Workshop 2G ethanol - CTBE
29/11/2017

Sucre Project – lessons learned about the implications of sugarcane straw recovery for energy purposes

Dr. João Luís Nunes Carvalho

Researcher

Brazilian Bioethanol Science and Technology Lab (CTBE/CNPEM)

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BIOETHANOL PRODUCTION

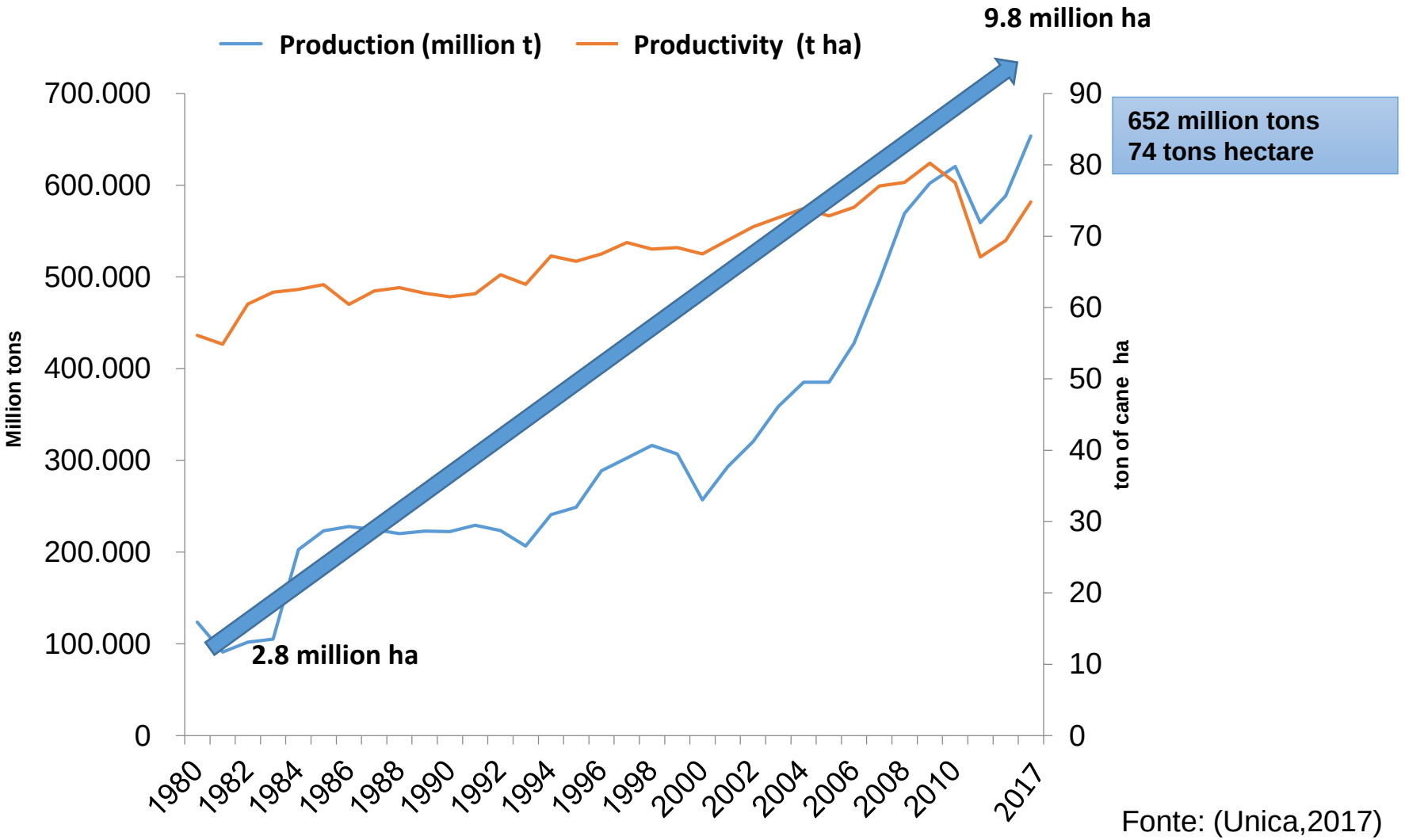
Ethanol production	50.3 billion liters	87%	30.1 billion liters
Main raw material	corn		sugarcane
	2.7 x		2 x
Projections to next decade	136 billion liters		61.6 billion liters

How to achieve these targets?

