

Bioenergy How2Guide

Biomass Resources and Bioenergy Potential in South America – Focus on Biofuels

Session 4 – Technology Focus – Prospects and Market

Application of GBEP indicators to sugarcane bioethanol production

Suani Coelho – CENBIO/IEE/USP

Piracicaba, November 27, 2014

Application of sustainability indicators of the Global Bioenergy Partnership (GBEP) in sugar/ethanol mills in the State of São Paulo, Brazil

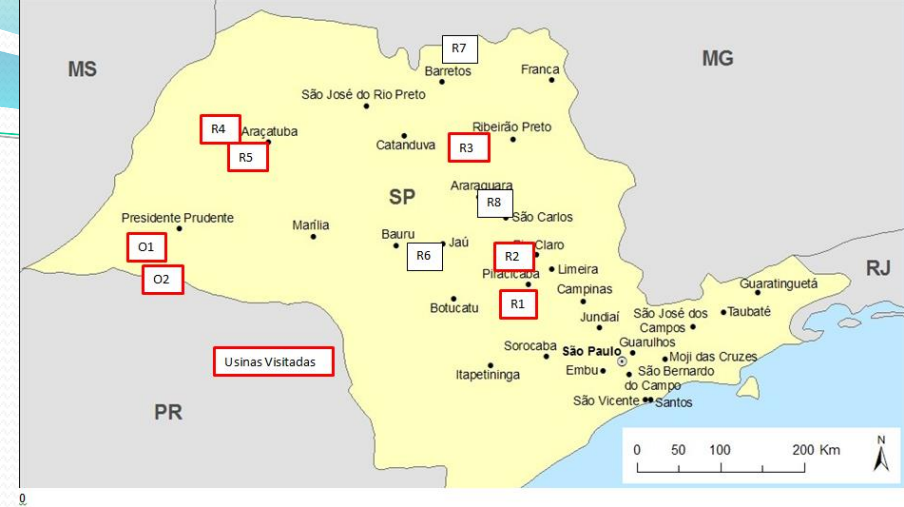
(2014-2016 – CENBIO/IEE/USP)

- Funding agency: Forum of the Americas (Government of Italy)
- Support: Brazilian Federal Government, Secretariat for Environment of Sao Paulo, UNICA/SP
- Coordination: Suani T. Coelho (CENBIO/IEE/USP)
- Collaboration: J. Goldemberg (USP), C. Cerri, C.A. Cerri, Marcia Azanha (ESALQ/USP), O. Lucon (USP/SMA/Cetesb)



Fig. 3.12 Mechanical harvesting of green cane. (Photo courtesy of Agricef Soluções Tecnológicas Para Agricultura Ltda, Brazil; reprinted with permission)



