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Sustainable biofuels, rural development and private sector engagement: What can we learn from Brazil?

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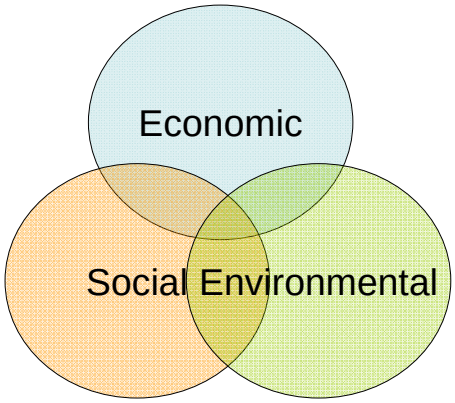
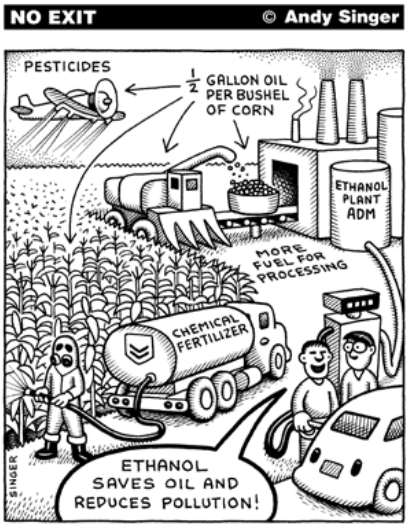
Agenda

1. Overview on the current biofuel debate
2. Ethanol production in Brazil
   - Feasibility and sustainability (small vs large scale): COOPERBIO, RGS
3. The Brazilian biodiesel program
   - Feasibility and sustainability: Quixadá project
4. Discussions

Key issues in biofuel production

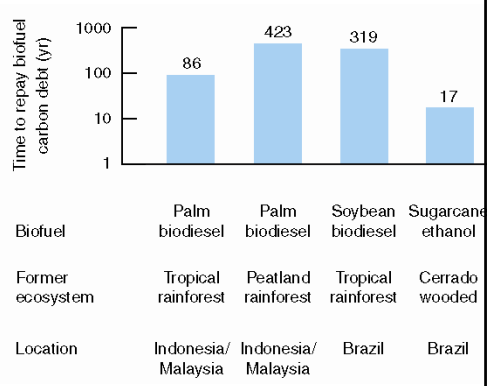
- Renewable energy
- Sustainability





Environmental sustainability

- Fargione et al (2008)
- Searchinger et al (2008)
- New expansions create a carbon debt that must be repaid
  - Clearing of rainforests or savannas (cerrado)
- Induced land use change
  - Food crops must be replaced
- Sugarcane ethanol
  - Between 4 to 45 years to repay the carbon debt



Economic sustainability

- Ethanol (2008)
  - Sugarcane: ~0.7$/gallon
  - Corn: ~3 $/gal
- Biodiesel
  - Soy: ~ 5 $/gal
  - Sunseed: ~ 7 $/gal

Social sustainability

- High commodity price
- This can have two opposite effects on poor/rural communities:
  1. Make them worse off
     - Excluded from the market
     - More expensive food and “food insecurity”
  2. Make them better off
     - Included in the “commodity” market
     - Producers and sellers
- How to make this link?

FINANCIAL TIMES

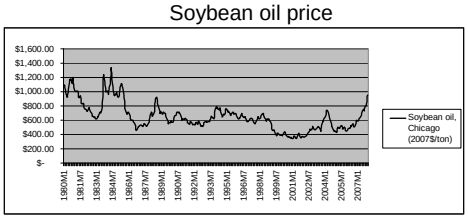
There will be oil

Pants, beards and tears

US housing crisis

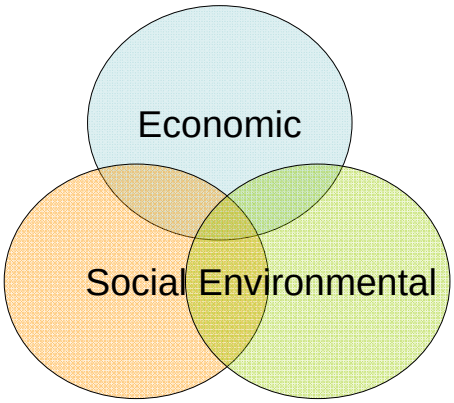
UN poised to ration food aid as prices soar

