

Utilization of Livestock Waste Management: Issues and Challenges from the Hisar District, Haryana

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Abstract- The study was carried out to estimate the livestock population and waste generation in the Hisar district. The study investigated the effect of open dumping of animal wastes on the farm workers' health and the environment. Total household is 449546 and more than 70 % population living in village in Hisar district. Hisar is primarily an agricultural and livestock region. Major livestock's of Hisar is buffalos, Cattles, Goats and Sheeps. To do this, livestock farms in 255 different settlement areas (villages) were investigated. It was seen that about 90% of the livestock farms were closer (1.0-500 m) to the residential area than they should be disposed or stored their wastes carelessly in open places around the barns. The majority of the people living in the research area complained of uncomfortable smells and sights. Wet waste was found dumped on ground, which is a big source of contamination of ground water and foul smell in the area. Improperly managed livestock wastes can lead to fecal contamination of waters receiving agricultural runoff. The danger to humans lies in the possibility of these fecal organisms entering water and food supplies. Concerns and worries about the effects of pathogens, anti-microbial drugs, heavy metals and pesticides that are present in animal manure on environments and consequently, human being health is fast gaining attention in recent times.

In order to prevent all these environmental problems, small farms should be unified under a cooperative and shifted to a certain safe distance. Wastes from the farms should be stored in leakage proof stores and be used for biogas and organic fertiliser production. The most appropriate techniques of animal waste management involve proper treatment followed by application of the treated wastes to cropland for agricultural use as organic fertilizer sources.

Key Words: Livestock Waste, Waste Management, Waste Generation, Open Dumping, Organic Fertilizer, Biofertilizer.

I. INTRODUCTION

Livestock sector plays a critical role in the welfare of India's rural population. Livestock sector includes

animal population. Livestock sector includes animal husbandry, dairy and fisheries sector which are considered major sectors. Its role is very crucial in the rural economy as supplements family incomes and generates gainful employment in the rural sector (Kumbhar, 2011). Buffaloes in the State are the major contributor to the livestock population especially the first largest contributor in the production of milk. As per 20th Livestock Census, 61.41% of the livestock population are buffaloes, 49.23 % of the cattle population are indigenous, 4.72% of the livestock population are Goats. Sheep are one of the major Livestock species under the small ruminant category of animal, 4.05 % of the livestock population (20th census, 2019).

The presence of livestock invariably generates wastes. In Hisar, 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 is 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).

According to the 19th Animals Census, India has 512.05 million livestock, producing 1095 million MT of manure annually. Waste from livestock and poultry industry includes a mixture of excreta (manure), bedding material or litter (e.g. wood shavings or straw), waste feed, dead animals/birds, broken eggs, feathers and farm sweep outs. A large portion of the estimated 35% of global greenhouse gas emissions

attributable to agriculture and land use, comes from the raising of livestock. 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). The animal wastes can be subjected to vermicomposting, biogas production and burial in pits. Galvanizing Organic Bio-Agro Resources-Dhan scheme was implemented by the Government of India in April 2018 in order to manage animal wastes. Both developed and developing nations should adopt and abide by the laws and standards necessary to clean up the environment by properly disposing of and handling animal excrement. In decades past, livestock waste management was not considered as a big problem. 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).The environmental problems caused by the improper disposal of livestock and poultry waste are prominent, causing not only water, soil, and air pollution, but also easily spreading bacteria and diseases, reducing breeding efficiency, and even posing a threat to human health (Fraison et al., 2013; Karadurmus et al., 2012).

The earthworm eats the organic matter and excretes little pelleted material called “Vermicompost”. During vermicomposting, the important plant nutrients, such as N, P, K, and Ca present in the organic waste are released and converted into forms that are more soluble and available to the plants. Among all advance methods biogas production and vermicomposting are most common in India. Animal husbandry specialists used to worry about how the effect of environment on animals can be mitigated. Indian livestock estimated using dry matter intake approach was 10.08 Tg (trillion grams = 1 ton) methane due to enteric fermentation in the year 2010, in which crossbred cattle, indigenous cattle, buffaloes, goats and sheep and other livestock (mule, yak, camel, donkey, pig, mithun, horse and pony) emitted about 4.6, 48.5, 39, 4.7, 1.8 and 1.4%, respectively. The manure droppings from livestock on pasture were not even recovered but left to become integrated in the soil. However, with the advent of modern livestock production, considerable