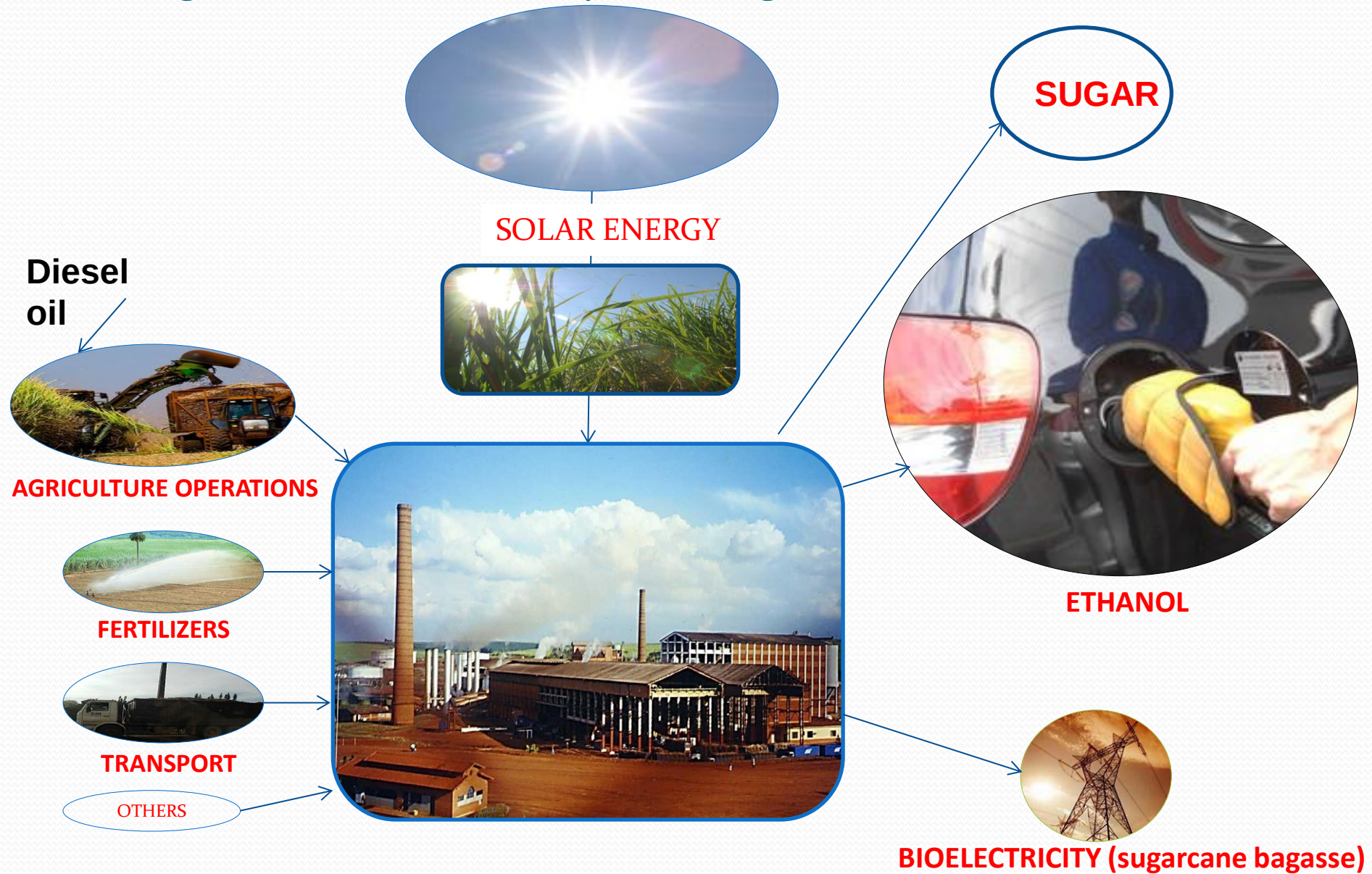


O1 – Fazenda Conquista do Pontal, Mirante do Paranapanema. Odebrecht.
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- Mills to be evaluated:
 - Ribeirao Preto/Piracicaba/Sertaozinho (traditional area)
 - Pontal do Paranapanema (recent expansion on cattle area - 2002 – 2008)
- Partners: Odebrecht and Raizen
- Harvesting seasons:
 - 2012/2013
 - 2013/2014
- Results to be presented consolidated for each region

Sugar/Ethanol/Electricity from Sugarcane



Methodology proposed for impacts allocation

Study case for an average sugarcane mill

SUGARCANE CRUSHED				300	tc/h
SUGAR PRODUCTION				17	t/h
ETHANOL PRODUCTION			anhydrous	7375	litters/h
			hydrous	7375	litters/h
ELECTRICITY TO THE GRID				40	kWh/tc

To be adapted to each mill

Preliminary Results

- Allocation – energy basis
(energy content)

	Energy equivalent		% in energy equivalent
		kcal eq/season	
Sugar	64.416.667	kcal eq/season	38%
Ethanol	96.243.750	kcal eq/season	56%
Electricity	10.320.000	kcal eq/season	6%
Total	170.980.417	kcal eq/season	100%

- Allocation – economic basis
(prices)

