Brazilian Bioethanol Science and Technology Laboratory - CTBE

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CTBE – Brazilian Bioethanol Science and Technology Laboratory

Campinas, August 26, 2014

Brazilian Bioethanol Science and Technology Laboratory

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✓ CTBE basics

✓ Programs

- Agriculture
- Industrial
- Technology Assessment
- Basic Science
- Sustainability

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

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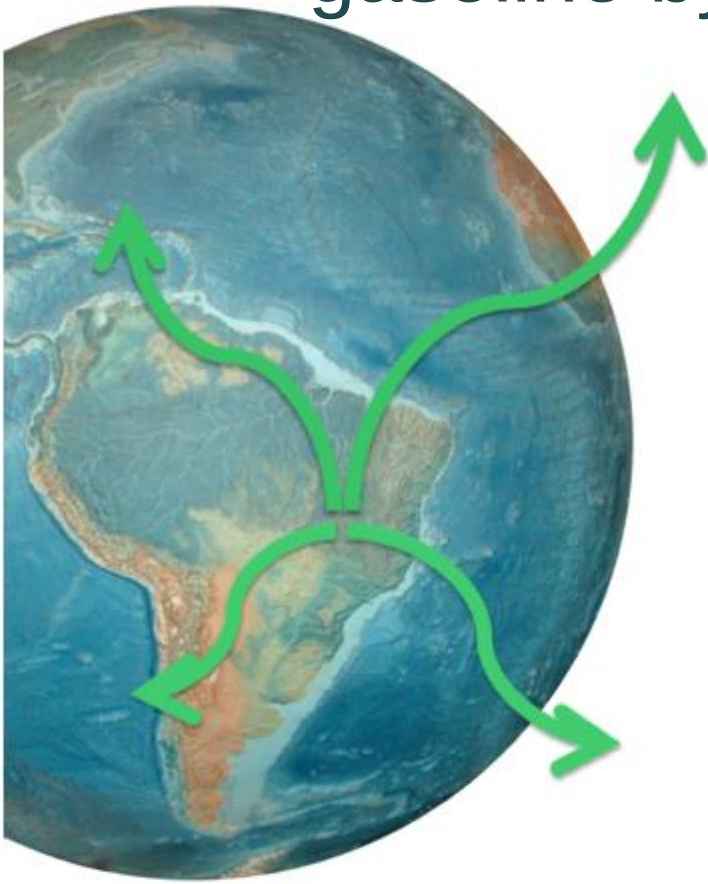
Replacing 10% of the world demand for gasoline by Brazilian ethanol in 2025



Ethanol Project (NIPE/Unicamp-CGEE/MCT)

A production of 250 billion liters of ethanol could generate in Brazil:

- Over **9 million new jobs** (direct, indirect and induced).
- **A raise of 13% in the GDP**.
- **1000 new distilleries.**

Strategy: To create a National Laboratory that can produce scientific knowledge on the bioethanol production cycle, and able to face technological bottlenecks.

A National Laboratory on Bioethanol

CTBE
Brazilian Bioethanol Science and Technology Laboratory

CNPEM

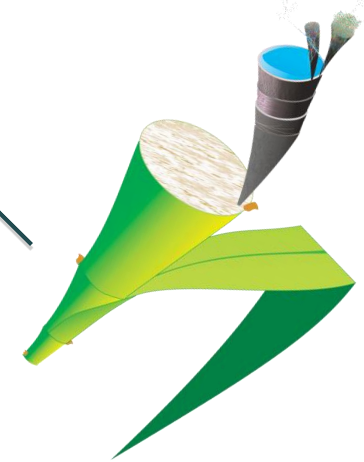
Own team dedicated to Research, Development and Innovation

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 m^2**
. Research team by 2013 (biologists, physicists, chemists and engineers): **110 employees**



Campus stimulates scientific production

CTBE is part of MCT’s Centro Nacional de Pesquisa em Energia e Materiais (CNPEM), (30,000 m^2 of buildings) with other three important National Laboratories

Brazilian Synchrotron Light Laboratory

The only synchrotron light source in L. America

- 2300 users per year
- Tool for different fields: molecular biology, materials science, polymers, catalysis and others

Brazilian Biosciences National Laboratory

Structural Biology / Biotechnology

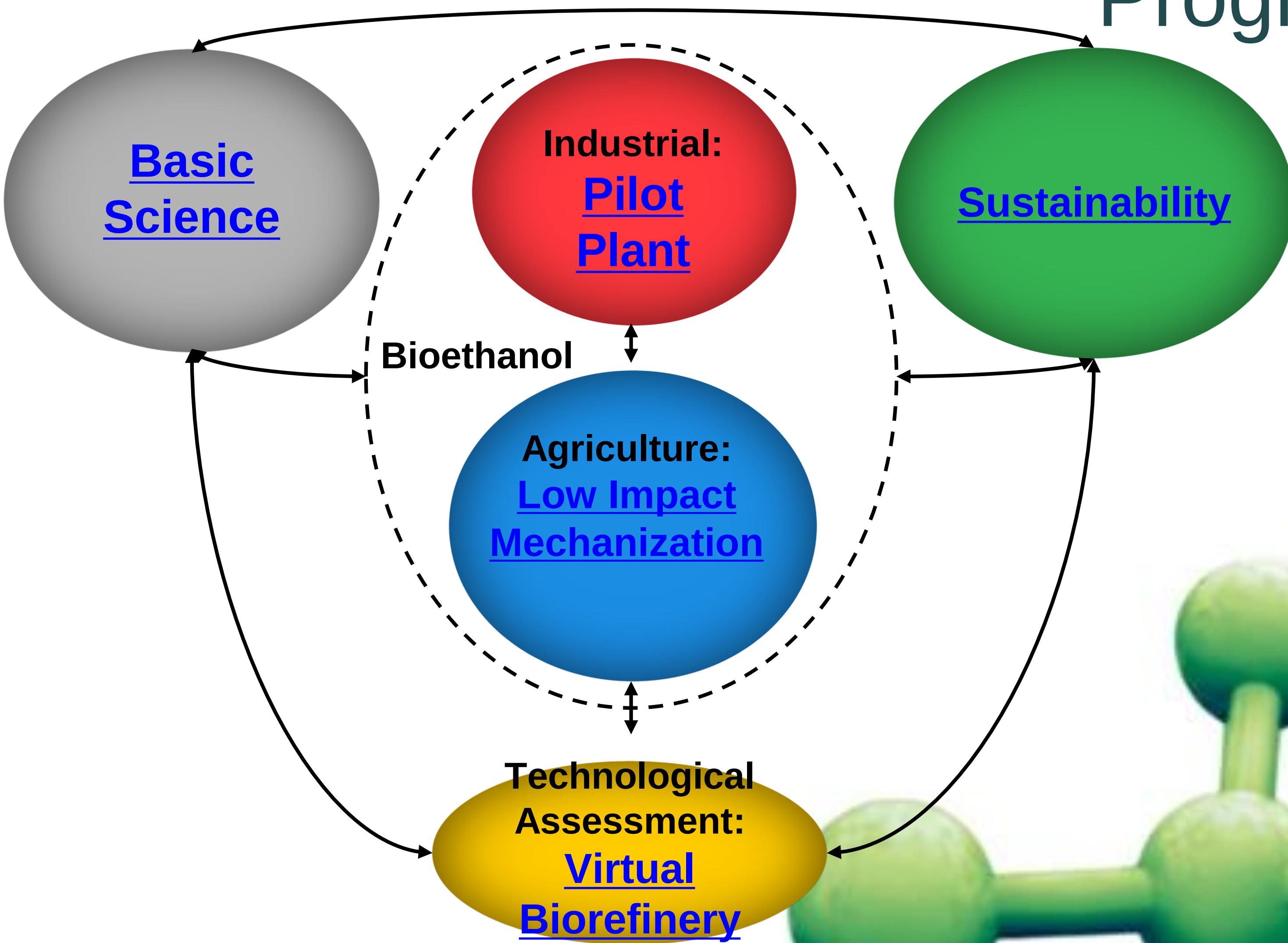
- Plants Microorganisms
- Neglected Diseases
- Cancer
- Cardiac Biology

Brazilian Nanotech. National Laboratory

Nanoscience / Microscopy

- Electron and Atomic Force microscopy
- Development of materials and process in micrometric scale
- Semiconductors research

Programs


Basic Science
Industrial: Pilot Plant
Sustainability
Bioethanol
Agriculture: Low Impact Mechanization
Technological Assessment: Virtual Biorefinery

www.bioethanol.org.br

Agricultural Program

1. No-till farming
Structure for Controlled Traffic farming

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

3. Trash recovery
Quality and cost of recovered trash

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

Agriculture Program:
Low Impact Mechanization for No-till Farming of Sugarcane

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

- Tests in the field will be coordinated by Embrapa (Brazil is a world leader in no-till farming of grains)
- 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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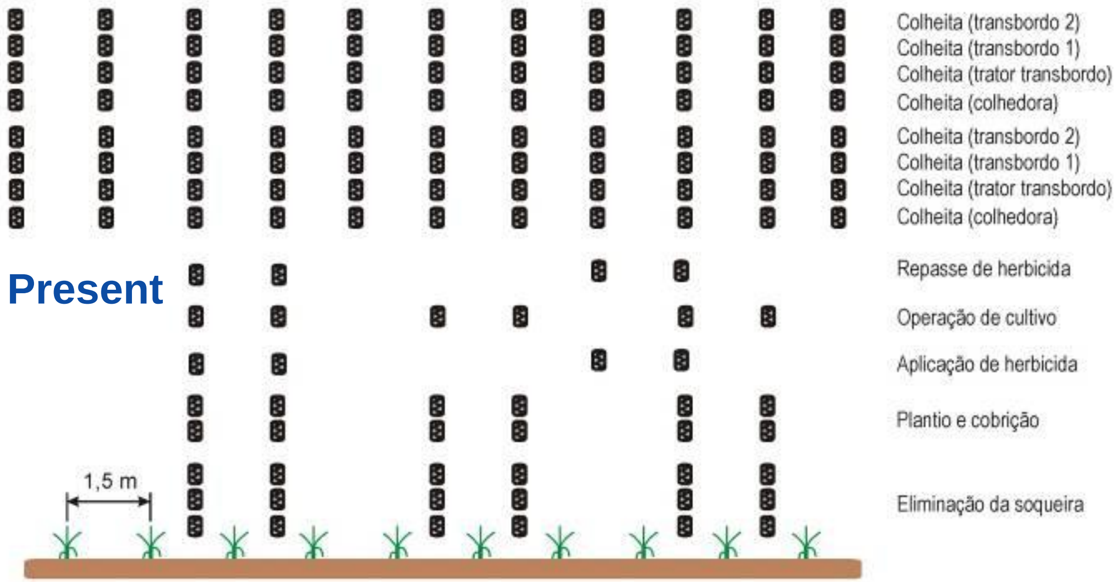
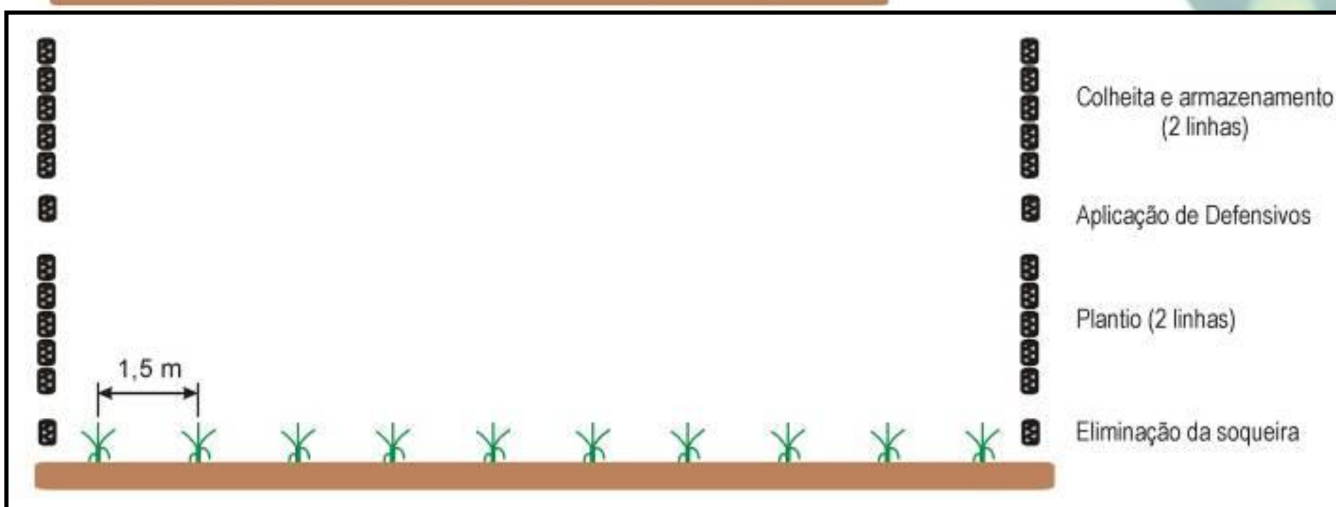
Present



