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Farmyard Manure: Bane to Boon

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India has the largest population of cattle and ranks first in the world in milk production since 1998. For several rural populations dairy farming is seen as a secondary source of income and helps in providing opportunities and employment. Dairy farms are establishments which house milch animals to produce milk for distribution and processing dairy products in milk processing plants. What was initially a small scale business has turned into a commercial industry largely due to the white revolution. Over the years there has been increasing demand to produce more from less. This has resulted in intensive and semi intensive farming. The intensification process of the livestock sector has been characterized in recent decades by increasing output of product per hectare, increasing stocking rate, including more concentrated feed in the diet, and improving the genetic merit of the breeds.

Promising climatic and infrastructure conditions have led to a very high livestock concentration resulting in over exploitation of natural resources (i.e., land, air, water) and high environmental pressure. Intensification of livestock production systems resulted in a larger amount of agricultural waste being generated leading to excess pollution. Agricultural wastes can be solid (dung, feed, bedding, carcass), liquid (urine, washings) or in the form of gases (methane, carbon dioxide, ammonia).

Disposal of solid wastes has offered the biggest setback to dairy farms. Waste water containing faces and urine is often discarded into water bodies leading to eutrophication. In addition to that manure that finds its way due to leaching into the soil and can affect the groundwater thereby leading to contamination. Although initially disposed off as a by-product, in recent years due to implementation of stricter laws and the need for sustainable farming, it has been utilized as a value added product. Manure as a fertilizer also saves the farmer finances which would have other wise been spent on chemical fertilizers.

Characteristics of Manure

A bovine animal, on an average, weigh 400 kg and discharges 15-20 kg/day of dung and 15-20 litres/day of urine. Out of this 70 per cent is solids and 30 per cent is liquid. Faeces and urine makes up 8 % of the animal's total body weight. The pH of manure ranges from 5 to 9. It has high amounts of nitrogen, phosphorous, potassium and calcium required for increased crop yield. Several different methods have been used to transform this waste material into a source of additional income.

1. Free stall

In this animals are reared in stalls with access to an open enclosed area. This way the manure does not collect at one place and does not have to be removed immediately. Instead there is sufficient time for it to dry out and become powdery and it can be stored for longer periods of time. The manure is spread evenly, and takes on a fine, powdery consistency, due to perpetual pacing of the animals. Loose housing barns, permit for the animals' urine to be properly

mixed with the manure, further increasing its fertilising efficiency. Whereas traditional manure is sold at Rs.5 per kilogramme this manure is sold at Rs.15 per kilogramme.

2. Windrows

They are formed by constructing long piles of manure with a triangular cross section. It comprises of 3-4 metres width at the base and a height of 1.5-2 metres. In a 75 metres long windrow, 225 cubic metres can be placed. Water shedding is promoted by the slopping sides and apex. Piles should not be too high or too low. If the pile is too low, lack of heat will prevent pathogen deactivation and weed seed destruction. If the pile is too high, excessive heating could lead to spontaneous combustion. Windrows should have minimum 5 metres distance between them to facilitate easy vehicular movement.

3. Stockpiling

The forming of long low windrows that are left to age for a couple of months. This leads to physicochemical changes, thereby making it more friable and easier to spread. The height of these windrows should be less than two metres. The dry matter content is reduced by about 35 percent if the stockpiling is left for a lengthy period of time. Although the dry matter content reduces certain nutrients like phophorous become more concentrated. Sometimes manure may contain weed seeds. The incidence of germination of these seeds can be reduced by exposing the manure to a high temperature of 55 ^{o}C.

4. Mortality composting

This method involves utilizing compost, along with agricultural waste and carcasses. There are different methods for this like bin, piling, rotating drums and windrows. The site and amount of space needed depends on the size of the animal. In mortality composting there are three layers, the base which adsorbs liquids, core media which adsorbs gases and odours as well as provides carbon, mass and energy and finally the cover or cap layer which provides insulation and deters pests.

Prior to using the carcasses for composting their rumens should be punctured to prevent accumulation of gases and easier decomposition. Special equipment is available for grinding and chipping of the carcasses. If however the animal is suffering from an infectious disease it is advisable to dispose off the carcass as early as possible following

all necessary precautions without opening it.

The base should consist of straw or sawdust and should be six metres wide to be able to absorb leachate during decomposition. The cover material on top of the carcass should be at least 50 centimetres and consist of a mix of sawdust and manure. If needed another carcass can be stacked on top of the first one before covering it again.

For each tonne of carcass there should be at least a 2.5 metre of windrow length. In addition to recycled compost, poultry litter, woodchips, corn stalks and peanut hulls can also be used. There should be turning over of the compost after four to six months to ensure proper aeration. The entire process takes up to a year including decomposition and curing.

