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A Short Review on Biomass Production from Agricultural Wastes

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***Abstract*— Energy shortage and inefficient ways of producing it over the years has led to the destruction of the environment and its high time we resort to eco-friendlier methods. Also keeping in mind that even after so much expenditure and eradication of natural resources we haven't been able to produce enough energy to supply it many places. Energy is not accessible to common man easily. We looking at this are looking at promoting domestic fuel production to meet the basic needs of the people of nations where energy outreach is not there. Considering India, many rural areas still don't have electricity to meet their basic needs and these rural areas do have access to domestic and agricultural wastes which be put to use for generation of energy.**

We want to promote bio-energy as one of the sustainable energies to be used in the future so as to cut down the convention fuel use and reduce pollution as a result. Producers of waste can add value by channeling their garbage to create a more profitable use in the form biomass energy. As society cannot stop producing manure or garbage, the organic materials which are needed to produce biomass are infinite. We also intend on the reduction of waste accumulation in landfills, and also the illegal burning of those wastes as it leads to major air pollution factor, rather be put into bioenergy production.

Keywords—Agricultural Waste; Biomass production; Waste Biomass; Energy.

I. INTRODUCTION

The bioenergy resources are one of the clean fuels and can be used instead of fossil fuels on large quantities, which is currently the main energy source [1]. Bioenergy and biofuel utilizing biomass such as bio refinery, plant materials and manure, and waste resources for application as renewable fuels for transportation and for power generation can ensure a sustainable, low-carbon alternative to fossil fuels. This also houses the promotion of food production and utilization of the by-products to produce these fuels which makes it easily available for everyone. This reduces the strain on traditional fuel production method hence reducing the pollution caused due to it. In accordance to the report of World Health Organization (WHO), United Nations Development Program (UNDP), 1.5 billion people, implying an estimated one-quarter of the world's population, do not have access to electricity [2], so setting up bio-mass production plant for electricity production can solve some of this problem.

Food security, as well as energy provision from these crops, can be ensured when the degraded farmlands are used to grow crops after the deforestation, which can result in CO2 emissions as a result of excessive land use. Hence, opportunities for dual cropping process, which can enhance agricultural productivity by generating bioenergy from agricultural waste while food production is ensured [3]. As these problems are majorly faced by the developing nation and countries having majority of their population below the poverty line are highly in need to adapt and incorporate bio-energy power plants for their vital energy requirements. Countries which have abundant agricultural resources such as India can help its people to live a happy and sustainable life and reach new heights of prosperity. Corn stovers are the stocks or the leaves left over after harvesting of corn. Ethanol can be produced in large quantities from these corn stovers near corn growing regions. . Corn residues are abundant near existing facilities fitted to produce and distribute ethanol made from corn grain. indeed, companies are constructing the first three business-scale efforts to supply ethanol from agricultural residues close to such current centers in Iowa and Kansas. generating ethanol from corn grain and corn Stover on the same region can lessen the use of natural gas and electricity by the combined facility, curbing the environmental footprint of the fuel [4]. Globally, 66% of the residual plant biomass comes from cereal straw (stem, leaf and sheath material), with over 60% of these residues produced in low-income countries. Sugarcane stems and leaves are the second largest contributors, with other residual biomass including the 'oil crops', roots and tubers, nuts, fruits and vegetables [5]. It is worth to mention that some of these have capacity of generating electricity on larger scale.

Our main objective consists of emphasizing on the use of organic and agricultural waste for the productions of biomass, the advantages and long-lasting effects of using agricultural biomass when put in use as one of the major energy sources, Highlighting the best organic waste that highly contribute to bio-mass production and how they can be brought into action and putting forth efficient ways to produce and utilize bio-mass from domestic waste.

