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MANAGEMENT OF POULTRY WASTE: A STRATEGY FOR SUSTAINABLE DEVELOPMENT

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Abstract: The Indian poultry industry has experienced phenomenal expansion since the late 1970s. States in South and West India have taken the lead in this area. According to the 19th Livestock Census from 2012, there are 729.2 million birds in India, which is a significant increase from the country's population of 73.5 million in 1951 and a growth rate of 21% each year in the grill industry alone. Poultry is one of the livestock species that is raised the most intensively and provides significant quantities of animal protein to the world. They frequently provide some environmental threats to both human and animal lives through water/soil and air pollution, in spite of their enormous socioeconomic advantages in terms of the production of eggs, and meat. These wastes include, but are not limited to, litters, on-farm fatalities, avian faces, and waste from hatcheries. These wastes cause severe environmental issues if they are not utilized properly. Due to their abundance in keratin proteins and amino acids, poultry feathers may be used to make important goods including feather meal, biodiesel, biodegradable plastic, and fertilizer. Additionally valuable as a source of fertilizer, methane, and power is poultry dung. This review goes into great length about the potential for using various poultry wastes. A lot of poultry waste is produced. The trash can still be recycled into valuable items, but cost-effective solutions have not yet been discovered.

Index Terms **-** *Poultry, Environment, Waste, And Biofuel*

1. Introduction

The poultry business is expanding quickly globally and helps to achieve important national development goals as well as raise people's standards of life by reducing poverty and opening up job opportunities. Said that the manure issue associated with chicken farming has to be addressed since improper handling or disposal of the manure poses a harm to the environment and individuals. For instance, if manure is not handled appropriately, it may contribute to the spread of illnesses and contaminate soil and groundwater resources. Anything that is no longer usable and needs to be rid of is considered waste. Additionally, garbage may be categorized based on the kind of production it is and the location, such as agricultural, domestic, industrial, and mining. Large volumes of wastewater and solid waste are produced by the chicken business. The solid waste is made up of bedding materials, excreta (manure), feed, feathers, shells, sludge, slaughterhouse waste (offal's, blood, feathers, and condemned corpses), mortality, and hatchery trash (empty shells, infertile eggs, dead embryos, and late hatchlings).

2. Classification of poultry waste

Given that they are the main source of environmental degradation, the following waste products from chicken farms require special attention:

- **a)** A chicken feather
- **b)** Chicken offal
- **c)** Chicken litter and manure

3. Poultry Feather

3.1 Composition

Chicken feathers include 91% protein (keratin), 1% fats, and 8% water as nutrients. A chicken feather's amino acid makeup is the same as that of other feathers, and it has a lot in common with the keratins that make up reptile claws. In the order of amino acids, cystine, glutamine, proline, and serine are the main amino acids. But histidine, lysine, tryptophan, glutamic acid, and glycine—all essential amino acids—are missing. Serine (16%) is the most common amino acid found in chicken feathers. [1] The stratum corneum contains keratins, which are insoluble proteins also present in feathers, wool, hooves, scales, hair, and nails (hard keratins). Scleroproteins are a subclass of proteins that are remarkably resistant to biological, chemical, and physical influences. The mechanical stability and high resistance to proteolytic degradation of keratin are due to disulfide bonds, hydrogen bonds, salt linkages, and cross links. The fibre extracted from chicken feathers mostly has helical and a few sheet conformations. Its outer quill is almost entirely made up of β- sheet conformations and few α- helical conformations. Hard β- sheet keratins have higher cystine content than soft α- helix keratins and thus a much greater presence of disulphide (S-S) bonds that link adjacent keratin proteins. The three-dimensional protein structure is stabilized by the strong covalent bonds that are present, and they are very difficult to break [1].

3.2 Utilization

3.2.1 Feather meal

Additionally, feathers are processed to create feather meal, which is used as a feed additive, organic fertiliser, and animal feed. Feathers are processed into feather meal because they contain more than 90% protein and are an excellent source of hydrophobic amino acids including cystine, arginine, and threonine. One of the most often used methods to create feather meal is the hydrothermal method, which digests feathers under intense heat and pressure. However, essential amino acids including methionine, lysine, tyrosine, and tryptophan are degraded during hydrothermal processing, which leads in limited digestibility and poor nutritional value [2].

