

PERSPECTIVES ON BIOFUELS AND IMPLICATIONS FOR CLIMATE CHANGE: GRAIN AS FUEL OR THERE IS A LIMIT* ?

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Abstract: Countries, motivated by different issues (e.g. increases of the oil prices, greenhouse gas (GHG) emissions) promote the expansion of biofuels industry. In this context, it is important that the development of strategies that promote biofuels not to have undesirable consequences over aspects such as environment, the level of GHG emissions, food security, the prices of food products, the living standards of people in developing countries. In this paper, some aspects regarding the choice between using grain for food or for fuel will be discussed. Two opinions will be under debate. First, using biofuels can help in the transition process from conventional to alternative sources of energy. Secondly, using grain for fuel could be considered a wrong idea, if we have in mind that people from some developing countries don't have enough food and suffer from hunger. Also, we bring into discussion aspect related to biofuels and their connection to climate change.

JEL classification: O13, Q42, Q43, Q54

Key words: biofuels; grain; food; climate change; future implications

1. Introduction

In their attempt to stimulate biofuels production, countries take different measures, sometimes without considering other important issues such as food security, food prices increases which are just some of the most sensitive topics in the daily list of researchers, politicians, professionals.

In the literature, the topic of increasing global energy demand is discussed extensively and also different opinions arise especially because in the following years the energy consumption will continue to increase. These represent maybe one of the

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reasons why biofuels have an important role with implications for their possible development on a large scale. In the literature there are various debates related to biofuels as they rise several problems, starting with the effects that may occur as a result of increased use of water resources and land, and the dilemma ‘food versus fuel’ which brings risks and controversy. According to Braun and Pachauri (2006), biofuels include fuel sources that have been used for millennia, like fuel wood and charcoal, as well as newer sources like ethanol, biodiesel, and biogas, these new sources depending on natural vegetation, crops grown specifically for energy, or agricultural or other forms of wastes and residues.

Biofuels made from cereals are the main concern of this paper. This topic needs to be discussed more in the literature, especially from the point of view of the ethical issue on the use of cereals to produce fuel, knowing that some developing countries are confronting with serious problems to ensure the food reserve for the population. Starting from this aspects, first question that arises, without waiting necessary for an answer, is about the necessity to drive luxury cars with a full tank with fuel made from cereals and if this is somehow above the necessity of measures to diminish the hunger endured by people in various countries.

In different parts of the world, people are suffering from hunger, but there are other opinion sustaining that even if this situation exists, it is not related to the fact that there isn't enough food. The study of Earth Policy Institute (2010) shows that 107 mil. tons of grain used by US ethanol distilleries in 2009 were enough to feed 330 mil. people for one year. The study argues that, in the competition between cars and hungry people for the world's harvest, the car is destined to win, and even if the entire US grain crop were converted to ethanol, it would satisfy at most 18 percent of US automotive fuel needs.

According to United Nations (UN) site, one of the Millennium Development Goals is “End Poverty and Hunger” with one target referring to a reduction in half, during the period 1990–2015, of the proportion of people suffering from hunger. Currently, some research body of literature underline the problems of the world, facing with diminishing resources and unacceptably high prices of food, and in many cases, starvation.

In our days, the cereals are used also to produce biofuels, among its purpose of feeding people or animals. It seems that this is not at all a strange thing, since this kind of development exists in our ‘normal’ world. Some researchers’ work shows that the increasing cereals demand may cause growth of grain prices and that biofuels’ use does not contribute to a significant reduction of GHG emissions.

In September 2007 the world price of wheat rose to over \$400 a tonne, the highest ever recorded until that moment, and earlier that year the price of corn exceeded \$175 a tone, at the level of \$150 a tone being 50% above the average for 2006 (The Economist, 2007). In the literature, researchers offer various point of view, such as: crops for fuel are replacing crops for food; increased use of cereals for fuel is causing the replacement of other types of crops with crops for fuel; biofuels release more GHG emissions than other type of fuels; the production of fuel from cereals may lead to poverty and hunger all over the world. In this paper we will review some aspects related to the idea above mentioned, namely if it is ethical to produce fuel from cereals when there are people in this world, in some countries, that suffer from hunger every day. We bring in the discussion the limit of this phenomenon, if it is one. We will address some questions related to the perspectives on biofuels and the implications for climate

