is decreasing [26].

These micro- and macro-economic factors will influence the rural economies and small farmers as follows [26]:

- (1) Rural economies depend on a sufficiently high concentration of wealthy farmer families producing a range of raw materials/goods to maintain the diversity of local economy and able to spend money on other local goods and services.
- (2) Small farmers may rarely be wealthy unless they associate into cooperatives to ensure more bargaining power in the value adding chains; cooperatives may add value by adjusting supply to the preferences of the final customers on that market.
- (3) Rural economies must add value at the local level, as much as possible to primary raw materials, which will generate and ensure that local jobs are preserved in the associated processing enterprises, as well as increase the positive effects of the local economic multiplier.
- (4) The families of the work force involved in the primary or processing sectors should be considered in order to ensure a sufficient quality of life.

Given these statistics, there is still a shadow of doubt in regard to the response of institutions acting in information, knowledge and innovation transfer [32]: to what extent they will have the necessary ability to meet the needs of consulting, advising, training and transfer of innovation, if the government decides to undertake massive reindustrialisation in rural areas, having family and community farms as main actors, corroborated with restructuring of the age of the land titleholders.

In relation to climate change and the globalisation of agricultural produce trade, Bulgaria must prepare itself by allocating funds for high performance irrigation systems and reducing the vulnerability to drought and floods.

Thus, Bulgaria is aware of the EU support through the EU BGRDP (Bulgarian Regional Development Programme) 2014–2020 in mitigating climate change challenges [33].

Therefore, for the next seven years, under the new CAP, about 7.4 billion euro will be invested in the agricultural sector and the Bulgarian rural areas; the currently active farmers will benefit from income-support systems; young farmers will get further support through the introduction of new aid supplement of 25% for the first five years, on top of the existing measures. The Bulgarian farmers will also commit to apply simple measures to promote sustainability and combat climate change, with CAP support. Thirty per cent of the direct payments will relate to environmentally-friendly farming practices: crop diversification, maintaining of permanent grazing meadows and conservation of 5% of the areas of concern or measures considered to be environmentally beneficial [33]. Examples of measures that the Bulgarian government has undertaken under the *Rural Development Programme* 2014–2020:

- Market measures: To consolidate the position of farmers in the supply chain of food and new instruments to be dedicated to farmers, enabling them to get better organised in cooperatives in order to improve the balance in the supply chain with a supply of indigenous foods.
- Support for key priorities in Bulgarian rural development: For 2014–2020, Bulgaria has allocated about 2.3 billion euro to measures targeting the rural areas, with the expenditure sum according to the priorities defined in the Programme.

In that event, the new Rural Development Programme 2014–2020 lays a special focus on farmers and investments in farms (with higher regard to the environment), through basic services and village rejuvenation services with ancestral customs and traditions, with measures relating to climate, the protection and conservation of farmland and environmental protection, and measures striving for business development in rural areas. Considering the polarised structure of Bulgarian farms, a thematic sub-programme will be applied as an incentive for small farms and association competitiveness [34].

When considering the age structure of the Bulgarian farming community which, on average, is older than in the EU-28, 6.9% of the farmers are under 35 (7.5% in EU-28) while 37.3% are over 64 de (30% in EU-28), Rural Development Funds were granted to help encourage a more sustainable agricultural model, as follows [34]:

- more than 4900 farmers (accounting for 841,000 ha) received agro-environment support; and
- nearly 1400 farms (accounting for 71,000 ha) were supported for ecological agriculture.

#### 4. Preserving Ecosystems and Sustainable Use of Natural Resources in Agriculture

##### 4.1. The Role of the Organic Farming Community

The ecological farming has been declared one of the national priorities in the agrarian policy of a country, with a very important role to be played by the State. An example in this regard may be Bulgaria which, after EU accession, won structural funds for Agro-ecology that proved to be a real financial incentive in developing the sector, which had been growing at a far slower rate by 2010 [35].

The Bulgarian ecological agriculture was thus gradually transformed, from a *culture* and *cause*, into a regular economic activity; in 2012 alone, the number of certified organic producers rose from 1054 to 2016 [35].

Although the ecological agriculture community in Bulgaria is described in terminology in the academic and non-governmental circles, without mentioning the participation of the farmers and their organisations, various forms of sustainable organisation, such as the Association of Organic Producers, Association of Organic Product Traders and others have been registered after 2008.