Traffic over 60% of the area



Minimum Tillage

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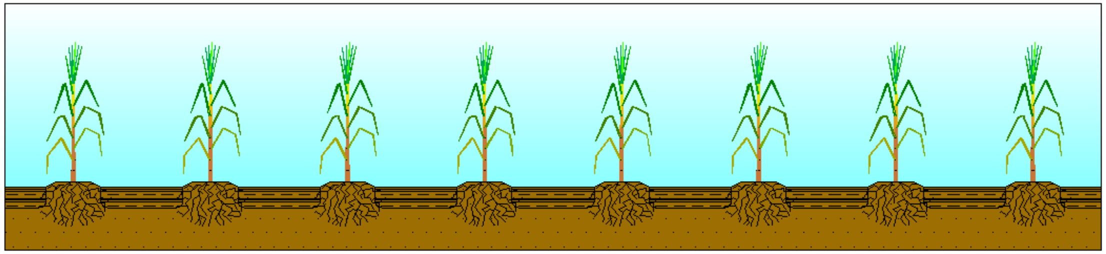
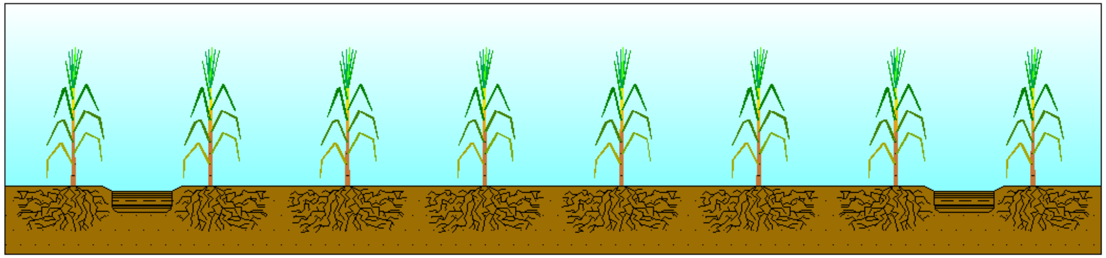
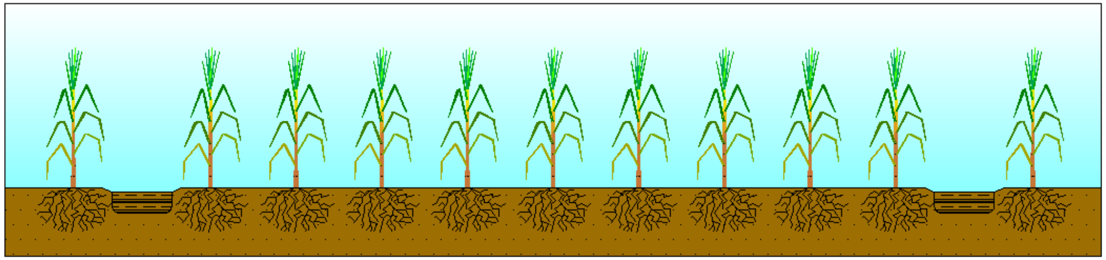
Better Condition for Roots Propagation



Conventional 1.5 m



ETC 1.5 m



ETC 1.0 m

Interline Distance Impact

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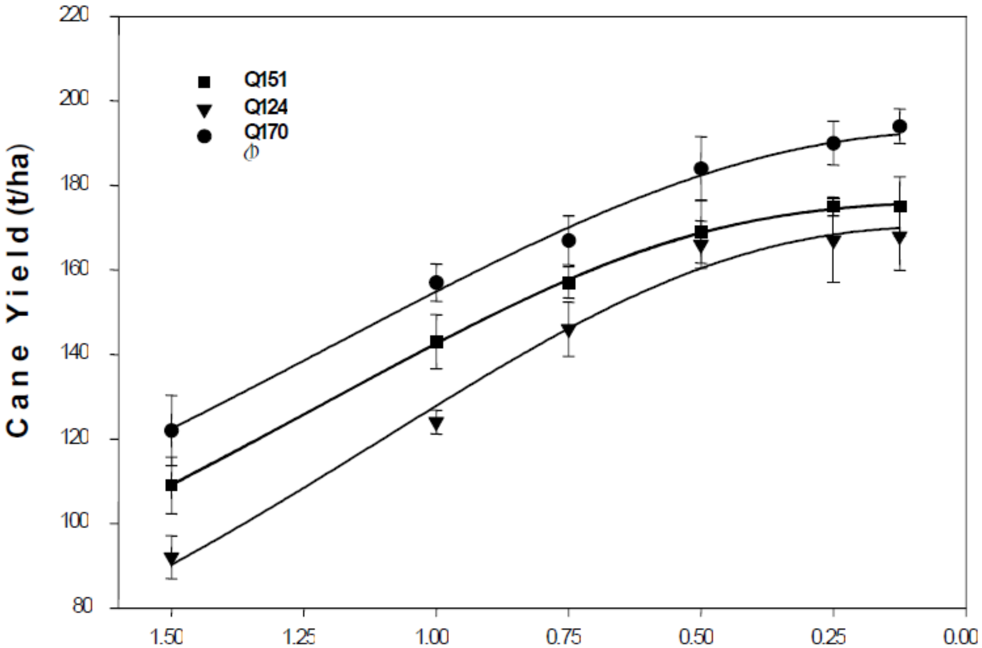
BUREAU OF SUGAR EXPERIMENT STATIONS

QUEENSLAND, AUSTRALIA

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



Row spacing (m)

Today (Brazil)

Initial Target(CTBE)

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

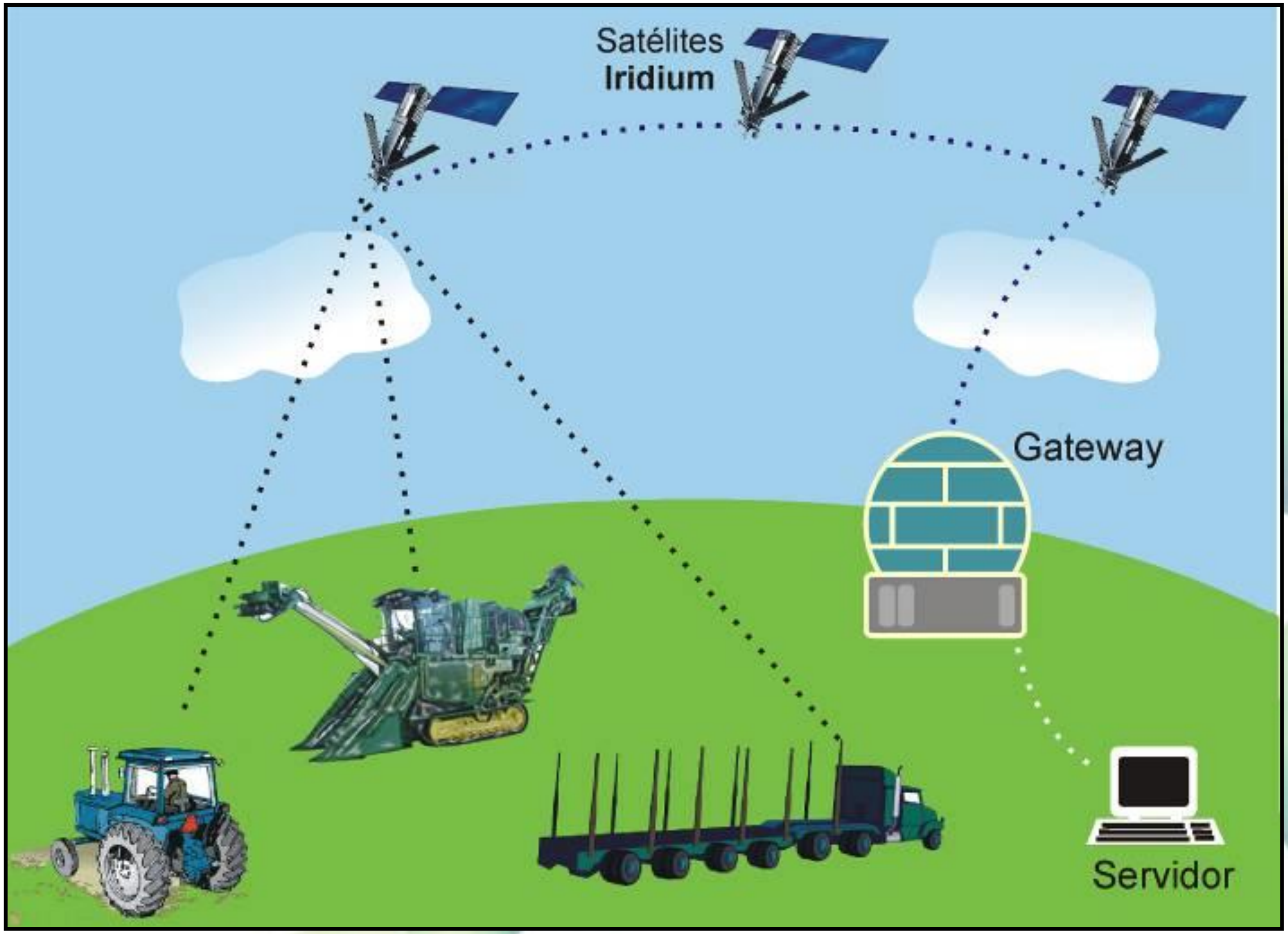
FINAL REPORT - SRDC PROJECT BSS212

INVESTIGATION OF THE LIMITS TO HIGH DENSITY PLANTING

by

J L Collins

Precision Farming



Industrial:
Pilot Plant for Process Development (PPDP)

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

Enzymatic Hydrolysis for Bagasse to Ethanol Conversion

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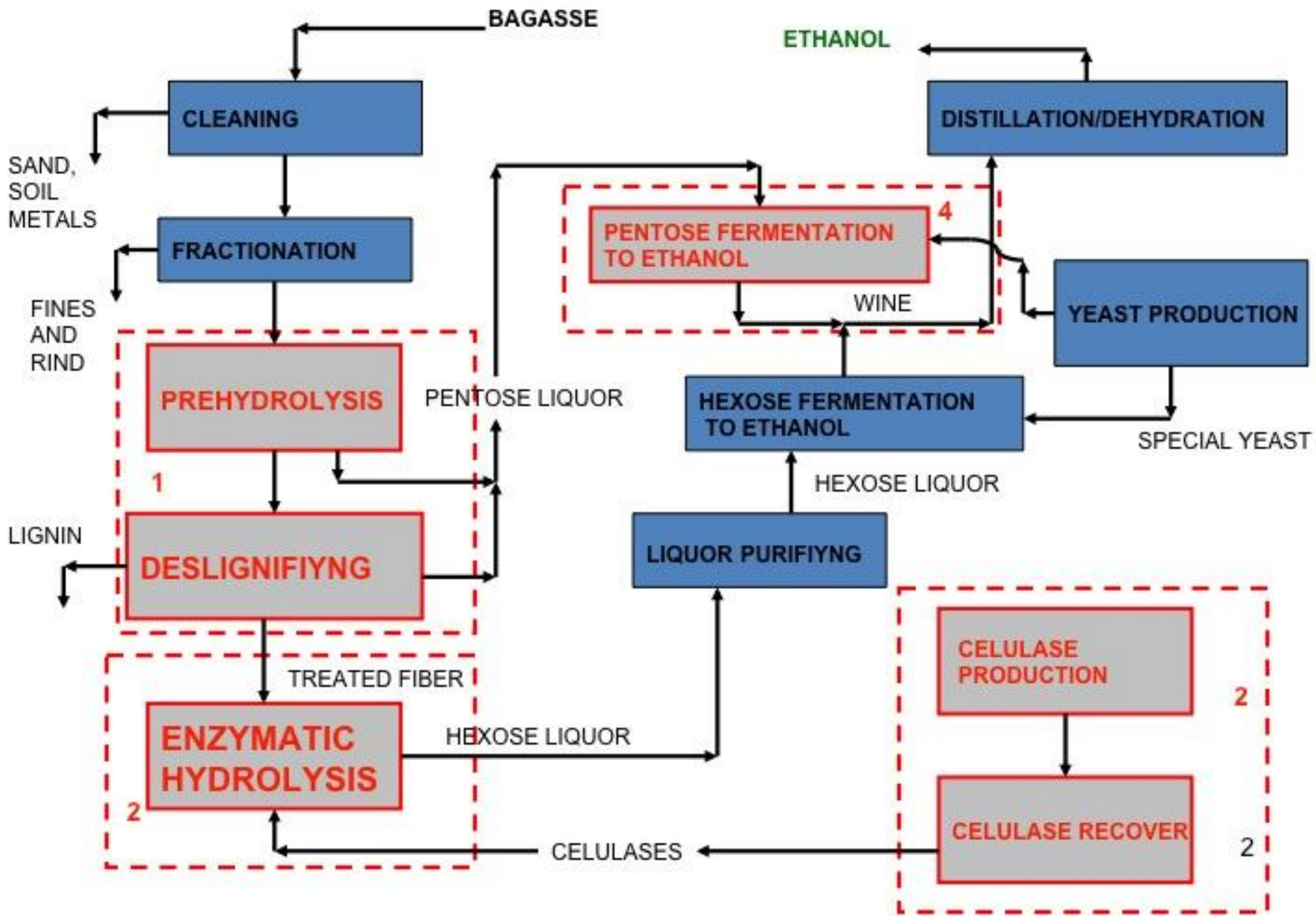

Pilot Plant for Process Development

Conversion of Bagasse to Ethanol

Critical steps

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

Pilot Plant for Process Development Justification

- Processes involved in Hydrolysis are extremely complex;
- Brazilian research projects are being executed (most of them) in laboratory scale, facilities in which industrial scale is reproduced must be provided;
- Most of the processes and unit operations involve a two phases solid-fluid heterogeneous system, which increases complexity and makes scaling-up difficult;
- A technical and economical evaluation can only be done after obtaining pilot data of balances (mass and energy) and process parameters.

