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Popular Article

Management And Utilisation of Dairy Farm Waste – An Insight

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Abstract

The waste generated by dairy farm sector is the major contributor to the environmental pollution and global warming. Efficient utilization and management decrease the harmful effect on environment while generating value added commodities and enhancing the socio-economic status of the farmer. Traditional methods like composting, vermicomposting, biogas, panchgabya, biodynamic fertilizer etc. are widely in use. Production of biodiesel, bioplastic, bio textile etc. from the dairy waste should be encouraged. Single cell protein production from the dairy waste is also a sustainable approach. Various waste management methods also have significant effect on reducing the pollution. Manure management starts from feeding because the feeding influences the manure characteristics. The collection, storage and treatment methods of the dairy farm waste should be appropriate to minimize the methanogenesis. Technological advancement in dairy waste management is necessary for a sustainable production.

Keywords: Dairy farm waste, Livestock manure

India is the largest milk producer in the world from 1998 onwards and has a bovine population of 302.79 million. Dairying is considered as the backbone of rural economy of India. Unfortunately, the growing population of bovine contributes significantly to air, water, soil pollution due to large amount of waste generation which is often left unattended. Adult cattle discharges about 18-30 kg of dung/day and 18-30 L urine/day which results in high BOD in the wastewater discharged from farms and causes eutrophication in the waterbodies. In addition, cattle dung, if untreated, releases carbon dioxide, ammonia, hydrogen sulphide, methane etc. which contributes to global warming. Environmental pollution is the major concern related with dairying in today's scenario. Therefore, it is imperative to effectively manage and utilize the farm waste to decrease its harmful effect on environment while generating value-added commodities for higher sustainability of the system.

The waste derived from the dairy farm also comprises bedding materials, feed leftovers, veterinary medicines, washed out water, placenta, still birth, hoof, and horn, among many others. This waste can either be separated into liquid and solid or flushing of both forms can be practised. The later needs large quantities of water but is suitable in buffalo farms due to the watery consistency of dung. Usually, there is variability in the generation of waste according to the farming system adopted. However, methanogenesis takes place from all types of manure which can be controlled by management practices like handling, storage and treatment.

Indian farmers are aware of the various uses of livestock manure. Cow dung is utilized as a fertilizer, fly repellant, cleansing agent and as a fuel. Gober gas or biogas production is majorly dependent on the cow dung in India. Apart from the conventional methods like composting, vermicomposting, biogas, biodynamic fertilizer, panchgabya etc. novel technologies that are effectively utilized nowadays to alleviate pollution from dairying. Robotic manure collectors, manure processing systems and methane digesters are also among these technologies. Further, biohydrogen production from dairy waste is also a sustainable approach which can be synthesized either photosynthetically by algae or photobiologically by fermentative bacteria.

The management starts from feeding of the farm animal, because the manure characteristics are affected by the feed. The nitrous oxide emission from manure is influenced by protein proportion in the diet. Methanogenesis is temperature dependent; it is observed that at lower temperature methanogenesis is less, so active cooling of the slurry is advised. Frequently removing the manure from farm to outside storage is recommended and more relevant in temperate areas because of the temperature difference in farm and outside storage. Covering the liquid manure to decrease the ammonia emission is also practised. The treatment technologies include manure separation into liquid and solid fraction, anaerobic digestion, aeration etc. Adding chemical additives during treatment is also an option. It will prevent the unwanted transformation in slurry. Acidification of cattle slurry with sulphuric acid is found to be very effective to reduce the methane emission from slurry.

Nutrient recycling is also a method that is often utilised but is problematic in intensive farming systems with very less land availability. The excessive application of fertilizer leads to heavy metal accumulation, pathogen build up and deterioration of soil quality. Pyrolysis can also help to reduce the waste volume and pathogen load. Pyrolysis of waste is the thermochemical processing of waste mostly in anaerobic condition at a high temperature leading to decomposition. Pyrolysing temperature of manure is 248.8-998.8˚C and the products are

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biochar, bio-oil and syngas. Biochar obtained has wide uses in agriculture since it improves soil fertility and also retains heavy metals. It can also be used as an adsorbent for pollutants.

One of the novel approaches in dairy waste utilization is the generation of biodiesel. Studies on biodiesel production from dairy waste scum is gaining widespread attention. Since it is a renewable and biodegradable energy source, the production and use should be encouraged. When compared with crude oil, it is cost effective. Studies are also going on utilizing algae grown on dairy farm waste for production of biodiesel. Basically, bio-oil is converted to biodiesel by transesterification process.

Dairy waste contains abundant amount of lignocellulose. It can be utilized as a substrate for various processes leading to waste valorization. Converting lignocellulose fraction into sugar for feeding lactic acid bacteria is a good option for polymerization to polylactic acid (PLA). Polylactic acid derived from cow dung can be utilized in bioplastic production. Bioplastics are biodegradable but require a high cost for production but still it is ecofriendly. It has uses in medical industry and food industry because of its water barrier properties. Bio textile processing from dairy waste especially from cow dung is another approach. The extracted cellulose, hemicellulose and lignin from the manure can be further used for the preparation of nanocellulose which can be used in the textile industry.

Dairy waste can also be used as a suitable substrate for food and feed production. Single cell proteins (SCP) are the dried-up form of microorganisms like bacteria, fungi, yeasts and algae. They can be included in both human food and animal feed as a protein supplement. Dairy waste can be utilized as a substrate for SCP production. Since SCP can be produced year-round without any seasonal fluctuations like agriculture, it is reliable cost effective and need only less land for production.

Cow dung has also been used as a substrate for the development of electronic components. Supercapacitors used in electrochemical batteries need porous carbon as electrode material. The synthesis of porous carbon is a costly procedure, so using biomass as a carbon precursor is a good alternative. By treating cow dung with potassium hydroxide, activated carbon can be formed. This can be used in supercapacitor electrodes. The electrochemical application of cow dung can be extended into lithium-ion batteries.

Summary

Over the past 25 years, there have been significant issues with dairy waste collection, transport, storage, treatment and disposal due to their time-consuming nature and the risk of pollution that resulted from inadequate management. Methods were developed to address the

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issues, but continued technological improvements are needed in this field to reduce operational expenses and energy needs. The dairy waste supply chain should also be strengthened. Managing livestock waste effectively will ultimately aid in enhancing the socioeconomic status of farmers and decrease the likelihood of illness spreading.

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