

## ASSESSMENT OF DEPOSITION OF POULTRY WASTE ON PHYSICO-CHEMICAL PROPERTIES OF SOIL

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### ABSTRACT

Information regarding the disposal of on-farm poultry wastes (manure, litter and dead birds) and the effects of poultry waste disposal on environmental quality was investigated in this study. Variability in the Physico-chemical properties of soils affected by poultry wastes were investigated on disposal area is 7m X 7m. Six soil sample were collected near and away from the poultry waste disposal site and the each soil sampling pit is divided into three layers of size vertical depth 0-30cm, 30-60cm, and 60-90cm respectively. Using standard methods the variations in quality of soil samples i.e., Physico-Chemical properties such as bulk density, moisture content, pH value, hydraulic conductivity, temperature and porosity has been analyzed. The bulk density is between 1.5 to 1.7g/cm<sup>3</sup> and the porosity is between 0.43 to 0.36 which conclude the soil type is sandy soil. The variations in quality of soil samples are good and safe when compared with standard values. Appropriate precautionary measures should be taken in the disposal of Poultry wastes to avoid environmental hazards.

**Keywords:** environmental, hazards, poultry waste, Physico-chemical, soil

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### INTRODUCTION

With an increasing rate of human population worldwide the rate of animal husbandry has been on the increase in order to meet up with food demand.<sup>1</sup> Soil is the key component of natural ecosystem because environmental sustainability depends largely on a sustainable soil ecosystem.<sup>2,3</sup> The evidence is the components of poultry dust are hazardous to health and the levels of dust exposure. The evidence that the poultry dust are hazardous to health and the levels of dust exposure resulting from a range of poultry farming tasks, provide strong evidence for treating poultry dust as a substance.<sup>4</sup>

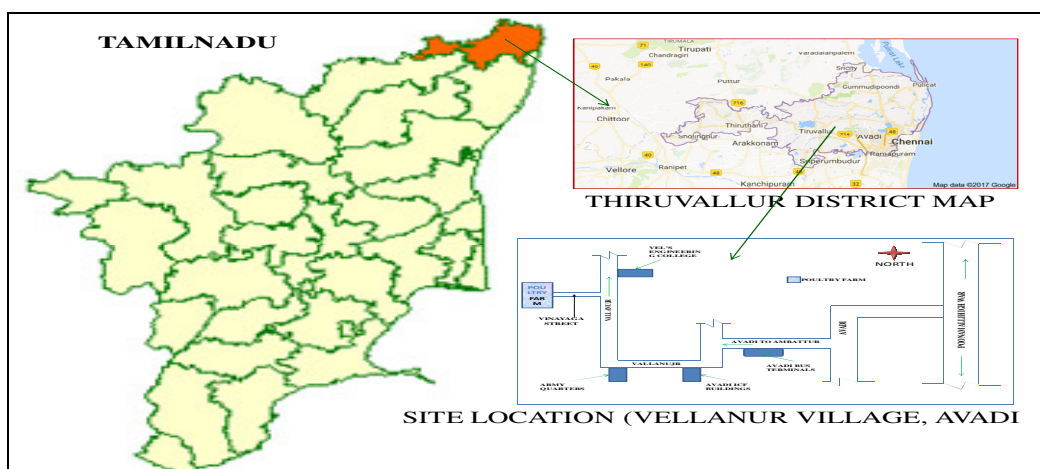


Fig.-1: Study Area

Knowledge of the amounts and compositions of chicken meat and eggs produced under different poultry production practices is essential for efficient and environmentally responsible management of these by-products as fertilizer, animal feed components or fuel.

The opportunities in the poultry waste sector arise out of the fact that the present disposal methods are environmentally unsound. Moreover the use of a renewable resource, which would otherwise emit methane due to anaerobic decomposition, makes this a potential area<sup>4</sup>.

Analysis of the present disposal methods reveal that poultry waste is left in the ground for 6 to 12 months before being used as a fertilizer. Growth and yield parameters such as number of leaves and branches, stem girth, length of internodes were increased by poultry manure treatments.<sup>5</sup>

### Study Area

The study area (Poultry Farm) located at Vellanur village, Ambattur Tehsil of Thiruvallur district in Tamil Nadu, India. Total extent of Poultry farm is 40,000square feet. The disposal area of poultry waste is 7m x 7m. Figure-1 shows the location of study area.



Fig.-2: (a) Entrance, (b) Separate bird's ventilation area, (c) Disposal area and (d) Disposal pit of the Study Area

