Notas técnicas

BiofuelsLines of debate around the production of agrofuels worldwide

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Abstract: The overall objective of the note is to characterize trends in biofuel produc-tion worldwide. The methodology is qualitative, and the method is of do-cumentary review by matrices with an observation window of the last decade. The main results in reference to the li-nes of discussion around the produc-tion of agrofuel worldwide are f rom the legislation underpinning the legal envi-ronment of trade; secondly, prices; third trade; fourthly production and finally the impact of production on the environ-ment. The main conclusion is that the-re is scientific evidence that establishes the advantages and disadvantages of biofuel production both economically, socially, politically, and environmenta-lly. One way the agribusiness of biofuels has responded to is through the use of technologies to minimize the effects of production. An example of this is se-cond-generation biofuels. However, the-re is still a long way to go to say that they are the best choice f rom the economic, environmental, and social dimensions.

Keywords: agriculture, green economy, oil, energy resources..

Resumen: El objetivo general de la nota técnica es caracterizar las tendencias referentes a la producción de los biocombustibles a nivel mundial. La metodología es de cor-te cualitativo y el método es de revisión documental por matrices con una ven-tana de observación de la última déca-da. Los principales resultados en referen-cia con las líneas de debate en torno a la producción de los agrocombustibles a nivel mundial son desde la legislación que sustenta el ambiente jurídico del co-mercio; en segundo lugar, los precios; en tercer lugar, el comercio; en cuarto lugar, la producción y por último el impacto de la producción en el medio ambiente. La principal conclusión, es que existe evi-dencia científica que establece las ven-tajas y las desventajas de la producción de biocombustibles tanto en lo econó-mico, lo social, lo político como lo am-biental. Una forma como ha respondido la agroindustria de los biocombustibles es a través de la utilización de tecnolo-gías para minimizar los efectos de la pro-ducción. Un ejemplo de ello son los bio-combustibles de segunda generación. No obstante, todavía falta mucho para afirmar que son la mejor opción desde las dimensiones económicas, ambienta-les y sociales.

Palabras clave: agricultura, economía verde, petróleo, recursos energéticos..

Introduction

The birth of biofuels goes hand in hand with the use of hydrocarbons in the 19th century. Precisely, the development of using vegetable oils as an energy source can be identified as early as 1895, when Mr. Diesel, who created the Diesel engine, intended his prototype to run on vegetable oils, such as those derived from peanuts. Similarly, Ford, with the Model T, was expected to use ethanol. Likewise, in the 1920s, the multinational Standard Oil used 25% corn-derived gasoline ethanol in the Baltimore area. However, the low gasoline prices at that time did not allow the proposal to be developed. Now, from the point of view of the first time it was used in public transport, it was in 1938 during the Second World War by both the Germans and the Belgians. However, with the oil crisis in the 1970s, the possibility of using biofuels was reopened due to the high prices of the commodity (Salinas and Gasca, 2009; Hernández and Hernández, 2008; Barrera et al., 2011).

Biofuels What are they?

Biofuels are all fuels that come from biomass. Biomass originates from the biological processes of plants, metabolic wastes, and newly living organisms. In other words, biomass comprises products derived from both animal and plant origin (Stachett et al., 2007; Serna, Barrera and Montiel, 2011). There are several types of biomass. For example, Primary Biomass refers to organic matter derived from plant biomass. Secondary Biomass, which is constituted by metabolic wastes such as fecal matter and meat from non-human animals. Tertiary Biomass, which is made up of the production of non-human animals that feed on Secondary Biomass. Natural Biomass is generated from wild ecosystems. Residual Biomass, as its name implies, includes residues derived from agricultural, forestry and human animal activities. Finally, Energy Crops, which can be categorized as any agricultural crop that provides biomass to generate biofuels (Salinas and Gasca, 2009; Rainforest Foundation Norway, 2020; Schmidhuber, 2006).

