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Analysis of the Effect of Biodiesel Energy Policy on Markets, Trade and Food Safety in the International Context for Sustainable Development

Rodríguez Estelvina[1], Amaya Chávez Araceli[1], Romero Rubí[1], Colín Cruz Arturo[1] and Carreras Pedro[2]
[1]*Universidad Autónoma del Estado de México- México*
[2]*Universidad Americana*
[1]*Mexico*
[2]*Paraguay*

1. Introduction

According by national objectives in each country to achieve energy alternatives, the reduction of gases which cause the greenhouse effect and new strategies for rural development, the production of biodiesel have increased in the last few years and a higher number of countries are adopting new policies. Nevertheless, in the annual report entitled The State of Agriculture and Food Supply presented by the FAO (Food and Agricultural Organization) (FAO, 2008b), the increase of biofuel production is presented as worrisome since the massive use of biofuels would generate more pressure on the food supply and could bring negative social and environmental consequences. However, there is no clear consensus on the level of connection between food and biofuel since high prices can also offer potential long term opportunities for agriculture and rural development. The demand for raw materials to produce biofuels could constitute a structural variation in the tendency for prices of agricultural products to decrease, creating opportunities as well as risks. The perspectives of growth in bioenergy for developing countries as well as the demand from countries of the OECE (Organization for Economic Cooperation and Development) can bring new opportunities for commerce in biodiesel and the securing of raw materials. In this way, the applied policies seem to play an important role in sustainability for this type of bioenergy. This chapter analyzes the tendencies in the market, the impact on raw materials as well as the repercussions in the food supply and in the policies of the sector, within a context of sustainable development.

The method used is an analytical approach by using data and statistics of international organizations to develop baseline scenarios and forecasts on the factors of sustainability, international policy and market and food security. The paper brings together the available knowledge and processes of the sustainability framework to support debate about the potential of biodiesel systems. Among the reflections, it is considered that the impact of biofuels depends upon the scale and type of system under consideration, and the policies,

regulations and subsidies that accompany them. The discussion is extended to include energy efficiency, impact assessment and research of biodiesel technology, to contribute to sustainable development from the use of this fuel.

2. Sustainability factors for a biodiesel fuel perspective

In recent years the protection and conservation the environment has become a priority on the global agenda, considering the natural environment is the most important capital humanity has and, knowing this it is best to preserve and regenerate. The condition and quality of life for all people will be guaranteed. However, it was not until 1987, when the United Nations World Environment and Development Commission unanimously approved the Brundtland Report, known as Our Common Future, where sustainable development is defined as "that which meets the essential needs of the present without compromising the ability to meet the essential needs of future generations." That is, sustainable development was established as a Model of Wise Production, whose central objective is the preservation of natural resources, based on three concepts:

a. Human welfare, whose lines of action were established in health, education, housing, safety and protection of children´s rights,
b. The ecological well-being through actions for the care and protection of air, water and soil, and
c. The interactions established through public policies on population, equity, distribution of wealth, economic development , production and consumption and exercising government.

Sustainability, in any production process, is achieved by harmonizing three fundamental principles: cost-effectiveness, social benefit and ecological balance. Based on this foundation, biodiesel should be a part of new energy policies. Within the literature on the topic, many definitions are offered. It should be noted, however, that the concept of biodiesel needs a dual approach: from the area of environmental science (sustainability criteria) and from a multidisciplinary standpoint. Biodiesel sustainability factors are mainly related to:

a. **Raw material:** The varieties of plants used as feedstock for biodiesel include sunflowers, soya and rapeseed, among others. It is best if the source of the biodiesel is second generation, of high yields and low cost in order to avoid putting pressure on the soil, competing with food demands and increasing availability (IEA, 2004). A positive energy balance depends upon the raw materials and the technology used.
b. **Technology used:** Different technologies are used in the production of biodiesel depending upon the raw materials used and the costs involved. In the case of biodiesel, transesterification processes are used continuously or with an acid or base as a catalyst. In the case of bioethanol is generally obtained through fermentation. It is best if the technology applied does not require a large quantity of energy to operate in order to avoid the possible generation of effluent contaminants.
c. **Waste generation:** Biofuels have several advantages: they reduce CO_2 emissions and other gases which cause the greenhouse effect by 80%; reduce the sulfur emission, which is the main cause of acid rain; it is biodegradable and doubles motor life because of the optimal lubrication (Stenblik, 2007). Nevertheless, the majority of studies compare biodiesel to conventional diesel, leaving out the life cycle of the product. It is important to understand the process from the conception of the product and verify the

