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Importance of Rural Biomass Post-Harvest Waste – An Overview

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Abstract. This study rather than focus on food security examines the potential in utilizing Post-Harvest Waste (P-HW) materials and their benefits to the immediate rural communities where lignocellulose waste are found in abundance. It was observed that researchers have proposed a lot of unique approaches to managing solid waste generation; with emphasis on perfect waste collection and disposal, but these approaches are very expensive considering the tight budgeting expenses Nigeria is faced with. This study shows that some rural communities experience huge post-harvest organic wastes from their farms and the cost of these losses has been estimated, which then forms a good spot to start the implementation process for this initiative. The research highlights the overview benefits of adopting microbial and pyrolysis approach in converting the lignocellulosic aspect of these waste to economically viable products that will have a direct positive impact on the immediate community. This study proposed a modified fast pyrolysis approach in the conversion process to reduce the production of pyrolytic gas and optimize the production of biochar and pyroligneous acid. Adopting these approaches will reduce the amount of carbon emitted into the atmosphere when burning these waste and produce bio-products instead of synthesized chemical products that have health implications.

1. Introduction

The Glossary of the United Nations Statistics Division on Environment Statistics [1] describes waste as "non-essential materials" (that is, products intended for the market) for which the generator no longer finds useful for production, processing or consumption. There are several types of wastes identified by modern waste management systems, as shown in Table 1. According to A A Adedibu [2], wastes differ in chemical and physical and composition. This study will consider agro waste. Waste management in Nigeria has attracted private organization, due to the lack of lasting solutions despite several attempts by successive governments in this direction. It is common to see or meet piles of waste dumps across the cities in almost every corner.

2. Progress so Far

Nigeria Government has invested largely in agriculture mostly in the Northern parts of the country for food sufficiency [3]. Figure 1 illustrates government effort and investments in the agricultural sector and rural community development over the years [4]. Table 1 shows the percentage of the budget

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allocated to the agricultural sector for some selected African countries, and it is compared with Nigeria's eight (8) years average agriculture and rural development percentage allocation from national budgets from 2011 – 2018.

