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SUGARCANE WASTE, ENERGY GENERATION AND THE ENVIRONMENT: ITS IMPACTS

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ABSTRACT

Sugarcane has been the economic support of many countries, not only in the production of sugar, but also in the generation of electrical energy with waste, the production of boards, and others products. The Junín canton of the Manabí province is one of the largest producers of products derived from this grass; but their production processes, today have difficulties, the objective of the research is to make an assessment of the pollution processes and how to propose the proper use of waste to achieve a sustainable benefit in the environment, economic and social in the territory, through obtaining biofuels and generating electricity.

The results obtained are presented in tables and graphs of descriptive statistics, for later analysis of the same, which allowed to write the research objectives, in which it is highlighted that the population of Junín is one of the cantons of Manabí that most cultivates the sugar cane, the inhabitants are dedicated to the artisanal industrialization derived from it, likewise there are several technologies that can be implemented in the production processes of the derivatives, taking advantage of the residual of the sugar cane.

INTRODUCTION

Estimates of the World Energy Outlook (WEO, 2017), on the world energy outlook with a projection to 2040, states that between 1940 and 2016 the demand for energy in the world grew by 60%, estimating a trend of sustained increase until year 2040, especially due to the exponential growth of the industry, population growth, use of technology, consumerism of society and increase in environmental pollution, in many cases increasing the carbon footprint.In another report from the International Energy Agency (IEA), but from the year 2018, (WEO, 2018) it is emphasized that the share of electricity in global energy use is growing, while the rise of low-carbon technologies it is causing a great transformation in the way electricity is generated.

In another publication of the IEA itself in 2019 (WEO, 2019), it is stated that energy analysis indicates the need for rapid and widespread changes. Decisions made by governments remain critical to the future of the energy system. It is emphasized that energy demand will grow by 1.3% annually until 2040. This will lead to tensions in all aspects of energy markets and strong growth in energy-related emissions.An investigation carried out in Spain in 2019 on the production of energy from biomass waste and a diagnosis of these resources available in Ibero-America, conclude that biomass resources have a wide potential, however, there is uncertainty about the current availability and future biomass suitable for energy use, depending on political-regulatory decisions, since bioenergy must compete in an open market against fossil fuels (Hidalgoet al., 2018).

In Cuba, a technical-economic study was carried out for the generation of electricity from agro-industrial biomass, (Sardiñas, Gonzalez, & Freide, 2017; Archana et al., 2016; Arnawa et al., 2019; Ghosh, 2016). The technical diagnosis of the existing installation made it possible to determine the weak points of the process, concluding in the economic evaluation that the best alternative is to generate electricity using all the sugar cane residues.In Guatemala, according to, the potential of agricultural residues from the sugarcane harvest was investigated, to be used as biofuel, assessing the amount of the remains that remain after the cane harvests, and these can be transformed into profitable, sustainable and biofuels. serve as self-consumption for power generation (Muñoz, 2017).

In Argentina, an initiative has just been presented to the Lower House to apply to conventional diesel and gasoline, the mixture with biodiesel, in a percentage of at least ten percent of the latter and 15% of bioethanol measured on the quantity total product. It is intended to modify the current Law 26.093, Regime of Regulation and Promotion for the Sustainable Production and Use of Biofuels, seeking to promote the use of biofuels for the development of regional economies and the high impact that derives from it for the maintenance and promotion of genuine jobs for the population (World Energy Trade, 2020).In Ecuador, biomass is an abundant source of energy, but little exploited, according to researchers from the University of Cuenca (Peláez, and others, 2015). In 1a shows statistics of primary energy production in 2013. It is observed that only 1.7% of the energy produced in the country.

Until 2015, the country was an international benchmark (ARCONEL, 2015); With the introduction of 51% renewable energy, although the panorama has not changed much, there are still isolated communities at present that present different difficulties in the electricity service (Rodríguez, Vázquez, Vélez, & Saltos, 2018), others are still without electrify. The fundamental difficulty is that the small potentials that exist near these isolated communities, which could be used in the form of distributed generation to solve power quality problems and in other cases isolated electrification problems, have not been taken advantage of. The residuals in small quantities from the sugarcane harvest can be used to produce energy and support the change of the energy matrix (Macias, Vázquez, Rodríguez, & Hidalgo, 2018) and in turn help reduce environmental pollution that it is produced on the ground, with the discharge of many of these residuals.Environmental protection measures are necessary to achieve sustained development, the increase in energy demand contributes to air pollution, soil, water, erosion, among other environmental problems (Andrade, 2015).