Conceptual Project

- A multipurpose unit;
- The highest level of flexibility. Divided in independent units that can operate simultaneously and are able to combine different arrangements of Physical, Chemical and Biological processes.
- Size compatible with installation and operation in a Research Centre and able to reproduce industrial operation;
- Able to incorporate new processes and to reformulate and up-grade existing processing lines;
- The highest level of Instrumentation, Automation and Data Acquisition and Transfer.

Pilot Plant for Process Development PPDP

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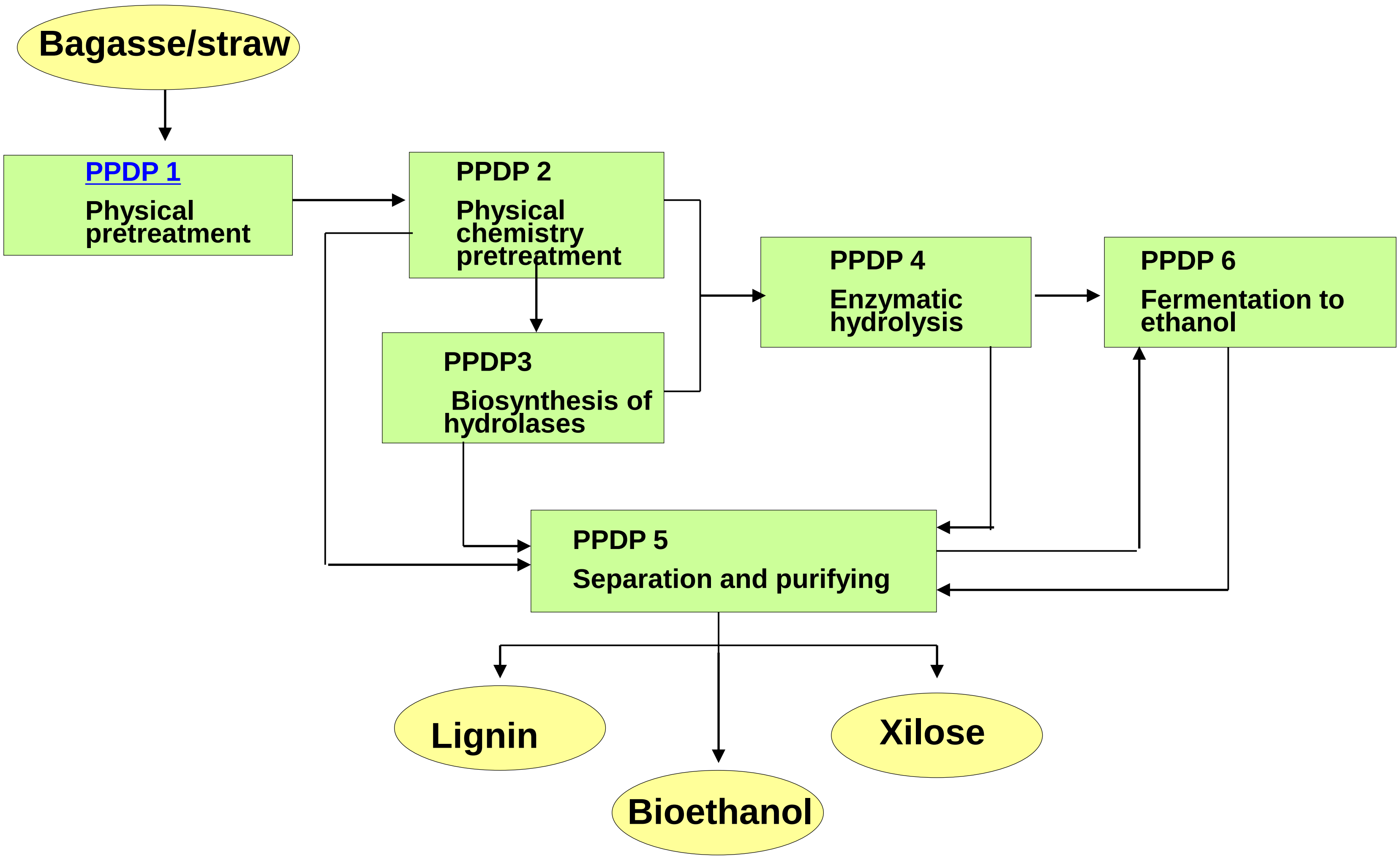

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PPDP Modules

PPDP1 Physical treatment of bagasse	**PPDP2** Physical chem. treatment of cellulose lignin material	**PPDP 3** Fungal, yeast and bacteria production
PPDP4 Enzymatic hydrolysis of biomass	**PPDP5** Separation and purifying	**PPDP6** Ethanol fermentation

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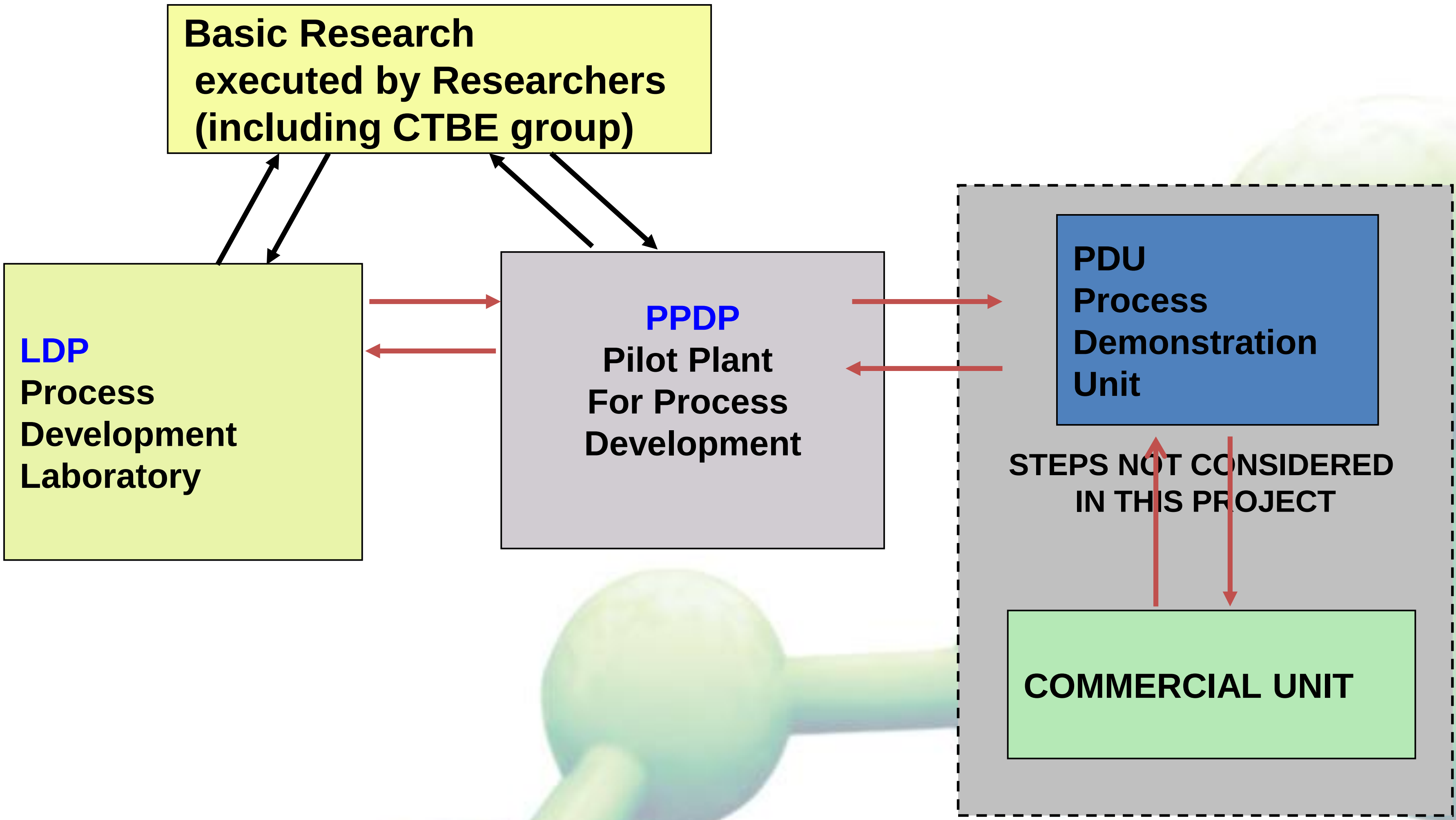
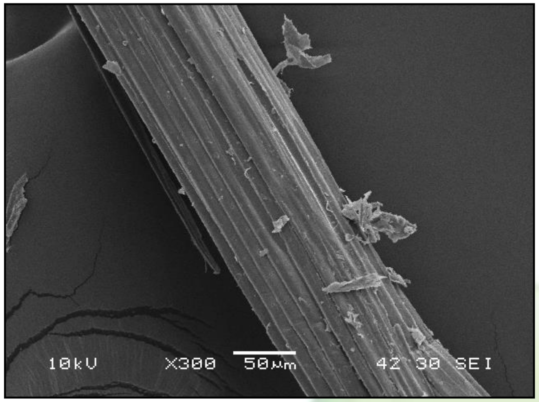
A Model for Process Research and Development

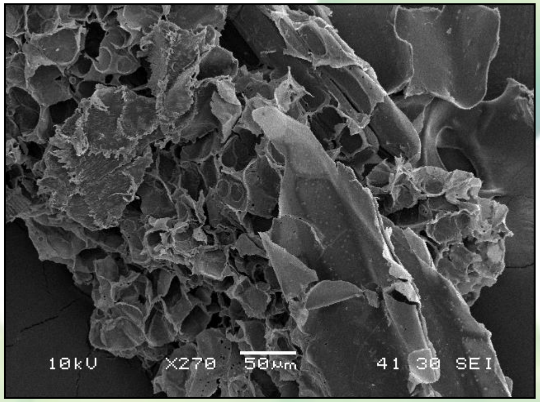
CNPEM



Sugarcane Bagasse Fractions







Fiber

Pith

Scanning Electronic Microscopy – C2Nano

Back

Technological Assessment:

Virtual Sugarcane Biorefinery

- 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

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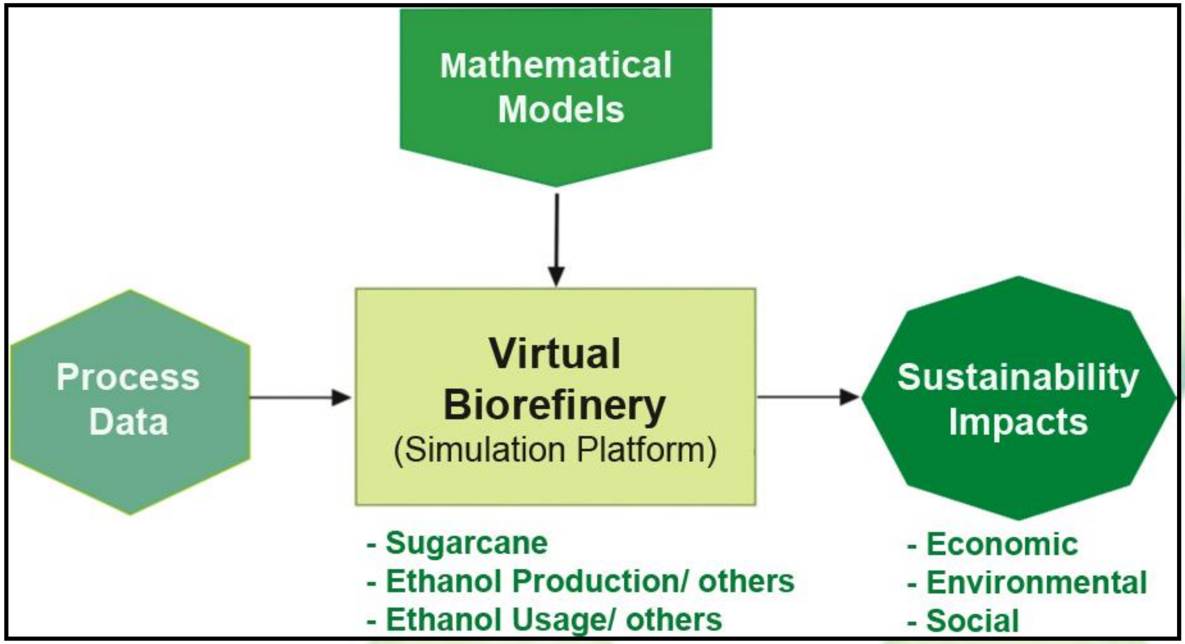
Concept



Virtual Biorefinery Flowchart

Objectives

(1) Optimize concepts and processes.

(2) Assess different biorefinery alternatives.

(3) Assess the stage of development of new technologies.