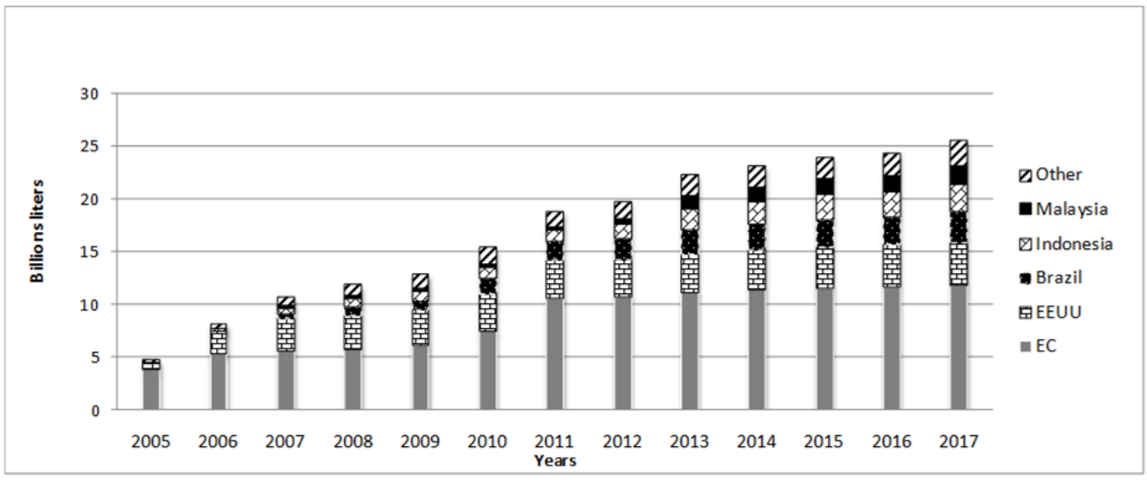
residual outflow, either as atmospheric emissions or effluents in the industrial process, agricultural residuals and the waste of pesticides.

d. **Development Policies and Standards:** Policies should encourage the development of biodiesel by coordinating efforts and avoiding the overlap of public resources (Mitchell, 2008). In order to operationalize the concept of sustainable development, it is necessary to use principles, criteria and indicators which cover social, environmental and economic issues for the management of resources in the production of biodiesel.

Sustainable development is a comprehensive process that requires different actors of society commitments and responsibilities in the application of the economic, political, environmental and social as well as in consumption patterns that determine quality of life.

3. Overview of international policy and markets

To date, the production of biofuels in industrialized countries has been developed under the protection of high tariffs and, at the same time, paying out large subsidies to producers. These policies hurt developing countries which are, or could become, efficient and profitable producers of biofuels in new export markets (Torero, 2010). For the most part, the recent increase in the production of biofuels has taken place in countries involved in the Organization for Economic Cooperation and Development (OCDE), mostly in the United States and in countries of the European Union (EU). It is expected that global production of biodiesel will increase, as shown in **Figure 1**, under the mandates and tax concessions arising from policies. However, trends in consumption for biodiesel haves remained stable **(Figure 2)** in relation to the percentage of total energy demand for transport.



Source: Analysis based on reference data from FAO (2008).

Fig. 1. World production of biodiesel and current projections to 2017, in billion liters.

Biofuels, including biodiesel, have been promoted by policies which support and subsidize their production and consumption. At present, these policies are applied equally in various developing countries. The driving forces of these policies have been the need to ensure the supply of energy and climate change mitigation by reducing emissions of greenhouse gases in conjunction with the desire to support agriculture and promote rural development (World Bank 2007a). These worries have even more relevance in an international context.

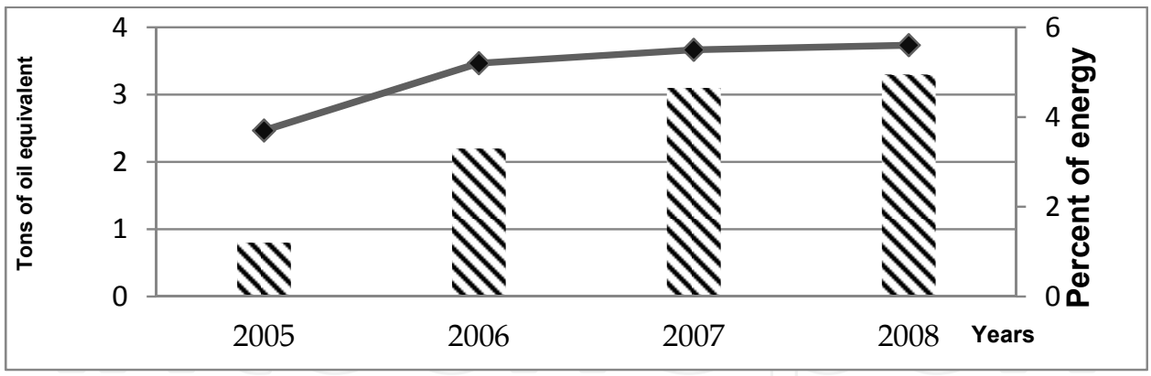


Fig. 2. Percentage of total energy demand for transport CEPAL-FAO (2007).