	Economic equivalent		Percentage
		R\$/season	
Sugar	88.191.493,06	R\$/season	45%
Ethanol	94.292.524,74	R\$/season	48%
Electricity	12.066.250,00	R\$/season	6%
Total	194.550.267,80	R\$/season	100%

Mills in SP State

(preliminary)

	Energy equivalent	Percentage
	kcal eq/season	
Sugar	3,46118E+11	32,3%
Ethanol	6,3222E+11	59,0%
Electricity	93740000000	8,7%
Total	1,07208E+12	100,0%

	Energy equivalent	Percentage
	kcal eq/season	
Sugar	647.213.575.000	42,5%
Ethanol	740.678.850.000	48,7%
Electricity	134.160.000.000	8,8%
Total	1.522.052.425.000	100,0%

	Economic equivalent	Percentage
	R\$/season	
Sugar	92.838.558	39,4%
Ethanol	121.352.385	51,5%
Electricity	21.473.000	9,1%
Total	235.663.944	100,0%

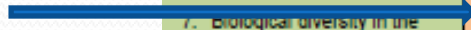
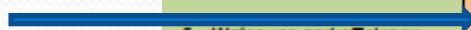
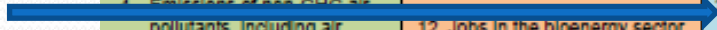
	Economic equivalent	Percentage
	kcal eq/season	
Sugar	173.600.599	50,1%
Ethanol	142.170.609	41,0%
Electricity	30.732.000	8,9%
Total	346.503.208	100,0%

PILLARS		
GBEP's work on sustainability indicators was developed under the following three pillars, noting interlinkages between them:		
Environmental	Social	Economic
THEMES		
GBEP considers the following themes relevant, and these guided the development of indicators under these pillars:		
Greenhouse gas emissions, Productive capacity of the land and ecosystems, Air quality, Water availability, use efficiency and quality, Biological diversity, Land-use change, including indirect effects.	Price and supply of a national food basket, Access to land, water and other natural resources, Labour conditions, Rural and social development, Access to energy, Human health and safety.	Resource availability and use efficiencies in bioenergy production, conversion, distribution and end use, Economic development, Economic viability and competitiveness of bioenergy, Access to technology and technological capabilities, Energy security/Diversification of sources and supply, Energy security/Infrastructure and logistics for distribution and use.
INDICATORS		
1. Lifecycle GHG emissions	9. Allocation and tenure of land for new bioenergy production	17. Productivity
2. Soil quality	10. Price and supply of a national food basket	18. Net energy balance
3. Harvest levels of wood resources	11. Change in income	19. Gross value added
4. Emissions of non-GHG air pollutants, including air toxics	12. Jobs in the bioenergy sector	20. Change in consumption of fossil fuels and traditional use of biomass
5. Water use and efficiency	13. Change in unpaid time spent by women and children collecting biomass	21. Training and requalification of the workforce
6. Water quality	14. Bioenergy used to expand access to modern energy services	22. Energy diversity
7. Biological diversity in the landscape	15. Change in mortality and burden of disease attributable to indoor smoke	23. Infrastructure and logistics for distribution of bioenergy
8. Land use and land-use change related to bioenergy feedstock production	16. Incidence of occupational injury, illness and fatalities	24. Capacity and flexibility of use of bioenergy

