



Brazilian Bioethanol Science
and Technology Laboratory



Overview of Important Sustainability Questions Regarding Bioenergy Production How Soil Sustainability Issues Fit the Overall Picture and Can Be Transformed Into Practical Actions

Manoel Regis L. V. Leal
CTBE – Brazilian Bioethanol Science and Technology Laboratory

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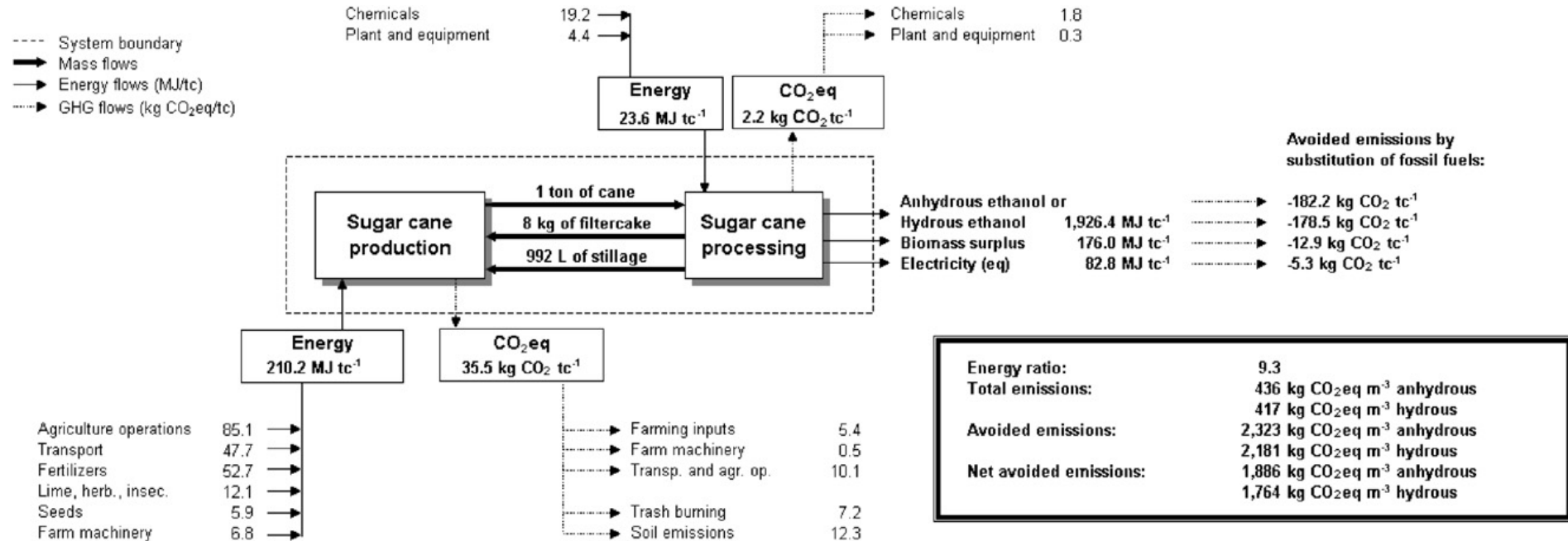


INDICATORS		
Environmental	Social	Economic
Lifecycle GHG emissions	Allocation and tenure of land for new energy production	Productivity
Soil quality	Price and supply of a national food basket	Net energy balance
Harvest levels of wood resources	Change in income	Gross value added
Emissions of non-GHG air 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



- ✓ GHG emission reduction
- ✓ Displacement of fossil fuels
- ✓ Natural resources demand (land, water)
- ✓ Impacts on soil and water quality
- ✓ Production costs
- ✓ Land use change (LUC)
- ✓ Impacts on food production
- ✓ Social impacts
- ✓ Impacts on biodiversity

