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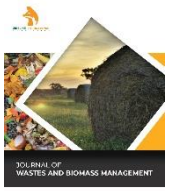

RESEARCH ARTICLE

UTILIZATION OF SOLID OR LIQUID WASTES IN AGRICULTURE

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ABSTRACT

Now-days increasing solid or liquid wastes are major problems in developing country therefore utilization of all these wastes are required because of its impact on the environment and as well as on agriculture. These wastes are decomposed and stabilized through composting, vermicomposting, anaerobic digestion, recycling and reuse. Solid wastes act as an organic fertilizer, nutrient supplier, and media for nursery and also helps in improving the physical, chemical and microbiological activity in agricultural soils. Reuse of wastewater helps in reducing water crisis in agriculture. Poultry wastes are used as organic fertilizer, feed for livestock, biogas production, products for commercial purposes.

KEYWORDS

Wastewater, Poultry wastes, recycling of organic wastes, composting.

1. INTRODUCTION

The boosting population of the world plays a major role in increasing solid or liquid wastes in developing countries. These wastes are very harmful to the environment, agriculture as well as for human health. These wastes are boosting the crop yield if they are used systemically otherwise, they create problems in agriculture. Municipal solid waste (MSW) refers to the "collection of wastes by the municipalities or other local authorities". Food waste, garden and park waste, paper and cardboard waste, wood, textiles, nappies, rubber and leather, plastics, metal, glass, and others (e.g., ash, dirt, dust, soil, electronic waste) are the MSW according to the Intergovernmental Panel on Climate Change (IPCC, 2006). Municipal solid waste management (MSWM) defines that storage, collection, relocation, carry-age, processing, and disposal of solid waste to minimize its adverse impact on the environment and as well as on agriculture.

Unmanaged MSW becomes a big problem for developing countries because its impact on human life also (Kumar et al., 2009). About 12 million tons of inert wastes are generated annually in India from street sweeping and C&D waste and it occupies about one-third of total MSW. In India Municipal solid waste management (MSWM) is governed by Municipal Solid Waste (Management and Handling) Rules, 2000 (MSWR). Solid Waste Management Act of 2011 was launched by the Government of Nepal on 15 June 2011. This act mainly focuses on maintaining a clean and healthy environment by reducing the effects of solid waste on the environment and public health. The local bodies, such as municipalities, rural municipalities to take all necessary steps to promote reduce, reuse, and recycle (3R) of MSW at the source. The SWM Technical Support Center (SWMTSC) under the Ministry of Urban Development shall provide technical support to all local bodies (such as municipalities, rural municipalities, NGOs) for effective and sustainable solid waste management and advance research and development in this sector. The utilization of solid or liquid wastes should be done in followings ways:-

2. COMPOSTING

Composting is a process of the solid waste management system (SWM) and used for recycling of organic matters into useful products and also helps in controlling the increasing wastes (Shymala and Belagali, 2012). Composting is a biological decomposition process which is circuited by microbial activity. Some physical-chemical parameter is affecting the composting process like temperature, aeration, moisture content, C: N ratio and pH (Fathi et al., 2014). The break-down of organic materials into carbon dioxide, water, minerals, and stabilized organic matter under increasing temperatures through successive microbial populations is known as composting (Evanylo et al., 2009). Some researchers reported that the small-scale of composting as maximum 5 t/d, medium-scale as around 5 to 100 t/d, and large scale as >100 t/d of organic waste processed (Pandyaswargo and Premakumara, 2014). High organic matter content, full ripeness, pH value from 6 to 7.8, absence of weed seeds and pathogenic organisms, particle size <13 cm, dark colour, absence of heavy metals and toxic substances, agreeable earthy odour and moisture content below 50% are the major characteristics of good quality compost. Application of various organic fertilizers such as manure, compost and vermicompost are playing a major role in the sustainable management of soil and safe food production (Milošev et al., 1998; Čuvardić et al., 1999; Čuvardić 2005; 2006).

A study reported that application of urban waste compost (UWC), manure and chemical fertilizer are found effective in the development and growth of corn (Naderia and Ghadirib, 2010). Urban waste compost and manure are helping in increasing the leaf area, leaf number, stem diameter, height and leaf N of corn because effective nutrient sources are found in manure and compost and also considered as potential alternatives to chemical N fertilizer. Composting is also known as a soil conditioner, organic fertilizer as well as containing high nutrients for the soil and also use of composting in agriculture is found more effective, environmentally safe and most agronomically sound. The microbial community of compost i.e. bacteria,

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fungi and worms can also stabilize the degradable organic matters (Rama and Dr. Vasanthy, 2014). A researcher compared MSW and cattle manure in 3 different trail (Varma and Kalamdhad, 2013). They used a different proportion of Composting of Municipal solid waste (MSW) mixed with different proportion of cattle manure i.e. 1:1.5 (Trial 1), 1.5:1 (Trial 2) and 1:1 (Trial 3) were compared in a rotary drum composter. It was observed that 1.5:1 (Trial 2) produced higher quality compost with final total nitrogen (2.16%), phosphorus (3.24 g/kg), Organic Carbon (17.04%) and electrical conductivity (EC) (2.78 dS/m) within 20 days of composting.