Scope

Basic routes to be designed and technically assessed:

Route 1: ethanol (1st generation), sugar, electricity;

Route 2: ethanol (2nd generation) – hydrolysis;

Route 3: liquid fuels – synthesis gas;

Route 4: alcoholchemistry;

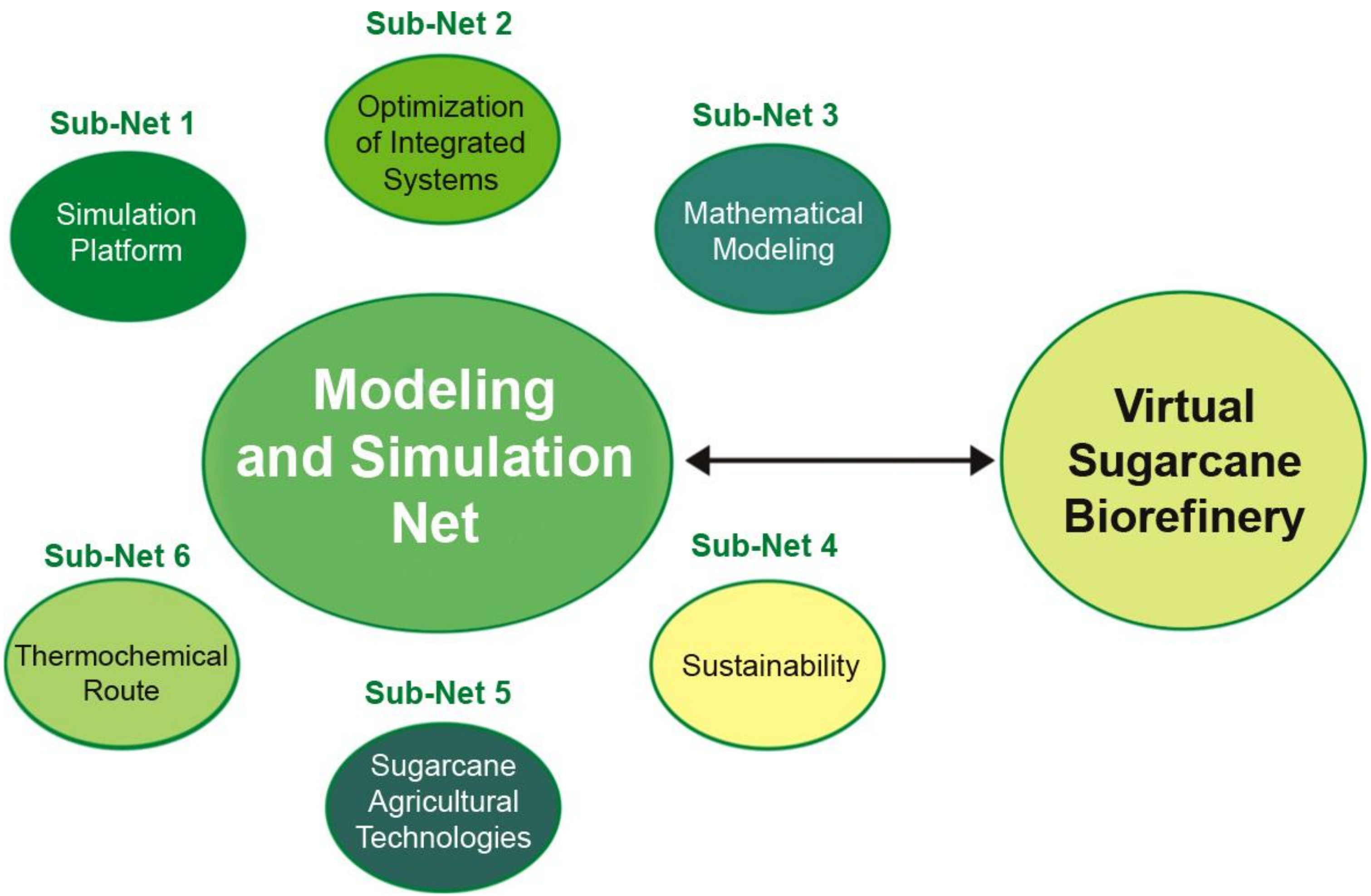
Route 5: sugarchemistry;

Route 6: lignocellulosechemistry;

Route n: other routes.

In all routes sugarcane agricultural technologies are included

Modeling and Simulation Net



Preliminary Results

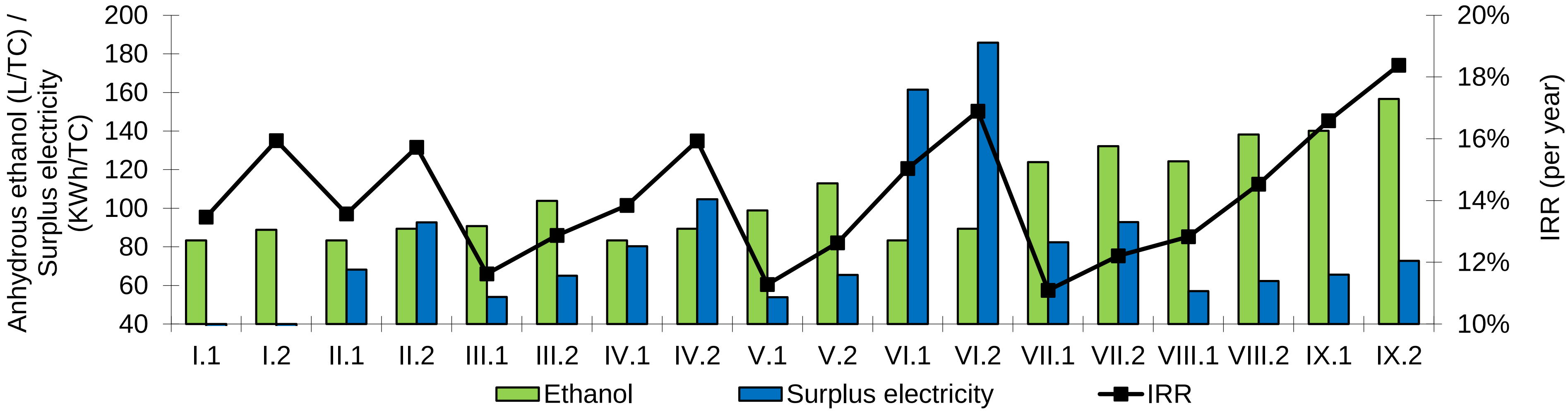
Characteristics	Scenarios								
	I	II	III	IV	V	VI	VII	VIII	IX
1st generation ethanol production	X	X	X	X	X	X	X	X	X
Surplus electricity credit		X	X	X	X	X	X	X	X
2nd generation ethanol production (hydrolysis yield 60%, 10% of solids)			X		X		X	X	X
90 bar boilers		X	X	X	X	X	X	X	X
Molecular sieves for ethanol dehydration		X	X	X	X	X	X	X	X
Complete electrification of the plant				X	X	X	X	X	X
20% reduction in process steam demand				X	X	X	X	X	X
50% of trash used						X	X	X	X
Improvements in 2G (hydrolysis yield 70%, 15% of solids, alkaline delignification, < enzyme costs)								X	X
C5 fermentation – 80% conversion to ethanol									X

Two qualities for sugarcane:

Scenarios I.1 to IX.1: sugarcane with 12% fiber, 14.7% TRS

Scenarios I.2 to IX.2: sugarcane with 14% fiber, 15.7% TRS

Preliminary Results



Item	I.1	I.2	II.1	II.2	III.1	III.2	IV.1	IV.2
Total Investment[1]	306	308	389	406	466	520	397	413
Operational costs[2]	106	106	106	106	108	110	106	106
Revenue[2]	168	182	186	205	189	212	189	208
IRR (% per year)	13,5	15,9	13,6	15,7	11,6	12,9	13,8	15,9

Item	V.1	V .2	VI.1	VI.2	VII.1	VII.2	VIII.1	VIII.2	IX.1	IX.2
Total Investment[1]	513	564	438	453	645	672	567	584	546	573
Operational costs[2]	110	113	111	111	123	124	114	115	114	115
Revenue[2]	197	221	212	231	231	248	224	245	256	284
IRR (% per year)	11,3	12,6	15,0	16,9	11,1	12,2	12,8	14,5	16,6	18,4

[1] mi R$
[2] mi R$/year

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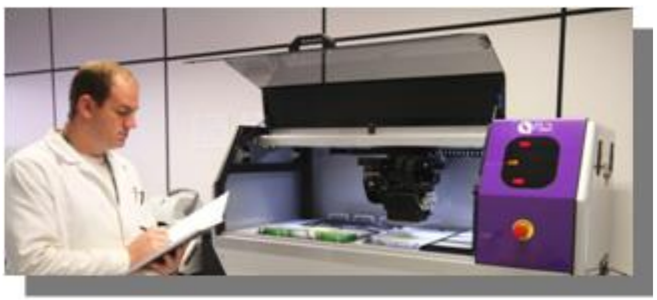
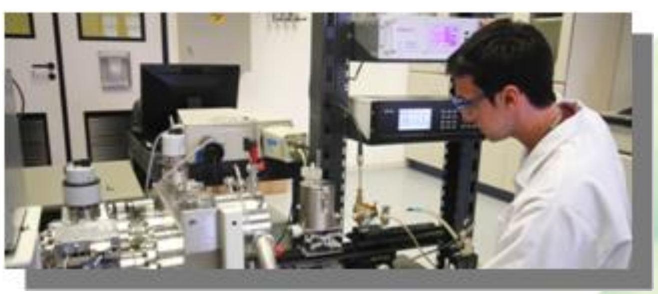
Basic Science