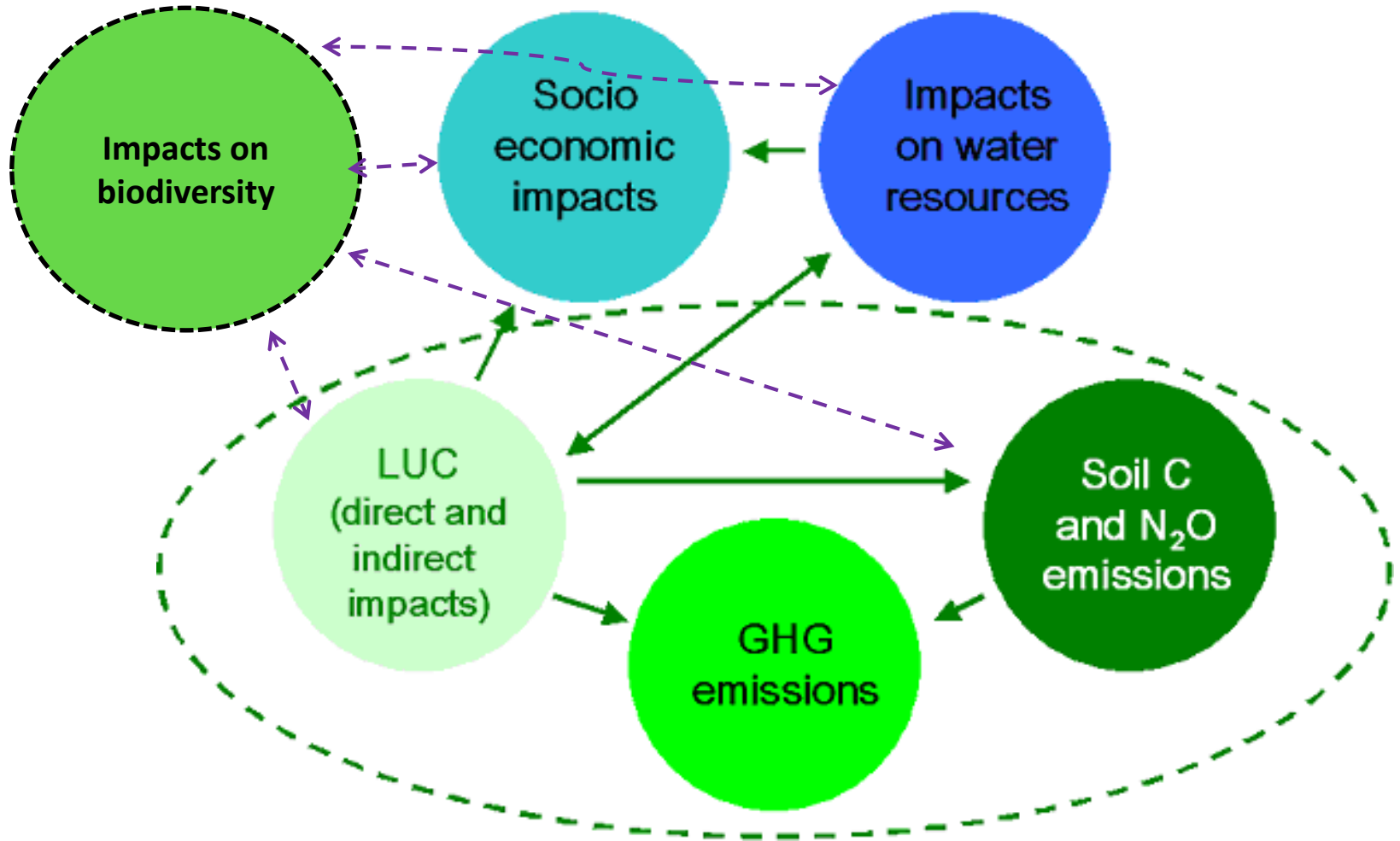
All these items bear a strong dependence on land demand, thus on the biofuel feedstock productivity



