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The Sustainability of Brazilian Sugarcane Ethanol: The Contribution of CTBE

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CTBE – Brazilian Bioethanol Science and Technology Laboratory

RCN Pan American Biofuel and Bioenergy Sustainability Conference

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Contents

- ✓ Sugarcane ethanol sustainability issues
- ✓ CTBE Programs and Impacts on ethanol sustainability
  - Agriculture
  - Industrial
  - Technology Assessment
  - Basic Science
  - Sustainability

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GEBEP Sustainability Indicators

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INDICATORS		
Environmental	**Social**	**Economic**
Lifecycle GHG emissions	Allocation and tenure of land for new energy production	Productivity
Soil quality	Price and supply of a national food basket	Net energy balance
Harvest levels of wood resources	Change in income	Gross value added
Emissions of non-GHG air pollutants, including air toxics	Jobs in the bioenergy sector	Change in consumption of fossil fuels and traditional use of biomass
Water use and efficiency	Change in unpaid time spent by women and children collecting biomass	Training and re-qualification of the workforce
Water quality	Bioenergy used to expand access to modern energy services	Energy diversity
Biological diversity in the landscape	Change in mortality and burden of disease attributable to indoor smoke	Infrastructure and logistics for distribution of bioenergy
Land use and land use change related to bioenergy feedstock production	Incidence of occupational injury, illness and fatalities	Capacity and flexibility of use of bioenergy

Source: GBEP, 2011

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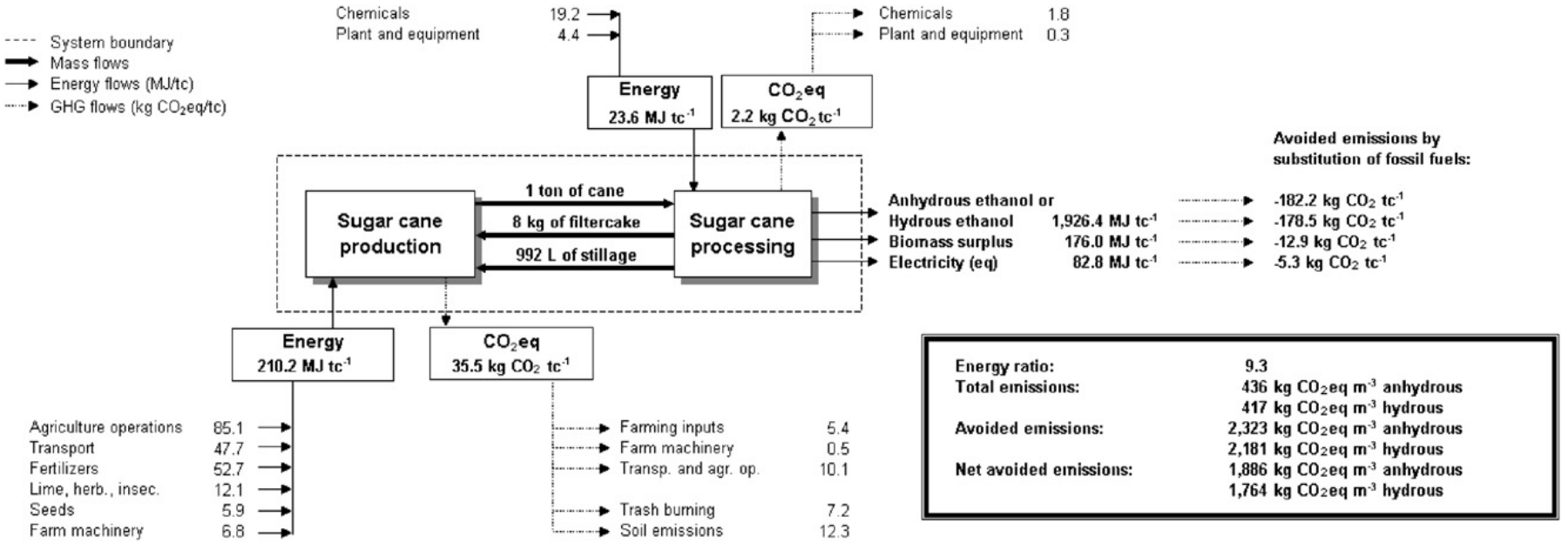
Energy and GHG Emissions Balances



Source: Macedo et al., 2008

Basic science and innovation: Fundamental initiatives to keep Brazilian leadership in sugarcane/ethanol production cycle.

A National Laboratory on Bioethanol

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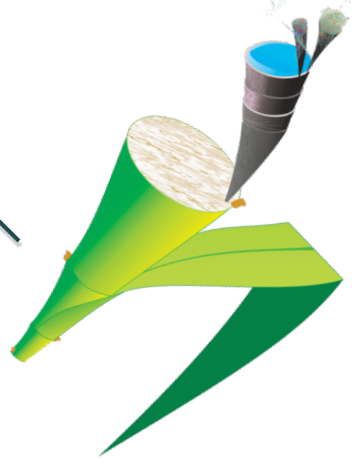
Own team dedicated to Research, Development and Innovation

Infrastructure available to research institutions (universities and industries)

Focus on innovation and integration of new technologies towards a more complex Bio-refinery of sugarcane

Numbers:

. Implanting Federal Funding (2008-2010): **US$ 50 million**
. Buildings: **8.722,28 m²**
. Research team by 2013 (biologists, physicists, chemists and engineers): **110 employees**



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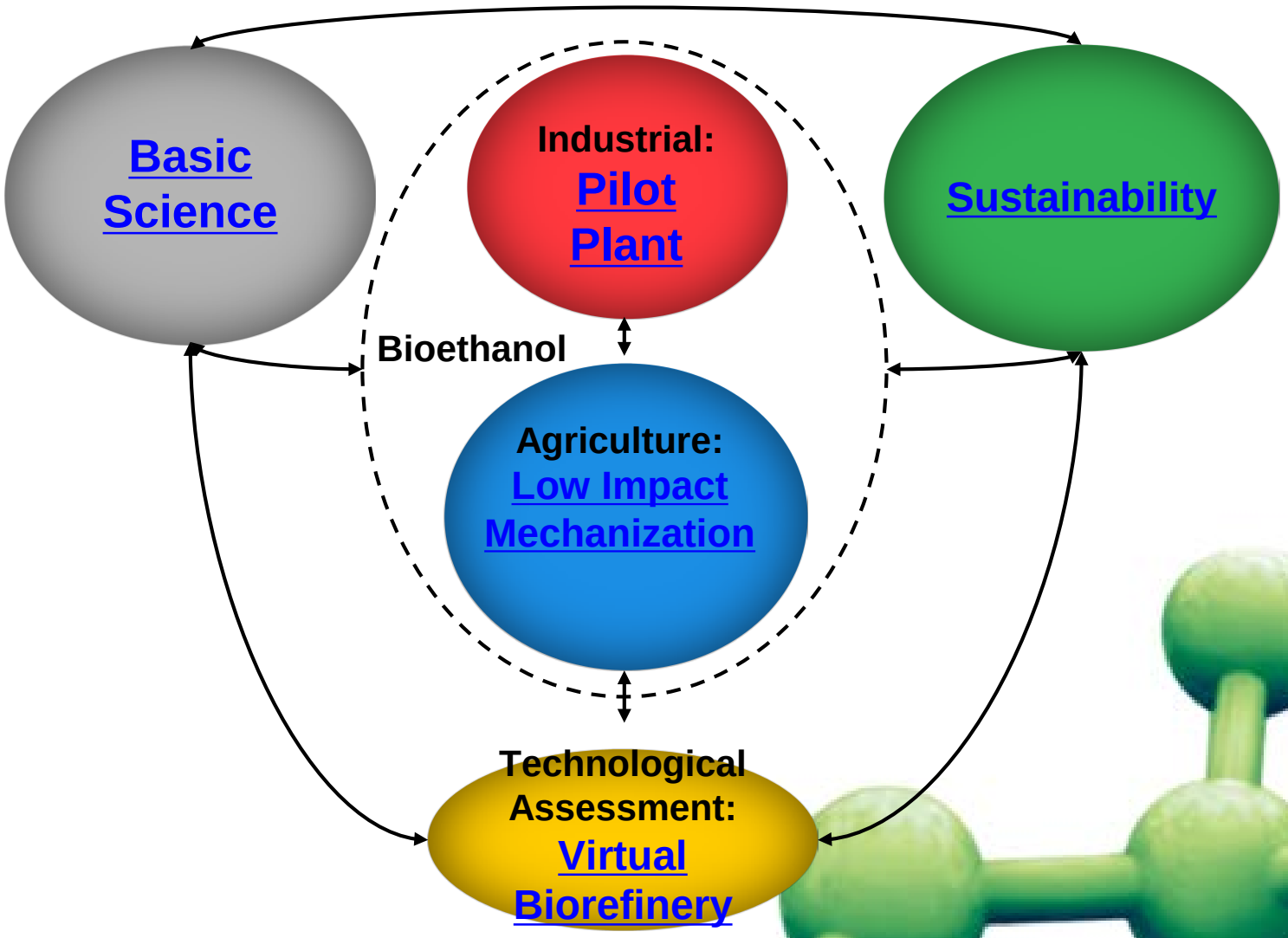
Programs



Low Impact Mechanization to Reduce Soil Compaction

1. No-till farming
Structure for Controlled Traffic farming (ETC)

2. Precision farming
IT for Agricultural Management - Data acquisition, communication and agricultural modeling

3. Trash recovery
Quality and cost of recovered trash; amount to be left on the ground

4. Mechanized Planting
Seed cane quality and distribution in the furrow.

Expected Results: improve soil quality, increase sugarcane yield, reduce fossil fuels and fertilizers use, reduce GHG emissions, reduce harvest losses, reduce sugarcane production costs, recover the straw integrated with sugarcane.