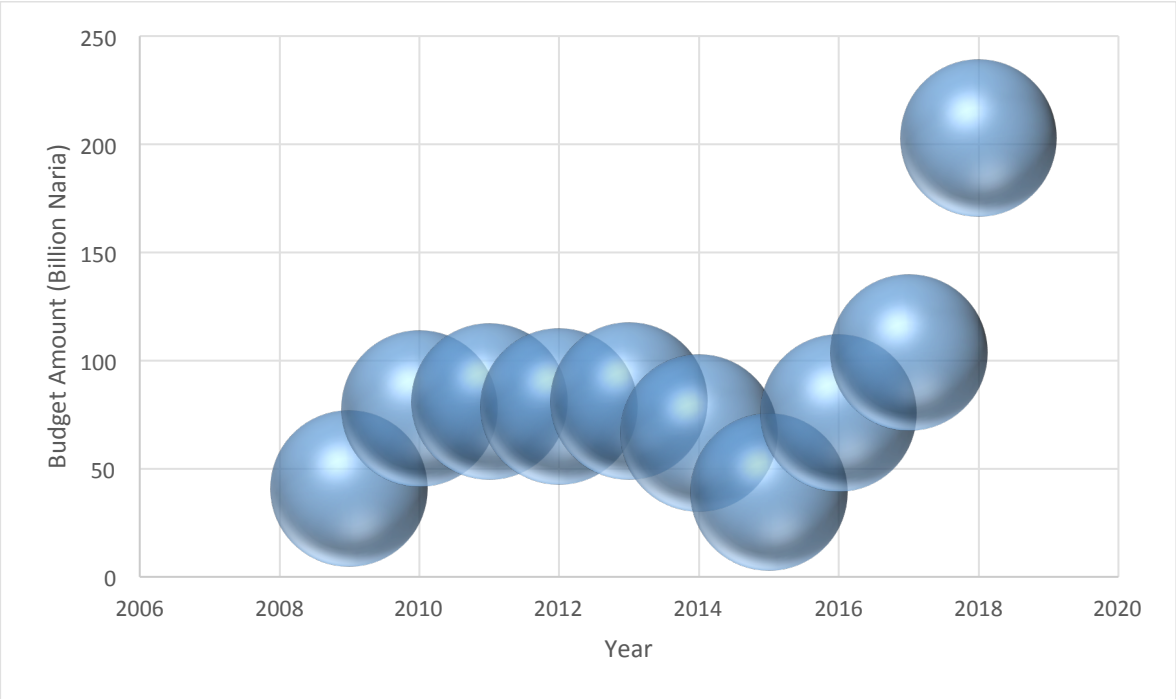

Figure 1: Nigeria Government allocation to Agriculture and Rural Development

Table 1: Percentage of Budget Allocated to the Agricultural Sector

S/N	COUNTRY(S)	PERCENTAGE ALLOCATION OF BUDGET
1	Malawi	27%
2	Zambia	10%
3	Burundi	10%
4	Mali	10%
5	Niger	13%
6	Sierra Leone	3%
7	Nigeria	1.6%

The Federal Institute of Industrial Research in 2017 puts the country's post-harvest losses at $ 9 billion. A survey on the six geo-political zones of the country as obtained from the Food and Agriculture Organization Fact Sheet also confirms the estimated value on post-harvest losses in Nigeria. The Institute observed that the quantity of crop loss is about 51.3 metric tonnes with huge amounts recorded in the rural communities. Post-harvest Engineering Director of NSPRI has acknowledged handling of these post-harvest waste as a major challenge in Nigeria's agricultural sector. The agency has researched and developed post-harvest technologies, but the generated wastes have not known much improvements in terms of their conversion for use or management within the communities (the source). According to the study by B T Abur et al., [6] it was observed that most local governments in Nigeria still record high post-harvest waste generations and they often have problems in discarding them from their farm and market areas [7, 8]. There is also a need for the government and all stakeholders to bridge the technological gap in the intensive commercialization of research products on wastes to bio-products. This research is a guild for in-country utilization of organic solid waste to stabilize the challenges of energy and clean environment which have a direct impact on the Nigerian economy and its citizens. The solution proposed in this study is an intensive waste to viable product initiative. The aim of this research is to highlight the benefits of microbial

process in converting lignocellulosic biomass waste components into some by-products that have direct advantages to the agricultural sectors of rural communities.

3. Post-Harvest Waste

The focus of this study is not on food security, but on how to utilize approximately 1.4 billion tons per year of wastes generated globally from production and postharvest stages [9]. In Nigeria, one-quarter of our expected outputs from farming are lost to postharvest activities which pose a concern to the rural area were this waste is generated [10]. F M Bolarin and S O Bosa [10] outlined six major factors that contribute to this huge amount of wastes and proposed strategies to minimize these wastes. Most rural areas depend solely on the agriculture sector for their economic growth and development. The fact remains that these wastes have not been eliminated, and there is need to convert them into economically viable products that will not only eliminate the environmental pollution but also bring in useful products that can be used in their natural state to improve agricultural activities [11]. The generation of agricultural post-harvest wastes in the South-East region of Nigeria was considered in this study. An investigative approach was adopted and current published literature was also considered. Straw is the major lignocellulosic waste in this region because of the type of crops planted. Some of these wastes are; bamboos, corn Stover, oil palm trunk, cassava pulp residue, and other crop straws. Figure 2 shows the results of analysis from the samples collected during field observations in the region. These waste materials are biomass feed stocks and mostly organic matters. They are the major materials of focus in this study due to the inexpensive routine conversions of biomass to useful products. The production of valuable products and chemicals from these agricultural crop residues would partly solve waste disposal issues and provide some more environmentally friendly alternatives to synthesized chemical products.

