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Editorial

Boosting Sri Lanka's Rice Industry Profitability: Leveraging Circular Economy through Rice Husk Utilization

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Paddy cultivation is a cornerstone of Sri Lanka's agricultural sector and food security, spanning around 1.1 million hectares and producing 5.1 million tonnes annually, making it the backbone of the country's agriculture. With a growing focus on sustainability, an emerging opportunity exists to leverage the by-products of rice cultivation specifically rice husk through circular economy practices to enhance the profitability of the rice industry in Sri Lanka. Rice husk, a by-product of rice milling, is one of the most abundant agricultural residues globally. Studies indicate that for every 100 kg of rice processed, around 20 kg of rice husk is produced. Despite its widespread availability, rice husk is often underutilized and considered a low-value by-product in Sri Lanka. The potential to harness this biomass for higher-value applications remains largely untapped. This editorial discusses the significant role rice husk can play in enhancing the profitability of Sri Lanka’s rice industry by integrating circular economy principles, specifically through energy generation, value-added products, and sustainable practices.

The rice milling process generates rice husk as a by-product, a resource that is often discarded or used inefficiently. However, some Sri Lankan rice millers have recognized the potential value of rice husk in various sectors. According to industry data, rice husk is primarily utilized by the cement industry, steam boilers for rice processing, as soil amendment, for poultry bedding, in masonry brick making, and for domestic use. A key observation is that large-scale rice millers rarely use rice husk for electricity generation, despite the fact that the Sri Lankan energy sector relies heavily on fossil fuels. As per the Sri Lanka renewable energy master plan, biomass, including rice husk, could potentially generate up to 2,400 MW of electricity by 2030. Currently, only a small percentage of rice mills use rice husk for energy generation, despite the substantial capacity for power generation.

With an average energy content of 13.4 MJ/kg, rice husk can be utilized in various conversion technologies, including gasification and steam turbine power plants. Gasifying the annually available rice husk in Sri Lanka (approximately 1 million tonnes) has the potential to generate around 40 MW of electricity, while utilizing it in steam turbines could produce up to 57 MW of power. This could significantly reduce Sri Lanka's dependency on fossil fuels, reducing greenhouse gas emissions and providing an affordable energy source for rural areas. Furthermore, the cost-effectiveness of generating electricity from rice husk is evident, as it reduces fuel costs by up to 92% and 54% when compared to diesel and coal, respectively.

In addition, rice husk is rich in silica, with rice husk ash containing up to 97% silica. Silica has numerous applications, including in the production of activated carbon, silicon products, and as a key material in construction and electronics. The extraction of bio-silica from rice husk can be achieved through thermochemical or chemical processes, which are economically viable for large-scale rice mills. The demand for silica is high, and utilizing rice husk ash for silica production can provide a lucrative income stream for rice millers.

The densification of rice husk into pellets or briquettes offers a solution to its low bulk density and irregular shape, making it easier to store, handle, and burn efficiently. Rice husk pellets (RHP) and briquettes (RHB) are an ideal alternative to traditional fuels such as wood and LPG for cooking, heating, and industrial processes. The production of RHP can increase the value of rice husk by up to five times, providing rice millers with a profitable opportunity to diversify their income sources.

Rice husk contains a substantial amount of cellulose and hemicellulose, making it a viable feedstock for bio-ethanol production. Although the process is currently not very economical due to high production costs, future advancements in microbial fermentation and enzymatic hydrolysis could enhance the efficiency and profitability of bio-ethanol production from rice husk.

The introduction of circular economy principles into the rice milling industry could result in significant economic benefits. An analysis of the profitability of fully automated and semi-automated rice mills in Sri Lanka shows that while rice husk contributes a small percentage the overall profits, this figure could increase substantially with more focused efforts on value-added applications. For instance, large-scale rice mills with a processing capacity of over 40 tonnes per day could produce surplus rice husk for electricity generation, silica extraction, or pellet production. The surplus husk from these mills, when utilized optimally, could substantially increase profitability and even reduce operational costs associated with energy consumption. By diversifying into alternative products like bio-ethanol,

pellets, and silica, rice millers can mitigate the risks associated with reliance on a single income stream and add a new dimension to their business models.

While the use of rice husk for energy generation and other value addition presents a promising opportunity to boost the circular economy in Sri Lanka's rice industry, several key challenges must be addressed to ensure sustainable implementation. One major concern is the competition with the existing applications of rice husk. Rice husk ash, which is rich in silica, is a valuable ingredient in the cement industry, particularly as a pozzolanic material in cement manufacturing. Additionally, the large volume of ash produced during combustion poses a significant challenge in energy projects. To address this, it is essential to develop synergies between electricity generation plants and cement manufacturing industries, where the ash by-product can be efficiently utilized, creating a mutually beneficial industrial linkage. Another important current use of rice husk is as bedding material in the poultry industry. However, studies have shown that alternative materials such as sawdust, a timber industry by-product and refused tea, a waste product from Sri Lanka's tea industry can effectively replace rice husk in poultry bedding without compromising quality. Utilizing these alternatives not only supports the rice husk diversion for energy but also helps solve environmental issues related to sawdust and refused tea disposal. Rice husk is also commonly used as a fuel in furnaces, brick kilns, and domestic stoves, owing to its low moisture content, high calorific value, and availability. A viable alternative to meet this fuel demand is rice straw, which is more abundantly available. However, due to its bulky nature, rice straw is less convenient for direct use. This challenge can be overcome by converting rice straw into briquettes, enhancing its usability and making it a suitable substitute for rice husk in fuel applications.

In conclusion, rice husk, often considered a low-value by-product, is actually a significant asset for Sri Lanka's agricultural and energy sectors. As the country moves toward more sustainable practices in agriculture and energy, the integration of rice husk into the circular economy presents a unique opportunity to improve the profitability of the rice industry while simultaneously addressing environmental concerns. Through strategic investments in infrastructure, technology, and education, Sri Lanka can unlock the full potential of rice husk, creating a more resilient and profitable rice industry for the future.