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Constraints and limitations to the application of Bio-fuel Production: Argentina as a major fuel supplier in the near future?

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ABSTRACT.

Bio-fuels appeared time ago as a possible substitute for non-renewable fossil fuel, given the latter's scarce condition; hence the prospect of generating fuel from renewable sources appeared to be the solution since it is also a clean way to produce and consume energy (they are bio-degradable) and this makes the whole process sustainable in the future. Since the introduction of key technological innovations, such as RR soybeans and direct sowing, along with other important economical and political factors, Argentina's grain harvest has become increasingly more important on a global level, doubling its production over the last decade and it has prospects of achieving the 100 million tons mark in the near future. On the other hand, North American and European countries along with Brazil have steadily increased their research, development and use of renewable bio-energy, mainly bio-fuels, as a means of substitution of scarce fossil fuels. Several sources have appeared, such as Brazilian sugar cane ethanol, American corn ethanol, European and Canadian Bio-diesel produced from soybeans, canola or sunflower seed. This paper's main objective is to analyse Argentina's current situation, while identifying its development opportunities using the STEP Analysis to compare it with leading producers globally and therefore to elaborate a strategy to fit Argentina's potential to be a leading fuel supplier in the world. Argentina does not yet have a complete bio-fuel bill, nor is it produced on a large scale, despite having every element necessary to be a world class producer and supplier. Actions to be taken to promote bio-fuel production should include a more transparent institutional environment (with a definitive Bio-fuel Law) and a strong lobby to increase public's awareness of the benefits that derive from their use.

Key words: Opportunities, Innovations, STEP Analysis, strategies, technology.

1) INTRODUCTION.

1.1) Problem statement.

Bio-fuels appeared time ago as a possible substitute for non-renewable fossil fuel, given the latter's scarce condition; hence the prospect of generating fuel from renewable sources appeared to be the solution since it is also a clean way to produce and consume energy (they are bio-degradable) and this makes the whole process sustainable in the future as long as the fields in which they are produced are well conserved. They can be produced from several primary products, such as vegetal and animal or even residual oils and fats, through different means of transformation. Most of them can be used as a complete substitute for fossil fuels, though it is

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much more common to use it as a complement in different proportions. Technological evolution over the last few years has generated an increasing use of both ethanol and methanol since they can be used directly on present day engines without any modifications. The great productive advantage of bio-fuels is the diversity of primary products used, as well as of the processes of production.

Bio-fuels are mostly researched and developed in North America[2] and Europe[3]. Nonetheless, Brazil has become a key global player making good use of a sugar production by-product, ethanol. Brazil is now the biggest producer and exporter, it has produced 327 million tonnes of cane during 2004, while the ethanol complex generated 22.5 million tonnes of sugar and 13.54 million litres of ethanol (source: UNICA, www.portalunica.com.br & EMBRAPA, www.embrapa.gov.br), and would appear to be following a path towards bio-fuel global leadership even though, and despite being an important producer and exporter, soybean bio-diesel is not yet fully developed.

In the USA during 2004 over 12 billion litres of ethanol were produced from 39 million tonnes of corn (source: www.usda.gov/nass), this represents about 13% of the corn production from a record of 300 million tonnes. Nevertheless, America's goal is to achieve a 20 billion litre production, predictions for 2005 include a production of over 16 billion litres from 50 million tonnes of corn (source: www.usda.gov/nass).

As for Europe, in September 2001 a proposal for the promotion of the use of bio-fuels for transport was drafted in which it was stated that by 2005 the minimum share of bio-fuels should be 2 percent and should gradually rise to 5.75 percent by the year 2010[4], this has led to a production increase of 100% over the last five years. In 2001, 780,000 tonnes of bio-diesel were produced in Europe, mainly in Germany, France, Italy and Austria. In 2001 they produced respectively 46%, 40%, 10% and 4%[5]. Today, Spain has become a very important producer surpassing Austria's production.

Argentina, on the other hand, has not yet developed a competitive bio-fuel sector, nor does it have a complete, fully functional bio-fuel bill including production incentives, which, added to a non-competitive price relation against subsidized fossil fuels, causes an inexistence of large scale production, which would more easily cope with quality, security and effluent treatment requirements. This would only happen after a minimum of 2 years after the sanction of a bio-fuel bill (Claudio Molina, personal interview).