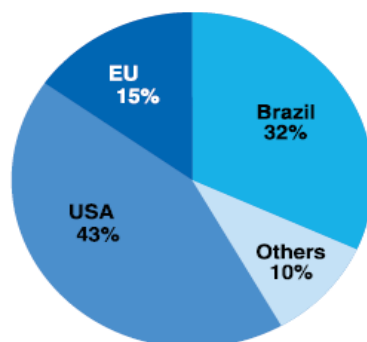
change. The objectives of the paper is to provide an overview of the main developments regarding biofuels production from cereals, and to underline issues related to implication of biofuels for climate change, considering the general context of regulatory framework.

2. Fuels from cereals: how does it look like today?

In 2000 around 15m tones of America's maize crop was turned into ethanol, in 2007 the quantity being around 85m tones. This country uses more of its maize crop for ethanol than it sells abroad, ethanol being the dominant reason for 2007 increase in grain prices (The Economist, 2007). The continuing increase in the price of staples in domestic markets remains a significant threat to food security and nutrition in the developing world (World Bank, 2010). The world is investing capital in projects for the production of biofuels and plantations of cereals crops for biofuels. The question that arises is if we use corn to fuel cars, should we really believe that food crises no longer exist?

Domestic staple food prices have experienced double digit increases in 2009, particularly in Sub-Saharan Africa, and also, regarding the global food prices, sugar prices rose 80% between January and December 2009 and rice prices rose 9% in December 2009. The following countries registered the largest increase in domestic price of maize for the period January - October 2009: Uganda (35%), Tanzania (23%), Kenya (16%) (World Bank, 2010).

Most of the fuels produced from cereals are so-called first-generation fuels like bioethanol, biodiesel, biogas, and plant oils. Basic feedstocks used to produce these fuels are seeds, grains, or whole plants from corn, sugar cane, rapeseed, wheat, sunflower seeds or oil palm (United Nations Environment Program, 2009). The main producing countries for biofuels are USA (mostly producing ethanol from corn), Brazil (ethanol from sugar cane), and the EU (biodiesel from rapeseed).

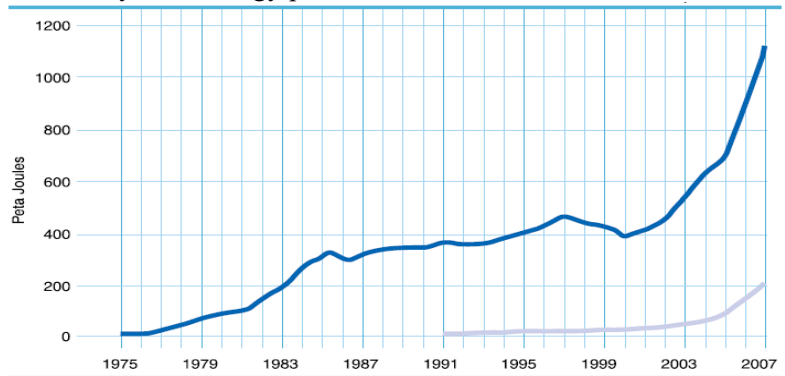


Source: United Nations Environment Program (2009)

Figure no. 1 Proportion of global production of liquid biofuels in 2007

USA takes the leading place in biofuels production mostly due to the government policies, encouraged by legislative measures, including notably the 2007 Energy Security and Independence Act, which mandated the use of 36 bil. gallons, or 136 bil. litres of biofuels annually by 2022. The US ethanol industry has boomed in the last few years. There are now at least 200 ethanol plants in at least 27 states, almost all using corn as a feedstock (The New York Times, 2010). The world biofuels production is

growing (see Fig. 2) mostly because of growing oil prices and the desire of the producers to diversify their energy portfolio.



Source: United Nations Environment Program (2009)

Figure no. 2 Global bioethanol and biodiesel production 1975 to 2007.
 Note: blue line - ethanol; gray line – biodiesel equiv.

