Popular Article

TRENDS IN AGRICULTURE SCIENCE

Vol.3 Issue 06 June 2024, Page: 2026-2035

Poultry Farm Waste Disposal Management

Dr. J. Shashank[1]*, Dr. N. Rajanna[2], Dr. J. Saikiran[3]
[1] Subject Matter Specialist (Veterinary Medicine)
[2] Programme Coordinator & Head
[3]Subject Matter Specialist (LPM)
Krishi Vigyan Kendra, P.V. Narsimha Rao Telangana Veterinary University, Mamnoor, Warangal - 506 166.
DOI: 10.5281/Trendsinagri.13144803

Introduction

India's poultry sector is currently the fastest growing segment with an impressive growth rate of 12.39%, making it the 3rd largest egg producer and 4th largest chicken meat producer in the world (Thyagarajan *et al.,* 2013). This extensive production scenario is directly linked to the large volume of poultry waste produced by the poultry sector, which needs to be managed responsibly. This large volume of poultry waste includes solid waste and wastewater. The solid waste consists of bedding material, feces, empty shells, feathers, dead embryos, dead chickens, and decaying tissues. Whereas wastewater is the water used for washing incubators, and chick handling areas, from where feces and urine get mixed in the water, besides, blood, sawdust, remnants of drug pesticides, residual acids, and metals (Bolan *et al.,* 2010). A sustainable approach in poultry farm waste management not only neutralizes adverse environmental impacts but also unleashes promising business opportunities through waste recycling and processing. Currently, the major concern in poultry waste management in most developing and under-developed nations is disposing of the waste by burying, rendering, or land filling. Unfortunately, each of these processes is not scientifically feasible and leads to more pollution by contaminating soil, air, and water. Moreover, the costs involved in the large-scale waste disposal process are an added concern, especially for small-ticket poultry farm owners (Akanni and Benson, 2014).

A glimpse of adverse poultry waste impact on the environment:

If not managed responsibly, poultry waste can lead to detrimental environmental and health challenges such as:

Alarming water pollution: Poultry waste is high in nitrogen and phosphorous, which when reached by waterways can cause eutrophication. The contamination leads to excess algal growth that depletes the oxygen level and harms aquatic life. Besides, runoff wastewater from farms can directly contaminate water bodies, ponds, and rivers. This runoff wastewater contains pathogens,

Published: 28 July 2024
ISSN: 2583-7850

antibiotics, and chemicals that can severely compromise water quality by making it unsafe for even basic regular use. Getting in contact with such contaminated water can even lead to chronic skin conditions and even cancer in humans as well as other organisms (Kannadhasan *et al.,* 2016).

Degrading air quality: Dumping poultry waste in landfill is not the end of the problem, but the beginning of the bigger one. A large volume of poultry waste in farms and landfills emits ammonia and hydrogen sulphide. These harmful gases not only degrade the air quality with obnoxious odor but also causes chronic respiratory syndrome among farm workers and inhabitants in close proximity to the landfills (De Priall *et al.,* 2022).

Pathogen contamination: Improper handling of poultry waste without proper precaution and gloves can lead to the spreading of pathogens like *Salmonella*, *Campylobacter*, and *E. coli* to cause unknown fever and infections. Moreover, the residues of the antibiotics in the waste when entering the environment can lead to the formation of antibiotic-resistant bacteria, posing a threat to human immunity (Hu *et al.,* 2017)

Emission of greenhouse gas: Decaying poultry waste emits methane, a potent greenhouse gas besides ammonia which when react with other pollutants in the atmosphere for fine particulate matter impacts both human health and the environment (Zhou *et al.,* 2018)

Odor and Nuisance: Unscientific way of meat and poultry waste management attracts pests and scavengers to unearth the buried waste and cause disturbances in the nearby communities. Plus, the foul odor from the farm often leads to never-ending conflict between the farm owners and nearby inhabitants (Liu *et al*., 2022)

Types of poultry waste:

1. **Poultry manure**
2. **Hatchery waste**
3. **Slaughter house and processing plant waste**
4. **Dead birds**

1. Poultry manure

Two main types of waste are produced by poultry enterprises depending on the rearing system adopted on the farm

• Poultry litter – Waste from deep litter systems

• Cage layer waste – Excreta collected under the cages, spilled feed and feathers.

a. Drying

- Oldest, cheapest and feasible method
- Dried under sunlight and depends on lengths of time, climate and humidity.
- Drying the manure with heat results in loss of energy and nitrogen.