3.2.2 Chemical hydrolysis

When lime (calcium hydroxide) is used to cure chicken feather keratin, a liquid product rich in amino acids and polypeptides is produced that may be added to animal feed. Eighty percent of feather keratin is soluble in 25 minutes at high temperatures (150°C).

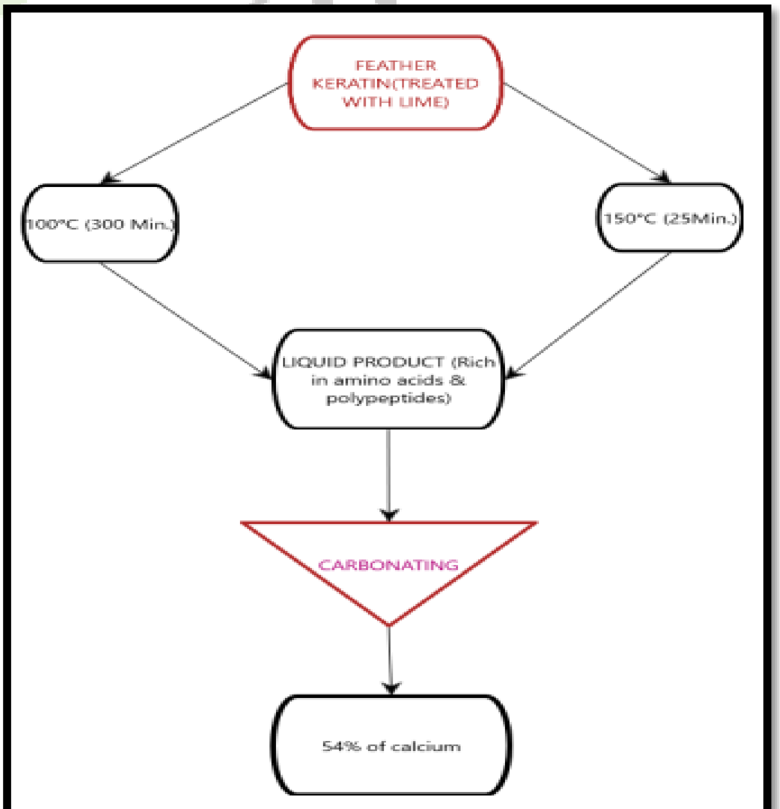

Fig 1: Chemical Hydrolysis of Feather Keratin

However, at moderate temperatures (100°C), a substantially longer reaction time (300 min) is required. 95% of the feather's After 3 hours of hydrolysis at 150°C, keratin is digested. After lime treatment, carbonating at the specified temperatures and times (100°C, 300 min, and 0.1 g $Ca(OH)_2$/g dry feather) can recover around 54% of the calcium. Feeding soluble keratin to calves won't result in ammonia toxicity, according to rumen fluid ammonia production from it, which is substantially lower than that from urea and is equivalent to that from soybean and cottonseed meals [3].

3.3 Feather bioconversion

Feather meal is a rare kind of feather debris that is utilised as a nutritional protein supplement. First, it is possible to chemically or steam-cook the feather wastes to make them more palatable, but these processes are expensive. Microorganisms, meanwhile, perform a different function in raising the biovalue of feather wastes. It has already been mentioned that the feather-lysate produced by Bacillus licheniformis PWD-1 is equivalent to soybean protein in terms of nutrition for feed. Feather-degrading bacteria have now been identified from chicken waste, despite the fact that bacterial keratinolytic proteases have the potential for feather bioconversion. Feathers may be broken down by three strains of the bacteria Bacillus subtilis, Bacillus pumilus, and Bacillus cereus, which had 142, 96, and 109 units of keratinolytic activity, respectively. Feathers are necessary for the production of keratinolytic protease in B. pumilus and B. cereus, but not in B. subtilis, which makes the enzyme on its own when casein, feather, and BSA are present. B. subtilis and B. pumilus have maximum keratinolytic activity of 161 and 149 units/ml after 84 and 72 hours of incubation, respectively. Improved enzyme activity and higher yields are required to make them suitable for industrial applications. [4]