Recent researches on the subject of biofuels production and consumption is still far from any certain conclusion. Most of the studies give controversial answers to the question whether biofuels are our future or not. We can divide the views on the subject into two parts of negative and positive characteristics (see Table 1).

Table no. 1. Positive and negative characteristics of biofuels production and consumption

Positive Characteristics	Negative Characteristics
New markets for farm products	Factor of raising of world food prices
No net addition of carbon dioxide	Create additional threats for the forests
Create opportunities for second- and third-generation biofuels	Growing use of fertilizers and pesticides

Source: Own compilation from different sources.

The most important question concerning biofuels is that actually they are not as reducing carbon emissions as we used to think. Actually, burning biomass produce carbon – and even more than fossil fuels. But since during it’s growth plants also absorb carbon - biomass becomes a zero carbon fuel (Grant and Clark, 2010).

Problems the world is facing now in climate change issues need solutions with doubtless effects. Since biofuels implications for climate change are still uncertain this subject needs more attention.

3. Biofuels and implications for climate change

After decades of food-overcharge, both producers and consumers are faced with a food economy marked by lack of food supply. The system focused on reducing costs and increasing volume, which grew fat one billion people and other one billion people are left to starve, and gives free rein to pathogens agents of food source to be transformed in global epidemic, now faces other problems, such as climate change (Roberts, 2009). The climate change will affect not only the poor countries but also the rich countries registering now a food over plus. All four dimensions of food security,

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namely availability, access, stability of supplies, food use (production and trade) will depend not only on socio-economic conditions but also on the climate. The climate change will have a major impact on food production, but also on trade flows, stocks, food subsidies policies. According to IPCC Reports, the increase of the average air temperature by 1-3 degrees Celsius will determine the increase in food production, but the increases above this level will lead to a reduction of food production. Also, an increased frequency of extreme events, such as droughts and floods, will negatively affect the crop yields, especially the agricultural areas at low latitudes.

Global warming is a global problem, yet nobody wants to pay to solve it. Everybody wants to take charge of the efforts of others, but it is in everyone's interest that the entire planet to act collectively to do something (Stiglitz, 2008). The resistance to change manifested by world countries will delay action to be taken globally, and therefore the problems to be solved at one moment at some point will become increasingly serious and difficult, and many of the solutions offered by experts from various fields will no longer be outdated, while the existing improvised solutions are not sustainable.

Climate change is one of the most pressing long term problems and also one of the most important factors influencing the development of future energy economy, climate change being a long term cumulative problem, the percentage of warming not being determined by the amount of CO₂ emitted in a certain year, but by the accumulation of CO₂ in the atmosphere for centuries (Roberts, 2008).

In the effort to take measures to overcome the effects of climate changes, some of them were more painful or destructive than other. In the attempt to mitigate climate change, governments of different countries sustain the biofuels production (ethanol and biodiesel), offering incentives and guarantee markets to producers and consumers, transforming biofuels production in billions of dollars market. According to IMF (2008), expansion of biofuels production in the US and Western Europe has pushed up food prices and boosted inflation. Poor food-importing around the world faced serious problems, central banks having limited solutions to ease monetary policy in response to recent financial turbulence. Thus, the macroeconomic policies should be design more carefully, so that to prevent chain negative reaction at macroeconomic level.

In the effort of cutting GHG emission from various activities through biofuels crops, some other more complex problems appeared on the way, related to the fact that not all biofuels are acting the same and some differences should be made in some cases. A range of biofuels crops being grown as alternative solutions to oil-based fossil fuels releases vast amounts of CO₂, as various studies indicate. In this way, biofuels crops instead to represent a solution to reduce the global warming, they contribute to it, not mentioning the indirect economic effect induced by increases in food prices and food crises.

It is time for countries to come with viable long term solutions to mitigate climate change, especially in agriculture, food production, energy production, as more researchers points out various issues regarding food crises. It is not the case to choose between environmental protection and food production, but to come with alternative solutions for both problems, such as alternative sources of energy (i.e. solar, wind, nuclear, hydroelectric, tidal power) or agricultural policies, and to address food security concerns.

4. General context of regulatory framework

In the following the legislation from European Union regarding biofuels is summarised, this part of the paper briefly describing the relevant documents.