2.1 Advantage of composting

The reduction of volume, weight and water content of the waste as well as producing inactive pathogenic organisms are the advantages that can arise from composting and also helps in improvement of soil contents and nutrients required for harvesting plants, and reduce the use of synthetic fertilizers (Hangreaves et al., 2008; Hernandez et al., 2010). The application of compost can improve soil properties and increase the organic carbon contents in the soil. Compost also helps in improving soil structure, water infiltration rate, water holding capacity and tilth of the soil (Risse, 2012). Compost provides nutrients that are required for agriculture also replace chemical fertilizer. Compost used as soil amendments and it is eco-friendly, hygienic economical and toxic-free. Composting of agricultural wastes with animal manure can enhance the degradation process and the composting of municipal solid waste (MSW) and kitchen waste it is important to measure the heavy metal content in compost because of its toxicity and different method of composting influenced the nutrient status of compost (Aeslina et al., 2016). Composting plays an important role in agriculture because it contains many macro and micronutrients and also helps in increasing the yield. Now-days compost is used in organic farming.

3. POULTRY WASTES

The poultry waste includes bedding material or litter (e.g. wood shavings or straw), broken eggs packing material and feathers removed from poultry houses, waste feed, dead birds, mixture of faecal and urinary excreta (manure), waste from cage, conveyer belt and water flushing systems (Kelleher et al., 2002). Approximately 91% protein (keratin), 1% lipids and 8% water are found in chicken feathers. The sequence of amino acids mainly composed of cystine, glutamine, proline which are found In chicken feather. The most abundant amino acid serine (16%) is also found in the feathers of chicken (Kannappan and Bharathi, 2012). Organic solid by-products and wastes produced in broiler farming and slaughtering are blood, feet, head, bone, trimmings and organs which contains 5.3% of nitrogen, 32% proteins, 54% lipids and 0.6 to 0.9 % methane production potential (Salminen and Rintala, 2002). Carbon (C), Nitrogen(N), Phosphorous (P), Chlorine (Cl), Calcium (Ca), Magnesium (Mg), Sodium (Na), Manganese (Mn), Iron (Fe), Copper (Cu), Zinc (Zn), Arsenic (As) and water are found in poultry manure and also contains solid dry matter of about 150 g/ kg (Kelleher et al., 2002). The continuous application of poultry manures helps improvement in physical properties of degraded soil and increased the yields of maize grain (Are et al., 2017). The approximated percentage of nutrient i.e. nitrogen (65.5%), potassium (83.5%) and phosphorus (68.5%) are excreted by poultry and beneficial for increasing crop production (Olumayowa and Abiodun, 2011). The amino acid nitrogen of cage layer waste ranges from 37 to 40% of total nitrogen and 40 to 60% of total nitrogen in poultry excreta are present in the form of non-protein nitrogen (NPN) and drying of poultry manure is the oldest procedure of processing waste for refeeding (Chaudhry et al., 1997). Dried poultry waste contains about 30% protein, of which about 60% is from non-protein nitrogenous sources. The drying process is affected by several factors which alter its property (Ghaly and Alhattab, 2013).

3.1 Utilization of poultry wastes

The feathers of poultry are converted into feather meal with usage as animal feed, organic fertilizers and feed supplements. The digestion of feathers under high pressure at high temperature by the hydrothermal process is known as feather meal production. Destruction of essential amino acids like methionine, lysine, tyrosine, and tryptophan is also done by hydrothermal treatment and that accounts to poor digestibility and low nutritional value (Ekta and Rani, 2012). Composting is a common method to treat poultry slaughterhouse wastes, manure, litter, grease trap residues and sometimes also feather. Composting helps in reduction of pathogens, and also used as a soil conditioner or fertilizer (Tritt and Schuchardt, 1992). The production of methane (biogas) is obtained from anaerobic digestion and biomethanation of poultry litter, which are used to run a turbine to generate power and generated biogas can be used as a source of thermal energy to heat the chicken at the beginning of the batch (Oliveira et al., 2012).