Some universities are preparing to face this challenge, from the classrooms preparing students to be trainers in the communities so that they understand the need to take advantage of residuals and reduce pollution (Vázquez, Rodríguez, Véliz, & Villacreses, 2018). There is organic residual from the small sugar industry, which can be used in the generation of energy, as it is cultivated in large areas. Egún exposes (Herrera, 2015), despite the fact that they are uneven terrain and no machinery is used in the process. Other studies by other researchers have taken cleaner production approaches into account; but they have not been able to establish indicators that evaluate the consumption of water, energy, emissions and waste produced in the process (Carreño & Palacio, 2012). This residual can help tackle the problems of global warming.

In Ecuador, approximately 196,000 homes do not have electricity in the country, where 54,000 are in urban areas and 142,000 in rural areas (Gomelsky R., 2013; Ifeanyichukwu, 2016; Rinartha & Suryasa, 2017; Sidu et al., 2016) Similarly, in the Junín canton the panorama is not different, the homes without any type of electric service representing 2.2% of the total in the urban area, 10.5% of rural dwellings (SGR, 2016). Due to the indiscriminate exploitation of natural resources, there is a depletion of them, a situation that invites reflection to engage in obtaining another type of energy, that is functional, economic, renewable, friendly with the environment, that reaches especially to rural communities, which are the ones that suffer the most from the lack of energy and are the ones that have the natural resource in their hands, which they do not know how to use them. In the Junín canton, an important part of its inhabitants is dedicated to agriculture, 76.6% of its population resides in rural areas, they have problems with access to conventional energy, it does not have any renewable energy system that contribution to the sustained development of its inhabitants, or to replace fossil fuel plants with biofuels, which can be produced with the residue of their productions (Hidrovo & Valverde, 2020; Singh et al., 2016; Widana et al., 2020).

In the country, a technical economic analysis of the generation of electricity with unconventional fuel (sugarcane bagasse) was carried out, in the sugar mill La Trunk, (Castro, Robalino, & Mendoza, 2006), they concluded that there is potential in the country to produce clean energy, there are 3 large mills that can take advantage of the sugarcane bagasse to generate electricity, the only requirement being to expand their facilities to produce energy with the bagasse. At the University of Guayaquil, the cogeneration system from biomass in the sugar mills was studied (Aguirre, 2015), and the advantages and disadvantages of these, the elements, machinery and technology that this type of energy generation needs were also exposed. to work; to obtain 1 Mega Watt (MW) of electrical energy and with this know the environmental impact and its efficiency.

In the province of Manabí, the use of sugar cane bagasse residue (was analyzed*Saccharum officinarum*)to obtain energy at the Agua Fría site, Junín (Intriago & Sabando, 2017). They obtained as a result of research, that in the study area an approximate of 1765 kilograms (kg) of waste is generated, there being no innovation methods to improve the process or the use of these residual sugarcane bagasse. The objective of the research was to analyze how the residues from sugar production can be used to produce energy and assess the positive contributions they have to the environment, in addition to the social impact that would be reported if they were used for the sustainability of the area.

MATERIALS AND METHODS

A georeferenced inventory of the producers of sugarcane derivatives in Junín canton was carried out, to know how the cultivation plots were distributed, in addition, the small industries were inventoried and a survey was applied to determine the sites where they were deposited the residuals, in addition to knowing the degree of knowledge that farmers have about environmental contamination and the final use that the residues may have, for this the Larry Murray equation was applied (Murray & Stephens, 2005), for infinite samples, as shown in equation (1), where it was obtained that the sample (n) was 391 who were the respondents.

$$n = \frac{N}{E^2(N-1)+1} \qquad \textbf{(1)}$$

Where:

N→population 19,000

n→sample size

E→Admissible sample error (5%)

ANALYSIS AND DISCUSSION OF THE RESULTS

In Ecuador, a strategy was designed, To achieve the change in the productive matrix that was accompanied by a new projection of the energy matrix, this would be directed to the leadership by the state of development of the strategic sectors, promoting the implementation of new projects and new technologies, with the purpose of diversifying the energy matrix (Correa, González, & Pacheco, 2016). This strategy took into account the export of energy; But the priority was related to supporting the productive sector; but they did not take

into account the use of small potentials in the form of distributed generation (Rodríguez, Vázquez, Saltos, & Ramos, 2017).