- Increasing the production area and/or crop yields

Overview of Sugarcane in Brazil

Brazil is largest sugarcane producer, producing almost 40 % global production



Fonte: (Unica,2017)

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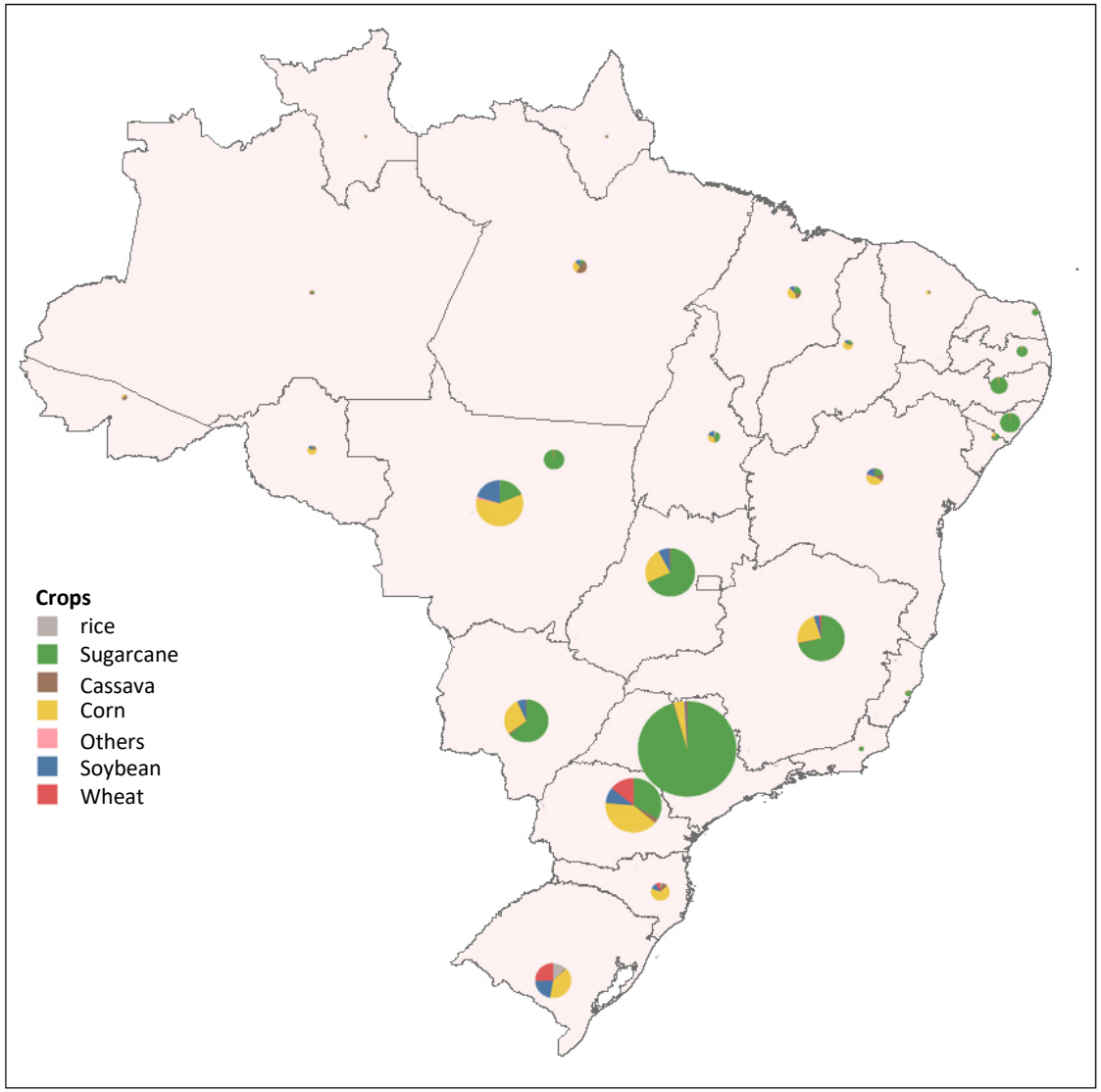
- Increasing the production area and/or crop yields
- Cellulosic ethanol from dedicated crops and/or crop residues (corn stover and sugarcane straw)