Table 1: Feather Degrading Bacteria and Properties

Bacteria Name	Production Of Keratinolytic Activities (IN Units)	Optimum Temprature (Degree Celcius)	Optimum PH
Bacillus subtilis	142	40	5-9
Bacillus pumilus	96	40	5-6
Bacillus cereus	109	30	7

3.4 Bio diesel

Abattoir wastes, such as feathers, blood, and internal organs, are processed and utilised as fertiliser or sources of high-protein animal feed because to their high nitrogen concentration. Estimates place the amount of fat in these wastes at up to 12%. Animal fat was effectively separated by University of Nevada researchers, who then created biodiesel that was comparable to that manufactured from other feedstocks. Environmentally friendly methods may be used to turn feather meal into biodiesel. Feather meal must first be rendered fat-free in boiling (70°C) water before being trans-esterified with potassium, nitrogen, and methane to create 7-11% biodiesel (on a dry basis). Feather meal biodiesel is better to that generated from other common feed components, according to an ASTM research.

3.5 Technical textiles

Cheap chicken feathers are used to make the nonwoven. The use of chicken feathers in the textile industry has many benefits. The nonwoven textile products made from chicken feathers are incredibly adaptable and have several uses in the industry of technical textiles.[5]

3.6 Biodegradable plastic

Fig 2: Formation of Biodegradable Plastic

Chicken feathers are also converted into biodegradable polymers through a process called polymerization. This technique involves grinding feathers that contain keratin proteins into a fine dust. When keratin molecules are linked together chemically, lengthy keratin strands result (polymerization). When heated to 170°C, it may be further sculpted into a variety of forms. Furniture, plastic plates and cups, and other things may be made with these thermoplastics.

3.7 Fertilizer

A slow-release nitrogen fertiliser is made from chicken feathers. In this process, the structure of the keratin fibres is changed by steam hydrolysis for a period of 12 weeks to break disulfide bonds, enzymatic hydrolysis by Bacillus licheniformis to break polypeptide bonds, steam hydrolysis (autoclaving) to improve mineralization, and protein cross-linking by a formaldehyde reaction to lessen excessive mineralization [6].

4. Poultry

Offal Blood, feet, heads, bones, trimmings, and organs are among the organic solid wastes and byproducts that are created during the raising and killing of broilers. Offal has 0.6 to 0.9% methane generation potential, 32% proteins, 54% lipids, and 5.3% of the total Kjeldahl nitrogen[7].

4.1 Micro flora

More than 100 different species of bacteria, including harmful pathogens like Salmonella sp., Staphylococcus sp., and Clostridium sp., are present in infected feathers, feet, intestinal contents, and processing equipment from chicken. According to the Ministry of Agriculture and Forestry (2000), Finnish beef products have considerably lower pathogen levels. For instance, in 1997, grill and turkey meat from slaughtered flocks and meat from cutting facilities, respectively, had positive Salmonella test findings ranging from 0.6% to 3.1% [8]. Comparatively, in the US, 60-80% of birds had Campylobacter contamination, which comes in a variety of types that are resistant to common treatments, and 30% of chicken products had live Salmonella contamination.