4.1 European regulation and legislation regarding biofuels

Regarding biofuels, important aspects are underlined in the Communication COM(97)599 final, being mentioned that renewable sources of energy make a disappointingly small contribution of less than 6% to the Union's overall gross inland energy consumption, which is predicted to grow steadily in the future, being necessary specific measures in order to help increase the market share for liquid biofuels from 0.3% to a significantly higher percentage. Also, it is mentioned that energy crops need to be considered if the objective of doubling the renewable energies' share by 2010 is to be achieved. Total contribution for bioenergy production from crops by 2010 is estimated at 45 Mtoe, of this 18 Mtoe being in the form of liquid biofuels (including however liquid biofuels from non-energy crops) and 27 Mtoe as biomass for heat and/or power. The concerns related to the security of energy supply raised in COM(2000)0769 final mention an observable fact: Europe's growing future energy dependence. EU is extremely dependent on its external supplies, importing 50% of its requirements, a figure that will rise to about 70% in 2030. The mentioned document underlines that it is important to ensure the continuing and growing presence of biofuels and other alternative fuels in the fuel market.

Directive 2003/30/EC underlines that the Member States should ensure that a minimum proportion of biofuels and other renewable fuels is placed on their markets, and, to that effect, shall set national indicative targets. A reference value for these targets shall be 5.75%, calculated on the basis of energy content, of all petrol and diesel for transport purposes placed on their markets by 2010. Another document, Directive 2003/96/EC mentions that it is desirable to establish a Community framework to allow Member States to exempt or reduce excise duties so as to promote biofuels, thereby contributing to the better functioning of the internal market and affording Member States and economic operators a sufficient degree of legal certainty.

In the Communication COM(2006)34 final it is mentioned that although most biofuels are still more costly than fossil fuels their use is increasing in countries around the world and it estimates global production of biofuels to be over 35 bil. liters. Communication COM(2006)845 final stipulates that there is a particular need for GHG savings in transport because its annual emissions are expected to grow by 77 mil. tones between 2005 and 2020, three times as much as any other sector.

The Strategic Energy Technology (SET) Plan is aiming to accelerate the development of low carbon technologies and comprises measures relating to planning, implementation, etc. in the energy technology area. Communication COM(2009)519 final indicates that one of the EU key ambitions must be to develop a low-carbon economy and that investments over the next 10 years will have profound consequences for energy security, climate change, growth and jobs in Europe. Directive 2009/28/EC establishes a common framework for the promotion of energy from renewable sources. Also, it is mentioned that, with effect from 1 January 2017, the GHG emission saving from the use of biofuels and bioliquids shall be at least 50% and the Commission shall, if appropriate, propose corrective action, in particular if evidence shows that biofuels production has a significant impact on food prices. In its Renewable Energy Roadmap - COM(2006)848 final, the EC has proposed new targets for renewable energy in EU

(20% by 2020 - renewable energy's share of energy consumption in EU) and for biofuels in transport (10% by 2020).

In Communication COM(2009)192 final is mentioned that growth rates of green electricity have increased, Eurostat data showing a share of 15.7% for the EU in 2006, up from 14.5% in 2004. However, Commission analysis still suggests the 2010 21% target will not be reached without significant additional effort. Biofuels production progressed much faster in 2006 and 2007 than in earlier years, in 2007 the use of biofuels in road transport was 2.6% (8.1 Mtoe), and biofuels share grew by 1.6 p.p. in 2005-2007, compared with 0.5 p.p. (2003-2005).

4.2 The situation and legislation of biofuels in Romania

In the National Report on the Promotion of the Use of Biofuels or other Renewable Fuels for Transport in Romania (2009) it is specified that the use of biofuels and other renewable fuels for transport is being promoted with the aim of partially replacing petrol and diesel, contributing to achieving certain objectives such as: meeting commitments for the reduction of GHG, ensuring fuel security in a manner compatible with the environment and increasing the level of energy independence, promoting the use of renewable energy sources. Promoting the use of biofuels could create new opportunities for sustainable rural development, with the potential to open up new markets for agricultural products.

