Title: **The energy function of sugar mills – a case in Nicaragua**

Abstract

A sugar mill in Nicaragua has been converted into a power generation plant. It generates power from bagasse during the sugarcane season and from eucalyptus from dedicated energy plantations during other periods of the year. The generated electricity makes the mill self sufficient energy-wise and the surplus is sold to the national grid. Actual generation with wood-energy started in October 2000 and results are presently being evaluated. However, preliminary studies showed that this type of power generation has economic, environmental and social benefits when compared to power generation from fuel oil. Employment generation is more than 3 times higher in the case of eucalyptus than with fuel oil. CO_2 and acidifying emissions of eucalyptus power generation are about a factor 30 lower than with fuel oil. The following are the main characteristics of the plantation and of the mill:

- Power production: 15 MW/h (all for sale during months outside harvest season)
- Wood chip requirements: 60,000 tons/year
- Required area for plantation: 4226 hectares
- 6 year cutting cycle
- Annual planting area 705 hectares
- Annual cutting area: 587 hectares

Key policy issues

Barriers

As when introducing any ne w technology or agricultural system, non-technical barriers exist. An important barrier is land ownership, which in the Nicaraguan context acquired special significance due to land confiscation by former governments and present reallocation policies. This creates uncertainty and fear of investment. Forestry plantations are particularly sensitive to this situation since they require relatively extensive planning. Other limitations regarding investment are linked to the overall sugar market situation. Import/export policies, quotas and prices are volatile, and in most countries the sugar industries are protected, with international sugar prices below production costs. As a result, the majority of mills still tend to focus exclusively on their original function as sugar producers and rarely view themselves as energy producers. From a technological point of view the main problem remains the low efficiency of heat production and use in the mills, although during the last decade some efforts have been made to have one boiler per mill, with units reaching 600 MWe.

An important barrier relates to the problem of achieving cooperation among institutions that rarely have had contact. Collaboration and joint planning is required between the forestry, agricultural and energy sectors.

Enabling framework

Various simultaneous circumstances have facilitated efforts to exploit the energy function of the sugar industry. In relation to the industry itself, new ways of utilizing the power plants attached to the mills, which remain idle during half of the year is an interesting proposition.

Sugar prices have fallen worldwide due to the massive entry into the market of artificial sweeteners, making diversification an important issue. Closing of sugar mills would represent a high loss of jobs in areas where few alternatives exist. In fact, by establishing energy plantations and converting mills to bioenergy power plants, a relatively important number of jobs are created. Lastly, the important contribution that the sugar industry can make to CO2 substitution by displacing fossil fuels is an added benefit that cooperates in creating enabling circumstances for this energy approach.

Regulatory issues

A new law to support private participation in power generation is in the process of approval in Nicaragua. Private investments in the power sector are now slowly becoming a reality.

Funding modalities

The partner owners of the mill have financed the eucalyptus plantations established in the surroundings of the sugar mill. Nevertheless, it is recognized that any further expansion of this or other energy plantations would require central government financial and incentive policies similar to those established in the agricultural sector, which would stimulate private investment.

Partnerships

Together with the sugar mill's own efforts to produce the required biomass, a strategy is being considered to expand the wood supply to the sugar mill by establishing a contract with the cooperatives of a nearby rural development project, named "Los Maribios". This project aims at the (environmental and economic) sustainable use of degraded soils near the volcanic area "Cordillera Los Maribios". It includes the establishment of small-scale farm based wood plantations. The project is characterized by strong farmer participation and was initiated in 1989. The San Antonio sugar mill is now offering to purchase standing stock, provided that long term contracts are established. Farmers will have to decide whether the alternative of supplying woodfuel to the market in the city of Leon (which is the case at present) is financially more attractive and whether a dependency on one customer, a large sugar mill, may cause problems for the still relatively fragile farmer cooperation system.

Recommendations for policy makers

- whilst recognizing the potentially important energy function of agroindustries such as sugar mills, energy, agriculture, rural development and environmental policies must recognize the importance of preventing **land competition** between food and energy production;

- stable and equitable **land tenure** policies are key to sustainable bioenergy production and use;

- policies need to be in place to compensate the inherently more complex organizational structures of bioenergy production schemes due to the strong interactions arising between **new institutional partnerships,** (between Ministries, with NGOs, with private sector, with farmers' organizations);

- longer term vision policies, considering the shorter **timeframe required** for fossil fuel based power plants than for bioenergy power plants, need to be developed;

- financial mechanisms and policies should consider that around 66% of the **investment** required for the bioenergy option stays in the country, whilst under the fossil fuel option 83% goes abroad;

- energy and rural development policies should bear in mind the new **employment** opportunities arising when the energy function of sugar mills is mobilized;

- local and global environmental policies should take into due consideration the fact that the energy function of the sugar industry can lead to more than 60 times less **CO2 emissions** than the fossil fuel option.

Country profile

Location

Nicaragua has a population of approximately four and half million people, with an annual growth rate of 2.9% and a per capita GDP of $452. The area of the country is 130,688 sq. km.