4.2 Residues

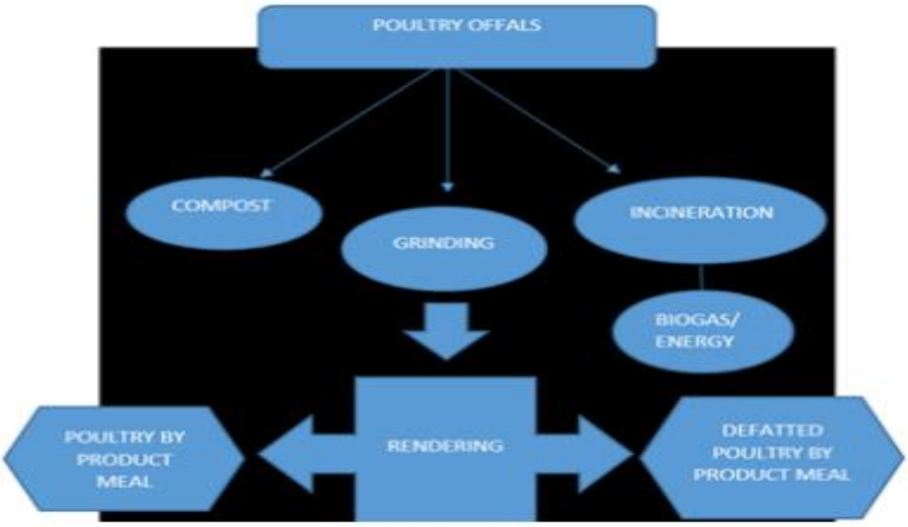

Fig 3: Poultry Offals Utilization

Additionally, a number of medications, heavy metals, and other substances that are added to bird food for nutrient and medicinal reasons can accumulate in birds. Furthermore, different concentrations of veterinary drugs and other chemical contaminants have been discovered in chicken. For instance, zinc and copper concentrations in chicken diets vary from 28 to 534 mg/kg TS in England and Wales, respectively. However, copper and zinc levels in chicken dung are 400 and 80 mg/kg TS, respectively [9]. In Israel, it was shown that differing concentrations of testosterone and oestrogen were present in chicken litter, which may have an impact on a bird's capacity for reproduction [10].

4.3 Incineration

The term "incineration" refers to thermal annihilation technologies, which are ostensibly one of the most efficient ways to eliminate potentially contagious agents [11]. The gross calorific value of air-dried chicken litter, which is roughly 13.5 GJ per tonne, is nearly half that of coal. It is a recognized combustible solid fuel. High moisture content materials, however, offer little to no energy value. Air pollution, process conditions, and the disposal of solid and liquid byproducts must all be rigorously regulated during incineration.

4.4 Burial and controlled landfilling

To prevent groundwater contamination, the burial of dead birds on the farm must be closely supervised. Under Directive 1999/31/EC, land filling operations, monitoring, and management were also subject to more stringent regulation [12]. Landfills in Europe are required to minimize any negative impacts on the surrounding environment, including contamination of the soil, groundwater, air, and surface water. All of these actions might raise the price of landfilling.

4.5 Rendering

The term "rendering" describes a variety of heating techniques used to render fat from meat. High risk materials used as animal feed or as an intermediary product in the production of organic fertiliser or other derived products must be rendered at 133°C for a minimum of 20 min at 3 bars or subjected to alternative heat treatment. Meat-bone meal, which is created during the rendering process, can be composted or used as fertiliser or animal feed. Rendering also yields fat, which may be utilised as fuel, in chemical industry products, or as animal feed. Because formic acid is a strong source of proteins and vitamins and is used as animal feed, abattoir by-products are stored with it [13]. Finland consumes 370 million kg of fur animal feed annually, more than half of which comes from the meat and fish industries. Finland is one of the largest producers of fur animals in the world. To lessen the danger of disease transmission in the feed and food chain, legislation has tightened its restrictions on the use of slaughter byproducts for animal feed.

4.6 Composting

Composting is a biological process that uses aerobic energy to break down organic matter. Manure, litter, grease trap leftovers, trash from chicken slaughterhouses, and occasionally even feathers are treated using this procedure. Pathogens are reduced during composting, and the resultant compost can be utilized as a fertilizer or soil conditioner. However, high-moisture wastes with low fiber content require more moisture-sorbing and structural support in order to compost properly [14].