Fonte: Macedo et al., 2008

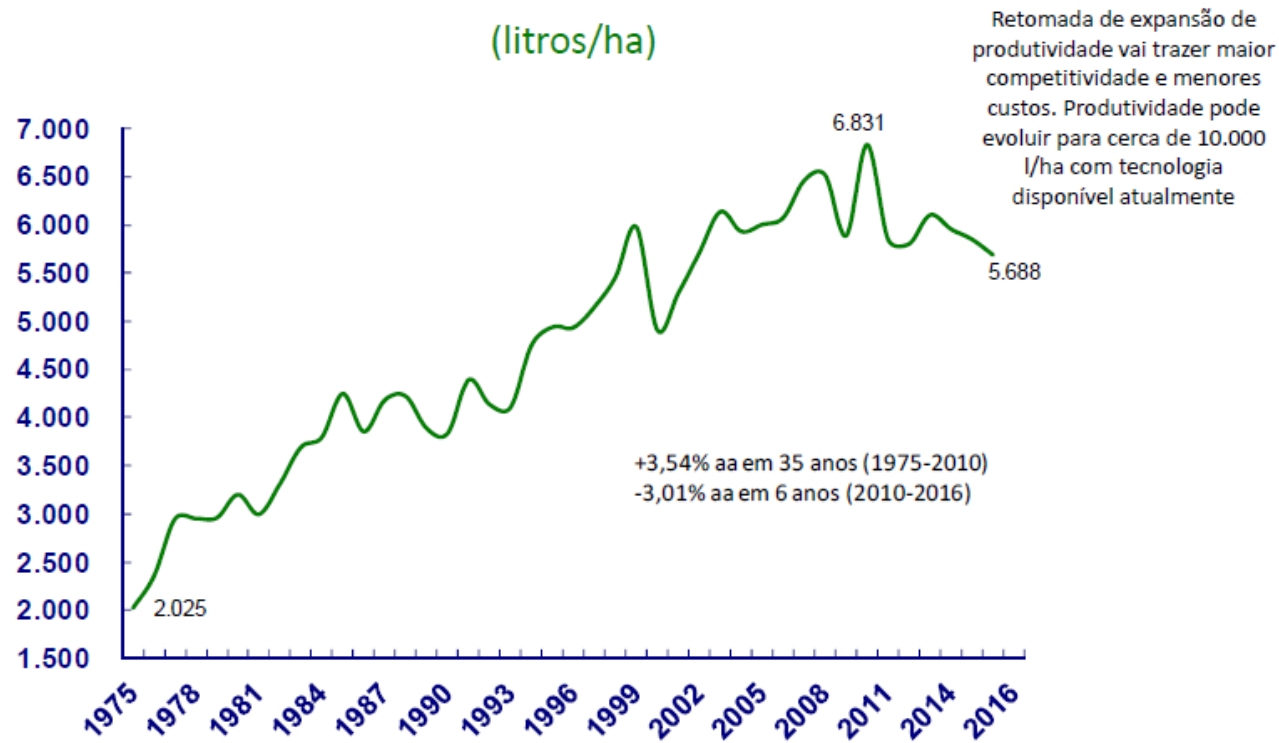
Energy Balance and LCA GHG Emissions

- ✓ The agricultural area is responsible for 90% of fossil energy consumption and 94% of GHG emissions
- ✓ Soil and straw burning GHG emissions (non-CO₂) represent around 55% of agricultural area emissions
- ✓ Agricultural operations consume 40% of fossil energy related to cane production
- ✓ More than 2/3 of GHG emissions depend solely on cultivated area
- ✓ LUC and ILUC emissions also depend only on the cropped area, and they can have a significant impact on the total LCA GHG emissions



