Effective use of Agricultural biomass: A Review

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Abstract

Waste generated from agriculture, it's application and management are so important. Developing countries like India need proper waste management strategies to mitigate the harmful effects caused by agriculture waste. Previously, under favorable conditions, this plant waste and biomass was either burnt or naturally turned into organic fertilizer. Agricultural biomass, on the other hand, is used for a variety of other purposes. As a result, it was necessary to propose some agricultural waste management techniques. However, the main justification for handling agricultural waste is that it is both environmentally and economically beneficial. This paper will illustrate agricultural waste management techniques that can be implemented so that every individual is aware of and take full advantage of the various options for plant waste recycling and further use for increased economic benefit.

Key words: Agriculture waste Management, Biomass, Crop residue, Waste recycling.

Introduction: When the human population grows, so does the need for food, resulting in a rise in agricultural waste production. Agricultural waste contains bio-degradable cellulose & hemicellulose, on decomposition supply good amount of nutrients to plants. On the other hand, this agricultural waste is cost effective and eco-friendly. Agricultural waste can be turned into steam charcoal, ethanol, methanol, biodiesel, animal feed, composting, energy, and biogas, among other items, and is a large pool of underutilized biomass resources that can be used to generate energy. Tiles, reinforced composites, polymer composites, cement boards, particle boards, and insulation boards can all be made from sawmill waste, cotton stalks, vegetable scraps, jute sisal, ground nut shells, luggage, flour, wheat straw, and husk. Straw from barley, rice, soya bean, and wheat; stover from maize; bagasse from sugarcane (Bentsen et al., 2014), rice husk corn cobs, cocoa pods, fruits, shell (Titiloye *et al.*, 2013), sorghum and millet husk, and groundnut pods are all examples of crop residue. This biomass is widely available around the world, it can be used as an alternative energy source to meet the world's energy demands. But the effective utilization of these waste is important in converting these wastes into energy. Otherwise, it will cause environmental pollution. As a result, attempts have been made and proper recommendations have been issued on the conservation and efficient use of farm waste for energy and production purposes. Agricultural waste utilization is a critical concern, especially in light of the global energy demand gap. Biomass is being explored as a way to fill this vacuum, as it can be used as a source of green energy and turned into consumer goods, among other things. Chemical acids, biodegradable fibers, and enzymes can all be made from wood waste materials. On the other hand, adds double the economic importance of electricity, animal feed, or gas (Kiran et al., 2015). The primary goal of this paper is to go into the different uses of agricultural biomass in detail.

Effective utilization of Agricultural waste:

There has been a lot of work published in the literature about biomass utilization, and some of the work done in this field is as follows:

Utilization of Agri waste for Bio-Gas production:

The use of agricultural waste in biogas technology was investigated by W. Schiiferr et al., (2008). A feasibility study was conducted to provide lawmakers with facts and statistics in order to promote the economic and environmental advancement of the most promising biogas technologies on-farm. Based on the results, manufacturers of on-farm biogas plants may be urged to develop and sell dry anaerobic digestion as a complementary technology. For farms that use a dry manure chain or even farms without livestock, this technology may be a cost-effective solution. In terms of only energy generation, farm-scale dry digestion technology has yet to prove competitive in biogas production when opposed to slurry-based technology. In the other side, the results provide a summary of emerging technical strategies for farm-scale dry digestion plants. The results also point to the fact that the best technical alternative is yet to be found. To boost the economics of biogas processing, modern dry digestion demonstration plants must be designed with enough compensation for environmental benefits such as closed energy and nutrient cycles.