attention is being given to alternative uses and treatments of livestock wastes to recover fertilizer, feed, and fuel and at the same time achieve pollution control. All these properties of animal waste will be available only if they are carefully managed. If not, they might cause detrimental effects on climate and human. The sustainable valorization of animal waste for producing biofuels and biofertilizers presents a promising solution to waste management and renewable energy challenges. Biogas is clean environment friendly fuel that can be obtained by anaerobic digestion of animal residues and domestic and farm wastes, abundantly available in the countryside. Biogas is bacterial conversion of organic matter in to gases under anaerobic conditions. Average calorific value of biogas is 20MJ/m³ (4713kcal/m³) (SS Parihar,2019). The idea of looking at manure as a resource, not a waste, has been central idea much of the more recent thinking on whole subject of good farm management. If we utilize this animal waste we can not only clean our environment but money spend on fertilizer could be saved (Burton and Turner, 2003).

II. INFORMATION ABOUT THE STUDY AREA OF HISAR

Hisar is located in the state of Haryana, India, at approximately 29.09° N latitude and 75.43° E longitude. It lies about 164 kilometers west of Delhi on National Highway 10. The city's elevation is about 215 meters (705 feet) above sea level, and it is part of the Ghaggar-Yamuna plain. Hisar is a district and municipal corporation in the Haryana state. Hisar population has 2022959 and households are 449546, district is divided into 6 blocks and 3 sub tehsils. More than 70 % population living in village in Hisar district (refer figure ,1).

Figure -1 Location of Hisar



Source: <https://www.alamy.com/stock-photo/india-map-with-states.html>

The Hisar district is renowned for its Haryana breed of cattle and Murrah breed of buffaloes and holds unique

position in India. According to 1977 livestock census, 'the livestock population of the district was 8.12 lakh which accounted for 11.9 percent of the livestock population of the state. The livestock "density-works om to 128 animals per square kilometre. Buffaloes had significantly larger population and accounted for 66 percent of the total livestock population in the district. The population of sheep was largest in the state and these were 1 percent of the total sheep population of Haryana. In sum, the position of the village' on an average is that it has 561 cattle and 671 buffaloes besides other livestock and poultry (Statistical Abstract of Haryana (1978-79). According to 20th livestock census Hisar livestock population is 657532(census,2019).

III. RESEARCH METHODOLOGY

Collection of data: The present study was conducted in Hisar districts of Haryana. This study is based on 255 villages. By using the primary and the secondary data and with ethnographic field visit and personal interactions, a mix approach dominated by case study method was chosen to study the issues. The main sources of secondary data are the published and unpublished records of Indian state Government, Research paper, Ministry annual reports, Journals, Books. This paper relies on analysis of archives and government documents. Govt. Policies and Programs related to animal waste management. The research paper, in the absence of Census 2021.

Data Analysis Tools - Microsoft word and excel software were used to represent the data and present them in the form of bar graphs. Secondary sources of agricultural waste data and their analysis through Microsoft-excel.

IV. OBJECTIVE OF THE STUDY AREA

- The objective of the study was to understand the importance of animal waste management, effectiveness and social acceptance of a small biogas plant in rural India that has been in operation using animal waste to produce biogas for domestic use and fertilizer.
- The objectives of this study were to investigate environmental pollutions by animal wastes from the livestock farms around the rural settlement

areas to examine their consequences and finally to find practical solutions.

- The objectives of this study are to assess the quantity and type of wastes generated from the livestock farms and their present mode of management in a typical Hisar District rural area and to use the information to identify the appropriate technologies which could enhance the value of the waste produced and at the same time improve the economic and social conditions of rural people.

V. LIVESTOCK HOLDING AND ANIMAL WASTE GENERATION IN HISAR REGION

In the Hisar region, has total animals are 649479 out of which total buffalos are 426486, Cattles are 170440, Goats are 18864 and Sheep are 33689. Cattle and buffalo emit 10–20 kg of manure per day respectively; sheep/goats emit 2 kg per day [5], [6]. (Jiamin,2023), Refer table,1.