Despite its annual grain production of 85 million tonnes (Claudio Molina, personal interview) and its world-class crushing cluster, Argentina appears to be one step behind other agricultural powers regarding bio-energy, producing annually only 160 million litres of Ethanol (source: SAGPyA), generated from under 440,000 tonnes (just 2% of Argentina's total corn production of almost 20 million tonnes) and low quantities of soybean bio-diesel versus 8,500 million litres of gasoline. Nevertheless, given its obvious agricultural potential, could Argentina become a major fuel supplier in the future?

1.2) <u>Objectives.</u>

This paper has two central objectives: a) studying Argentina's relative position regarding major bio-energy players in the world; b) identifying the institutional, organizational, technological,

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[2] USA produces ethanol from corn and Canada produces bio-diesel from canola

[3] Bio-diesel from soybeans, canola and sunflower seed

[4] Source: Proposal from the Directorate-General for Transport and Energy of the European Commission on a Directive from the European Parliament., April 27th, 2003.

[5] Source: Proposal from the Directorate-General for Transport and Energy of the European Commission on a Directive from the European Parliament, April 27th, 2003.

commercial and socio-cultural environments, which rule the production of bio-fuels in Argentina, thus determining the main constraints and limitations.

2) <u>PROCEDURES.</u>

This paper evaluates data on market shares, what commodities and food companies in the country analysed (EU, USA, Brazil and Argentina) operates as well as data on commodity and bio-fuel production and productivity.

This paper works with secondary and primary data for the analysis. Secondary data is composed by local newspaper and journal articles and international scientific papers (Yoshiro Yuuki, et al., 2005, Zylberstajn et al, 2005). The authors faced a severe lack of information (especially of a scientific nature) in Argentina. Most of the results are given out of the experience of the authors in the field of research. However, some primary data has been collected from in depth qualitative interviews (at least 5) with specialists in agribusiness (Malhotra, 2001). Some of the interviews were done to: Claudio Molina (Executive Secretary for the Argentine bio-fuels and hydrogen Commission) and Héctor Huergo (Head of same Commission and Journalist).

Finally, two major concepts were used to discuss the results of this paper: STEP analysis (Johnson and Scholes, 1997), and new institutional economics (North, 1990, Williamson, 1985, 1993; etc.). According to Johnson and Scholes (1997 p. 96) an important tool to analyze future trends and opportunities is the STEP analysis. With this analysis, the major political, economical, technological and socio-cultural drivers are elaborated bringing opportunities in each factor.

The paper also studies the results according to the new institutional economics framework –institutional comparative approach based on a discrete structural analysis (Williamson, 2000)–. In this analysis is important to identify the main constraints and limitations in the institutional, organisational and technological environments.

3) <u>ARGENTINA: A WORLD CLASS COMMODITY PRODUCER.</u>

Being Argentina in a unique position to produce food and other agricultural and stock products because of its comparative and competitive advantages, it is not strange that it is one of the biggest producers and exporters of these kinds of products. For the past 15 years, agribusiness has been a fundamental sustain towards adding value in argentine food.

Within the agricultural sector, Argentina is a key player on a global level, excelling in the four most important productions: soybean, sunflower seed, maize and wheat. Argentina is the 10th biggest wheat producer and the 5th biggest exporter, the 6th biggest producer and the 2nd biggest exporter of maize, the 3rd biggest producer and exporter of sunflower seed and soybean in the world, but it is the number one exporter of sunflower and soybean oils and pellets and the number three producer of soybean oils and pellets (Ordóñez et al. 2004, see Table 1).

The oil complex has achieved the record production of 42.51 million tons of grain during the 2004/2005 harvest. Argentina now produces 14% of the world's sunflower seed and 18% of the world's soybean total production, exporting as much as 77% of the former and 94% of the latter. Small grain crops generated 17.54 million tons in the same harvest (Argentine wheat represents 2.5% of total world production), while coarse grain crops totalized 23.47 million tons (Argentina produces 2.8% of the world's maize); 65% of the wheat and 67% of the maize national production was exported[6].

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[6] SAGPyA: *Secretaria de Agricultura, Ganadería, Pesca y Alimentación* Deparment of Agriculture, Stock. Raising, Fishing and Food, 2005.

Table 1. Main Crops in Argentina (2005).