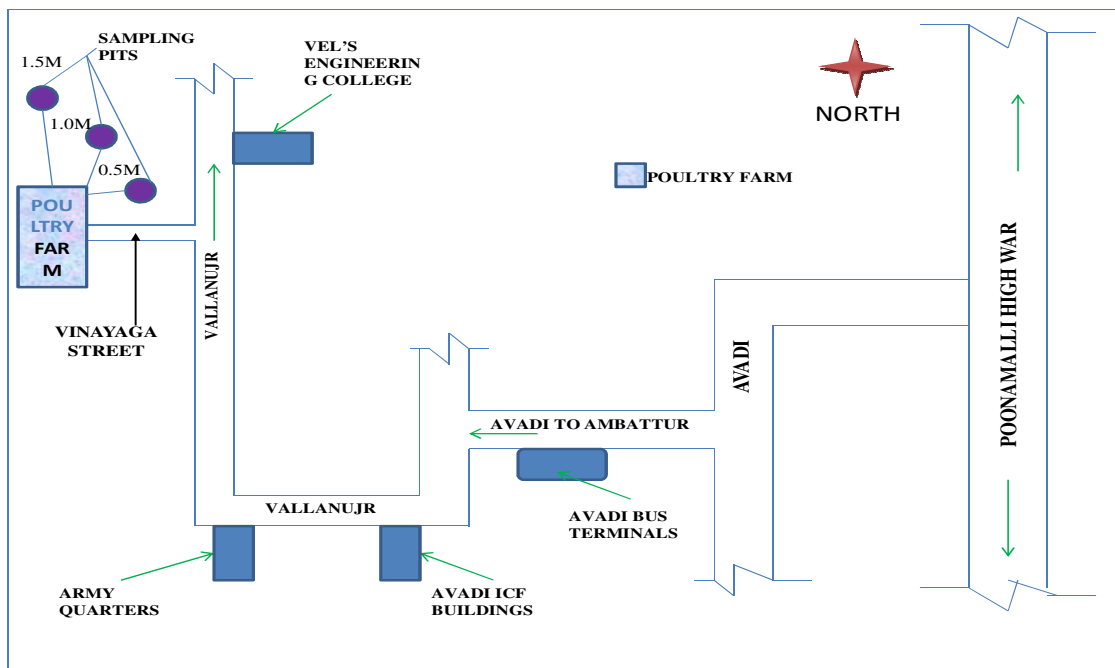


Fig.-3: The location of sampling pits near by the Poultry waste dumping site

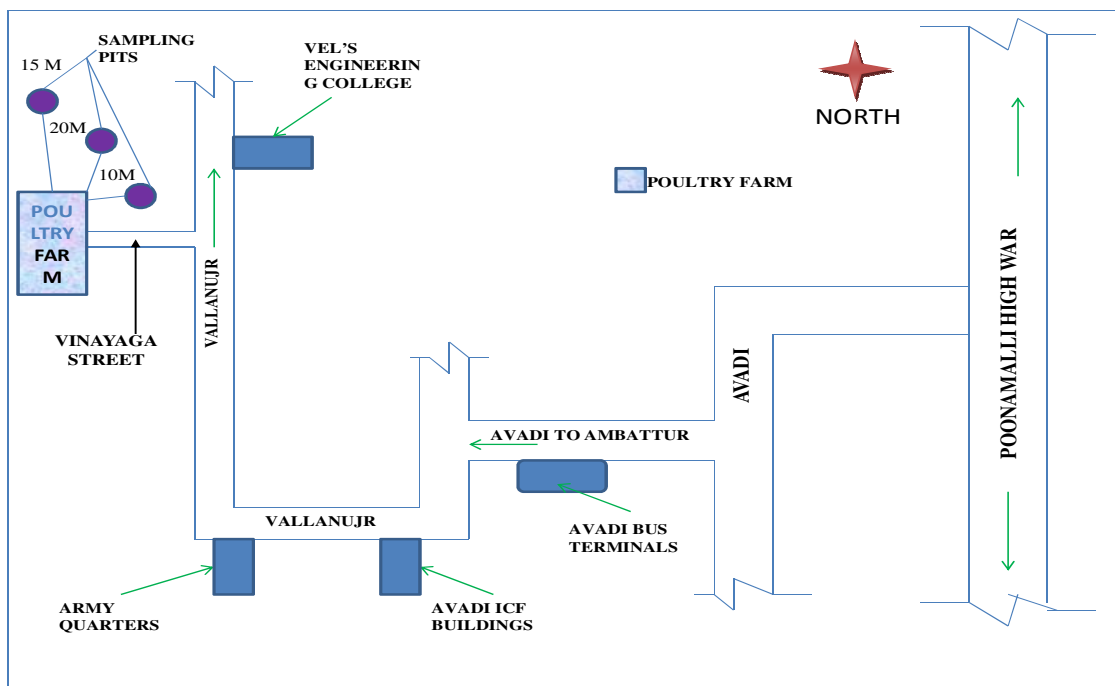
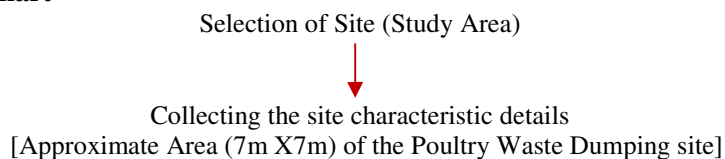


Fig.-4: The location of sampling pits away from the Poultry waste dumping site

## EXPERIMENTAL

### Methodology Flow Chart



Soil sample collection from selected poultry waste dumping site [Near by the 3 pits & Away from the 3 pits each pit 3 layers (0-30cm, 30-60cm, 60-90cm) Poultry waste dumping site]

↓

Physico-Chemical Properties of soil sample is to be determine in the laboratory using Standard methods [pH, Moisture content, Bulk density, Porosity, Temperature, Hydraulic conductivity]

↓

Analyzing the Physico-chemical Properties of the soil sample in Laboratory using standards methods (Table-1)

↓

Comparison of Soil Physico-chemical properties of selected soil sample pits with standards

Table-1: Method used in the study

Parameters	Used In The Lab Methods /Instrument / Equipment
Bulk Density, $\rho$	Core Cutter Method
Moisture Content, w	Standard Proctor Compaction Test
pH Value	Hydrometer Method
Hydraulic Conductivity, K	Infiltrometer Method
Temperature	Thermometer
Porosity, n	Sand Replacement Method

### Soil samples collection

The experimental was carried out the location of Poultry farm. A 30cm X 30cm land area located on the experimental place on pit 1. Pre-application sample of the soil was taken to laboratory for textural analysis using hydrometer method and to know the physicochemical parameters of the soil before application. The physicochemical parameters were determined using USDA, (1998) method. A pit has been taken in the soil 1 kg per each layer. To taking the soil, the equipment used is auger and the soil sample is collected by using ploy thin covers. This was repeated remaining 5 pits.

