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THE EFFECTS OF TOXIC AGRICULTURAL WASTES ON THE ENVIRONMENT AND THEIR MANAGEMENT

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Abstract

Agricultural wastes are non-product outputs of production and processing of agricultural products that may contain material that can benefit man but whose economic values are less than the cost of collection, transportation, and processing for beneficial use. Estimates of agricultural waste arising are rare, but they are generally thought of as contributing a significant proportion of the total waste matter in the developed world. Agricultural development is usually accompanied by wastes from the irrational application of intensive farming methods and the abuse of chemicals used in cultivation, remarkably affecting rural environments in particular and the global environment in general. Generally, agricultural wastes are generated from a number of sources notably from cultivation, livestock and aquaculture. These wastes are currently used for a number of applications through the '3R' strategy of waste management. Agricultural waste management system (AWMS) was discussed and a typical waste management options for a poultry farm was also described using the six agricultural waste management functions. Agricultural waste has a toxicity potential to plant, animals and human through many direct and indirect channels. The effects of these toxic agricultural wastes on the environment were discussed as well as their management.

Keywords: Agricultural Waste, Generation, Management, Utilization, Environment, Health.

Introduction

The leftovers from growth and generation of raw agricultural products like crops, meat, poultry, dairy goods, fruits and vegetables are known as Agricultural wastes. They are non-product crops of the processing and production of agricultural products. They might comprise of the material which can be profitable for people but their economic values are not more than cost of gathering, conveyance and processing. They could be in shape of slurries, solids or liquids and their composition would rely on system and the kind of agricultural actions. Also known by the name of agro-waste, Agricultural waste consists of the animal waste (dead bodies of animals, dung), food processing waste (just 20% of total maize is preserved while 80% is waste), crop waste (sugarcane bagasse, corn stems, scraps and drops from the fruits and vegetables, cropping) and the poisonous agricultural waste (pesticides, herbicides, insecticides) [1]. It is not often that the approximations of agricultural waste occur and yet they are considered as an important benefactor of total waste matter in the developed world. Intensified quantities of the cattle waste, agricultural crop waste and agro-industrial derivatives are the outcomes of the increasing production of agriculture. If the developing nations keep on strengthening the farming systems then there is a probability of a remarkable growth in the agriculture wastes worldwide. An approximated is made that nearly 998 million tonnes of agriculture waste is generated annually. Organic waste are about 80% of total solid waste produced in any farm of which the dung production can be 5.27 kg/day/1000 kg live weight, on a wet weight basis [2].

Agricultural Waste Generation

As it was also seen before, the agricultural development often comes together with the wastes from baseless implication of concentrated farming techniques and exploitation of the chemicals used in agriculture which have an effect on the rural atmosphere and global atmosphere [3]. Waste processed relies on the kind of agriculture actions implemented.

A. Wastes from Cultivation Activities

The tropical climate is the reason for the insects and weeds even though it is beneficial to grow crops. A high requirement of pesticides occurs due to this so that the insects can be diminished and the diseases can be averted. Such requirement always leads to the exploitation of pesticides by the farmers. After the pesticides are used, almost all the bottles and packages in which pesticides are filled are dumped in the ponds. Around 1.8% of the chemicals stay in the packaging as per the estimation by Plant Protection Department (PPD) [4]. Unexpected ecological outcomes like food poisoning, hazardous food hygiene and polluted farmland can occur because of these wastes as they are the long-lasting and poisonous chemicals. The inactive or unexploited pesticides and packages with the waste from original fillings lead to the severe ecological outcome. They can be preserved or buried in an improper way which might leak via the osmosis and thus have an influence on environment. Fertilizers have a significant part to

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perform in the agricultural production, which is to preserve the efficiency and quality of plants. Inorganic fertilizers are not much costly and are regarded as high efficiency. There are number of farmers who make use of more fertilizers than the actual amount required by plants. To grow the yearly agricultural output, more fertilizers are used than the actual requirement which can prove to be a dangerous outcome [5]. Absorption rate of these fertilizers compounds such as nitrogen, potassium and phosphorus is different and it relies on the features of land, kinds of plants and the fertilization technique. If more fertilizers are uses, then some part is preserved in soil, some part goes in the rivers, lakes or ponds; some part goes into the ground water and some part just vanishes or turns de-nitrated which leads to air pollution.