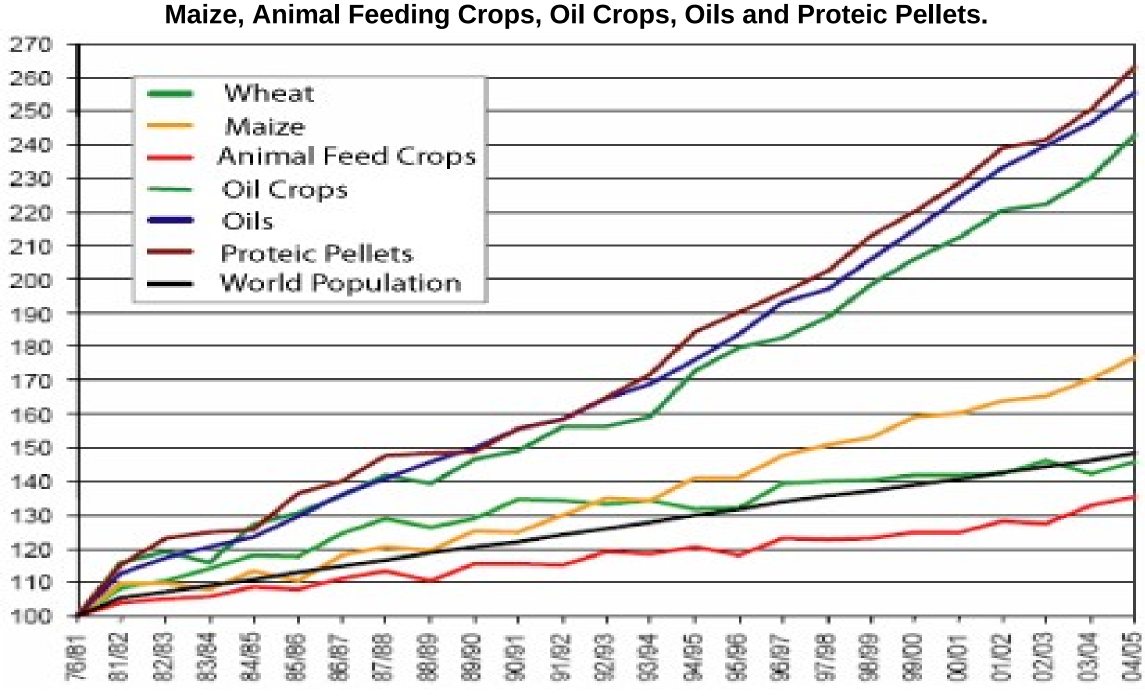
Crop	Harvested Surface (hectares)	Total Production (tonnes)	Production per Hectare (tonnes/ha)
Maize	2,740,000	19,500,000	7.12
Soybean	14,037,000	38,300,000	2.73
Sorghum	558,000	2,900,000	5.2
Sunflower Seed	1,869,000	3,652,000	1.95
Wheat	6,069,000	16,000,000	2.6

Source: SAGPyA

This combination of crops made it possible to achieve a record grain production of almost 84 million tons (doubling the production achieved 10 years ago), an absolute record for Argentina as regards income too, with exports representing u$s 12.4 billion.

The importance of Agribusiness in Argentina is of such magnitude, that 10 out of the 20 biggest exporting companies are related to the sector, they export grains and grain products, mainly oils and pellets. (Cargill, Bunge Argentina, Aceitera General Deheza, Louis Dreyfuss, Nidera, Vicentin, Molinos Río de la Plata, Toepfer, Asociación de Cooperativas Argentinas and ADM Argentina)[7]. The whole crushing complex in Argentina has an installed capacity of 100,000 tonnes per day.

Figure 1: Comparison of growth in world population and consumption indexes of Wheat, Maize, Animal Feeding Crops, Oil Crops, Oils and Proteic Pellets.



Source: USDA and Oilworld

The obvious questions are then, being Argentina a world class leader as regards agriculture, why is it that it is not a world class bio-fuel producer? Why are some other countries producing so much more in quantity and quality? Are other agricultural powers seeing something in the field of bio-energy that Argentina is not? Is Argentina missing out on a big opportunity?

[7] Source: Mercado Magazine, July 2005.

4) BIO-FUELS AROUND THE WORLD: A STEP ANALYSIS.

4.1) Global situation.

4.1.1) Socio-cultural aspects.

Globally, consumers with a high purchasing power have started to become more and more aware of the value of taking care of the environment (Ordóñez, 2002; Palau, 2005), this naturally causes them to seek ways in which they can stop air pollution for example. This is the case with bio-fuels, they're widely demanded by this type of consumer because they're seen as a low-pollutant product, which helps preserve the environment and because of its source, it helps make agriculture sustainable.