Sustainability Indicators

- Under development for the selected mills
- Field assessment
- Desk review

Not applicable



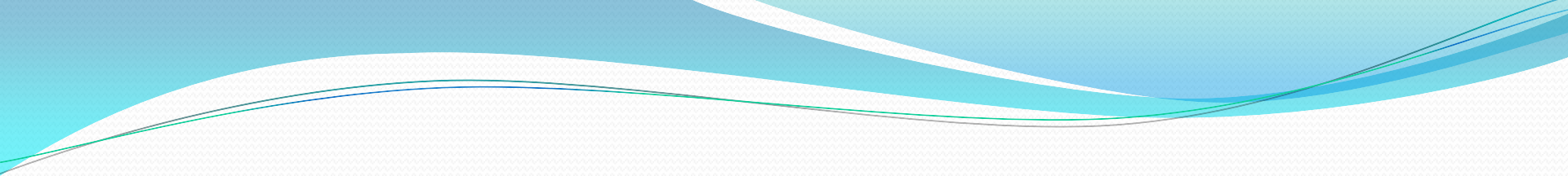
Environmental indicators

Desk review

1. GHG		89% REDUCTION COMPARED TO GASOLINE			
2. SOIL QUALITY					
3. HARVEST LEVELS OF WOOD RESOURCES	NOT APPLICABLE				
4. EMISSIONS OF NON GHG	AGROCHEMICAL CONSUMPTION		90,2 (Sugarcane)- 208,5 (corn) (kg/m3)		
5. WATER USE	5m3/tc(1997)-0,85m3/tc(2010)				
6. WATER QUALITY					
7. BIODIVERSITY	riparian forests mandatory in SP				
8. LAND USE CHANGE	EXPANSION OVERCATTLE AREAS (SP)		1,28(2001)-1,56 (2008) heads/hectare		
9. ALLOCATION AND LAND TENURE	Sugarcane suppliers: 40% of all sugarcane processed				

Field Assessment (next steps-under development)

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Some figures updated...

8. LUC - Evolution of the pasture area in the State of Sao Paulo

Desk review

	2001	2002	2003	2004	2005	2006	2007	2008
Cattle (million heads)	13,15	13,46	13,76	13,77	14,07	13,75	12,20	11,95
Pastures (million hectares)	10,29	10,10	10,11	10,12	10,01	9,71	9,12	7,64
Density (heads of cattle/ha)	1,28	1,33	1,36	1,36	1,41	1,42	1,34	1,56

Trend for more intensive use

Example of preliminar results

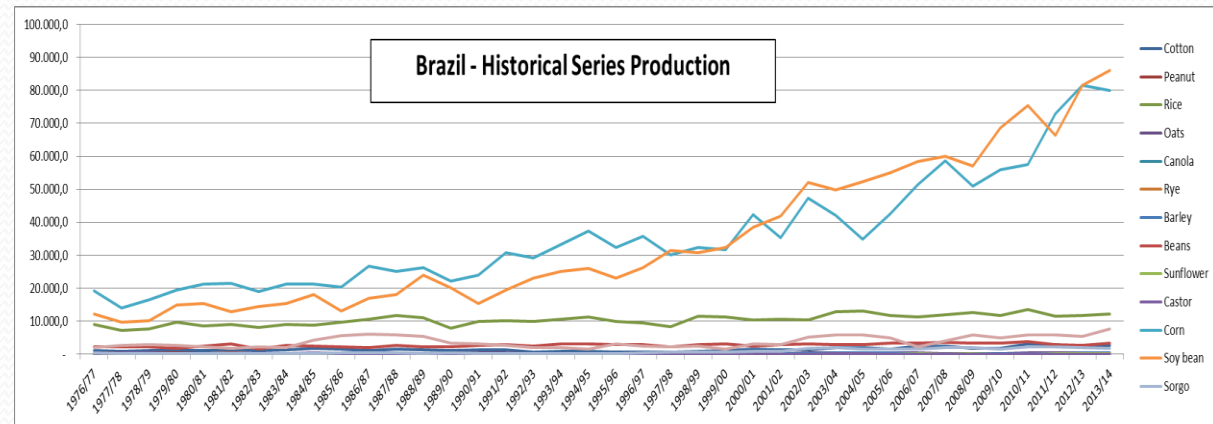
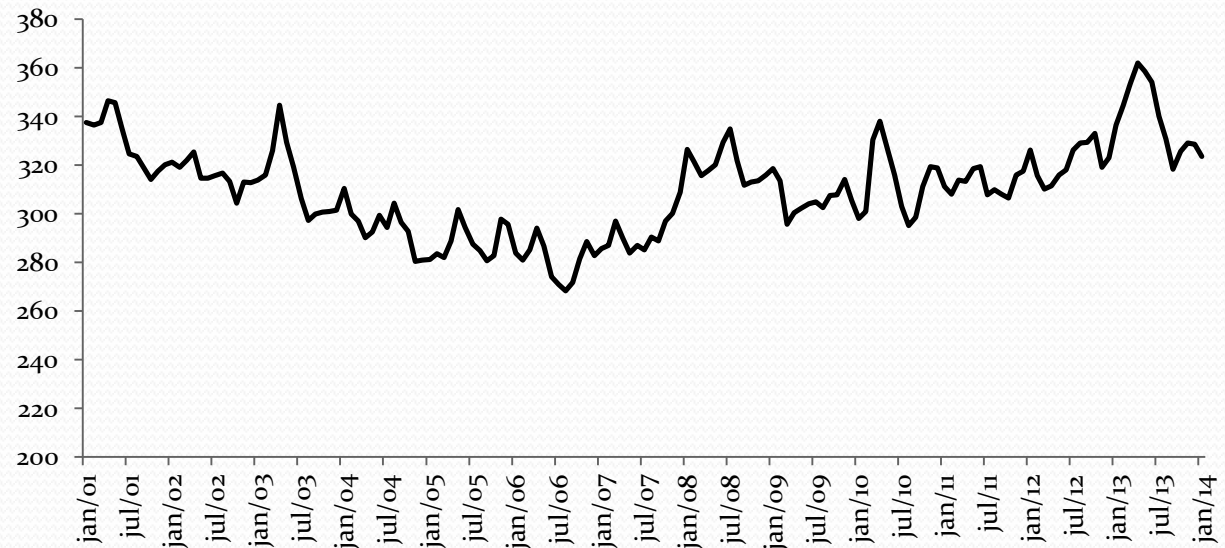
10. Price and supply of a national food basket