CROP RESIDUES AVAILABILITY IN BRAZIL

> 251 million tons of crop residues



Sugarcane represent 65% of the total
- Bagasse - Straw

~80 million tons of dry straw

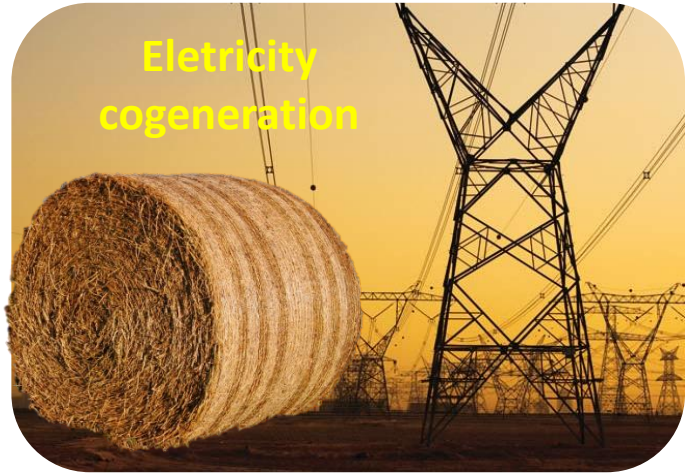
Source: Boletim CTBE, 2017

Current dilemma

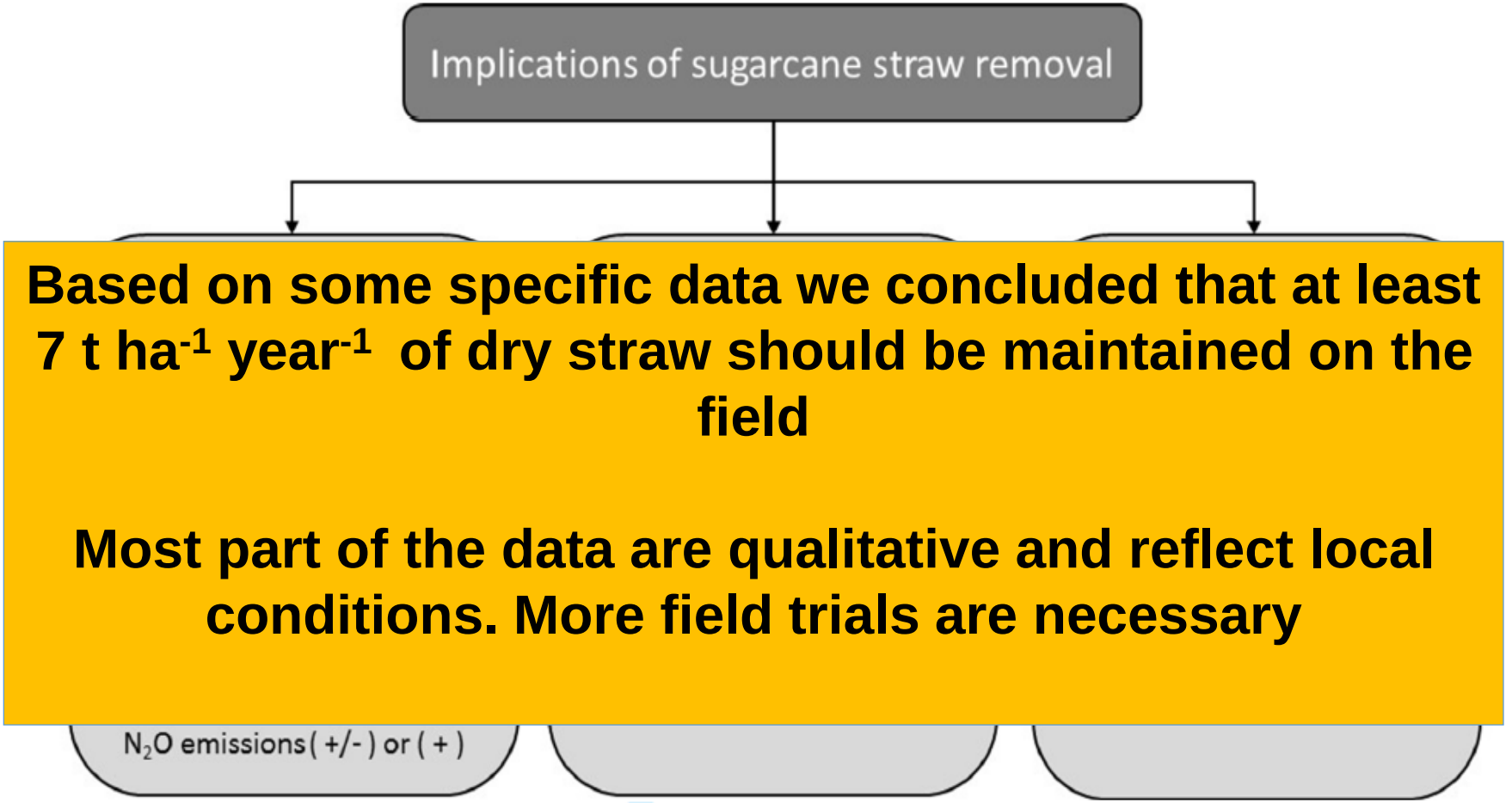
Sugarcane field

What is the best use of straw ?
There is one?

