Remediation of Agricultural Waste into Wealth

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ABSTRACT

India is associated primarily as an agricultural based country. Farmer's square measure the rear bones of our nation. Previously farmers used domestically obtainable natural materials like harvest trashes, weeds, cow dung, etc as manure. Anon they become victimized to use chemical fertilizers for quick growth and sensible yield, though they got sensible results in that period. Due to constant use cultivated land becomes unproductive. As a result, the crop becomes less protective of environmental stress. To dispose of the agricultural waste, they started burning and digest anaerobically within the land itself, which leads to pollution, unleash of unpleasant and dangerous gases. The present study is based on the remediation of agricultural waste into valuable vermicompost production. In the vermicomposting process, the agricultural wastes were brought together from different locations and undergo anaerobic digestion by using earthworms for about 25 days in the vermipits. On analysis, it was found that there is an increase in C, N, P, and K within the final vermicompost. This study offers bio remedial technology for agricultural waste that meets an increase in agricultural input and additionally conserves the atmosphere.

Keywords – Agricultural waste, chemical fertilizers, and vermicompost.

1. INTRODUCTION

To meet the food requirements of the rapidly increasing world's population coupled with urban migration resulted in the production of huge amounts of agricultural waste at farmer, municipality and city level (Sabitti, 2011). As we know that rural areas are the backbone of our country. The wealth and prosperity of the country are depending on rural development. Some important parameters required for rural development are proper sanitation, water supply, electricity and agricultural yield. In the present scenario to increase the agricultural yield, farmers extensively use chemical fertilizers. The extensive use of chemical fertilizers, however, increases the crop yield but their excessive use results in the results in the permanent damage to the soil texture and quality (Lokeshwari and Swamy, 2010). In ancient times, farmers adopted some good methods for agricultural waste management. After harvesting the major crop, the remains of straw, sugarcane trashes, grass, herbs, weeds, etc. were dried and left as such in the fields for several months for anaerobic digestion that results in the formation of compost.

Cow dung is commonly available in rural areas and contains a high microbial community and rich in nutrients. When this cow dung is mixed with agricultural waste, it serves as a seedling material and the microorganisms present in the cow dung helps in the rapid decomposition of the agricultural waste and also reduce the overall time required for the composting process (Kale, 2000). Agricultural waste is easily available, renewable and free of cost hence it can be an important resource and can be easily converted into heat, steam, charcoal, methanol, ethanol, biodiesel (Sabitti *et al.,* 2005). It is estimated that about 998 million tonnes of agricultural waste are generated every year (Agamuthu, 2009). Out of this up to 80% portion accounts for organic nature of solid waste generated in any farm from which approximately 5.27 kg/day/1000kg manure can be produced (Brown and Root Environmental Consultancy Group, 1997; Overcash *et al.,* 1083).

2. SOURCES OF AGRICULTURAL WASTE

Agricultural waste is mainly available from the crop residues (such as residual stalks, straw, leaves, roots, husks, shell excreta) and animal waste (manure). The source of the generation of agricultural waste depends on the type of agricultural method or activity carried out (Obi *et al.,* 2016).

2.1 WASTE GENERATED FROM CULTIVATION ACTIVITIES

Under favorable climatic conditions for the growth of the agricultural crop, also supports the development of insects and weeds. So, farmers need high requirements of pesticides to kill these pests and weeds. Usually, farmers spray the pesticides over the crop and their empty bottles are thrown onto the field. The plant protection department (PPD), estimates about 1.8% of chemical remains in the empty bottles (Dien and Vong, 2006)**.** These chemical wastes pose unpredictable environmental consequences such as insecure food hygiene, food poisoning, and toxic farmland.

To increase the crop yield, fertilizers play an important role. Inorganic fertilizers are inexpensive and have high productivity. But it has been observed that many farmers apply the extensive amount of fertilizers to their crops than the actual demand needed by the crop, to increase the crop yield (Hai and Tuyet, 2010). The rate of absorption of such fertilizer components (N, P, and K) depends on the quality of soil, type of plant and fertilization method (Thao, 2003).

2.2 WASTE GENERATED FROM LIVESTOCK PRODUCTION

Waste is also generated by different livestock activities e.g. their excreta, urine, organic materials in slaughterhouses, water collected after animal washing and washing their cages. The putrefaction process of manures results in air pollution. The development of foul odor is due to the presence of ammonia (NH_3), hydrogen sulfide (H_2S) and methane (CH_4) in the waste. In livestock waste the major portion i.e. 75-95% accounts for water, while they may include organic matter and microorganisms and parasite egg (Hai and Tuyet, 2010)**.**

2.3 WASTE GENERATED FROM AQUACULTURE

Waste generated through aquaculture is mainly associated with metabolic waste that could be dissolved or suspended. It was observed that in a properly managed farm, approximately 30% of the feed will become solid waste.