ETC: Low Impact Mechanization System

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- Help in the implementation of no-till farming of sugarcane (soil protection and costs and GHG emission reduction)
- Introduce Precision Agriculture
- Develop mechanization to reduce traffic on planted area from 60% to 13%
- Permit sugarcane cultivation with optimized row spacing

- Tests in the field will be conducted with the participation of collaborating mills
- This is a joint project with a Brazilian Industry JACTO with financial support of US$ 9.4 million from BNDES

Low Impact Agricultural Mechanization

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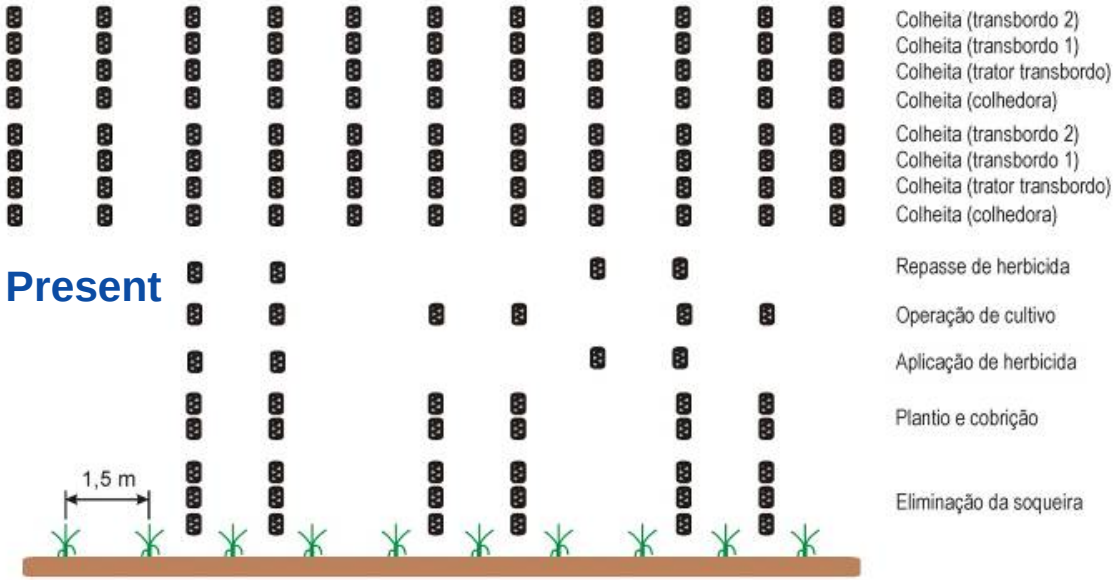
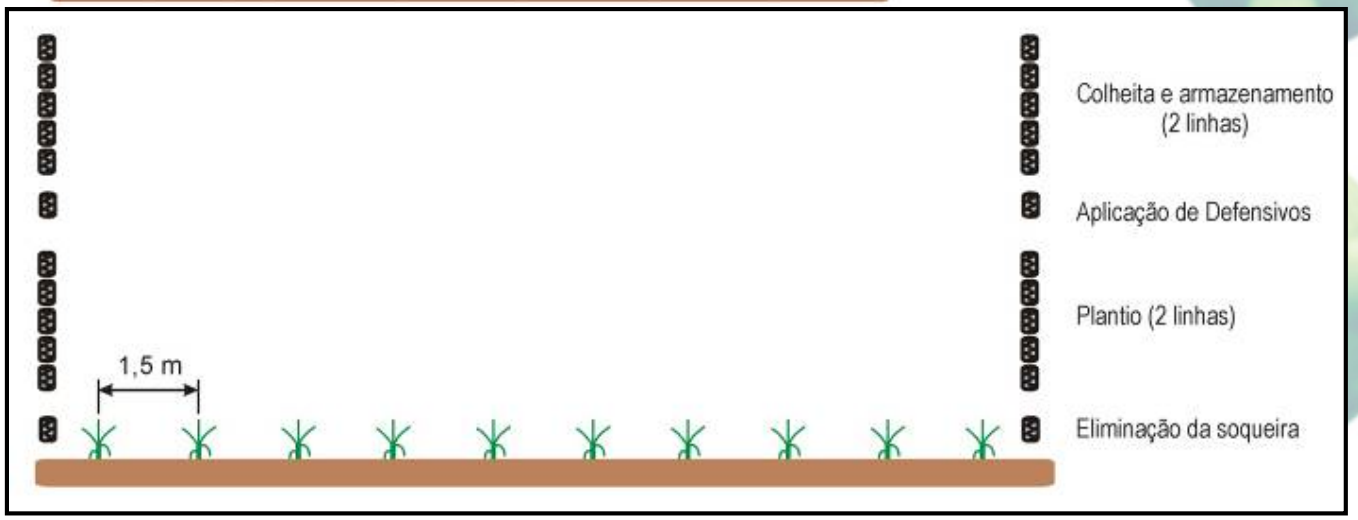
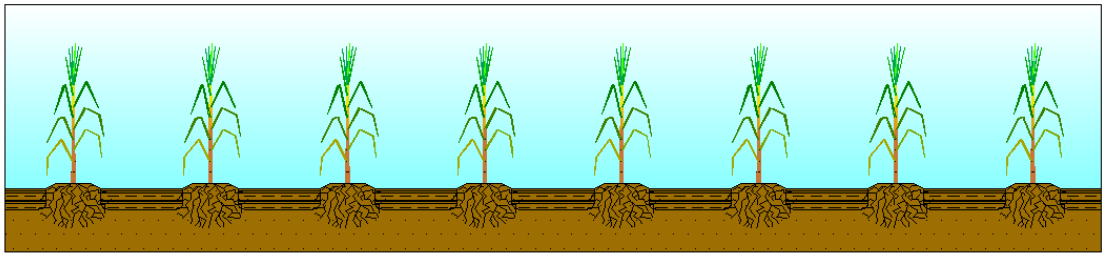
Present



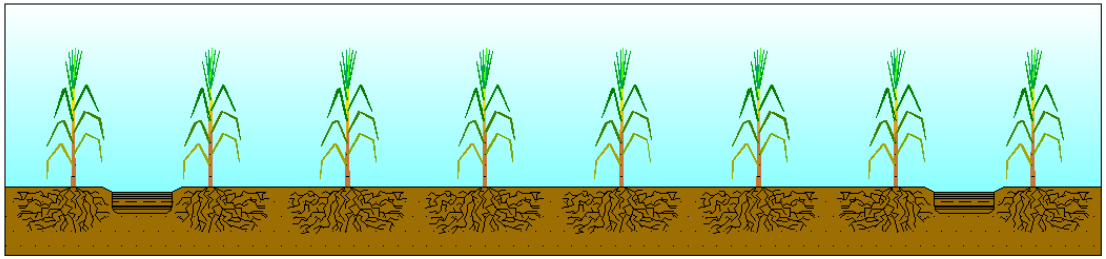
Traffic over 60% of the area



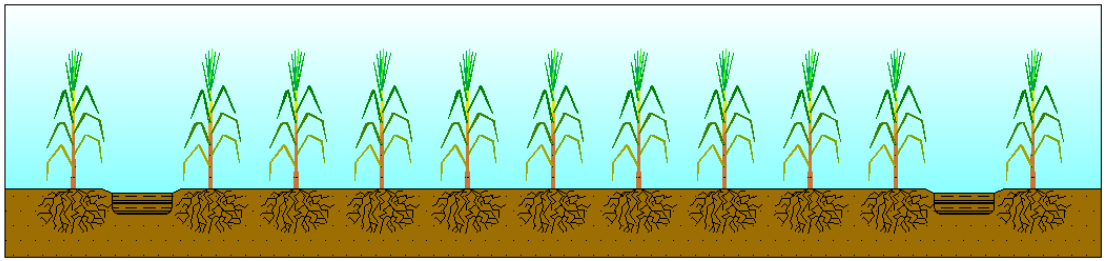
Better Conditions to Propagate the Root System