5. Vermicompost

An excellent bio-fertilizer, it is an aerobic method of composting which makes use of earthworms to degrade the manure. The worms consume organic matter and excrete little pellets known as vermicompost. Nutrients such as nitrogen, potassium, phosphorous and calcium are released in to more soluble forms that can be utilized more efficiently by plants. Vermicompost enhances the water retention capacity, aeration and texture of soil as well as its nutrient status.

Furthermore in plants, it promotes better root growth and nutrient absorption. The passage of water through a column of worms provides a liquid fertilizer known as Vermiwash. Used as a spray, on foliage it contains micronutrients, plant growth hormones and cytokines. It is further enriched by the presence of phosphate solubilizing bacteria and nitrogen fixing microbes. It serves as a plant tonic and decreases the incidence of plant diseases. A major disadvantage of this method is that the temperature must be maintained at below 35 ^{o}C which will not remove all the pathogens. Cost of Vermi compost is Rs.20 per kilogramme and the cost of enriched Vermi compost is Rs. 35 per kilogramme.

6. Biogas

Biogas has methane gas as its main component and is produced by the anaerobic digestion of animal manure and municipal waste water sludge. In addition to methane (50-80%), it contains carbon dioxide (20-50%) and traces of hydrogen sulphide (0-0.4%). This mixture is saturated with water vapor and may also contain the presence of dust. Depending on the quality of feed and conditions used for anaerobic digestion, the percentage of gases would vary.

Calorific value of biogas fuel is determined only by the percentage of methane gas. The formation of biogas occurs in four steps viz. hydrolysis, acidogenesis, acetogenesis and methanogenesis. Since agricultural and animal waste is freely available from farms utilization of biogas as a source of energy for various purposes is a good alternative. This also leads to complete recycling of organic wastes without adding to environmental pollution. Biogas plants can either be permanent made out of fibre glass reinforced plastic or it can be a small portable unit.

A biogas plant can be used for cooking purposes. For an average sized family a plant of two cubic metres is sufficient. It can be used for lighting purposes as well. Biogas has also been used to replace 80 percent of diesel oil in a duel fuel engine. Vehicles have also had their engines modified so as to enable them to run 100 percent on biogas. Cylinders containing pure biogas can be sold as a marketable product in place of LPG cylinders. The digested slurry obtained from biogas plants can be utilised as a fertilizer since it is a rich source of micronutrients and humus. It contains 80 per cent carbon, 1.8 per cent nitrogen, 1 per cent phosphorous and 0.9 per cent potash. Over the years biogas plants have been advanced to process garden wastes, sewage sludge, market wastes, etc.

7. Dung wood

This is made using dry manure, saw dust or paddy husk. This mix is fed to a machine which produces dried cow dung cylinders similar to logs. The starting price of one of these machines is retailed at Rs. 30,000. Surplus of these can be sold in the market.

8. Panchgavya

Panchgavya is a term used to describe five major substances, obtained from cow, which include cow's urine, milk, ghee, curd and dung. It contains macronutrients like nitrogen, phosphorus, potassium and micronutrients which are required for the growth and development of plants and also contains various amino acids, vitamins, growth regulators like Auxins, Gibberellins and also beneficial microorganisms like pseudomonas, azatobacter and phosphor bacteria etc.

The advantages of this are multiple fold. It has been reported to enhance soil fertility and health as well as increase the yield and quality of produce. Since it can be used against some pests and diseases the cost for separate pesticides and fungicides is further reduced. Plants that were sprayed with this mix were observed to have a denser canopy of leaves and a higher degree of branching due to the production of a larger number of side shoots. Panchagavya can restore the yield level of all crops when the land is converted from inorganic cultural system to organic culture from the very first year. The harvest is advanced by 15 days in all the crops. The cost per litre is Rs.280.

Conclusion

Although India occupies the top spot in milk production in the world this has come at a heavy price. Intensification has lead to higher generation of agricultural wastes and the current need of the hour is to obtain more from less. With the current focus on organic and sustainable farming it is even more important to make use of every single animal product and by product to add more value to the farmer's profits. What was initially considered to be a useless by-product or a product that can only be treated as a nuisance, manure obtained from cattle has been shown to have ample uses.

It has been reported by combining it with various other methods, the nutritional content goes up and it has been reported to increase the growth and yield of crops. In India, manure from cattle and buffaloes has been used in carp polyculture without any additional supplementary feeding. Furthermore research is going on to see if manure which contains 80 per cent of the original feed rations can be recycled and reused again.

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