Nimisha Tripathi et al.[6] studied biomass waste utilization in low-carbon products. We can see the how we are going to do

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Biomass waste management. There are many advantages or benefits given in the mentioned paper. And also, the implications of biomass produced. Discussed an alternative approach using captured carbon dioxide and utilization and Preparation and characterization of products from biomass. It is concluded that, as biomass residues are increasingly burnt in power plants to produce energy, it has been shown that their ashes and point source CO_2 can be combined in the manufacture of carbonated products. This circular management technique has capabilities to hold and preserve landfill area, and can decrease amount of carbon dioxide emissions and other environmental harms.

A.B.M. Sharif Hossain et al.[7] conducted study regarding Bioethanol production from agricultural waste Biomass as a Renewable Bioenergy Resource in Biomaterial. It was found that Algae, pineapple, chicken waste and fish processing waste by-products are economical choices for bioethanol production. The produced bioethanol can be a significant source of ethanol that is used in medicinal manufacturing industries as well as a solvent in the diagnostic waste.

Yuliansyah et al. [8] studied Production of Solid Biofuel from Agricultural Wastes of the Palm Oil Industry by Hydrothermal Treatment. Upgrading of oil palm frond and trunk was investigated by hydrothermal treatment at 200–350°C for 30 min. Approximately 35–65 wt.% of the original material was recovered after the process as solid fuel. It was proposed that hydrothermal treatment could become an advantageous technology for producing solid fuel from biomass waste.

Agricultural waste disposal is becoming a problem due to its increasing production and potential pollution. But, conversion of agricultural waste into electric energy seems to be inevitable in countries like India to meet the renewable energy goals. Agricultural residues are rich in carbohydrate, protein, lipid, cellulose, and hemicellulose and are used as a substrate for biogas production. Among the various agricultural wastes, animal manure is a suitable feedstock for biogas generation because of its high organic and moisture content and low C/N ratio. Agricultural Waste Agricultural waste is defined as unwanted waste produced as a result of agricultural activities (i.e., manure, oil, silage plastics, fertilizer, pesticides and herbicides.

II. METHODOLOGY

- Literature Survey:

This will be done by putting the observations and methodologies adopted by around fifteen other reputed scientists, researchers and innovators through their research paper on the field of biomass production. This part has already been done.

- Overall System Design:

This part will include the kind of agricultural waste used based on the above-mentioned factors, a suitable way to transport and store this waste and lastly, advanced scientific and technological ways to convert this waste into useful biomass

- Choosing Best Available Technologies:

This will be done by looking at the various technical and chemical processes used to convert waste to biomass and then to store and transport it. Further research will be required for this selection.

- Legal and Economic Feasibility:

Since waste management has high ecological impact, there are a lot of state as well as central government interferences. We will abide by all these laws and work accordingly.
Cost effectiveness is also a big factor in our system design, as this is supposed to be used by the masses.

- Alternate Uses:

Since environmental impact is one of the central issues of importance in our project, we will try to maximize the utility of the biomass produced. Apart from the conventional use of energy production, other uses will also be thought about and suitable implementation techniques will be discussed.

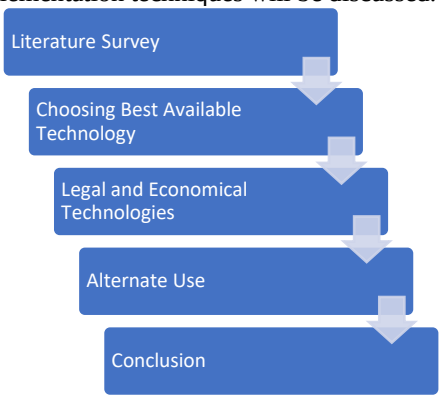

Fig. 1. Methodology flowchart adopted for study

III. AGRICULTURAL WASTE

Agricultural wastes consist of leaf litters, weeds, sawdust, crop residue, livestock waste and forest waste. Livestock waste is primarily preferred by numerous researchers over other agricultural wastes, as feedstock for earthworms and as bulking substrate for vermicomposting. Livestock waste is considered an appropriate biological supplement to improve the vermicomposting process due to its ease availability, low cost, adequate nutrients, and a proper C / N ratio. [9]