There are different projects at the country level, to use biomass for energy purposes, the National Institute of Energy Efficiency and Renewable Energies (INER), investigates fundamentally with garbage, the Corporation for Energy Research has a waste gasification biofuel plant of the African palm, rice and coffee. The Neotropical Center of the Pontifical Catholic University works with resources for Ethanol, the Laboratory for thermovaluation of biomass and solid urban waste; It is also investigated in the production of hydrogen, from residual biomass from banana production and the production of biofuels from microalgae is investigated (EOI, 2017).There are different forms of energy generation, to enhance systems that present low quality of service or for isolated areas where distributed generation with renewable sources of energy plays a significant role, since it reduces the use of fossil fuels, environmental pollution and use of residuals from small industries (Macias, Vázquez, Rodríguez, & Hidalgo, 2018), which can be studied and exploited.
The Junín canton is a totally agricultural territory, it is one of the largest sugar cane producers in the province of Manabí, according to experts, 87% of its population is linked to obtaining different products derived from that plant (Sumba, Moreira , & Calderon, 2019), according to the authors, a large amount of sugar cane is harvested, with small and medium by-product processing industries that supply the province; but the residuals that they produce in their process, such as bagasse and production must, are dumped on the ground, or burned, causing levels of contamination to the ecosystem.

The canton is dedicated to the production of sugar cane (435 hectares, which is approximately 40% of the total production of Manabí), the most outstanding thing is that it does not remain alone as a producer of cane to commercialize it in the large sugar factories Instead, its inhabitants have dedicated themselves to its industrialization, largely in a traditional way, being a significant income for the economy of the province.
The research carried out recommends how the residues caused by crops and small industries cause an impact by not giving proper management. The methodology used for the analysis was related to the field visits carried out in a research project, obtaining as a result that a large amount of bagasse is dumped on the ground, or burned causing contamination that affects the ecosystem of the territory.

The residues, bagasse or biomass from sugarcane have the potential to produce sustainable energy. Figure 1 shows the inventories made to small industries that produce derivatives from the cane harvest. It was found that the largest amount of sugarcane industrialization is located in the cold-water site of Junín canton, especially because the highest sugarcane production is located in that specific area

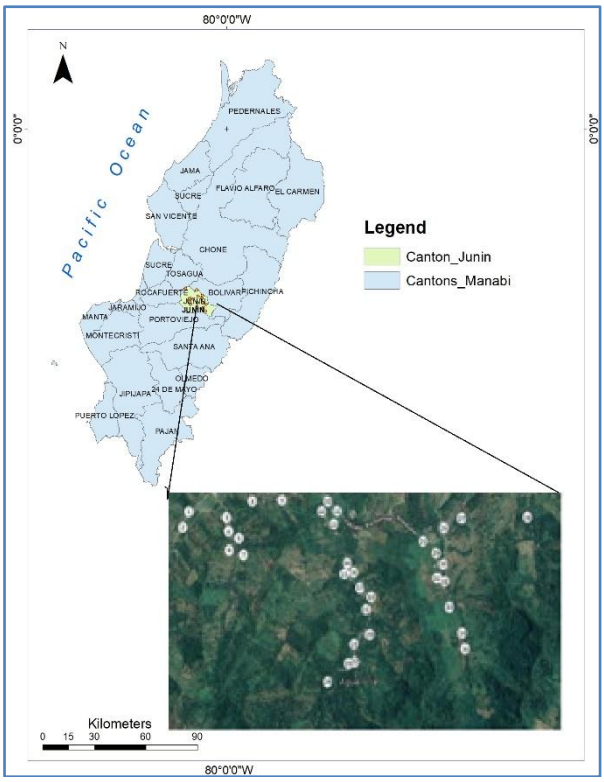

Figure 1 Position of small industries of derivatives of sugar cane
Source: Own elaboration (Hidrovo & Valverde, 2020).

The image inside the map shows the sites of 35 small producers that were inventoried, which have small industries of derivatives of sugar cane, located mainly in the Agua Fria site where the largest producers.
The technologies used in small industries are obsolete and polluting, as can be seen in figure 2, they manipulate Diesel generators to electrify the small sugar mills, polluting the air with their emissions and the ground the fats from the fuel when they are deposited on the ground when Winter is coming, the rivers filter into the polluted water table.