Official Website: trendsinagriculturescience.com
e-mail Address: trendsinagriculturescience@gmail.com
Published: 28 July 2024
ISSN: 2583-7850

- Thin bed drying prevents the breeding of flies, reduces obnoxious odours and maintains the nutrient value of the manure particles.
- The faster the manure is dried, the higher is the nitrogen value.

b. Heaping

- Deep stacking of poultry waste produces considerable heat and had been shown to destroy coliforms.
- The maximum temperature was reportedly attained in 4-8 days.

c. Poultry manure as organic fertilizer

- Poultry manure applications increase the moisture holding capacity of the soil
- Improve lateral water movement, improves irrigation efficiency and decreases drought
- Improve soil retention and uptake of plant nutrients.
- Increase the number and diversity of soil microorganisms.

d. Biogas / Electricity generation from poultry litter

- Poultry litter has a good calorific value for power generation by combustion under controlled conditions.
- The technology for anaerobic conversion of poultry manure to biogas (methane) has been developed.
- Electricity production facilities estimated assuming poultry litter utilization rates of 1000 tons/year, 10,000 tons/year, and 50,000 tons/year for various technologies range from 34–70 kW, 340–700 kW, and 1.7–3.5 MW, respectively (Gohil *et al.*, 2019).
- Economic analysis accounting for capital expenditures, operation and maintenance costs, litter cleanout and transportation, and recoverable sludge/ash value reveal that gasification at a small scale (100 kW) and medium scale (1 MW) is potentially economically viable compared to anaerobic digestion and combustion.

e. Composting

- Can be stored for long time
- Aerobic bacterial action occurs
- The top foot is composed of fresh manure, the bottom foot is in an anaerobic condition and the central portion is undergoing composting.
- The essential requirement in managing the deep pit is that the fresh, wet material be adequately aerated to remove the moisture.
- To further the composting process and to prevent odours the pit must be watertight so that seepage water cannot enter.
- Little or no odour arising from the pits and manure removal may be delayed for years (Yuvaraj *et al.*, 2019)

Published: 28 July 2024
ISSN: 2583-7850

f. Pond disposal

- Fresh poultry manure may be flushed into an open, shallow pond.
- Bacterial action reduces the waste material to a smaller volume.
- Bacterial growth occurs only during the warm months, the use of ponds is seasonal.
- The resulting solution may be spread in its liquid state on farmland.
- Aerobic action produces little odour as the sludge builds up, anaerobic activity takes place and odours may be pronounced.

g. Aeration

- Water is poured into the trough to keep the manure fluid and pumps keep the sludge circulating. The effluent is aerated by paddles.
- The addition of oxygen by the paddles increases the activity of aerobic bacteria, greatly reducing the incidence of any odours.
- The material is removed in liquid form and usually spread on the land. The material is practically odourless.

2. Hatchery waste disposal

- Solid hatchery waste comprises empty shells, infertile eggs, dead embryos, late hatchings and dead chickens and a viscous liquid from eggs and decaying tissue.
- Wastewater comes from water used to wash down incubators, hatchers and chick handling areas.
- Traditional disposal methods for solid hatchery waste include land fill, composting, rendering, and incineration.

a. Power generation

- The hatchery waste can be automatically fed by conveyor belts into a furnace which is equipped with a rotating shredder unit for chopping and grinding solid waste.
- An incinerator system can be used as a furnace to heat the solid and liquid waste to produce steam.
- The steam can power a turbine generator to produce electricity (Arshad *et al.,* 2018)

b. Rendering

- Simultaneously dries the material and separates the fat from the protein and yields fat and a protein meal should be pathogen free.

c. Autoclaved and extruded

- Extruded or autoclaved hatchery waste could be used as livestock feed.

Published: 28 July 2024
ISSN: 2583-7850

d. Boiling

- Hatchery waste should be boiled at 100ºC with a pressure of 2.2 kg/cm^2 for 15 min; then boiled again at 100ºC for 5 hours, followed by boiling at 130ºC for 1 h then cooled to ambient temperature.
- Dead embryos could be boiled for 100ºC for 30 min, soaked in cold water for 20 min to remove shells, sun dried for 4d and used in poultry feed.

e. Ensiling

- The eggs were mixed in a 1:1 ratio with formic and propionic acids for 8 weeks at room temperature.
- The acids act by intervening specifically in the metabolism of the microorganisms involved in spoilage.
- The reduction in the pH creates an environment which is unfavourable for microorganisms. The rapid reduction in the pH diminishes the growth of bacteria which produce butyric acid and ammonia and promotes the growth of lactic acid-producing bacteria.
- The lactic acid is responsible for the low pH necessary for storage of the by-product before being used in animal feed.

