

Use of *Theobroma cacao* L. residues for energy generation in Para State, Brazil

B. R. P. da Rocha ^{*a}, I. M. O. da Silva^a, I. T. da Silva^a, A. O. F. da Rocha^a,
M.G.M. Pina^b, P. J. S. Neto^{*b}

^a Electrical Engineering Department – Campus Universitário do Guamá – CP 8619,
CEP 66075-900, Belém, Pará, Brazil

FAX:+55-91-211-1634; brigida@ufpa.br

^b Comissão Executiva do Plano da Lavoura Cacaueira - CEPLAC/SUPOR

Cacao (*Theobroma cacao* L.), one of the various tropical species, is spontaneously found in the inferior stratum of forests, belonging to the humid plains of South and Central Americas, from parallel 18° N to 15° S. It constitutes a culture that settles the man to the land with high ecological, social and economic importance in several tropical areas of the world.

Cacao cultivation reproduces, in some aspects, the existent conditions in its natural habitat, for cacao crops, besides perennial, manifest sharply conservationist characteristics, what is highly beneficial to the maintenance of the ecological balance. Cacao tree and associated species biomass give the environment a series of benefits such as: 1. favorable microclimate formation to the balanced coexistence among the existent live beings in the system; 2. recycling of nutrients; 3. organic matter aggregation; 4. erosion and leaching process contention of soil nutrients.

Brazilian Amazon Region is an area composed of a vast extension of lands, making 488 million hectares into a total. Of these, approximately 32 million hectares are kinds of soils with excellent physical and chemical characteristics, becoming an area for agriculture development and especially for cacao crop in agroforest systems.

Cacao culture expansion in the Amazon Region has been accomplished with institutional support of Comissão Executiva do Plano da Lavoura Cacaueira - CEPLAC, organ of the federal government subordinated to the Ministry of Agriculture and Provisioning. The agricultural model used is based on the action of only an organ integrating all the necessary activities to the technical and rational development of cacao culture: agricultural research, technical assistance, agricultural fomentation and hand labor training, as well as to Agroforest System Integrated Handling considering the enhancement of cacao crops already existent or which may be implanted, with forest lumber and regional fruit essences with recognized economic value.

The self-sustainment of cacao agrosystem implanted in the region is very important to contain the increasing demand for the felling of new forest regions so as to implant new cultivation sites making it possible to make good use of altered areas, what is a preponderant factor concerning the man settlement to the field, together with his and his family's social development. Cacao culture in the Amazon Region is carried out the States of Pará, Mato Grosso, Rondônia, Acre and Amazonas, basically by small and medium producers, in areas the land average size of which is around 10 hectares. Most of these small producers, about 70%, live without electric energy in their properties, on account of lack of investments for energy generation to supply agroindustry and own consumption, mainly in the area of Transamazônica Region, which is the largest producing pole of the State of Pará. Such being the case, the main purpose is to look for alternatives to meet a sustainable development, considering the use of the fruit biomass of cacao tree for energy generation, objectfying the socioeconomic situation improvement of rural producers, the creation of local employments, contributing, as a result, to reduce the environmental matters.

Cacao primary processing and industrialization generate considerable amounts of several amounts of by-products and residues potentially explored. That expressive biomass potential is available, on farms and industries, for rational use in the energy recovery, food production and recycling of organic matter in the soil. Another important aspect to be detected concerns the use of by-products as the pulp and residues, the fresh rind of the postcropped cacao fruit, what is a diversification opportunity in the cacao cropping activities.

About six tons of fresh rind, on the average, come from the fruit break process, are annually produced per hectare, and which became useless. They are usually stacked in heaps at the plantation areas so that, after decomposition process, they become as fertilizer for cacao tree. In spite of its well-known value as nutritional source in the soil, such rinds can constitute themselves, in certain situations, as inoculation sources of diseases such as blight and witches-brom, requiring, therefore, chemical product-based treatment, making the cacao tree production cost still more expensive. Thus, each property, which on the average possesses 10 hectares of cacao tree, produces about 60 tons of fresh rind, 70% of which are produced in May, June and July, and can be used for energy generation. The rind of cacao tree fruit can be used in biogas production and fertilizer, in composting and vermicomposting processes, in soil-cement-base constructions, in obtaining microbial protein or unicellular protein, in manufacturing endocarp candies, in alcohol production and in the pectin extraction, among other products. However, in spite of the well-known economic importance of the rind and the pulp of cacao fruit, the seed is still the main wealth generating product.

Electric Energy Production using Cacao Residues

In order to use cacao residues for electrical energy production in Pará State, different technologies were investigated. Specific consumption, costs for obtaining the raw materials, transportation costs and technologic costs were obtained for gasification, and for systems working with direct burning of agricultural residues. The equivalent information was also obtained for traditional electric generators using conventional diesel motors. Pollutant emission was also determined for the different technologies[1]. The project was developed using a Geographic Information Systems(GIS) with an ArcView software as support [2]. To evaluate the costs related with several electrification solutions industrial and technology representatives were contacted, obtaining a representative database of economic and technical parameters for the several technologies. Energy value of the residues and transformation efficiency were also determined. All the information concerning biomass resources, and costs involved mainly with concentration of cacao residues were feed in the project data base. Other parameters like system efficiency, emissions, direct and indirect jobs were also calculated and introduced into the data base.

Conclusions

This preliminary evaluation shows that electricity generation using cacao residues in Para State is a good solution for the isolated farmers. Moreover, generation costs, even higher in some cases, are still smaller than those for existing diesel oil generators, besides the environmental advantages (no pollutant emissions and carbon absorption during biomass growth). Further technical and economic analysis shall be developed, as well as maintenance difficulties, from the experiments under development for biomass gasification

References

- [1] Moraes SB, Rocha BRP, Monteiro C, Silva IMO, Rocha AOF, Pinheiro ECL, Miranda V, Lopes JP. Technologies for Electric Energy Production using Biomass in Marajó Island, Brazil. Proceeding of the Fourth Biomass Conference of the Americas, California, Aug 29-2, 1999, p. 233-239.
- [2] Rocha BRP, Monteiro C, Pinheiro ECL, Silva IMO, Rocha AOF, Miranda V, Lopes JP. Evaluation of Decentralized Power Generation from Biomass in Competition with Alternative Technologies in Marajó Island, Brazil. Proceeding of the Fourth Biomass Conference of the Americas, California, Aug 29-2, 1999, p. 187-192.