B. Wastes from Livestock Production

In the cattle activities, the waste comprises of solid waste like dung and organic materials in abattoir; wastewater like urine, cage wash water, wastewater from bathing of the animals; from keeping cleanliness in the abattoir; air pollutants like H2S and CH4 and odors [6]. Thus cattle activities lead to severe issue of pollution as most cattle are constructed nearby the residential areas. The air pollution comprises of the small coming from the cages which comes from digestion of the cattle waste; decay procedure of organic matter in dung; animal urine or the unwanted food. Intensity of smell can come because of various reasons such as animal thickness, drying process, temperature and moistness. Proportion of NH3, H2S and CH4 keeps changing as the phases of digestion procedure keep changing. The proportions also rely on the organic materials, food mechanisms, microorganisms and animal's health condition. This waste which is unprocessed and cannot be reused can produce the greenhouse gases and also lead to the negative outcomes on soil fertility while giving birth to the water pollution. Quantity of the water is 75-95% of the total quantity in the cattle waste whereas the remaining comprises of inorganic and organic matters, numerous kinds of microorganisms and insect eggs [7]. The people can face diseases because of the germs and those matters while effecting our environment at the same time.

C. Waste from Aquaculture

Growth in the usage of foodstuff for the enhance production is seen because of the increase in aquaculture. The most significant aspect in calculating the volume of waste processed is by calculating the amount of food used in system. Use of the aquaculture feeds generates waste and it is described in detail here along with a short review of the information. Metabolic waste is one of the primary wastes processed in the aquaculture which has the ability to be deferred or dissolved. Around 30% of feed used turns to the solid waste in a farm which is correctly managed [8]. Feeding rates rely on ambient temperature. The growth in the temperature leads to the growth in feeding and it thus the growth in processed waste is seen too. For the waste management, water flow structure in the production units is essential as the appropriate flow would reduce fragmentation of fish excrement. It can be dangerous as high amount of non-fragmented excrement can be seized rapidly and it will significantly decrease the dissolved organic waste.

Waste Utilization Routes

The agricultural waste utilization technology should exploit the leftovers as quick as possible or preserve them in the situation which does not lead to decay or makes the leftovers unfitting for processing to desired finished product. Numerous applications are there for which such leftovers can be exploited and they are:

A. Fertilizer Application

Animal excrement usage for the fertilizer has a positive influence on the input energy necessities at farm level. With the help of excrement, we can witness 19% of nitrogen, 38% of phosphorus and 61% of potassium in the chemical fertilizers [9]. The fertilizer usage of the composts from large incarceration is related with high energy costs for carriage, supply, storage facility necessities, smell issues and the groundwater pollution. It was stated that the composts from the poultry comprises high amount of phosphorus and it has a positive impact on progress and efficiency of crops. It is mixed with mineral phosphorus fertilizer for the farm use, it is even more efficient. If we mix poultry composts with soil, the fertility can witness a growth as nutrient retention ability enhances physical situation, water-holding ability and soil structure balance.

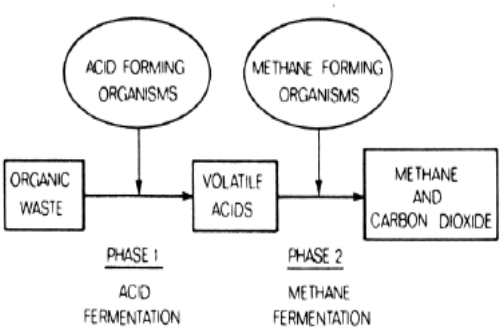

Figure1: Methane production by two-stage microbial fermentation

B. Anaerobic Digestion

Agricultural wastes can be the reason of production of methane gas, especially the composts. Methane gas is useful for heating such as broiler procedure, water heating, grain-drying, etc. Anaerobic digestion of the agricultural waste to create the methane gas is a two-step microbial fermentation. At the beginning, the bacterium which forms the acid breaks down unstable solids into the organic acids and then they are used by methan-ogenic organists to harvest the methane-rich gas. The gas which is generated, its components are: methane, 50-70%; CO2, 25-45%; N2, 0.5-3%; H2, 1-10% and indications of H2S; heating value of gas comes in scale of 18-25 MJ/m3 [10]. There are primary cons of digestion system and they are: high capital costs and volatile properties of methane gas. There are many benefits too and they simply overshadow the disadvantages. Anaerobic digestion leads to the Management and dumping of large poultry, practicality of swine and diary waste, reduction of smell issue. Because of it, the waste is balanced properly and digestion mud has comparatively no smell but it still preserves fertilizer value of original waste.