Table-1 Livestock and Amount of Waste Sharing (%).

Livestock	No. of animals	% of animal	Waste(kg/day)	% of waste
Cattle	170440	26	2556600	28
Buffalo	426486	66	6397290	71
Sheep	33689	5	67378	1
Goat	18864	3	37728	0

Buffaloes make up the largest portion of the livestock population (66%) and produce the highest amount of waste 6397290 kg/day (71% of the total waste). Cattle account for 26% of the animals and contribute 28% (2556600 kg/day) of the waste. Sheep and goats, despite being part of the livestock population, contribute very little to the overall waste (together only about 1%). Buffaloes are the most preferred livestock in the region. Cattles are the second most preferred livestock in the region. Goats and Sheeps are the third most preferred livestock in the Hisar region (20th Census,2019).

VI. CURRENT UTILIZATION OF LIVESTOCK WASTE AS BIOGAS ENERGY IN HISAR

Gaushalas: Block wise total household is 449546, total gaushalas cattle are 77500 and total animal waste generate 3875 ton per day (31 gaushalas). 400 m3

capacity of biogas plant 4-ton animal wastes are require. In whole district total 7122 kWh energy is generate through 400 m³ biogas. Highest biogas capacity in Adampur, Narnound, Ladwa and Data Guarana is 85 m³ because there are more no. of cattle's and quantity of animal waste main reason their livelihood depends on livestock. Livestock more in Gausihala because all villages protect their crops from Estray Animals, reduce the traffic jams and avoid the accidents through animals. Govt. gives 40-50 % subsidy on the bases of energy generation and the quantity of animal waste

Community Level: Biogas plant in Nayagaon Gram Panchayat in Hisar District of Haryana has constructed a biogas plant of 400 m³ capacity under the GOBAR-Dhan programme of Swachh Bharat Mission Grameen (SBM-G). Cattle dung from around 300 households (HH) is collected and treated here in the facility that is completely managed by the GP. Department of Drinking Water and Sanitation (DDWS) is coordinating the implementation of Pilot Project 'GOBARDHAN 2020-21: Waste to Wealth a Unified Approach of GoI.' GOBARDHAN is also the integral part of SLWM component under the SBM -Grameen Phase II. In principle, biogas can be used like other fuel gas. When produced in household-level biogas reactors, it is most suitable for cooking or lightening. Additionally, electricity generation is a valuable option with the biogas produced in large anaerobic digesters. Bio gas plant installed under scheme NNBOM (2021-2022). In this scheme 21 villages installed 140 cubic foot size plant and 12000 subsidies given on installation time by the govt. to the villages(sbmgramin,2021).

In this case more potential of biogas energy to increase the energy efficiency conservation of non-renewable energy resources. Increasing demand of electricity can be done through bio energy it is the best form of energy to fulfil the energy need of Hisar district and bridge the energy demand and supply gap. Biogas Energy is an environmentally-friendly, renewable energy source. It's produced when organic matter, such as food or animal waste, is broken down by microorganisms in the absence of oxygen, in a process called anaerobic digestion.

VII. OBSERVED IMPACTS OF LIVESTOCK WASTE ON SOIL AND ENVIRONMENT

Water Pollution

The Environmental Protection Agency (EPA) and The Centers for Disease Control and Prevention (CDC) identify agriculture as a major source of water contamination. When waste or effluent enters water bodies like streams, rivers, lakes, and oceans through runoff or direct discharges, it can have disastrous effects, such as:

- *Nutrient pollution:* Excess nitrogen and phosphorus act as fertilisers in water, leading to eutrophication. This process causes rapid algae growth, creating 'dead zones' depleted of oxygen, which kill aquatic life.
- *Pathogen contamination:* Bacteria, viruses, and parasites from animal waste can leave water resources unsafe for drinking, swimming, or irrigation. Outbreaks of waterborne illnesses are often linked to animal waste, leading to health outcomes ranging from gastrointestinal distress to more severe complications.