Ethanol Yield Loss in Brazil

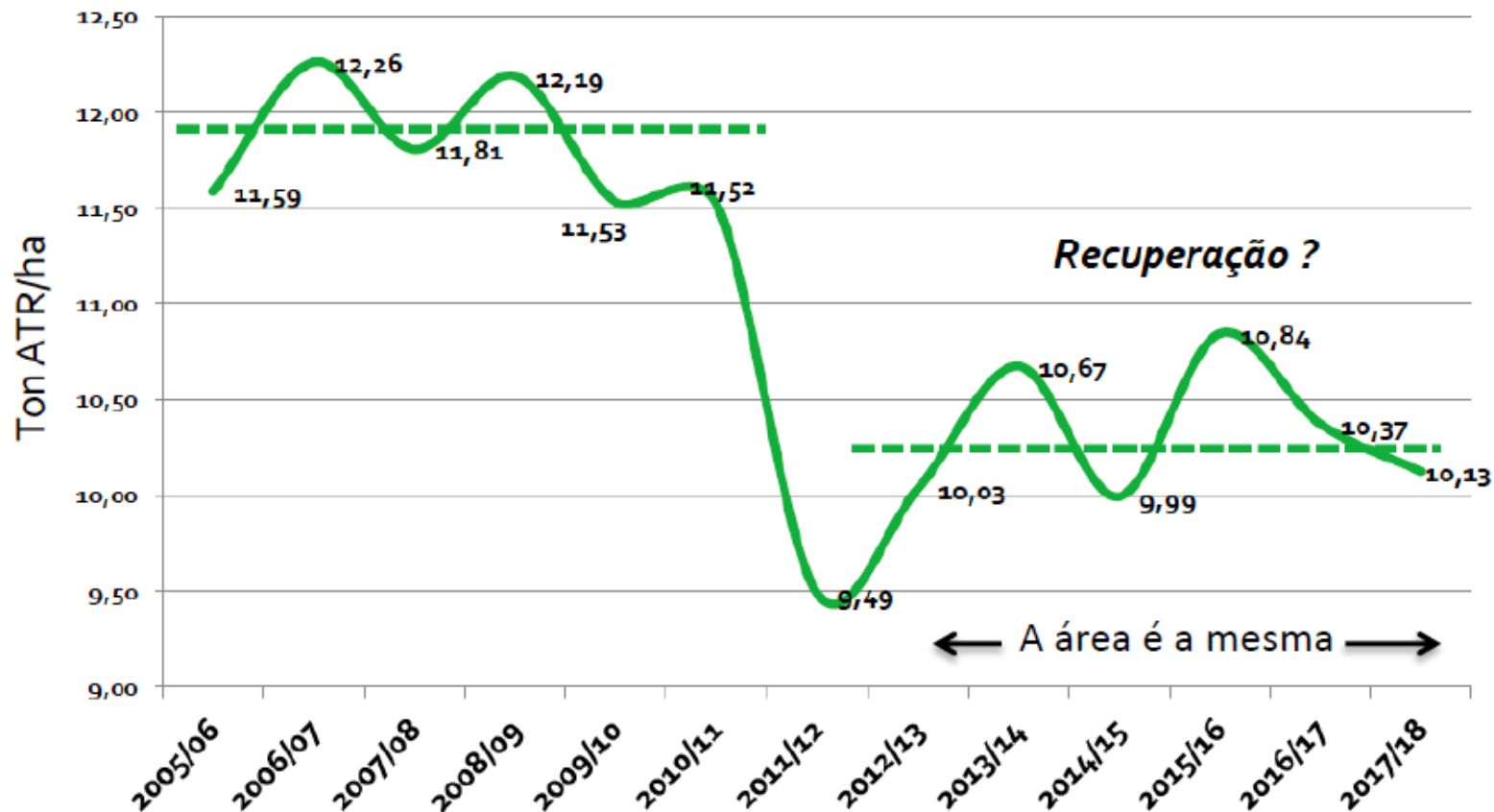
Produtividade Agroindustrial na Produção de Etanol (litros/ha)



