

SUSTAINABILITY IN SUGARCANE PROCESSING IN BRAZIL

By

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Abstract

SUSTAINABILITY involves the three 'Ps': People, Planet and Profit. Brazilian sugarcane is a sustainable industry that has made significant gains in its sustainability over the last 30 years. A typical mill today can process twice as much sugarcane with the same equipment and with approximately the same energy, maintenance, labour, water, etc., so that twice as much product can be produced. All residues are recycled back to sugarcane fields. The use of energy and chemicals in processing are also considerably reduced. The use of sugarcane bagasse, other carbohydrates from sugarcane, production of bioplastics and second and third generation biofuels represent new avenues for increased sustainability. The entire Brazilian sugarcane production chain has to be very well prepared for a more intense scrutiny of sustainability.

Introduction

Sustainability is a complex concept involving the so called three 'Ps': People, Planet and Profit.

The production and processing of sugarcane in Brazil is definitely a sustainable industry and is a very important activity in that country.

It occupies less than 10% of the commercial agricultural area or less than 2% of the total arable land, but the sector generates 1.5% of the Brazilian GNP (same order of magnitude as Uruguay).

The sector is responsible for around 1 200 000 jobs, and employees are paid better than in other Brazilian agribusiness, and have superior labour rights.

The investment needed to generate these jobs is much less than in other sectors of the Brazilian economy.

In the automotive sector, about US\$80 000 is needed per job while, in sugarcane processing, only about US\$12 000 is required.

Considering all jobs in the production of ethanol and cars, ethanol-driven cars generate 20 times more Brazilian jobs than the gasoline ones.

In terms of impacts on the environment, it is acknowledged that any economic activity has an impact, but the sugarcane agribusiness consistently demonstrates that its production and processing are feasible in the long term.

This is the case in São Paulo state, where 70% of the sugarcane is produced and where the environment protection agencies are more active and the legislation more comprehensive.

In São Paulo, there are many sugarcane mills that have been in operation for more than 50 years and their productivity is still increasing.

Life style indices of the population in the sugarcane cities are improving and are better than in other cities.

Sugarcane processing in Brazil can be summarised in the flowsheet presented in Figure 1.