### Sampling locations

Soil sample is collected from selected poultry waste dumping site [Near by the 3 pits & Away from the 3 pits each pit 3 layers (0-30cm, 30-60cm, 60-90cm) Poultry waste dumping site. Figure-3 and Figure-4 shows the location of the sampling pits. Figure-2 shows the Separate bird's ventilation area, Disposal area and Disposal pit of the study area.

## RESULTS AND DISCUSSION

The Physico-Chemical Characteristics of soil sample collected near and away from the poultry waste disposal area and analyzed with standard methods (Table -1) and the test results of bulk density, moisture content, pH value, hydraulic conductivity, temperature and porosity are shown in Table- 2 and Table-3.

Table-2: Soil Physico-Chemical properties of soil sample (Near by the poultry waste disposal area)

S. No.	Soil Sample Pits	Depth (cm)	Location	Distance of soil sample pit (m)	Bulk Density ( $\text{g/cm}^3$ )	Moisture Content (%)	pH Value	Hydraulic Conductivity ( $\text{cm/sec}$ )	Temp. ( $^{\circ}\text{C}$ )	Porosity (%)
1	Pit 1	0-30	Near Poultry Waste disposal area	0.5	1.59	17	6.4	$0.27 \times 10^{-3}$	32	0.41
		30-60			1.43	15	3			
		60-90			1.40	14	5.3			
							5.30	$0.22 \times 10^{-3}$	30	0.36

2	Pit 2	0-30	Near Poultry Waste disposal area	1.0	1.59	17	5.9	$0.27 \times 10^{-3}$	32	0.41	
		30-60			1.52	14	5.3				$0.19 \times 10^{-3}$
		60-90			1.49	15	2				
							5.12				
3	Pit 3	0-30	Near Poultry Waste disposal area	1.5	1.60	17	5.6	$0.29 \times 10^{-3}$	32	0.39	
		30-60			1.59	16	5.5				$0.26 \times 10^{-3}$
		60-90			1.53	14	2				
							5.45				

Table-3: Soil Physico-Chemical properties of Soil Sample (Away from the poultry waste disposal area)

S. No.	Soil sample Pits	Depth (cm)	Location	Distance of soil sample pit (m)	Bulk Density (g/cm <sup>3</sup> )	Moisture Content (%)	pH Value	Hydraulic Conductivity (cm/sec)	Temp. (°C)	Porosity (%)	
1	Pit 1	0-30	Away Poultry Waste disposal area	10.0	1.60	16	5.23	$0.30 \times 10^{-3}$	32	0.41	
		30-60			1.55	15	5.03				$0.28 \times 10^{-3}$
		60-90			1.53	14	4.53				
2	Pit 2	0-30	Away Poultry Waste disposal area	15.0	1.59	16.5	5.20	$0.29 \times 10^{-3}$	32	0.41	
		30-60			1.52	15	5.15				$0.25 \times 10^{-3}$
		60-90			1.49	13	5.12				
3	Pit 3	0-30	Away Poultry Waste disposal area	20.0	1.60	17	6.2	$0.29 \times 10^{-3}$	32	0.39	
		30-60			1.59	16	5.5				$0.26 \times 10^{-3}$
		60-90			1.53	15	2				

### Bulk Density

The Figure-5 and Figure-6 shows the variations in quality of soil samples in Bulk density near and away from the poultry waste dumping site pits. The value is within the standard value of bulk density (1.0g/cm<sup>3</sup> to 1.60g/cm<sup>3</sup>). The variations in quality of soil samples bulk density is good and safe– No contamination.

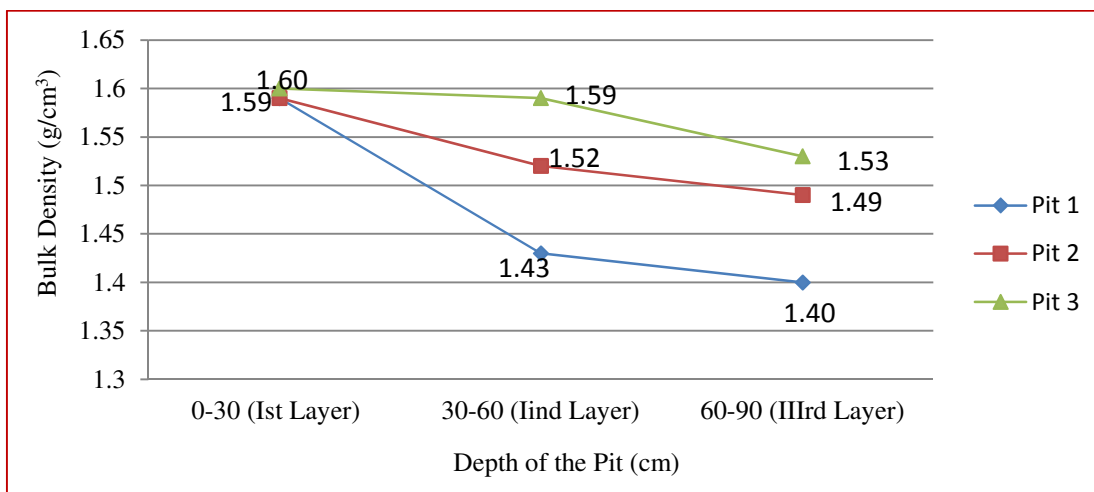


Fig.-5: Variations of quality of soil sample in Bulk Density (Near by the Poultry waste dumping area)

**Moisture Content**

The Figure-7 and Figure-8 shows the variations in quality of soil samples in Moisture content near and away from the poultry waste dumping site pits. The value is within the standard value of bulk density (11% to 17%). The variations in quality of soil samples Moisture content is good and safe- No contamination.