4. REUSE OF WASTEWATER IN AGRICULTURE

The world water which is obtained from rivers and pumped from underground is used in 70% for irrigation, 20% for industry and 10% goes to residences. If the world is facing a water shortage then it is also facing a food shortage because food production depends on the irrigations (Earth Policy Institute, 2002). During 1950-60, application of wastewater on land in the western hemisphere as wastewater treatment technology advanced and quality of treated effluents steadfastly improved and land application became a cost-effective alternative of discharging effluent into surface water bodies (Asano, 1998). The wastewater used in agriculture for irrigation can be collected from different sources. These wastewaters can be mechanically purified or particularly purified or fully purified, treated biologically or completely untreated municipal or industrial wastewater (Donta and Antonia, 1997). The benefits of wastewater use in agriculture will help in decreasing the pressure on freshwater sources. Thus, wastewater provided as an alternative source of irrigation in agriculture, 70% of available water is consumed by water user (Pimentel and Pimentel, 2008). The cost of extracting groundwater resources could be avoided by using agricultural wastewater and the energy required for pump groundwater can represent up to 65% of the costs of irrigation activities (Cruz et al., 2009). According to a study, wastewater have potential source of macronutrients - (N, P and K) and micronutrients (Ca, Mg, B, Mg, Fe, Mn or Zn) (Liu and Haynes, 2011). Wastewater helps in improve the crop yield and reduce the use of fertilizers in agriculture (Oliveira, 2008; Adrover et al., 2012).

5. RECYCLING OF ORGANIC WASTES IN AGRICULTURE

The organic wastes are stabilized through techniques such as composting, vermicomposting and anaerobic digestion and act as an organic fertilizer. These organic fertilizers help in increasing soil fertility and crop yield. The utilization of organic wastes in the agricultural field offers a double opportunity for sustainable organic waste management and soil management. The environmental deteriorations are minimized due to their unscientific disposal (Dias et al., 2010). Organic wastes are important for improving the physical, chemical and microbiological activity in agricultural soils (Hernández et al., 2016). Organic wastes are decomposed and stabilized in terms of reduction in the volume of waste, pathogens and malodorous compounds. Organic wastes can be utilized as organic manure in an agricultural field and help in increasing crop production (Diacono and Montemurro, 2011).

Composting/vermicomposting is the process of recycling organic waste in an agricultural field. Recycling of organic waste has multiple benefits like (a) these composts are used as a source of fertilizer, (b) increasing the nutrient profile of the soil, (c) improve soil structure and reduced soil erosion, (d) reduce the volume of wastes from dumpsites, (d) helps in increasing the crop production, (e) reducing environmental pollution, (f) conservation of the land resource.

6. USAGE OF DOMESTIC SEWAGE IN AGRICULTURE

There are two types of domestic sewage, one is treated sewage and the other one is untreated sewage. The treated sewage refers to the wastewater which has passed through the process of a sewage treatment plant. Sludge is the byproduct of sewage treatment. Wastewater is used as a form of water by either residential or industrial communities and 99-99.94 % of wastewater is water and the remaining is solid waste. The wastewater segregated in residential areas into two components -

A) Blackwater comprising of toilet discharge

B) Greywater comprising of shower, washing machine and kitchen discharge

The US Environment Protection Agency defined sewage sludge as an organic solid product yielded by the municipal wastewater treatment process (US EPA, 1993). This sewage sludge can be beneficially recycled for soil amendment. Sewage sludge is defined as a stabilizing organic solid derived from the biological treatment process.

6.1 Sewage use

The sewage sludge can be safely managed to sustainably utilize its nutrients or to improve the soil conditions. All have reported that the sewage effluent from the municipal origin is rich in organic matter containing appreciable amounts of major macro and micronutrients necessary for crop growth (Feign et al., 1991; Bara et al., 2002; WHO, 2005). Recycling of wastewater is used for irrigation in agricultural cultivation is a normal practice in most countries especially in arid and semi-arid regions with poor irrigation sources.

6.1.1 Case study for sewage applications in Indian agriculture

A reported the usage of sewage irrigation in different proportions has proved to improve the organic matter content to 1.2-1.78% (Yadav et al., 2002). The research results showed that the application improved soil fertility to a distance of 1km along the sewage disposal channel. The observations indicated initiation of groundwater contamination with traces of heavy metals like NO3 (upto 2.8 mg/l), Pb (upto 0.35 mg/l) and Mn (upto 0.23 mg/l). However, the heavy metal content in crop samples from the area was below the permissible critical level. The results showed changes in the nutrient content of the soil which was reflected in the nutrient uptake by wheat, berseem (winter) and rice, sorghum (summer) crops growing at the studied area. Higher NPK contents were observed in their shots when the crops were irrigated with the sewage water. NPK and heavy metal concentration in the samples declined with the increasing distance of sampling from the disposal site.

7. Conclusion

The large-scale industrialization and urbanization is resulting in huge quantities of effluents production all over the world. This sewage is either used or disposed in water bodies and on lands which have various advantages and disadvantages. The sewage effluents being rich in organic matter content and various macro, as well as micronutrients, can be used for irrigation purposes or improving the soil nutrient levels. The application of sewage water or sludge should be done only after the proper treatments and keeping a check on the nutrient levels of the sewage. This will prevent in further accumulation of nutrients, heavy metals like NO3, Pb, Mn etc. in the soil profile and reduce the chances of groundwater contamination.

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