Soybean oil price



Research question

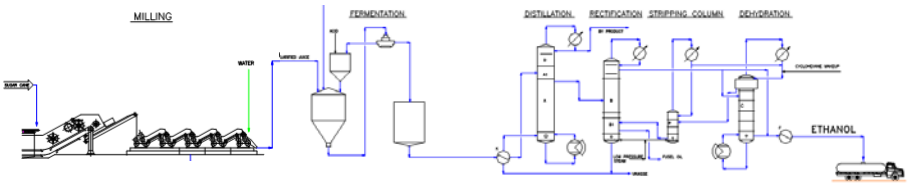
- Is it possible to have a model that is <u>truly</u> sustainable?
  - Focus on the social and economic sustainability
  - Biofuel as a rural development policy



Biofuels and the Brazilian experience

- Over 30 years experience with biofuels
  - Sugarcane ethanol is cost-competitive with gasoline
- Second largest producer of ethanol
- Large number of projects
- Innovative policies
  - Biodiesel program is promoting “socially responsible” biofuels
- Availability of different feedstock
  - Biodiesel
- Large number of small farmers (80%)
  - Interesting from a rural development perspective

Sugarcane ethanol



Hydrous ethanol

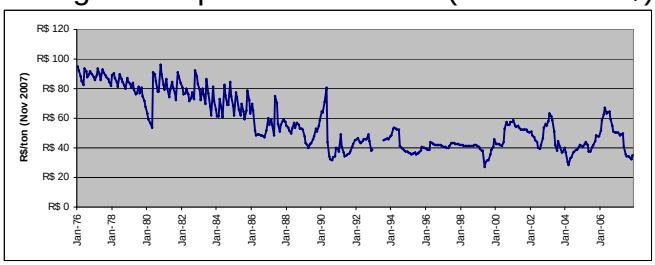
- ~93º GL
- Used pure in “flex-fuel” cars
- About 50% of the ethanol produced

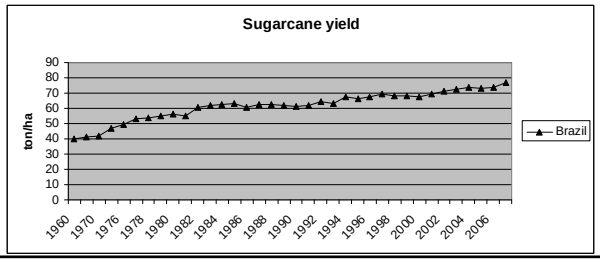
Anhydrous ethanol

- >99,3º GL
- Mixed with gasoline
- 22% (law n. 8.723/93)
  - Mixture changes in relation to market price and volume (20%-25%)
  - Today: 25%

Trends

Sugarcane price: 1976-2007 (Nov 2007 R$)