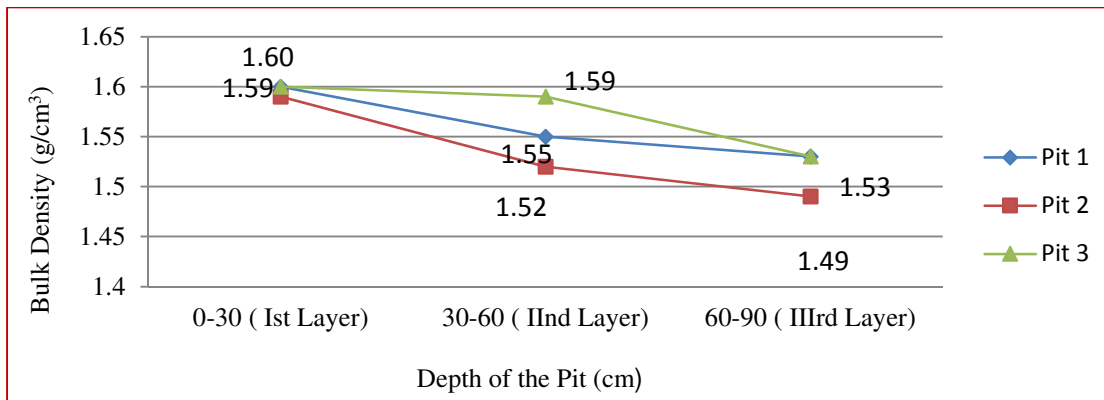


Fig.-6: Variations of quality of soil sample in Bulk Density (Away from the Poultry waste dumping area)

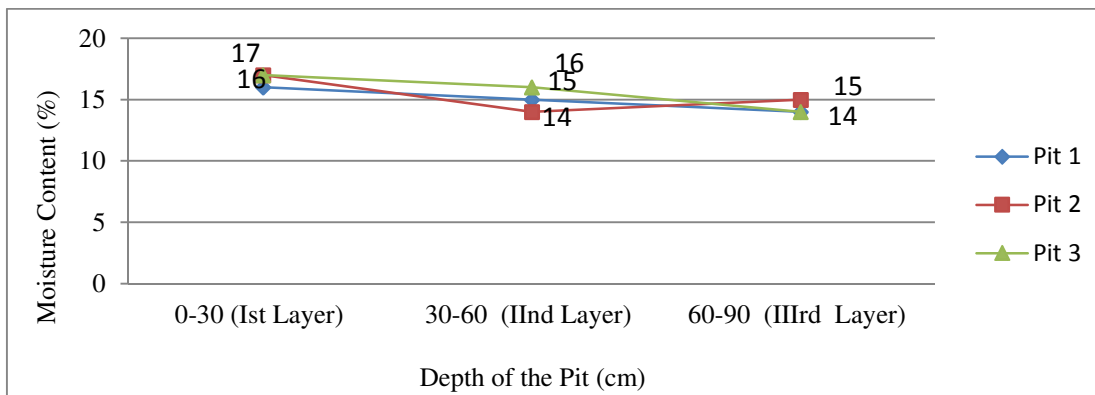


Fig.-7: Variations in quality of soil sample in Moisture Content (Near by the Poultry waste dumping area)

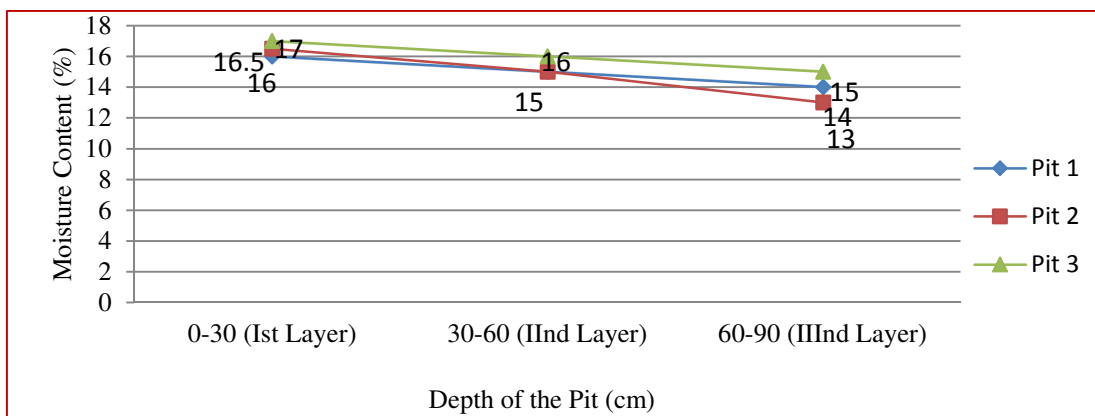


Fig.-8: Variations in quality of soil sample in Moisture Content (Away from the Poultry waste dumping area)

The Figure- 8 the variations in quality of soil samples in Moisture content away from the poultry waste dumping site pits (Pit 1, Pit 2, Pit 3) at the layers 0-30cm, 30-60cm, 60-90cm, respectively. The variation in highest points is 1 Layer – 16%, 16.5% and 17%. As per standard Moisture content value is 11% to 17%.The variations in quality of soil samples in Moisture content good and safe – No contamination.