The general objective of this article is to characterize the trends in the production of biofuels worldwide. It begins with the introduction already presented and continues with the different types of biofuels. It continues with the lines of debate on the production of agrofuels worldwide. It continues with a brief discussion and ends with some small conclusions of the research exercise. The methodology is qualitative, and the method is a documentary review by matrices (Gómez et al., 2017a;2017b;2016) with a window of observation of the last decade before the pandemic, by virtue of the changes in the business and social fabric (Fedesarrollo, 2020a; 2020b).

Different types of biofuels

First Generation Biofuels (IG)

First Generation Biofuels -(IG) are those that are liquid. Among them are Bioalcohols, Biooils, and Biodiesel. Among their advantages, it can be identified that they are a strategy to "combat" climate change by being able to substitute part of the fossil fuels. Biofuels have no net impact on the amount of carbon dioxide in the atmosphere. Another advantage, and following Precision Agriculture, is that it could generate planting and harvesting cycles considering that resources are not exhausted or polluted and finally this kind of technology is much more adaptive than using hydrogen, for example. Without forgetting that blending ethanol with gasoline generates better combustion in engines, for example in the case of the E85 combination; however, the distance traveled is less per liter (Benavides, et al., 2007; De Paula and Cristian, 2009).

"Replacing a percentage, for example, of gasoline and diesel with biodiesel or bioethanol, is the easiest way to increase the availability of fuels in the transport sector (Camus and Laborda, 2006) and replace part of the fossil fuel energy in vehicles. However, the efficient use of the resources used in the biofuel production chain is an aspect that deserves as much attention as its own alternative development" (Yáñez et al., 2009, p.78).

Continuing with the disadvantages, another one is the so-called "food crisis". The use of biofuels greatly increases food prices. In anecdotal terms, filling the tank of a pickup truck with ethanol means the consumption of cereals of an average person in the U.S. Also, the consumption of fresh water is a disaster for generating biofuels, since if a car travels 20,000 km it would be equivalent to the consumption of 100 people in Europe and 500 people in Africa. Another disadvantage is that the production of biofuels requires high concentrations of agrochemicals, contributing to pollution. Not to mention the deforestation caused by the cultivation of biofuels, which is estimated to cause 18% of greenhouse gas emissions (Salinas and Gasca, 2009; Solano et al., 2008).

In other words, there is evidence that the concentration of biofuels production tends to be located mainly in territories with reiterative legal insecurity and little institutional framework (De Paula and Cristian, 2009), favoring the usurpation of possible economic and social benefits in groups outside the law. Examples of these can be found in Latin American countries such as Colombia and Mexico. The latter, taking as an example the constructions for the generation of biofuels that were carried out in Sinaloa in 2006, have increased the corn transport quota, generating an absurdity such as the importation of food to reduce prices, which has caused society as a whole to support an inefficient activity that is not profitable and is also exported (Chauvet and González, 2008). In Colombia, a symmetry is identified between the growth of oil palm monocultures that generate biofuels and the loss of farmers' land and violence (Gómez et al, 2020). Even if, the simulations that have been carried out in the territory of Colombia for the production of biodiesel by means of oil palm using biocatalysts are the best option for production in terms of efficiency and effectiveness (Solano et al., 2008).

In Brazil, for example. It is presented that the high value of the oil received and the relatively low extraction method since the use of technology makes production unfeasible on average unless state subsidies are used (Stachett et al., 2007). Agricultural subsidies granted in the U.S. for biofuel development do not reduce fiscal costs as the literature on ethanol policy claims. On the contrary, it increases food prices (Gorter and Just, 2010).

Each of the biofuels is described below:

Biodiesel

Biodiesel is a liquid fuel that substitutes a part of diesel by means of different vegetable oils and oleaginous crops such as oil palm, soybean, rapeseed, sunflower, and Jatropha. Moreover, it could be stated that there are more than 300 plant species that could be used as a substitute for diesel (Aimaretti et al., 2008; National Biodiesel Board, 2007).

Bioalcohols

Bioalcohols are of organic origin and are divided into ethanol and methanol. Ethanol, according to its chemical composition and productivity studies, is the most widely used and is called bioethanol. The raw material of ethanol is wide, it can be derived from wheat, corn, barley, sweet potato, potatoes, sweet potato, agricultural residues, wood, sugar beet, sorghum, molasses, etc. In general terms, this raw material is transformed into sugar, from which alcoholic fermentation takes place. The blends can range from E5 to E95 for the use of this biofuel (Recompensa et al., 2008; IEA, 2004; Agarwal, 2006).