Both of these facts are very important to a consumer who's aware, not only of environmental issues but also of social responsibility. Both in Europe and in the US it's very common to find this type of consumer, but it is not the case of Brazil and Argentina, where its society is not yet so environmentally aware.

4.1.2) Technological aspects.

Europe has a highly developed bio-fuel producing chain. EU obtains a high-quality product through the use of cutting-edge technology. Europe mainly produces bio-diesel from canola or rapeseed and has a competitive high-tech rapeseed crushing sector. As for the US, the main source for producing bio-ethanol is corn, a crop in which they are absolute world leaders. The technology that is applied is still incipient. As for Brazil, its sugar cane complex has really boomed in the last 10 years, producing far more sugar than they actually need and are able to consume, because of the use of the formerly by-product of sugar cane alcohol as a means for obtaining methanol with which they mix their fossil fuels. In recent years, "flexible" cars have become more and more popular, with a technology that allows using alcohol or gasoline or a mix of both.

4.1.3) Economical aspects.

On a global scale, fuel provision represents more than anything an economical problem. The distribution of the energetic demand indicates that fossil fuels (basically petrol) dominate over other sources: 84% of the energy in developed countries comes from fossil sources which represent a 90% of total energy consumption in developing countries (source: www.undp.org). The global Diesel market is of about 1.4 billion cubic meters (1.18 million tonnes) per year against a global production of about 137 million tonnes of vegetal and animal oils and fats. Due to the fact that most developed countries have "green" policies that include a mandatory mixing of fossil fuels with bio-fuels (mainly 5% of total gasoline purchased: B5), the consumption of bio-fuels becomes mandatory. This is where bio-fuels' potential becomes huge. Nevertheless, further study on non-traditional oils' potential should be performed in order to accommodate for this increase in demand, since vegetal and animal oils and fats are often edible and compete with the food market.

4.1.4) Political aspects.

Europe's policy towards bio-fuels is clear, Europe intends to replace as much fossil fuels for bio-fuels as possible, in order to pollute the least possible, but more important than that, in order to depend as little as possible on the "mood" of the raw petrol cartel, the instability of the main producing regions and in this way to be able to be independent from petrol's prices and their constant comings and goings. Furthermore, European law states that bio-fuel crops have been even more subsidized than other type of crops. In table 2 the bio-diesel production in Europe can be seen, segmented by countries.

Table 2: Main Bio-Diesel Producers in Europe.

Country	Production (thousands of tons)
Germany	715
France	357
Italy	273
Spain	66
Denmark	41
Austria	32
U.K.	9
Sweden	1
Total	1,428

Source: Repsol-YPF

Brazil has realized the importance of bio-fuels globally and has a very encouraging law regarding sugar cane alcohol for cars.

4.2) <u>Constraints and limitations in Argentina.</u>

4.1.1) Socio-cultural aspects.

The average Argentinean consumer is only now starting to become more aware of certain environmental issues, but most of the times is not willing to pay an overprice in order to help cope with them (Palau, 2005). The matter of the subject is that in Argentina there is very little knowledge about bio-fuels in the common public and only over the last year has it become a more important issue through newspapers and other media. The fact remains that most of the consumers do not know what bio-fuels are, what benefits can be obtained from them or why they could become extremely important for an expanding economy such as this country's (source: interview with Claudio Molina).

If the domestic consumer were in fact aware of the many environmental benefits derived from the use of bio-fuels, it would most definitely begin to demand such a product. Such is the case of the European consumer. The reduction of pollutants, not only carbon dioxide is a strong point in favour of bio-fuels, table 3 shows the amount of reduction of some pollutant gasses when fossil fuels are replaced by bio-fuels.

Table 3. Reduction of gas emissions through bio-diesel use in comparison with fossil diesel.

Type of Emission	B100	B20
Carbon Dioxide (CO2)	-66%	-13%
Total Unburnt Hydrocarbs	-93%	-30%
Carbon Monoxide (CO)	-50%	-20%
Solid Particles	-30%	-22%
Sulphur	-100%	-20%
Polynucleated Aromatic Hydrocarbs (PAH)	-80%	-13%
PAH Nitrates (PAHN)	-90%	-50%
Smog	-50%	-10%

Source: SAGPyA.
Note: B100 means a use of 100% bio-diesel;
B20 means a use of 20% bio-diesel and 80% fossil diesel.

4.1.2) Technological aspects.

