MANAGEMENT OF LIVESTOCK WASTE

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Received: 30-05-2015, Accepted: 10-06-2015

INTRODUCTION

Livestock sector plays a critical role in the welfare of India's rural population. Livestock sector includes animal husbandry, dairy and fisheries sector which are considered major sectors. It plays an important role in the national economy and in the socio-economic development of the country. Its role is very crucial in the rural economy as supplements family incomes and generates gainful employment in the rural sector (Kumbhar, 2011).

The total livestock population consisting of cattle, buffalo, sheep, goat, pig, horses & ponies, mules, donkeys, camels, mithun and yak in the country is 512.05 million numbers in 2012. In 19th Livestock Census, 37.28 percent were cattle, 21.23 percent buffaloes, 12.71percent sheep, 26.40 percent goats and 2.01 percent pigs.The livestock sector alone contributes nearly 25.6 percent of value of output atcurrent prices of total value of output in agriculture, fishing & forestry sector. Theoverall contribution of livestock sector in total GDP is nearly 4.11 percent at current pricesduring 2012-13(19th Livestock Census-2012).

The presence of livestock invariably generates wastes. In India, livestock wastes are managed generally in three ways. The waste excreted by livestock are removed by dumping into heaps nearby the cattle sheds. The heaps get converted into manure, which are spread subsequently in the fields as an organic matter. Much of the livestock waste is utilized for energy purpose in village level where the waste are made into small cakes and dried and later used as fuel for cooking purposes. Another method of livestock waste management is the establishment of bio-gas plant where waste is used for the production of methane under anaerobic (lack of oxygen) conditions. The methane gas is used for cooking purpose,and the slurry after methane extraction is used as farm manure(Gautam, 2006).

Among the livestock wastes, animal dung and wastewater constitute the maximum of the total.Animal dung waste produced ranges from 3 MT/ day to 6000MT/ day. Other types of wastes like fodder and hay, fat and grease may lie in the range of 25 kg/day to 1500 kg/day. More than 60 percent of the waste generated is treated aerobically and less than 5 percent by anaerobic treatment. It is estimated that only 9 percent of the livestock sector is involved into methane recovery and utilization projects (FICCI,2009).In decades past, livestock waste management was not considered as a big problem. However, as milk and meat production needs increased, herd size and waste production also increased.

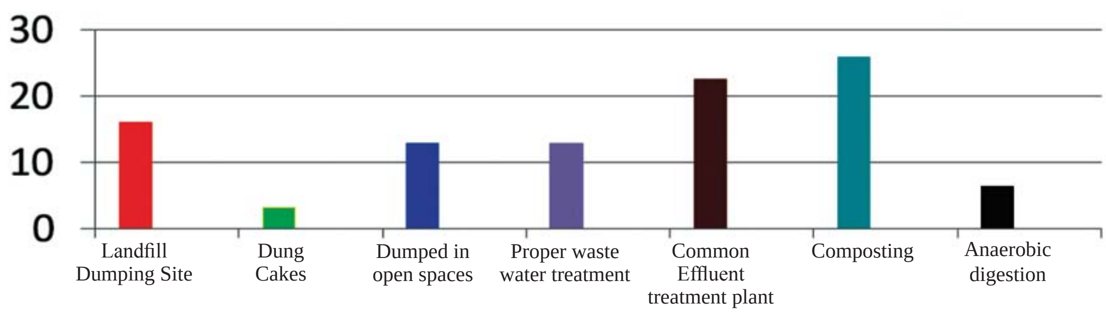
This has heightened the awareness for waste management.

Livestock production systems are intensifying worldwide, particularly in urban and peri-urban areas. As a result, livestock waste is emerging as a serious environmental and public health concern. Livestock waste can lead to huge nutrient surpluses concentrated in areas close to humans leading to soil and water pollution and has even been implicated in climate change. (Martinez *et al*., 2009). Untreated and ill-disposed hog waste can cause air pollution by the release of noxious gases like hydrogen sulfide, methane, and ammonia leading to health effects such as respiratory ailments, skin irritation, “blue baby syndrome,” and cognitive impairments due to the growth of *Pfiesteria* in the air and water at high nitrate concentrations. Accumulation of livestock waste attracts flies and parasites causing bad odour and other nuisance. The health issues generated from waste accumulation affects public health, livestock health, farm staff health and food quality(Martinez and Burton,2003).