**pH Value**

pH Value of the selected soil sample pit (3 pits each pit having 3 layers) near by the Poultry waste dumping site is determining the laboratory by using standard method of the result has been furnish below inFigure-9.

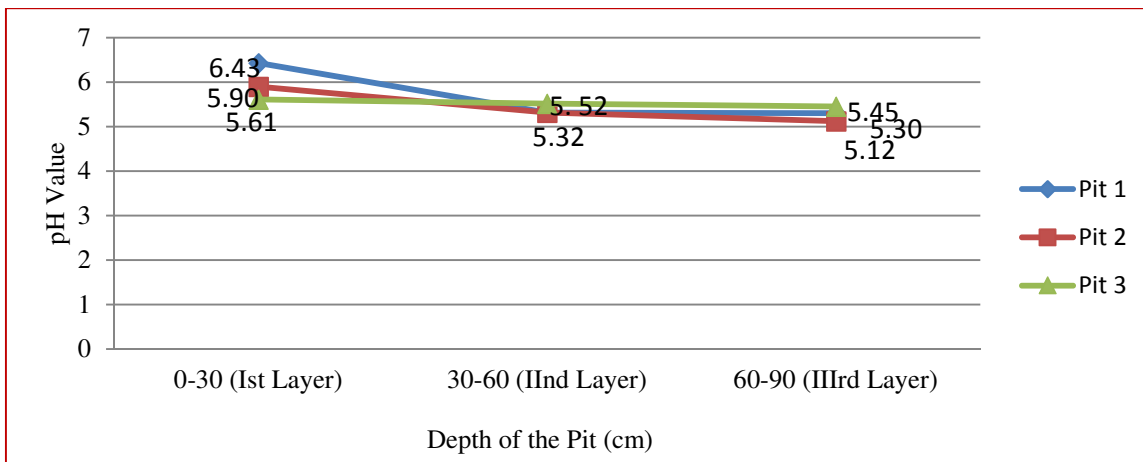


Fig.-9: Variations in quality of soil sample in pH Value (Near by the Poultry waste dumping area)

The Figure-9 shows the variations in quality of soil samples in pH Value near by the poultry waste dumping site pits (Pit 1, Pit 2, Pit 3) at the layers 0-30cm, 30-60cm, 60-90cm, respectively. The variation in highest points is 1 Layer – 5.61, 5.90 and 6.43. As per standard pH value is 5.2 to 8.0.The variations in quality of soil samples in pH value are good and safe – No Contamination. pH Value of the selected soil sample pit (3 pits each pit having 3 layers) away from the Poultry waste dumping site is determining the laboratory by using standard method of the result has been furnish below in Figure-10.

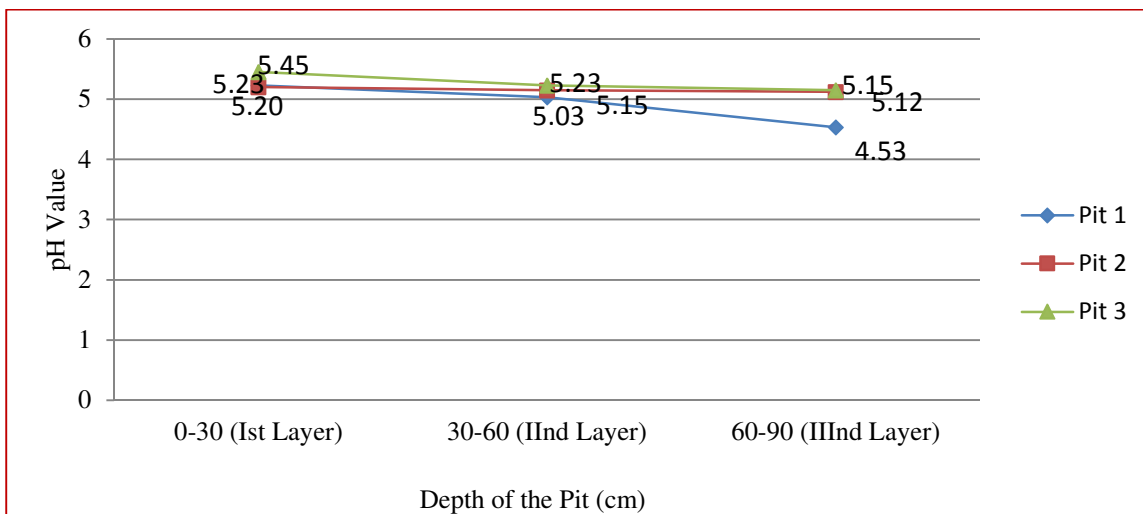


Fig.-10: Variations in quality of soil sample in pH Value (Away from the Poultry waste dumping area)

The Figure-10 shows the variations in quality of soil samples in pH Value away from the poultry waste dumping site pits (Pit 1, Pit 2, Pit 3) at the layers 0-30cm, 30-60cm, 60-90cm, respectively. The variation in highest points is 1 Layer – 5.20, 5.23 and 5.43. As per standard pH value is 5.2 to 8.0. The variations in quality of soil samples in pH value are good and safe – No Contamination.

**Hydraulic Conductivity**

Hydraulic Conductivity of the selected soil sample pit (3 pits each pit having 3 layers) near by the Poultry waste dumping site is determining the laboratory by using standard method of the result has been furnish below in Figure-11.