Bio-oils

Bio-oils are the result of oleaginous plants such as vegetable oils, specifically cooking oil. One advantage of this biofuel is that it does not release harmful pollutants such as sulfur dioxide into the atmosphere (Salinas and Gasca, 2009).

Second Generation Biofuels (2G)

Second Generation Biofuels (2G) have two different characteristics than First Generation Biofuels. The first is that they are produced by means of technological innovations that are more "responsible" with the environment and the second is that the biomass obtained from plants is not intended for food. Hence, one of the great advantages is that by having a greater variety of raw materials that are not edible, it does not compete with hectares that are predisposed for food. Likewise, plantations to obtain these biofuels can be harvested in non-agricultural areas such as cattle ranches, which can diversify the use of forests as an incentive for forestry and reduce deforestation (Stachett et al., 2007; De Souza et al., 2009).

Third and Fourth Generation (3G y 4G)

Third Generation biofuels are also those derived from "energy crops". They are non-food plants that reflect rapid growth with high energy density. Examples are green algae, perennial grasses, trees, and plants exhibiting rapid growth. These are still in the development phase, although it has been possible to generate biodiesel and ethanol in pilot plants. However, they have disadvantages, since they are developed on cropland, except for green algae. The advantages are that they are carbon dioxide (CO2) sequestrators. Anyway, Fourth Generation Biofuels are derived from genetically modified bacteria, which use carbon dioxide (CO2) or another carbon source, as the case may be. Their distinctive feature in comparison with the other generations of biofuels is that the bacteria are the ones that carry out the biofuels process. Also, this Fourth Generation, like the Third Generation, is under development (Álvarez, 2009Ritter, 2007).

Methodology

The methodology is qualitative, and the method is a documentary review by matrices (Gómez et al., 2017a; 2017b; 2016) with a window of observation of the last decade before the pandemic by virtue of the changes that emerged in the business and social fabric (Fedesarrollo, 2020a; 2020b).

The documentary review was based on a matrix. In which the objective of the article or document consulted was identified, followed by the methodology and the cut used, followed by the results of the writing, the author's conclusions, and the reader's synthesis. With this, it was possible to identify the divergences as well as the convergences of the authors and consequently the general objective of the article (Paramo, 2008). Similarly, in order to answer the problem question, which was: What are the lines of debate on the production of biofuels at world level in the last decade?

Results

Lines of debate on the production of agrofuels at a global level.

After having presented what biofuels are, the different generations of this product and their advantages and disadvantages, the following are the current lines of debate on biofuels at the international and national level.

Legislation

Since the 2000s, the biofuels market has been supported worldwide on average by the governments of the producing countries. In the U.S. they have an Energy Independence and Security Act that was enacted in 2007.The EISA Act that establishes the regulations that require biofuels to achieve a share of at least 20% to 50% GHG reduction as the standards of biodiesel as cellulose. There is also the 2017 final regulation of the United States Environmental Protection Agency-EPA that set the requirement regarding the volume of Biodiesel from 2018.For the European Union EU, the legal framework is set by the Renewable Energy Directive (RED) of 2009. It states that biofuels must be used beyond 10% of total transport fuel use from 2020. In China, it is estimated that the government generated mandatory standards for the development of biofuel-based transport fleets. India's standard is that at least 10% ethanol must be used. In Thailand, goals have been established until 2036 in which the use of ethanol and biodiesel should be 4.1 billion liters and 5.1 Mml. Brazil has standards that biofuel derivatives such as Gasohol must be used. A fusion between gasoline and Anhydrous Ethanol with Hydrated Ethanol. The mandatory biodiesel standard is 10% and must be met by 2020, ending with Colombia where it is assumed that since 2016 the State meets a standard of 9% ethanol. However, they estimate that by 2026 it will only reach 7% (FAO,2017; OECD and FAO, 2017; 2016; Official Journal of the European Union, 2009).

