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Assessing Environmental Impact of Wastes from Animal Husbandary Practices in a Tropical Environment

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Abstract: Dumping of decaying wastes from animal pen as soil conditioners and pen wash water for irrigation is a common practice in developing countries. Releasing wastes to land and water may affect biological, chemical and physical properties of soils, plants and water. Hence, this paper assesses pollution effects of untreated animal husbandry wastes in tropical environment. Samplings were done on a daily basis over a 6-weeks period from the University of Ibadan Teaching and Research Farm which had been in operation for over 25-years. Assessing the degree of pollution was performed on the basis of Nitrate, Phosphorous, Potassium and Magnesium measurements in dump yard soil samples with average values ranging 0.38-0.40, 0.54-0.86, 0.16-0.37, and 0.58-1.05 mg/l respectively. These values are higher than recommended FEPA standard, which makes the wastewater and slurries unsuitable for irrigated farming. Consumption of soluble nitrates and nitrites at this concentration could result to health problems such as methemoglobin. The pH of feacal discharge, wastewater, dump yard Soil being 6.5, 5.8, and 6.2 respectively were acidic. Heavy metals; Manganese and Iron ranged between 191-324 and 1.3-2.3 mg/kg respectively. Presence of heavy metals and trace elements in excess of FEPA/WHO recommended standards makes both feacal discharges and wastewater unsuitable for use as manure. Values of BOD_5, DO, and Temperature ranged 1350-1420mg/l, 0.55-0.75mg/l, and 27.0-33.5^{0}C respectively. Observed high BOD_5 and low DO values at an average temperature of 28-33^{0}C fall short of the WHO water standard for irrigation, this is indicative of high polluting power of the wastewater.
Key words: Animal wastes, wash water analysis, animal husbandry, pollution assessment, tropical environment

INTRODUCTION

The greatest agricultural water pollution is obtained from the farmyard area and its vicinity and in particular, animal husbandry is pinpointed as a major environmental contaminator (Galka, 2004). Animal production is becoming more intensive with larger operations due to increasing demand for more animal products and the projections are that this rising demand will continue as a result of steady population growth and urbanization, hence there is need for sustainability of the production through the prevention of harmful effects on the environment (Tamminga, 2003). Subsequent pollution of the environment has continued to increase due to intensive farming practices, improved farming techniques, increased use of agrochemicals, and intensive animal husbandry. The secondary effects of pollution from animal husbandry are damages in the biosphere (plants, animals, human) caused by nutrients, hazardous compounds and pathogens. Agricultural wastes or residues can be in the form of animal waste from animal production facilities, agricultural chemicals losses, crop residues, runoff and Leachate from manured fields, and liquid/solid wastes from food producing operations (Obasohan et al., 2010).

Animal wastes if not properly managed according to Copeland (2010), can be transported over agricultural land to lakes, streams and groundwater resources. This contamination of surface water, ground water, soil and air is associated with wide range of human health and ecological impacts thereby contributing to the degradation of vital natural resources (USEPA, 2002). For example, Nitrogen presence in manure and agricultural wastewaters can contaminate drinking water causing nitrate poisoning at elevated levels which is known as methemoglobinemia or blue baby syndrome. The primary pollutants associated with animal wastes are

nutrients (particularly Nitrogen and Phosphorus), organic matter, solids, pathogens, and odorous/volatile compounds. Animal waste also contains salts and trace elements, and to a lesser extent, antibiotics, pesticides, and hormones (Copeland, 2010). Rapid increase in volume and different types of wastes as a result of intensive agriculture due to population growth and improved living standards, is becoming a problem as agricultural waste biomass emits methane and leachate, and open burning by the farmers to clear the lands generate CO_2 and other local pollutants. Hence improper management of waste agricultural biomass is contributing towards climate change, water and soil contamination, and local air pollution (UNEP, 2009).

In developed world, environmental considerations largely constrain how, where, and with what intensity livestock production can be undertaken by individuals or organizations. Wastes from livestock and poultry are stored and applied to crop land in a manner that minimizes contamination of adjacent water, air, soil, and crops. Mandated authorities such as EPA generally develop policies, regulations and guidelines to manage the risk of human and environmental exposure to microbial contaminants on the basis of the best available science (Topp et al., 2009). However developing countries lack these regulatory authorities to effectively manage exposure to contaminants from different sources of wastes. In Nigeria, gross contamination of most major river bodies as a result of the discharge of industrial effluents, sewage and agricultural wastes was reported by Omole and Longe (2008)

In developing countries, surface and ground water pollution is a major problem. The pollution can either be point or non-point sources (Omole and Longe, 2008). Major sources of soil and water pollution are municipal, industrial and agricultural wastes (Omofonmwan and Eseigbe, 2009). In Nigeria, the concern for increases in the level of pollutants in surface and groundwater is justified since a large proportion of rural and semi urban dwellers in Nigeria obtain domestic water, and sometimes drinking water from ponds, streams and shallow wells (Sangodoyin, 1990). Proper agricultural waste treatment and disposal serve three important purposes which are to protect human and animal health, and safeguard environmental quality by limiting degradation of the ecosystems.

Awareness of environmental problems such as water pollution and eutrophication at local level and global warming at global level has been on the increase in animal production. The need to take action in solving these environmental problems has been recognized, therefore Ogino et al. (2007) stressed the importance of identifying and quantifying the impacts of such animal production systems have on the environment. Hence the objective of the paper is to determine the polluting strength parameters/factors of wastes and wastewater from livestock, goat and sheep yards and assess the suitability of animal husbandry wastewater for irrigation.