4.7 Anaerobic digestion

Anaerobic digestion involves the biological breakdown of organic material into methane. By using methane as a bioenergy source in place of fossil fuels, carbon dioxide emissions can be reduced. In addition to handling wet and pasty wastes, anaerobic digestion uses less acreage for processing and has lower pathogen and odour levels [15]. The method also permits carefully regulated emissions to the air, water, and land. After treatment, the majorities of the nutrients are still in the material and may be collected for use in crops or as feed.

4.8 Methane production

The yield and biological methane generation rate of various poultry slaughtering wastes vary. Rich in proteins and lipids, poultry offal, blood, and bone meal demonstrated substantial methane production at various volatile solids concentrations. Methane was quickly created by blood and bone meal. Offal's slower methane synthesis is presumably caused by the suppression of long-chain fatty acids. The duration is influenced by the source, different inoculum concentrations, and incubation temperature. Granular sludge did not create methane after 64 days of incubation, while sewage sludge at 35oC had the least delay of a few days. In Feather, the addition of volatile solids (50 m3 ton-1 wet weight) resulted in a considerably reduced methane output of 0.21 m3 kg -1. Methane production was improved by 37 to 51% as a result of combined thermal (120oC, 5 min) and enzymatic (commercial alkaline endopeptidase, 210 g 1-1) pre-treatments. The amount of methane production increased by thermal pre-treatments (70-120oC, 5-60 min), chemical pre-treatments (NaOH 2-10 g 1-1, 2-24 h), and enzymatic pre-treatments is only 5 to 32%. The considerable methane output and high nitrogen content (8 to 14% N of total solids) of the poultry slaughter leftovers make anaerobic digestion of these residues seem like a potential option.

5. Poultry Litter Management

Poultry litter also contains manure, feathers, water that has been accidentally spilled, and leftover feed from the production process. The principal biomass source utilised for bedding has a high carbon content, increasing the waste's energy content [16]. The materials used include straw, sawdust, wood shavings, shredded paper, and peanut or rice hulls [17]. Due to its high amounts of plant nutrients, it is an advantageous organic fertiliser that provides plant nutrients including nitrogen (N), phosphorus (P), and potassium (K). The soil's organic content, tilt, and capacity to retain water will all be improved by adding leftover chicken litter to crop soil. However, one of the main risks related to agricultural areas is the imbalance of N and P in chicken manure. In contrast to what plants need, chicken litter has a different ratio of these two nutrients. Although many of the advantageous macronutrients included in costly commercial fertilisers are also present in chicken litter, a soil study is still required to determine the ideal balance of N, P, K, and Ca for the targeted crop [16]. The NPK ratios could not, however, be a perfect match for the soil's nutritional needs. There are many other alternatives for handling litter garbage, including applying it to the ground as organic fertiliser.

5.1 Utilization

5.1.1 Litter re-uses

Reusing litter for successive batches of broilers is one extensively utilized approach in the United States of America for dealing with wasted or used litter. The eventual multi-batch litter makes for an improved compost due to its higher proportion of nutrients from greater proportion of chicken excreta to bedding material in the litter, which comes with the cost-saving benefits of not completely replacing spent litter with new bedding material for each batch. Methods to lower pathogen load developed as part of the Poultry CRC project are available if there are concerns about the spread of disease organisms in re-used litter. The following links will take you to techniques for measuring and deactivating viruses in chicken litter. These consist of the Litter Heat Map model to forecast and optimize temperatures in litter being pasteurized by piling and standard processes for in shed pasteurization of litter between batches.

