POULTRY WASTE MANAGEMENT

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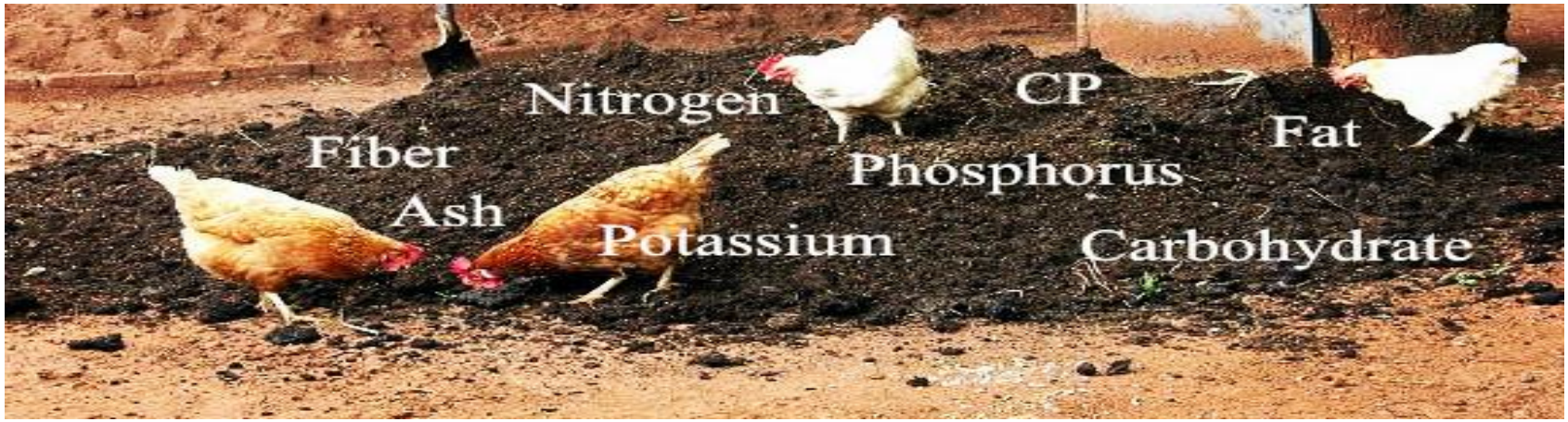
Introduction

- One of the challenges facing livestock and poultry industry worldwide is manure management
- Improper management - Environmental degradation, and ultimately be detrimental for human and animal population.
- The disposal of raw poultry manure without further treatment is deleterious, not safe and poses serious environmental problems such as obnoxious odour, leaching of toxic elements as heavy metals, methane emissions, eutrophication of waterways, nutrient imbalances, phytotoxicity and dissemination of pathogens and weeds,

- The average daily fresh manure production by broiler chicken is about 43 kg per 1000 kg live weight. On a dry weight basis, poultry litter production ranges from 0.7 to 2.0 tons per 1000 broilers per flock.
- Technologies includes burning for electrical generation, biogas production, pelletization and composting



Composting

- Composting is a ‘’spontaneous simple, natural, exothermic, bio-oxidative, aerobic decomposition process of organic materials’’ and it is hygienic, economic and ecologically sound system of waste management.
- Thermophilic, aerobic microorganisms such as bacteria, epiphytes, actinomycetes micro arthropods, etc., transform the highly heterogeneous solid state organic materials into hygienic, bio-stable product mature humic substance under controlled conditions.

Composting methods

- Static pile
- Passively aerated piles
- Actively aerated piles
- Active and passive aerated windrow composting
- In vessel composting

Active aeration

In-house windrow composting

Vermicomposting

- ‘’Using earthworms to convert organic waste into vermicompost is an value added manure management system’’.
- Poultry manure is always a problematic feed substrate for earthworm because of high ammonia content, uric acid and use of other feed supplements and antibiotics in intensive poultry feeding also detrimental to earthworm survivability in poultry manure.
- Attempts were made to optimize C:N ratio of feed substrate for earthworm by Nayak and Sahu, 2013.