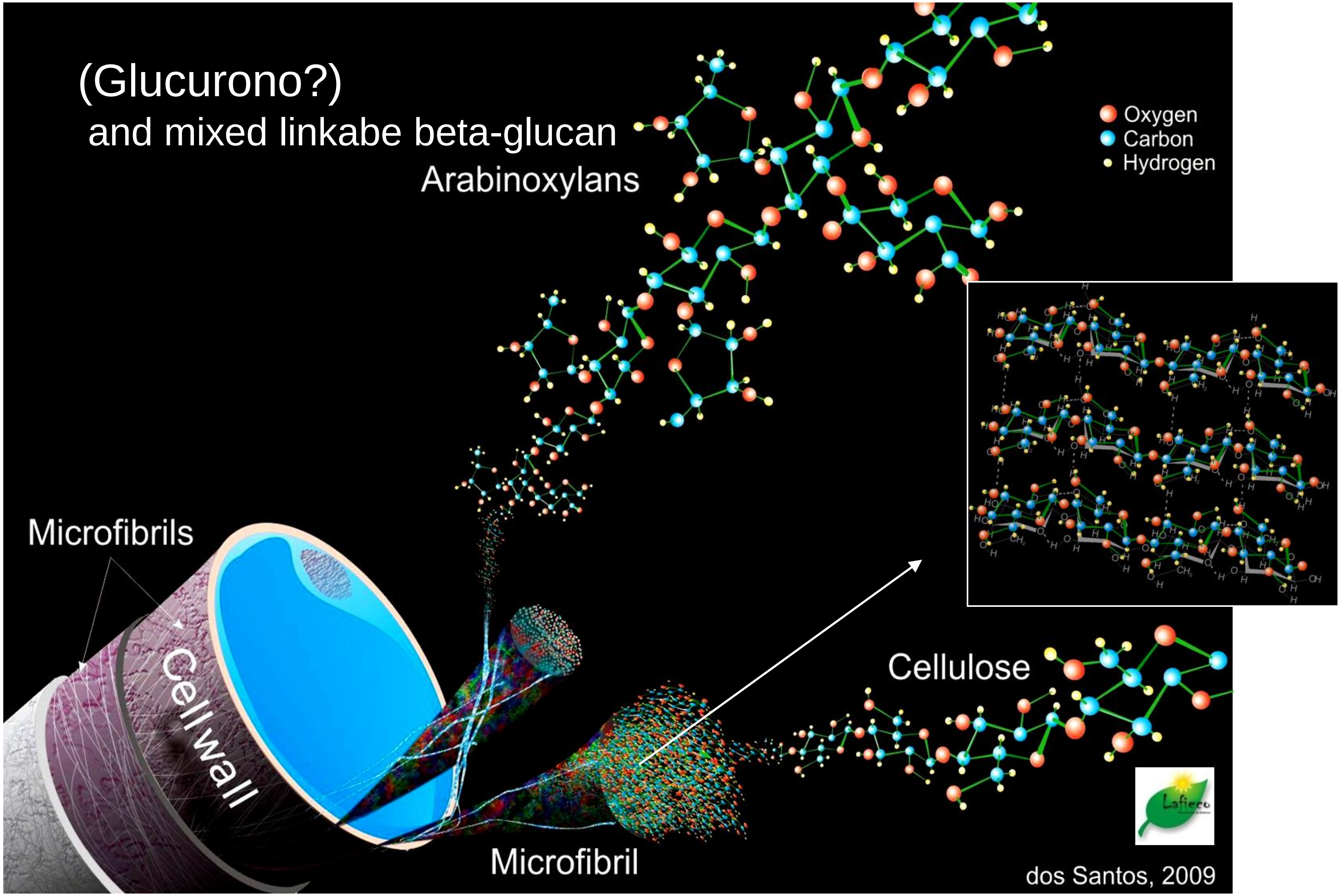




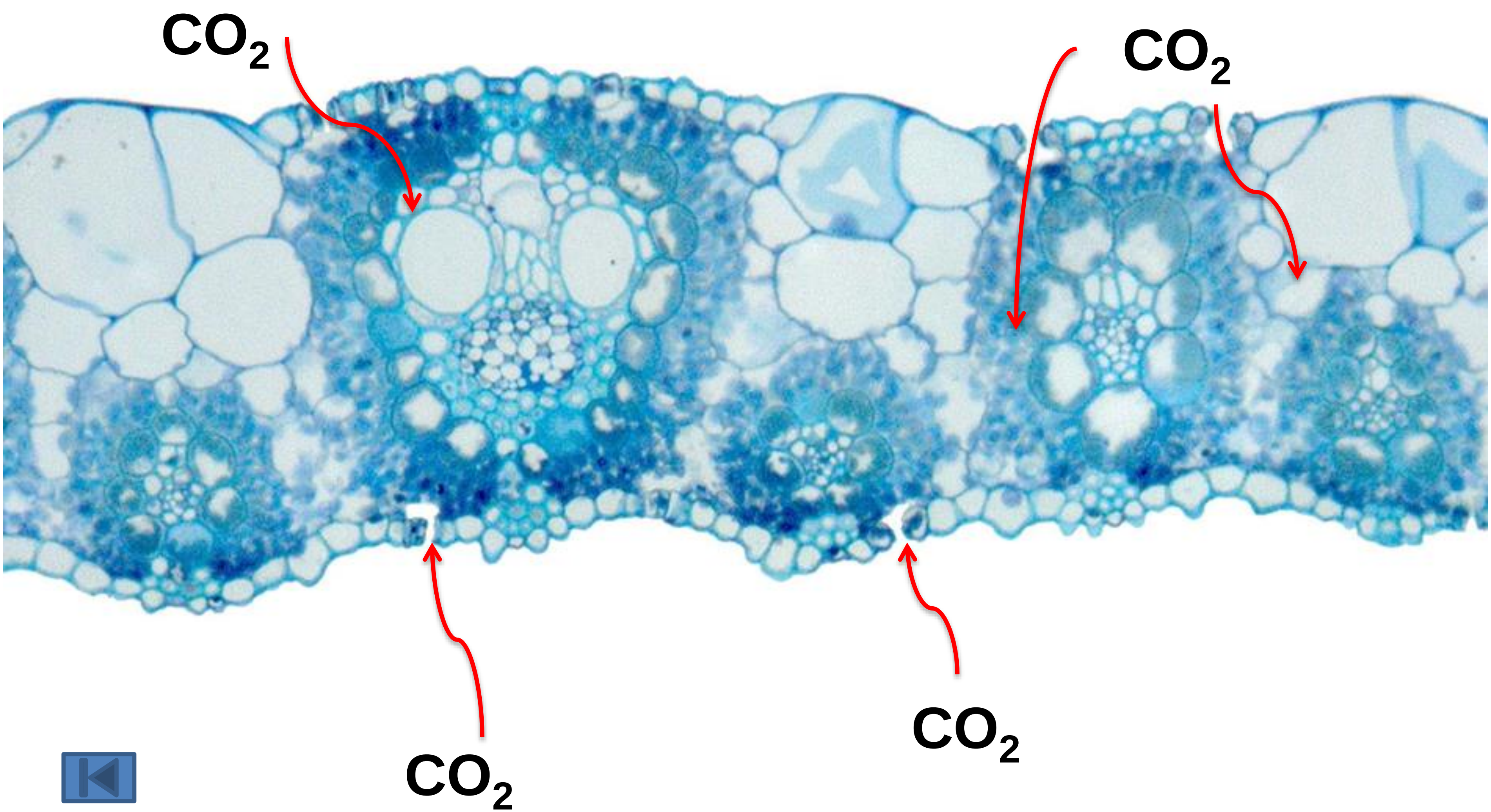
- Agenda that goes from sugarcane photosynthesis to the deconstruction of cellulose structure into fermentable sugars (controlled recovery of sugars from bagasse and trash cellulose for ethanol production)

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

Sugarcane Cell Wall



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



Sustainability

• Ethanol sustainability evaluation, considering present and future technologies.

• Generating data for public policies.

• Focus (obtaining data in the sugarcane cycle for a scientific discussion on):

- Energy balance and GHG emissions
- Direct and indirect land use change
- Soil carbon stock change, N_2O and CH_4 emissions
- Socio-economic impacts
- Impact on the quality and availability of water resources

Programs

Aims of PSE

- In short-term: PSE intends **to evaluate the sustainability of bioethanol** production from sugarcane, **considering current technologies, traditional areas of production and all changes that can be implemented in the years to come**.
- In mid-term: evaluating the production of different products from sugarcane (from a sustainability point of view), **considering the expansion to new areas** and **taking into account all science and technology innovations that shall be incorporated to the production chain** (e.g., low impact mechanization in the agricultural side, ethanol production through hydrolysis of the bagasse, diversification of products, etc.).

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Examples of Controversial Papers

CNPEM

Sciencexpress Report

Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change

Timothy Searchinger,[1]* Ralph Heimlich,[2] R. A. Houghton,[3] Fengxia Dong,[4] Amani Elobeid,[4] Jacinto Fabiosa,[4] Simla Tokgoz,[4] Dermot Hayes,[4] Tun-Hsiang Yu[4]

[1]Woodrow Wilson School, Princeton University, German Marshall Fund of the U.S., Georgetown Environmental Law and Policy Institute. [2]Agricultural Conservation Economics, [3]Woods Hole Research Center, [4]Center for Agricultural and Rural Development, Iowa State University.

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Most prior studies have found that substituting biofuels for gasoline will reduce greenhouse gasses because biofuels sequester carbon through the growth of the feedstock. These analyses have failed to count the carbon emissions that occur as farmers worldwide respond to higher prices and convert forest and grassland to new cropland to replace the grain (or cropland) diverted to biofuels. Using a worldwide agricultural model to estimate emissions from land use change, we found that corn-based ethanol, instead of producing a 20% savings, nearly doubles greenhouse emissions over 30 years and increases greenhouse gasses for 167 years. Biofuels from switchgrass, if grown on U.S. corn lands, increase emissions by 50%. This result raises concerns about large biofuel mandates and highlights the value of using waste products.

Most prior life-cycle studies have found that replacing gasoline with ethanol modestly reduces greenhouse gasses (GHGs) if made from corn and substantially if made from cellulose or sugarcane.(*1–8*). These studies compare emissions from the separate steps of growing or mining the feedstocks (such as corn or crude oil), refining them into fuel, and burning the fuel in the vehicle. In these stages alone, as shown in Table 1, corn and cellulosic ethanol emissions exceed or match those from fossil fuels, and therefore produce no greenhouse benefits. But because growing biofuel feedstocks removes carbon dioxide from the atmosphere, biofuels can in theory reduce GHGs relative to fossil fuels. Studies assign biofuels a credit for this sequestration effect, which we call the "carbon uptake" credit. It is typically large enough that overall GHG emissions from biofuels are lower than those from fossil fuels, which do not receive such a credit because they take their carbon from the ground.

For most biofuels, growing the feedstock requires land, so the credit represents the carbon benefit of devoting land to biofuels. Unfortunately, by excluding emissions from land use change, most previous accountings were one-sided because they counted the carbon benefits of using land for biofuels but not the carbon costs – the carbon storage and sequestration sacrificed by diverting land from its existing uses. Without biofuels, the extent of cropland reflects the demand for food and fiber. To produce biofuels, farmers can directly plow up more forest or grassland, which releases to the atmosphere much of the carbon previously stored in plants and soils through decomposition or fire. The loss of maturing forests and grasslands also forgoes ongoing carbon sequestration as plants grow each year, and this foregone sequestration is the equivalent of additional emissions. Alternatively, farmers can divert existing crops or croplands into biofuels, which causes similar emissions indirectly. The diversion triggers higher crop prices, and farmers around the world respond by clearing more forest and grassland to replace crops for feed and food. Studies have confirmed that higher soybean prices accelerate clearing of Brazilian rainforest. (*9*) Projected corn ethanol in 2016 would use 43% of the U.S. corn land harvested for grain in 2004 (*1*)—overwhelmingly for livestock (*10*)—requiring big land use changes to replace that grain.

Because existing land uses *already* provide carbon benefits in storage and sequestration (or, in the case of cropland, carbohydrates, proteins and fats), dedicating land to biofuels can potentially reduce greenhouse gasses only if doing so *increases* the carbon benefit of land. Proper accountings must reflect the net impact on the carbon benefit of land, not merely count the gross benefit of using land for biofuels. Technically, as shown in Table 1, to generate greenhouse benefits, the carbon generated on land to displace fossil fuels (the carbon uptake credit) must exceed the carbon storage and sequestration given up directly or indirectly by changing land uses (the emissions from land use change).

Many prior studies have acknowledged but failed to count emissions from land use change because they are difficult to quantify. (*1*) One prior quantification lacked formal agricultural modeling and other features of our analysis. (*11, 1*) To estimate land use changes, we used a worldwide model

Atmos. Chem. Phys., 8, 389–395, 2008
www.atmos-chem-phys.net/8/389/2008/

Atmospheric Chemistry and Physics

N_2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels

P. J. Crutzen[1,2,3], A. R. Mosier[4], K. A. Smith[5], and W. Winiwarter[3,6]

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Received: 28 June 2007 – Published in Atmos. Chem. Phys. Discuss.:
Revised: 20 December 2007 – Accepted: 20 December 2007 – Publish...

Abstract. The relationship, on a global basis, between the amount of N fixed by chemical, biological or atmospheric processes entering the terrestrial biosphere, and the total emission of nitrous oxide (N_2O), has been re-examined, using known global atmospheric removal rates and concentration growth of N_2O as a proxy for overall emissions. For both the pre-industrial period and in recent times, after taking into account the large-scale changes in synthetic N fertiliser production, we find an overall conversion factor of 3–5% from newly fixed N to N_2O-N. We assume the same factor to be valid for biofuel production systems. It is covered only in part by the default conversion factor for "direct" emissions from agricultural crop lands (1%) estimated by IPCC (2006), and the default factors for the "indirect" emissions (following volatilization/deposition and leaching/runoff of N: 0.35–0.45%) cited therein. However, as we show in the paper, when additional emissions included in the IPCC methodology, e.g. those from livestock production, are included, the total may not be inconsistent with that given by our "top-down" method. When the extra N_2O emission from biofuel production is calculated in "CO_2-equivalent" global warming terms, and compared with the quasi-cooling effect of "saving" emissions of fossil fuel derived CO_2, the outcome is that the production of commonly used biofuels, such as biodiesel from rapeseed and bioethanol from corn (maize), depending on N fertilizer uptake efficiency by the plants, can contribute as much or more to global warming by N_2O emissions than cooling by fossil fuel savings. Crops with less N demand, such as grasses and woody coppice species, have more favourable climate impacts. This analysis only considers the conversion of biomass to biofuel. It does not take

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Indirect land-use changes can overcome carbon savings from biofuels in Brazil

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Edited by B. L. Turner, Arizona State University, Tempe, AZ, and approved January 8, 2010 (received for review July 2, 2009)

The planned expansion of biofuel plantations in Brazil could potentially cause both direct and indirect land-use changes (e.g., biofuel plantations replace rangelands, which replace forests). In this study, we use a spatially explicit model to project land-use changes caused by that expansion in 2020, assuming that ethanol (biodiesel) production increases by 35 (4) x 10^9 liter in the 2003-2020 period. Our simulations show that direct land-use changes will have a small impact on carbon emissions because most biofuel plantations would replace rangeland areas. However, indirect land-use changes, especially those pushing the rangeland frontier into the Amazonian forests, could offset the carbon savings from biofuels. Sugarcane ethanol and soybean biodiesel each contribute to nearly half of the projected indirect deforestation of 121,970 km^2 by 2020, creating a carbon debt that would take about 250 years to be repaid using these biofuels instead of fossil fuels. We also tested different crops that could serve as feedstock to fulfill Brazil's biodiesel demand and found that oil palm would cause the least land-use changes and associated carbon debt. The modeled livestock density increases by 0.09 head per hectare. But a higher increase of 0.13 head per hectare in the average livestock density throughout the country could avoid the indirect land-use changes caused by biofuels (even with soybean as the biodiesel feedstock), while still fulfilling all food and bioenergy demands. We suggest that a closer collaboration or strengthened institutional link between the biofuel and cattle-ranching sectors in the coming years is crucial for effective carbon savings from biofuels in Brazil.

deforestation | integrated assessment | livestock | policy analysis | Global Environment Outlook 4

Brazil's government and biofuel industry are planning a large increase in the production of biofuels in the next 10 years. This increase is driven by internal and external market demand (ethanol), as well as by government-enforced blending (biodiesel) (1–3). Although Brazilian sugarcane ethanol is often considered to have one of the best production systems with respect to carbon savings (4–8), there are concerns about the land-use changes (LUC) that would be incurred by an expansion of biofuel croplands (6, 7). Soybean plantations, from which most of the Brazilian biodiesel is produced (1, 3), already occupy 35% of the country's cultivated land (9). It is known that biofuels can replace vast areas of farmland and native habitats, driving up food prices and resulting in little reduction of or even increasing greenhouse gas (GHG) emissions (6, 7, 10–15).

Previous studies focused on the direct land-use changes (DLUC) and the "carbon debt" caused by the replacement of native habitats by biofuel crops in Brazil (7, 8, 10, 11). Others pointed to the probable indirect land-use changes (ILUC) in Brazil caused by future expansion of biofuel croplands in the United States (14–16). Overall, these studies show that potential LUC must be taken into account to assess the efficacy of a given biofuel. However, these studies were neither spatially explicit, nor did they explicitly consider competition between different land uses in view of concurrent food and biofuel demands. Fargione et al. (7), for example, show the LUC carbon debt in terms of rate (e.g., $MgCO_2$ ha^{-1}), since they did not consider the total extent of land dedicated to biofuels or the total area of native habitats affected. Therefore, the net debt in absolute terms (e.g., $MgCO_2$) arising from future biofuel production remains undetermined. Moreover, the cascade effect of biofuel crops pushing the agricultural and cattle ranching frontier is still poorly understood.