HOW MUCH STRAW SHOULD BE MAINTAINED ON THE FIELD?



Literature background



Based on some specific data we concluded that at least 7 t ha^{-1} $year^{-1}$ of dry straw should be maintained on the field

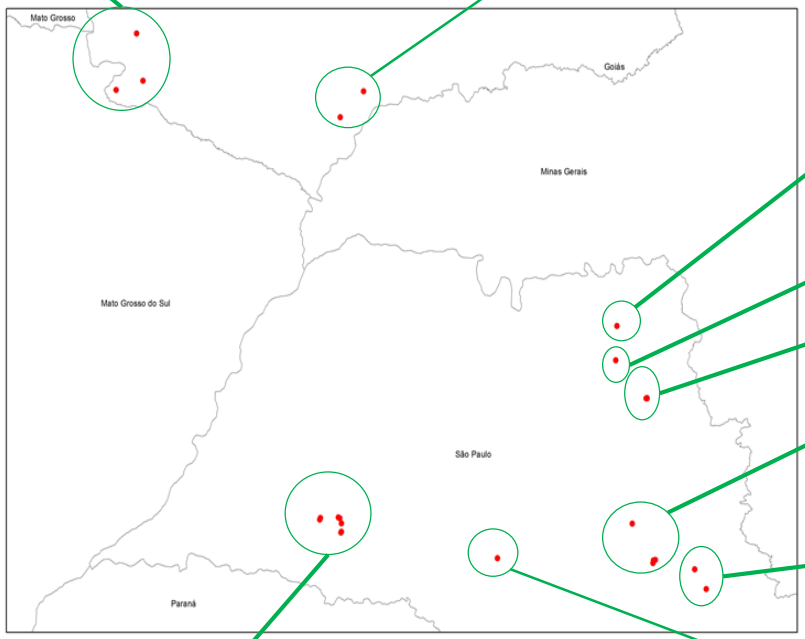
Most part of the data are qualitative and reflect local conditions. More field trials are necessary

Carvalho et al., 2017 – GCBBioenergy

GLOBAL CHANGE BIOLOGY BIOENERGY Open Access

Agronomic and environmental implications of sugarcane straw removal: a major review

In four years of Project we collected data in 26 field trials totaling 57 sugarcane harvests



Cerradinho Bio – Chapadão do Céu / GO

Boa Vista – Quirinópolis / GO

Alta Mogiana – São João da Boa Vista / SP

4S – Sales de Oliveira / SP

Pedra – Serrana / SP

Iracema – Iracemápolis e Itirapina / SP

Ester – Cosmópolis / SP

Quatá (Zilor) – Quatá / SP

Agrícola BPZ – Agudos / SP

Evaluations:

Soil, water, sugarcane plant and environment

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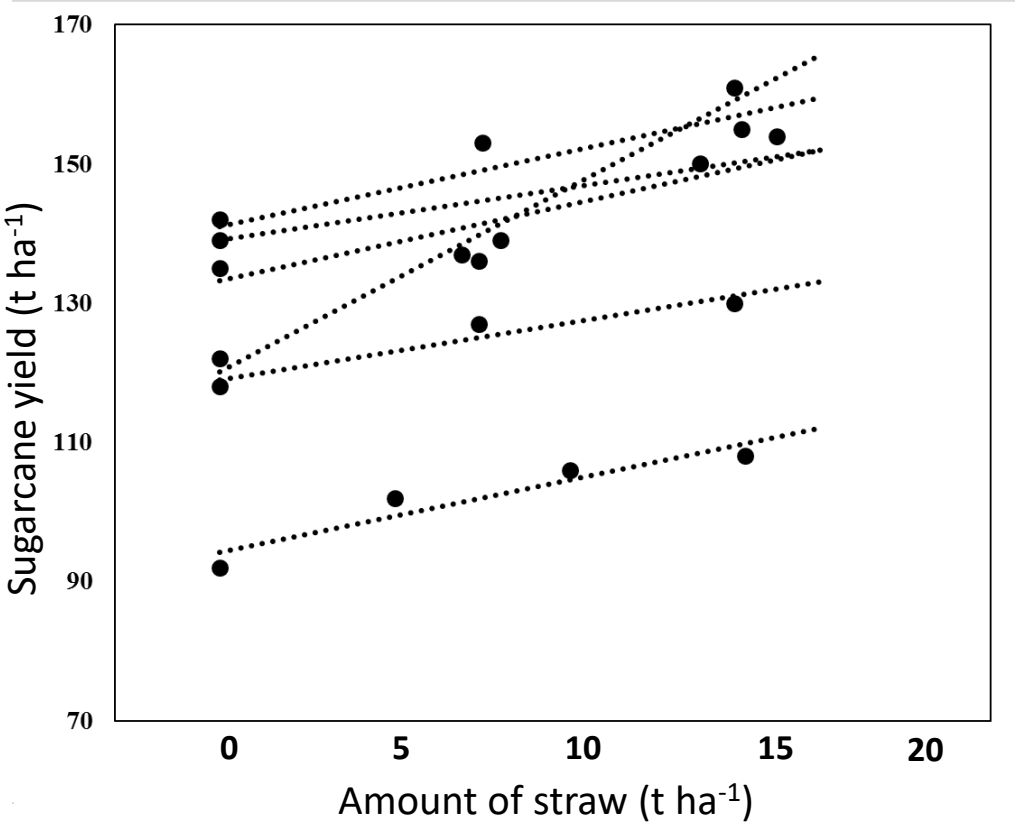
Impacts of straw removal in soil quality indicators (ongoing research)