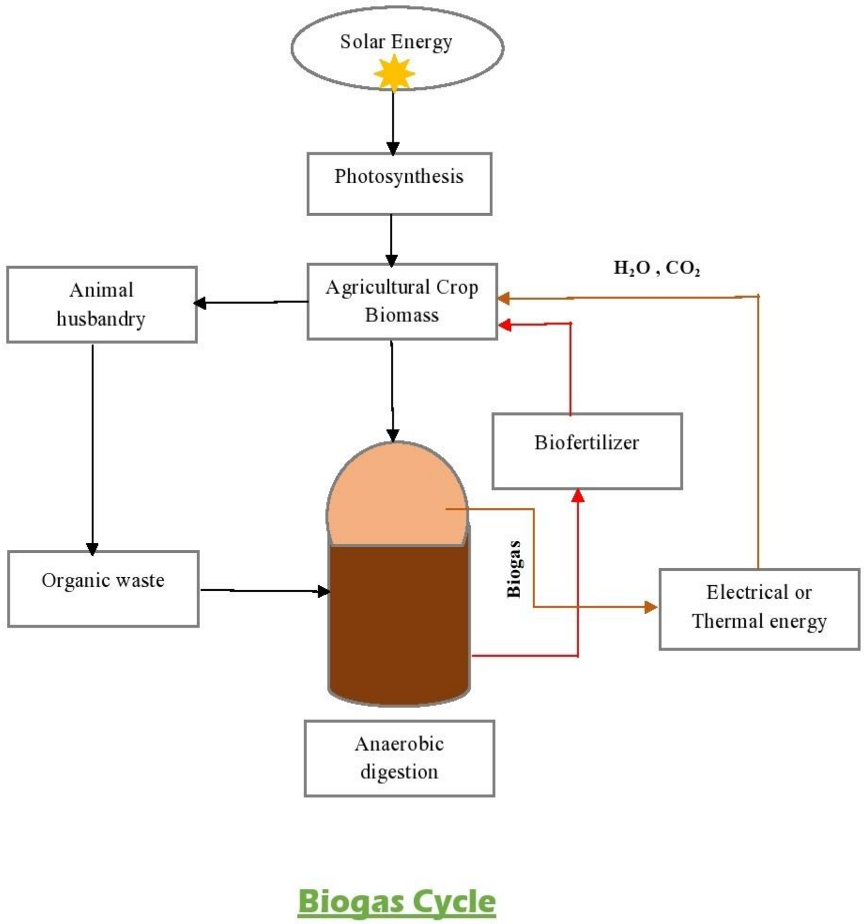

Fig.1.General schematic cycle of Biogas

(Y. He, Y. Pang, et al., 2008) looked at the various methods for improving biogas production from manure and straw during the year. The requirements include retention time, temperature, heat pre-treatment, micronutrient enhancement, surface area active ingredient, enzyme addition, germ enhancement, manure co-digestion with straw, and manure co-digestion with straw pretreated with fungi. With a mixture of manure and compost, and long retention periods, methane returns of 380 L/kg unstable solids (75 percent energy recovery) can be achieved (120 days). In family-size digesters, high solids digestion of livestock manure with long retention times produced methane yields of 230 L/kg unstable solids.

S. ojolo *et al*., (2007) investigated the use of kitchen waste and coal for biogas production. Three waste reactors were loaded with three kilograms of cow waste and nine liters of water from the mixer. It was figured out that waste can be treated by converting a regular quantity of waste into biogas, which can be made use of for both industrial and household purposes.

Utilization of Rice waste:

RHA is a rice milling industry byproduct produced by burning rice paddy husks. Regulated burning of rice husk at 500 ^{0}C to 800 ^{0}C produces non-crystalline amorphous rice husk ash, which is grey or whitish in color. Cellular structures in rice husk ash particles have a wide surface area. Because of its high surface area and silica content, rice husk ash contains up to 95% amorphous silica and has excellent pozzolanic activity. Following Metha's results in 1973, RHA became more widely used in building materials. Rice husk ash has a strong workability and can be used in concrete and mortar. Rice husk ash was used as an additional resource cementing agent to produce high-strength and high-performance concrete. RHA decreases porosity while increasing concrete's flexural, tensile, and compressive capacities. Rice husk ash also increases concrete's corrosion resistance and durability. Rice husk ash may be used in building materials such as blocks and bricks.

Fig.2.Rice Husk Ash Bricks (source: The Constructor Building ideas)

The use of farm waste in land fill soil stabilization was investigated by M. Nidzam *et al.,* (2014). Palm oil ash as well as rice husk ash were used as the essential components of the product as an all-natural alternative to standard Portland cement. POFA or RHA is used to preserve land fill soil on its own either in combination with laterite clay earth, either alone or in combination with Lime or Portland Cement (PC). Standard stabilizers like lime or Portland Cement (COMPUTER) were used as controls. The landfill soil mixed with laterite clay (50:50) maintained with 20% RHA: PC (50:50) and POFA: PC (50:50) had the greatest possible compressive strength as compared to the other stabilizer and soil combinations. The compressive strength values of the samples begin to boost as the quantity of POFA as well as RHA in the device increases. These searching's for indicate the technological, financial, and environmental advantages of making use of POFA and also RHA, along with various other commercial by-products, to achieve long lasting facilities growth with very little industrial waste.