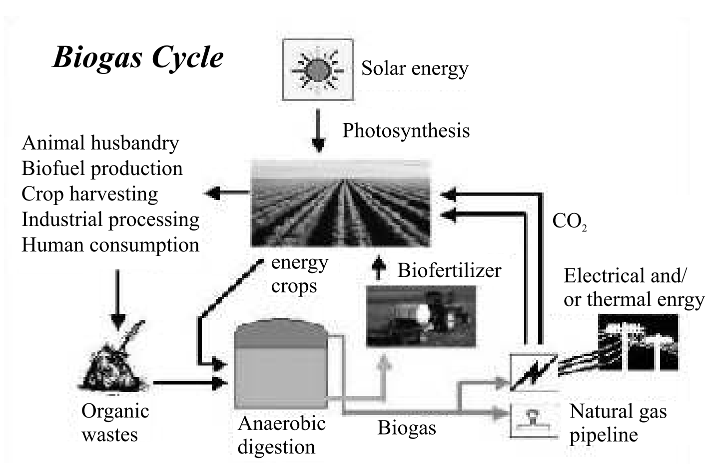

Figure 1: Biogas Production through agricultural waste

3. WEALTH FROM AGRICULTURAL WASTE

Waste collected from different agricultural activities is biodegradable and can be converted into organic fertilizers, organic pesticide production. Through waste management technologies, all types of agricultural wastes could be converted into useful products such as it can be utilized as fuel for heat and power generation. In the sugar industry, the waste product such as bagasse (waste generated after extraction of sugar) is an excellent fuel source. The waste from rice i.e. rice husk can be incinerated in boilers and can be used for heat and power production.

3.1 USE OF STRAW WASTE

There are various cereal crops such as wheat, rice, barley, oats, etc, which produces straw as a waste product. This straw can be used as a fuel source, bedding for livestock's, fodder and making baskets. In the cultivation of mushroom, straw can be used as a nutritional source and provide self-employment and good income source.

3.2 BIOGAS PRODUCTION

Biogas is produced from the fermentation of organic biomass and biogas is a flammable gas. It is generated through anaerobic digestion of organic waste such as agricultural waste, biomass, manure, sewage, municipal waste, and plant materials, etc.

The biogas is generated by the breakdown of organic material under anaerobic conditions. Basically, biogas generated from agriculture waste comprises mainly of methane (CH_4) 50-80%, carbon dioxide (CO_2) 30-50%, hydrogen sulphide (H_2S) 0.7%, hydrogen (H_2) 0.2%, nitrogen (N_2) 0-1%, oxygen (O_2) 0-1% and carbon monoxide (CO) 0-1%. Biogas can be used as fuel for generating heat for cooking purposes. Biogas can be used to generate electricity that undergoes anaerobic digesters.

3.3 USE OF RICE HUSK

The ash content is very high in rice husk and it contains 92.95% silica i.e. highly porous and light weighed compound. Due to its absorbent and insulating properties, it can be used in many industrial applications such as acting as a strengthening agent in building materials. It is estimated that 5 tonnes of rice paddy produce approximately one tonne of rice husk waste and approximately 100,000 tonnes of rice husk waste is sufficient to run a 10 MW power plant efficiently.

3.4 COMPOSTING

The organic portion of agricultural waste such as plant leaves, grass, food scraps, etc undergoes microbial decomposition called the composting process. Through this process, all the organic matter can be recycled with the help of microorganisms such as bacteria, fungi, and actinomycetes and after decomposition, it produces a black colored product called compost **(Fig. 2)**.

This humus like end product i.e. compost is rich in nitrogen (N), phosphorus (P), potassium (K) and carbon (C). In addition to it during this process, methane (CH_4) gas is also evolved that can be captured and used in producing electricity. Composting is a very safe, cheap and eco-friendly process that can reduce the quantity of organic agricultural waste very efficiently. This compost when applied to the fields, enhances the water holding capacity of the soil and makes the soil more porous and healthy.

3.5 VERMICOMPOST

Nowadays the vermicomposting process is the choice of farmers. It is a type of composting process but vermicomposting earthworms are used **(Fig. 3)**. These earthworms help in the decomposition of organic matter and also enhance the rate of the decomposition process.

For the composting process, approximately 45-50 days are needed for complete decomposition of the organic matter, while the same process takes place in just 25-30 days and the worm casting possess more nutritional value in comparison to compost. Vermicomposting is an aerobic process, in which no hazardous gas is produced. So, it is an eco-friendly and environmentally sustainable process.

4. AGRICULTURAL WASTE MANAGEMENT SYSTEM (AWSM)

Agricultural waste management system (AWSM) is a burning issue for sustainable agricultural nowadays for policymakers (Hai and Tuyet, 2010). The major objective of an agricultural waste management system is to manage or dispose of the agricultural waste in such a way that it becomes free from contaminants and not pollute the air, water, and land resources along with its transmission.