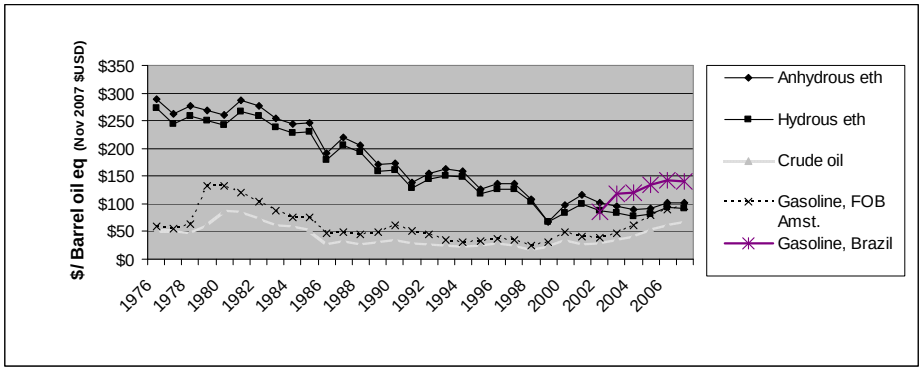




Trends

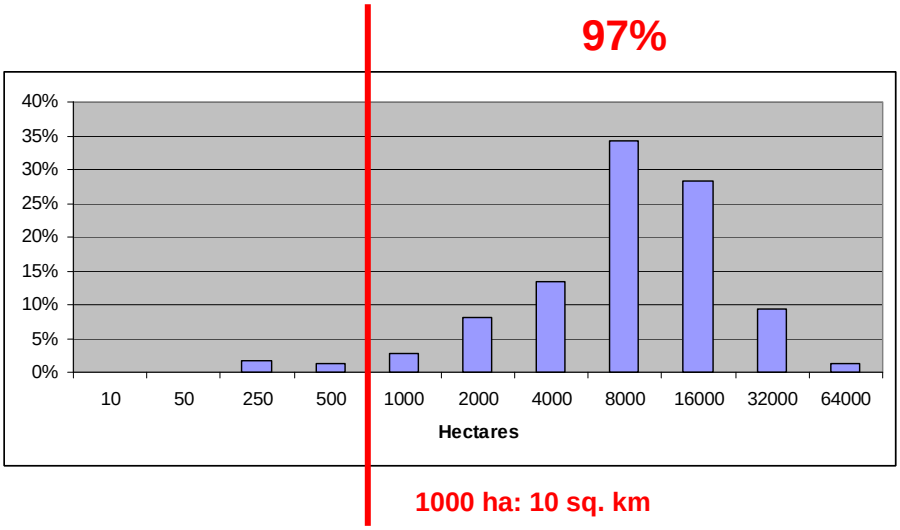
	Distillery data (Nov 2007 $)	
	1979	2007
Distillery type	Autonomous	Autonomous
Installed capacity	32,000 gal/day	260,000 gal/day
Investment cost	$ 28.5 M	$ 50 M
Unit investment cost	890 $/gal	200 $/gal
Plant efficiency	77%	98%
Sugarcane, production cost	3,100 $/Ha	1,314 $/Ha
Anhydrous ethanol, total cost	4.05 $/gal	>1 $/gal

Trends



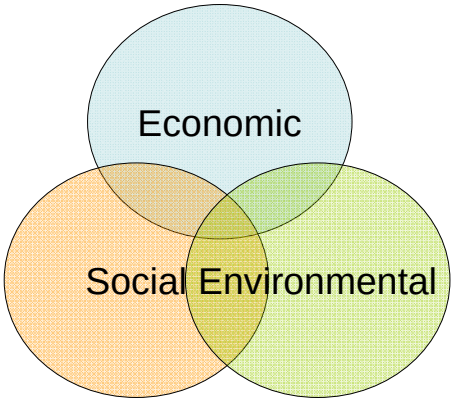
Fuel type	Energy content	Energy content in relation to oil
Anhydrous ethanol (MJ/l)	21.27	55%
Hydrous ethanol (MJ/l)	20.50	53%
Gasoline (MJ/l)	32.00	83%
Crude oil (MJ/l)	38.5	-

Scale of production



Research question

- Is it possible to have a model that is <u>truly</u> sustainable?
  - Are smaller units more sustainable?
  - How smaller?