The administration of rice husk agricultural waste was analyzed by H Singh et al. in 1986. Rice straw is used in less than 20% of livestock bedding, paper, feed, and cardboard processing. Due to a scarcity of coal, consumers have begun to use husk in furnaces, brick kilns, as a packaging material to protect eggs, porcelain goods, and fragile buildings, and in the manufacture of insulation boards.

Anil et al., 2014 looked at the efficacy of using fly ash and rice husk in soil stabilization. Black cotton soil was treated with fly ash and RHA at a proportion of 5 percent, 10 percent, 15 percent, 20 percent, and 25 percent for fly ash and 10 percent, 15 percent, 20 percent, 25 percent, and 30 percent for RHA and checked after 28 days of curing. It was discovered that when 20% fly ash and also 25% RHA were integrated with soil sample, the liquid limitation was minimized to 55%. When 20 percent fly ash and 25 percent RHA is mixed with soil, the plasticity index was reduced to 86 percent, differential free swell was reduced to 75 percent, and specific gravity was substantially reduced.

Utilization of Coffee waste:

(Aeslina *et al.*, 2016) reported that the viability of using coffee waste in the manufacture of bricks. The cw (coffee waste) ratio and temperature were the study's parameters. The material's shrinking density and compressive strength is taken into account. In this technique, control bricks and three different volumes of coffee waste brick (CWB) (1 percent, 3 percent, and 5 percent) were made and fired at 1050°C. The leaching of heavy metals from manufactured clay brick was investigated using a toxicity characteristic leaching method, in addition to the core properties of physical, shrinkage, density, and compressive strength. The shrinkage increased linearly with the addition of CW, but remained within the minimum norm of less than 8%, and good quality bricks were made. As a result, coffee waste can be used to make fire clay bricks with varying proportions of cw. It also has solutions for repurposing coffee waste. In brick processing, the cw may be used as a low-cost waste additive.

Fig.3.Coffee Waste Bricks (source: RMIT research, Melbourne)

Utilization of Palm oil tree waste:

According to research studies, the POFA (Palm oil fuel ash) has solid pozzolanic activity and is sufficiently inactive, so it can be used as a cementing product in concrete production. Due to its low pozzolanic property, ungrounded POFA has partly changed OPC (average portland cement). The only thing to note is that ungrounded POFA should not be made use of with a product of greater than 10% concrete by weight. Hussin and Ishida (1999) discovered that when ordinary portland cement was replaced with 20% to 40% ground POFA by weight, the concrete's modulus of elasticity, compressive resistance, shrinking, poison's proportion, and creep approached that of OPC concrete by as much as 30%. Hussin and Awal (1996, 1997) claim that utilizing 40% ground POFA without sacrificing concrete strength is practical. It is likewise recognized that 20% ground POFA can be used as a cement substitute requirement with a resilience element at least comparable to ordinary portland cement. POFA is used in a range of concrete applications, including aerated concrete, high-performance concrete, and high-strength concrete. In later years, high-strength concrete made with POFA revealed that concrete having approximately 30% ground POFA had higher compressive toughness than average portland cement concrete. POFA can additionally be made use of in other structure materials such as brick as well as rock mastic asphalt, according to researchers.

Fig.4.Palm Oil Fuel Ash (source: Afiq Tambichik et al., 2018)

In palm oil processing mills, solid wastes from oil palms are commonly used as a source of heat. By proportionally combining the ash formed by this method with cement, the ash demonstrated its ability to be used as a building material. The ash showed reasonable shrinkage, segregation, density, water absorption, and soundness of cement (Tay, 1990).

Waste from oil palm trunks is used to produce light building materials. Production of block board, ply wood (Lim and Gan, 2005), binder less particle board (Aidawati *et al.*, 2013), concrete reinforcement (Ahmad, Saman, and Tahir, 2010), and Syngas generated by steam gasification of oil palm trunk lumber is used to generate electricity and heat, as well as for other industrial and domestic purposes (Nipattummakul *et al*., 2012)

Utilization of Sugarcane waste and Coconut coir waste:

R. Balaji et al., (2014) investigated how to strip iron from drinking ground water using all-natural adsorbents made from farm waste. The research was conducted in Chennai, where the iron level was 0.3 mg/L. Sugarcane bagasse and coconut coir as a solid step additional coir for full iron removal were used to assess iron removal. These products have actually been kept in mind for their outstanding attributes and also capability to extract full iron. pH, adsorbent dose, touch time, initial concentration, and a variety of other variables were all examined. In comparison to sugarcane bagasse, coconut coir has the highest rate of full iron elimination.