Argentina has a world class crushing sector, one of the most important both in volume and quality in the world, so the technological changes that would be needed in order to produce bio-fuels, mainly soybean, sunflower seed or rapeseed bio-diesel would be scarce. There's not a big difference between edible oil and bio-fuel productions as regards crushing technology. Furthermore, the technology used in crushing companies is world class technology, with about 50% of machinery imported from Europe. Despite this fact, having Argentina an installed capacity of about 100,000 tonnes per day, it would need an increase in capacity to accommodate for an increase in the demand of bio-diesel. This is the reason why the most important crushers have announced over the last months important investments in increasing installed capacity in the country. The current bio-diesel production in Argentina is quasi-artisan, namely small producers with very low levels of technology and scale.

4.1.3) Economical aspects.

Argentina's energetic matrix shows a dominant participation from fossil fuels with about 88% of total energy consumption in 2002[8] (see table 4). Argentina's Diesel consumption is today over 12 million cubic meters –in table 5 it is shown the distribution by sector–, although predictions from the National Energy Department estimate an annual increase of around 3.5% for the next 20 years achieving almost 22 million cubic meters in 2023 (see table 6). Bio-fuels in Argentina present, from the economical point of view, three basic aspects:

1) it is usually more expensive to produce a litre of bio-diesel than a litre of fossil diesel, and this is due to the fact that obtaining non-renewable fossil oil is cheaper than obtaining the same quantity in bio-oil.

2) bio-fuel producers must compete for the same primary product with edible oil refineries, hence there's a tension between producing food or fuel from the same primary product, and solving this tension becomes a true challenge when we consider that vegetal oils in general have shown a growing demand of almost 2.5 times over the last 30 years (even when if we didn't consider the bio-fuel producer's demand).

3) bio-fuel producers have today the opportunity to obtain primary products cheaper than anywhere else in the world. Due to the fact that Argentina's agricultural exports must pay an exporting tax of up to 25% (which is the case of oil seeds), in the domestic market one can buy soybeans or sunflower seeds almost 25% cheaper as if one bought it in Chicago.

Table 4: Fossil Fuel Consumption in Argentina (2004).

Product	Quantity (Cubic Meters)	Share
Diesel	11,381,011	48%
Gasoline	3,438,599	15%
GNC (compressed natural gas)	3,062,000	13%
Kerosene	1,346,877	6%
Fuel Oil	1,131,746	5%
Coke	1,090,823	5%
Propane	652,999	3%
Butane	398,523	2%
Other	1,203,422	5%
Total	**23,706,000**	**100%**

Source: Energy Department, ENARGAS, Argentinean Chamber for Compressed Natural Gas

[8] Data from Argentina's Energy Department (Secretaría de Energía).

Table 5: Distribution of Diesel Consumption by Sector (2004).

Road Freight Transport (trucks, lorries)	**56%**
Agricultural	**20%**
Passenger Transport	**14%**
Private Vehicles	**6%**
Railroads	**2%**
Ships and Energy Generation	**2%**
Total	**100%**

Source: Argentine Bio-fuel and Hydrogen Association

Table 6: Projection of Diesel and Bio-Diesel Consumption in Argentina.

Concept	2008		2023	
	Diesel	B5	Diesel	B5
Estimated Consumption in 2008 (million litres)	13,060	653	21,880	1,094
Number of plants needed for the first year		17		30
Estimated Investment per plant (million US dollars)		8		8
Total Estimated Investment (million US dollars)		136		240

Source: SAGPyA. Figures based on a production capacity of 40,000 tonnes of bio-diesel per year.
Note: Diesel consumption is based on an annual 3.5% growth.

4.1.4) Political aspects.

Only as from April 2006 has Argentina passed its bio-fuel law, this represents a delay of several years in comparison to the other agricultural powers. Furthermore, this law does not appear to encourage the production of competitive production, imposing several taxes on bio-fuels which are not applied to the production of fossil fuels. What's more, the Argentinean government has recently signed a treaty with Venezuela in which Argentina agrees to purchase fuel from Venezuela paying in State bonds (during last December, Venezuela acquired 1.5 billion dollars in Argentinean debt).

This clearly describes the position taken by the Argentinean government to discourage bio-fuel production by deciding to purchase fossil fuel in a great amount instead of investing in a sector that could not only cope for the country's fuel needs but would also generate an exportable surplus which would in turn generate an important income for the country. This lack of interest from the political sector has caused a lack of an institutional frame for too long, thus failing to encourage initiative in the sector.

5) CONCLUSIONS.