COOPERBIO, Palmeira das Missões, Rio Grande Do Sul

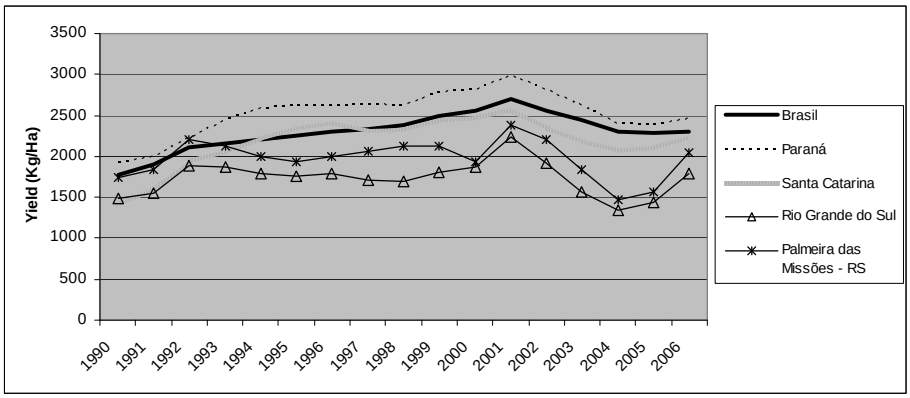
Socio-economic context

- Small farmers
  - 95.1% of farmers own less than 50 hectares of land
- Poverty
  - 90% of the families in the region live with less than 400 $/month
  - The region concentrates 36% of the poorest families in RGS
- One of the largest soy-producers of Brazil
  - 4.9% of landowners have 43.9% of the land

Why small scale ethanol?

- Transgenic soy
  - Highly risky for small farmers
  - Concentration of income
- Climate change
- High ethanol price
  - 2% produced in RGS

Baseline: soybean yield



1

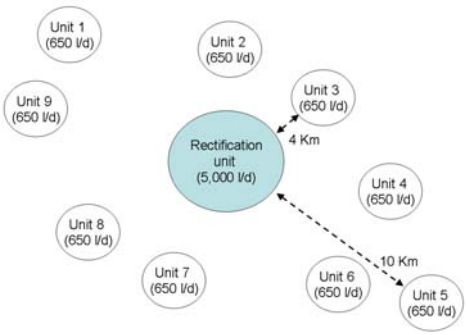
2

Objectives of COOPERBIO

- Cooperative of small farmers
  - 23,000 small farmers in the region
- Pilot project
  - Diversify farmer's production through small-scale ethanol unit;
  - Create a new logistical and distribution system for ethanol;
  - Integrate food and biofuel production.
- Project sponsor
  - Petrobras and Electrosul (about 2 M $)

Project outline

- 9 micro-distilleries
  - Quality standards (?)
- 1 rectification units
  - Reach ANP standards
  - Produce ethanol (1,200 l/day)



Micro-distilleries

Eucalyptus

Animal feed

Feedstock production

- Negotiated with Bank of Brazil specific credit conditions for farmers (PRONAF)
  - 500 $/Ha
    - 2% interest rate, 12 years
    - Seeds or seedlings
      - Semi-perennial trees (jatropha, tungue): vegetable oil
      - Native species: reforestation especially along water course
      - Energy crops: sugarcane and eucalyptus
      - Fruits: oranges and apple
  - Maximum of 2 Ha per family of sugarcane
    - Avoid monocultures
    - Product diversification
    - Share benefits among families
    - Borderline effect

Feasibility analysis: assumptions

Small-scale	Large-scale
New project (greenfield)	New project (greenfield)
Operated by 15 farmers	Centralized operator (i.e. investment fund) employing 2,400 workers
Manual harvesting	Some mechanization in harvesting.
The hydrous ethanol will reach the ANP standards	The hydrous ethanol will reach the ANP standards
Farmers sell sugarcane to the distillery at production cost	Distillery rents 70% of the land and purchases 30% of the feedstock at market price
All production costs keep constant with time, 12 years	All production costs keep constant with time, 12 years
Hydrous ethanol is sold to the final consumers	Hydrous ethanol is sold to a distributor
All sugarcane (29.5 hectares) is planted during the first year	All sugarcane (26,638) is planted during the first year
Fully operational already in year 1	Fully operational already from year 1