Even if the organic operators have joined forces in several relevant organisations, the membership rate is quite low, of about 5% participation in the development of the national policies and measures in support of the sector [35]. This assumes that the sustainable development of the ecological community institutions seems to continue to depend on external forces and financial support from the EU. Unfortunately, this is also the case in Romania.

Moreover, it becomes inexplicable why the State action in preparing national policies, introducing financial instruments and encouraging the development of ecological agriculture organisations, has not led to an evident growth of the ecological market in either Bulgaria or Romania. Even though the number of ecological product stores and stalls has increased in the past three years, proportionally raising the interest of potential consumers in such products in the larger towns, the higher price barriers in ecological products combined with those of low income in the country, are still impacting the development of a domestic ecological market in both Bulgaria and Romania.

Currently, the consumption of organic food accounts for less than 0.5% of the total purchase of food products in Bulgaria [35]. A majority percentage (90%–95%) of organic food production goes to export, rather than to the local Romanian or Bulgarian markets.

Plus, the absence of a country brand established for ecological products on the national and international markets, except for a very small number of producers, is a further important aspect to consider in setting a State policy to support the farmer associations. This triggers a depreciation of the export product value, by obtaining non-competitive price quotes on the sale markets, with local ecological products being exported mainly as primary agricultural raw material rather than finished products.

In Bulgaria, the institutionalisation started in the 1990s, without the initiative or support of any social movement of farmers/peasants or without any financial or political policies provided by the State.

During the pre-accession period (1990–2006) in Bulgaria, the creation and development of the organic farming sector was strongly supported by the Swiss power of example as a leader in the process.

After accession, in both Bulgaria and Romania, the role of the State increased, through the implementation of a national legislation in the relevant sector, as a result of the EU accession requirements.

The active promotion of the organic farming concept in the country by operator organisations, NGOs, consultants, corroborated with the increase of certified ecological operator numbers and of cultivated lands after 2010, did not generate significant increases. The main cause was the existence of an underdeveloped organic market [35]. Therefore, in EU Member States transitioning to market economies, the solution is to develop a new type of agricultural activity, entrepreneurial culture, with a potential to consolidate the rural areas of the country.

#### *4.2. The Competition for Cultivating the Lands for Food versus Energy*

The domain of the energetic cultures is a relatively new for agriculture and the real coordination of the energetic cultures and for food by the community policies becomes a prerequisite of the European Parliament, as such: 40% of the objective meant to bioenergy should come from sources that do not compete with the food production. [36] This is how each country can establish the destination of the appropriate use of its lands so that would be a win-win situation in a durable manner.

The energetic cultures are intended as agricultural cultures used to produce biofuels, i.e., bioethanol, biodiesel or for energetic value derived from burning, to generate heat or electricity. The minimum costs for setting the plants cultures and the low level of harvesting expenses are criteria for the development of energetic cultures; this information is well known, even though the new Regulation (EC) No. 1307/2013 that came into effect on 1 January 2015 does not include it [37].

There are lands in Romania not cultivated, found in different degradation degrees, fact that makes improper the agricultural cultivation under durable conditions: 800,000 ha that were not capitalized on in 2013 (without including the contamination-based degraded lands), a surface of which the most part can serve to the energetic cultures, without needing for land improvement [12].



For the herbaceous energetic culture, *maize* and *wheat* are the main grains to use for obtaining bioethanol, thus raising the issue of competition between the food and energetic agricultural productions. A recent stipulation of the EU refers to the limitation by 5%, until 2002, of the consumption of biofuels derived from agricultural cultures, as wheat and rapini [38]. Moreover, should maize be kept as the main source for biofuel, the crop meant to feed the humans and animals would be smaller and trigger a food crisis—the food prices would rise and lead to disastrous results for less developed countries.

The current technology for the conversion of biomass of *Panicum virgatum* into ethanol [12] can produce circa 340 L per ton, compared with the ethanol production from maize of circa 400 L per ton. The main advantage of using *Panicum virgatum* as a raw material for bioethanol compared to maize consists in the lower production cost (approximately half) and the energy trapped from the biomass, which is higher per hectare. The biomass culture from *Panicum virgatum* is focused on a single harvesting in November or later, whereas there are more harvestings for the fodder production.

*Rice corn* (*Sorghum* sp.) also called the “camel plant”, since it grows where other plants cannot, is a plant cultivated in areas with low, or sometimes irregular, precipitation. It is successfully used in obtaining bioethanol; moreover, the cultivation of rice corn has a positive impact upon the environment, since a hectare of rice corn consumes more than 50–55 tons of CO<sub>2</sub> from the atmosphere for its growth and development [39].