Fonte: DATAGRO

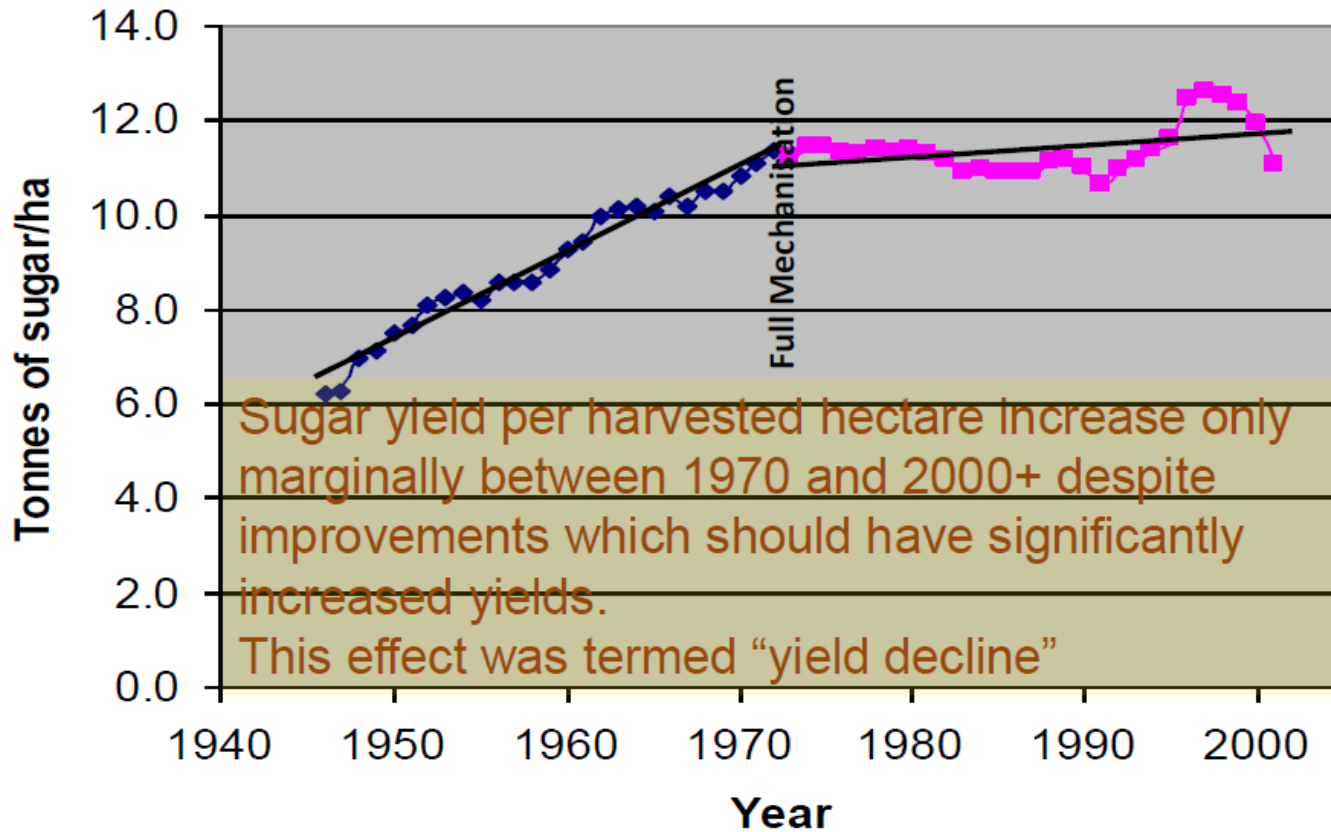
Source: DATAGRO, 2017

Sugarcane Yield Loss in Brazil



Source: Canaplan, 2017

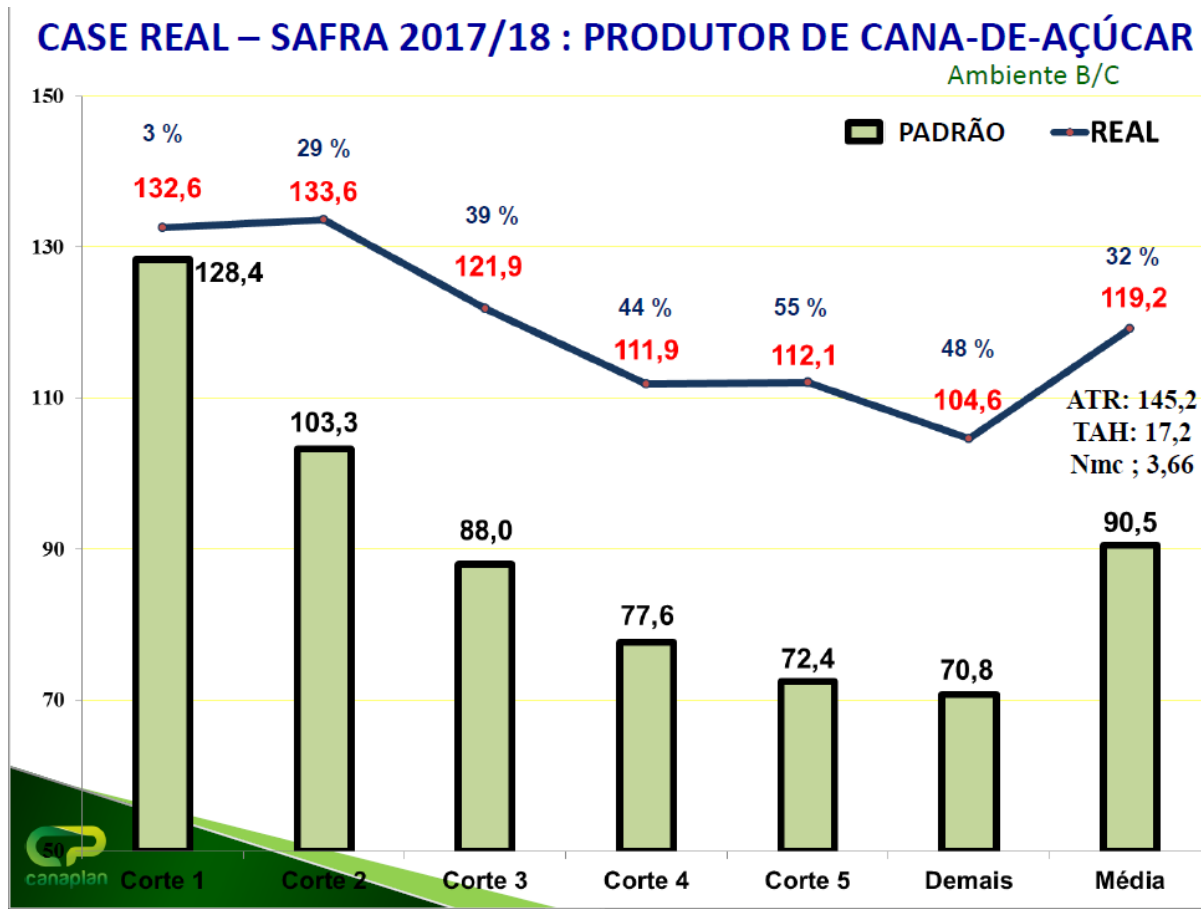
Sugarcane Yield Problem in Australia



Actions

- **Australia:** Sugar Yield Decline Initiative
 - Soil biological health represents a significant production constraint
 - Modern farming system: controlled traffic, permanent beds, minimum tillage, legume break crops, crop residue retention (soil biological health)
- **Brazil:** practically nothing at country level; mostly blamed to increase in cane field average age (reduction in renewal) and mechanization
 - Several mills improved traffic control and tried to reduce tillage