- Reduce nutrient recicling
- Reduce soil C stocks
- Reduce soil moisture and soil temperature
- Increase soil and nutrient losses by erosion
- Increase weed infestion
- Increase N_2O emissions
- Increase soil pests

WHAT IS THE IMPLICATION OF THESE CHANCES IN SOIL QUALITY ON SUGARCANE YIELD IN SOUTH-CENTRAL BRAZIL?

Implication on sugarcane yields
A case study in Goiás State



Predominant conditions

Dry period is well defined
High water déficit
High solar radiation
High air temperature
High evaptranspiration

Straw oportunity cost:
Each ton of straw in the field resulted in gain of :

1.2 ton of stalk (wet basis)
300 kg of bagasse (wet basis)
144 kg of straw (dry basis)

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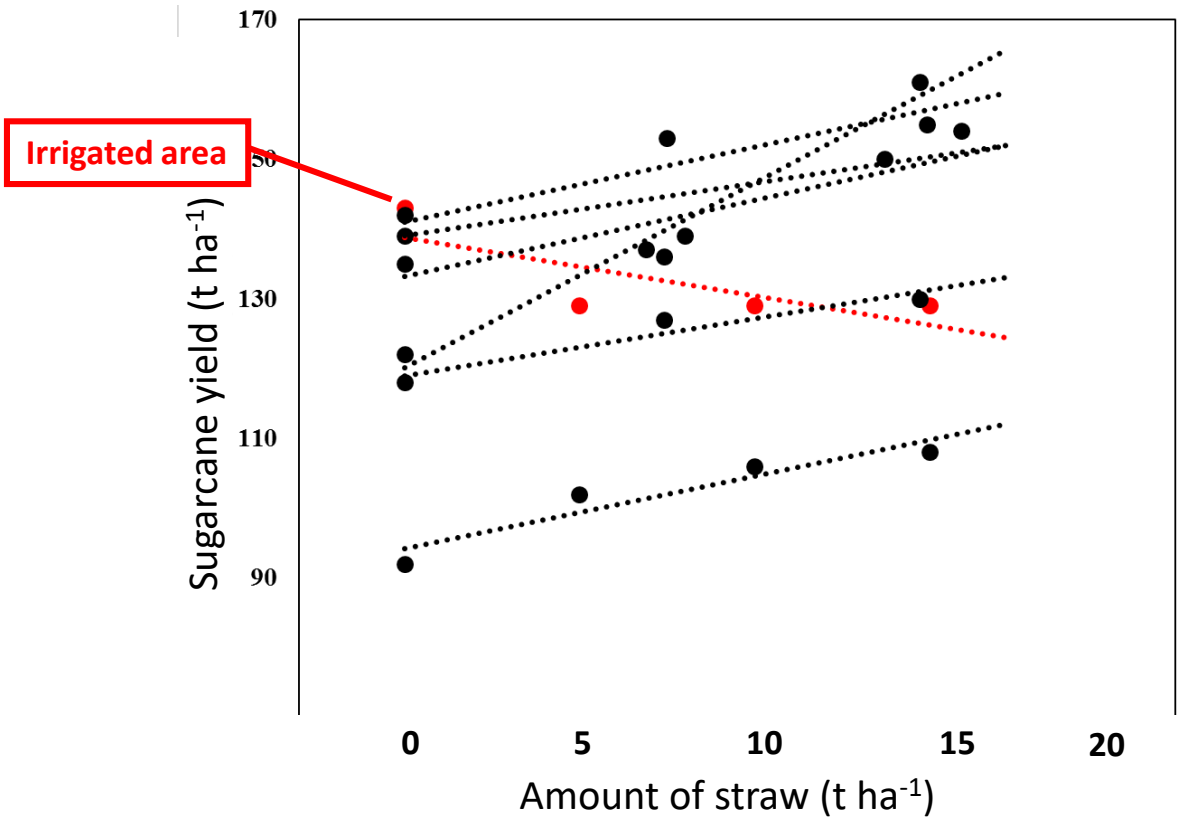
Implication on sugarcane yields
A case study in Goiás State