The Figure-11 shows the variations in quality of soil samples in Hydraulic conductivity near by the poultry waste dumping site pits (Pit 1, Pit 2, Pit 3) at the layers 0-30cm, 30-60cm, 60-90cm, respectively. The variation in highest points is 1 Layer –  $0.27 \times 10^{-3}$  and  $0.29 \times 10^{-3}$ . As per standard hydraulic conductivity value is  $0.10 \times 10^{-3}$  to  $0.41 \times 10^{-3}$ . The variations in quality of soil samples in hydraulic conductivity value are good and safe – No Contamination.

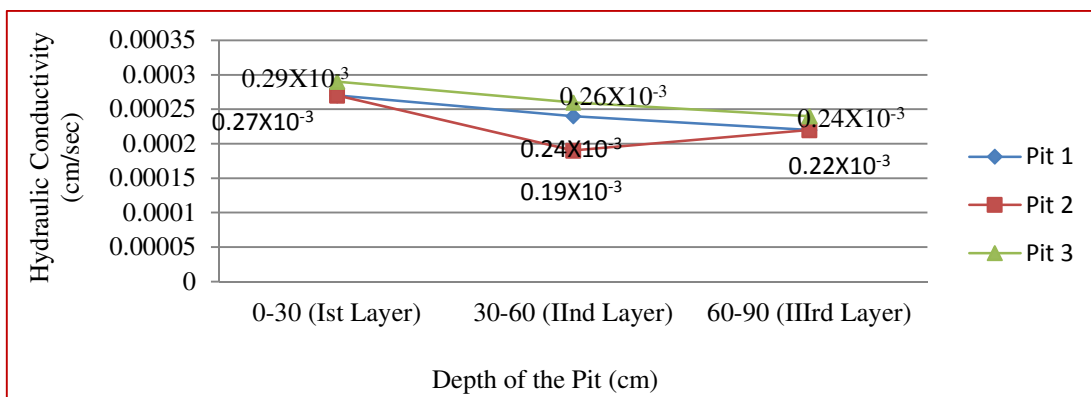


Fig.-11 Variations in quality of soil sample in Hydraulic Conductivity (Nearby the Poultry waste dumping area)

Hydraulic Conductivity of the selected soil sample pit (3 pits each pit having 3 layers) away from the Poultry waste dumping site is determining the laboratory by using standard method of the result has been furnish below in Figure-12.

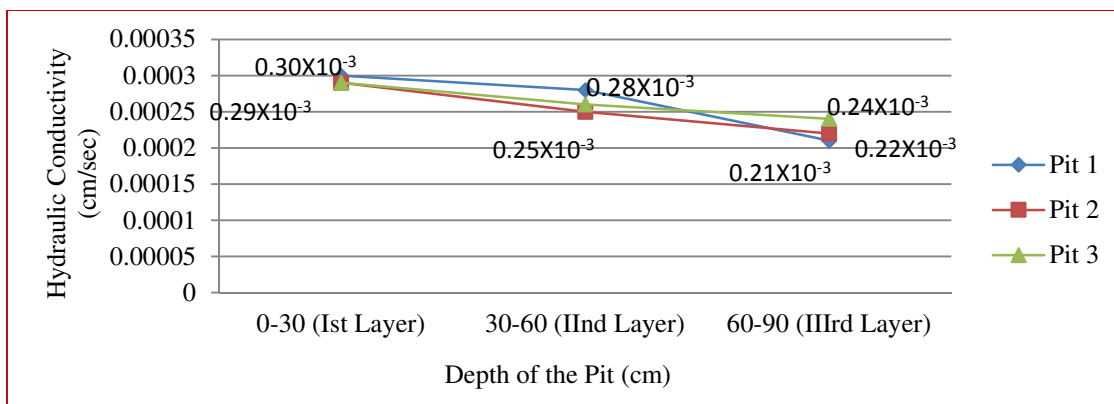


Fig.-12: Variations in quality of soil sample in Hydraulic Conductivity (Away from the Poultry waste dumping area)

The Figure-12 shows the variations in quality of soil samples in Hydraulic conductivity near by the poultry waste dumping site pits (Pit 1, Pit 2, Pit 3) at the layers 0-30cm, 30-60cm and 60-90cm respectively.



The variation in highest points is 1 Layer –  $0.29 \times 10^{-3}$  and  $0.30 \times 10^{-3}$ . As per standard hydraulic conductivity value is  $0.10 \times 10^{-3}$  to  $0.41 \times 10^{-3}$ . The variations in quality of soil samples in hydraulic conductivity value are good and safe – No Contamination.

### Temperature

Temperature of the selected soil sample pit (3 pits each pit having 3 layers) near by the Poultry waste dumping site is determining the laboratory by using standard method of the result has been furnish below in Figure-13.