However, the role of biofuels in the solution for these problems with adequate policies for their application, are subject to more rigorous examination. Because the current policies are costly, their coherence and foundations are being questioned. Current subsidies for biofuels are high and have a limited role in the world supply of energy. The estimates made by the Global Subsidies Initiative for the United States and other countries of the OCDE and a large part of South America suggest the maximum level of support for biodiesel and ethanol in 2006 was between 11,00 and 12,000 million USD (Steenblik, 2007). In dollars per liter, the support fluctuates between 0.20 and 1,000 USD. With the increase in production levels, costs could also increase. It is possible to argue that the subsidies are only temporary, depending upon the long-term economic viability of biofuels. This will also depend upon the cost of other sources of energy, like fossil fuels, or, in the long-term, alternative sources of renewable energy. If we take into account the recent increase in the price of oil, of the larger producers, only the sugar cane ethanol of Brazil appears to be able to compete against fossil fuels without subsidies. Direct subsidies, nevertheless, represent only the most evident costs. Other costs are the result of a disproportionate allocation of funds, a consequence of select support for biofuels and the use of quantitative instruments for mixing.

It is difficult to identify the pertinent policies and quantify their effects in specific cases given the variety of normative instruments and the way they are applied. Nevertheless, policies can influence the economic attractiveness of its production, commerce and use. Subsidies can affect this sector at different stages. **Table 1**, adapted from the Global Subsidy Initiative (Steenblik, 2007), shows the different ways direct and indirect measures can help along the chain of biofuels production. At the same we can see that the policies cover the entire biodiesel chain, from raw material production to distribution and end use. Some of these factors are interrelated so applying policies to one category or another can be risky without considering the international context.

The policies applied, as previously mentioned, are based on quantitative and qualitative instruments **(Table 1)** which are a combination of mandates, direct subsidies, tax exemptions and technical specifications. They span the entire chain of production and commercialization of the biomass of biofuels, final use and international commerce. However, while these policies are interrelated in practice they are i confusing and inadequately implemented.

It is believed that the policies and help directed towards the levels of production and consumption are distorting the market most significantly, while help for research and development most likely distort the market less. In **Figure 3** the repercussions of eliminating biofuels policies on production and consumption of biodiesel are summarized, which distort commerce in several countries.

	Biomass production	Biofuel production	Biofuels use	Biofuels market
Quantitative requirements			Mixing duties.	Import quota.
Qualitative requirements	Obligations of land for biofuel production.	Quality standards.		Fuels estandards.
Financial incentives	Payment for energy crops. General measures of agricultural support.	Grant loans. Investment support. Public research in to the conversion process.	Tax concessions. Tax concessions for the sale of biofuel-compatible vehicles. Public research in development	Import tariffs.

Table 1. Operations and activities directly affected by the policies applied from production to market for biodiesel. Adapted from Steenblik, 2007.

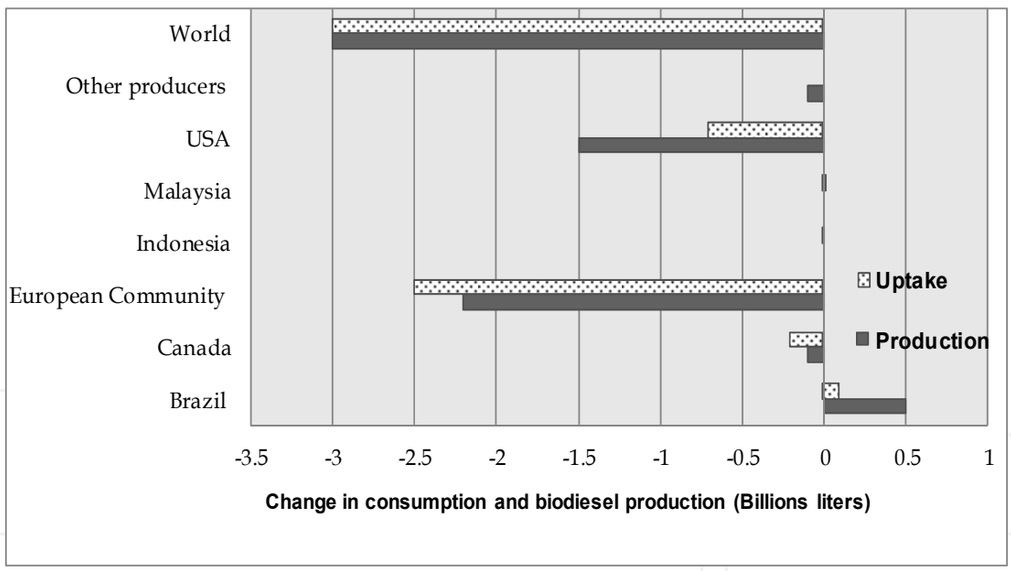


Fig. 3. Total impact of the elimination of policies that distort trade in biodiesel.