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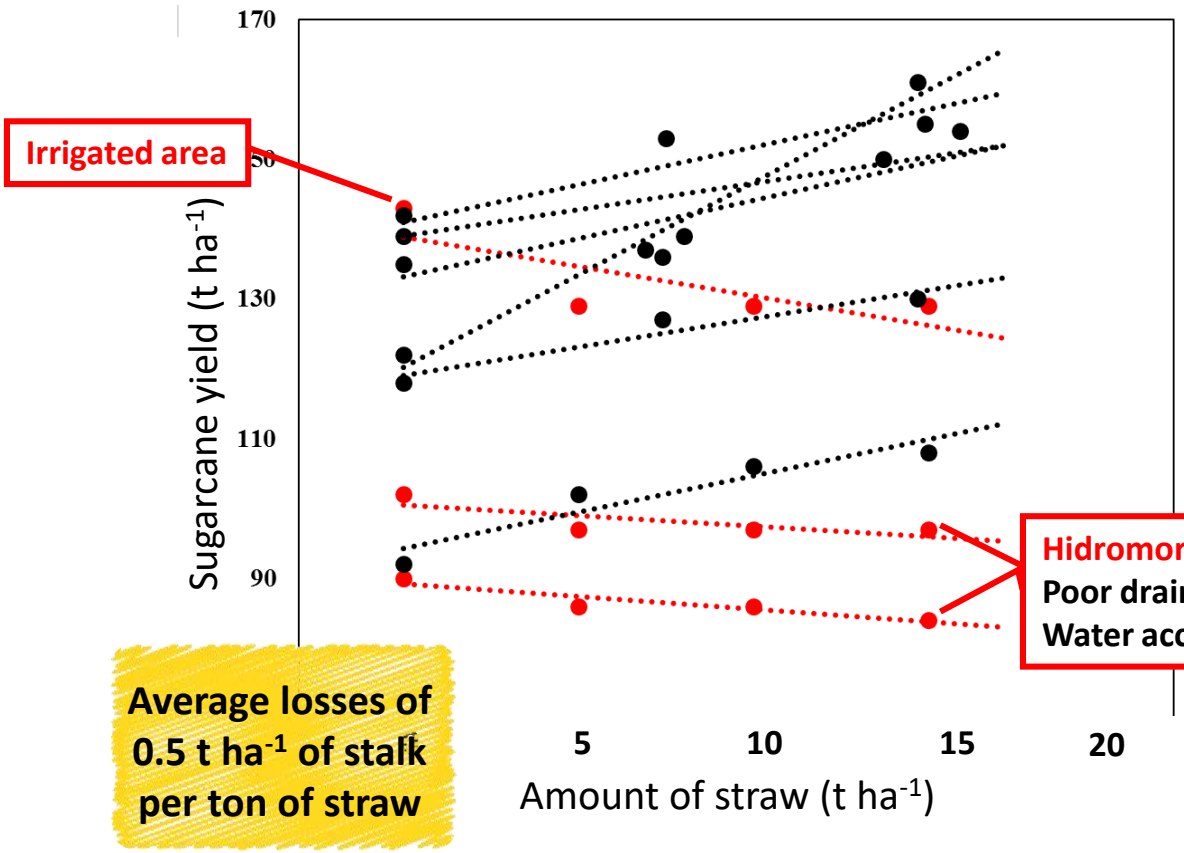

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***Straw opportunity cost*:**
...on of straw on the field ...esulted in gain of :

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Case study in São Paulo state – Sandy soils