Argentina has not yet developed its bio-fuel chain as much as other agricultural powers have, mainly because of an immature legal and institutional environment and a lack of initiative from the private sector in demanding clearer rules. Moreover, the scarce information and diffusion on bio-energy in the society causes the public not to know about it and thus not to demand it.

Despite these reasons and added to the fact that Argentinean agriculture is one of the most competitive in the world, some opportunities do arise. For instance, the hi-tech domestic oil sector would not need too much extra infrastructure to accommodate for an increase in production, and the opportunity to get cheaper subsidized grain causes costs to be lower would have a very positive impact on bio-fuel (mainly soybean bio-diesel) production. However, if huge-scale bio-fuel exporting opportunities arise, the oil complex will have to be ready to rise to the occasion and be able to accommodate for such a surplus.

Actions to be taken to promote bio-fuel production should include a more transparent institutional environment (with a definitive Bio-fuel Law) and a strong lobby to increase public's awareness of the benefits that derive from their use, similar to what happened when direct sowing was first discussed in the country.

As future research, a study on the ideal governance structure for producing bio-fuels in Argentina should be attempted.

6) REFERENCES.

Accademia Nazionale di Agricoltora, 1993. Programa di indagini, prove pratiche e analisi economiche relative alla produzione di etanolo da biomasse agricole. Bologna, Italy.

Baillo, C.1994. Situación general de los biocarburantes en la Unión Europea. I Jornada sobre biocombustibles. Madrid, Spain.

Camps, M. 1994. Alcohols: ethanol and methanol. BIOFUELS. European Commission. DG XII. Science, Research and Development.

Coxworth, E. 2004. Overview of bio-energy policy issues. Saskatoon, Saskatchewan, Canada.

Johnson, G.J and K. Scholes, 1997. Exploring corporate strategy. Prentice Hall.

Lorleberg, W. 1994. Biomasse und Biodiesel in Deutschland.

Malhotra, N., 2001. Marketing Research: An applied orientation. Pearson Education 1999.

Mercado Magazine. Various editions. Buenos Aires, Argentina.

North, D., 1990. Institutions, institutional change and economic performance. Cambridge: Cambridge University Press.

OCDE/AGR. 1994. Rapports FAT 427: Esther méthylique de colza comme carburant pour moteurs diesel. Station fédérale de recherches d'economie et de génie rural (FAT). Tänikon, Switzerland.

Ordóñez, H., 2000. New institutional economics and food agribusiness. Food and Agribusiness Program. School of Agronomy, Buenos Aires University.

Palau, H. 2005. Agronegocios de ganados y carnes en la Argentina: restricciones y limitaciones al diseño e implementación de sistemas de aseguramiento de origen y calidad; estudio de caso múltiple. ("Beef Agribusiness in Argentina: Constraints and limitations to the design and implementation of origin and quality assurance systems; multiple case study"- English abstract available.) Facultad de Agronomía-Escuela Para Graduados. www.agro.uba.ar/epg

Penido Filho, P. 1981. O álcool combustível. Obtenção e aplicação nos motores. Ed. Nobel. São Paulo, Brazil.

Poitrat, E. 1994. Estrategies pour l'introduction de l'alcohol au marché de biocarburantes: le cás de France.

Riva, G. 1992. Impiego energetico delle oleaginose: una soluzione fattibile? Rev. L'informatore agrario nº 42.

Stont, B. A. et al. 1980. Energía para la agricultura mundial. Ed. FAO. Roma, Italy.

Williamson, O. 1985. The economic institutions of capitalism. New York, Free Press.

Yoshiro Yuuki, P., Conejero, M., Fava Neves, M., Martins Guilhoto, J. 2005. Avaliação dos impactos econômicos da Produção de Biodiesel no Brasil. XLIII Congresso da SOBER. Ribeirão Preto.

Zylbersztajn, D. 1996. Governance structures and agribusiness coordination: A transaction costs economics based approach. Research in Domestic and International Agribusiness Management. Editor Ray Goldberg. Graduate School of Business Administration. Harvard University. Vol. 12.

Zylberstajn, D. et al. 2005. Sistemas agroindustriais de fornecimento de oleaginosas para produção de biodiesel na região do semi-árido brasileiro. Aspectos conceituais para desenhos contratuais. São Paulo, Brazil.

Web based references:

energia3.mecon.gov.ar

faostat.fao.org
www.embrapa.gov.br
www.fao.org
www.portalunica.com.br
www.sagpya.gov.ar
www.usda.gov
www.un.org
www.undp.org