Conventional
1,5 m



ETC 1,5 m



ETC 1,0 m

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Impacts of Row Spacing on Cane Yield

BUREAU OF SUGAR EXPERIMENT STATIONS

QUEENSLAND, AUSTRALIA

Figure 4 Impact of row spacing on cane yield in the plant crop in three cultivars

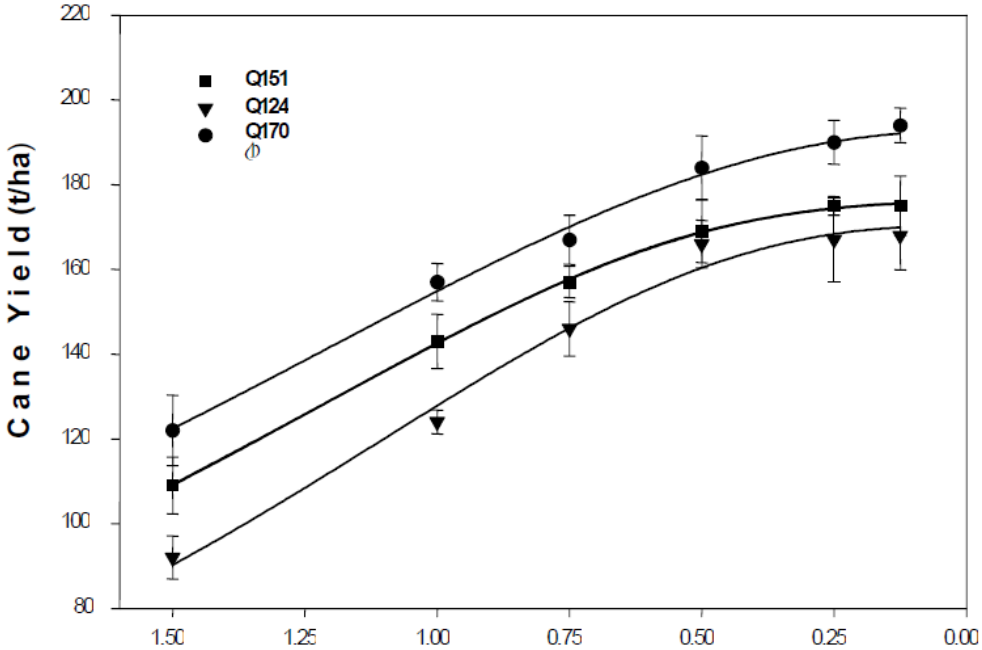

Table 5 Relative impact of inter-row and intra-row spacing on key yield parameters of cultivars Q124, Q151 and Q170[Φ]

Row spacing (m)	Within-row space (eyes/m)	Eyes planted (,000/ha)	Stalk number (,000/ha)	Weight /stalk (kg)	Cane yield (t/ha)	CCS	Sugar yield (t/ha)
1.5	2.5	17	70.6	1.25	88	16.6	15.6
1.5	5	33	80.7	1.19	96	16.9	17.0
1.5	10	67	97.7	1.12	112	17.4	20.1
1.0	2.5	25	113.2	1.07	123	16.6	23.3
1.0	5	50	122.3	1.13	138	16.6	24.4
1.0	10	100	131.3	1.04	137	15.8	23.9
0.5	2.5	50	128.4	1.17	150	16.0	24.3
0.5	5	100	146.6	1.08	159	16.2	27.2
0.5	10	200	157.1	1.04	164	16.8	31.1

October 2002

FINAL REPORT - SRDC PROJECT BSS212

INVESTIGATION OF THE LIMITS TO HIGH DENSITY PLANTING

by

J L Collins

Mechanized Planting

Quality of seed cane and seed spacing in the forrow

Seed distribution in manual and mechanical planting

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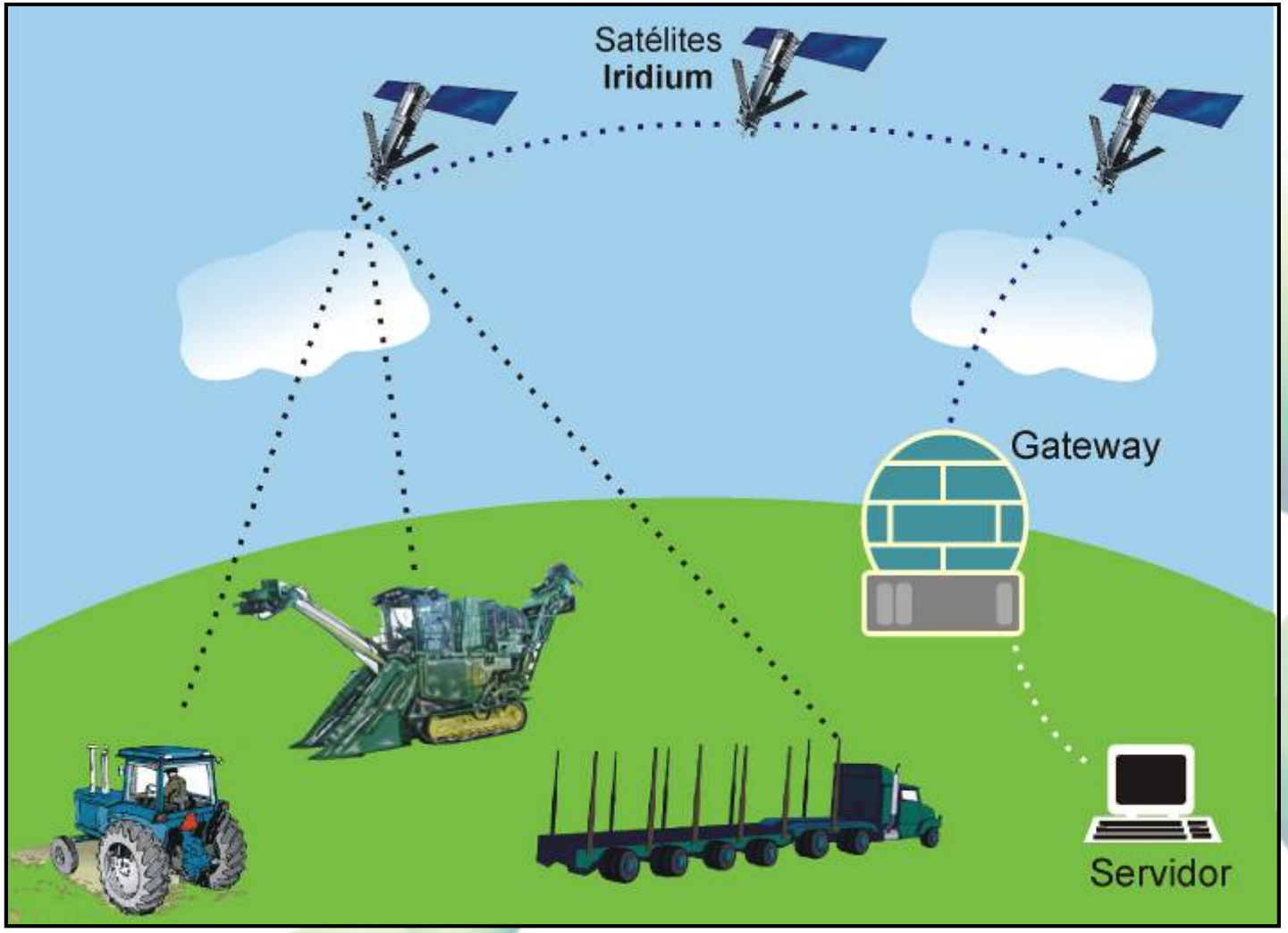
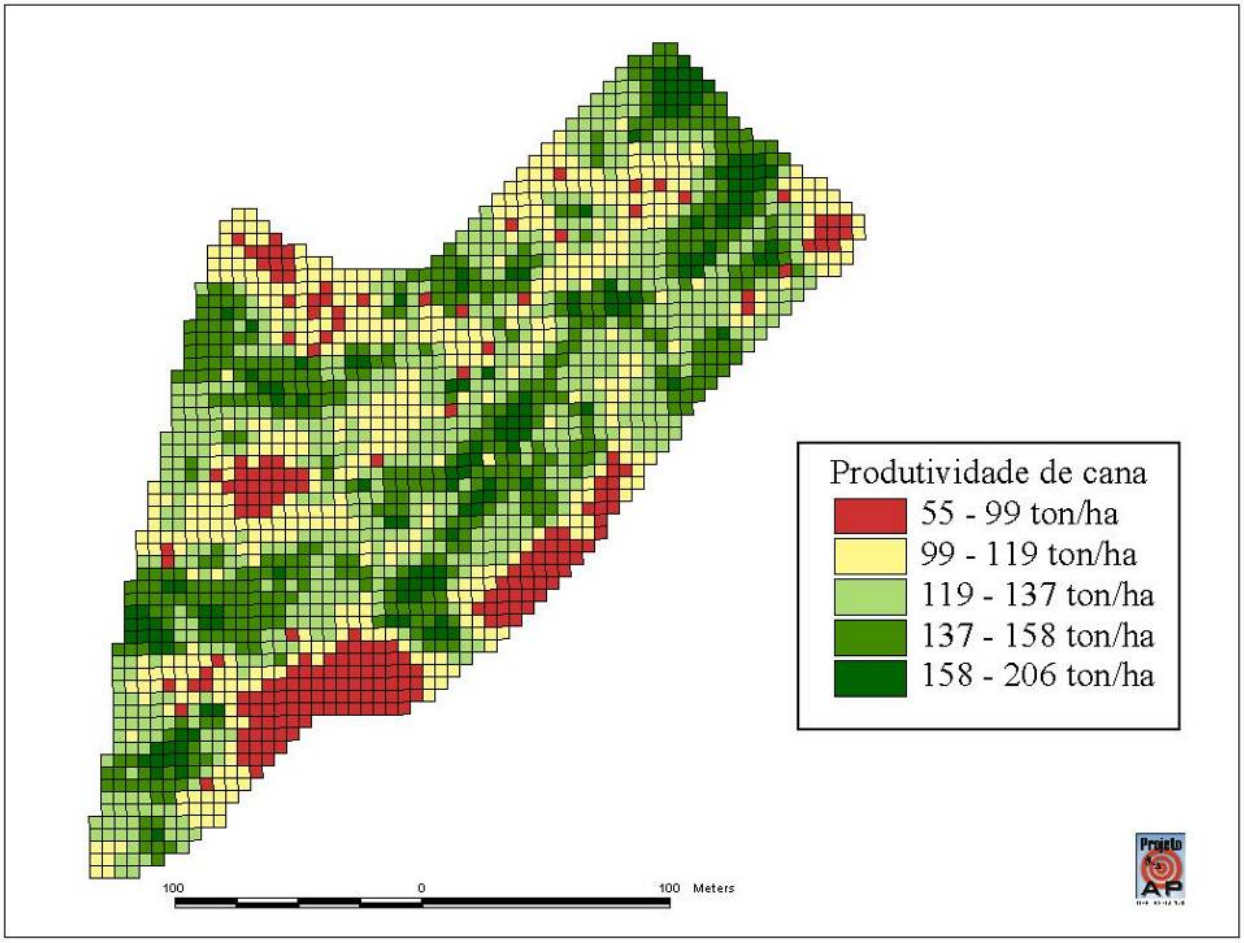
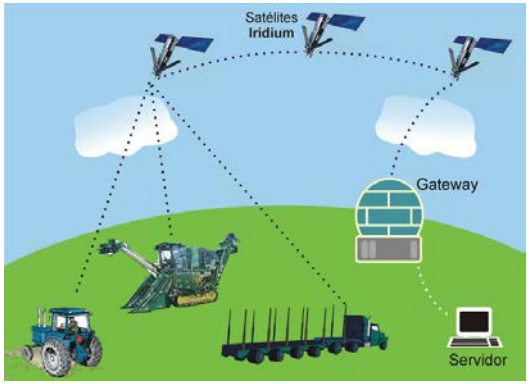
Precision Farming



