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Paraguay taps its potential for biofuel production

Guillermo Souto[1]

Summary

Despite the concerns of some regarding the use of agricultural crops for the production of biofuels, and the fact that traditionally they have been used exclusively to feed humans and animals, Paraguay has begun to produce biofuels to be mixed with fossil fuels. The data included in this article will serve as input for a later study on the possible effects of mixing different percentages of such crops with fossil fuels. The results of this study will be significant due to the volume of biofuels currently consumed in the country (under the rules regulating the mixture of gasoline with ethanol) and the trend toward their increased use thanks to the recent introduction of flex vehicles.

1 Agricultural Engineer, Specialist in Agribusiness Development, Information and Communication, IICA. gsouto@iica.int

Key words: *biofuels, ethanol, biodiesel, naphtha, diesel, raw materials, cultivated area.*

Introduction

Paraguay has the potential to become a producer and exporter of biofuels thanks to its agricultural and forest resources and experience in the production of crops suitable for use in biofuel production. In addition, the county is endowed with other conditions (climate, soil, labor, available land) that favor the cultivation of a wide range of high-yield crops that can be used as raw material in the generation of biofuels.

Within the broader topic of biofuels, this article focuses on ethanol and mainly on biodiesel, and on some of the raw materials used in their production, tallow in particular. It also describes alternative scenarios for the use of different crops and the percentage of same to be used in the manufacture of biodiesel in Paraguay.

In addition, the county is endowed with other conditions (climate, soil, labor, available land) that favor the cultivation of a wide range of high-yield crops that can be used as raw material in the generation of biofuels.

Ethanol production

Considering that some 264 million liters of gasoline are consumed per year in Paraguay, and that the average mixture of ethanol in gasoline is close to 21%, some 55,400,000 liters of absolute ethanol must be produced annually to meet current demand. At present, the mixtures permitted by law are: up to 18% in 95 octane gasoline and as much as 24% in 85 octane gasoline, which is known as Econo85. No ethanol is added to 97octane gasoline.

Raw materials available for ethanol production:

- Sugar cane (*Saccharum officinarum*)
- Corn (*Zea mays*)
- Cassava (*Manihot esculenta*)
- Sorghum (*Sorghum vulgare*)
- Rice (*Oryza sativa*) (in smaller proportion)

In Paraguay, most ethanol is produced from sugar cane; other raw materials used include sorghum, rice, etc.

Nationally, some 82,000 hectares are planted in sugar cane, of which 33% are used to produce alcohol, 62% sugar and 5% cane syrup.

In 2007, ethanol production nationally reached some 53 million liters, a figure expected to rise in 2008 with the opening of two new alcohol mills, which should make it possible to supply all the ethanol needed for the different mixtures with gasoline. However, in 2008, demand for ethanol will increase with the introduction of flex vehicles, which can use gasoline, ethanol or any mixture of the two. This means that more land will have to be planted in sugar cane to supply the ethanol needed by such vehicles.

In June 2008, the Customs Directorate approved Resolution No. 280, which called for lower customs duties on flex vehicles. Shortly after the approval of this resolution, some automobile dealers began to import such vehicles. Likewise, individuals began to import flex vehicles for their own personal use or subsequent sale.

Further, it is possible to install what are known as "Flex kits" to adapt gasoline motors for use with ethanol, gasoline or any combination of the two. Given the short time this type of vehicle has been in use, it is too early to determine what percentage of the vehicle fleet is flex vehicles.

Biodiesel production

In 2007, the Ministry of Industry and Commerce (MIC) mandated a mixture of 1% of biodiesel with diesel. In other words, in each 100 liters of diesel there would be one liter of biodiesel. By 2008, the percentage would be 3%, and from 2009 on, 5%, up to a maximum of 20%. According to data provided by the state-run Petroleos de Paraguay (PETROPAR), some 1 trillion liters of diesel are consumed per year at the national level. This means that, to comply with the mandated 1% mixture, 10 million liters of biodiesel will be needed, for the 3% mixture 30 million liters, and for the 5% mixture 50 million liters.

Should the biodiesel obtained from tallow, currently the principal raw material used, not be sufficient to meet national demand, it will be necessary to look for alternative raw materials. The country produces a number of crops that could be used as raw materials in the manufacture of biodiesel.

The following table presents the different crops, cited above, considered suitable for use in biodiesel production. It also shows the cultivated area need to produce the amount of biodiesel required for each mixture percentage.

Table 1. Cultivated area needed to produce required amount of biodiesel, for each mixture percentage.