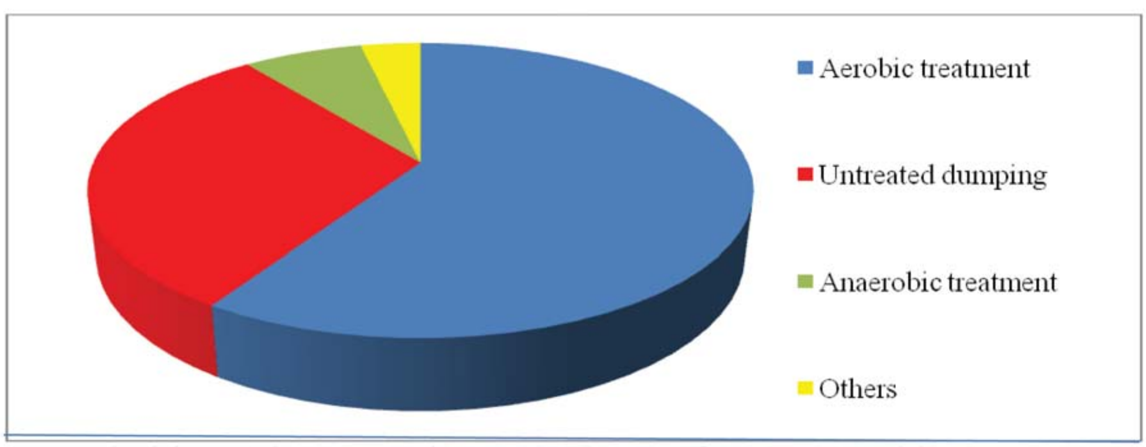
FARM ANIMAL WASTE MANAGEMENT

Composting

Composting is a naturally occurring process in which bacteria, fungi, and other microorganisms convert organic material into a stabilized product known as compost. Within the carcass, anaerobic microorganisms work to degrade it, releasing fluids and odorous gases such as hydrogen sulfide and ammonia. These



WASTE MANAGEMENT AND DISPOSAL METHODS IN INDIAN LIVESTOCK SECTOR (%) (FICCI Report 2009)



LIVESTOCK WASTE MANAGEMENT SCENARIO IN INDIA(FICCI Report, 2009)

diffuse into the surrounding bulking agent. In this bulking agent, aerobic microorganisms degrade these materials to odour-free carbon dioxide (CO_2) and water (H_2O). The aerobic process produces considerable heat, causing the temperature of the compost pile to rise. The active bacteria in both the aerobic and anaerobic zones are heat tolerant. However, the heat kills common viruses and bacteria that may be present in the carcass. Odour is controlled by having an adequate quantity of bulking agent around the carcass. It is a simple way to add nutrient-rich humus which fuels plant growth and restores vitality to depleted soil(Morse *et al*., 2001).

Vermicomposting

Vermicomposting is a simple bio technological process of composting in which certain species of earthworms (*Eisenia fetida, Eisenia andrei, Eudrilus eugeniae Dendrobaenaveneta, Perionyx excavates*) are used to enhance waste conve rsion and to enhance a better endproduct. Vermicomposting involves bio-oxidation and stabilization of organic materials by the joint action of earthworms and microorganisms.and (Dominguez Edwards, 2010)

Combining the two systems in an experiment in Spain resulted in a superior product with more stability and homogeneity. In this system, Composting combined with subsequent vermicomposting was carried out by composting the manure for 15 days and then vermicomposting in a $1m^3$vermireactor containing a stable and very active population of the earthworm *Eisenia andrei* for 40days. Samples were collected from the vermireactor 40 days after the addition of the third layer of composted manure. (Lazcano *et al*. 2008)

Type of by-product	% of live weight	Uses
BY-PRODUCTS FROM PRODUCTION PHASE		
Poultry litter and manure	-	Recycled feed, surface dressing of agricultural land
HATCHERY BY-PRODUCTS		
Egg shells, infertile eggs, unhatched eggs and dead as well as culled chicks	-	Hatchery by-product meal upto 3–5% into feed. Egg shell meal as high calcium diet
BY-PRODUCTS OF POULTRY DRESSING PLANT		
Feathers	7–8	Bedding material, decorative purpose, sporting equipment, manure or fertilizers, feather meal.
Heads	2.5–3.0	Poultry meal
Blood	3.2–3.7	Blood meal
Gizzard and proventriculus	3.5–4.2	Edible,source of chitinolyticenzyme.
Feet	3.5–4.0	Soup, technical fat/poultry grease
Intestines and glands	8.5–9.0	Sportgats, meat meal, poultry grease and active principles (hormones and enzymes)

