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Sustainable Energy Model for the production of biomass briquettes based on rice husk in low-income agricultural areas in Peru.

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Abstract

The proposed Sustainable Energy Model is based on rice husk and the development of briquettes made from agricultural waste, which will increase efficiency in the domestic sector, and potentially replace conventional polluting fuels such as firewood. Large volumes of rice husks from millers are found scattered in rural agricultural areas of the San Martin region of Peru, where people are exposed daily to the emissions of polluting gases produced by burning these wastes, causing respiratory and lung diseases. Despite present circumstances, this waste has a great energetic potential that is not yet used by society, representing an opportunity to encourage socioenvironmental development and generate added value to the husk. Based on a compaction and drying process, briquettes were obtained with 4,040 kcal / kg of heat power and 80.39% combustion efficiency, allowing the little use of biofuel compared to firewood, and consequently, the utilization of this biofuel would reduce levels of deforestation. In contrast to similar projects, the sustainability of an energetic model of briquette production will be achieved when economic, environmental and social aspects are met, developing clean technologies and an efficient supply chain, from the supply of the husk to the commercialization of briquettes.

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Keywords: Biomass, Briquettes, Caloric Power, Millers, Socioenvironmental, Sustainable Energy Model

1. Introduction

1.1. Problematic

One problem of the rice industry is the accumulation of high volumes of rice husks, which are ultimately burned and thrown into rivers by rice paddy companies. Currently there is little reuse of rice by products in industrial sub-processes, there by presenting an opportunity to generate added value to this waste. The average rice company in Peru accumulates 9 tons of rice paddy per day [1], comprising 20% of rice paddy production [2]. Rice is one of the most important crops in Peru, with the highest contribution to agricultural GDP, generating approximately 161,300 jobs annually and having a strong impact on social and economic development in rural agricultural areas [3].

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The tendency of rice growth production is based on the number of hectares planted per year. For example, at the regional level in Peru, the department of San Martín has the largest area of planted rice, covering 86,053 hectares. [4]. While establishing a sustainability model, it is important to determine the place where the energy proposal will be developed. The largest amount of rice is processed in the Central Huallaga sector of the San Martín region, composing 73,343 tons. However, high index of rice husks is not the only factor for correct development of the model, and it is also necessary to raise environmental awareness among people. In this context, one example is the municipality of "San Hilarion", located in the Central Huallaga, established Municipal Ordinance No. 013 - 2004 / MDSH / A, which prohibits the burning of husks by mill owners, whose economic sanction is valued at 2 ITU [5].

1.2. Product Design

Briquette is based on different aspects. Size depends on intended use and specifications of the briquetting machine, which defines the width of the briquette. For industrial processes or businesses, length varies between 30 and 100 cm, between 10 to 50 cm for producers or restaurants, and finally, between 3 and 8 cm for the family sector.

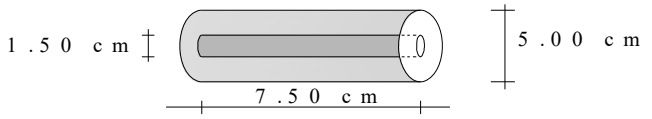

Fig. 1. Dimensions of rice husk briquettes

Presence and shape of an inside hole can give more oxygenation, but could increase volatile matter. For that reason, this aspect also depends directly on intended use, whether industrial or domestic, and the market in focus. Density is another main characteristic. Denser briquettes occupy less volume, facilitating manipulation of the product, storage and transportation. The value should be 1,000 kg/m^3 [6], depending on rice husk density and pressure exerted by the briquetting machine. Finally, humidity directly influences heating power, so the higher the moisture content, the lower the heat energy released in the combustion, because the evaporation consumes the heat. Humidity should vary between 8% and 10% [7].

1.3. Backgrounds

Prior research has verified the energy efficiency of briquettes, and made it possible to collect important aspects that establish a sustainable energy model and allow the positioning of biofuel in the market.

Table 1. Relevant aspects of the current energy model

Characteristic	Relevant description	Company
Manufacturing cost	The large supply of rice husks generates a zero cost, unlike the cost of coal for the production of briquettes.	"Briquettes Corinay"
Production programs scenarios	Different production scenarios will establish a relationship between the demand and production capacity.	"Maderera del Norte"

An important aspect is the zero cost of the project, due to the large supply of rice husks in agricultural areas, which stands in sharp contrast to the cost of coal assumed by "Nanay Briquettes" to have an installed capacity of 5,000 tons per year [8]. Another important factor is the different production programs that can be established within a proposal, depending directly on various scenarios of supply and demand. For instance, companies such as "Maderera del Norte" can have a production program only for a population with a constant demand, without considering economic and social variables that could affect the business. Finally, the perception of an ecological product is important within society, therefore the briquettes should be presented as compact agricultural waste, and not as carbonized leftovers, which would reflect a dirty fuel and not friendly to the environment.