National food basket - São Paulo

Food	amount
Meat	6kg
Milk	7,5kg
Bean	4,5kg
Rice	3kg
floor	1,5kg
potato	6kg
vegetables	9kg
bread	6kg
coffee	600g
Fruits (banana)	90unid.
Sugar	3Kg
Oil	750g
Butter	750g

Source: Dieese (2014)

Real value of the food basket in the State of São Paulo (prices of jan / 14)



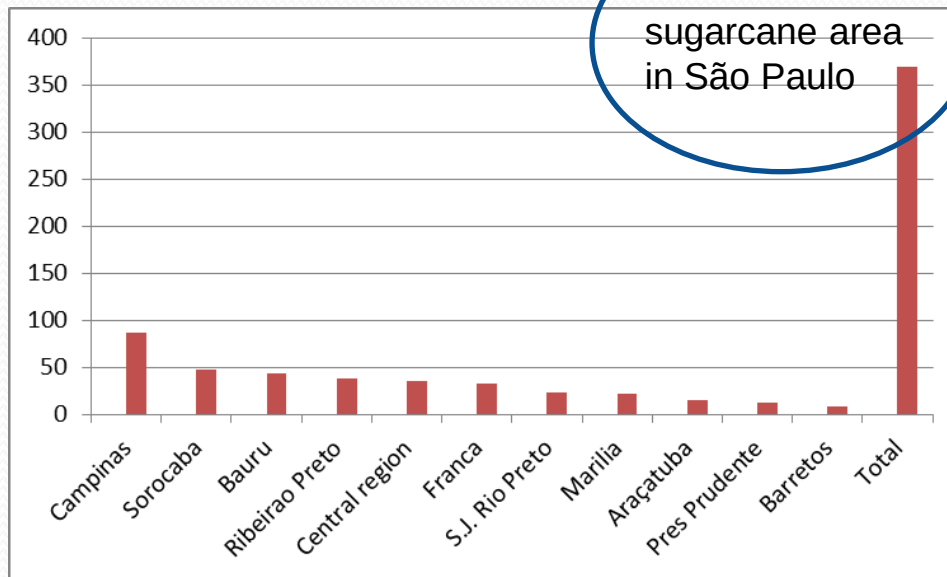
21. Social impacts from mechanized harvesting