Precision Farming





Source: Molin, J.P.

Pilot Plant for Process Development (PPDP)

- Development of technologies for cellulosic ethanol (estimated increase of 40% in ethanol production).
- Complex for technological development is open to external groups.
- Offer *"scaling up"* to scientific community and industry
- Deep scientific knowledge to overcome technological challenges pointed out by the productive sector.

Conversion of Bagasse to Ethanol

Critical steps

- Physical and/or Chemical pretreatment of sugar cane bagasse;
- An enzymatic complex (hydrolases) tailored for conversion of cellulosic raw materials into fermentable sugars;
- Development of enzymatic hydrolysis process;
- Microorganisms for fermentation of pentoses to ethanol.

Once commercial the 2G ethanol from sugarcane residues will increase yields by ~40%

Pilot Plant for Process Development
PPDP

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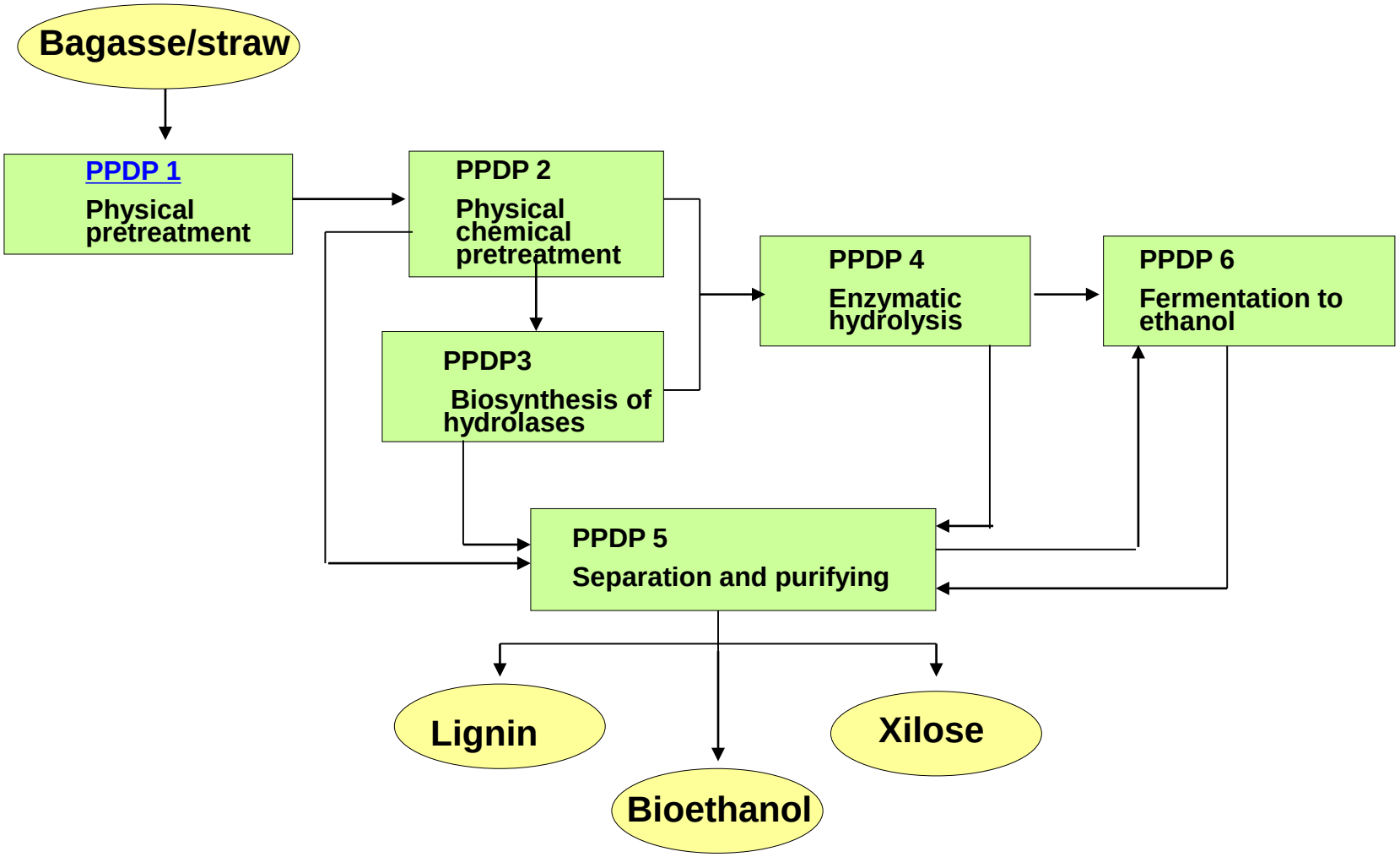
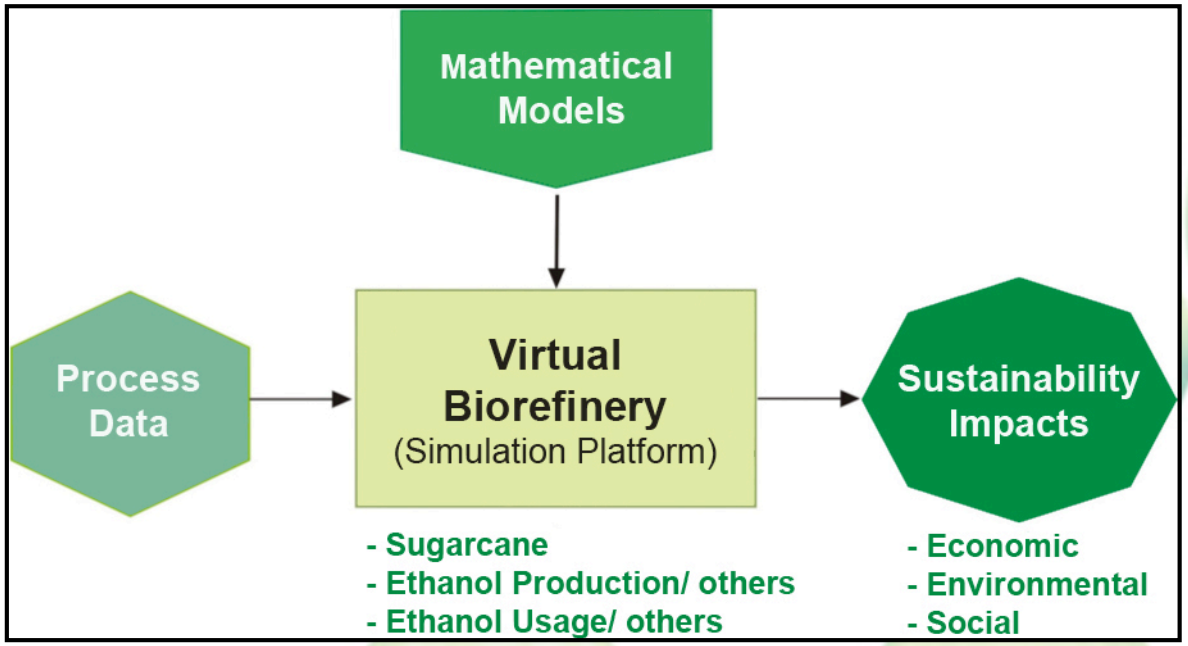