- At any stage pre-composting of poultry litter is essential to mineralize volatile ammonia. 100% earthworm mortality in broiler poultry litter as such used (Saravanan,2017).
- But excellent survivability and bioconversion was noticed when C:N ratio was optimized to 30: 1 or 35:1 used coconut coir pith waste as added carbon source.
- Mixing of poultry manure with cow dung had good success in vermicomposting

Pelletization of poultry manure

- Pelletization involves the use of mechanical pressure to increase the density of the material while converting it into pellets.
- Pelletization of fertilizers also contributes to facilitating their broadcasting and application.
- Pelleting process decrease the moisture content by over 44.1% from an average of 25.4% (74.6% dry matter) in fresh litter to an average of 14.2% (85.8% dry matter) in pelleted poultry litter (Lopez-Mosquera et al., 2008).

Chicken Manure

Drying Machine

Crushing Machine

Flat Die or **Ring Die** Pellet Mill

Pellets Cooling Machine

Manure Fertilizer Pellets

Advantages

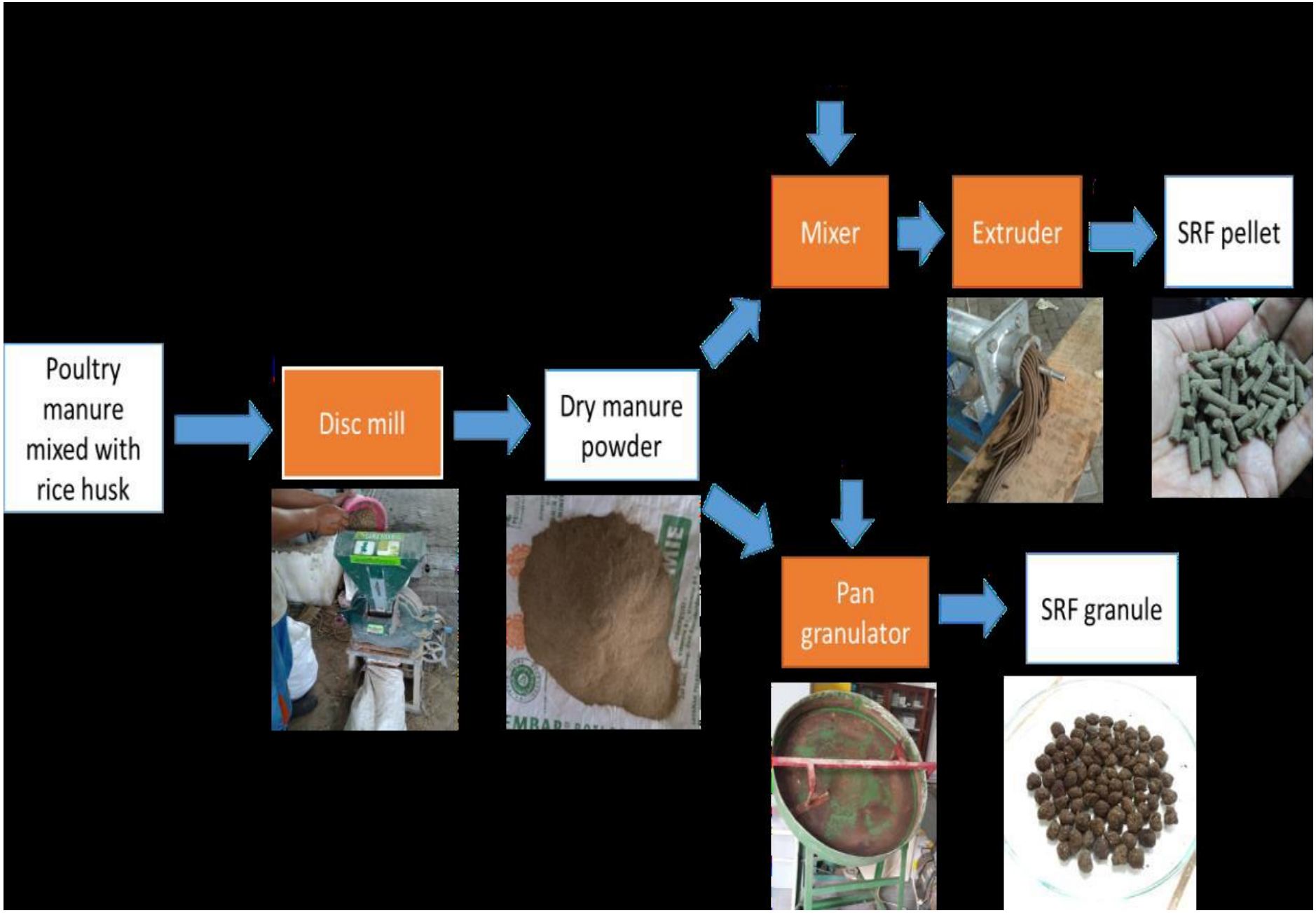
- Pellets release nutrient at a steady rate and are effective in decreasing soil and nutrient losses from agricultural fields.
- Reducing the conservation space
- Suitable for mechanization,
- Suitable for residential places (no dust, no pollution for environment)
- More precision with spreaders and reducing manure consumption
- Suitable for transporting to long distances, planters and no need to separate operation,
- Ability of long time conservation, adding other materials for increasing the quality of pellets is also possible (Suppadit and Panomsri, 2010).