Air Pollution and Emissions

Animal waste mismanagement contributes significantly to air pollution. Animal feeding operations, waste storage, and land application of animal waste produce emissions such as: Nitrous oxide, Methane, Hydrogen sulphide, Carbon dioxide, Ammonia and Unpleasant odours

These emissions, regulated under the Clean Air Act, pose health risks for communities and negatively impact climate stability.

Soil and Land Contamination

The overapplication of animal waste on agricultural land can also result in soil and land contamination:

- *Excess nutrients:* If applied beyond crop needs, nutrients like nitrogen and phosphorus can build up in soils. This increases the risk of leaching into the ground and runoff into surface waters, potentially impacting drinking water sources.
- *Heavy metals:* Some animal feed and waste contain heavy metals, like zinc, copper, and cadmium. These can accumulate in soils and crops over time, potentially contaminating the food supply.

Repercussions For Human Health

- Contaminated water, air emissions, and soil pollution from animal agriculture all pose risks to human health. As mentioned, polluted water can cause gastrointestinal illnesses if ingested.
- Ammonia and hydrogen sulphide air emissions contribute to respiratory issues, nausea, headaches, and fatigue for those living near CAFO facilities.
- In addition, prolonged exposure to nitrates and certain heavy metals found in animal waste-applied soils could potentially increase cancer risks. Antibiotic-resistant bacteria in animal waste also pose health threats as resistance genes transfer to human pathogens.
- These dangers show the close relationship between environmental damage and harm to human health, highlighting the seriousness of mismanaged animal waste. (inciner8,2024).

VIII. ISSUES AND CHALLENGES ASSOCIATED WITH LIVESTOCK WASTE HANDLING

- Livestock waste operations have been shown to cause significant environmental and public health problems including nutrient enrichment of surface and ground waters, contamination of drinking water supplies, fish kills, and Odors.
- Livestock waste, if not properly managed, can be transported by water over the surface of agricultural land to nearby lakes and streams. There, the nutrients in livestock waste can reduce the oxygen content of the water, leading to algae blooms, fish kills, and threats to other wildlife.
- Solids deposited in water bodies can accelerate eutrophication by releasing nutrients over extended periods. Leaching from manure storage lagoons and percolation through the soil of fields when livestock waste is applied has resulted in nutrient contamination of groundwater resources, and also can contribute to surface water pollution through subsurface groundwater recharge of lakes and streams.
- Atmospheric deposition of nitrogen from animal operations is also an environmental concern. This occurs when nitrogen in liquid waste is volatilized as ammonia nitrogen from anaerobic (oxygen-

deprived) lagoons, causing ammonia to evaporate. Volatilization also occurs after land application. Once in the atmosphere, it is converted to forms which are redeposit within 50-100 miles on land or in surface waters. These forms of nitrogen are water-soluble, meaning the nitrogen can adversely affect water quality much like nitrogen fertilizer if it enters a stream as direct surface runoff. Therefore, livestock waste can be a contaminant for food, soil and water. It may also be a cause of offensive odor.

- The public health and economic costs in form of disease outbreaks, rejects of products, products recalls and regulatory fines and so on that could be associated with improper disposal of livestock waste or animal manure contaminated foods and food products may far exceed whatever cost-savings are being targeted by the producers who adopt unsustainable livestock waste management practices. Therefore, manure management systems must integrate appropriate measures for odor control. Reducing the frequency, intensity, duration and offensiveness of the odor is the main goal of effective odor control (Smith et al., 2001) [21].
- The open dumping method of waste disposal adopted in the farm has significant effect on the workers and the environment. The dumping site creates growth conditions for disease vectors; insect pests also lay their eggs on the rotten wastes. This later hatch and invade the farm animals (Olusi, 1998) and workers inclusive.
- The workers were not adequately informed on various safer and more hygienic waste management methods. Hence, they are limited to open dumping, thereby recording low waste management and poor prevention of air-pollution and air-borne diseases. The whole heap of the dump site creates obnoxious odour and encourage the growth of pathogens and insect pests lay their eggs on the heap (Madukwe et al., 1996).