Biorefineries Integrated Evaluation

- Assessing impacts of new technologies on the ethanol production cycle
- Optimization of processes and integration of new technologies in the present industry
- Analysis of priorities for investment planning
- Investigating the possibility of using sugarcane biomass as a carbon source

Concept



Virtual Biorefinery Flowchart

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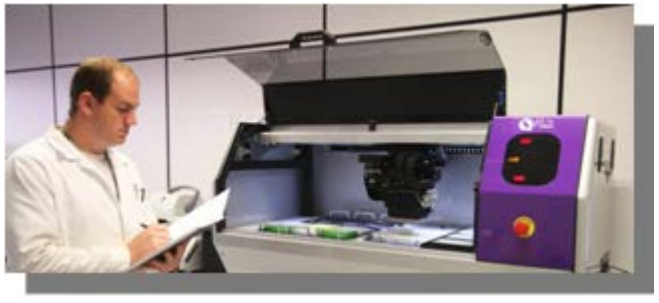

- Agenda that goes from sugarcane photosynthesis to the deconstruction of cellulose structure into fermentable sugars (controlled recovery of sugars from bagasse and trash cellulose for ethanol production)

- In addition to its own research agenda, supporting other CTBE programs

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Sugarcane Physiology - Leaves: How does CO_2 turn into sugars?

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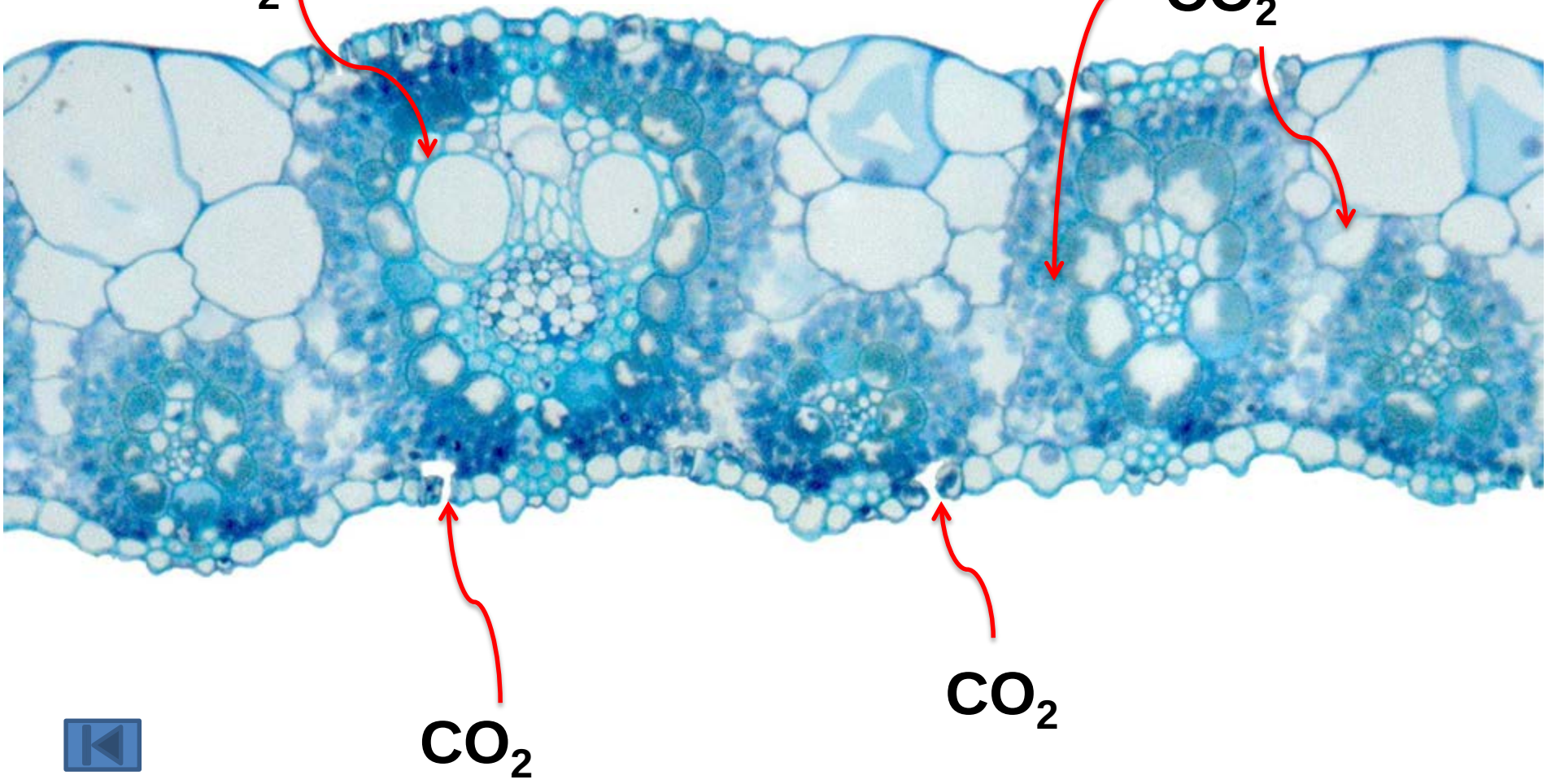
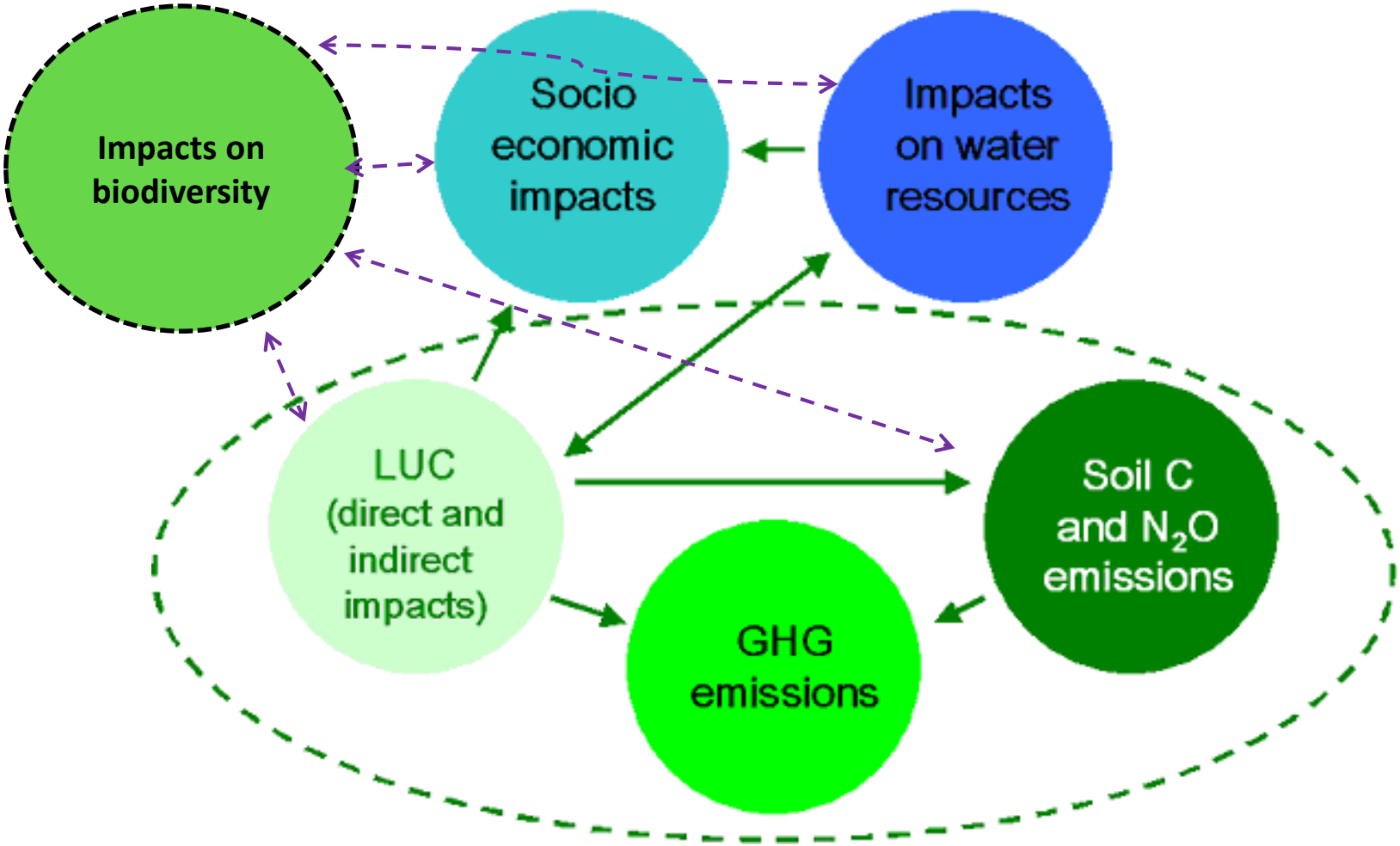