Granulation of chicken manure

- A granular product reduces the opportunity for runoff because it does not add additional moisture to the soil, unlike raw manure.
- Granulation produces a dry, granular product, transportation costs are significantly reduced,
- Opening up opportunities for extended hauling of the product that were once discouraged because of the high moisture content of raw manure.

Slow release fertilizer

- Slow release fertilizers (SRF) could be prepared by mixing poultry manure with urea power and then mixed starch binder, using screw extruder or granulator, pellets or granules can be prepared and should be oven dried followed by sun dried to exclude moisture (Purnomo et al.,2017).
- Poultry manure is suitable to be used for SRF matrix to contain nutrients inside the fertilizer using screw extrusion or pan granulation method.
- Pellet SRF using extrusion method has longer release of nutrient compared with the granulated SRF. This study has opened up a new possibility of poultry manure utilization for SRF production with or without inorganic nutrient addition.
- The poultry power also has a strong bond with urea that open a possibility of SRF production specific for yearly crops.


Poultry manure mixed with rice husk
Disc mill
Dry manure powder
Mixer
Extruder
SRF pellet
Pan granulator
SRF granule

Bio gas from poultry waste

- Poultry droppings could serve as a suitable substrate for biogas production Approximately 2 kw electricity can be generated from 1 m3 of bio- gas and India can produce 270 MW electricity annually from poultry litter.

- A total of 5 kg of poultry litter is required to produce 1 m^3 of bio-gas. A total of 80 m^3 of biogas can be produced from ton of poultry manure.

- The utilization of this substrate for biogas production could eliminate its disposal problems and create another abundant source of sustainable energy.

- The remaining slurry in the bio-digester after biogas production is also found to be enriched compost which can be used to improve agricultural soil nutrient and productivity.

- The biogas generated from poultry droppings produces an energy resource that can be purified and stored in gas cylinders and used efficiently for direct heat conversion (Rajeniekkaand et al., 2016 and Liew Kian Heng 2017).


Egg-laying hens
N rich manure
Biogas
Anaerobic
mono-digester
NH4-N > 7200 mg/l
34
Se
Selenium
78.96
Supplement

Generation of insects' biomass using BSF

- One potential insect that could be utilized for waste management is the **black soldier fly (BSF**), *Hermetia illucens*.
- The black soldier fly is widely distributed in temperate and tropical regions throughout the world. Often found near confined animal feeding facilities, BSF recycle manure, thus reducing associated nitrogen (N), phosphorus (P) and dry matter (DM) by 50% or more.
- BSF larvae convert poultry manure into a 35–44% protein and 28–35% fat biomass (dry weight basis).
- Black soldier fly larvae consume a wide variety of organic matter including animal manures and food waste. While consuming this material they assimilate nutrients thus significantly reduce its volume and pollution potential.