f. Composting

- Composting is a common method for solid organic waste disposal.
- The decomposition of organic waste is performed by aerobic bacteria, yeasts and fungi. The composting process kills pathogens, converts ammonia nitrogen to organic nitrogen
- The product can be used as a fertilizer.
- Disadvantages of composting are loss of some nutrients including nitrogen.
- Composting with litter eliminates Salmonella
- The hatchery waste can be mixed with wood shavings to reduce the moisture then composted.
- The composter turns manure, litter, sour feed stuffs and carcasses into compost in 4 days with minimal labour and mechanical devices (Joshi *et al.,* 2022).

g. Anaerobic digestion systems

- High efficiency process
- Produces biogas for power generation or heating
- The bio-solids may be used as a high-quality fertilizer and generation of electricity
- Anaerobic digestion of organic waste by microbial organisms to produce methane and inorganic products (Neshat *et al.,* 2017).

Published: 28 July 2024
ISSN: 2583-7850

3. Slaughter house waste disposal

- Rendering is a process of cooking and sterilizing non-edible waste
- Best options for treatment of non-edible wastes by converting waste into meat meal
- Poultry by-product hydrolyzed feather meal (or PBHFM) or simply Meat Meal (Asses *et al.,* 2019).

Advantages of rendering:

- Rendering is more effective and profitable
- Converts entire poultry waste into high protein sterilized meat meal
- Prevents environment pollution by disposing of all biological waste
- Meat meal is used for making animal feed

4. Dead bird disposal

a. Burying

- Disposal of birds for small farms that cannot construct an incinerator.
- Deep hole may be dug and carcasses buried deeply to prevent worms from carrying infections from the carcass to the surface of the ground
- Deep narrow trench can also be used

b. Pit disposal

- Effective and convenient method for disposal of dead birds.
- 150 feet from the poultry houses and water supply
- Flies and insects should not enter the pit
- The pit should be covered with tar paper or plastic
- The pit should be near the post mortem room
- Practical size for pit is about 1.8 m square by 2.4 m deep with drop tube
- Tight fitting lid on the upper end of the tube to prevent the escape of foul odours and the entrance of flies.

c. Incineration

- Burning of the carcass
- An incinerator is a furnace used for burning.
- Incineration process uses electricity, firewood or oil
- Electrical or oil-fired incineration is the best available technology
- Rapid destruction of disease-producing organisms, leaving only a small amount of ash which can be distributed on the land
- Smokeless and odourless burning with minimal air pollution

Published: 28 July 2024
ISSN: 2583-7850

d. Septic tank disposal

- Breaking down the carcasses and waste products in an electrically heated septic tank by the action of mesophilic bacteria.
- Heat is applied at 37.8ºC and requires 2-3 kwh per day of electricity to maintain this temperature for the two weeks needed for destruction of all but the bones of the carcasses.
- The bacterial action and speed of decomposition can be accelerated by adding lime and hot water at intervals.
- Usually a tank of 2000 litre capacity is required for a flock of 10000 birds.

e. Composting

- Composting reduces and transforms organic waste into a useful end product called "compost".
- Alternate layers of litter and paddy straw and dead birds and water
- Finally, the carcasses are covered with a layer of manure.
- Once full, a final cover of litter is placed over the carcasses.
- The temperature of the compost increases rapidly to 60-70ºC within 10 days.
- Decomposition starts and kills micro-organisms.
- Temperature decreases after 14-21 days later
- At this point, the material is moved to the secondary bins
- Aerated and allowed for a second rise in temperature.
- The compost material can be safely stored
- 10 m3 of bin space is required for every 1000 kg of carcass.

f. Rendering

- Rendering is a heating process that extracts usable ingredients, such as protein meals and fats.
- Rendering converts the inedible results from the slaughtering process into meat meal, bone meal, and feather meal

The following methods may be followed as pre-treatment or method for rendering

1. Daily pickup

- Daily pickup of poultry carcasses leads to disease transmission.
- Biosecurity should be practiced.
- Central carcass disposal sites should be used for commercial conditions

2. Freezing

- Dead birds can be stored on the farm in freezing condition until they can be rendered.
- Freezing reduces or eliminates pollution and improves conditions on the farm

Published: 28 July 2024
ISSN: 2583-7850

3. Fermentation

- Mixes dead birds (which have been ground into 1-inch particles) with a fermentable carbohydrate source, such as sugar, whey, ground corn, or molasses.
- Reduces the pH level so that pathogenic microorganisms are inactivated and the organic materials are preserved.
- Biologically safe, pathogen free safely transported to a rendering plant, recovery of nutrients and recycled into usable foodstuffs or animal feed.