Sustainability

- Ethanol sustainability evaluation, considering present and future technologies.
- Generating data for public policies.
- Georefenced data basis

- Focus (obtaining data in the sugarcane cycle for a scientific discussion on):
  - Energy balance and GHG emissions
  - Direct and indirect land use change (LUC and ILUC)
  - Soil carbon stock and soil emissions (CO_2 and N_2O)
  - Socioeconomic impacts
  - Impacts on water resources quality and availability
  - Impacts on biodiversity
  - Integrated sustainability analysis


Impacts on biodiversity
Socio economic impacts
Impacts on water resources
LUC (direct and indirect impacts)
Soil C and N_2O emissions
GHG emissions

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Soil Carbon Stocks

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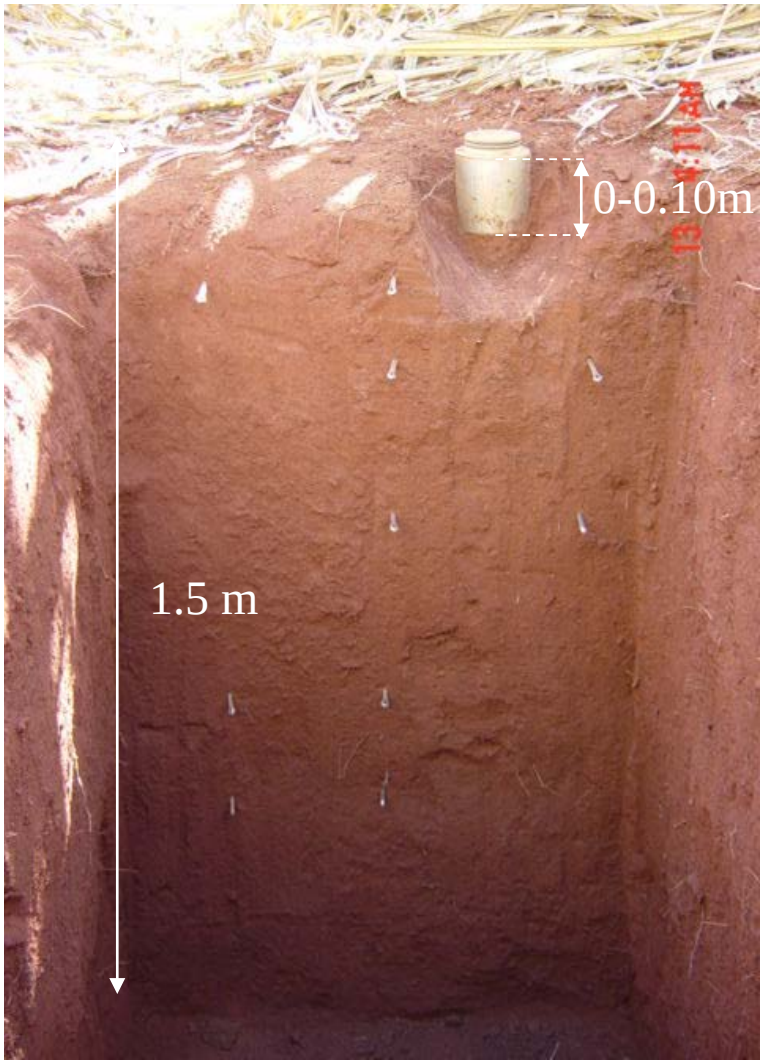