Elimination of sugarcane crops in the state of São Paulo

Slopes higher than 12%

6.7% of
sugarcane area
in São Paulo

Thousand hectares



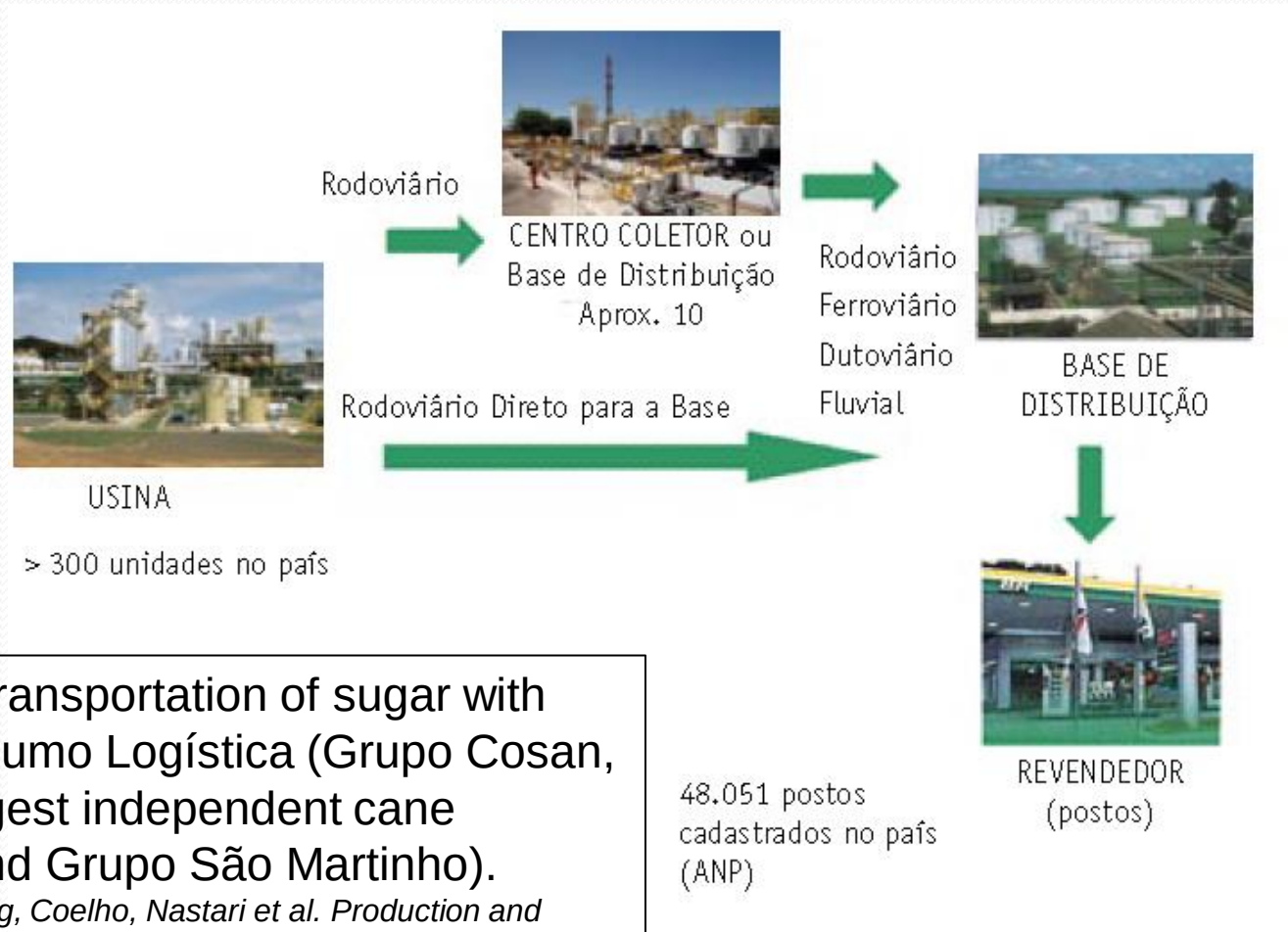
Other crops?
Or
New
harvesting
machines for
slopes higher
than 12%?