The sugar mill referred to in this case study, called San Antonio, is located in the northwestern region of Nicaragua, eight kilometres from the town of Chichigalpa. The mill owns 3500 hectares of land and, for energy plantation purposes, also contracted another 1000 hectares. Annual rainfall is around 1850 mm and mean annual temperature is 30 C.

Project area profile

Agriculture is the main activity of the population of the area of the case study. The San Antonio sugar mill provides employment for both sugar cane production, harvesting and processing and the energy plantation opened new job opportunities.

Rural energy issues addressed

A particular characteristic of this rural energy case study is that it recognizes the double role **(as an energy user and as an energy producer**), of a rural activity producing sugar, energy and a series of environmental and socioeconomic benefits.

In the past, mainly due to low energy and high sugar prices, the combustion of bagasse (a by-product of the process of producing sugar out of sugarcane) was seen as a method of getting rid of a residue. The collapse of the world sugar market and the two energy crises made bagasse a useful by-product to generate heat and power. The sugarcane industry has historically been using bagasse for generation of heat and power to fulfil its own energy demand. Depending on the level of technology and of investment regarding energy efficiency, sugar mills can reduce their energy intensity and, in fact, sell surplus power to the national grid. The San Antonio sugar mill referred to in this case study identified the potential to extend its power production and sell power to the national grid, both during and outside the sugarcane crushing season by using eucalyptus produced from dedicated energy plantations.

The rural energy implications are substantial both at the micro as at the macro level. At the micro level, energy plantations create new employment opportunities for local inhabitants. There is the potential to expand further the use of this kind of biofuels and to purchase biomass from nearby producers. This would create a formal and assured market benefiting potentially large numbers of people. Care must be taken though of the sustainability of this production, an issue more easily verifiable due to the existence of an actual contract. Large potential could also exist to expand the availability of biofuels in rural areas adjacent to the mill, since small branches, twigs and leaves will probably not be used in the wood chipping machines feeding the burners. Nevertheless, care should be taken not to negatively impact present wood producers.

Sugar industries world-wide are facing critical economic balances due to reasons already explained before. Energy plantations and the mobilization of the energy function of mills can contribute to economic benefits and to diversification, potentially saving a large number of jobs.

At the more macro level, electricity availability will increase in Nicaragua, where only 48% of the population are connected to the national grid. About 60% of the electricity is generated from oil derived fuels (mainly imported fuel oil). Due to its environmental benefits, bioenergy could profit from funds available through the (still to be detailed) Clean Development Mechanism or through the Global Environmental Fund.

Objectives

- diversification of the sugar industry through:
  - increased productivity
  - energy generation
  - reduce costs

- produce a clean and cheap biofuel
- assure a continuous supply of electricity to the grid during the year with bioenergy
- rehabilitate degraded and marginal land
- create new rural jobs
- promote local and global environmental benefits.

Implementation

The programme has completed the most important launching phases which included the design of a multi-partner strategy. The energy plantations are now in their first year of exploitation with positive productivity and economic results, to be published in detail shortly. These seem to confirm the predicted values calculated with a theoretical model in 1998. Most policy interventions already carried out, or in need of being designed and implemented in order to expand the project and consolidate its sustainability, have been reflected in the text above.

Outcome and impacts

- a well established energy field experience which includes forestry, agriculture, energy and environmental elements

- the production of 15 MW/h of fully renewable energy
- a closely monitored plan of action which is allowing a detailed socio-economic analysis and which will serve as point of reference for other energy initiatives of the same nature
- a high level of awareness on the benefits of the energy function of sugar mills by all stakeholders, ranging from farmers, energy planners and sugar market specialists
- trained technical personnel which could provide their expertise elsewhere

Replicability

From the technical point of view, the approach taken at the San Antonio sugar mill is replicable in most sites in the sugar producing tropics. Adjustments would have to be made regarding cane and eucalyptus or other tree varieties, and regarding the best forestry and agronomic practices, but no main barrier is foreseen. Larger bottlenecks can come into view when dealing with institutional cooperation, energy production and price policies, land tenure problems and contact arrangements regarding the production of the bioenergy resource. These situations are highly site (and country) specific and as such require rigorous local attention.

Lessons learnt

Besides the ones already reflected above, the following seem relevant as a corollary:

- it is critical to integrate and synergize the roles of all stakeholders; in the case of the San Antonio sugar mill, these included the farmers, the mill owners, the mill's managers, national and international researchers, an international technical assistance agency and policy decision makers;
- precise technical and economic studies assisted in mobilizing the decision to launch the plantations and the changes;
- information was made constantly available, helping in maintaining support for the initiative;
- the selection of the eucalyptus species to be used is important

and more importantly:

- nothing is more important than professionalism and enthusiasm; this activity benefited from both these ingredients by the group of people mentioned below, without which the mill would still be operating in the old traditional way.

Further information

The following persons can be contacted for further information:

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