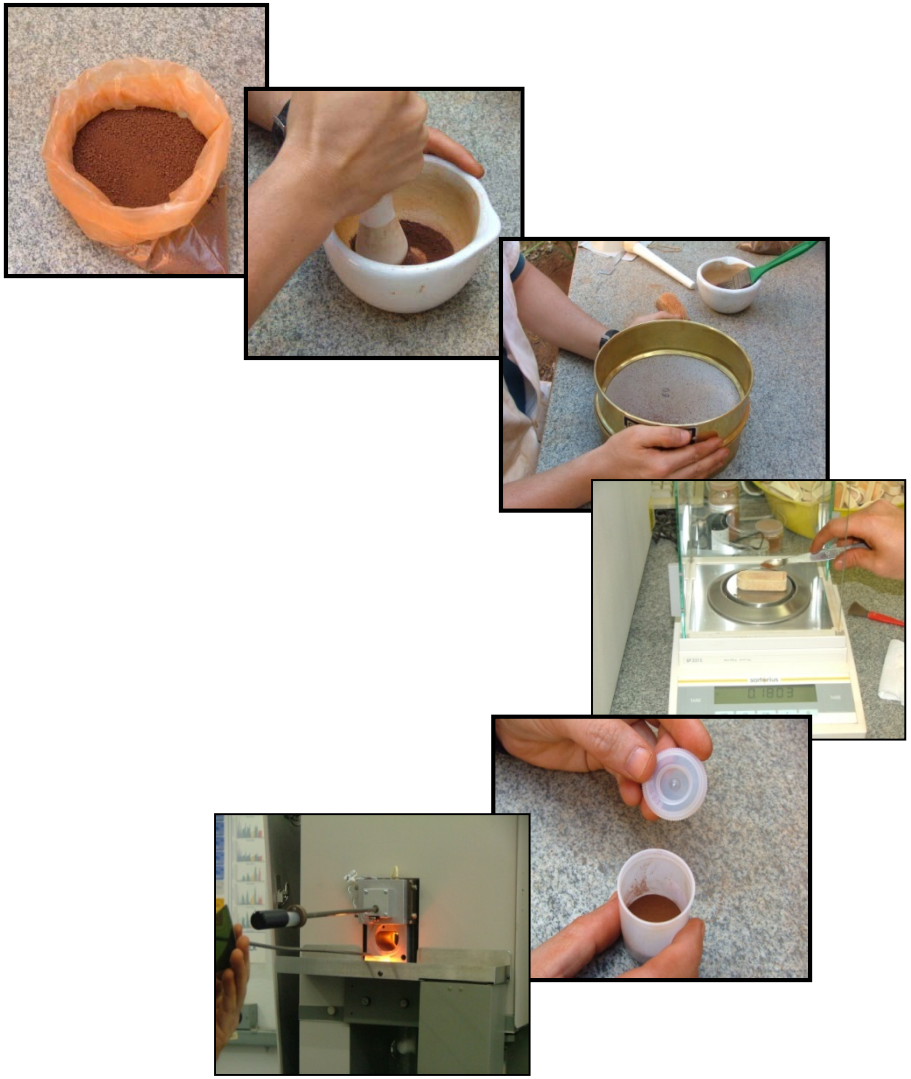

Soil GHG Fluxes

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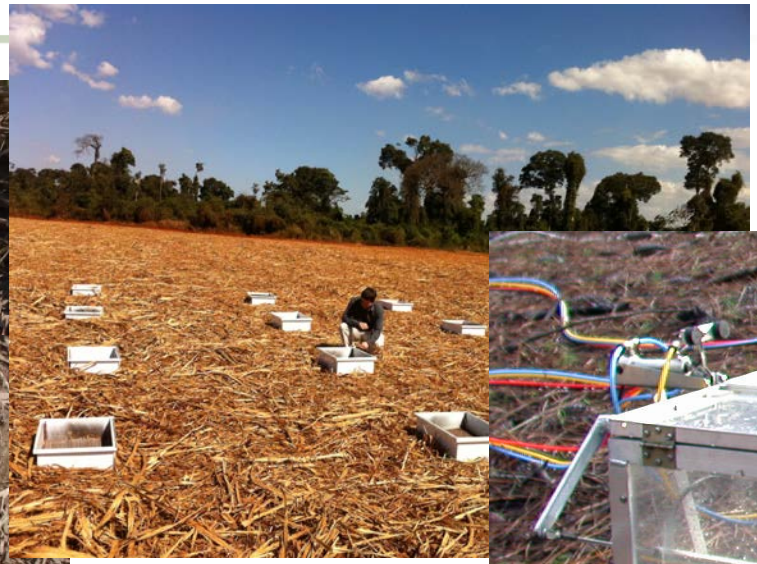

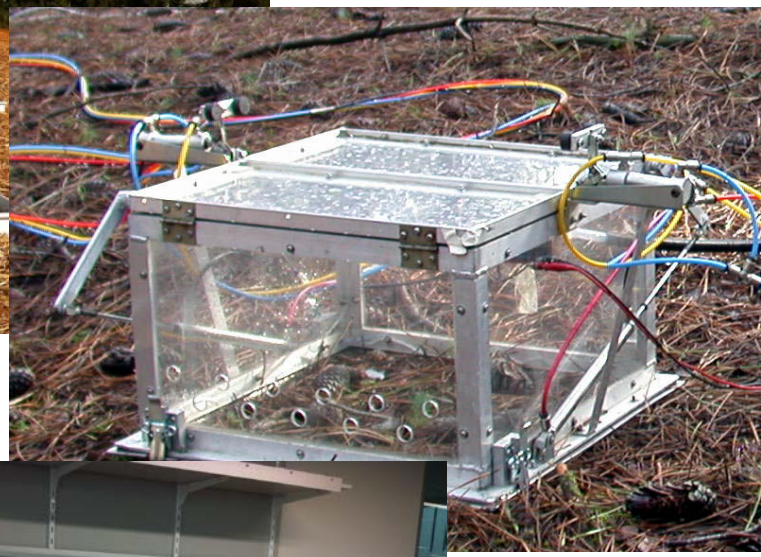

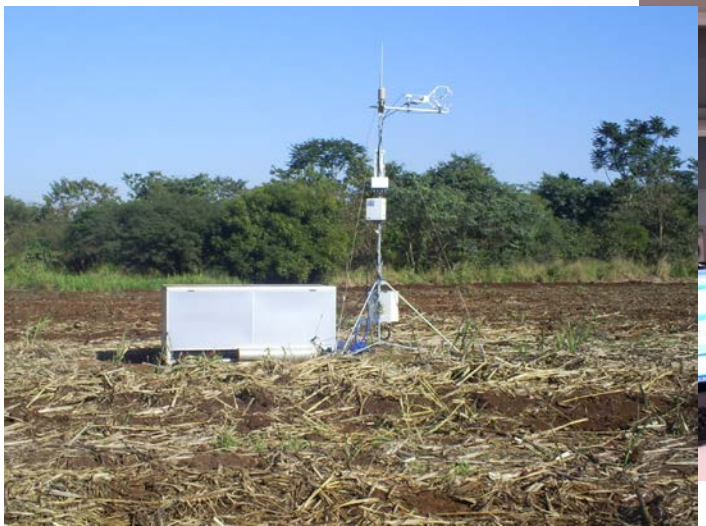

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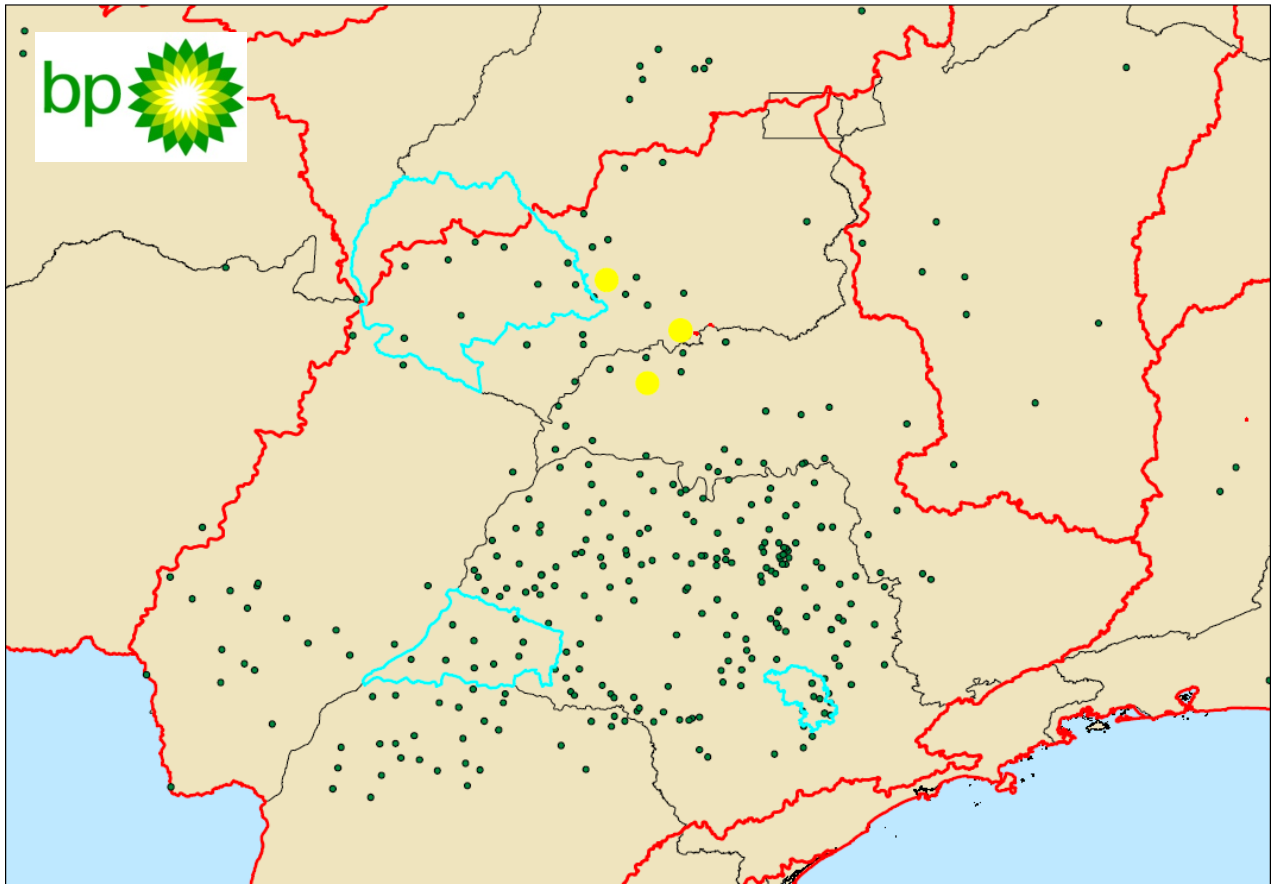
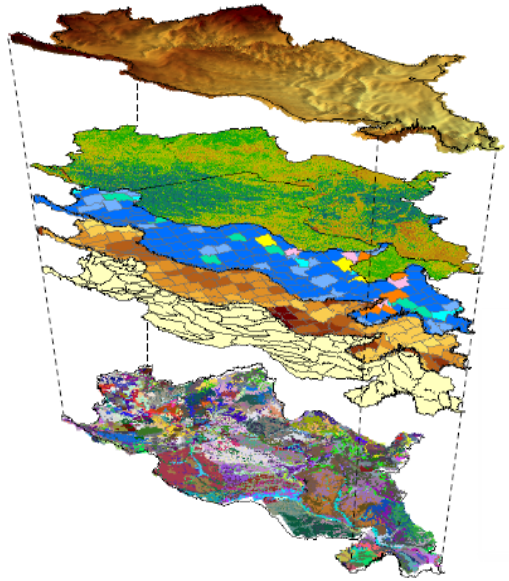
CTBE/UTA/BP