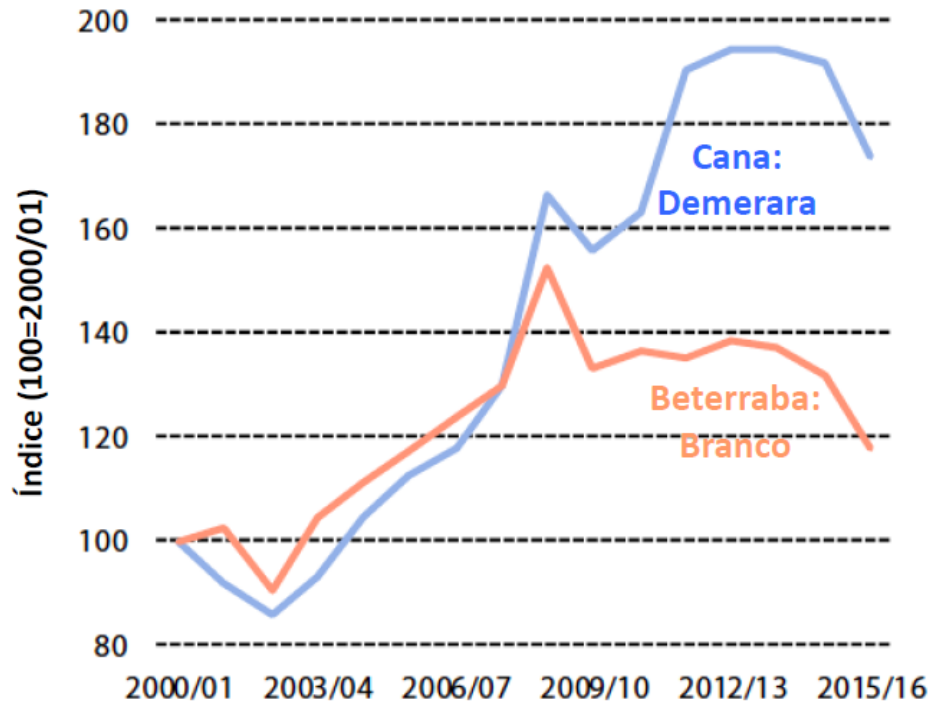
How to Explain Such Difference?



Source: Canaplan, 2017

Sugarcane Vs Sugar beet

CUSTOS DE PRODUÇÃO DE AÇÚCAR CANA E BETERRABA – BASE 2000/01



Fonte: LMC International

Source: Canaplan, 2017

Present Situation

- Mechanization is here to stay
- RenovaBio creates Sustainability requirements for ethanol internal market affecting the economics (CBios)
- GHG emissions reduction will be certified for each ethanol producer and certified reductions will define the CBios allowed
- Brazilian sugar lost competitiveness in the international market, mainly due to yield loss
- Surplus electricity generation is increasing in the mills; straw recovery also
- Several changes in cane management affecting soil health