Source: Embrapa/FIESP
(2014)



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23. Infrastructure and logistic Ethanol distribution system

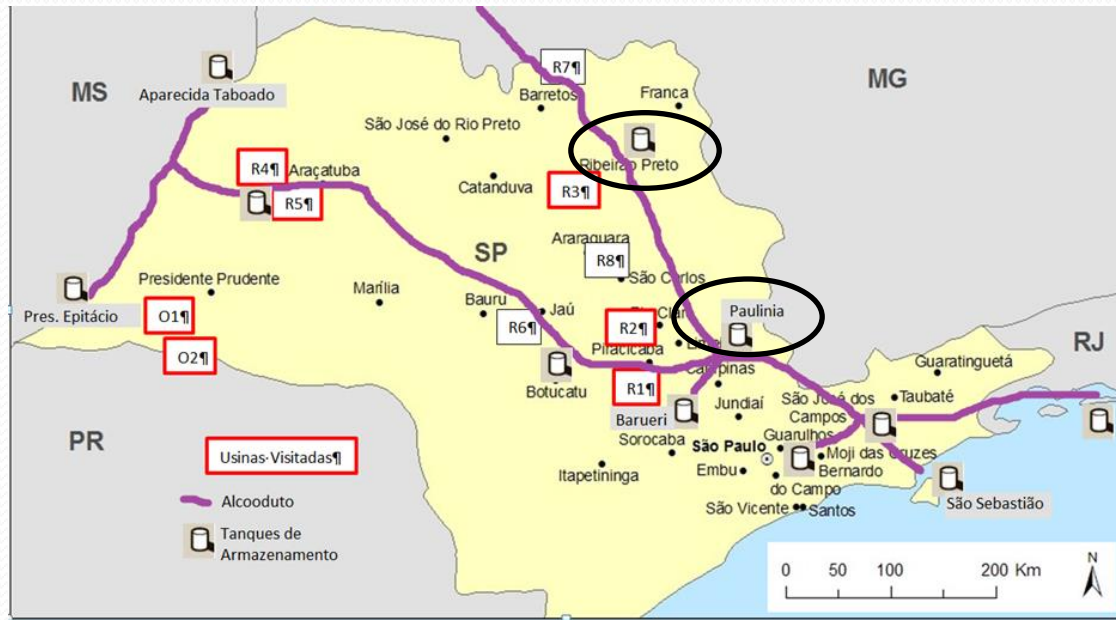


Sao Paulo: Transportation of sugar with **railcars** by Rumo Logística (Grupo Cosan, the world largest independent cane processor, and Grupo São Martinho).

Source: Goldemberg, Coelho, Nastari et al. *Production and Supply Logistics of Sugarcane as an Energy Feedstock*. In Wang, L. (ed), "Sustainable Bioenergy Production", 2013.

23. Infrastructure and logistic

Logistic - Ethanol pipelines in São Paulo



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 R7 – Junqueira, Igarapava. Raízen.
 R8 – Serra, Ibaté. Raízen.

- Logum Co. was formed as a joint venture of Copersucar, Cosan, Petrobras, ETH Bioenergia, and other independent producers.
- To construct and operate a dedicated ethanol pipeline (21.8 billion liters per year when it becomes full operation).
- First section - linking Ribeirão Preto to Paulínia (later on to Ilha d'Água terminal in Rio de Janeiro) - commissioned in March 2013.

Source: Goldemberg, Coelho, Nastari et al. *Production and Supply Logistics of Sugarcane as an Energy Feedstock*. In Wang, L. (ed), "Sustainable Bioenergy Production", 2013.

Next steps

- Field visits - Data assessment for each selected mill (under development)
- Evaluation of indicators for each mill
- Comparison with data available from desk review
- Comparison of the average figures between the two regions
 - Araçatuba/Pontal do Paranapanema (nov-14)
 - Ribeirao Preto/Piracicaba (dec-14)



Timetable

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Thanks!
Obrigada!



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