Most of Brazil's sugarcane expansion in the last 5 years occurred on land previously used as rangeland in the southeastern states (11, 17). The same holds true for more than 90% of the soybean plantations in the Amazon region after the 2006 moratorium was implemented (18). One of the potential consequences of such LUC is the migration of cattle ranchers to other regions and possible increased deforestation (16, 19–21). In light of the role rangeland plays in deforestation in Brazil (16, 19–21) and the steadily increasing cattle herd [average of 3 million additional head per year in the 1974–2007 period (9)], the ILUC to replace rangeland displaced by biofuels are highly important (22).

In this study we use a spatially explicit modeling framework to project the DLUC and ILUC arising from the fulfillment of Brazil's biofuel production targets for 2020 concurrent with increasing food and livestock demands. This modeling framework comprises: (*i*) a land-use/land-cover change model for land-use suitability assessment and allocation (23); (*ii*) a partial equilibrium model of the economy of the agricultural sector for future food and livestock demands as well as technological improvements of crop yields (24); and (*iii*) a dynamic global vegetation model for crop and grassland potential productivity driven by climate (25, 26). Competition among land uses (for land resources) is considered based on a multicriteria evaluation of suitability, hierarchical dominance of major land-use activities (settlement, crop cultivation, grazing), and a multiobjective land allocation algorithm which looks for land-use pattern stability. Final outputs of this modeling framework are maps of land use and livestock density (Ld). DLUC and ILUC are determined by comparing land-use maps derived from scenarios with and without biofuel expansion. A number of different scenarios are considered to assess the isolated contribution of ethanol and biodiesel fuel production, as well as their impacts on different native habitats. The carbon debt and payback time from such LUC are calculated by using the average emission values employed by Fargione et al. (7). We investigate only the effects of ILUC inside Brazil. We do not consider cellulosic biofuels because the technological development of these fuels is unlikely to be fast enough to enable their large scale use in Brazil by 2020 (27).

Author contributions: D.M.L., R.S., J.A., and J.A.P. designed research; D.M.L., and R. S. performed research; D.M.L., R.S., J.A., A.B., J.K., C.K., and J.A.P. analyzed data; and D.M.L. wrote the paper.

The authors declare no conflict of interest.

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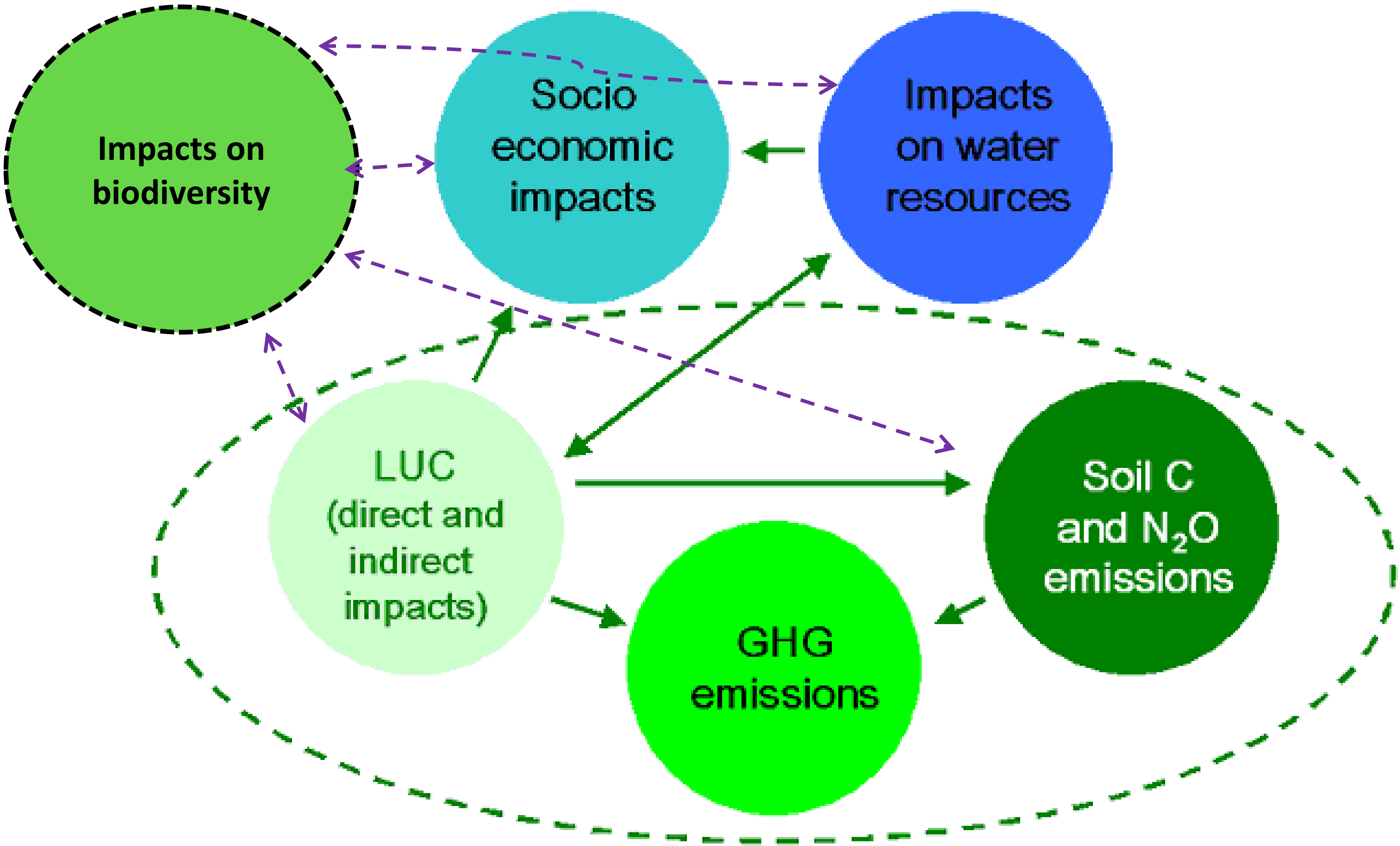
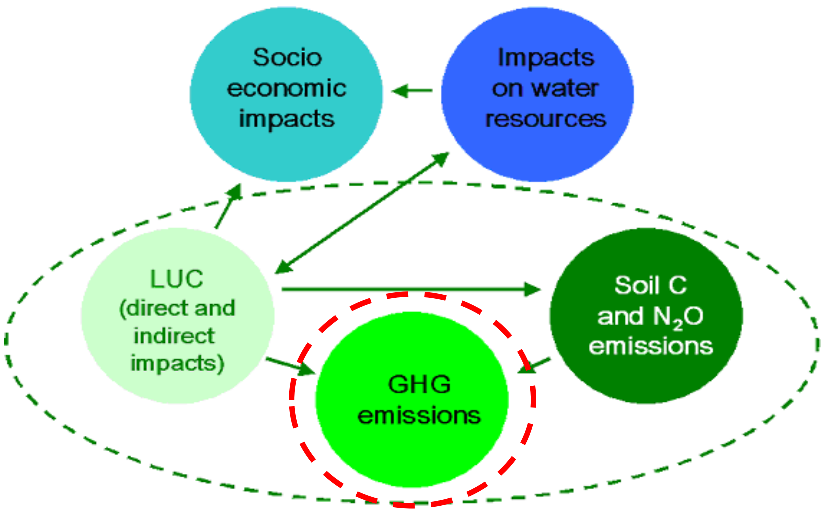


At the moment three priorities and five projects

GHG emissions



- GHG emissions: the main aspect in all sustainability initiatives; it’s necessary to get substantial reduction regarding GHG emissions of the displaced energy sources.

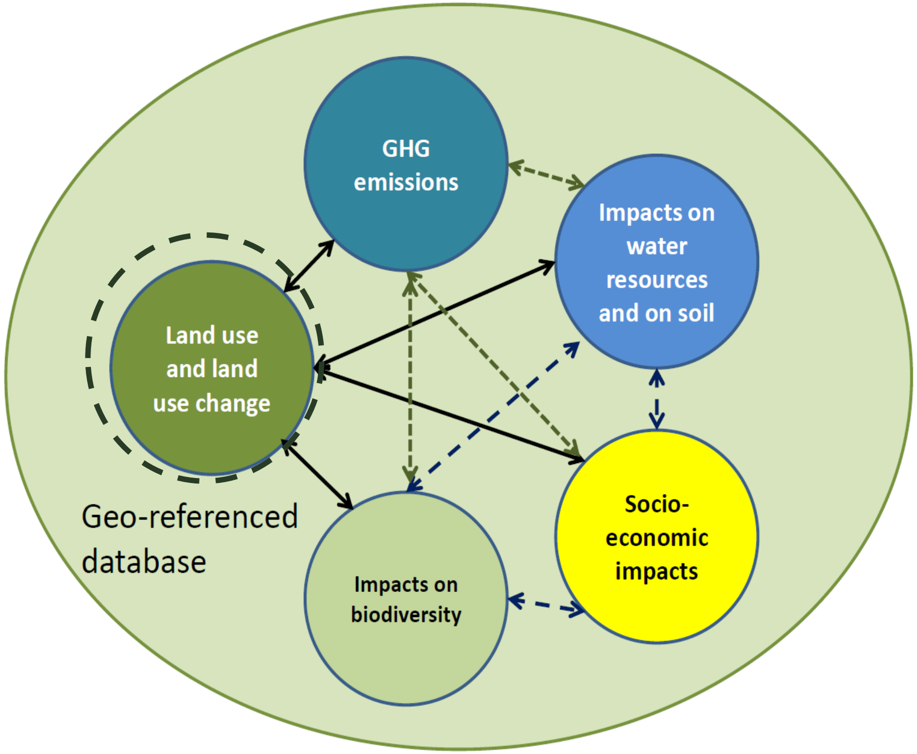
- **Activities have been developed at the CTBE**. Focus on improving data basis, gathering more appropriate information to the Brazilian conditions.
- **Prospective studies have been developed**: e.g., considering scenarios for 2020, and the combined production of ethanol and biodiesel.

LU and LUC

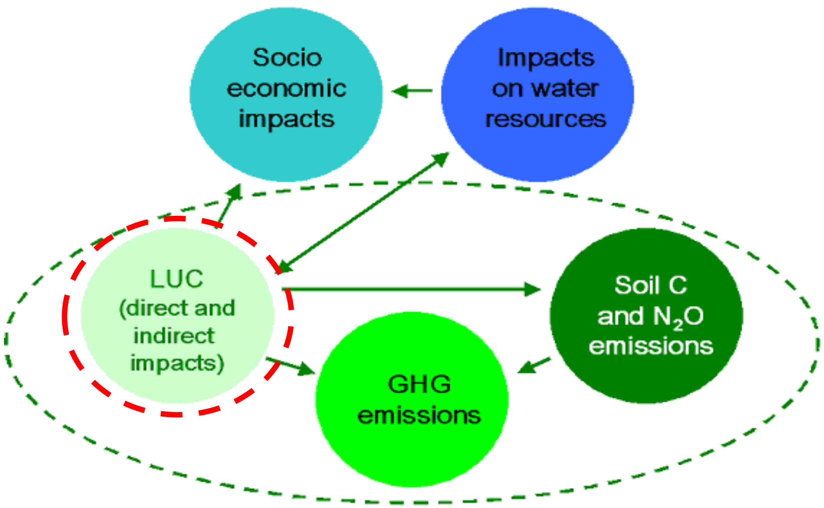
- Land use and land use changes (LUC) are today the key issues in the sustainability of biofuels

- Identification of areas where feedstock cultivation are likely to go and the land use changes associated is essential to the case study selection to evaluate the local impacts on GHG emissions, water resources, soil, biodiversity, local community and others

- LUC modeling using econometric model (BLUM)



Modeling on LUC

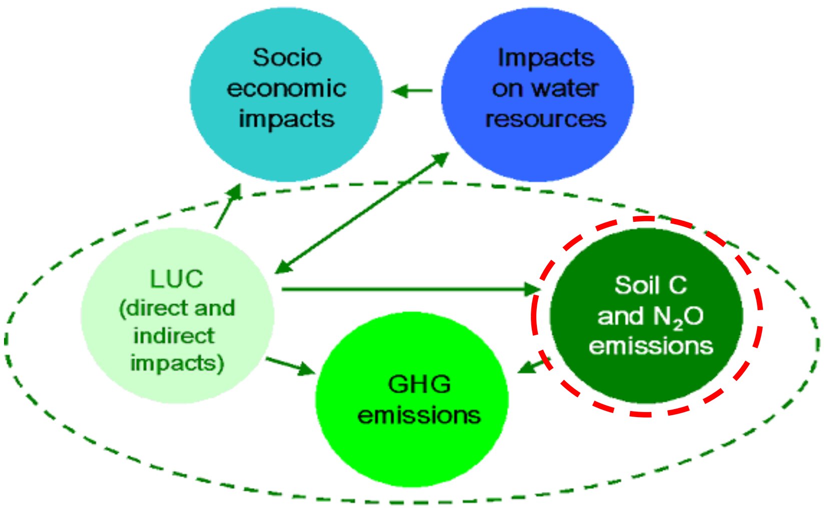


- In a very first moment it was conceived as an activity to support the assessment of GHG emissions -> LUC and iLUC.
- Nowadays, Land Use and Land Use Change are the key drivers for identifying cases to be studied.

- **Activity developed by a partner (ICONE)**, since September 2010. The project is close to be finished. Knowledge internalized.
- **The Brazilian Land Use Model (BLUM) was improved according to the interests of CTBE and ICONE**. Scenarios will be explored in 2013.