BIOMETHANATION TECHNOLOGY

In this method, production of methane occurs from livestock waste under anaerobic condition through biodegradation of organic materials (used in biogas technology).Biogas plants help in total recycling of organic wastes in an environment-friendly manner. This is the best alternate source of energy from organic waste. It is used as fuel for cooking and lighting purposes.It can also be used in diesel engines to substitute diesel-oil up to 80 per cent. In recent years, with advanced processes of biomethanation, the technology is further being expanded as a solution to waste handling and mitigating environmental problems. The left over decomposed slurry is a good source of manure for agricultural lands. Biomethanation can be applied as a profitable waste management plan in institutions that generate large quantities of organic waste, like schools, markets, restaurants, and hotels (Ngumah, 2013). The methane potential in manure is assessed on the basis of the content of volatile solids in the manure and empirical standards for the production of methane per kg of Volatile Solids. The methane potential has been estimated to be 0.29 m^3 CH_4/kg of Volatile Solidsin pig manure, 0.21m^3 CH_4/kg of Volatile Solids in cattle manure.(Nasir *et al*., 2012).

GENERATION OF ELECTRICITY

From 1 ton of manure with 20 percent solid content, 20–25 cubic meter biogas can be produced with a total energy value of 100–125 kWh and the same can be utilized to generate 35–40 kWh of electricity and 55–75 kWh of heat energy (Burton and Turner, 2003).

UTILISATION OF COW URINE

Roughly about 11.4- 22.8 crore litres of cow urine is produced each day and it can be utilized in many ways. This has to be considered as a precious natural resource, and not as a waste generated from livestock.Cow urine is one of the ingredients of 'Panchagawya' capable of treating many curable as well as incurable diseases and has been used extensively in ayurvedic preparations (Pathak and Kumar, 2003).'Panchgawya' is also used as fertilizer and pesticide in agricultural operations. Cow urine is basically an excellent germicide and a potent antibiotic. Distillate cow's urine is an activity enhancer and availability facilitator for bio active molecules (Mohanty*et al*., 2014).

METHODS OF POULTRY WASTES UTILIZATION (Sams, 2001)

It is assumed that every year, approxi mately 1.2 croretonne manure is produced from the broiler and layer industry and more

Animal	Kg/Head	% of animal weight
Bovine	83	27.5
Goat/Sheep	2.5	17
Pig	2.3	4

Quantity of solid waste generated from the bovine, goat, sheep and pig slaughter houses (USDA,2001)

Waste Source	BOD Value(mg/l)
Cattle slurry	10,000-20,000
Pig slurry	20,000-30,000
Silage effluents	30,000-80,000
Slaughter house wastes	10,000-30,000

Ranges of BOD concentrations from various wastes(MAFF,1998)

than 14.1 crore kilogram of slaughter waste from broiler birds produced in India.

SLAUGHTER HOUSE WASTES AND ITS MANAGEMENT

The changing dietary trends of future population is expected to increase the consumption of livestock products. Percentage increase in consumption of beef, pork and poultry by 2030 is estimated to be 51 percent, 160 percent, 844 percent respectively of that in 2000 (FAO 2011). Most of the slaughter houses in the country perform the killing and dressing of animals without an onsite renderingoperations and are more than 50 years old. These slaughter houses are without adequate basic amenities like proper flooring, ventilation, water supply, lairageetc. In addition to these deficiencies, slaughter houses suffer from very low hygiene standard posing a major public health and environmental hazard. This is attributed to the in-discrete disposal of waste and highly polluted effluent discharge. Unauthorizedand illicit slaughtering has also increased many fold leading to the related problems.Most of the meat industry does not meet the standards for discharge of effluents as laid down and notified under the Environment (Protection) Act, 1986. (Govt of India. 2000)

The wastes from slaughter houses and packaging houses are similar chemically to domestic sewage, but are considerably more concentrated. They are almost wholly organic, chiefly having dissolved and suspended material. The principal deleterious effect of these wastes on streams and water courses is their deoxygenation(Chakraborty and Mukhopadhyay, 2014**)**.