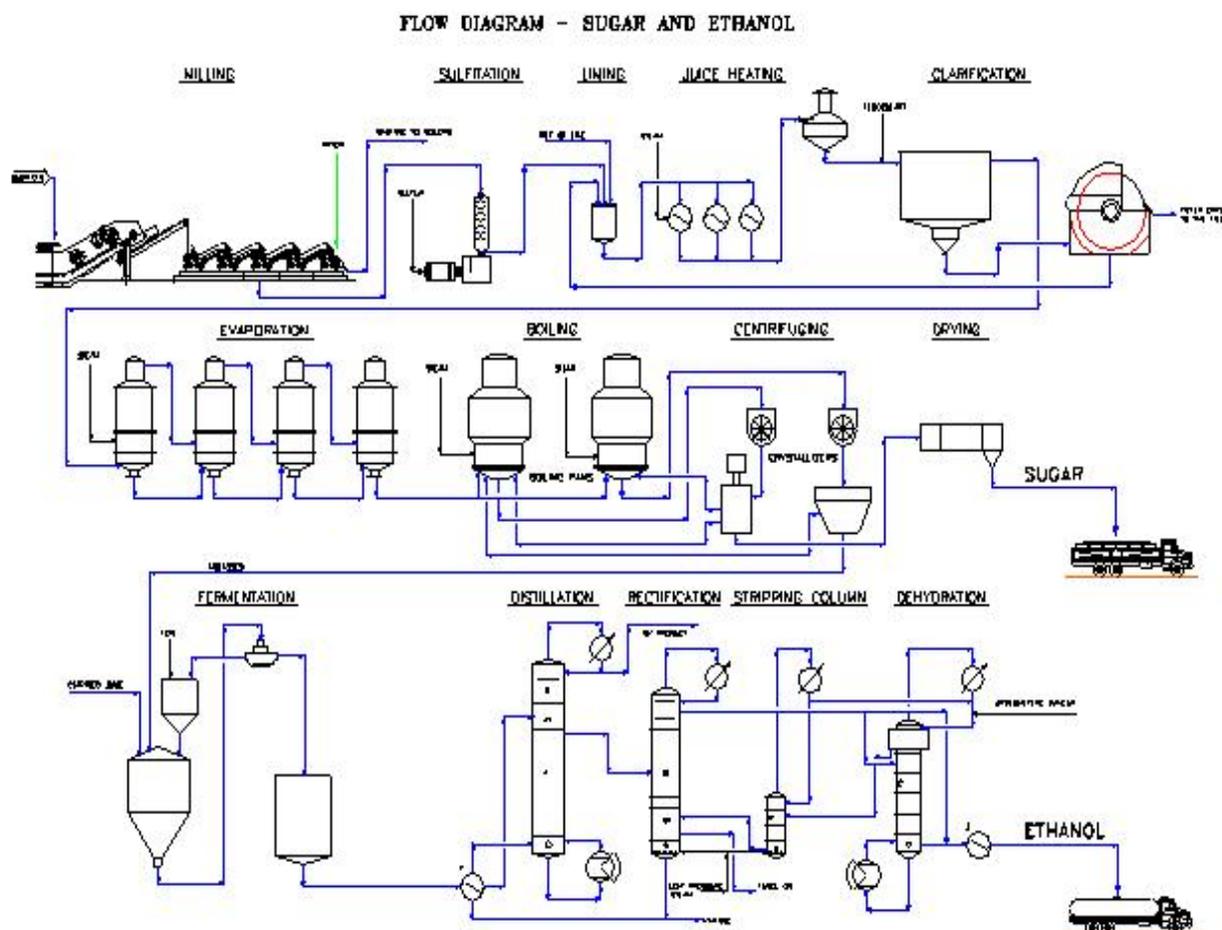


Fig. 1—Flow sheet of sugarcane processing in Brazil.

Sustainability

The sustainability aspects that can be emphasised in the processing are:

- Productivity,
 - Producing more with the same equipment;
- Efficiency,
 - Producing more with the same raw material,
 - Reducing losses and emissions – pollution;
- Energy,
 - Producing more with the same energy;
- Water,
 - Producing more with the same water;
- Chemicals,
 - Producing more with the same chemicals,
 - Less contamination – pollution.

Due to the Oil Crisis in 1973 and a severe debt and currency crisis, Brazil established the National Alcohol Program in 1975, called the Proalcool. This program, the most important renewable energy program in the world for replacement of fossil fuels with biofuels, created a

steady demand and established the logistics needed for its use. Government support and private investment and then competitive production led to the gains in sustainability in the sugarcane sector.

In terms of investment and production costs, losses and possible development of bottlenecks, the most important part of sugarcane processing is the sugar extraction mill (or diffuser) and the distillery. Gains in productivity in sugar extraction (the most expensive and energy intensive part of processing) are shown in Figures 2, 3, 4 and 5.

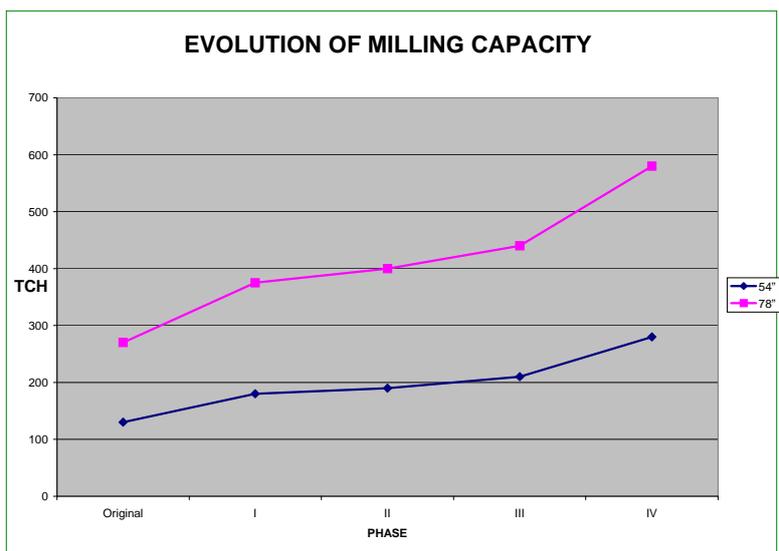


Fig. 2—Evolution of milling capacity.

Figure 2 shows that a typical mill today can process twice as much sugarcane with the same equipment and with approximately the same energy, maintenance, labour, water, etc., so that twice as much product can be produced.

At the same time as the productivity doubled, the efficiency (the amount of sugar in the juice compared with the sugar in the raw material) also increased (Figure 3).



Fig. 3—Evolution of milling efficiency.

The efficiency gains are driven mainly by the need to produce more with the same raw material (sugarcane) that is the main cost driver.

In Figure 4, it can be seen that the productivity in ethanol plants (measured here by the fermentation time) also almost doubled. Simultaneously, the efficiency also increased significantly (Figure 5).