The elimination of tariffs and subsidies entail a decrease in the world production and consumption by 12% approximately. This would actually make it more competitive in the market, contributing to economic sustainability (Von Braun, J. *et al.* 2008). The European Community would be the most affected by this change. In contrast, Brazil would maintain a stable level of production and consumption since the biofuels market in that country is competitive. These data are consistent with other studies on the issue raised.
Decisions such as increasing export tariffs and withholding inventory, even when they increase the supply in a given country or region, can have a negative impact on the

international offer, depending on the country's involvement as producer and exporter and the scale of fees or deductions. The barriers to biodiesel trade are summarized in **Table 2.**

Trade Barriers	Tariff barriers	Non -tariff barriers
	Stepping rate	**Domestic support**
	Contributions	**Technical Standards**

Table 2. Trade barriers of biodiesel. Dufey, 2006.

There is currently no specific customs classification for biodiesel, this biofuel in the form of esters fatty acid methyl (FAME) is internationally classified under HS code 3824 9099. 72 73 However, in neither case is it possible to establish whether the imported FAME is used as biofuel or for any other purpose. The evidence also shows that an application fee is common practice in many countries. In the U.S. a fee of 6.5 percent for biodiesel is classified under HS code 3824 909 976, the EU (European Union) applies a tariff of 5.1 percent for biodiesel from the U.S. Moreover, there are substantial tariffs on imports of raw materials for biodiesel production, including energy crops, especially on other materials with added value such as oils and molasses, and the use of tariff escalation and the use of quotas to regulate trade.
Another important trade barrier is domestic subsidies, which hinders the competitiveness of biodiesel, and the existence of divergent technical regulations in different countries. These can cause conflicts and costs for producers who wish to enter multiple markets, each with different standards.
The higher production costs of biofuels compared to conventional fuels, together with the existence of positive externalities associated with biofuel policies suggest that support could be justified to assist the development of industry in its early stages. However, the way that these policies should take and the time in which they should be implemented are issues that require further analysis.

4. Food safety

In addition to the environmental advantages of biodiesel (Marchetti *et al*., 2007), there is a debate about the quantity of land available to cultivate biomass, in a world market with mostly first generation biodiesel. This product could compete with the availability of food, but at the same time, give farmers new and growing opportunities.
According to the definition from the Food and Agriculture Organization (FAO), ¨Food safety exists when all people have physical and economic access to sufficient innocuous and nutritious food to satisfy their nutritional needs¨. Food safety implies compliance with the following conditions:

- An adequate supply and availability of food.
- The stability of the supply without fluctuations or shortages because of the season.
- Access to food or the ability to acquire it.
- Good quality and innocuous food.

Food safety is studied in the following way (Rodriguez, 2007):
Food use: including the social value, nutritional value of the food in each region and harmlessness of the food.

Availability of food: local production, distribution and exchange (import/export). There is safety in terms of food availability nationally, when food resources are sufficient to provide an adequate diet every person in this country, regardless of the origin of the food.
Access to food: Ability to purchase, preferences and mechanisms of allocation.
The relationship between the production of biofuels and food safety is a complex topic. One of the main worries is the possible conflict of land and water use, which could have negative repercussions, since more than 50% of the impoverished population of Latin America and the Caribbean live and depend upon the rural sector (Robles & Torero 2010).
The fact that the demand for grains has increased in the last few years, while supply has decreased, has many countries worried (Heady & Fan 2008). One measure of vulnerability is the number of countries which need food assistance (FAO, 2011). In 2008, 36 countries (FAO, 2010) required external assistance because of an exceptional debt, food production/supply, general lack of access or a focused food danger. The large scale production of biodiesel in these regions without an adequate policy means more pressure. However, it should be noted that most of these countries are not exporting grains nor are they biodiesel producers, so there is not causal effect of the deflection of grain into the fuel market in this countries. With this situation and the high price of food **(Figure 4),** countries have taken measures to reduce tariffs and subsidize food.
The observed measures have weak points, above all the subsidies which are dependent upon the economy of each region and for that reason are ambiguous according to production, per capita income, etc. (CEPAL, 2008). Subsidies are not a solid foundation since it is probable that, with time, they will be discontinued.
Current technologies for liquid biofuel production, such as biodiesel and ethanol, are used as raw material in basic agricultural products. Biodiesel is based on various oleaginous crops, whose large scale production entails considerable land, given the volume of raw materials and the related needs for production.
If the price of combustibles is high enough, agricultural products can be excluded from other uses. Given that the energy markets are larger than the agricultural markets, a small change in energy demand can mean an obvious variation in the demand for raw agricultural materials, and as a consequence, the prices of crude drive the price of biofuels and, at the same time, influence the price of agricultural products (Schiff, 2008). The relationship between the price of food and the price of oil is more obvious than the relationship between