IV. WASTE BIOMASS RESOURCES

For an overall global assessment of waste biomass resources, comprises of waste biomass projection and generation, accompanied by potential use and reduction of GHG equivalent, please see the Report on the Global Assessment of Agricultural Biomass Waste Resources [10]. The major crops and waste utilized in the biomass technology entries are the following:

- Coconut - Fronds, husk, shell
- Coffee - Hull, husk, ground
- Corn - Cob, stover, stalks, leaves
- Cotton - stalks
- Nuts - Hulls
- Peanuts - Shells
- Rice - Hull/husk, straw, stalks
- Sugarcane - Bagasse
- Agricultural Crops - Mixed agricultural crops, not limited to crop waste
- Mixed type - Agricultural crops and waste including non-organic wastes

V. STORAGE AND TRANSPORT OF WASTE

Storage is the temporary containment of the waste. The storage facility of a waste management system is the tool that

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gives the manager control over the scheduling and timing of the system functions. [11]

- Locate farm waste storage areas away from food handling, input storage and livestock housing areas to prevent cross-contamination and avoid attracting pests.
- Make sure farm waste storage areas and containers are adequate for the amount of waste generated between disposal times.
- Clean farm waste storage areas often enough to avoid creating conditions that can cause cross-contamination or attract pests.
- Where possible, use containers with lids for the storage of farm waste until removal.

A. Suitable Temperature and Pressure Conditions

The biological breakdown of manure produces ammonia, hydrogen sulphide and other compounds such as mercaptans and amines. Combinations of these compounds can produce offensive odors at very small concentrations (parts per billion). The types of compounds produced depend on the biological processes which take place in the manure. Temperature controls the rate of bacterial action. The higher the temperature, the faster the biological action and therefore the greater the gas production. This explains the fact that fewer odors are produced in cold weather conditions [12]. Frequent cleaning and a high level of sanitation are the most effective ways of minimizing odors from feedlots. Time the cleaning process in relation to seasonal weather conditions i.e., temperature. Also, proper temperatures within the compost pile will reduce pathogens.

Composting of poultry and other small agricultural animals is considered a low cost, environmentally acceptable method of disposal of dead stock. The use of composting technology in the disposal of poultry and hogs is becoming more widespread [13]. Temperatures throughout the compost pile must exceed 55°C (130°F) for adequate reduction of pathogen levels [14].

The behavior of the manure when being handled will depend primarily on the ratio of solids to water, and to a less significant extent on properties such as the particle size and shape, temperature of the liquid, dissolved chemicals and so on. low-pressure, high-volume systems are most efficient.

B. Technical Advances in Storage and Transport of Agricultural Waste

Litter from poultry operations is stored outside the housing facility or on the floor of the housing facility. It can be directly transported to the field for land application, when it is removed. In some areas the litter may be compacted in a pile and stored in the open for a limited time; however, it generally is better to cover the manure with a plastic or other waterproof cover until the litter can be used. But if it is needed to be stored for a long time, the litter should be stored in a roofed facility. If the manure from layer operations is kept reasonably dry, it can be stored in a roofed facility. If it is wet, it should be stored in a structural tank or an earthen storage pond [11].

Manure management encompasses manure collection, storage, transport and land application. The goal of manure management must be to minimize the potential for environmental degradation and maximize the soil amending value of manure. The technique utilized to convey the waste rely largely on the consistent supply of the waste [15]. Liquid waste and slurries can be transferred through open channels or pipes or in a portable liquid tank. Solids and semisolids may be transferred by using mechanical conveyance equipment, by transporting the waste in solid manure spreaders. We can also use the Piston pumps or air pressure can be used to transfer semisolid waste through large pipes. Avoid transporting manure on public roads during periods of high traffic such as rush hours before and after work in case of odor management. Make sure transport vehicles are easy to clean and sanitize and constructed of non-absorbent, non-toxic, smooth, corrosion-resistant materials that can hold up to repeated cleaning. we Clean transport vehicles between loads and sanitize them where necessary. waste collected from the side of roads, agricultural fields all the transported to decomposed site and for further treatment by trucks, trailers, carts. Different types of waste are collected and then transferred to the further treatment and the waste which is not burn in open air it is then transported to incineration.