Utilization of Crop residue:

When residues decompose, they add organic matter and nutrients to the soil, improving soil tilth and fertility over time. As residues decompose, they provide metabolic energy and nutrients to microorganisms and soil arthropods, assisting in the recycling of nutrients in the soil and thereby increasing biodiversity and beneficial organism operation (Tian *et al*., 1993).

Just a small percentage of crop residues added will ultimately decompose into humus. Around 70% of crop residues will be converted to CO2 after a year of application, while 5-10% will be converted to new biomass. This newly formed biomass can decompose at a slower rate, with some of it being converted to humus. Humus decomposes slowly, at just 2-5 percent each year, but these amounts are usually replenished as part of the ongoing humus formation in the soil (Bollag *et al.*, 1998).

Crop residues provide organic C to soil microorganisms while also providing nutrients to plants. Crop residue accumulation on the soil surface decreases runoff and soil degradation while also lowering soil evaporation and land preparation costs (Singh and Rengel, 2007).

Crop residues provide a physical coating on top of the soil surface that protects the soil from the elements (like temperature, sun, and water), may act as a barrier to smother weed growth, protect the soil from wind or extreme rainfall events, and may act as a shelter for beneficial organisms after application. They are low-cost and high-yielding. In order to incorporate current agricultural practices, it is important to consider the useful pieces of agricultural wastes and how to apply them (Elisetty and Upadhyay, 2020).
Residues in the soil help to minimize nitrogen and sediment runoff, as well as irrigation needs, by lowering evaporation rates (Silva and Moore, 2017).

Fig.5.Collection of Crop Residue

Fig.6.Compost making at house

Other beneficial use of Agri waste:

Tay lay et al., (2015) investigated the physio-chemical properties of coconut shell in asphalt mixes as well as their use in road building. It has been discovered that x-ray fluorescent scanning electron microscopy can be used for it.

M Vikas et al., (2014) investigated the effectiveness of Neem as a natural absorbent in the management of dairy product drainage. Using big quantities of water as well as the manufacturing of natural compounds as fluid effluents have actually been taken into consideration as significant ecological concerns in the milk handling industry. In both the production of potable water and the treatment of wastewater effluents, a large number of chemicals are used. The adsorption process is one of the most efficient methods for removing contaminants from dairy manure, and a variety of natural adsorbents are widely used. Natural adsorbents have been studied widely as a potential substitute for conventional expensive methods of separating toxins from dairy effluent. The aim of this study is to contribute to the quest for less expensive adsorbents by examining the potential for different agricultural waste products like sugarcane bagasse, rice husk, oil palm shell, coconut shell, and coconut husk to remove impurities from wastewater. Turbidity, pH, as well as colour are several of the research's parameters. The pH of the effluent was initially estimated to be 10.5, showing that the water was incredibly alkaline. The pH dropped to 10 after 1 hour, 9.8 after 2 hours, 9.5 after 3 hours, 9.0 after 4 hrs, and also 8.2 after 24 hr, showing that the effluent is substantially much less alkaline than it was at the beginning.

Agricultural fluid waste can be made use of to boost soil fertility, plant efficiency, as well as condition control. The fluid formulations are simple and also environmentally friendly to make from conveniently available products. The biological productivity of soil and also crop plants is affected by natural liquid formulation. Bijamrut, Jeevamrut, Panchagavya and Vermiwash are the fluid formulations. These can be used as foliar sprays, direct soil applications, crop treatments, and also irrigation water ingredients. These formulas aid in the enhancement of soil fertility and also plant production, along with the reduction of pest occurrence. (Bagathi, G., and Upadhyay, H. 2020).

By combining agro waste attributes with clay or calcium bicarbonate, Ankit et al. (2013) investigated agro waste as an innovative commodity in the field of India. The most financially important wastes for the building industry have been identified as groundnut husk, hemp fiber, rice husk, rice straw, saw dust, coconut fiber, and various other fibrous materials. Every year, India generates nearly 700 million tons of organic waste, which is either burnt or deposited in the environment. The large amount of agricultural waste produced in the market location has caused environmental damage.