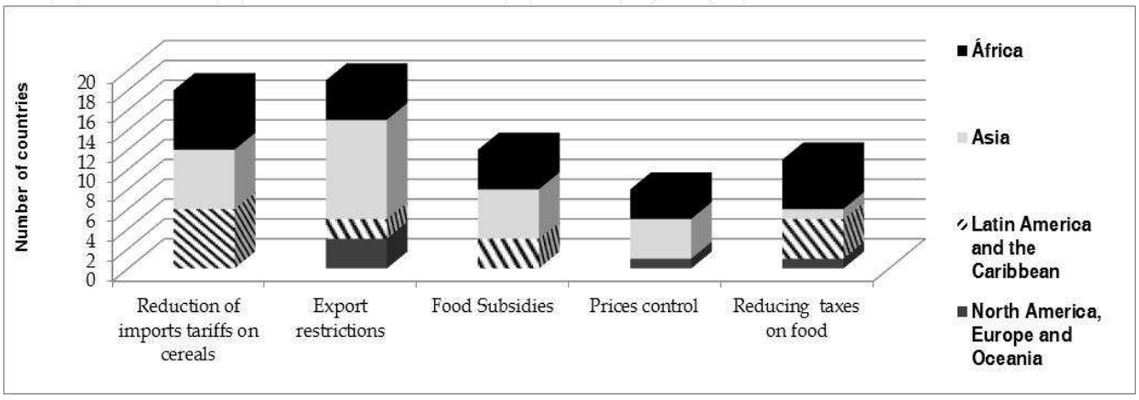


Fig. 4. Measures in response to high food prices by region. Data adapted from the World Food Program, United Nations (2009).

biofuel and agricultural products, leaving biofuels between the two. The narrow link between the price of crude and the price of agricultural products, through the demand for biofuels, establishes minimum and maximum prices for agricultural products determined by the prices of crude (FAO, 2006a). When the prices of combustible fossils reach or surpass the cost of production of substitutive biofuels, the energy market creates a demand for agricultural products. If the demand for energy is high in relation to the agricultural product markets and raw agricultural materials for the production of biodiesel are competitive in the energy market, there will be a minimum price effect for agricultural products, determined by the prices of fossil fuels. However, agricultural prices cannot increase simultaneously faster than the price of energy, since that would raise prices in the energy market.

The situational factor that has played a leading role in the sharp increase in food prices between 2007 and 2008 was financial speculation, which has injected millions of dollars in the futures markets for basic grains as a safe bet in these times of economic uncertainty, private investors and pension funds have drawn wealthy financial market investments, real estate funds in U.S. dollars and developing economies, and have gotten into commodity funds, investments and agricultural futures market (Von Braun, J. *et al.,* 2008). Investment in agricultural futures markets has had a very prominent speculative, even through this market only represents 10% of the grain traded in the world (Per Pinstrup, 2000).

Factors influencing the agricultural market and the determination of the price of food, which also depend upon supply and demand, are listed below:

a. **Climate variability**: The most recurrent source of price variability in agriculture has historically been the supply shocks caused by extreme weather events. According to OFDA / CRED International Disaster Database (EM-DAT), the frequency of floods and droughts have increased dramatically between the first half of last century and this decade. These climatic factors have led to crop losses worldwide, prompting not only fluctuations in the prices of agricultural product prices, but also famine in the most vulnerable regions.
b. **Public Policy:** Decisions, such as increasing export tariffs and withholding inventory, even when they increase the supply in a given country or region can have a negative impact on the international offer, depending on the country's involvement as producer and exporter and the magnitude of tariffs or withholding.
c. **Changes in income**: Decreases in income can occur abruptly, either because of economic crisis, the reduction of social programs or both. The effect on price volatility in these cases will be different depending on the type of product, since the income elasticity of demand for agricultural products varies considerably between products.
d. **New uses for agricultural products**: The discovery of new uses for agricultural products, driven by technological developments (such as biotechnology applied to agriculture) and social or ideological changes are other factors that can, at least in theory, lead to pressure on demand in the short term (Trostle, 2008). Although these changes are gradual, they often have incentives (such as law, investment decisions of large companies or public policy) that ultimately define their economic viability and make their effective introduction into the market. These incentives can generate volatility in the markets.
e. **Effects of foreign exchange markets and oil:** Exchange rate and international prices of agricultural products also have an effect, commonly given in U.S. dollars, they are subject to the appreciation or depreciation of that currency. In that sense, Shaun

(2010), analyzing the factors that determine changes in the longer term (over one cycle) in the volatility of international food prices, found positive and statistically significant changes.