5.1.2 Poultry waste in livestock feeding

The diets of pigs, lambs, ewes, lactation cows, wintering cattle, and brood cows have all included poultry litter. Most nations utilise poultry litter and/or manure as animal feed [18]. Israel and a few US states are included. The majority of the poultry waste utilised for animal feeding comes from broiler operations and laying hen operations, both caged and uncaged. Animals are also fed with poultry litter. Ruminants can utilise the faeces from cage layers as a source of extra protein. (1997) Chaudhry et al. indicated that the amount of total nitrogen in chicken excrement is between 40 and 60 percent in the form of non protein nitrogen (NPN), with the amount of amino acid nitrogen in cage layer waste ranging from 37 to 40% of total nitrogen. The primary NPN source in poultry, uric acid, is broken down to ammonia by rumen microorganisms. The National Research Council (NRC) (1984) states that ruminant diets can contain chicken manure at a maximum inclusion rate of 20%. According to Crickenberger and Goode (1996), beef cattle diets that contain grill litter at a level of 20% or more (on an as-fed basis) often satisfy the animal's requirements for crude protein, calcium, and phosphorus. The 30% addition of chicken litter to maize silage, according to the researchers, has positive consequences. Additionally, Muller (1980) noted that chicken waste fed at levels exceeding 35% often meets almost all of the protein needs of sheep and makes a significant contribution to the overall ration's energy. The researcher stated that the toxicity caused by the high copper content in chicken diets is the sole issue with feeding processed poultry waste to sheep. When sheep were fed dry chicken waste, soybeans, or urea as winter supplements, Jordon et al. (2002) assessed the body conditions and came to the conclusion that the performance was comparable to that of standard supplements comprising soya bean meal. When Owen et al. (2008) examined the nutritional value of heat-treated chicken litter in Nigeria, they found that the values for ash, dry matter (DM), crude protein, energy, crude fibre, and ether extract were 87%, 20%, 621.41 kcal/kg, 10.40%, and 2.2%, respectively. Additionally, the litter's concentrations of phosphorus, calcium, sodium, potassium, and magnesium were

4.50%, 2.00%, 0.10%, 2.05, and 0.48%, respectively. The researchers came to the conclusion that animal meals might include poultry litter.

5.1.3 Closed-loop systems

A closed-loop system, in which outputs from one industry become inputs for another, is a crucial idea for a waste management. Therefore, a resource or raw material that has a negative impact on the ecosystem and has not been converted into another beneficial product might be regarded as pollution. This criterion is satisfied by land application because trash is converted into plants and soil structure is enhanced by increasing soil organic matter. Before adding trash to the ground, composting it can improve the soil's structure and plant development.

5.1.4 Composting

Organic material is broken down and destroyed naturally by the biological process known as composting. In order to speed up the breakdown process, organic materials' normal aerobic biological decomposition is also being interfered with. The breakdown of organic molecules into carbon dioxide, water, minerals, and stabilised organic matter is carried out by successive microbial populations that work at rising temperatures. Composting garbage is seen as a practical way to cut back on the need for litter by recycling and reusing it. Additionally, composting produces a product that is considerably more suitable for use on land than raw trash. Organic wastes are stabilised and transformed into a product that may be utilised as a soil conditioner and organic fertiliser through a biological process. Composting offers a less expensive alternative for getting rid of biological wastes and other animal-based pollutants, claims Anon (2002). Composting done well is both healthy for the environment and a great way to improve the soil for some crops. Composting's main goal is to increase microbial activity at the cost of the waste product. Thermophilic bacteria must produce their greatest amount of metabolic heat in order to do this. Malone (2005) asserts that in the presence of oxygen (>5%), moisture (4060%), and the right carbon to nitrogen ratio (20:1 to 35:1), microbes will quickly decompose corpses. Compost, water vapour, heat, and carbon dioxide are all byproducts of this process. In the right circumstances, thermophilic organisms will raise the compost's temperature to a range between 57 and 63 oC. Mesophilic bacteria, according to Evanylo et al. (2009), flourish between 25 to 42 °C, while they may endure greater temperatures. Mesophilic bacteria eat the most accessible proteins and carbs. Their metabolic activity boosts the windrow's temperature enough to promote the colonisation of thermophilic bacteria, which thrive at temperatures between 50 and 60 °C. The vast bulk of the bacterial population and many other living things will perish if the temperature increases significantly over 66 °C. According to Anon (2002), the animal takes 2 to 6 months to disintegrate.