According to Government Decision 1844/2005 (which transposes the provisions of Directive 2003/30/EC) a minimum of 5.75% of biofuels or other renewable fuels should be in use by 2010, calculated on the basis of the energy content of all types of petrol and diesel used in transport. Government Decision 456/2007 foresees the gradual introduction of a minimum percentage of biofuels content in conventional fuels. This Decision sets down a calendar for the phased introduction on the market of a minimum percentage of biofuel content in conventional fuels: from 1 July 2007, diesel will contain a minimum of 2% in volume of biofuel and rise up to a minimum 4% from 1 July 2009.

Regarding biomass potential, in the National Report on the Promotion of the Use of Biofuels or other Renewable Fuels for Transport in Romania (2009) it is specified that the country has a total surface area of 91,843 square miles of which 62% occupied by agricultural land. Romania's agricultural lands break down into five classes of suitability. Regarding Romania's potential for production of biofuels, in the same National Report it is specified that the potential to supply the raw material necessary for: biodiesel, namely vegetable oil (sunflower, soya, oilseed rape) is approx. 500-550 thou. tones/year; bioethanol, namely for corn seed is approx. 390 thou. tones/year and for wheat germ approx. 130 thou. tones/year. Romania has a production capacity of approx. 400 thou. tones/year for biodiesel and approx. 120 thou. tones/year for bioethanol.

5. Food vs. fuel. Future implications

Countries around the world are investing in RD for other sources of energy, having in mind the reduction of imports of fossil fuels, to diminish emissions and pollution. According to Energy Information Administration (2007) total world consumption of marketed energy is projected to increase by 57% from 2004 to 2030, the largest projected increase in energy demand being for the non-OECD region. However, many research works stipulate that renewable energy represents only a partial

solution to environmental problems facing mankind. We begin this chapter with a definition for food security, which represent the physical and economic access, at all times, to sufficient, safe and nutritious food to meet dietary needs and food preferences for an active and healthy life (FAO Glossary). Thus, food security refers to food availability and also to access to it. From the total number of hungry people in the world of 852 mil. in the 2000-2002 period, 815 mil. hungry people were in the developing countries, 28 mil. in the countries in transition and 9 mil. in the industrialized countries (FAO, 2004). This is happening in our days, when fuels are made from cereals.

To the question ‘will crop production for biofuels compete with and drive out food production, thereby increasing food insecurity?’, Braun and Pachauri (2006) conclude that energy crop production does not need to lead to increased food insecurity, new ways of combining food production with energy production being developed, food insecurity being a result not simply of a lack of food availability, but poverty. According to an article from *The Economist* (2007) quoting from Gary Becker (Nobel economics laureate at the University of Chicago), if food prices rise by one-third, they will reduce living standards in rich countries by about 3%, but in very poor ones by over 20%.

Another idea found in the literature is related to the fact that bioenergy developments offers opportunities but also risks, and that biofuels may contribute to rise in food prices with impacts on food security and environment. Ethanol accounts for some of the rise in the prices of other crops and foods too (*The Economist*, 2007). Biofuels lead to higher agricultural prices, affecting poor consumers. Braun and Pachauri (2006) believe that when the demand for biofuels increases agricultural prices, the competitiveness of biofuels will start to decline, and the price increases for cereals in 2006 may signal such a trend. The authors include in the energy crops maize, soybeans, rapeseed, and oil palm, many developing countries already grow or could grow these and other potential energy crops.

There are also ethical aspects related to the use of food crops to produce energy in a world where there are 860 mil. people undernourished, the malnourishment which occurs being a result of lack of access to food rather than global food shortage (Fraiture et al, 2008). The high prices of food products can lead to increased income of farmers, but could also obstruct the consumers’ access to these products. According to Fraiture et al (2008), biofuels are promoted for energy security, economic, political and environmental reasons, and there are plans and policies in place around the world to increase biofuel production. If all national policies and plans for biofuels are successfully implemented, 30 mil. additional hectares of crop land will be needed along with 180 km³ of additional irrigation water withdrawals. On the other hand, biofuels production brings disadvantages, starting with deforestation, ecosystem degradation, biodiversity loss, etc.

Despite all the grievances with regard to biofuels, the issue of ‘food versus fuel’ overshadow a more important one, concerning the demand and supply of modern food economy (Roberts, 2009).