C. Adsorbents in the Elimination of Heavy Metals

There has been a huge universal issue due to the disproportionate release of heavy metals in environment because of growth and industrial development. Most of the organic pollutants are vulnerable to biological degradation but unlike them, the heavy metal ions like mercury, zinc, copper, cadmium, chromium do not lower to nontoxic finished products. Because of too much poisonousness, presence of heavy metal ions is a significant issue [11]. There have been researches regarding the treatment of the heavy metals which releases waste and it was seen that the adsorption to a highly functioning method for elimination of heavy metal from waste stream and activated stream is implied universally. In the past few years, it has been proved that agricultural wastes are cheap substitute for treatment of waste which comprises of heavy metals via adsorption procedure. The numerous researches have studied about cheap agricultural waste like rice husk, coconut husk, neem bark, oil palm shell, sugarcane bagasse, etc. for removal of heavy metals from the wastewater.

D. Pyrolysis

If there is no oxygen, agricultural waste is heated to a temperature of 40-600°C to evaporate a part of material which leaves burn behind; this process is called pyrolysis system. Pyrolysis system is regarded as a high technology process for use of agricultural wastes while the others are hydro-gasification and hydrolysis. Those two are used to formulate the chemicals from the agricultural waste and for the recuperation of energy.

E. Animal Feed

There is only limited number of protein sources available in almost all developing nations which is quiet an issue but there are attempts being made so the optional complements can be found as soon as possible. There is high fiber content in the crop remains and they are also low in fat, protein and starch. Thus the conventional technique of growing the cattle production by expanding the feeds and fodder with grains and protein concentrate might not match the expectations of meat protein in the future. The usage of protein and grain for the food of human will race with usage of protein and grain for animal feed. There is a possibility to avoid these issues by making use of the leftovers to feed the pet animals.

F. Direct Combustion

Burning the agricultural waste as the fuel is an ancient biomass transformation method. The thorough combustion of agro-waste comprises of quick chemical reaction of oxygen and biomass, discharge of energy and concurrent creation of oxidation products of organic matter like CO2 and water [12]. Energy which is discharged is often in form of radiant and thermal energy given that the oxidation arises at the adequate degree, amount of which is a function of enthalpy of biomass combustion. The biomass wastes need to be devised if we want agricultural waste to be used productively via the thermal conversion procedure. Biomass waste is often flamed for production of charcoal, steam generation, mechanical application, electric power applications, cooking and heating. There are many procedures which can help transform the agricultural waste into the energy or fuels, among all of them, combustion is widely accepted procedure as it accounts for more than 95% of biomass energy used at present.

Agricultural Waste Management System (AWMS)

For the policy makers, lately there has been a problem in the form of agricultural waste management (AWM) for the environmental agriculture and maintainable growth. Wastes should be regarded as the possible resources instead of being considered as detrimental. If the wastes are considered as resources then there is a possibility to avert the air, water and land pollution and the spreading of toxic materials. Use of superior technology and inducements, change in the viewpoint and better tactics for the agricultural waste management are required. Organic wastes and the composts produced by animals can lead to

remarkable degradation in quality of air, water and soil if they are not handled or treated [13]. A channel is provided by the immobile wastes where the insects are born and the diseases are spread. Scented gases along with the ammonia volatilization are generated if the organic wastes not decayed properly which causes the acid rain. As there is growth of animal production on a small area of land, the issues keep growing too, such as:

- Greater filling of nitrogen and phosphorus leading to the quality of water;
- Composts consisting of pathogens and antimicrobial compounds;
- Releases of ammonia, nitrous oxide and methane causing the release of filthy smell and air quality;
- Soil quality due to the filling of potassium and phosphorous.