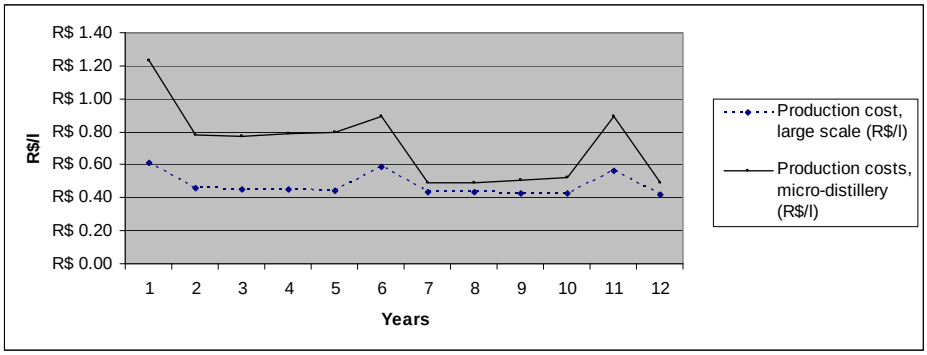
Feasibility analysis: cash flow

	Small-scale	Large-scale
Installed Capacity (l/day)	650	1,000,000
Total investment – turn key (R$)	161,500	105,389,000
Unit investment (R$/l)	248	105
Total number of farmers or workers	15	2400
Investment per farmer (R$)	10,766	-
Interest rate (%)	2	12
Loan period (years)	5	12
Debt (%)	100	70
Depreciation (years)	20	20
Sugarcane production cost, year 1 (R$/Ha)	1,920	1,920
Sugarcane production cost, year 2-5 (R$/Ha)	470	470
Feedstock cost, average 5 years (R$/ton)	7.00	35 (30% purchased at 35 R$/ton)
Local price, hydrous ethanol RGS (R$/l)	1.89	-
Selling price, ethanol (R$/l)	1.50	0.75

Feasibility analysis: technical input

	Small	Large
Area required (Ha)	30	25,862
Sugarcane yield (ton/Ha)	66	87
Installed Capacity (l/day)	650	1,000,000
Operating days/year	180	180
Operating hours	24	24
Production efficiency, milling (%)	75%	97%

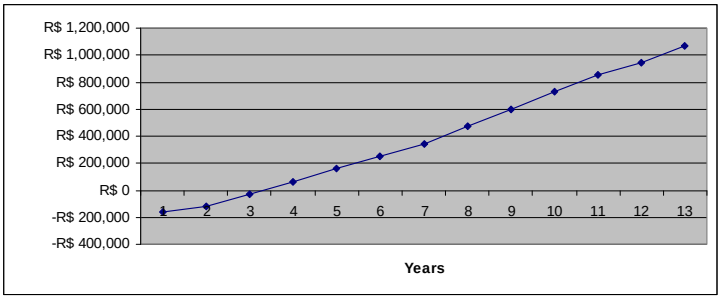
Results



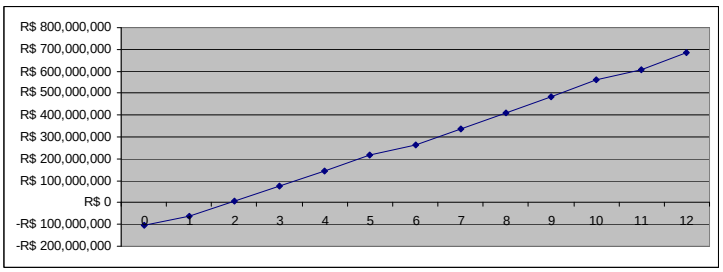
- Small scale: more expensive
  - 0.73 R$/l equivalent to:
    - 96 $/barrel oil eq <u>or</u>
    - 2.11 $/gallon of gasoline
- Large scale: less expensive
  - 0.47 R$/l equivalent to:
    - 61 $/barrel oil eq <u>or</u>
    - 1.35 $/gallon of gasoline