Soil Carbon Stocks and Gaseous Emissions

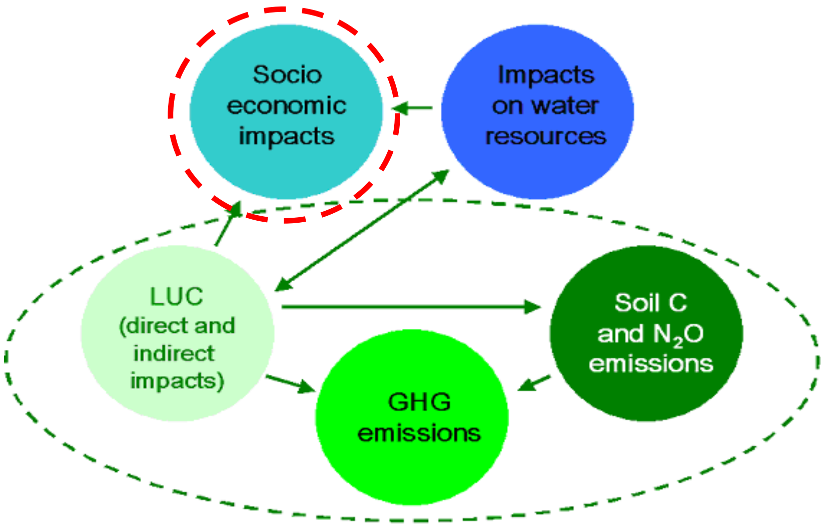
Brazilian Bioethanol Science and Technology Laboratory



- Project conceived in order to support the assessment of GHG emissions (due to LUC).
- Regarding gaseous emissions, priority was given to N_2O emissions from straw decomposition and from the application of nitrogen fertilizer, vinasse and filter cake and CO_2 emissions due to soil C dynamics

- **Activity developed by a partner (Delta CO2)**, since February 2011. The project is also close to be finished.
- **Different possible situations related with sugarcane expansion have been explored**: sugarcane displacing pasture, sugarcane displacing other crops, different agricultural practices, different regions.

Socio-economic Impacts



- Priority is assessing socio-economic impacts at the level the economic activity (e.g., sugarcane production, ethanol production) takes place.
- **Three main projects, being one developed by a partner**.

- **Evaluation of the impacts of the sugarcane "industry"** at a regional level (municipalities) **working with indicators**.
- Evaluation of the impacts of the sugarcane "industry" **in a new producing area**. **Activity based on modeling**.
- **Evaluation of working conditions in the agriculture**. Activity developed by Reporter Brasil, since July 2011.

Impacts on Water Resources

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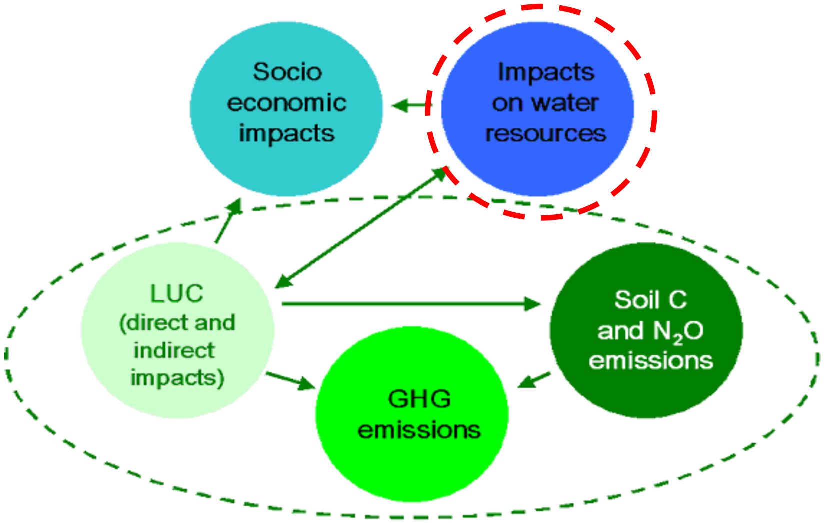
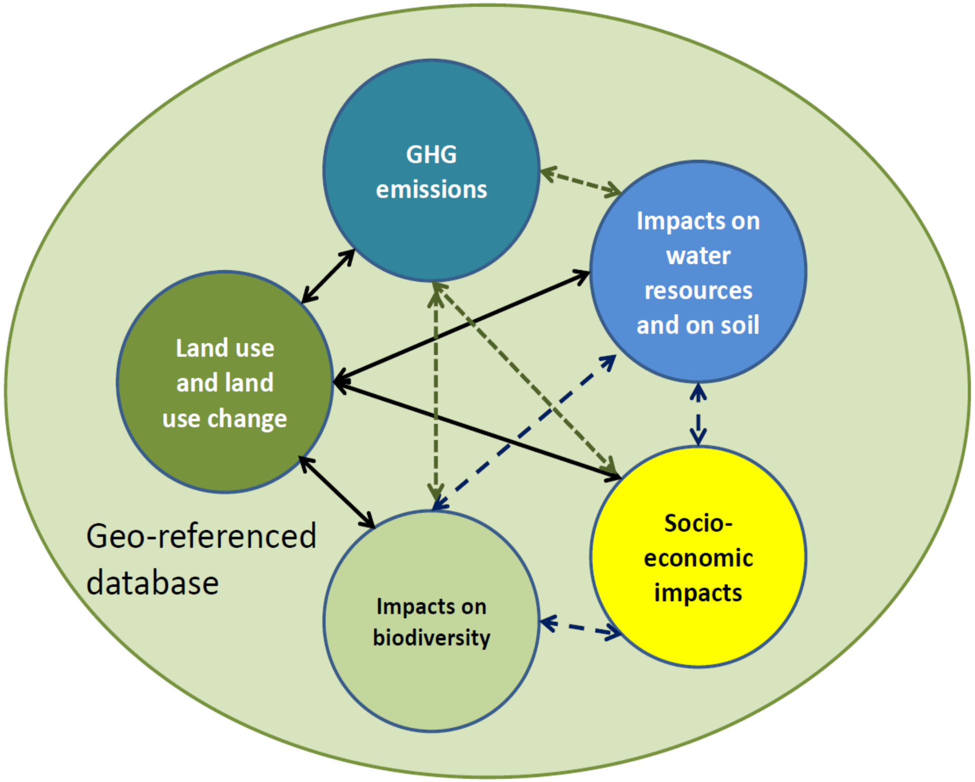


- No doubts about the importance of the nexus “biofuels” and “impacts on water resources”.
- Assessment of impacts on availability and quality.
- Difficulties to set partnerships.

- **So far, activities have been developed in-house, with focus on modeling** (at the cropping site level and at a basin level) and data gathering.
- Preliminary results on water footprint and on assessing impacts on watershed.
- It’s is our intention to address the impacts due to irrigation.

New Research Priorities



- Since 2011, we've made an effort to add/detail three other research activities: (1) to include **biodiversity as a research subject**; (2) to be more ambitious regarding the **database (geo-referenced database)**; (3) to go for an **integrated sustainability assessment**.

Land use and LUC

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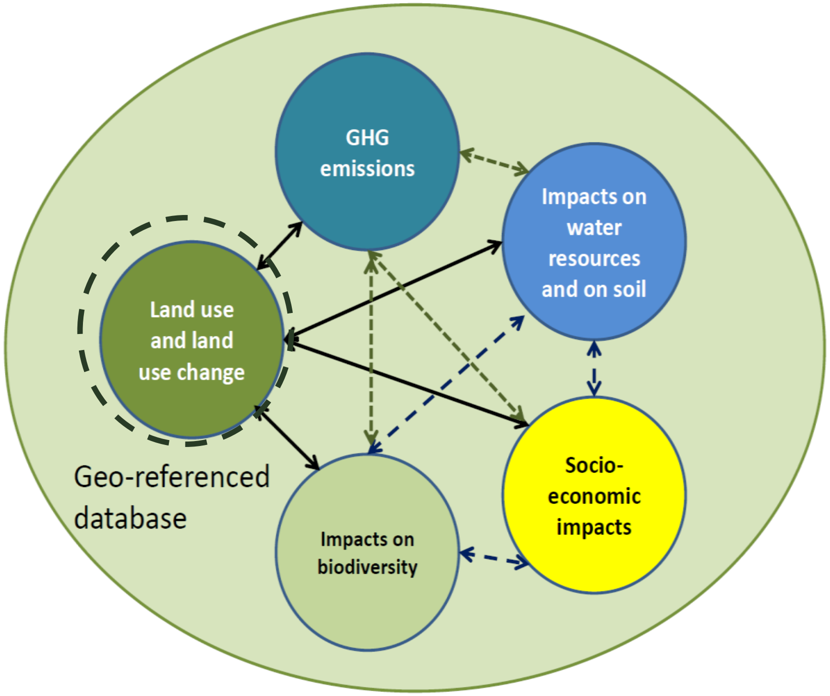
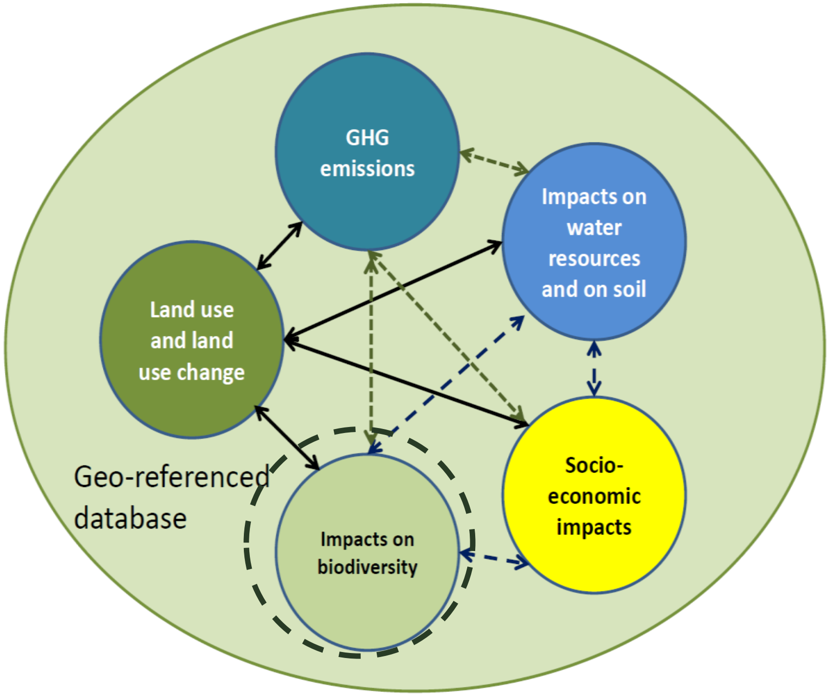
- From our point of view, land use and LUC are the main drivers of impacts.
- Identifying the potential regions of sugarcane expansion, for instance, is essential for defining case-studies and the efforts on data gathering.



Biodiversity

- We recognized the importance of the subject and understand that impacts on biodiversity should be assessed.
- But, what aspects should be considered? Which taxonomic groups should be focused?



- Unfortunately, at this moment we don't have a collaborator with expertise on the subject.

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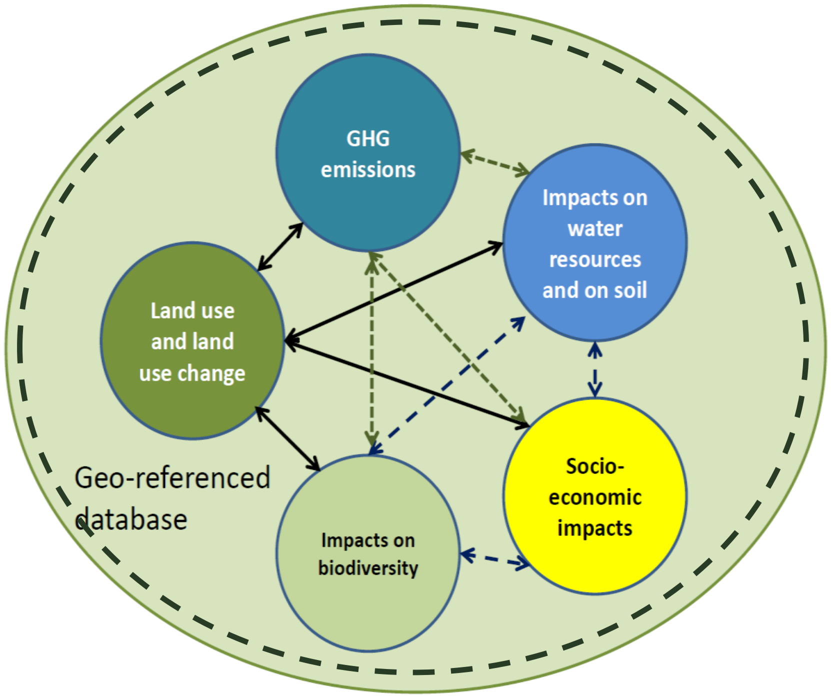
Database

- In 2009, the aim was just a database for disseminating information (also to outside CTBE).
- Since 2011 we've worked in a more ambitious project: the database, with all geo-referenced data, is fundamental for an integrated assessment.



- We've worked in-house. A first version is available, and the aim is a full integrated base in few years.

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CNPEM

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.