5.1.5 Biogas production

Biogas is created by the anaerobic digestion of organic waste and contains around 60% CH_4 and 38% carbon dioxide (CO_2). The remaining 2% is made up of supplied hydrogen, NH_3, and water vapour. Although there are many methods to use CH_4 as an energy source, traditionally it has been mostly burnt directly to generate heat or as fuel for internal combustion engines (Hashimoto et al., 1980). The digester effluent may be used for fertiliser and animal feed additions, however the nutritional content of the effluent depends on the digestion system, operation mode, and collecting method. Studies on the anaerobic digestion of various animal wastes, including chicken manure, reveal that a range of variables influence the formation of biogas. The digestive systems employed by chicken manure systems have been extensively studied and described. According to Smith (1980), the bulk of these systems were designed to operate in the mesophilic region (about 35°C). The net energy produced during digestion ranges from around 60% to 75% of gross output, according to Morrison et al. (1980). Although there is a strong theoretical foundation for anaerobic digestion of poultry manure, which has to be diluted for hydraulic conveyance, there have been reports of operational difficulties. Among the most significant problems are mechanical ones, which include mixing, screening, pumping, piping, scum formation, grit buildup, and others. Additionally, operating the digesters usually necessitates the absence of skilled professionals due to the complexity of the gear. These problems could have an impact on how economically viable biogas production is. Barth and Hegg (1979) found that biogas generation is economically justifiable when the digestion systems are operating at full capacity, even though none of the eight plants they visited were operating at design capacity. Operators' lack of technical knowledge was cited as the primary factor; as a result, the digestive system was suddenly turned off when a problem developed.

5.1.6 Mass burn combustion

One of the waste products from chicken poultry farms [19] is chicken litter, which is a complex source of organic nutrients with an impact on the ecosystem. These wastes can be employed in the production of energy. The percentage of thermal energy produced by broilers and laying hens is higher than that of other farm livestock. The utilization of mass burn combustion, and specifically step-grate combustion systems, is necessary for the most effective and productive conversion of chicken litter to energy [17]. Incinerators designed for this purpose can burn the wastes. After that, the heat may be used to generate power or to heat the buildings. The harm to the environment from the waste gases released from these plants can be minimized by using advanced technology.

5.1.7 Fluidized bed combustion

There are three primary types of fluidized beds used in fluidized bed combustion systems: bubbling, turbulent, and circulation bed types. In all of the designs, primary combustion air is driven from below via a bed of sand inside a chamber that is walled with refractory material. Sand particles get fluidized when the airflow is changed. To circulate the sand back to the bed, cyclones are positioned within the freeboard. The fluidized bed reactor makes it easier for incoming fuel to disperse, quickly