The effects on the world prices of wheat, rice, corn, vegetable oils and sugar, in relation to the consistent reference in the maintenance of raw materials for biofuels in reported 2007 levels are reflected in these **figures 5 and 6.**

With a 14% reduction in the use of raw materials for biofuels from 2010-2011, world prices would be lower by 5% for corn, 3% for vegetable oils and 10% for sugar. By contrast, an increase in the use of raw materials for biofuels of 30% would result in an increase, but on a small scale. The sugar price would increase by 5% and between 2% and 6% for maize and vegetable oil. Since the biodiesel market represents not even 1% of global energy market. Therefore the actual impact is low. The results show little variation compared with the data

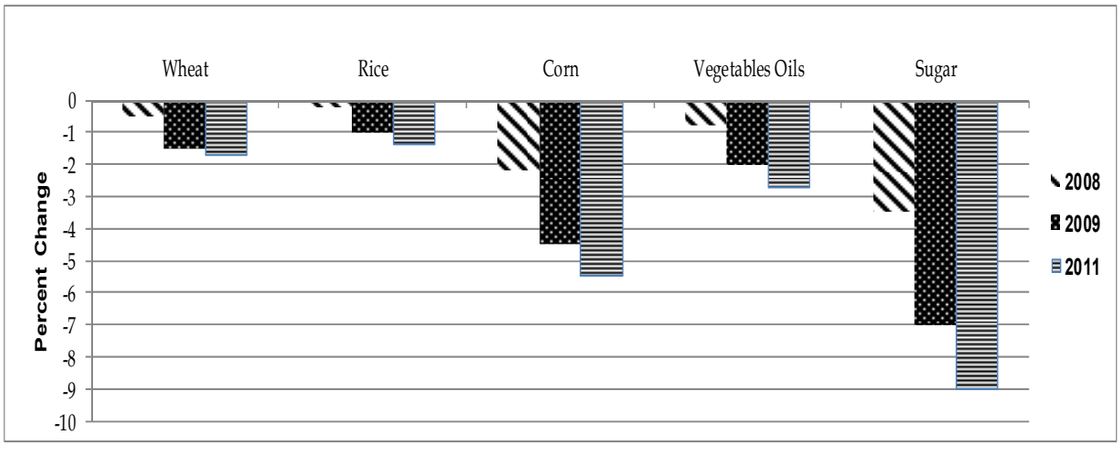


Fig. 5. Reduced use of raw materials (decrease by 15% to 14%). Source: Biofuel support policies: an economic assessment (2008), OCDE, pp. 67.

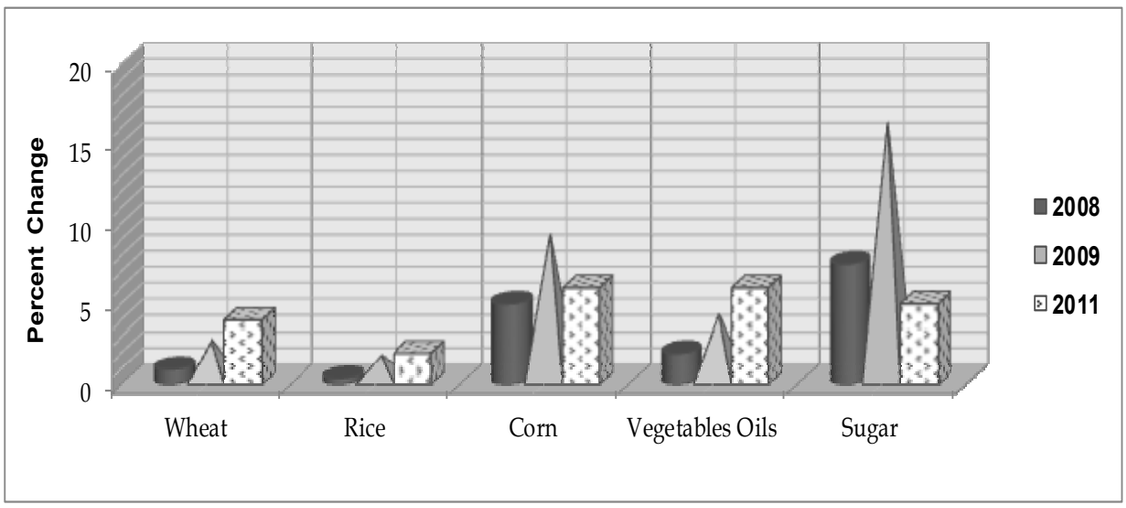


Fig. 6. Increased use of raw materials (increase of 30% in biofuels by 2010).