Economic sustainability: payback

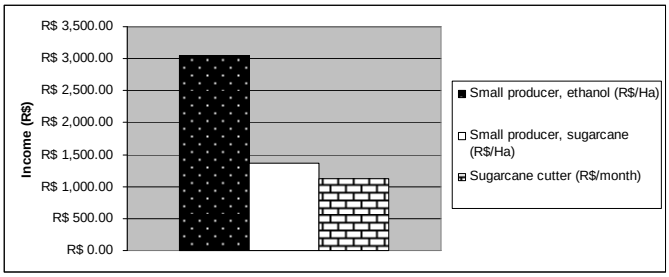
Small

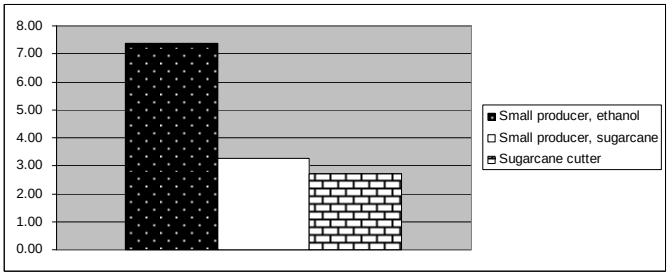


Large



Social sustainability: income





Minimum salary: 415 R$/month

Sustainability: other factors

- Job created/$ invested
  - 1980's: $ 23,000/direct job (nominal)
  - 1991: $ 41,000/job in 35 leading sectors
  - 2007
    - Large scale: 44,285 $/job created
    - Small scale: 27,726 $/job created (*)
- Job quality
- Number of jobs
  - 44,800 in the 5,600 municipalities (a new Petrobras)
- Food security
- Environmental impacts
  - New crops: displace food crop and induced Amazon or "cerrado" deforestation
- Roundtable on sustainable biofuels (labor rights, food security, poverty alleviation, land rights)

* Including subsidies

Key issues

- **Commercialization**
  - Auto-production and consumption
  - Niche market
    - New ANP resolution (through Petrobras) where microdistilleries up to 5,000 l/day can have own retailers
    - "Socially responsible ethanol" (certification or fair trade product)
    - Avoid "dumping" effect
  - Airplanes used in agriculture
- **Quality standards (ANP)**
  - Achivable if there will be a market
- **Financing**
  - Currently, too risky
  - New financing mechanisms there will be a niche

Job quality

- "*Blitz in Alagoas gives freedom to over 550 workers in a sugarcane distillery*"
  - "*…terrible working conditions*"
    - *"several people living in one room"*
    - *"no windows"*
    - *"workers felt humiliated and treated like slaves"*
  - "*The auditor that was in charge of the operations said that it will be very difficult to export ethanol under these [working] conditions*"

March 2008

A8 brasil

Blitz em Alagoas liberta mais 550 trabalhadores de usinas

Toda Mídia

Fé renovada

Força-tarefa encontrou empregados alojados em locais insalubres e sem água potável

Usinas dizem que vão sanar irregularidades

Conclusions

- Microdistilleries are viable and sustainable
  - The can occupy a portion (i.e. 5 %) of the market share
- Several socio-economic benefits compared to large scale
- However their dissemination is fully dependent on the creation of a protected niche market
  - There are the conditions that this will happen
- **Can some of these features be scaled-up to larger plants?**

Biodiesel

Biodiesel

- It is a renewable energy source that can be used for:
  - Transport (when blended with diesel – B5; B20; B100)
  - Energy generation
- It comes from the *transesterification* of vegetable oils or animal fats
  1. Seeds that have oil
  2. Press them to get the oil out
  3. Refinery: add methanol or ethanol + catalyst (NaOH)
     - Biodiesel
     - Glycerol