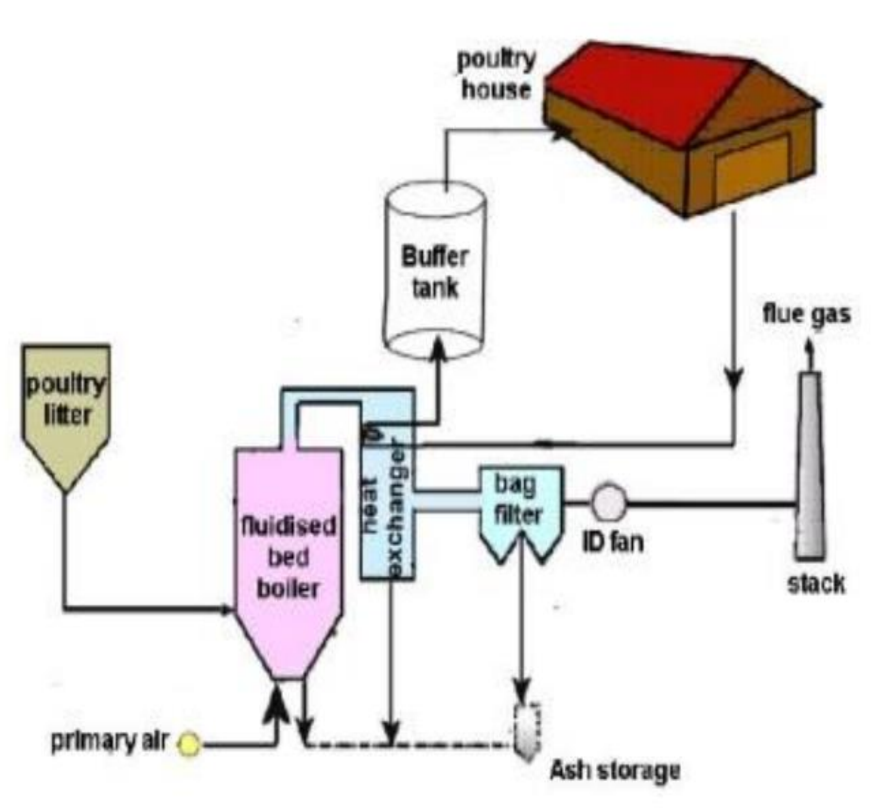

Fig 4: Fluidised bed combustion [21]

heat it to ignition temperature, and give it enough time to stay in the reactor for full combustion. Fluidized beds are small, have high heat storage and transmission rates, and may ignite low-combustible waste more quickly to recover heat. Combustion tests of chicken litter alone or blended 1:1 with peat were conducted in an atmospheric bubbling fluidized bed using poultry litter as an energy resource (combined heat and power) [20]. The study discovered that peat will not need to be added to the combustion as long as the moisture percentage of chicken litter is kept below 25%. This was because of the high moisture content of chicken litter. The collected ashes were subjected to leach ability tests to determine whether or not they could be utilized safely in agricultural regions. Little propensity to leach was revealed by the findings. These experiments demonstrate how chicken litter may be burned directly using fluidized bed technology. For all combustion approaches, it is obviously desirable and worthwhile to investigate ways to reduce moisture content at a reasonable cost. It could be worthwhile to investigate food modification to reduce the moisture level of poultry litter. To examine the impact on the gastrointestinal system and, subsequently, the moisture level of the poultry manure, high moisture barley, which is occasionally used as part of the feed supplied to grill chickens in Norway, was stored under various circumstances. The barley was preserved either aerobically with propionic acid or anaerobically by ensiling with various additions [17].

5.1.8 Direct combustion

By using direct combustion and incineration, which are seen as efficient ways to produce ash appropriate for use as fertilizer and renewable energy from litter, the poultry industry may be able to shut the nutrient loop. There are currently a big number of successful off-site energy companies operating in the UK that mostly burn rubbish for fuel. Smaller direct combustion systems are being researched and developed for on-site power and heat generation; if commercialized, they might provide Australian grill manufacturers energy and waste disposal that is environmentally responsible.

5.1.9 Vermiculture

Vermiculture is the use of specific species of earthworms to decompose waste. This technique is often used by backyard gardeners to recycle their vegetable and plant waste. Vermiculture may produce humic-rich vermi-compost (also known as vermicast) and meat meal (also known as vermimeal) from waste. Vermiculture's primary objective has historically been to produce vermicast, a highly coveted organic fertiliser.

6. Conclusion

If not disposed of appropriately, poultry waste is one of the main pollutants. To increase the nutritional content of feather wastes that may be utilised as animal feed, poultry feathers can be treated chemically or biologically with microorganisms. They can also be spontaneously transformed into organic fertiliser, biofuel, feed additives, and biodegradable plastic. Diverse methods, including as anaerobic digestion, composting, controlled land filling, rendering, and incineration, are employed to utilize the offal. During rendering, meat-bone meal is produced, and it may be utilized as fertilizer or animal feed. Composting lowers the number of pathogens. Compost may improve soil quality or be used as fertilizer. In chicken litter, you may find carbon, nitrogen, phosphorus, chlorine, calcium, magnesium, sodium, manganese, ferrous, copper, and arsenic. This source of fertilizer is quite efficient. Methane gas produced by chicken excrement may be converted into electricity using a novel process. Overall, it is possible to utilize chicken wastes effectively provided they are handled correctly to reduce any harmful effects. It is possible to produce a wide range of value-added goods, including fertilizer, biodiesel, animal feed, power, bone meal, and biodegradable plastic.

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