Figure 2 Diesel generators used in small industries

Many of these communities do not receive electric service or have poor power quality because they are far from the grid; If the residues from the harvest such as bagasse will be used, small bioenergy's or liquid residues could be designed for the production of biogas, achieving better the quality of life of the producers and with it the collateral benefits to the environment and the

economy.In figure 3, the residuals from the harvesting and industrial processing of sugar cane are observed.

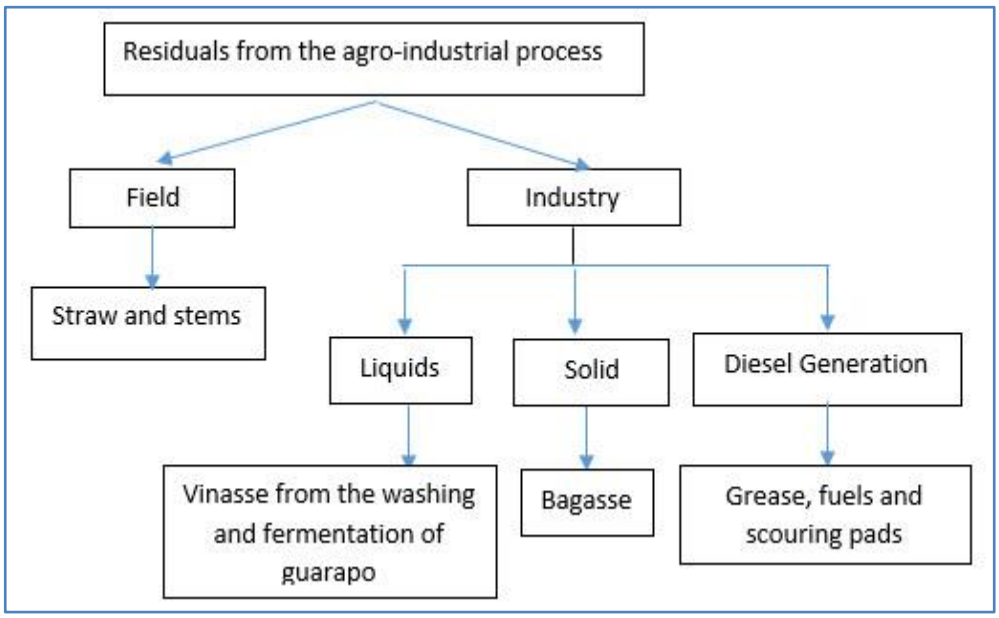

Figure 3 Residual from the production and industrialization of sugarcane derivatives

As can be seen, they are derived from the liquid and solid residual harvest that most of these can be used improving the economic, environmental and social impact of the inhabitants of the site studied.A survey was applied to the population to know the technical, economic, environmental and social impacts of the technologies that can be used and their advantages. They were consulted about why they grow sugar cane and no other crops.In figure 4, the percentages of the responses obtained by the producers are shown.

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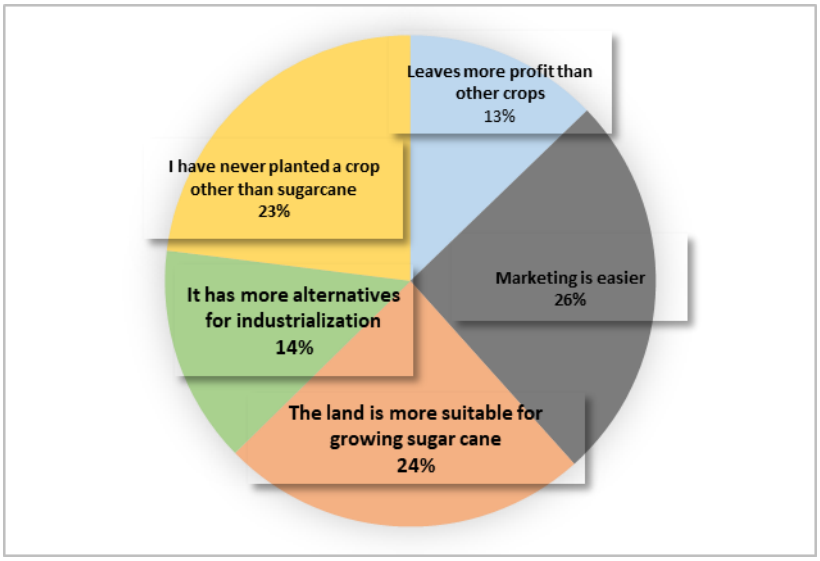

Figure 4 Because they plant sugar cane

The highest value obtained corresponds to its easy commercialization, then the quality of the land for planting the crop follows and others responded that they have always planted these crops. Micro industries produce those that are most in demand in the market, such as cane liquor (schnapps), panela, weakling and others.They were consulted, if they knew that the residuals of the production process affected the environment, where the majority agreed that environmental effects occur and that strategies for their use should be proposed, in the graph of figure 5, the proposals are shown What does the surveyed population do to take advantage of the residuals.