MATERIALS and METHOD

Field experimentation site was the university of Ibadan Teaching and Research farm located at the South-west part of Nigeria (latitude $7^0$30'N and longitude $3^0$54'E; al an altitude of about 210 m above mean sea level). The animal production system at the experimental site can be classified as mixed animal production system in which both livestock and non-livestock farming activities are carried out. In this type of system, the type and intensity of animals is an important factor in the extent to which the system may contribute to environmental degradation (Tamminga, 2003).

Soil samples were collected beneath the dump site at a depth of 5 to 12 cm with the following particle size distribution of 47.2% Sand, 43.4% Silt, and 9.4% Clay; this belong to the Silt loam textural classification of soil while feacal discharge mixed with wash water in slurry form samples were collected within the drainage channel 50 to 100m downstream section over a period of six weeks in the vicinity of the goat and sheep yards at the Faculty of Agriculture and Forestry Teaching and Research Farm, University of Ibadan, Ibadan which had been in operation for over 25 years. Collected samples were analysed at the Soil Analysis Laboratory, Department of Agronomy, University of Ibadan, Ibadan and the pollution strength parameters determined includes Biological Oxygen Demand (BOD_5), Dissolve Oxygen

(DO), Temperature, pH, Nitrates, Phosphates, Potassium, Sodium, Magnesium, Calcium and heavy metals such as Iron and Manganese were determined.

RESULTS and DISCUSSION

The slurries analyzed are excreta consisting mainly of faeces, urine, bedding material, runoff water from natural rainfall and wash water from farm buildings. In the slurry samples, varying amounts of different constituents of elements and metals are present in the following average proportion; N (0.38mg/L), P (0.34 mg/L), K (0.16mg/L), Mg (0.58 mg/L), Fe (2.3 mg/L) and N (0.40 mg/L), P (0.86 mg/L), K (1.05 mg/L), Mg (0.37 mg/L), Fe (1.3 mg/L) for the goat and sheep yards respectively (Table 1). Some of these ions are beneficial, however beyond recommended limits (in excess) they impact negatively on the plant growth and changes soil properties. Copeland (2010) reported that primary pollutants associated with animal wastes are nutrients (particularly nitrogen and phosphorus). Comparing above values of N and P with the FAO proposed allowable limit and criteria for reuse in irrigation given as 30mg/L in restricted irrigation for cooked vegetables, parks and playgrounds, the observed values are within tolerable limits for restricted irrigation application.

Table 1. Average constituent proportions of water samples

S/N	Constituent	Goat yard Sample	Sheep yard Sample	FEPA*(1991) Recommended Limits
1	N (mg/L)	0.38	0.4	30
2	P (mg/L)	0.34	0.86	-
3	K (mg/L)	0.16	1.05	-
4	Mg (mg/L)	0.58	0.37	-
5	Fe (mg/L)	2.3	1.3	0.3
6	pH	6.5	6.8	6.0 - 8.5
7	Mn (mg/L)	324	191	0.2

*Federal Environmental Protection Agency, Lagos Nigeria.

The pH of the samples of feacal discharge in both goat and sheep yards are 6.5 while that of washwater and both yard Soils ranged between 5.8 to 8.2. Comparing this pH to recommended pH limit range of irrigation water given as 6.0 to 8.5 (Mahmud et al., 2007), the pH of samples feacal discharge in both yards which is slightly acidic falls within the recommended standard while the washwater pH exceeds the acidity limit of the recommeded standard.

Runoff and washwater downstream section of the teaching and research farm gave the following range of values for biochemical oxygen demand 1350 – 1420 mg/L, while the dissolved oxygen level was as low as 0.55 - 0.75 mg/L. The pH of the wash water samples from the goat and sheep yard is 6.5 and 6.8; respectively.

The above values were compared with the water quality criteria for irrigated agricultural water uses and health due to the use of municipal wastewater in agriculture is unlikely to occur except if ingested over it was discovered the laboratory analysis of the slurry samples from both yards that the high level of pollution makes the wastes (slurry and wash water) unfit for irrigation or manure. Further more, water reports of the Food and Agriculture Organization of the United Nations (FAO, 1997) on quality control of wastewater for irrigated crop production repoted the use of faecal coliform determination as a primary indicator of contamination. However the laboratory analysing the wastewater samples lacked the resources to accurately analyse faecal coliform.

From the results above, it can be deduced that the elements and metal are in excess, which makes the slurries rather harmful to plant health growth. It is, therefore, evident that the slurries can neither be used as soil conditioners nor manure in their untreated form. Furthermore, Ayers and Westcot (1985) reported that detrimental effects on human a prolonged period of time even at low concentrations.

Contamination of both the groundwater from leachate or seepage, and surface water from surface run-off as a result of heavy rainfall will result in contamination of nearby watercourses. The consumption of water contaminated with soluble nitrates and nitrites could result to health problems such as methemoglobinemia. The low values of DO indicate high polluting power of the wash water from the two yards.

CONCLUSIONS

The results from the study revealed that agricultural waste has effect on the environment; air, soil and water.

- The strength of parameters from the soil test is low and does not constitute pollution to the soil.
- However, strenght of parameters in the wastewater is very high and constitutes a potential pollution to surface and ground water if discharged directly into or near the water course respectively.
- The high BOD leads to low Dissolved Oxygen (DO) which will cause water body to have odour and consequently not support aquatic life due to depletion of oxygen needed to sustain fish and other aquatic lives.
- Wastewater must be pre-treated by any of the primary treatment methods before discharging into any water body or used for irrigation purposes.

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