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Balance Energético de los cultivos potenciales para la producción de biocombustibles
ENERGY PRODUCTION STUDY OF CROPS WITH BIOFUEL POTENTIAL IN ARGENTINA

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ABSTRACT: The present study is focus on the final energy balance of bioenergy production in Argentina using soybean, sunflower, rapeseed, corn and sorghum as feedstoks. The balance considers the difference between the energy contained per unit and the amount used for its generation in all the different steps from sowing to final destination. For direct energy consumption costomaq software was employed using local fuel consumption forecast for each field labor. Particular attention is payed to the energy consumption in the agricultural steps considering the particular no till system spread out in Argentina that has a very low energy input. Direct and indirect energy were considered in the different steps of bioethanol and biodiesel generation. Industrial conversion consumption was based on international literature data. Comparisons were made between tilled and no till practices and considering or not the energy contained in coproducts. Results indicate a balance with ranges between 0.97 to 1.57 not considering the coproducts. If coproducts were introduced the balances ranged between1.2 and 4.67

KEYWORDS: biofuels, energy, feedstock's

INTRODUCTION: Argentina is considered one of the future mayor players as a biomass producing country, first, because of its favorable climate and soil conditions for growing biomass; second, low land and labor costs are beneficial for reducing the overall production costs. In addition, Argentina's existing infrastructure and human resources facilitates the production and transportation of bio-energy. Argentina has a framework that regulates and promotes the production and use of biofuels since 2007. The law mandates the use of biofuels by 2010, with an obligatory mix of 5 percent of ethanol in gasoline and 5 percent of biodiesel in diesel. To comply with the Biofuels Law, it is estimated that a volume of about 700 million liters of biodiesel and 250 million liters of ethanol will be needed (Hoff 2007). Similar increases are mentioned by indicating a demand of 717000 m^3 for internal consumption which leads to an increasing soy production area of 1.288.651 hectares[1]. This is around 10% of the seeded soy area in the country in the year 2006/2007 (J. Adámoli 2007).
The particular type of agriculture practiced in Argentina differs from northern hemisphere common practices, no till covers more than 70 % of the crop area with more than 30 million hectares. The industrial conversion sector is growing at a great speed the total biodiesel exports 2008 will reach 1300 million dollars, several new plants ranging 100.000 to 300.000 T/year are under construction and a total capacity forecast of 5.500.000 T/year of biodiesel is expected in the next three years. Bioethanol potential is also very large but growing at a lower rate.

[1] Based on the following data: density biodiesel 0.88 ton/,3, conversion oil/biodiesel = 0.83, oil content soy = 18%, yield soy average = 2.6 ton/ha

Basing on this an overall energy study was carried over in order to obtain the energy balance of the principal crops in Argentina under different agricultural practices.

METHODOLOGY: Extensive and well established crops were selected from a broad variety of feedstock's, soybeans, sunflower and rapeseed for biodiesel production and corn and sorghum for bioethanol. The liters per hectare used by each crop included seeding, crop protection and harvest differences according to homogeneous regions were used and two levels of technology were considered on no tillage. Comparisons between no till and conventional tillage practices were calculated. Fuel consumption was calculated using Costo Maq software that gathers 30 years of field information DONATO et al., (2007; 2006, 2003). Harvest consumption was based on mean harvesters field capacity adding transport of the grains within the farm. Short grain transport to the local grain storage facility was considered using a fuel consumption of 2 liters of diesel per ton of grains.
Indirect energy use was determined using literature data DOS SANTOS et al (2000) the same criteria was applied for the transformation stages from grains to biofuels.
On the other side of the equation the energy contained in distilled grains, expellers or crushed seeds were calculated. For the overall balance SHAPOURI (2002) approach was used and specific mass balance spreadsheets were developed.
In the final stage all the energy information was related to the actual vegetable mass produced according to the level of agronomical applied technology. When the information is related to the produced biomass the top numbers were obtained with sunflower and rapeseed and the minimum with no till soybeans

RESULTS AND DISCUSSION: The fuel consumption of the selected crops was very sensitive to the tillage practice in use numbers ranged from 49 l/ha on conventional tillage to 12 l/ha on no tillage practice. The greatest consumptions were obtained on conventional tillage crop. Considering soybean as the principal biodiesel crop in Argentina there are great differences according to the treatment of the coproducts that in this crop reach more than 80 % of the grains. With no coproducts energy ratios have a minimum of 1.12 (conventional tillage and low technology level) to 1.94 with no tillage and high technology input. Considering coproducts ratios rice to 3.74 and 6.48.
There were no higher figures found in the literature SHEHAN et al (1998) gives a ratio of three and LOBATO (2007) founds ratios of 1.16 and 3.38.
Regarding an adecuatemethodology to take into account the copproducts generated by the different crops there are several criteria adopted by the life cycle analysis. The most reasonable is to consider the amount of energy needed to produce a high protein value product. This numbers are not available for local production so the raw energy was used 18 MJ/kg for expellers and protein flower and for glicerine 16.5 MJ/kg. Taking into account the grean weight of this products final balance numbers are very sensitive to the methodology used.
On the other hand is not realistic to achieve all energy used for the production of a crop to a minor percentage of the biomass, the extreme case being soybean. No tillage practices alter the final balance and a deep study must be done on this issue

TABLE 1. Scenario description comparing the results from field data in commercial herd

CULTIVOS	MAXIMUM	OUTPUTS		BALANCE			
	INPUTS	Biofuel	Coproducts	VEN 1	VEN 2	RE 1	RE 2
Rapeseed	22,71	35,00	25,37	12,29	37,66	1,54	2,66
Sunflower Convenc.	23,32	35,00	20,00	11,68	31,68	1,50	2,36
Sunflower SD	26,92	35,00	20,00	8,08	28,08	1,30	2,04
Sunflower SD T.P.	25,02	35,00	20,00	9,98	29,98	1,40	2,20
Soybean 1° Convenc.	29,32	35,00	81,75	5,68	87,43	1,19	3,98
Soybean 1° SD	31,22	35,00	81,75	3,78	85,53	1,12	3,74
Soybean 1° SD T.P.	25,02	35,00	81,75	9,98	91,73	1,40	4,67
Soybean 2° SD	29,42	35,00	81,75	5,58	87,33	1,19	3,97
Corn Convenc. M.H	20,29	22,50	3,34	2,21	5,55	1,11	1,27
Corn Convenc. M.S	23,30	22,50	3,09	-0,80	2,29	0,97	1,10
Corn SD M.H	20,29	22,50	3,34	2,21	5,55	1,11	1,27
Corn SD M.S	23,30	22,50	3,09	-0,80	2,29	0,97	1,10
Corn SD T.P. M.H	20,49	22,50	3,34	2,01	5,35	1,10	1,26
Corn SD T.P. M.S	23,50	22,50	3,09	-1,00	2,09	0,96	1,09
Sorgo Convenc.	21,16	22,50	3,65	1,34	4,99	1,06	1,24
Sorgo SD	22,46	22,50	3,65	0,04	3,69	1,00	1,16

CONCLUSION: The results showed that important differences are present in different biofuels produced in Argentina compared with northern hemisphere numbers. More deep studies are needed on the industrial part.

VEN 1 = E Prod – Consumption
VEN 2 = E Prod + E Coproducts– Consumption
RE 1 = E Prod/Consumption
RE 2 = (E Prod + E Coproducts)/Consumption

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