Black soldier fly larvae (Hermetia illucens)

Chemical composition	
Crude protein (% in DM)	42.1
Crude fibre (% in DM)	7
Gross energy (MJ/kg DM)	22.1
Ca	5–8% DM
P	0.6–1.5% DM

Poultry manure biochar

- Poultry Litter (PL) biochar is made from chicken manure and the bedding used in poultry operations like wood shavings, saw dust, straw or other organic materials as well as feathers, feed spillage and mortalities.

- It can be produced by thermal conversion techniques, which include slow pyrolysis, fast pyrolysis, hydrothermal carbonization, torrefaction and gasification.

Stages of pyrolysis

- i) Hydration: biomass = water + dry organic mass Initial charring
- ii) Dry organic mass = tarry vapors + primary char
- iii) Final Charring : primary char = tarry vapors + secondary char.
- Poultry litter biochar is high in ash content, which may have positive effects on soil agricultural and biochemical properties (Amita Shakya and Tripti Agarwal, 2017).


Pyrolysis
200 - 600 °C
Wastewater treatment
Chicken manure biomass
Chicken manure biochar
Removal efficiency
2,4-dinitrophenol (83.4 %)
phenol (78.5 %)

Cardboard or paper board making or building material

- Cow manure can be processed into fiberboard for construction.
- Best suited for sheds, barns, and other outdoor structures because it is not yet recommended for use in building homes.
- The fiberboard is not 100 percent manure, and animal processed fiber could be used as a supplement to other fiber that are used to make fiberboard.
- Similar efforts can also be made with poultry manure and broiler litter to give value addition.

Other value additions

- Feather meal,
- Bio diesel production,
- Technical textiles,
- Thermal energy production,
- Mushroom cultivation,
- Flower pot ornamental

Non-green waste disposal

Farm operation
- Manure
- Feathers
- Broken eggs and
- Dead birds

Hatchery operation
- Non-fertile eggs
- Egg shells
- Egg membranes
- and dead embryos and chicks

Burial

small farms
300 feet away from water source
Incineration
safe and hygienic method
costlier

Disposal pit

- Sanitary and practical method for larger farms
- Concrete block / monolithic concrete
- Air tight cover
- Should be free from water seepage