Prices

In nominal terms, it is expected that after 2020 ethanol will grow by 3% and biodiesel by 11%. From the point of view of real prices, it is estimated that the price of ethanol will remain stable and that of biodiesel will fall accordingly, assuming that by this time demand will fall both in the USA and the European Union (EUROPEAN COMMISSION, 2016; Faaij, 2010).

Trade

Estimates on global ethanol trade for example remain constant and are expected to exhibit 5% globally. Likewise, following with prices, it is projected that after 2020 and after 2028 it will fall back to 7.9 Mml in production. However, for the EU it will grow by 0.5Mml since 2016 and by 2020 it is projected to drop by 0.7Mml. In addition, countries such as Canada and Japan are expected to reduce their imports, as they are expected to use less transportation fuels. For the USA, the estimate of being a net exporter of ethanol is maintained while in Brazil it will remain constant as it is expected to be more for domestic consumption (OECD & FAO, 2017; 2016; 2014; Furtado, 2009; FAO, 2010).

Production

By 2026, global biodiesel production is estimated at 40.5Mml which is equivalent in percentage terms to a 12% increase over 2016. Similarly, vegetable oil is the preferred feedstock for production. Estimating that both US and EU will generate production also through waste oil and tallow oil. Likewise, the USA will keep its production stable at around 7.4 Mml, which is related to its use and its legal framework. On the other

hand, Argentina increases its production from 3.1 Mml in 2016 to 3.7 Mml in 2020 and is expected to reduce in 2026 to 2.9 Mml. Brazil, Thailand, and Indonesia will contribute to the total world market with 36% biodiesel. Indonesia estimates that by 2026 it will be 4.4 Mml, as will Malaysia and the Philippines, although the latter will be mainly for domestic consumption. Finally, Colombia shows a miniscule increase since 2006 compared to the producers described above. However, the Colombian domestic market has a deficit of at least 61%, although as time goes by it is the first exporter in Latin America and fourth worldwide of oil palm derivatives. Without forgetting the leadership of large producers such as Malaysia and Indonesia (Vásquez, De la Cruz & Coello, 2016Delgado, Salgado and Pérez, 2015; OECD and FAO, 2017; 2016; 2015).

Repercussions in terms of the environmental dimension

In environmental terms, biofuels, as mentioned above, reduce greenhouse gases (GHG). Not to mention, a much higher energy balance than petroleum-derived fuels, assuming that they are obtained under sustainability certification systems. However, this also permeates barriers as it raises costs when obtaining such certification (OECD and FAO ,2016;2015;2014). Such as (Rajagopal and Zilberman; 2007), argue that biofuel production is based on renewable resources that can reduce carbon emission. If forgetting and generalizing the indirect injuries of carbon emission such as agriculture in general and its processing (Vásquez et al., 2016).

However, studies by (Solange and Martinelli, 2008; Gerlad and Robertson, 2008) on sugarcane biomass indicate that biofuel production contributes to soil damage, that burning sugarcane heats and removes density and erodes soils. Likewise, leaving soils exposed decreases water infiltration, which further affects erosion density. In the same sense, the same authors indicate that burning has harmful effects on the air, since it dissolves carcinogenic substances that cause damage to health, which inevitably increases the costs of governments and individuals in weighing health contingencies. These particles also reach water sources as sediments, pesticide residues and heavy metals are spread in the ecosystem.

"With a focus on biofuels, it has been claimed that carbon debts caused by deforestation are eventually offset by carbon savings from the production of biodiesel from oil palm, rather than diesel produced from petroleum. However, the time required for offsetting depends largely on the previous land use. It is about 86 years when oil palm replaces tropical rainforests and up to 840 years when deforested and drained peat (Fargione et al., 2008), therefore, relative to emissions caused by fossil fuels, biodiesel production from oil palm actually increases net CO2 emissions for decades or even centuries (Qaim, Sibhatu, Hermanto & Grass, 2020, p.55).