The use of farming charcoal for power generation was investigated by Navdeep Singh et al., (2013). Agricultural waste can be converted into fuel cakes and even charcoal using a destructive purification process. Charcoal fuel is a form of energy source that can be rated based on its calorific value. Depending on the availability of raw materials, a good carbonizer may aid in the development of electricity.

By growing mushrooms on aerobically digested waste and agro waste debris, L. Udayasimha et al. (2012) investigated the prospect of long-term waste management. The digestive content, when combined with farming deposits such as coir pith, paddy straw, and mushroom cultivation, provides an opportunity to use renewable energy in the production of edible protein-rich food, which would undoubtedly help to ensure food safety.

D. Jansirani *et al.* (2012) investigated the manufacture and application of vermicast made from organic waste. Vermicast handling from spent tea waste, coconut coir, and sugarcane bagasse decomposition is a test parameter.

Igor sepelev et al., (2012) explored the opportunity of making use of potato peel waste produced in food handling systems. Furthermore, potato peel powder can be used as a partial flour substitute without compromising the sensory properties or fermentation of the material.

Eng-cheong *et al.* (2011) explored the use of organic waste as a bio absorbent for dye removal from aqueous solution. Sugarcane bagasses and improved rice hull have been discovered to be low-cost materials for dye removal. Atomic force microscopy, batch, and column experiments were used to conduct the tests. Breakthrough was found to be based on influent concentration, flow rate, and bed height.

Kaur *et al.*, (2011) investigated the use of agricultural waste in civil engineering and established a method for lowering construction costs while increasing material control. Coconut shells were utilized to change smashed granite by volume in a 1:2:4 concrete blend. Seventy-two cubes were made, as well as their thickness and compressive strengths were measured after seven days, fourteen days, twenty-one days, and twenty-eight days. As the percent of concrete changed increased, the density as well as compressive strength of the concrete decreased. 20%, 30%, 40%, 50%, and 100% substitute concrete had 28-day compressive strengths of 19.7 N/mm2, 18.68 N/mm2, 17.57 N/mm2, 16.65 N/mm2, and 9.29 N/mm2, respectively, which were 94 percent, 89 percent, 85 percent, 79.6%, and 44.4 percent of the control concrete's compressive intensity. According to the findings, concrete produced by replacing 18.5 percent of crushed granite with rice husk ash and sugarcane bagasse produces strong performance.

Akshaya et al. looked at the impact of polypropylene fiber on RHAL construction characteristics in 2012. In 0.5 percent increments, 0.5-2 percent polypropylene fiber was added. RHA: Lime fiber proportion was discovered to be 84.5: 10: 4:1.5 in the perfect soil. Agricultural waste and other environmentally burdens are now a major concern. Furthermore, profitability is plummeting at an alarming pace. Our reliance on compound composts and pesticides has fueled the growth of projects that deliver poisonous synthetic compounds that are not only harmful to humans, but also have the potential to destroy the natural balance. When farming faces a variety of environmental challenges, role of biofertilizers and agricultural waste management will help to meet the needs of an ever- increasing global populations and sustainable management of agroecosystem (Elisetty and Upadhyay, 2020).

Andrade et al., (2001) checked out the performance of transforming horticulture waste into beneficial items. Moisture quality, bulk density, compression ratio, as well as compressive strength are all elements to take into consideration for much better use and also secure handling. Horticultural wastes consist of damaged or spoiled vegetables and fruits, along with dead plants, roots, leaves, as well as unsold fruits and vegetables. 70.31 percent of farmers us compost or vermicompost from rotting fruits and vegetables or feed them to animals. Animals were fed the dead plant branches and leaves. Surplus vegetables and fruits can be become value-added goods, which can then be sold in the market, enabling farmers to not just reduce waste yet also get even more money.

Conclusion:

Agri waste is organic waste that is fully biodegradable. Composting is one of the many uses for agro biomass. Other uses, according to the literature, include brick manufacturing, biogas production, and building materials. It is a vital resource, and good agro waste management benefits both the economy and the environment. Agricultural waste is not properly treated or disposed of due to a lack of coordination, inadequate public knowledge, ineffective government policies and legislation, and inefficient water utilization, resulting in environmental destruction and even harm to human health. This necessitates increased public awareness of the benefits and risks associated with agricultural waste, especially in developing countries.

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