In Romania, The National Agricultural Research-Development Fundulea succeeded to obtain the hybrid between the rice corn and the Sudan grass under the brand name of “Theresa 2004”, adjusted to the cultivation conditions in our country and used for the bioethanol and in fodder for animals [40].

The usual wood species for obtaining alternative fuel are poplar and willow. Their cultivation has the advantage of a good valorification of the lands that are inappropriate for other cultures, such as the floodable meadows. The establishment of the energetic willow plantation is not a cheap investment, but it will be paid for itself in three years.

Starting with 2008, the culture of energetic willow in Romania has entered the valorization program and, hence, it has become more attractive for the farmers. The maintenance costs are minimum, as the culture only needs attendance in the first year and it can last for up to 30 years.

There has been an energetic willow nursery in Romania (Miercurea Ciuc, 2007) that is in partnership with the Lantmännen Agroenergi Institute of Sweden—they are the first licensed distributors of energetic willow saplings [12].

Many energetic species have evolved and grow on dry or polluted lands and they can provide the improvement of the soil conditions for the future cultures, thus assuring the maximization of the carbon content and the cycles of the nutrients.

A great challenge is to adequately increase the quantity of biofuels by intensifying the harvesting of raw materials. According to some feasibility studies, focused on sufficient biofuel production, many of the countries have turned the open space and remaining forests into farmland. Thus, recent data show that the annual world production of biofuels is the highest in volume, with the USA as leader that produces 50 billion L (from maize) and Brazil, with nearly 35 billion L (from sugar cane) [41].

In 2012, the conventional ethanol obtained from maize in the US was estimated to cost 0.9 USD to 1.1 USD per litre of petrol equivalent (LGE) to produce, while Brazilian ethanol from cans was estimated to cost 0.7 USD/LGE to 0.9 USD/LGE. The cost of ethanol from other cereals (such as wheat) was higher. This will be compared with the average wholesale refining prices in the US, a monthly average of 0.72 USD/L to 0.84 USD/L in 2012, for petrol. Characterised by several complex processes, the bioethanol from ligno-cellulose raw materials has higher costs than those estimated if obtained via conventional bioethanol technologies. Nowadays, bioethanol is estimated to cost 1.04 USD to 1.45 USD/LGE [42].

In Romania, the bioethanol is obtained in a single refinery, located outside the town of Zimnicea, on the bank of the Danube, on the site of a former thermal power plant. “The location does not cut us off from Europe, but it rather exposes us, as we have the cheapest transport to the Rhine, along the

Danube, access to the neighbouring countries and the Black Sea market, as we can take our barges out to Greece”, explained the management of Bio Fuel Energy, the company operating the refinery [43].

For now, the oil companies in Romania import the necessary biofuel and the position of Bio Fuel Energy refinery on the Romanian biofuel market becomes strategic [44], knowing that their ethanol production is 99% exported. As raw material, the refinery uses the maize supplied by Interagro, who own 100% of Bio Fuel Energy [43].

The factory capacity is 100,000 tons of bioethanol per year, 70,000 tons of maize flour processed as DDGS (dried distillery grain with solubles), 70,000 tons of food grade carbon dioxide and about 6600 tons of edible oil.

Romania consumes about 2.2–2.5 million L a year, of which 4% should be ethanol. Thus, with a 275 tons/day ethanol output, one year can cover the entire ethanol requirements for petrol in Romania from just one refinery. The bioethanol manufactured at Zimnicea will serve both domestic consumption and exports, especially to neighbouring countries, such as Bulgaria. Moreover, the refinery in Zimnicea also produces carbon dioxide, as well as edible oil, that will then be sold to food manufacturers.

The refinery, covering an area of 13 ha, also has its own thermal power plant, producing energy in six 2 MW turbines—about 60% of the energy used by the plant and the rest sold to external consumers, one ton of bioethanol going at 675 euro on the stock markets [43].

Although it has already reached a capacity of 136 tons per 12 h, is still undergoing technological testing. It employs 350 people on a full-time basis—Romanians, Bulgarians and Chinese [43].