Agricultural Waste Management System (AWMS) is a strategic system where all the required elements are positioned and handled so the derivatives of agricultural production can be controlled and use in a way that preserves or improves air, water, plant, soil quality along with animal resources. With the help of total systems technique, such system is created. It is made to provide for all the waste related with the agricultural production to the use in the whole year. Concentration of Total Solids (TS) of the agricultural wastes is a primary feature which controls the material handling. To take an instance, for the defecated compost, the aspects which have an influence on TS concentration are type of animal, atmosphere, volume of water consumed by animal and the type of food. Uniformity of waste can be predicted or ascertained in most of the systems. If the beddings or other solid waste are added, then the TS concentration of waste can see a growth. On the other hand, if the water is added, it can be reduced. If we have to balance it, then there is no need to add the extra amount of water. TS concentration is necessary as it has an impact on the total amount of waste to be treated. The liquid waste management systems are always comfortable to systemize and handle in comparison to the solid waste management systems but the cost of liquid handling tools might be more than the cost of solid waste management systems [14].

Six basic functions are comprised in AWMS and they are: production, collection, storage, treatment, transfer and utilization. Production is a function of volume and the kind of agricultural waste processed. If the volume generated is adequate to turn into a resource issue, then the waste needs management. Complete analysis of production comprises of type, uniformity, amount, place and the timing of waste generated. Collection means the collection of processed waste in the beginning i.e. from the installation. It is necessary that AWMS plan should recognize the technique of collection, place of where the collection was done, preparation of collection, the efforts and tools required for collection, treatment and the connection charges of elements and the effect which collection has on waste uniformity [15]. Somewhere the storage function is responsible for brief suppression of waste. Storage provision of waste management system gives the control over scheduling and timing of system functions like the management and the implication or usage of waste that can have an impact by the climate or can be interrupted by other functions. There are few things which waste management system should recognize and they are: storage tenure, storage capacity needed, kind, predicted size, place, fitting charges of storage provision; management cost of storage procedure and influence of storage on waste uniformity.

Treatment is always done to decrease the volume of pollution or the hazardous waste comprising of physical, biological and chemical treatment and increase the possible valuable usage. The treatment comprises of the pre-treatment tasks like the review of features of waste, calculation of the wanted features of waste, choosing of the kind, predicted size, place and connection charges of treatment provision and management charges of treatment process. The Transfers means the interchange or the carriage of waste in the whole system ranging from the collection to the utilization phase, be it solid, liquid or slurry, depends on TS concentration. Utilization refers to treatment of waste for our advantage and it comprises of recycling reusable waste products and restoring non-reusable waste products in the environment. The usages of the resources enhance the worth of the resources which are already used along with reducing the waste quantity and negative influences. Rule of decreasing the waste and reusing and recycling the resources has a goal to obtain the productive minimization of waste generation by:

- Selecting to carefully use the products so the volume of waste processed can be decreased
- Frequent exploitation of the products or its parts which still are somehow useful
- Use of waste as resources