Figure 2: Compost Production through agricultural waste

Figure 3: Vermicompost production through agricultural waste

If organic waste (manure) left untreated, it can result in significant degradation of soil, water, and air quality. Agricultural waste also provides a good source for the breeding of flies and mosquitoes through which various kinds of diseases can be transmitted. Uncontrolled degradation of organic waste produces huge amounts of toxic gases such as ammonia (NH_3) and carbon mono oxide (CO) etc, which after volatilization leads to acid rain (Wright, 1998).

To meet the drawbacks of agriculture waste, Department of Agriculture in the United States developed a well-managed system (AWSM) that controls and utilized various agriculture waste and its by-products in a planned manner that maintain and increase the quality of air, water, soil, animal and plant resources (USDA, 2012). There are six major objectives of AWSM i.e. production, collection, storage, treatment, transfer and utilization (USDA, 2012) (Fig.6). The nature and quantity of agriculture waste generated are called production. The process of gathering the agriculture waste from different sites is called collection. The storage function has to do with holding agricultural waste. The waste management system should recognize the storage period, storage volume, type, size, location and cost of the storage facility. The treatment process can be designed to reduce the pollution or toxic potential of the waste along with physical, biological and chemical treatment and increases its potential use. Transfer means movement and transportation of the waste throughout the system from the collection to the utilization stage either as a solid, liquid or slurry form. Utilization is the last step of this process in which agricultural waste is recycled for beneficial use (USDA, 2012).

4.1 THE '3R' APPROACH TO AWM

The '3R' concept refers to minimizing the quantity of waste along with awareness of its ill effects. The generation of agriculture waste can be minimized by adopting the '3R' approach by reducing, reusing, and recycling resources. The '3R' approach directed to reduce waste generation by-

(I) Selecting the items with care to minimize the production of waste materials.
(ii) Reuse the items or part of items that can have useful properties.
Waste can be used as such.

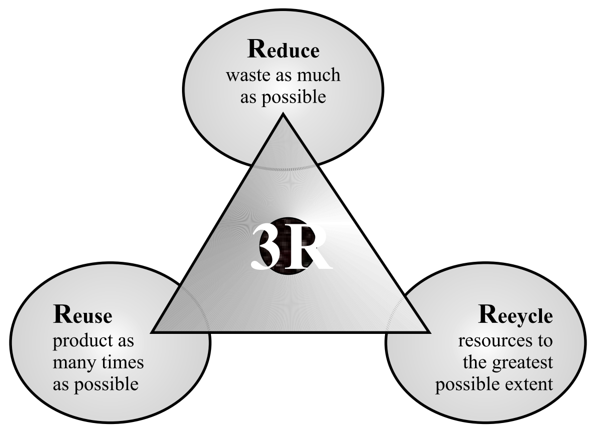

Figure 4:'3R' Approach to handle agricultural waste

A decline in waste generation can be achieved by using the '3R' approach in a sequential manner i.e. reduce, reuse and recycle (Fig.4). The major objectives of this '3R' approach are to achieve maximum benefit from the product and generate less amount of waste. The '3R' approach is conventionally expressed through a pyramid hierarchy in which an increase in environmental benefits of each approach is placed from bottom to top **(Fig. 5).**

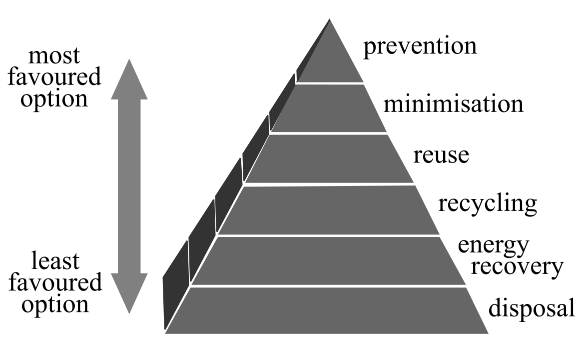

Fig 5: Pyramid hierarchy of '3R' approach

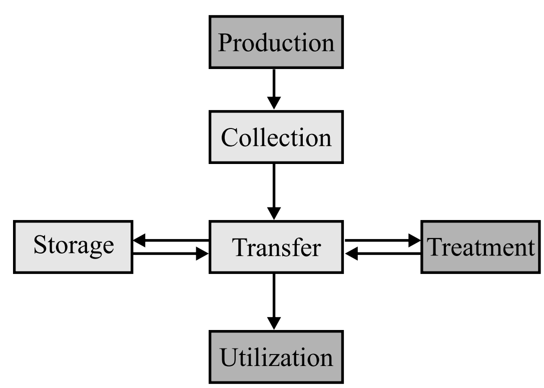

Fig.-6: Major objectives of AWSM

5. CONCLUSION

Agriculture waste is generated from various cultivation practices and these residues may have the potential to generate valuable products that are beneficial for human beings. These cultivation practices may include livestock production, cultivation, and aquaculture. The agriculture waste can be managed properly by using the '3R' approach and converted into useful products that can be used for human welfare and sustainable environment. It is important to note from the findings so far those proper waste collections, storage, treatment, transfer, and utilization is a panacea to a healthy environment. Proper waste utilization will assist in developing our agricultural sector and provide a viable biofuel resource.

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