National Biodiesel Program (PNPB)

- Introduced in 2004
  - 2% blend by 2008; and
  - 5% blend by 2013
- Brazil imports ~9% of its diesel
  - About 3 Billion US$
- Keep leadership in biofuel
- Link poverty reduction to biofuel
  - President Lula's social policy

The Social Fuel Certification

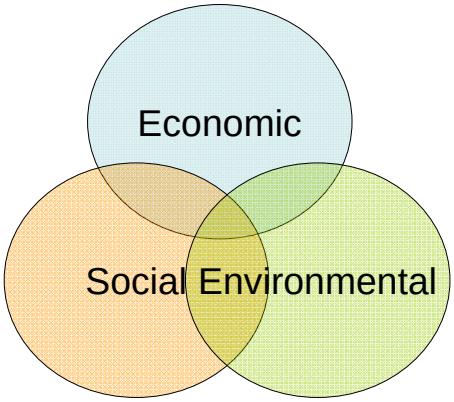
- Tax incentives to biodiesel producers that buy feedstock from small farmers
  - Small farmers and water scarcity

Geographical region	Participation of family agriculture (%)	Participation of intensive agriculture (%)
North	10%	90%
Northeast and semi-arid	50%	50%
Center-west	10%	90%
Southeast	30%	70%
South	30%	70%

	North region		**Northeast and semi-arid region**		**Center-west**	**South East**	**South**
	Small farmers	**Other**	**Small farmers**	**Other**	**Small farmers**	**Small farmers**	**Small farmers**
Castor seed	100%	30.50%	100%	30.50%			
Palm tree	100%	30.50%	100%	30.50%			
Any raw material	67.90%		67.90%		67.90%	67.90%	67.90%

Research question

- Is it possible to have a model that is <u>truly</u> sustainable?
  - Can an “energy production” policy help reducing poverty?

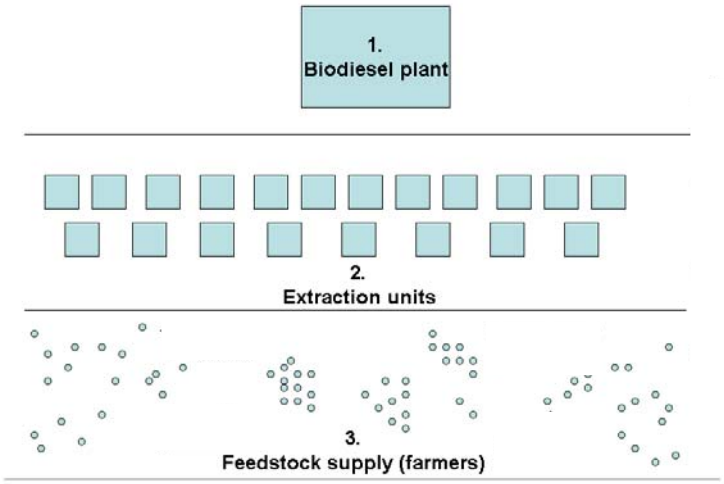


Quixadá biodiesel plant, Ceará

Quixadá biodiesel plant, Ceará

- Developed by Petrobras
  - Model for other 4 plants
- Capacity: 50 Million l/year
- About 45 M$
- Located in the semi-arid region of Brazil
  - Poorest
  - Potential for some oil seeds
    - Castor
    - Jatropha
    - Cotton
    - Palm