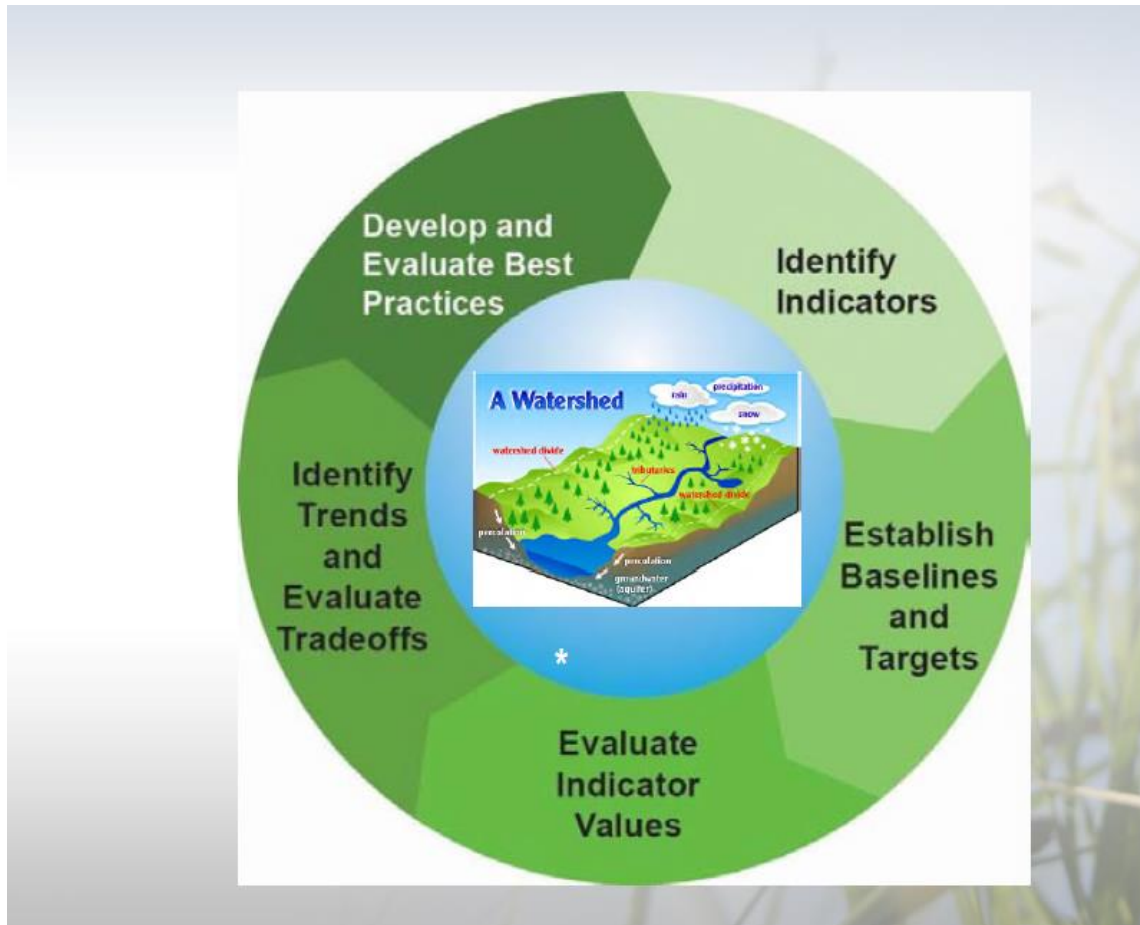
Desirable Future

- RenovaBio will promote a significant expansion of ethanol production and use in Brazil and it must be done sustainably
- Reduce production costs that must start by increasing yields, at least to the pre 2010 levels
- Reduced LCA GHG emissions including LUC (this requires a better knowledge of soil C and N cycles)
- Improve sugarcane straw recovery, to increase power generation, but watching for the impacts on soil health

What Should We Do?

- Reduce the negative impacts of mechanization: soil compaction, harvesting losses, spread of pests and diseases, etc
- Produce better varieties for new production frontier and more resilient to drought and adequate for mechanical harvesting
- Improve residue management (straw, vinasse, filter cake) and other management practices
- Increase our knowledge about soil health:
 - Microbial population dynamics
 - Impacts of crop management on this dynamics and results affecting plant growth and GHG emissions
 - Develop practical indices to indicate soil health status
 - Recovery of degraded land
- Start to work with the Landscape Design Sustainability concept

Landscape Design Concept



Final Comments

- Bioenergy sustainability is increasing in importance due to NDC commitments (in Brazil has already resulted in RenovaBio)
- The impacts of LUC need to be better determined and soil health has to be part of the process
- The sustainability requirements for bioenergy have a good chance to be extended to food/feed production (e.g. FAO IFES methodology)
- ABC initiative in Brazil can take advantage of increased soil microbiology knowledge



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Thank you for your attention!

regis.leal@ctbe.cnpem.br

regis.leal@gmail.com