published by FAO 2008. The same may be due to methodological differences in the estimates this paper; the proper levels of uncertainty have been taken into account, such as agricultural markets, weather conditions, tariffs, etc.

The agricultural market has some characteristics that can be seen as an additional risk in the potential increase in food prices in the coming years or the retention of current levels of volatility for a longer period than those applied in past episodes. These market characteristics not directly attributable to biodiesel (Cotula *et al.*, 2008).

In practice, it is possible that the link between the prices of agricultural products and energy may not be so close at least until biofuel markets are sufficiently developed. And although an increase in biodiesel production worldwide is expected there is no significant increase in trading and cost, according to the outlook through 2017 **(Figure 7).** That is, it tends to remain stable so that the influence on the food market may be representative but not influential on a massive scale. Studies in recent years have analyzed the causes of the crisis in agricultural commodity prices in 2007-2008 (Heady & Fan, 2008, Mitchell, 2008, World Bank, 2008, Robles et al., 2009; Baffes & Haniotis, 2010, Sinnott et al., 2010, Shaun, 2010). Since many of the cases analyzed are structural in nature, different studies focus on analyzing more or less homogeneous factors, seen as potential causes of that crisis. It is important to note, however, that most studies make a qualitative, not quantitative diagnosis, these factors, and even present empirical results should be consulted with caution. On one side are supply-side factors such as climate variability and public policy and on the other hand, those related to demand such as changes in revenues and new uses for agricultural products in relation to the currency market (oil prices).

In the short term, the ability for response from the biofuel sector to the changes in prices relative to fossil fuels and agricultural products can be limited to a group of obstacles. Some examples are: dysfunction in distribution, technical problems during transport and mixture systems or the inability of factories to transform raw materials. The more flexible the capacity for response to demand and the signs of changing prices, the closer the link will be between the price of energy and agricultural markets

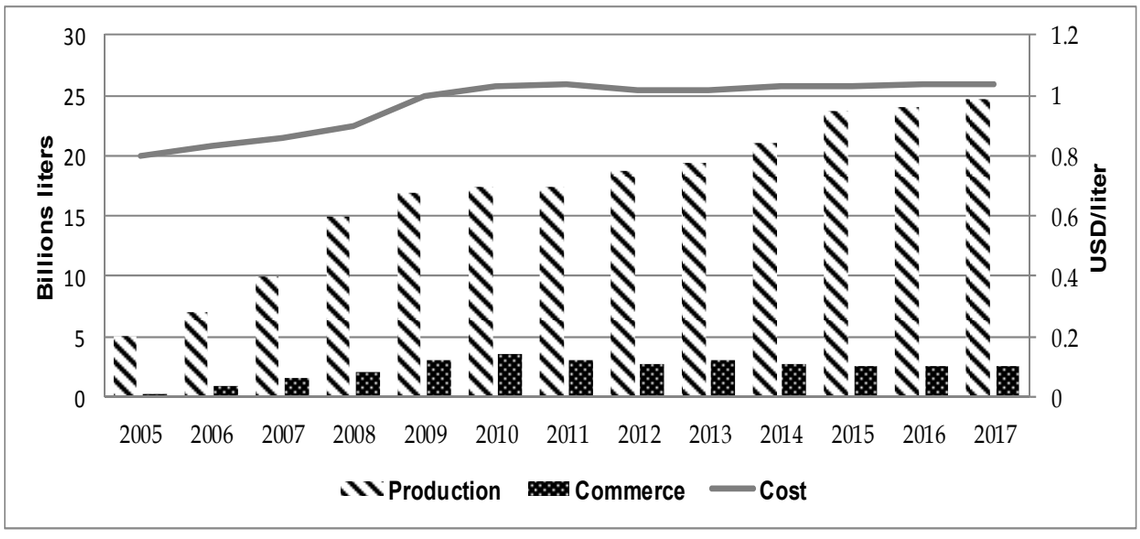


Fig. 7. Production, trade and world prices for biodiesel.