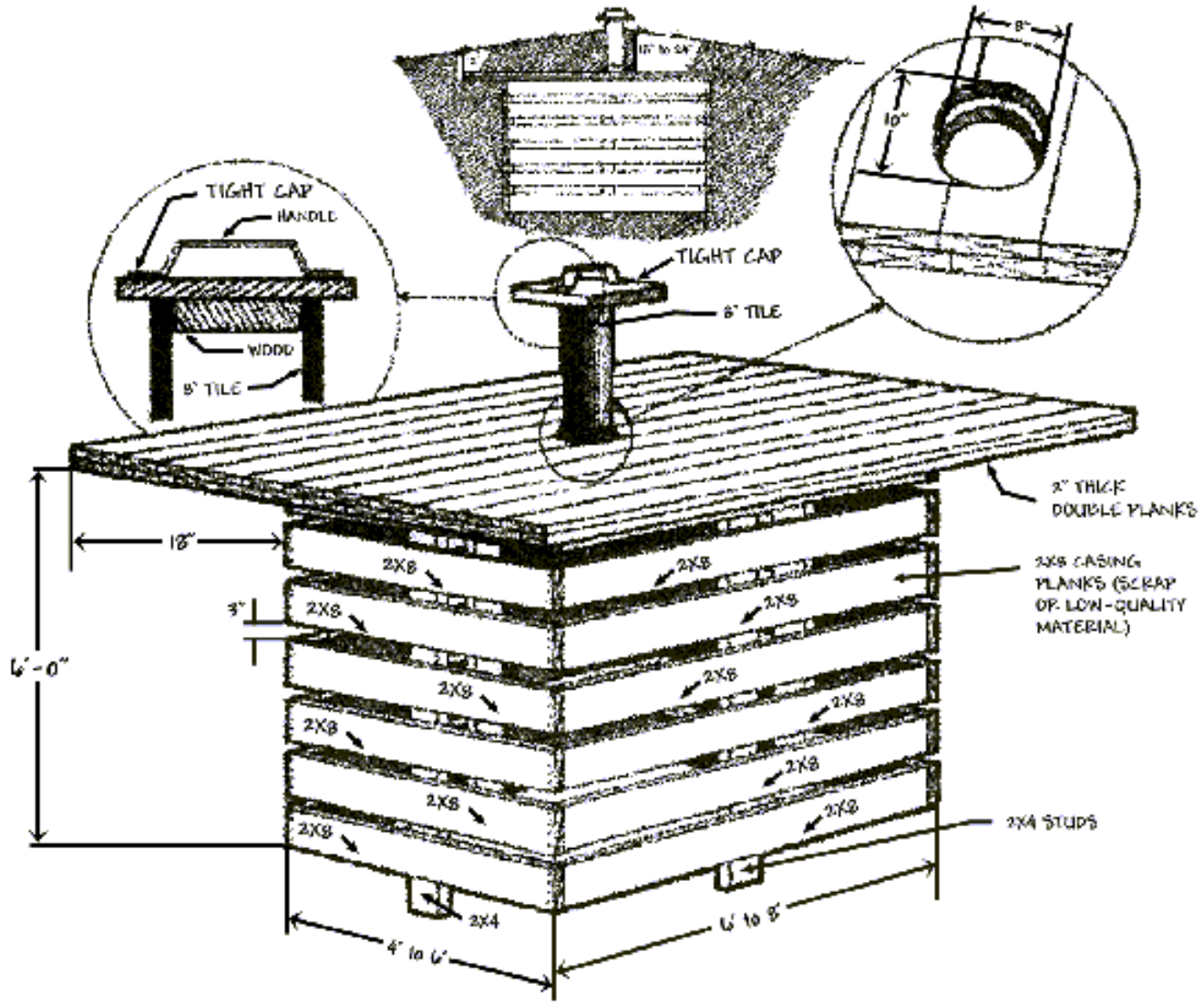


Figure 3. Construction of a poultry disposal pit with a wooden top.

Disposal pit

- Method of decomposition’

  array of aerobic and anaerobic bacterial decomposition
- More of objectionable odour due to anaerobic decomposition
- Potentially pathogenic bacteria were continuously isolated from the pit

- High acidity problem
- Hydrated lime 0.5 – 1 lb per sq. feet
- pH should be between 7.5 to 8.5
- Size

Broilers	50 ft^3/1000 birds
Turkeys (to 18 weeks)	100 ft^3/1000 birds
Commercial layers	55 ft^3/1000 birds

Composting of dead bird

- Aerobic composting
- Transfer of organic waste in to useful end product
- Odour less humus like mass

Basic requirement of dead bird composting

- Carbon nitrogen ratio 20 –30 : 1
- Moisture content 45 to 60 %
- Wooden bins
- Mini composter