Crop	10 000 000 liters (1%)	Percentage (%) of total cultivated area	30 000 000 liters (3%)	Percentage (%) of total cultivated area	50 000 000 liters (5%)	Percentage (%) of total cultivated area
	Hectares and percentages (%)					
Grugru palm (number of plants)	13 333 000	22.2%	40 000 000	66,6%	66 666 000	(+) 11%
Castor bean	19 840	(+) 98.4%	59 520	(+) 495%	99 200	(+) 892%
Soybeans	21 050	1.0%	63 160	2.6%	105 260	4.8%
Sunflower	13 300	6.7%	40 000	20.0%	66 600	33.3%
Tung oil tree	5 500	45.8%	16 500	(+) 37.5%	27 500	(+) 129%
Peanut	20 000	54.0%	60 000	(+) 62.2%	100 000	(+) 170%
Cotton	83 300	46.3%	250 000	(+) 38.9%	416 600	(+) 131.4%
Sesame	22 200	31.7%	66 600	95.0%	111 100	(+) 58.7%
Jatropha	10 000	-	31 600	-	52 600	-
Canola	18 520	32.3%	55 560	96.8%	92 600	(+) 61.4%

(+) % of additional land planted required to meet estimated demand, based on each mixture percentage and in relation to the cultivated area currently planted in the crop.

Source: prepared by the author.

Tables 2, 3 and 4 present alternatives for the use of crops in the production of biodiesel, by mixture percentage. Production levels are considered in terms of cultivated area nationwide, as well as the respective yields.

The first column identifies five crops proposed for use as raw material in biodiesel production. The second column shows what percentage of all the raw material earmarked for this purpose corresponds to each crop. The next columns show the cultivated areas needed to supply the required mixture percentages (1%, 3%, 5%). To the right of these columns are figures which show the area planted in each crop as a percentage of the total cultivated area in Paraguay during the 2006-2007 agricultural season.

Jatropha Curcas

Table 2. Alternative No. 1 for use of crops in biodiesel production in Paraguay.

Crops proposed	Percentage of all raw materials earmarked for biodiesel production (%)	Hectares required to comply with established mixture percentages					
		Cultivated area needed to supply 1% mixture (10 000 000 liters of biodiesel)		Cultivated area needed to supply 3% mixture (30 000 000 liters of biodiesel)		Cultivated area needed to supply 5% mixture (50 000 000 liters of biodiesel)	
		Hectares	*(%)	Hectares	*en %	Hectares	*(%)
Soy	50%	10 512	0.44%	31 580	1.32%	52 603	2.19%
Jatropha	25%	2 500	-	7 900	-	13 150	-
Castor bean	10%	1 984	19.84%	5 952	59.52%	9 920	99.20%
Grugu palm (plants)	10%	1 333 300	2.22%	4 000 000	6.67%	6 666 000	11.11%
Canola	5%	926	1.61%	2 778	4.84%	4 630	8.07%

* Corresponds to the area planted in each crop, as a percentage of the total cultivated area in Paraguay during the last agricultural season.

Source: prepared by the author.

Table 3. Alternative No. 2 for use of crops in biodiesel production in Paraguay.

Crops proposed	Percentage of all raw materials earmarked for biodiesel production (%)	Hectares required to comply with established mixture percentages					
		Cultivated area needed to supply 1% mixture (10 000 000 liters of biodiesel)		Cultivated area needed to supply 3% mixture (30 000 000 liters of biodiesel)		Cultivated area needed to supply 5% mixture (50 000 000 liters of biodiesel)	
		Hectares	*(%)	Hectares	*(%)	Hectares	*(%)
Soy	40%	8 420	0.35%	25 264	1.05%	42 104	1.75%
Jatropha	30%	3 000	-	9 480	-	15 780	-
Castor bean	15%	2 976	29.76%	8 928	89.28%	14 880	148.80%
Grugu palm (plants)	10%	1 333 300	2.22%	4 000 000	6.67%	6 666 000	11.11%
Canola	5%	926	1.61%	2 778	4.84%	4 630	8.07%

* Corresponds to the area planted in each crop, as a percentage of the total cultivated area in Paraguay during the last agricultural season.

Source: prepared by the author.

Table 4. Alternative No. 3 for use of crops in biodiesel production in Paraguay.

Crops proposed	Percentage of all raw materials earmarked for biodiesel production (%)	Hectares required to comply with established mixture percentages					
		Cultivated area needed to supply 1% mixture (10 000 000 liters of biodiesel)		Cultivated area needed to supply 3% mixture (30 000 000 liters of biodiesel)		Cultivated area needed to supply 5% mixture (50 000 000 liters of biodiesel)	
		Hectares	*(%)	Hectares	*(%)	Hectares	*(%)
Soy	30%	6 315	0.26%	18 948	0.79%	31 580	1.32%
Jatropha	30%	3 000	-	9 480	-	15 780	-
Castor bean	20%	3 968	39.68%	11 904	119.04%	19 840	198.40%
Grugu palm (plants)	15%	2 000 000	3.33%	6 000 000	10.00%	10 000 000	16.67%
Canola	5%	926	1.61%	2 778	4.84%	4 630	8.07%

* Corresponds to the area planted in each crop, as a percentage of the total cultivated area in Paraguay during the last agricultural season.

Source: prepared by the author.

Tallow

Given the importance of tallow in the production of biodiesel, its use should be promoted throughout Paraguay.

Almost all biodiesel marketed in 2007 came from tallow; however, by the end of that year, total production was not enough to cover even 2% of the 10 million liters needed for the 1% mixture mandated at the time. Only 1.6 million liters of biodiesel were produced.