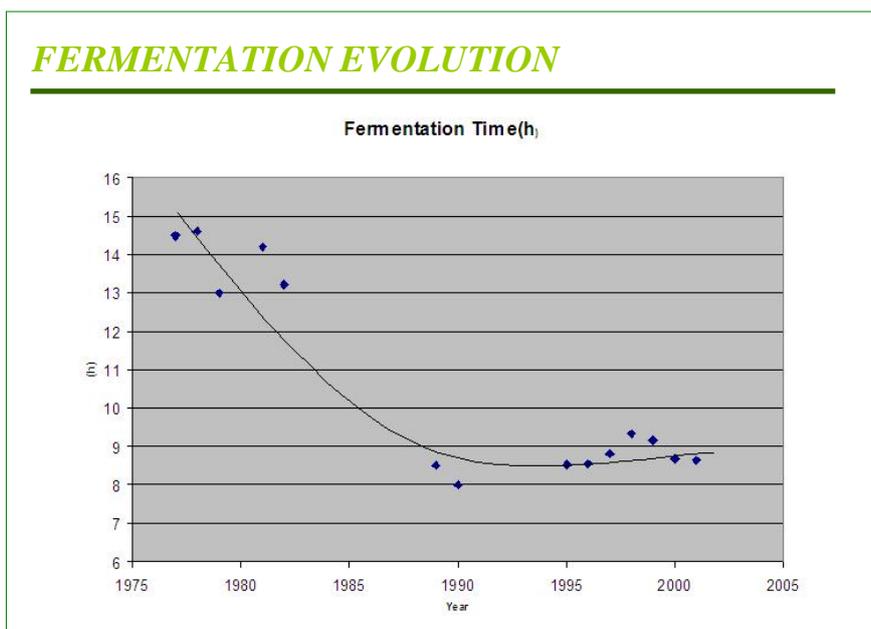


Fig. 4—Improvements in fermentation time since 1975.

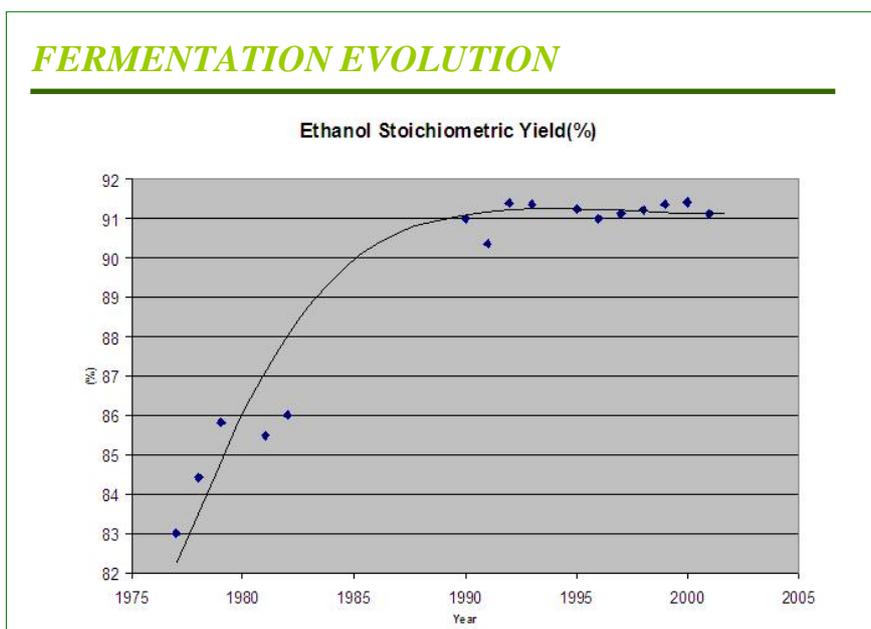


Fig. 5—Improvement in yield of ethanol since 1975.

The water used (from a water body) dropped considerably from 5.6 m³/ tonne of cane in 1990 to around 1.8 m³ / tonne of cane, through reduction and reuse (closed circuits). Water returns are now treated, with more than 98% reduction in organic matter.

All residues, including solids such as filter cake, from the juice clarification, and vinasse, from the bottom of the distillation column, are 100% recycled back to sugarcane fields, with better performance than the corresponding chemical fertilisers.

The use of energy and chemicals in processing are also considerably reduced due to the synergistic behaviour of the distillery adjacent to the sugar factory.

All streams containing sugars, even low quality, may be sent to the distillery as well as the richer molasses or even syrups, because there are no losses when this sugar is converted into other valuable products such as ethanol.