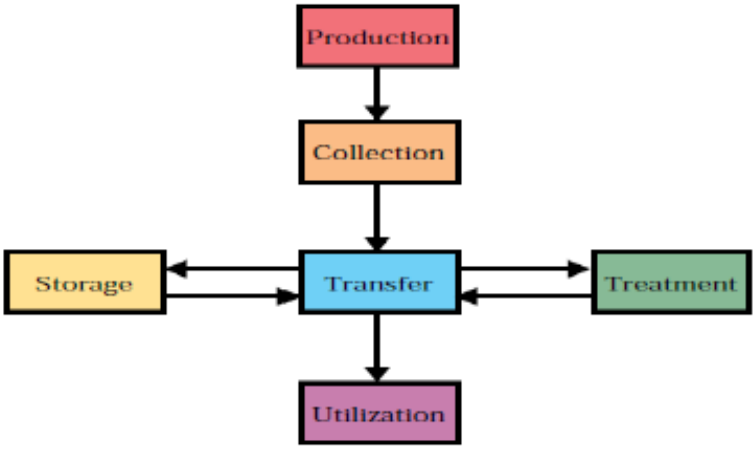

Figure 2: Agricultural Waste Management Functions

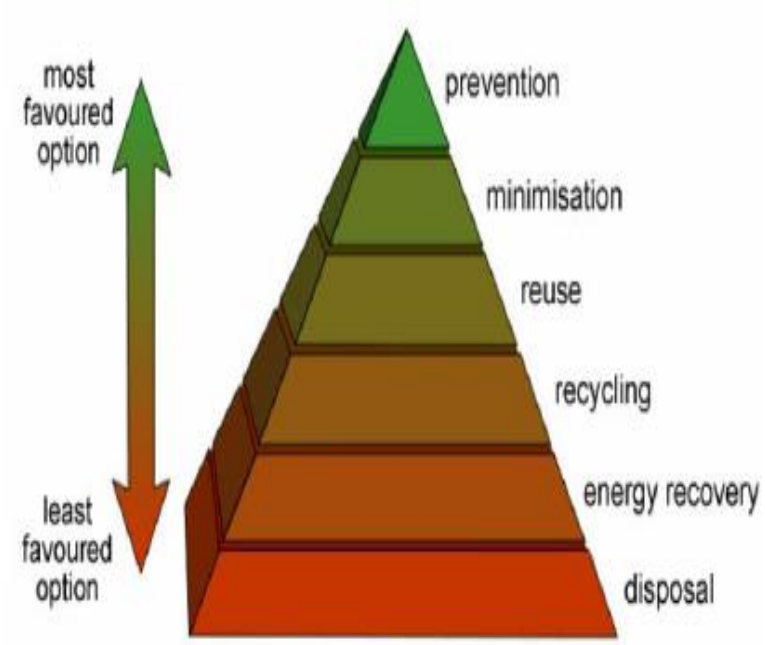

Figure 3: The 3Rs Hierarchy

A. The '3R'Approach to AWM

Idea of reducing the waste decreases the volume and the negative impacts of the waste generation by reducing the waste volume, reusing waste items with basic managements and recycling wastes by using them as resource to generate the same goods or even a little bit altered. The idea is often denoted as "3R". There are a few waste goods which can be used as the resources for the manufacture of different products or even the same one, which would mean the recycling of resource. When we reuse the wastes every time, it balances the harvesting of the new products. It leads to the savings of use of new resources thus decreasing the waste generation.

B. The 3R Hierarchy in AWM

The waste minimization can be productive if the 3Rs are implied in the hierarchical order which is Reduce, Reuse and Recycle. 3Rs are reduce, reuse and recycle that categorize the waste management strategies as per the need. 3Rs are a chain of command in the order of their significance. In the last ten years, waste hierarchy has taken numerous forms but basic concept has stayed as groundwork of many waste minimization approaches. 3R

technique is traditionally conveyed with the help of a pyramid hierarchy where the growth of ecological advantages of every tactic is located from the bottom to the top.

C. Typical Poultry Waste Management Options

To explain a waste management system, use of poultry farm is done which displays the usage of function of every element of an AWMS. Complete view of numerous waste management alternatives for the poultry production can be seen in Figure 4.