SLAUGHTER HOUSE WASTE MANAGEMENT

Different methods for the disposal of such wastes exist, including composting, anaerobic digestion (AD), alkaline hydrolysis (AH), burial, aerobic fermentation, rendering, incineration and burning. (Whittle and Insam, 2013).

Utilization of blood for blood sausages, blood pudding, biscuits bread, blood curd and for non-food items such as fertilizer, feedstuffs and binders and in pharmaceutical industry (Ghost, 2001)

Utilization of hides and skins for manufac turing leather shoes and bags, athletic equipments, reformed sausage casing and sausage skins, cosmetic products, edible gelatine and glue. (Benjakul *et al*. 2009)

Utilization of edible tallow and lard for preparation of french fries and other fast foods, Margarine,sausages or emulsified products (Ghotra *et al*. 2002)

Treatment of meat industry waste waters by ultrafiltration – reverse osmosis, chemical precipitation – reverse osmosis, chemical precipitation –ultrafiltration–reverse osmosis (Bohdziewicz and Sroka, 2005)

UTILIZATION OF WASTE AS BIOFUEL

Due to sanitary, environmental problems and operational costs related to the discharge, land disposal and re-use of wastes and the utilization of biofuel for steam generation has shown to be a viable alternative. (Jayathilakan *et al*., 2012).

Poultry litter with 9percent or less water content can be burnt without extra fuel, hence can be used as fuel for generation of electrical power (Davalo s *et al.,* 2002).

Commercial ferric sulfate treatment as coagulant allows the retention of 0.83–0.87 kg of biomass fuel for each cubic metre of treated wastewater (Jayathilakan *et al*., 2012)

Thermal recycling of residues in power plant (Arvanitoyannis and Ladas, 2008)

Compressed Natural Gas: New system of biogas purification and bottling was developed at IIT, New Delhi (Vijay, 2011). Biogas can be purified up to 98 % methane content and can be stored into CNG cylinder compressed to 150 bar pressure and can be easily used any time anywhere as LPG cylinders. Further, the stored biogas was used to run petrol-based auto rickshaws (Kapdi *et al*. 2006) and diesel engines (Ilyas, 2006).

Generation of biodiesel from animal fat–"Biodiesel is a mono alkyl ester of long chain fatty acids derived from renewable sources (vegetable oil or animal fat)for use in diesel engines" (National Biodiesel board, 1996). Manure can also be combined with plant and animal fat to make biodiesel. (HSUS Report, 2009). The use of biodiesel can reduce the engine emission of smoke level by 47.14% when compared to petrol and diesel used in an engine test rig. Importing of crude oil can be reduced to an extend by blending of 20% biodiesel (John Abraham *et al*., 2014).

SOLID WASTE POLICY IN INDIA

(Municipal Solid Waste Rules, 2000).

1. Prohibit littering on the streets by ensuring storage of waste at source in two bins; one for biodegradable waste and another for recyclable material.
2. Primary collection of biodegradable and non-biodegradable waste from the doorstep, (including slums and squatter areas) at pre-informed timings on a day-to-day basis using containerized tricycle/handcarts/pick up vans.
3. Street sweeping covering all the residential and commercial areas on all the days of the year.
4. Abolition of open waste storage depots and provision of covered containers or closed body waste storage depots.
5. Transportation of waste in covered vehicles on a day to day basis.
6. Treatment of biodegradable waste using composting or waste to energy technologies meeting the standards laid down.
7. Minimize the waste going to the land fill and dispose of only rejects from the treatment plants and inert material at the landfills as per the standards laid down in the rules.

FUTURE TRENDS IN LIVESTOCK WASTE MANAGEMENT

(Martinez *et al*., 2009 and Martinez and Burton, 2003)

Early separation of liquids from solids in livestock houses can reduce the gaseous emissions in the buildings and it generates liquid and solids that can be processed separately.

Development of techniques allowing nutrient recycling from wastes, especially phosphorus.

Amendment of environmental protection policies by notifying about new "emerging" pollutant like antibiotics, endocrine disrupters, antibiotics-resistant pathogens etc

Finding new global methods to assess the viability of production chain and food supply.

Manure-soil interactions studies are required to study the effect that various treatments have on the subsequent interactions of the manure with the soil in order to verify that subsequent pollution is reduced. Development of newer technologies for the re-use of diluted effluents for washing and irrigation purposes

Development of methods to work on both the inputs and the outputs of livestock production and the integration in "regional" or geographical aspects.

Better use of the nutrients in organic material.

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