Impacts of straw removal on crop yields per harvest season

Early harvest *(March – May)*	Medium harvest *(June – August)*	Late harvest *(August – November)*
Fina… season Fast suga… uting with subsequen… r surplus High e… sure Straw inc… déficit Each to… on the field re… ins of:		
1.15 ton of stalk (wet basis) 288 kg of bagasse (wet basis) 138 kg of straw (dry basis)	0.23 ton of stalk (wet basis) 58 kg of bagasse (wet basis) 28 kg of straw (dry basis)	0.56 ton of stalk (wet basis) 140 kg of bagasse (wet basis) 67 kg of straw (dry basis)

Sugarcane straw can increase bioenergy production when is used in industry (2G ethanol or bioelectricity) and also when is maintained on soil surface

Average gain = 0.65 ton of stalk; 163 kg of bagasse; 78 kg of straw

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Luciano et al., 2017

Sugarcane mill area

~50.000 ha
Dominated by sandy soils

Using GIS information

Considering the folowing criteria:

Soil type
Slope
Crop season
Expected yield

WE SHOULD NOT ADOPT THE RECOMENDATION OF 50% OF STRAW REMOVAL

AVERAGE NUMBERS CAN BE USED FOR POLICE MAKERS TO ESTIMATE AVAILABLE BIOMASS BUT NEVER FOR MANAGERS

THERE ARE SOME SITES AND/OR MILLS THAT THE STRAW REMOVAL SHOULD NOT CAUSE CROP YIELD REDUCTION

THESE AREAS MUST BE A PRIORITY

After definition of the amount of straw that could be removed from the field it is necessary the establishment of the best methods to collect this raw material