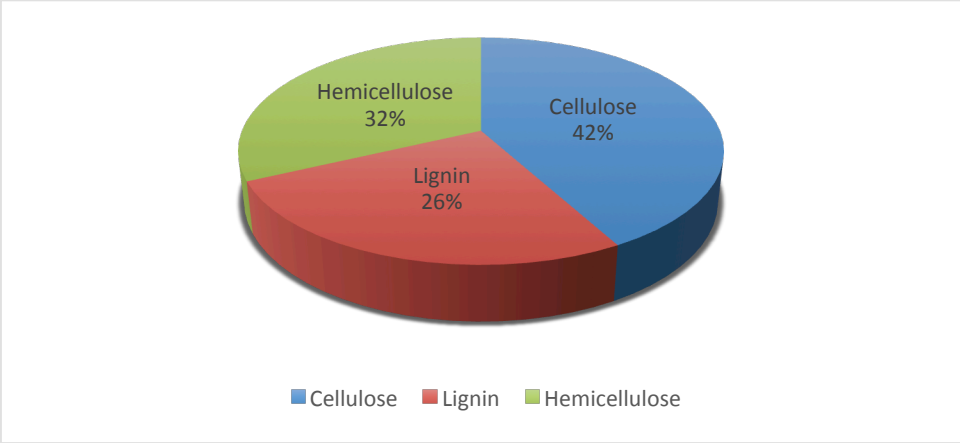

Figure 2: Post Harvest Waste Field Sample Composition

4. Utilization of Lignocellulosic Waste and its Economic benefits

Literature has shown the typical microbial technique adopted for the conversion of lignocellulosic agro-wastes. This technique has been applied to producing agro-food, beverages, textiles, and pharmaceutical products. Recent advancements in process engineering have shown that it is possible to optimize the production of micro-organisms and their metabolites when used to handle lignocellulosic agro-wastes. Bio-ethanol can be produced from lignocellulosic wastes with starch and simple sugar as by-products, and also a feedstock for the next stage of reaction (Fig. 3).

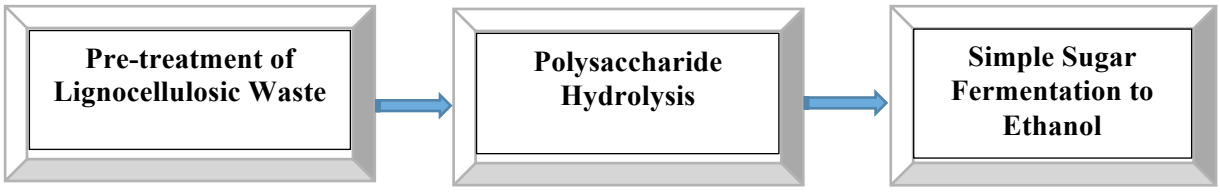

Figure 3: Steps in the production of Bio-Ethanol from Lignocellulosic Waste

One approach often adopted in the conversion of biomass feedstock into valuable chemicals is pyrolysis using a batch reactor process. The approach utilizes the principle of carbonization of biomass. This process produces charcoal and pyroligneous acid which can improve the growth, yield, and quality of crops at a lower cost. The aforementioned acid can be used to also produce acetic acid that serves as a preservative/additive for woods to discourage the growth of molds and fungi, thus reducing the health and environmental impacts of synthetic chemicals used as biocides and pesticides. A drive for the massive production of this preservative should be an action point for all stakeholders and government. This study proposes the use of modified fast pyrolysis in the production of pyroligneous acid from Lignocellulosic waste (Fig. 4 and 5). This process will significantly reduce the production of pyrolytic gases and optimize the production of pyroligneous acid and bio-char which has numerous application in farming, wastewater treatment, electronics, building, clothing, decontamination of soil, and other range of consumer products. This biochar when treated through a chemical process to improve its chemical and physical properties, can be applied as activated carbon for absorbing different types of pollutants [12]. Bio-char can be used in its natural form as acid soil neutralizer and micro-organisms activity promoter. Thus, acting as a nutrient to the soil [12].

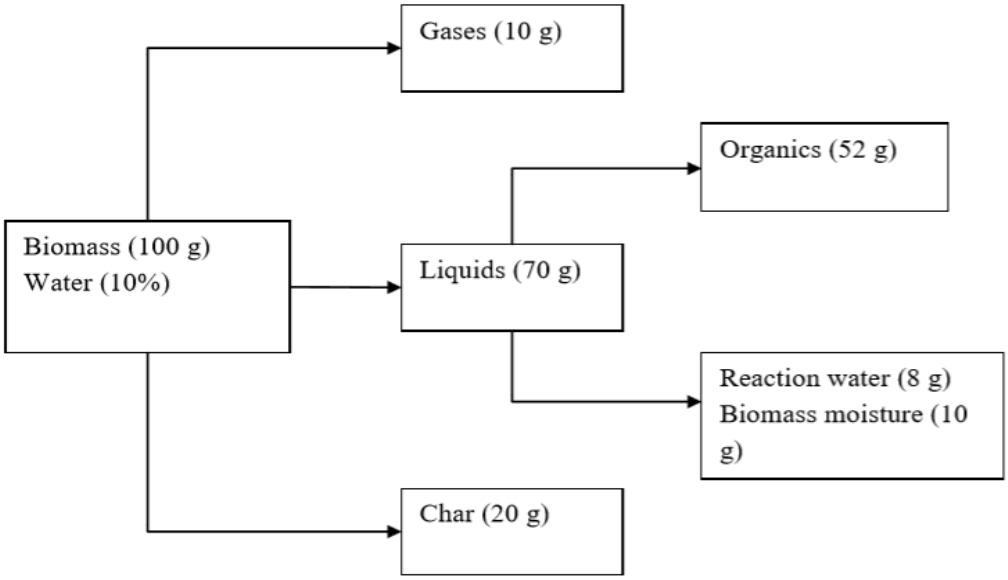

Figure 4: Fast Pyrolysis Mass Balance during Production (Fivga, [13])