IX. FOUR STAGES TO TURN THE ORGANIC MATERIAL INTO BIOGAS

First, bacteria break down carbohydrates; then acidogenic bacteria turn sugars and amino acids into carbon dioxide, organic acids, hydrogen, and

ammonia. In the third stage, these organic acids are transformed until methanogens can finally break the components. In the fourth stage and obtain methane and carbon dioxide. Since half of the world's energy consumption goes into heating or cooling, the world can significantly reduce the need for fossil fuel sources by shifting to biogas. Studies have revealed that the usage of biogas could reduce global greenhouse gas emissions by 18-20% (Burton, 2007).

X. MANAGEMENT STRATEGIES FOR ANIMAL WASTES

Cattle are the largest contributors to global manure production (60%), while pigs and poultry account for 9 per cent and 10 per cent, respectively (Herrero et al., 2009). Improved waste management through enhanced manure management and biogas production for energy should be the main interest. Improperly managed animal waste can have severe consequences for the environment such as odor problems, attraction of rodents, insects and other pests, release of animal pathogens, groundwater contamination, surface water runoff, deterioration of biological structure of the earth and catastrophic spills (Sakar et al., 2009). Therefore, following strategies for management of animal waste can be put to use.

Strategies Dealing with Nutrients Balance: Phase separation can be used as a simple method to enhance manure management capability. It allows separating manure into a solid fraction, which can be composted on-farm, transported to farther distances or delivered to a centralized composting plant, and a liquid fraction, which can be used in the nearby lands by means of irrigation systems or further processed (Burton, 2007).

Strategies Dealing with Hygienization: A temperature-time criterion of 70°C for 1 hour has been stated as a minimum for specific thermal treatments prompting reductions equivalent to 4-log₁₀ units, although it could be excessive for certain pathogens and low for others (Heinonen-Tanski et al., 2006). Aerobic digestion of liquid manures in self-heated thermophilic bioreactors has been proposed as effective for hygienization (Juteau et al., 2004), although with high electrical power requirements for transferring oxygen.

XI. ENVIRONMENT PROTECTION THROUGH UTILIZATION OF ANIMAL WASTES

Animal waste management via recycling is an important step in sustainable livestock waste management as well as to reduce the negative environmental impact associated with its mismanagement.

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 sulphide and ammonia. These diffuse into the surrounding bulking agent. In this bulking agent, aerobic microorganisms degrade these materials to odour-free carbon dioxide (CO₂) and water (H₂O). 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 are used to enhance waste conversion and to enhance a better end product. Vermicomposting involves bio-oxidation and stabilization of organic materials by the joint action of earthworms and microorganisms. (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 1m³ Verm reactor containing a stable and very active population of the earthworm *Eisenia Andrei* for 40days. Samples were collected from the Verm reactor 40 days after the addition of the third layer of composted manure. (Lazcano et al. 2008)

Bio methanation 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 bio methanation, 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. Bio methanation 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 m³ CH₄ /kg of Volatile Solids in pig manure, 0.21m³ CH₄ /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).

Biogas Production: Biogas production from animals by anaerobic digestion has been traditionally a common practice in Asia, particularly in tropical areas such as Indonesia, India and Vietnam (Henuk, 2001). Biogas is used as fuel for cooking and lighting purposes and in diesel engines to substitute diesel-oil. The left-over decomposed slurry is a good source of manure for agricultural lands as it contains 80 per cent carbon, 1.8 per cent nitrogen, 1 per cent phosphorus and 0.9 per cent potash making it an excellent source of not only humus but also micronutrients for crops.

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).

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 extent by blending of 20% biodiesel (John Abraham et al., 2014).

XII. GOBAR-DHAN SCHEME BY THE GOVERNMENT OF INDIA

Galvanizing Organic Bio-Agro Resources Dhan is known as GOBAR-Dhan (Ministry of Jal Shakti, GoI, 2021). It debuted in April of 2018. This programme was a part of the Swachh Bharat Mission’s Biodegradable Waste Management Component (Grameen). The objectives of the plan included boosting rural households’ incomes and using the excrement from the cattle to produce organic manure and energy. The GOBAR-Dhan principles include collecting cattle waste and turning it into biogas for domestic and industrial use, using bio-slurry as a by-product of the biogas process to make bio-fertilizer, actively involving the community, Self-help groups, and milk cooperatives in operation and management, concentrating on making the process financially viable for everyone along the value chain, and fostering entrepreneurship for the large-scale production of compressed biogas and bio-fertilizer.