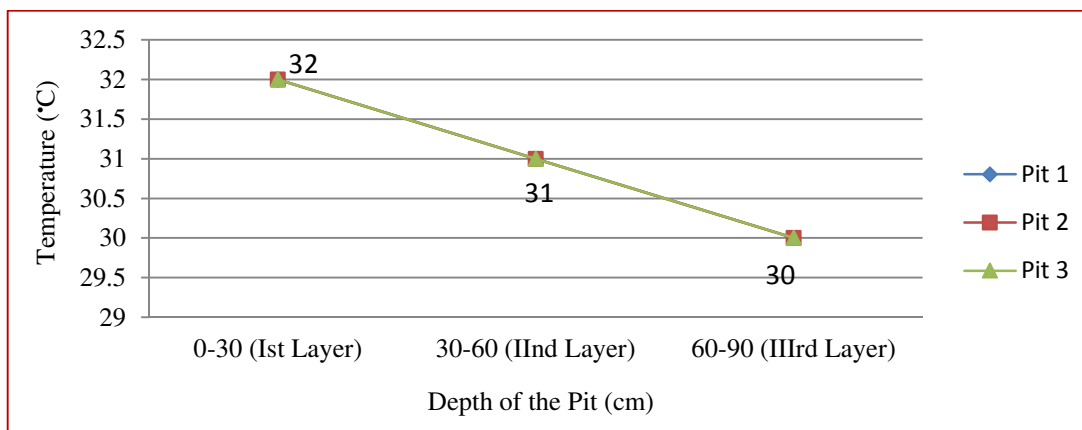


Fig.-13: Variations in quality of soil sample in Temperature (Near by the Poultry waste dumping area)

The Figure-13 shows the variations in quality of soil samples in Temperature near by the poultry waste dumping site pits (Pit 1, Pit 2, Pit 3) at the layers 0-30cm, 30-60cm, 60-90cm, respectively. The variation in highest points is 1 Layer – 32°C. As per standard Temperature value is 29°C to 34°C.

The variations in quality of soil samples in temperature value are good and safe – No Contamination. Temperature of the selected soil sample pit (3 pits each pit having 3 layers) away from the poultry waste dumping site is determining the laboratory by using standard method of the result has been furnish below in Figure-14.

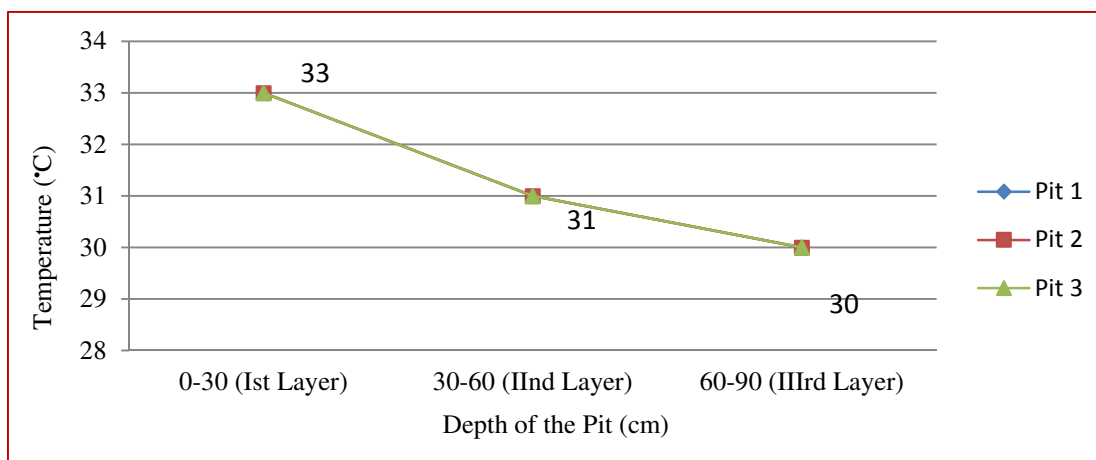


Fig.-14: Variations in quality of soil sample in Temperature (Away from the Poultry waste dumping area)

The Figure-14 shows the variations in quality of soil samples in temperature away from the poultry waste dumping site pits (Pit 1, Pit 2 and Pit 3) at the layers 0-30cm, 30-60cm, 60-90cm, respectively. The variation in highest points is 1 Layer – 33°C. As per standard temperature value is 29°C to 34°C. The variations in quality of soil samples in temperature value are good and safe – No Contamination.

### Porosity

Porosity of the selected soil sample pit (3 pits each pit having 3 layers) near by the poultry waste dumping site is determining the laboratory by using standard method of the result has been furnish below inFigure-15.

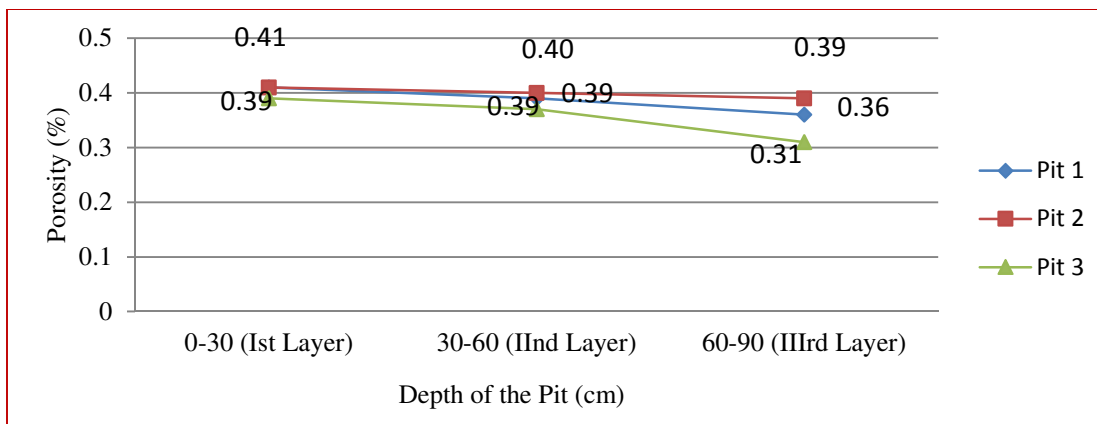


Fig.-15: Variations in quality of soil sample in Porosity (Near by the Poultry waste dumping area)

The Figure-15 shows the variations in quality of soil samples in porosity near by the poultry waste dumping site pits (Pit 1, Pit 2, Pit 3) at the layers 0-30cm, 30-60cm, 60-90cm, respectively. The variation in highest points is 1 Layer – 0.41 and 0.39. The variation in lowest points is 3 Layer – 0.31, 0.36 and 0.39. As per standard porosity value is 0.43 to 0.36.