Joachim Von Braun details various factors which have influenced the increase in the price of agricultural products, together with a reaffirmation of the importance of launching biofuel. He adds additional factors like the high rate of growth experimented in Southern Asia which was close to 9% between 2004 and 2006, as well as an important growth rate in Africa which was 6%. Of the 34 countries with the most food safety problems, 22 of them had even more problems during those same years at a rate of 5 and 16%. This growth represents strong pressure on the demand for food and in countries with less income. The growth in these numbers translates to a higher demand for food. Also consider the volatility in agricultural commodity markets which has important economic implications for countries that specialize in export. Using price data from the eighteenth century, Jacks, *et al*., (2009) concluded that the volatility of commodity prices has been higher than the prices of manufactured products. Thus, the dependence on few export commodities is a fundamental cause of instability in terms of the trade of countries that specialize in production and consequently greater economic vulnerability to which they are exposed to this excluding biodiesel.

At the same time, Manuel Chiriboga emphasizes the strong increases in the demand for food in China and India. In fact, he states that in China the average incomes increased 8 times in last 25 years. A strong change towards urbanization and the expansion of the middle class provoked changes in consumption patterns. At the same time, the per capita consumption of food grew by 30% in the last few years making China the third largest importer of food in the world, after the United States and Japan. The world production of cereals also decreased by 2.4% in 2005 because of, climate problems and a decreased of area production in countries who are main exporters of cereals. The strong presence of investors speculating on these products has also influenced the increase in the price of cereals, as well as commodities in general.

It is also important to mention that the increase in the price of food has underlying causes like: the increase in the price of oil, speculations about the market and the growing demand for grains. According to the United Nations, the cause of hunger is inequity, not the lack of food.

5. Conclusions

The criteria for economic, environmental and social sustainability should be a fundamental part of any analysis of biofuel policies. Exhaustive research is needed to identify practices for sustainable management, technological options and the environmental and social impacts at various levels of biofuels production. Guaranteeing energy sources without comprising food sources means raising rents agricultural, while at the same time reducing financial aid and subsidies. Although there are special tariffs, barriers and subsidies in several countries, the international trade of biofuels benefits from preferential schemes through trade agreements, mainly from two major importers, such as the U.S. and the European Union (EU).

While the political pressure to produce biofuels has been considerable, there are no incentives or norms which guarantee the use of new and innovative technologies to avoid the substitution of food crops.

Energy prices have been influenced for a long time by the prices of agricultural products due to the importance of fertilizers and machinery as inputs in production processes. The trend of rising food prices is positively correlated with the increase in oil prices, not

increasing production of biofuels directly, because biofuels represent only 0.3% of total world energy supply.

Biofuels should be considered within a larger context. Biofuels are only part of the solution to the energy problem and should remain in that role. The development and production of biofuels should be accompanied by other alternative energy measures like the reduction of consumption and the improvement of technology. Sustainable production of biodiesel can be an opportunity for rural development and a form of clean energy when considering the appropriate economic and environmental policies. The existence of trade barriers, both tariff and non tariff is a key issue. The further liberalization of trade in biofuels is threatened by the lack of a comprehensive multilateral trade regime applicable to biofuels, which means that business conditions vary from country to country. This scenario is further complicated by the vast number of products involved in the trade - from the different types of raw materials (energy crops) to the final product (biofuels) - passed by a wide range of semi-processed products.

Available data show that economic policies are not the most appropriate and create distortions in the market. It highlights the need for sustainability criteria in each country at the same time, international trade regulation to ensure social acceptability, economic viability and environmental quality.

6. Acknowledgment

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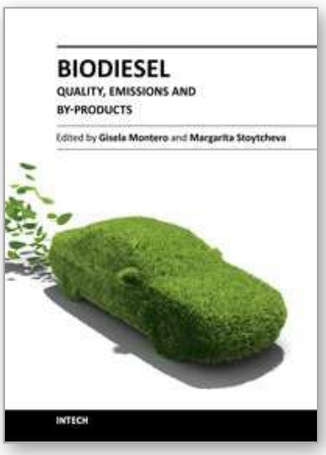

Biodiesel- Quality, Emissions and By-Products

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This book entitled "Biodiesel: Quality, Emissions and By-products" covers topics related to biodiesel quality, performance of combustion engines that use biodiesel and the emissions they generate. New routes to determinate biodiesel properties are proposed and the process how the raw material source, impurities and production practices can affect the quality of the biodiesel is analyzed. In relation to the utilization of biofuel, the performance of combustion engines fuelled by biodiesel and biodiesels blends are evaluated. The applications of glycerol, a byproduct of the biodiesel production process as a feedstock for biotechnological processes, and a key compound of the biorefinery of the future is also emphasized.

InTech Europe
University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China
Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

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