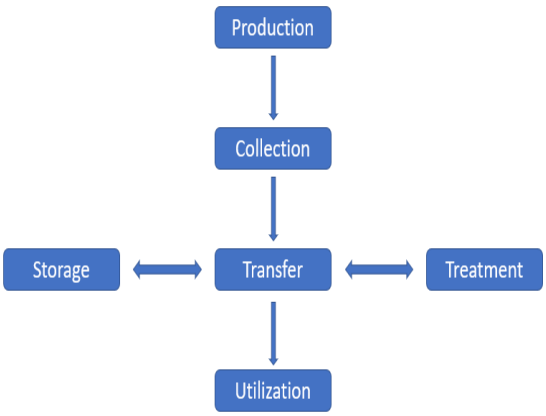

Fig. 2. Storage and Utilization flowchart of waste

It includes the transfer of the waste from the collection point to the storage facility, to the treatment facility, and to the utilization site. As shown in figure 2 above, the waste may actually be transferred several times before utilization.

C. Economical Feasibility

As agriculture is the largest contributor of any resource sector, to the economy, it enormously generates high quantity of wastes. the first goal of any waste management system is to maximize the economic benefit from the waste resource and maintain acceptable environmental standards [16]. To be practical, the system must also be affordable and suitable to the operation. When various types of farm by-products are managed appropriately, it can be economically valuable resource. The Waste Review is a step towards more efficient and cost-effective waste disposal, treatment, and prevention. As policy evolves over time, opportunities exist to make the waste system more efficient, both with respect to the amount of waste that arises and the way in which that waste is dealt with. There are several environmental impacts associated with waste management like greenhouse gases, air quality, water pollution, noise and land use that we have to handle and can me not economically feasible and other economic factors are dependent upon many factors like transportation based on the geographical condition of the considered are or quality of the manure or agricultural waste.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 06, June-2022

VI. BIOMASS CONVERSION METHODOLOGIES

The current scenario regarding greenhouse gas emissions has dawned upon us the urgency to find an alternative to fossil fuels. The higher portion of this demand is being met by hydrocarbon energy sources like coal, oil, and natural gas. So to find a new technology to generate electricity sustainable approach for bioenergy production are in demand. Successful implementation of zero waste discharge policy is one such way to attain a sustainable development of bioenergy. Numerous various technologies were studied and exploited to generate bioenergy based of bio-waste. [17] The conversion technology of waste to energy involves the transformation of waste matter into numerous forms of fuel that can be utilized to supply energy. The general processes are trans esterification process, thermochemical process and biochemical process. Zero waste discharge can be achieved only through generating bioenergy by the use of organic wastes. Waste management is pivotal and considering its importance of minimizing the issue and menace of wastes, conversion strategy of organic waste is effectively recommended. Present review is concentrated on providing a broad view of the efficient conversion techniques and its potential organic waste. Different types of organic wastes used for bioenergy generation and its sources, anaerobic digestion biogas production and its related process affecting parameters including fermentation, photosynthetic process and novel nano-inspired techniques are discussed.

A. Thermochemical Conversion

Conversion by means of thermochemical is the decomposition of organic components in the biomass using heat. The high-temperature chemical reforms and initiates bond breaking and reforming of organic matter into bio char (solid), synthesis gas and highly oxygenated bio-oil (liquid). [18]

This conversion has 3 major types: [19]

1. Gasification,
2. Pyrolysis and
3. Liquefaction

1) Gasification process

Gasification process of biomass consists of burning of biomass at appropriate temperature in a very limited supply of air. It usually emits combustible gases which are comprise of carbon dioxide, carbon monoxide, methane, nitrogen, hydrogen, along with other contaminants. The gas is used in boilers, turbines and in engines by cleaning it for producing power and heat. The very basic idea of gasification process consists of processes like devolatization, combustion and reduction.