Project outline

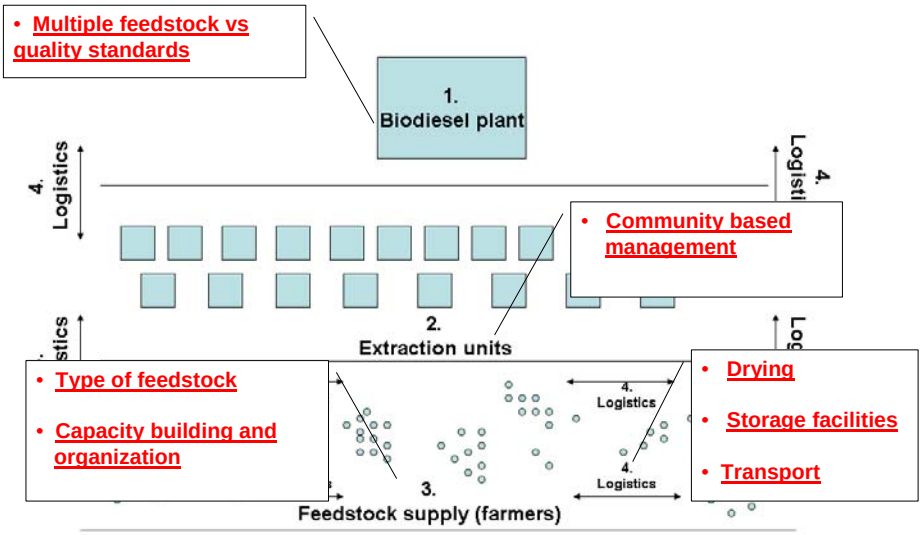


Incentives to farmers

- Minimum price for the seeds
  - 0.35 to 0.5 $/kg
- Cash (75 $/Ha)
- Free seeds
- Technical assistance (EMATERCE and BNB)
- 50% of the cost for chemical stabilization of land

- BNB (regional development bank) helps in setting up the financial structure of the project

Project outline



Social benefits: assumptions

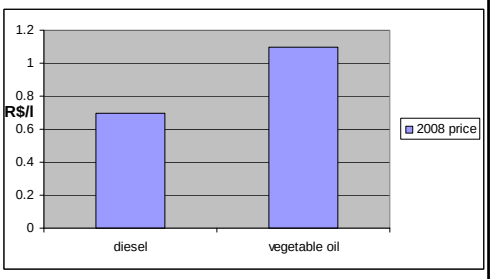
- Baseline: minimum salary (200 $/month)
- Production cost, any oilseed (300 $/Ha)
- Yield
  - Castor
  - Sunflower
  - Cotton
- Transport cost
- No pressing cost
- Price to producers: seeds
- Price to producers: oil
- Price to producers: cake/protein meal

Preliminary results

	A - Selling seeds		B - Selling oil		C - Selling meal	D - Selling oil and meal	
	With incentive	Without incentive	With incentives	Without incentives		With incentives	Without incentives
Baseline (R$/Ha)	1	1	1	1	1	1	1
Cotton (R$/Ha)	1.8	1.4	1.2	0.8	1.3	2.4	2.1
Castor bean, NE (R$/Ha)	0.7	0.4	0.7	0.4	-	-	-
Castor bean, BRS En (R$/Ha)	1.7	1.3	1.7	1.3	-	-	-
Sunflower (R$/Ha)	0.3	0.4	1.3	1	0.8	2.2	1.8

General considerations

- Still work on progress
  - Weekly changes
  - Why castor bean?
- Crop modifications may increase yield
- Conflict of interests between small farmers and biodiesel producers
  - The largest biodiesel producer did not pay what agreed with the farmers
    - Net losses of 20 M$ in 2007 (0.1 $/l)
- Smaller “local scale” units or larger “regional” ones?
  - Pressing units and biodiesel
  - Start from a “social” perspective



Micro-entrepreneurship

Final considerations

- It is possible to link poverty and rural development to the commodity market
  - Quiet a lot of work needs to be done
- Next steps
  - Ethanol
    - Understand the carbon balance
    - Can some of the features that characterize small scale plants be scaled up?
  - Biodiesel
    - Refine a business model that is viable at a local and national level
    - Work with the private sector to look at all the different components