Compost bin

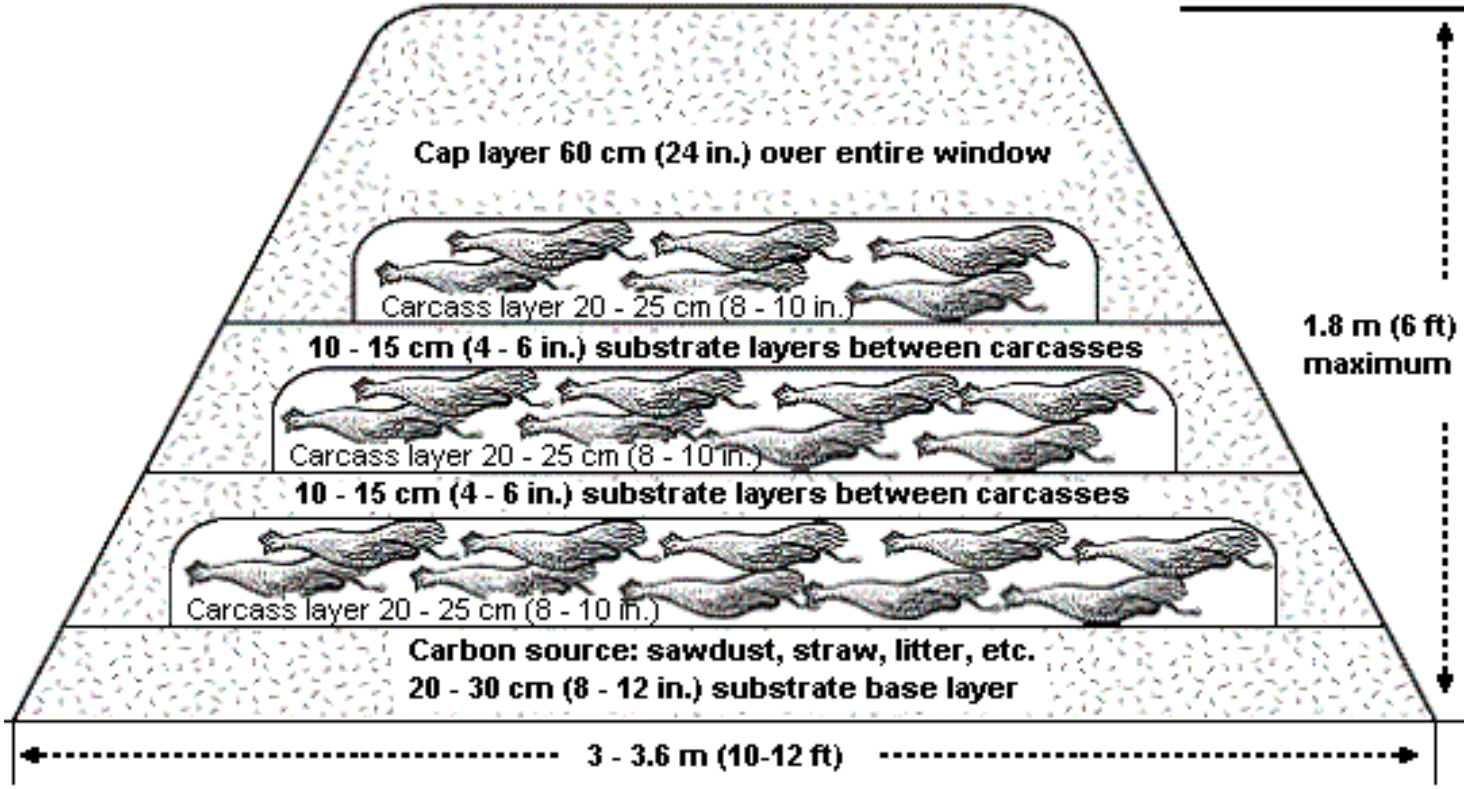
- First stage or primary composting bin
- Secondary bin
- Above ground level
- 4 feet x 4 feet x 4 feet size
- Floor – cement concrete

Recipe

- Carcass + Caged layer manure + Straw/hay + water (1 : 3 : 1.75 : 1.7)
- Carcass + Farm Yard manure + Straw / hay + water (1 : 3: 0.65 : 0.57)

Method of filling compost bin

- Carcass + manure + carbon source + added water was layered sequentially
- C:N ratio was adjusted to 20:1
- Moisture was adjusted to 60%
- Temperate was recorded at different levels.


Cap layer 60 cm (24 in.) over entire window
Carcass layer 20 - 25 cm (8 - 10 in.)
10 - 15 cm (4 - 6 in.) substrate layers between carcasses
Carcass layer 20 - 25 cm (8 - 10 in.)
10 - 15 cm (4 - 6 in.) substrate layers between carcasses
Carcass layer 20 - 25 cm (8 - 10 in.)
Carbon source: sawdust, straw, litter, etc.
20 - 30 cm (8 - 12 in.) substrate base layer
1.8 m (6 ft) maximum
3 - 3.6 m (10-12 ft)

- No fly problem
- No foul smell was noticed from the start of trial
- No seepage
- Temperature rose up to 65° C and maintained up to 7 days
- Average period to complete first stage 7 weeks and for second stage 6 weeks
- Temperature raise up to 64° C
- Volume reduction
- No parasitic eggs found