According to data provided by the meat processing industry, an average of 8% of the carcass weight of a slaughtered animal is tallow. Based on data published by the National Animal Quality and Health Service (SENACSA), an average carcass of 232 kilos would yield 19 kilos of tallow. In 2007, some 1,041,550 head were slaughtered, yielding some 241,640 tons of meat. Some 19,331 tons were tallow that could be used for biodiesel production. The yield of tallow is similar to that of vegetable oils, meaning that from the volume mentioned above (19,331 tons of tallow) some 19 million liters of biodiesel can be produced if all animal fat is earmarked for that purpose.

However, since almost all the biodiesel produced and marketed in 2007 (approximately 1.6 million liters) was manufactured using animal fat, in this case tallow, biodiesel production was affected when the price of tallow rose. According to the private sector, the price climbed to between 4000 and 4500 guaranies per kilo, which made the manufacture of biofuel unviable and shut down production.

Currently, however, tallow prices appear to have come down because some biodiesel companies have renewed production. Also, the industry indicated that the earlier increase in the prices was due to a reduction in the amount of animals slaughtered during that period.

If 50% of the tallow from slaughtered animals were used to produce energy, approximately 9.5 million liters of biodiesel could be produced per year, enough to supply the mandated 1% mixture. This volume of biofuel could be used to reduce the use of other raw materials to produce biodiesel.

Conclusions

In the case of biodiesel, the situation is different. Despite the existing legal framework and industrial capacity, it has not been possible to produce enough biodiesel on a regular basis to comply with the mandated mixtures.

It is clear that current and potential demand for biofuels will require an increase in the production of raw materials. As regards ethanol, Paraguay has experience in its production, marketing and use in vehicles. It is estimated that in 2008 it will be possible to meet the demand that went unmet between harvests, thanks to the operation of new alcohol mills and to an increase in the area under cultivation in sugar cane. Likewise, in 2008, customs duties on imports of flex cars were lowered, which will mean a significant increase in consumption of ethanol.

In the case of biodiesel, the situation is different. Despite the existing legal framework and industrial capacity, it has not been possible to produce enough biodiesel on a regular basis to comply with the mandated mixtures. In the judgment of biofuel producers, the basic cause of this situation is the high prices for their principal raw material (tallow). This situation reveals the need to consider using other crops available in the country or to introduce new crops such as jatropha, as well as the possible socioeconomic impacts they would have at the local level.

What is needed are more thorough analyses that consider the use of agricultural products for energy generation and its possible effects on "food security" at the national level.

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Résumé / Resumo / Resumen

Le Paraguay examine son potentiel en matière de biocarburants

En réponse à l'intérêt suscité par l'utilisation de denrées agricoles aux fins de la production de biocarburants, bien que, traditionnellement, ces denrées aient servi exclusivement à l'alimentation humaine et animale, le Paraguay a fait une incursion dans le domaine de la production de matières premières à partir de denrées agricoles, destinées à la production de combustibles d'origine biologique, au marché des combustibles fossiles et à la production éventuelle de mélanges avec des dérivés du pétrole. Les données fournies dans le présent article seront utilisées dans une étude subséquente des effets possibles de l'utilisation, dans diverses proportions, de denrées agricoles destinées à la consommation humaine et animale pour produire des biocarburants à l'échelle nationale. Les résultats seront importants compte tenu du volume de biocarburants consommé actuellement dans le pays (avec le régime en vigueur concernant le mélange essence-éthanol) et de la tendance à la hausse de la consommation de biocarburant (avec la récente introduction des véhicules Flex dans le parc automobile).

Paraguai explora seu potencial em biocombustíveis

Em face da preocupação por utilizar insumos agrícolas na produção de biocombustíveis, embora, tradicionalmente, seu fim exclusivo tivesse sido a alimentação humana e animal, o Paraguai deu início à produção de matérias-primas a partir de culturas para a obtenção de combustíveis de origem biológica, o consumo de combustíveis fósseis e a eventual mescla com derivados do petróleo. Os dados incluídos neste artigo podem servir para um estudo posterior sobre os possíveis efeitos do seu uso em diferentes proporções de insumos agrícolas de consumo humano e animal na produção de biocombustíveis em nível nacional. Os resultados serão significativos, tendo em vista o volume de biocombustíveis atualmente consumido no país (com o atual regime de mistura de gasolina com etanol) e a tendência de aumento do seu uso (com a recente introdução dos veículos Flex à frota automotora).

Paraguay explora su potencial en biocombustibles

Tradicionalmente en Paraguay el fin exclusivo de la producción agrícola había sido la alimentación humana y animal, pero este país ha incursionado en la producción de materias primas a partir de cultivos para la obtención de combustibles de origen biológico, el consumo de combustibles fósiles y la eventual mezcla con los derivados de petróleo. Los datos incluidos en este artículo contribuyen a un posterior estudio sobre los posibles efectos de su uso en distintas proporciones de rubros agrícolas de consumo humano y animal para la producción de biocombustibles a nivel nacional. Los resultados serán significativos debido al volumen de biocombustibles consumido actualmente en ese país (con el vigente régimen de mezcla de nafta con etanol) y la tendencia al aumento de su uso (con la reciente introducción de los vehículos Flex al parque automotor).