## 5. Conclusions and Recommendations

The issue of bioethanol production from plants, on a short term, can contribute to a decrease in pollution and an increase in the number of jobs, mainly in the relevant industry, which is a performance in the rural area that has become a more viable space, from economic, social and ecological perspectives. Similarly, the diversification of the activities within the farms can be a real solution for the absorption of the excess labour force which leads both better living conditions and a rise in the work quality, under conditions of a sustainable use of the resources. However, for the medium and long term, I consider that this is not an efficient solution at the planetary level and, more importantly, is not a sustainable solution but only for the use of waste derived from the agro-zootechnical technological processes, as well as of the urban residential and rural waste [45].

The most significant potential for Romania is the agricultural biomass developed in an integrated and durable system (food and energetic), which is a vital source of fixed carbon for which there are no organized and competitive practices of collecting and processing at present.

Therefore, a dilemma is likely to emerge on the competition between the energetic and food cultures, as it is known that the developed countries would rather the lands in the developing countries for energetic cultures in exchange for a decrease in the consumption via difference strategies and provision of the food agricultural production of that country. On the other hand, some lands used for animal breeding can be used for both purposes—food for animals and obtaining of bioenergy—without having a negative effect upon health or producing greenhouse gas emissions.

Since any surface meant for growing plants for biofuels represents a withdrawal from the agricultural use meant to produce food on that surface, a correct and sustainable solution could be the use of the desert-type lands that are improper for growing plants with a large production of biomass and, hence, proper for the production of biofuels.

In the immediate future, Romania has the ability to demonstrate its sustainability regarding the promotion of the energetic cultures, as a consequence of its great potential coming from possessing available lands; what is missing and needs to be stimulated, it is in the interest of the farmers to decide which type of culture should be established.

Herbaceous and wooden plants with energetic potential, similar to the ones described in the material, are not enough promoted at the level of agricultural policy, even if they can be representative in Romania as energetic cultures, mainly for the recovery and use of some degraded lands.

It is my belief that, once this main objective is maintained as a higher interest in this sector, a requirement will be to set forth certain diversified mechanisms of stimulating the production of raw material for obtaining biofuels, by granting facilities to the agricultural workers, farms or associations, with the purpose to cultivate energetic plants, as well as incentives for collecting the agricultural and forestry waste.

Moreover, the stimulation of competitiveness in this field of the renewable sources of energy will lead to the following:

- development of a regulation framework to support both the industrial policy and the technological improvement; and
- a functional market of carbon and taxes on energy attracting investors by clear and strong incentives so that they will invest in low carbon emission technologies and in their development.

Even at a lower scale, agriculture has greenhouse gas emissions, as it is the most important sources of emissions of nitrogen oxide (resulted from the microbial changes from soils containing nitrogen) and methane (mostly coming from the fertilizers derived from the digestion processes of the ruminant animals). As a consequence, it is recommended to implement practices that limit the greenhouse gas emissions [12]:

- conversion of animal waster into biogas;
- a higher efficiency of the agricultural technique; and
- improvement of the carbon pit function of the agricultural soils.

The sustainable use of the resources and the maintenance of the ecosystems in a good operating condition involves both the protection of the environment per se and the success of the farmers by providing fertility and productivity to the agricultural ecosystems, which gives them the key of competitiveness on the market and food safety on a long term.

Plus, other related aspects aim not only the surging increase of the research achievements in the hybrid transport means (electrical—fuels, with a focus on the former ones) but also the feasibility of the technologies in use and the reduction of the production costs, which makes the transport means competitive.

On the other hand, I believe that, in the short term, the biofuel production is necessary and may support the transition of vehicles from fossil fuels to electricity and hydrogen. In the long term, however, I consider that biofuels will be overtaken by electricity and hydrogen. However, irrespective of the evolution of transport solutions, the production and use of farm products will generate waste that can be recycled. The human existence itself generates waste. For example, Romania generates seven million tons of waste annually, which is currently creating huge problems with pollution, storage, safety, etc. This waste could be gasified without pollutant emissions and, hence, an ecological problem may be turned into a renewable source of energy.

The problem of agricultural public policies for the production of biofuels, of agri-industrial technologies used in this field is an important and necessary stage at present and in the short-term. It is an important opportunity in the development of a country, which should be capitalised on as soon as possible. I reckon that the implementation of the local, regional and European strategies and programmes is very up to date and, in this context, countries like Romania or Bulgaria should strive to use European funding in the development of crops that allow higher capitalisation in the production of biofuels. Apart from the high economic efficiency of such crops, they also serve an important role in reducing pollution, promoting social inclusion, reducing poverty, and increasing economic development in rural areas. This is a major expectation in the national and European public policies targeting the environment and climate change.

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