Attending to two different markets (sugar and fuel—ethanol) makes the production more flexible, robust and less dependent on subsidies. The industry is also less prone to big losses due to excessive volatility in the prices of commodities.

The use of energy is another important aspect of the processing. Because sugarcane bagasse can be used to fuel all energy needs, the amount of renewable energy in the final product (ethanol biofuel) is about nine times greater than the energy used from fossil fuels.

This is much better than when sugar beet, wheat or corn is used at the same production level.

Today the use of sugarcane bagasse represents around 16% of the total primary energy used in Brazil. There is a surplus of energy in the best processing units and electricity (and excess bagasse) is being sold in some cases, representing around 10% of the total sales of these more modern mills.

Although most energy is generated from hydroelectricity in Brazil, the surplus energy generated from sugarcane makes it possible to save water during the drier periods of the year, when sugarcane is harvested and processed.

There is considerable potential to increase electricity exports, which will add to the sustainability of the Brazilian economy.

This is because co-generation investments are much cheaper, and the electricity will be added to the grid much faster than with any other generation option.

Finally, the carbohydrates from sugarcane, as well as the 'excess' energy, can be used for establishing so called biorefineries, replacing practically all imported products from petroleum, such as plastics.

This will add significantly to sustainability on a global scale. Even fertilisers can be produced from sugarcane residues through gasification and other processes, as well as other biofuels such as biogas, biogasoline and biodiesel.

Production of bioplastics from plants in factories annexed to a sugarcane processing plant is the most likely to succeed. This represents a very interesting method of CO₂ (carbon) 'sequestration' and storage.

The so-called second and third generation biofuels, based on the use of cellulosic residues and CO₂ as a raw material, respectively, are also very likely to be competitive with the sugar-based biofuels and products, in the short or mid-term.

This will add efficiency to the entire production. For this to happen, however, considerable international research efforts are needed.

More R&D in the broad area of sustainability is an urgent need for the short term, and forums such as ISSCT can facilitate decisions on what to prioritise.

The entire sugarcane production chain has to be very well prepared for a more intense scrutiny of sustainability, particularly as biofuels become rational alternatives to fossil fuels.

DURABILITE DANS LE TRAITEMENT A L'USINE DES CANNES A SUCRE AU BRESIL

Par

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**MOTS-CLÉS: Durabilité, Biocarburant,
Bioplastiques, Résidus, Productivité.**

Résumé

LA DURABILITÉ implique les trois P: Population, Planète et Profit. La canne à sucre brésilienne est une industrie durable qui a progressé significativement dans ce domaine de la durabilité depuis les 30 dernières années. Aujourd'hui une usine typique peut traiter deux fois plus de cannes avec le même équipement et avec approximativement la même énergie, maintenance, main-d'œuvre et quantité d'eau, ce qui génère aussi deux fois plus de produits. Tous les résidus sont recyclés et utilisés dans les champs de cannes. L'utilisation d'énergie et de substances chimiques dans le traitement à l'usine sont aussi considérablement réduits. L'utilisation de la bagasse et d'autres matières carbonées issues de la canne à sucre ainsi que la production de bioplastiques et les biocarburants de seconde et troisième génération représentent de nouvelles voies pour accroître la durabilité des opérations. Toute la chaîne de production brésilienne doit être très bien préparée pour une exigence accrue en matière de durabilité.

SOSTENIBILIDAD EN EL PROCESAMIENTO DE CAÑA DE AZÚCAR EN BRASIL

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Bioplásticos, Residuos, Productividad**

Resumen

LA SOSTENIBILIDAD involucra Gente, Planeta y Rentabilidad. La industria azucarera brasileña es sostenible y ha obtenido ganancias significativas en su sostenibilidad durante los últimos 30 años. Hoy en día un ingenio azucarero puede moler el doble de la caña de azúcar de lo que hacía antes, con el mismo equipo y usando aproximadamente la misma cantidad de energía, mantenimiento, mano de obra, agua, etc., por lo que se puede obtener el doble de producto. Todos los residuos son reciclados y vuelven a los campos de caña. El uso de energía y de productos químicos en el proceso también se ha reducido considerablemente. El uso del bagazo, de otros carbohidratos de la caña, producción de bioplásticos y los biocombustibles de segunda y tercera generación, representan las nuevas líneas para el incremento de la sostenibilidad. La cadena completa de producción de azúcar del Brasil tiene que estar preparada para un escrutinio más intenso en cuanto a la sostenibilidad.