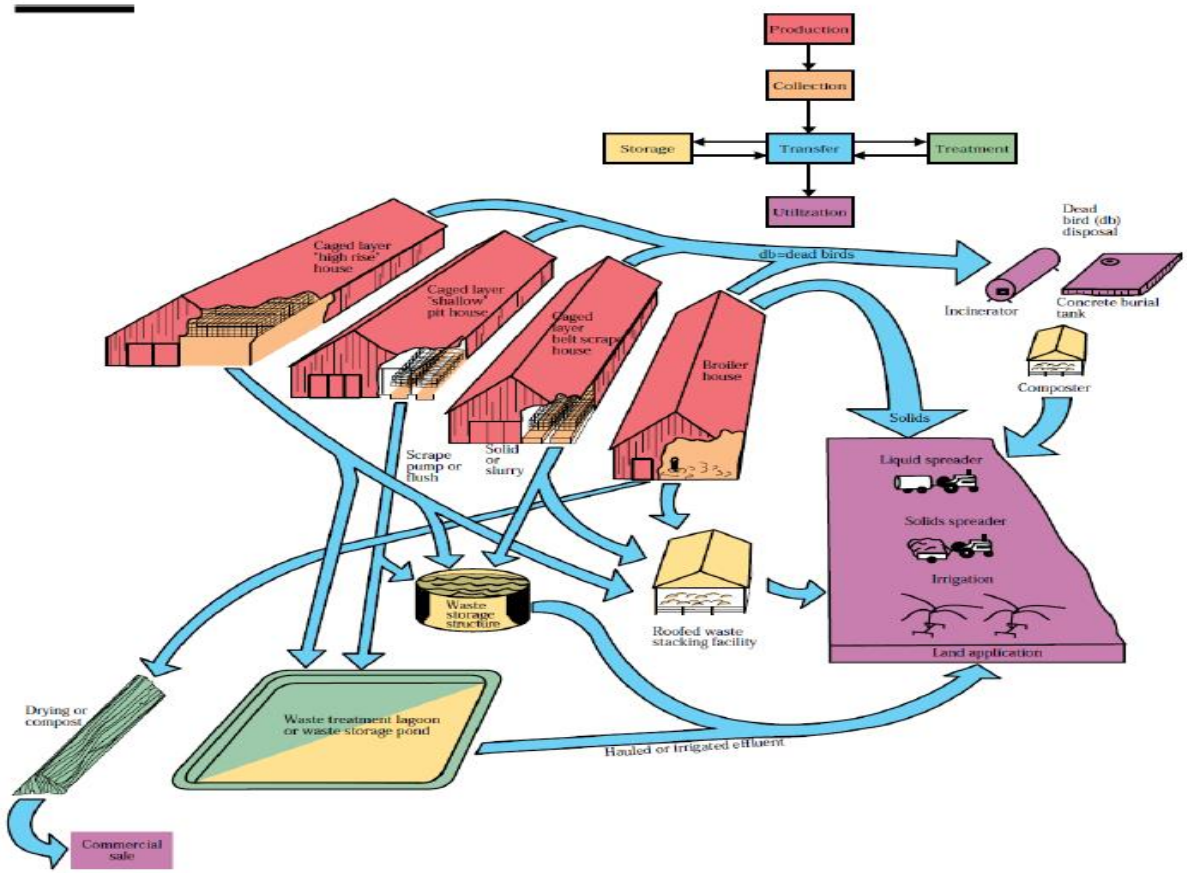

Figure 4: Poultry Waste Management Options

A. Production: Wastes associated with poultry operations include manure and dead poultry.

The waste can comprise of the garbage, wash-flush water and waste feed, which relies on the system.

B. Collection: Compost from the poultry processes can be gathered on floor and then mixed with garbage.

A cake is created from the compost garbage combination and it is usually eliminated between the flocks. To avert the transfer of disease between flocks, garbage pack can be eliminated regularly. The compost in the layer houses which falls under the cage is gathered in deep stacks or it is eliminated regularly with the use of shallow pit that is situated under the cages for flushing or scraping or belt scrapers situated under cages.

C. Storage

The garbage processed from the processes of poultry is gathered on floor of housing facility or the outside of housing facility. When the garbage is confiscated, it can be carried to field for the land application. Litter might be compressed in the load in few situations and preserved in open for limited period. It is better if the compost is covered with a waterproof cover until the time we have to actually make use of litter. Litter should be preserved in roofed facility if it has to be preserved for long time. If the compost from the layer procedures is stored as rationally dry, it can be preserved in roofed facility otherwise it is necessary to preserve it in a structural tank or earthen storage pond.

D. Treatment

Composition of poultry litter can be done and it alleviates the litter into a comparatively unscented form. It also assists in eradicating the disease organisms so the littler can be used again as the bedding or supplemental food to cattle. We can also dry or burn the litter. Liquid compost can be put in an aerobic digester so the methane gas can be generated.

E. Transfer

Technique which is used to transfer waste relies on total solid content of waste. Liquid waste can be transported in gutters or pipes whereas dry litter can be worn out, loaded and towed as solid and carried with the use of trucks.

F. Utilization

Poultry waste can be used for agricultural land application or it can even be marketed because of its high nutrient value. Production of methane gas is also done with the help of poultry waste. It can be buried as a fuel, reused as bedding or it can also be used as food add-on to the cattle.

Conclusion

The agricultural wastes are remains of developing of raw agricultural products. The raw agricultural products are non-product outputs of production and processing which might comprise of the material which can be useful to people. Numerous activities of agriculture can generate these remains and the activities are: farming, cattle production and aquaculture. When these wastes are treated carefully with the help of knowledge regarding the agricultural waste management systems like 3Rs, they can be converted to useful materials for the human and agricultural use.

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