4. Acid Preservation

- Propionic, phosphoric, or sulfuric acid is added to carcasses.
- Stored in airtight, plastic containers
- Eliminate the potential for transmitting pathogenic microorganisms

Advantages of rendering:

- Removal of all mortalities from the farm.
- Eliminates environmental pollution
- Nutrient losses, water quality, and recycling for profit increase

References:

Thyagarajan, D.; Barathi, M.; Sakthivadivu, R. Scope of poultry waste utilization. IOSR J. Agric. Vet. Sci. 2013, **6**: 29–35.

Bolan, N.S.; Szogi, A.A.; Chuasavathi, T.; Seshadri, B.; Rothrock, M.J., Jr. and Panneerselvam, P. Uses and management of poultry litter. Worlds Poult. Sci. J. 2010, **66**: 673–698

Akanni, K.A. and Benson, O.B. Poultry wastes management strategies and environmental implications on human health in Ogun States of Nigeira. Adv. Econ. Bus. 2014, **2**: 164–171.

Kannadhasan, M.S.; Lawrence, C.; Kumar, V.R.S. Study on disposal of broiler slaughter waste implying eco-friendly waste management. Int. J. Environ. Sci. Technol. 2016, **6**: 1918–1924

De Priall, O.; Brandoni, C.; Gogulancea, V.; Jaffar, M.; Hewitt, N.J.; Zhang, K. and Huang, Y. Gasification of Biowaste Based on Validated Computational Simulations: A Circular Economy Model to Handle Poultry Litter Waste. Waste Biomass Valorization 2022, **13**: 3899–3911.

Hu, Y.; Cheng, H. and Tao, S. Environmental and human health challenges of industrial livestock and poultry farming in China and their mitigation. Environ. Int. 2017, **107**: 111–130.

Zhou, S.; Han, L.; Huang, G.; Yang, Z. and Peng, J. Pyrolysis characteristics and gaseous product release properties of different livestock and poultry manures: Comparative study regarding influence of inherent alkali metals. J. Anal. Appl. Pyrolysis 2018, **134**: 343–350.

Liu, C.; Zhang, X.; Zhang, W.; Wang, S.; Fan, Y.; Xie, J.; Liao, W. and Gao, Z. Mitigating gas emissions from poultry litter composting with waste vinegar residue. Sci. Total Environ. 2022, **42**, 156-157

Published: 28 July 2024
ISSN: 2583-7850

Gohil, A.; Budholiya, S.; Mohan, C.G. and Prakash, R. Utilization of Poultry Waste as a Source of Biogas Production. In Proceedings of the International Conference on Advances in Materials Research (ICAMR), Sathyamangalam, India, 6–7 December 2019; pp. 783–787.

Yuvaraj, A.; Thangaraj, R. and Maheswaran, R. Decomposition of poultry litter through vermicomposting using earthworm Drawida sulcata and its effect on plant growth. Int. J. Environ. Sci. Technol. 2019, **16**: 7241–7254.

Arshad, M.; Bano, I.; Khan, N.; Shahzad, M.I.; Younus, M.; Abbas, M. and Iqbal, M. Electricity generation from biogas of poultry waste: An assessment of potential and feasibility in Pakistan. Renew. Sustain. Energy Rev. 2018, **81**: 1241–1246.

Joshi, T.N.; Nepali, D.B.; Sah, R.; Bhattarai, T. and Midmore, D.J. A comparison of composting and vermicomposting for the disposal of poultry waste. Anim. Prod. Sci. 2020, **60**: 986–992.

Neshat, S.A.; Mohammadi, M.; Najafpour, G.D. and Lahijani, P. Anaerobic co-digestion of animal manures and lignocellulosic residues as a potent approach for sustainable biogas production. Renew. Sustain. Energy Rev. 2017, **79**: 308–322.

Asses, N.; Farhat, W.; Hamdi, M. and Bouallagui, H. Large scale composting of poultry slaughterhouse processing waste: Microbial removal and agricultural biofertilizer application. Process Saf. Environ. Prot. 2019, **124**: 128–136.

Published: 28 July 2024
ISSN: 2583-7850