The dispute regarding biofuels continues. While, on the one hand the production of biofuels is encouraged, on the other, there are some scientists warning about possible effects on global warming. Other specialists argue that more research is needed in the area, before being sure of the beneficial role of biofuels used on a large scale. According to this idea, if mankind will use biofuels on a large scale, many

forests, lakes, swamps, etc. will be endangered, because of the need to be replaced by crops for biofuels production.

If most food economists and policy makers believe that food economy has more or less a self-correction capacity, the critics have a different point of view in the matter, arguing that precisely those technologies which imply that food economy is self-correcting on the contrary, they are destroying it (Roberts, 2009).

The demand for biofuels can be a mechanism for raising the level of a country development. On the other hand, focusing on using crops to produce biofuels and neglecting the production of food may worsen the existing problems related to hunger, as higher food prices can reduce the access to food, with consequences for health or well-being of the population.

Another stringent problem for the world countries relates to climate change. Parry et al. (1999) stated that in 2080, climate change will increase the number of undernourished by 55 mil. people, nearly all in Africa. The effects of climate change are studied especially in relation to forecasts regarding precipitation, temperature, concentration of CO₂ in the atmosphere, etc. Researchers used various methods and models to measure the effects of climate change. Stern Review (2006) shows that the scientific evidence is overwhelming, climate change being a serious global threat, demanding an urgent global response. It estimates that the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year if measures are not taken and if a wider range of risks and impacts is taken into account, the estimates of damage could rise to 20% of GDP or more, poorest countries being most vulnerable to climate change. But, the costs of action (reducing GHG emissions to avoid the worst impacts of climate change) can be limited to around 1% of global GDP each year.

6. Final remarks and conclusions

In this paper we had in mind to provide an overview of the main developments regarding biofuels production from cereals, and also to underline issues related to implication of biofuels for climate change, in the general context of regulatory framework. We took a short look over the points of view regarding the question of choice between using grain for food or fuel. We tried to examine both ideas, first using biofuels helps in the transition from conventional to alternative sources of energy, and secondly that using grain for fuel may be considered as bringing negative consequences for people in developing countries.

Climate change represents a challenge at macroeconomic level in all world countries particularly in poor or developing ones, being likely that climate change to influence the production and the productivity of various sectors. The new reality of the new century should mobilize the social and political community to take the appropriate measures not to exacerbate the effects of the climate changes and not aggravate the current environmental patterns (Surugiu and Surugiu, 2009).

Regarding the production of biofuels from grain, if there is a limit to it, maybe it's time for countries around the world to understand the negative effects brought by increasing fuel consumption and to rethink the biofuels production methods. Using biofuels pushes up the price of food on the world market, threatens overuse of scarce water resources and diverts attention away from other alternative sources of energy.

In the future, the world could find better solution for generating fuel and not necessary to use biofuels as a solution to limited oil resources. Biofuels could be just a

temporary solution while scientists look for a better one, while on the other hand the population could be more responsible and begin to reduce the unnecessary fuel consumption such as for luxury cars and re-orient through other means of transportation, and to try to embrace a lifestyle that consume less energy, less of all the planet's depleting resources. The world population need to be aware on the necessity to reduce the energy consumption and to increase the efficiency of the activities.

Contemporary world is changing very rapidly, and so do the technology. It seems that the idea of alternative fuel source will lead to future research, when much less controversial fuels will be produced. Some improvements in this direction are already presented by so-called third-generation biofuels.

The most important thing is to orient political, technological, financial and all the other powers the world has to sustainable development that will logically result in the fuel production that gives the less damage to the worlds' weak points.

Biofuels are produced from crops that could also be used for food purposes. Regardless of biomass used for biofuels production, there are some influences on the land and other resources, with implications on production of agricultural products. Biofuels are a potential source of energy, but if these biofuels are effective in combating climate change it depends on the type of raw materials used, on the production process, on the changes occurred in land use, etc.

In this paper we have noted some of the consequences that may arise due to the use and production of biofuels widely, affecting the quality of the environment and food security, mainly because the production of biofuels consider the use of resources of which the food industry depends.

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