Route - 1: Forrage harvester

Conventional Sugarcane harvest

Straw on the Soil

1

Windrowing

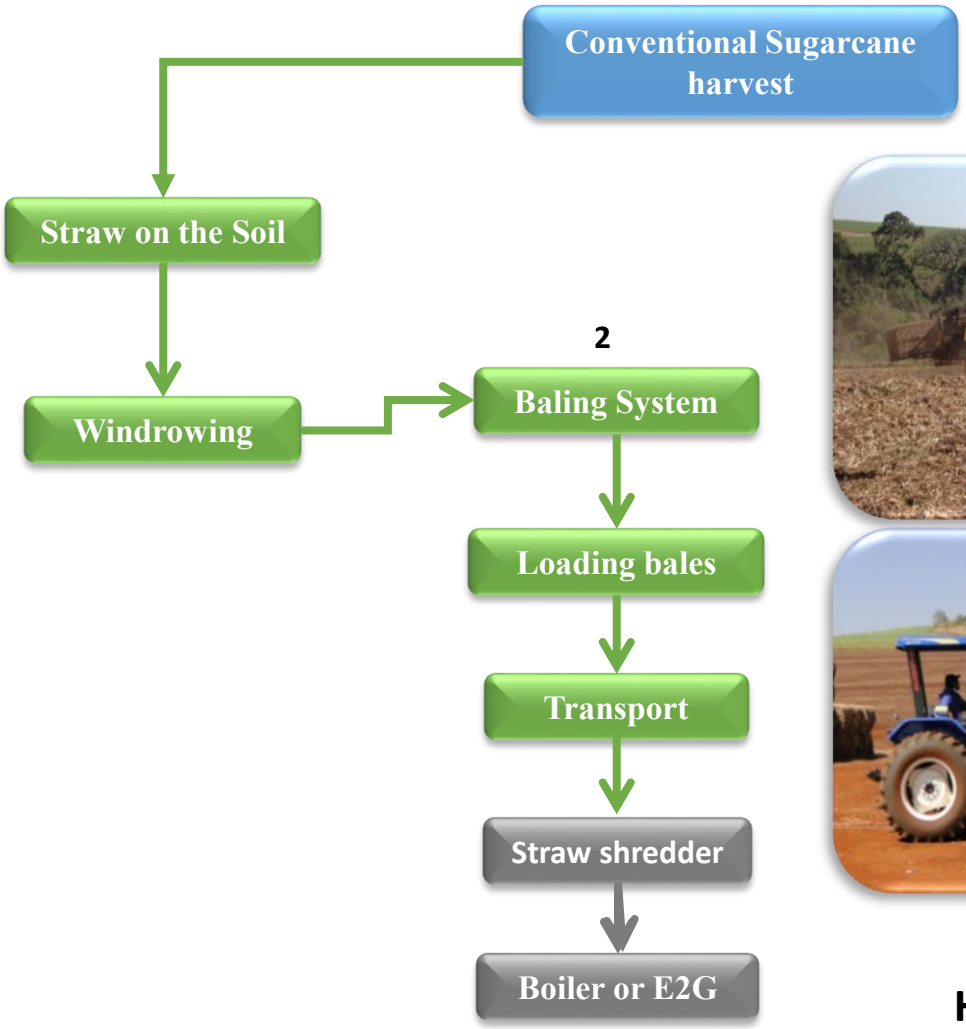
Forage harvester

Transport

Boiler or E2G

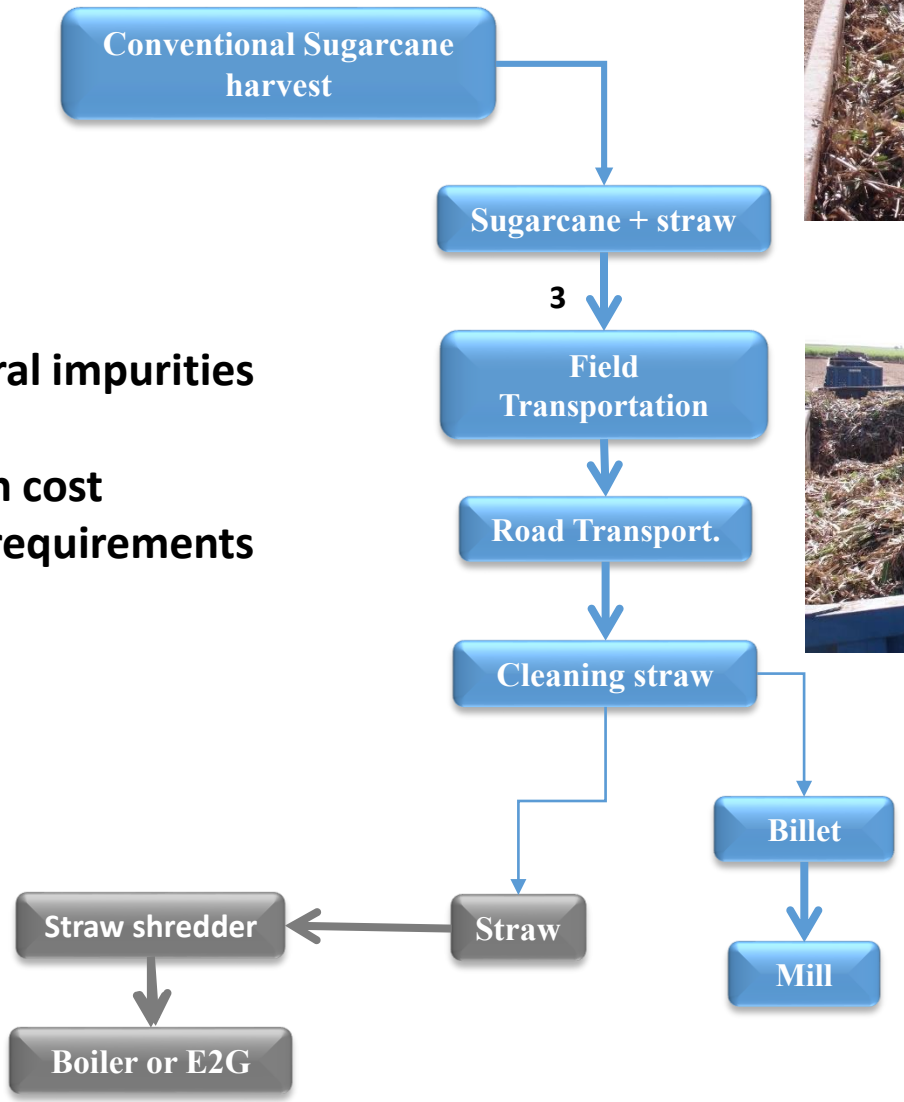
Higher levels of mineral impurities
Lower load density and
Higher transportation cost

Route - 2: Bailing system



Higher levels of mineral impurities
Higher load density and lower transportation cost

Route - 3: Integral system



Lower levels of mineral impurities
Lower load density
Higher transportation cost
Increase equipment requirements

Our estrategy

Definition of the straw removal rate

Modeling and simulation

Estrategies to straw collection

Industrial parameters

Laboratório Nacional de Ciência e Tecnologia do Bioetanol

Project team and financial support

CNPEM

Research team

CTBE Sucre Team

Mills team

Iracema (São Martinho)
Boa vista (São Martinho)
Porto das Águas (Cerradinho)
Quatá (Zilor)
Barra Grande (Zilor)
Ester
Pedra Agroindustrial
Alta Mogiana

Financial Support

GEF (PNUD SUCRE)

Thank you!

joao.carvalho@ctbe.cnpem.br