CTBE IBGE INPE Ministério da Agricultura e do Abastecimento NASA

INMET ipea Instituto de Pesquisa Econômi DELTA CO2 Sustentabilidade Ambiental DATASUS MINISTÉRIO DA SAÚDE

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

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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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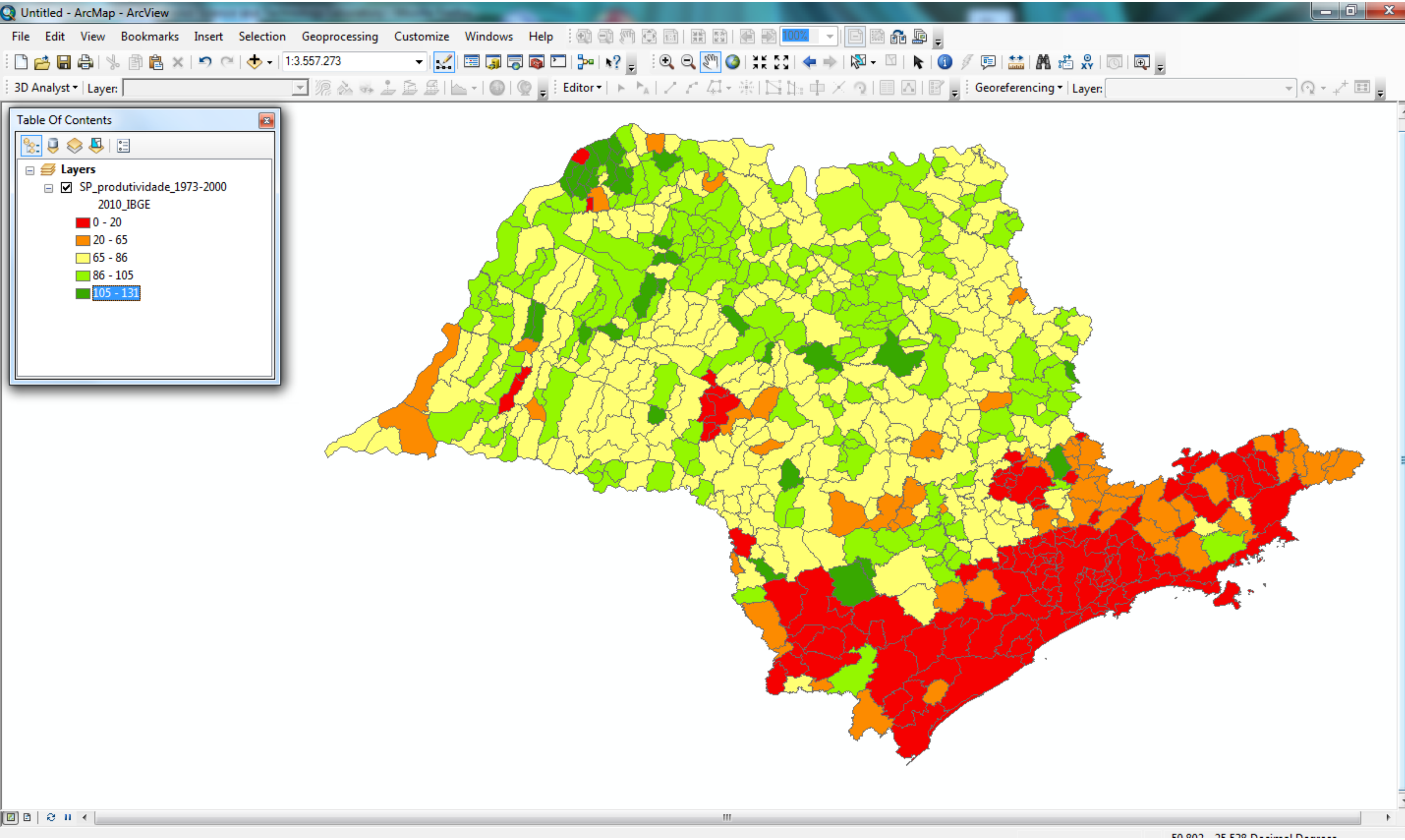
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Layers
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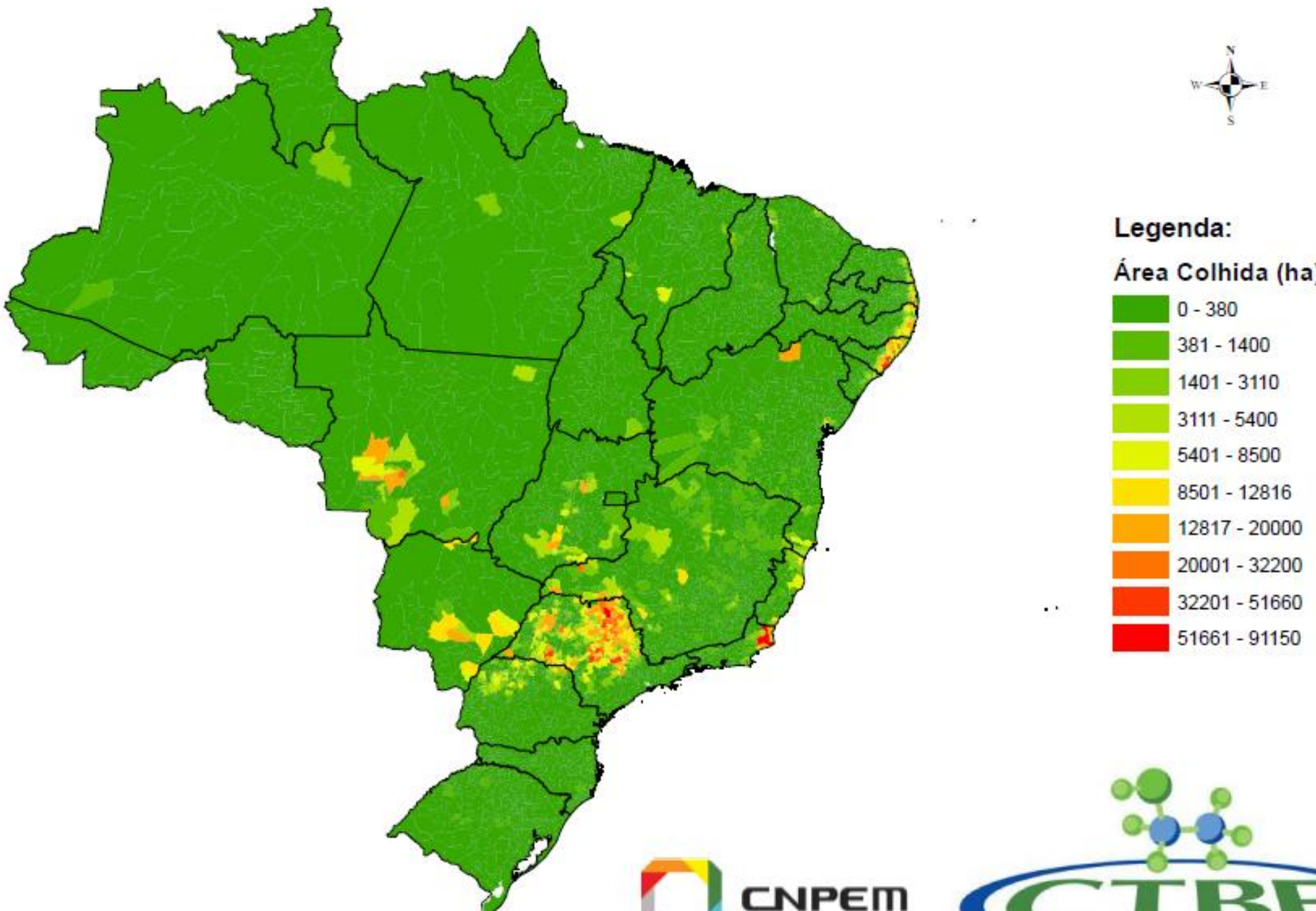
Sugarcane Harvested Area (2000)



Source: IBGE

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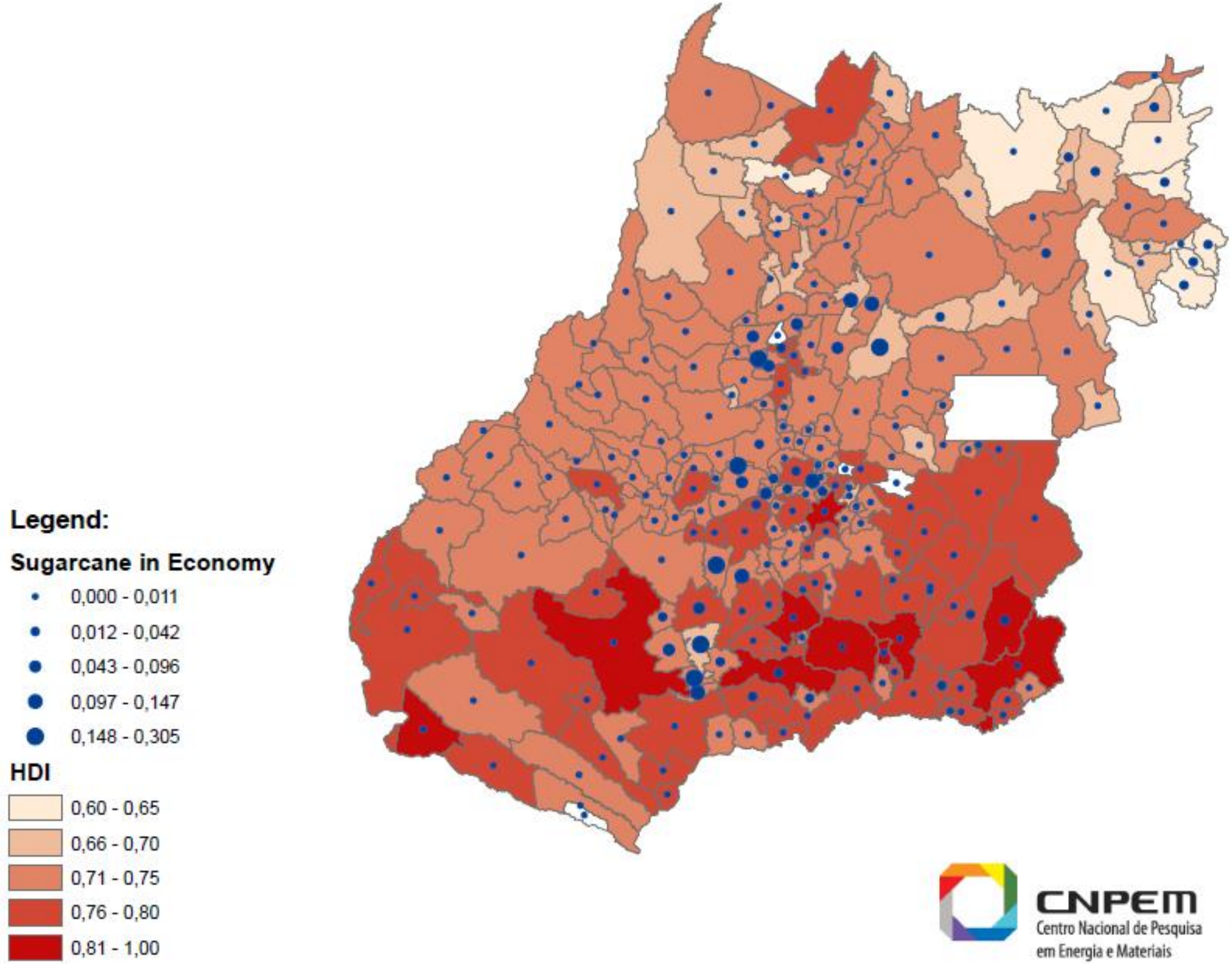
Goiás (2000)



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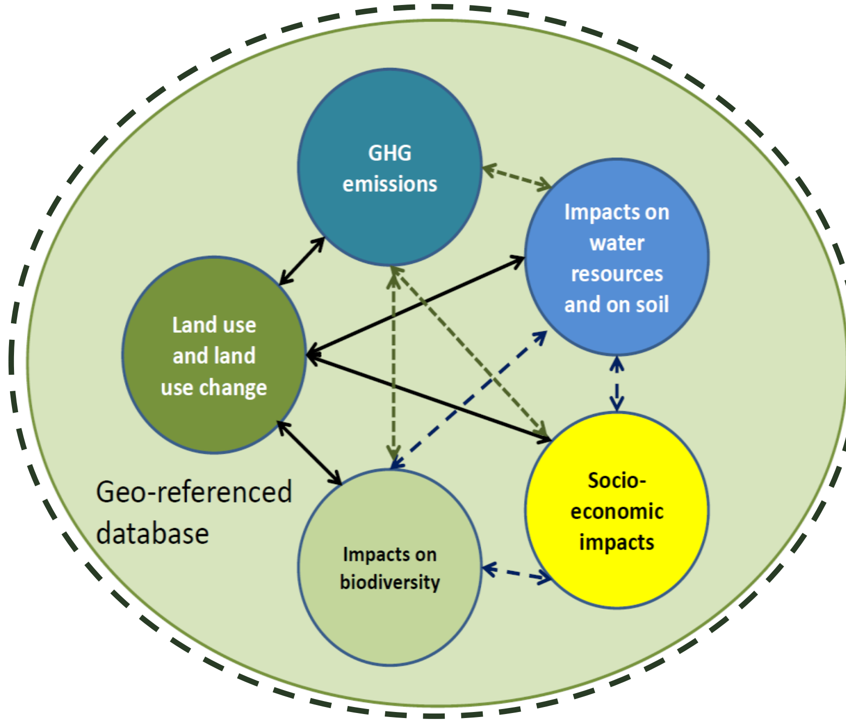
Integrated Sustainability Assessment

- Integrated Sustainability Assessment is the way forward.
- Honestly, we're just starting activities related with this approach.
- The aim is to improve methods, in order to address different sustainability aspects within an integrated approach (as integrated as possible).



- We do not intend to use/define methodologies aiming to compare alternatives using few (or a single) indicators.

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Thank you for your attention!

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