The variations in quality of soil samples in porosity value are good and safe – No contamination. Porosity of the selected soil sample pit (3 pits each pit having 3 layers) away from the poultry waste dumping site is determining the laboratory by using standard method of the result has been furnish below inFigure-16.

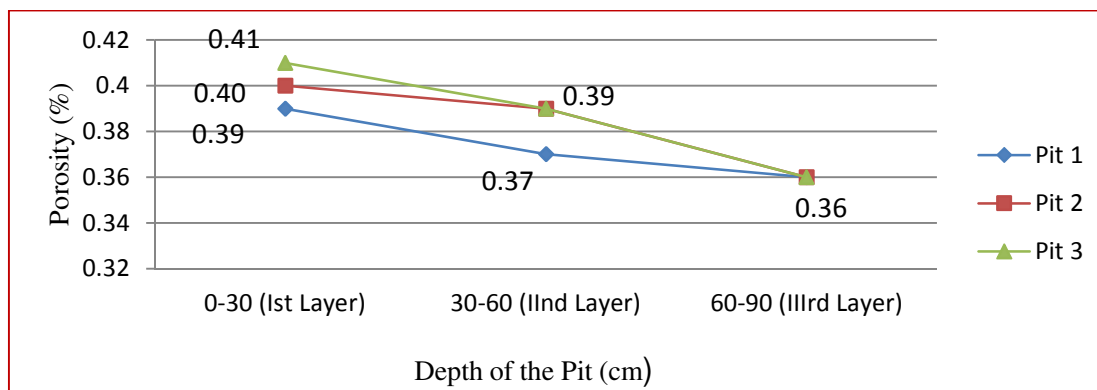


Fig.-16: Variations in quality of soil sample in Temperature (Away from the Poultry waste dumping area)

The Figure-16 shows the variations in quality of soil samples in porosity away from the poultry waste dumping site pits (Pit 1, Pit 2, Pit 3) at the layers 0-30cm, 30-60cm, 60-90cm, respectively. The variation in highest points is 1 Layer – 0.39, 0.40 and 0.41. The variation in lowest points is 3 Layer – 0.36. As per standard porosity value is 0.43 to 0.36. The variations in quality of soil samples in porosity value are good and safe – No Contamination.

### CONCLUSION

Direct disposal of poultry waste at the landfills, application on farm lands as a fertilizer, burning and composting are the most commonly practiced methods of poultry waste disposal. These methods are challenged by issues of environmental pollution and restricted land to use. On the Physico-chemical properties, the application has effects on virtually all the physical and chemical properties of the soil.

From this study, it was concluded that the application of different poultry waste has different effects on the Physico-chemical properties of soil.

The variations in quality of soil samples collected from selected poultry waste dumping site [Near by the 3 pits and away from the 3 pits each pit 3 layers (0-30cm, 30-60cm, 60-90cm) are good and safe – No contamination on compared with standard values.

### Recommendations

1. From the finding of this study, it is recommended that long term deposition of organic wastes should be discouraged.
2. A sustainable approve such as utilizing them as organic fertilizers should be adopted than dumping them as mean of disposal.
3. Spreading it in fields with much treatment.
4. Composting and using the compost as a fertilizer with or without balancing.
5. Digestion to produce biogas for a variety of uses including power generation, and producing fertilizer from the digester slurry.
6. Incineration to generate heat or produce electricity.

### REFERENCES

1. B. Ndukwu, S. U. Onwudike, M. C. Idigbor, C. E. Ihejirika and K. S. Ewe, *African Journal of Agricultural Research.*, **8(4)**, 373(2013).
2. O.M. Adedokun and A.E. Ataga, *Scientific Research and Essay*, **2(5)**, 197(2007).
3. C.O. Adenipekun, *African Journal of Biotechnology*, **7(1)**, 55(2008).
4. CDM Project Potential in the Poultry Waste Mangement Sector In Bangladesh. (2005) ([www.wasteconcern.org/Publication/Poultry%20Final.pdf](http://www.wasteconcern.org/Publication/Poultry%20Final.pdf))
5. M.A. Awodun, *Asian Journal of Agricultural Research*, **1**, 67(2007).
6. Nasima Alter, Lammia Shrmin and Lily Lapenna, *Int. J. Environment and Pollution*, **22(5)**, (2004).
7. O.B. Aluko, D.J. Oyedele, *J. Appl. Sci.*, **5(2)**, 357(2005).
8. M.O. Onuh, D.K. Madukwe, G.U. Ohia, *Soil. Science World Journal.*, **3(2)**, (2008).
9. O.O. Olatunji, O.A.Aderinola, *Department of Animal Production and Health*. Oyo State Nigeria. (2012)
10. M. Heidi Waldrip, Zhongqi He, M. Susan Erich, *Biology & Fertility of Soils* . **47(4)**, 407 (2011)
11. M.A. Blazier, B.P. Gaston and H.A. Evans, *Journal of Environmental Quality*, **37(4)**, 1546 (2008a).
12. T.M. Agbede, A.O. Oladitan and M.O. Ale, *World Journal of Agricultural Science*, **6(5)**, (2010).

[RJC-1586/2017]