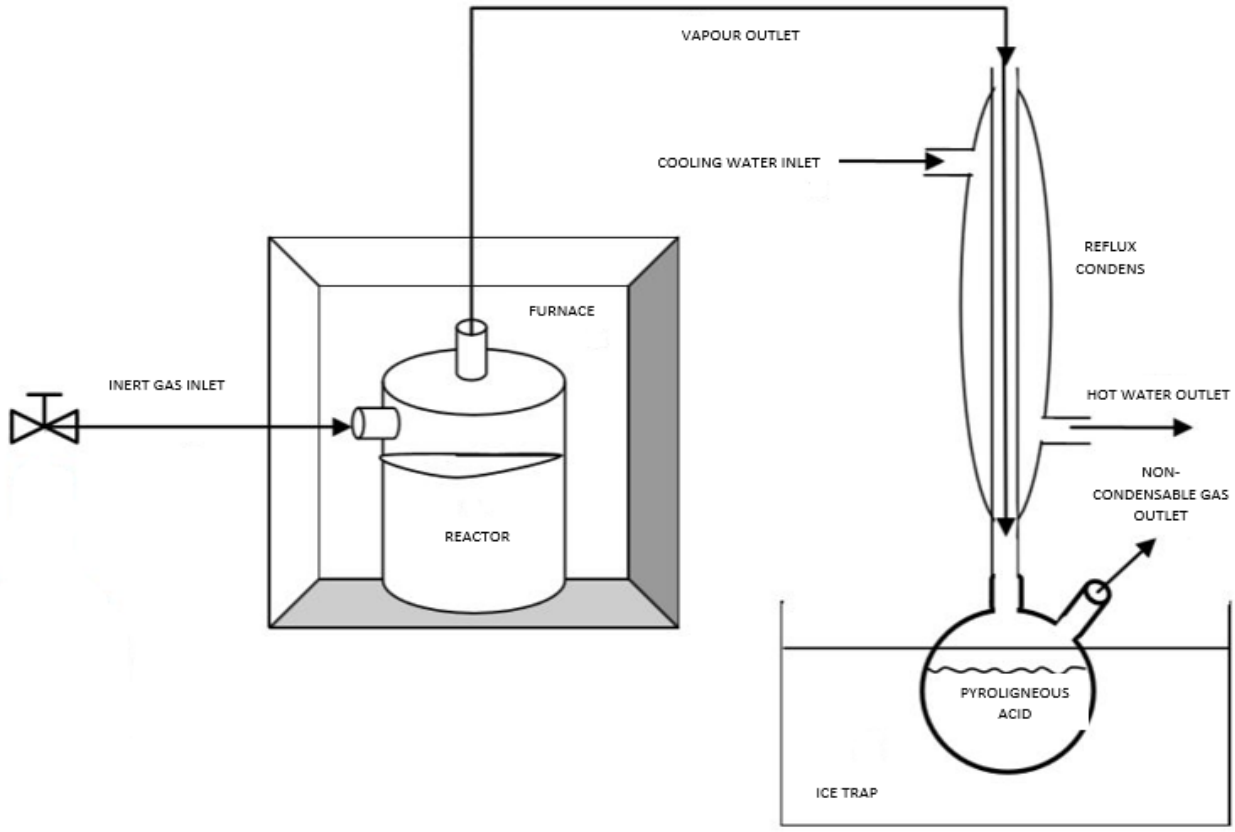

Figure 5: Modified Fast Pyrolysis Schematic Set-up

5. Conclusion

Wastes generated from the agricultural sector in Nigeria though huge and considered worthless, can serve as raw materials for viable products which are capable of sustaining and supporting wealth creation in the country. The study demonstrates the potential therein and benefits of utilizing huge post-harvest waste biomass materials in South-Eastern rural communities of Nigeria. Literature has shown that some agro waste that has biomass can produce 70-95 percent of lignocellulose. Thus, there is need to further research in this area.

Acknowledgment

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