The above explained process of gasification provide diverse forms of energy than conventional combustion process of biomass. [20] The different types of feedstocks and their respective type of energy formed is mentioned in the table 1 below:

TABLE I. DIFFERENT TYPES OF FEEDSTOCKS AND CORRESPONDING TYPES OF ENERGY FORMED FOR GASIFICATION PROCESS

TYPES OF FEEDSTOCKS	TYPE OF ENERGY FORMED
Pine woodchips, Acid hydrolysis residues and sewage sludge	Fuel gas
MSW and hazardous waste	Bioelectricity
Eucalyptus chips and coffee husk, Rice Straws	Fuel gas

2) Liquefaction Process

Liquefaction process of biomass is one of the primary and important process to gain high quality biofuel from biomass. It mainly consists of two types which are direct liquefaction and indirect liquefaction. In which, indirect liquefaction follows Fischer-Tropsch process with the use of syngas from biomass which is the raw material to produce quantity of liquid fuel which consists of ethyl alcohol, methyl alcohol and dimethyl ether. Where in direct liquefaction process of biomass the main technology used if hydrolysis fermentation and thermodynamic liquefaction to convert biomass into bio-oil. [21]

The different types of feedstocks and there corresponding types of energies formed are shown as below in table 2:

TABLE II. DIFFERENT TYPES OF FEEDSTOCKS AND CORRESPONDING TYPES OF ENERGY FORMED FOR LIQUIFACTION PROCESS

TYPES OF FEEDSTOCKS	TYPES OF ENERGY FORMED
Microalgae, Human faeces, Jatropha curcas cake	Bio-crude oil
Domestic sewage in high-rate ponds	Bio-oil
Wet & dry microalgae	Crude biodiesel
Microalgae	Methane and Energy

3) Pyrolysis Process

Pyrolysis technology consist of thermal decomposition of biomass in the absence of oxygen gas. It is the very fundamental process comprise of both gasification and combustion process. It gives products like bio-oil, biochar and gases which are hydrogen, methane, carbon dioxide and carbon monoxide. This process occurs naturally within very first two seconds. [22]

The different types of feedstocks and there corresponding types of energies formed are shown as below in table 3:

TABLE III. DIFFERENT TYPES OF FEEDSTOCKS AND CORRESPONDING TYPES OF ENERGY FORMED FOR PYROLYSIS PROCESS

TYPES OF FEEDSTOCKS	TYPE OF ENERGY FORMED
Sugarcane residues sugarcane leaves and tops, Pinyon- juniper wood chips, beech wood	Bio-oil
Spent coffee grounds loaded with cobalt	Syngas (H_2 and CO)
Greenhouse vegetable wastes and coal	Biochar, Bio-oil and gas

B. Biochemical Conversion

Biochemical conversion encompasses the utilization of the yeast and/or specialized bacteria yeast to convert biomass or waste into useful energy. Biomass sources such as agricultural products and residues, plantation forests, sawmill residue and native forests are incorporated for this method.

Different types of biochemical conversion methods are mentioned below,

1. Anaerobic digestion
2. Alcoholic fermentation
3. Photo biological hydrogen production

In anerobic digestion technique, under oxygen-free atmospheric conditions, organic substrate decomposition takes place by the use of anaerobic micro-organisms. End products of this process consists of organic nitrogen compounds and

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Vol. 11 Issue 06, June-2022

biogas. With production of biogas, it also provides essential nutrient recovery from lipids from extracted algae biomass. Onsite electricity can be generated from the biogas produced by anaerobic digestion process. Many researches are still going on to optimize this process to increase the efficiency and produce on large quantities. [23]

An additional method of biomass production which break down simple sugars and saccharides into carbon dioxide and ethanol. Alcoholic fermentation is quite complex and exothermic process. Some plants with high amounts of saccharides and starch are grown intentionally for production of ethanol on industrial level. These consists of crops like potatoes, grain or sugarcane. This bioethanol produced from waste biomass can be used as an additive for petrol or diesel.