The Different Models Of GOBAR-Dhan are Explained Below:

Individual Household Model: In accordance with this concept, Gram Panchayats will select potential households for the installation of GOBAR-Dhan units and make arrangements to offer technical and financial help for the development of biogas plants. Additionally, GPs would urge households to build biogas plants using their own resources or resources obtained from CSR through IEC initiatives. According to the NNBOAMP funding guidelines, the New National Biogas and Organic Manure Programme (NNBOAMP) of MNRE, the 15th Finance Commission, MPLAD, MLALAD, and other State schemes, among others, can be utilised to fund the construction of housing units.

Cluster Model: According to this methodology, the GPs can pinpoint a group of residences for the installation of residential biogas plants. While the slurry will be gathered and processed at a central location that has been decided upon, the houses will use the biogas that is produced. The GPs will make sure the targeted homes utilise the generated biogas and sell the slurry to the agency for additional processing and conversion to bio fertilizers/organic manure. Cluster units can be established using a variety of funding sources, including the New National Biogas and Organic Manure Programme (NNBOAMP) of MNRE, SBM(G), 15th Finance Commission, MPLAD, MLALAD, and other State schemes, etc. The NNBOAMP funding guidelines shall be followed. Cluster model's participating households will receive assistance from SBM-G.

Community Model: Construction of community-level biogas plants is possible for a group of at least 5-10 families. Household garbage will be gathered and delivered to the biogas plants. While the slurry can be utilised in agriculture, sold to farmers, transformed to bio-fertilizers, or used as organic manure, the biogas produced will be distributed to homes, restaurants, institutions, etc. It is possible to utilise the various financing sources, including NNBOAMP, SBM-G, the 15th Finance Commission, MPLAD, MLALAD, and other State programmes.

Commercial Model: Huge Bio-Gas/ Compressed Bio-Gas (CBG) facilities can be built under this paradigm by businesses, cooperatives, gaushalas, dairies, etc.,

with the aim of producing a lot of raw biogases on a large scale. After being transformed into CBG, the biogas can either be sold directly through fuel dispensing devices or to businesses like Oil Marketing Companies (OMCs), (S. M. Nanda1,2022).

XIII. 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.

XIV. CONCLUSION AND RECOMMENDATIONS

Livestock contributes a major chunk to the economies of both developed and developing countries. Livestock production systems produce a large quantity of animal manure. The management of manure as a resource can offer benefits to livestock producers. Livestock waste management helps to maintain soil fertility in soils lacking organic content. Technologies are present and more research is being carried on for evolving more technologies for safeguarding the environment. The

initiatives should be taken by the national governments in co-ordination with civil societies and incentives should be given to farmers and general public for adoption of such technologies and hence safeguarding the environment and making Earth a better place to live in. Efficient management of livestock waste helps to increase socio- economic status of developing country, and also reduce chances of spreading disease from waste.

The following precautions should be taken to prevent or minimize all these problems:

- Non-profitable family type small administrations should be unified under cooperatives.
- A safer preservation belt around the settlement area should be investigated by a technical commission and animal barns should be carried beyond this belt. In the determination of the belt length, human and environmental health due to contamination by the animal waste and causing diseases should be considered.
- Animal wastes should be stored as defined in the Haryana Environmental Regulation. Stores should be built in a suitable place far enough from the family houses considering topography and groundwater level of the location. Solid wastes are suggested to leakage proof tanks or concrete digs.
- In the investigation of the storage duration, climatic condition of the region, destruction time period of the wastes, farming practices, methods how and where the wastes are used, administration principles and regional or central regulations should be taken into account.
- Animal wastes should be used to produce biogas. Farmers should be educated and subsidised by the State and Central government for motivation. By this way, environmental damages may be decreased to minimum while the considerable part of the farm energy requirement is met.
- Organic fermented fertilisers, main residue after the biogas production should be used in plant production to decrease commercial chemical fertiliser and decrease the cost.
- Farmers and people living in rural areas should be educated on environmental pollution and

ecological balance by seminar, group meetings, leaflets and other suitable publications (Kocaman,2011).

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