By the way, Gerald, and Robertson (2008) argue that increased production of biofuels inevitably leads to problems in land use and land vocation. First, because more inputs will be demanded, so that the agricultural goods used will increase their prices, encouraging greater use of soil and change of other crops. Secondly, as more soil is needed for production, more fertilizers are also needed, contributing to the generation of greenhouse gases and greater exploitation of water sources. Finally, the contributions of Venghaus and Selbmann (2014) who analyzed the socioeconomic and socio-environmental effects generated by large-scale production of biofuels and synthesized that biofuel production would meet the growing world demand without generating negative impacts on both the production of agricultural products and land use, especially in societies where subsistence agriculture persists, for example, Colombia. Although they also proclaim that biofuels if effectively produced could be considered positive if they go hand in hand with social justice of the territory and territoriality (Vásquez et al., 2016; Hill, Nelson et al.,2006).

"Due to the nature of bioenergy, developments in this sector are closely related to food security. Moreover, as demand increases, agriculture also has to increase food production due to economic and population growth" (Faaij, 2010, p.76).

Discussion

Biofuels are a possible response of orthodox economics to the problems of the 21st century in relation to the negative effects of the use of fossil fuels as energy to lubricate the capitalist socioeconomic system. Therefore, this article agrees with the postulates of (Gómez, 2021; Neumayer, 1999; Trigo et al., 2013) when these relate biofuels with weak sustainability and especially when they identify them as results of the Bioeconomy. Both from the postulates of New Economy and Environmental Economics. Both are anchored in the paradigm of modernity, in Kuhn's terms, which argue that manufactured capital can supply the ecosystem services of natural capital.

In addition, "the object of sustainability science is the socio-ecological resilience of systems" (Salas, 2012, p.6). Indeed, the results of the trends on biofuels emphasize that the dynamics of biofuels are in accordance with the predictions of continuing with the economic cycles of the orthodox economy and not necessarily with the resilience of the systems from the strong sustainability, much less with the social ones. Since it is intended through technology in the case of second-generation biofuels to use them as an answer to supply the energy needs having as a path the classical economy that does not conceive in its category and as concepts to nature as a living and dynamic being but as a given input (Aguilera et al., 2020;Zarta, 2018; Maldonado, 2018).

"A bioeconomy-based economic growth strategy is one in which biodiversity and residual biomass are efficiently and sustainably managed to generate new products, processes and value-added services, based on knowledge and innovation, that leverage growth, development and progress in Colombia's regions" (EAFIT et al., 2018, p.12).

Therefore, biofuels, having a strong political and economic lobby at the global level, have positioned themselves and continue to be a possible answer to the incessant energy needs of the capitalist machinery, taking weak sustainability as a path. Indeed, multilateral entities such as the Inter-American Development Bank -IDB, the United Nations Organization, the Organization for Economic Cooperation and Development -OECD, among others, in their lines of argument support this strategy (OECD 2020; 2019; Henry et al., 2017) to the detriment of other possible energies that are in tune with the territories such as territorialities since they are the hegemonic discourse that demerits strong sustainability.

Conclusions

Biofuels are a bioeconomic strategy that seeks to guarantee the scaffolding of growth and economic development from the conventional economy. Evidently, the non-renewable resource of oil in full reduction has generated strategies of economic agents worldwide, supported on average by governmental and intergovernmental entities to maintain world production. One of these strategies is the use of biofuels.

The neoliberal discourse of the free market is synchronized with non-renewable energy sources and, by virtue of the fact that they can be easily controlled. However, this is especially true in countries with strong property rights such as the European Union, some English-speaking countries, Japan, etc. On the other hand, in countries that present institutional precariousness regarding minerals and these new energy sources, such as biofuel exporters on average, there is little technology to develop them, violence by illegal or legal groups against the population and above all a great dependence on the former to export them under their conditions and with gradual detriment to the territories and territorialities, without forgetting the impacts on the environment, which has very little of a sustainable nature.

There is scientific evidence that establishes the advantages and disadvantages of the production of biofuels. Indeed, there are both positive and negative features, economically, socially, politically, and environmentally. One way in which the biofuel agribusiness has responded is through the use of technologies to minimize the

effects of production. An example of this is second-generation biofuels. However, there is still a long way to go before we can say that biofuels are the best option for energy use after the disappearance of oil.

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