Assessing Water Resources in Data Limited Regions and Changing Land Use



- Satellite images;
- Hydrological models
- Meteorological information;



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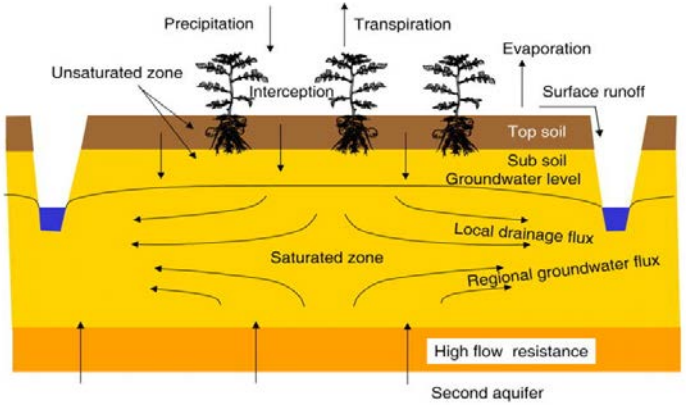
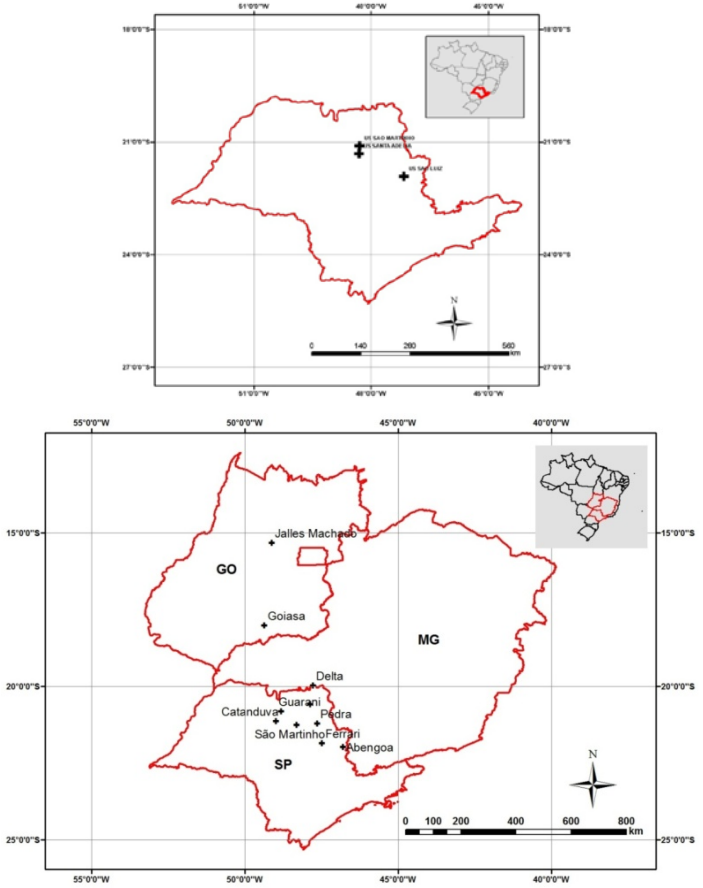
Water Balance Modeling - SWAP

Calibrating and validating an agro-hydrological model to simulate rainfed sugarcane growth

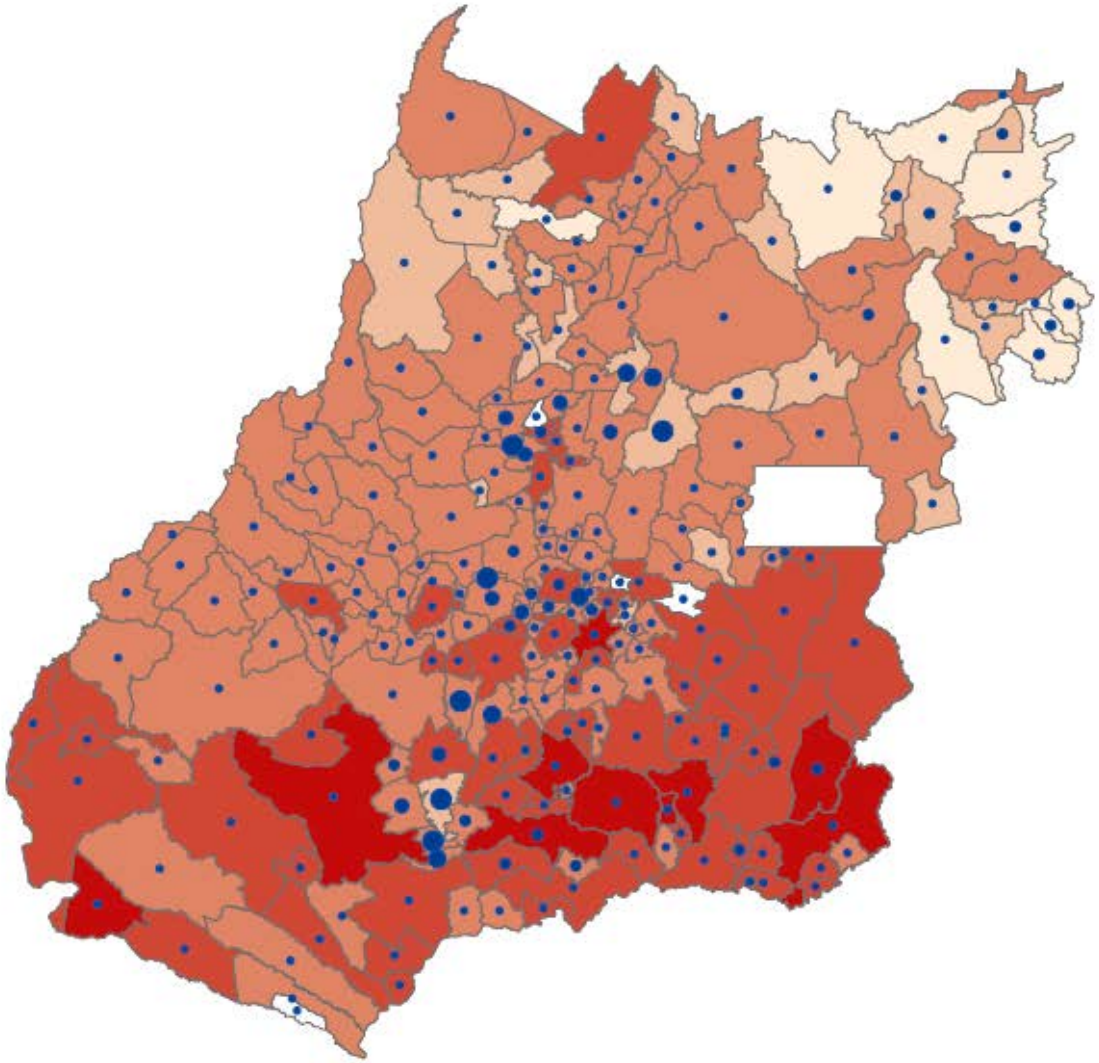
SWAP *Soil Water Atmosphere Plant*



Field scale



Goiás (2000)



Legend:

Sugarcane in Economy

- 0,000 - 0,011
- 0,012 - 0,042
- 0,043 - 0,096
- 0,097 - 0,147
- 0,148 - 0,305

HDI

- 0,60 - 0,65
- 0,66 - 0,70
- 0,71 - 0,75
- 0,76 - 0,80
- 0,81 - 1,00

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CTBE

Data will be available to the community through a web page, that would allow users: to access a single source of information and consequently to get assertiveness in actions, to frequently monitor the results and to easily handle data and results.

Presentation

The Sugarcane Integrated Information System (SIIS) was developed by the Sustainability Research Program of the Brazilian Bioethanol Science and Technology Laboratory (CTBE) with the purpose of disseminating information. The SIIS also enables to combine geographic database information from different institutions.

Comparison of sugarcane harvested area in Brazil

Maps produced by the CTBE's Sustainability Research Program show the comparison of the Brazilian sugarcane harvested areas from 1973 to 2011. It is possible to notice a gradual evolution and an advance between the years 2001 to 2011 for the Central-South. Click here

Post date: 4-12-2012

Socioeconomic data and the sugarcane production

The Sustainability Research Program has produced maps based on a collection of socioeconomic data from Alagoas and Sao Paulo States between 1970 and 2000. It can observed that the progress of socioeconomic indexes along with the advancement in sugarcane production. Click here

Post date: 4-12-2012

Home
Socioeconomic
Yield
Maps
Team

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About this website

The purpose of this website is to disseminate the data used and produced by the Sustainability Research Program, CTBE.

Acknowledgements

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CTBE

Thank you for your attention!

regis.leal@bioetanol.org.br