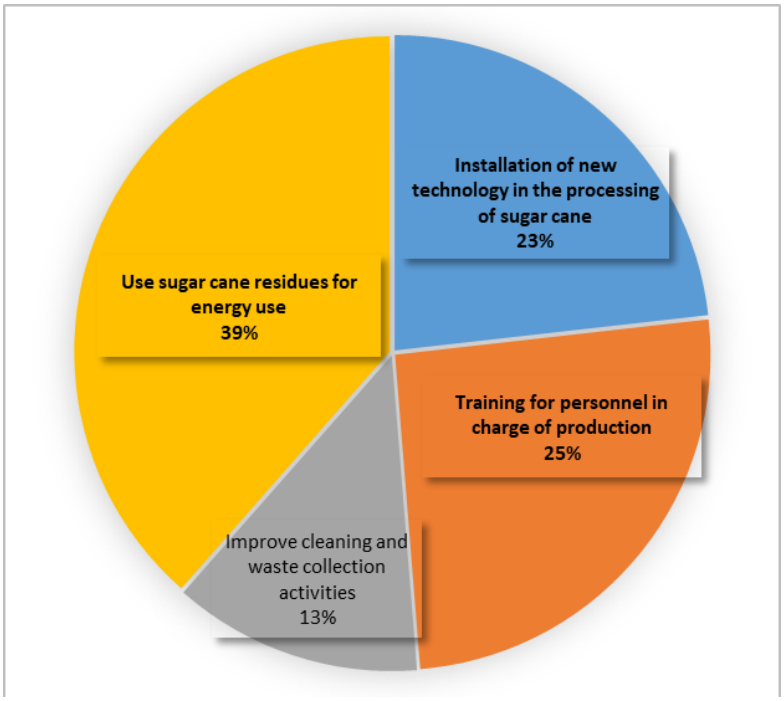

Figure 5 Proposals for the use of waste and cultivation of sugar cane

As can be seen, the highest percentages are associated with the use of waste for energy use, the training of personnel working in production and the improvement of technology among others.The use of the different types of residuals will improve the economy of the producers as well as the impacts on the environment. The inhabitants of the Junín canton, who make brandy, panela, and weakling, can take advantage of the potential that the residual sugarcane has, for the generation of heat, electricity and fuel. Cogeneration would make it possible to obtain more profitability, by reducing the costs used in the disposal of biomass and in the acquisition of fossil fuels and electricity to power boilers and move engines. The cogeneration process could contribute significantly to productive improvement.

The results of the surveys applied to the inhabitants of the Junín canton, from their responses, it was possible to deduce a great need of the population to invest in technologies, machinery, especially in the sugarcane production chain, which employs a large number of workers. of local work, but for the most part they are artisan enterprises, because they have limitations in the processes, to improve the profitability of their enterprises. The production of sugarcane derivatives, being artisanal, highly polluting residuals remain,

making it necessary to improve environmental sustainability by completing the use of residuals that will offer better job opportunities for the inhabitants and thus improve profitability in the manufacture of the derived from sugar cane.

CONCLUSIONS

The residuals from the collection and processing of sugarcane can be used as fuel for cogeneration, allowing thermal and electrical self-sufficiency in different production processes. There are several technologies that can be implemented (thermal production, biofuels and electricity using biomass) and that would help to take advantage of the residual of sugar cane. The biomass resulting from the productive processes of sugar cane, have polluting elements for the environment, and that producers must invest money for its final disposal. Its use in the generation of biofuel or electricity would forge an opportunity to use it in the same industry, since the cogeneration of fuels, heat and electricity using residual biomass would give an added value to waste that is generally not granted any benefit, in addition It would lower costs in investment of fuels, electricity, at the same time that it would greatly benefit the environment.

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