Basically, photo biological hydrogen production method uses sunlight and various micro-organisms to turn organic waste matter into hydrogen. It is one of the most effective and clean method for producing hydrogen with very low environmental impact with low-to net-zero carbon emissions. Still, there are number of challenges faced while producing hydrogen by this method. Many of these problems can be solved with further research. [24]

C. Physical and Chemical Conversion Processes

- In physical method of conversion, biomass is densified into solid briquettes which are used for direct combustion or extraction of oil.
- Direct combustion of biomass in the presence of oxygen/air to produce heat and by products.
- Complete combustion of biomass to ash is called incineration.
- The heat generated by combustion can be used to produce steam to rotate turbines and produce energy.
- In chemical method of conversion, certain chemical substitutes are added in the agricultural waste to convert them into suitable biomass, fuel or oil.

VII. ALTERNATE USES

- Agriculture Wastes can be utilization for electricity and combustible gas production.
- Utilization of Agricultural Wastes in stabilization of Landfill Soil.
- Use of nuclear techniques for mutation and selection of fungi for high protein yield utilizing carbon from agricultural waste of rice and wheat straws.
- Utilization of agricultural waste in construction for developing of Green Concrete
- Utilization of some agricultural wastes in treating water pollutants
- Can be utilization for agricultural cellulose wastes.
- Preparation and characterization of clay bonded high strength silica refractory by utilizing agriculture waste
- Utilization of agricultural wastes to remove petroleum oils from refineries pollutants present in waste water.
- Utilization of agricultural wastes for production of ethanol.

VIII. CONCLUSION

Biomass is a renewable energy resource with high potential fuel source for the creation of steam and electricity, transportation fuel, medicinal manufacturing industries as well as a solvent in the laboratory. More advance use of biomass with use of various techniques is expected to replace the energy production from conventional methods such as fossil fuels. At present times, it is approximately estimated to contribute of the order 10–14% of the total world energy supply. Although total energy produced from combustion of this solid product was less than that of raw material, the use of this fuel offers other benefits. Storage and handling characteristics can be enhanced because of higher energy density and lower EMC of the fuel. Thus, it is proposed that hydrothermal treatment could become an advantageous technology for producing solid fuel from biomass wastes. Many countries do seek to avoid biomass waste disposal through resource recovery and utilization, and we have seen the increased use of wood residues for energy generation. However, incineration and pyrolysis generate substantial amounts of ash that requires management. Countries such as China, Brazil, USA, Russia and France annually generate ash from wood utilization of 0.061– 0.24 Mt and from power production, 0.03–1.91 Mt. a slight risk to human health is an issue that need to be considered with increase in production of agricultural biomass waste. Which have considerably greater global warming potential than CO2. Agricultural residues are rich in carbohydrate, protein, lipid, cellulose, and hemicellulose and are used as a substrate for biogas production. Among the various agricultural wastes, animal manure is a suitable feedstock for biogas generation. It has lower ratio of C/N and high moisture and organic content, which is fermented more easily. The digestion of manure with crop residues having low N content is always preferable for enhancing biogas production. Other than cereal crops, fruits and vegetable wastes are very common types of waste being used for biogas production.

Biomass residues and waste can be converted into transportation fuels and bioelectricity using trans esterification, thermochemical and biochemical pathways. The choice of process technology depends on the desired end product, environmental impact and the feedstocks. In general, thermochemical technology that employs thermal heat might not be sensitive to the biomass waste composition when compared to the biochemical strategies for the production of biofuels. Nevertheless, the production of biofuels from biomass waste is still considered more robust in material handling, transportation, and conversion technology, when compared to traditional editable food crops-based biofuels. Still, ongoing research studies are devoted to fill up the inadequacies of the existing technologies and improve the efficiency and economics of the production technologies employed.

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