

Effects of Open Dumping Waste Disposal Method on Some Soil Properties within Igboora, Oyo State

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Abstract

The study was carried out to evaluate the effect of open dumping method on pH, OC and particles size analysis of selected dumpsites within Igboora, Oyo state. The experiment was a Completely Randomized Design (CRD) with five treatments replicated three times. The treatments were five different locations of dumpsites within Igboora; Old Abattoir, New Abattoir, Oja Igboora, Oja Oba and Towobowo. Control samples were taken per location at 20 meter interval from each dumpsites. Three soil samples were randomly taken from each of the five selected dumpsites with the aid of a soil auger, which was bulked to form a composite sample per location. The samples were collected at two different depths, 0-20 cm and 20-40 cm and analyzed for pH, organic carbon (OC) and particle size analysis. Data collected were analyzed using Genstat statistical package and means separated using least significant difference at 5 % level of probability. The pH, OC, % sand, silt and clay were significantly different amongst the different dumpsites investigated. The results showed that the dumpsites greatly contributes to the pH, OC and percent sand of the soils from these soils when compared with the control. Old Abattoir had the highest pH (7.33) while Oja Igboora dumpsite had the lowest pH of 6.42. The organic carbon at the dumpsites ranged from 23 g kg⁻¹ (Old Abattoir) to 50 g kg⁻¹ (Towobowo). The pH, OC and percent sand reduced with the sampling depth. The pH of the top soil (0-20cm) was 6.81 while sub-soil (20-40cm) was 6.73. The same trend was observed for OC and sand fraction with top soil and sub- soil having 35 g kg⁻¹, 20 g kg⁻¹, 848 g kg⁻¹ and 794 g kg⁻¹, respectively. However, silt and clay fractions increased with the sampling depth. The study revealed that the dumpsites greatly influenced the pH and organic carbon contents of the soil in the area.

Key words: Dumpsites, soil depth, organic carbon, particle size, disposal method.

Introduction

Increase in world population with its associated high industrial activities has resulted in the production of large volumes of domestic, municipal and industrial wastes (Lagerkvist and Dahlen 2019). The increased waste generation has however not commensurate with capacity in waste management especially in developing countries. The result of this is wide instances of improper waste disposal and management which pose serious threats to the environment and development of major cities around the globe especially in Africa (Lebreton and Andrady, 2019). One menace of improper waste disposal practice that have been widely observed is the issues of leachate from improperly cited or managed waste dumping sites. These sites are known to be responsible for toxic leachates from wastes which have been found to significantly impact all forms of life. Such leachates often find themselves in surface water bodies, underground water, soils

and other biophysical components of the environment resulting in adverse effect on humans, aquatic organisms, plants and animals (Lebreton and Andrady, 2019).

Solid waste handling and disposal are major environmental problems in many urban centres in Nigeria. Municipal wastes in the form of garbage and waste from food processing plants have been incinerated or simply dumped (Amusan *et al.*, 1999). The soil has traditionally been an important medium for organic waste disposal (Marshall *et al.*, 1996). Within some limits, such wastes enhanced soil fertility and improve the physical properties of soils. When waste is properly managed and carefully monitored to supply the crop fertilizer needs of urban farmers, it reduces cost of production. However, lack of effective waste management in overcrowded modern cities can have substantial negative effects that include the fetid waterways emitting stench from sewage,



spreading diseases and harboring vehicles that spew leaded exhaust into dust filled air (Helmores and Ratta, 1995). The excessive input of unsorted municipal household wastes may likely lead to changes in soil physical and chemical characteristics. This can distort interrelationships among biophysical and chemical soil functions. It may also lead to loading of nitrates and heavy metals in soil and ground water.

The negative influences of improper management of solid wastes on the ecosystem have been at alarming rate in developing countries such as Nigeria. Much research have been conducted on the influence of solid waste dumpsite on water resources quality as well as the heavy metal contamination on the environment (Akintola and Bodede, 2019). Recent use of solid wastes as compost to replenish the deteriorated soils and growing of crops on the abandoned waste dumpsite due to their richness in organic matter by farmers is of great concern. Leachates, the liquid substances emanating from the wastes during decomposition in the dumpsite contain considerable quantity of elements, compounds and organic substances which increase over time and may be more than the required amounts needed for environmental sustainability (Essienubong *et al.*, 2019).

These leachates may enter into the soil through surface run off, leaching, percolation or infiltration and become dangerous to soils, plants, surface and groundwater over time. This may also have significant effects on the physical and chemical properties of the soil by increasing the soil moisture content, organic matter content and alkalinity nature of the soil through decomposition of organic wastes by the action of soil microorganism and climate (Kebede *et al.*, 2018). Waste-amended soils have been reported to have high organic matter content (Anikwe, 2000). Soil organic matter influences the degree of aggregation and aggregate stability and can reduce bulk density and increase total porosity and hydraulic conductivity in heavy clay soils (Anikwe, 2000). The important effects of organic matter on soil and its maintenance are of importance to ensuring soil quality and sustainability since long term use of inorganic fertilizers can cause loss of soil organic matter (Dominquez *et al.*, 2019). Small farmers and co-operative farms produce vegetables and other crops in old garbage dumps in small and large cities around

the world where improper management of municipal waste exists (Helmores and Ratta, 1995). Ali *et al.* (2014) observed significant modifications in soil properties of some dumpsites with high values of pH, total dissolved solids and electrical conductivity as compared to the control sites. Also, Breza-Boruta *et al.* (2016) found that accumulated waste in the dumpsite causes depletion in soil organic matter which inhibits microorganism growth. Alteration in physical and biochemical properties of soil can lead to soil degradation (Civeira and Lavado, 2008).

The objective of this study therefore, was to determine the effect of open dumping waste disposal method on pH, Organic Carbon (OC) and particle size analysis in some selected dumpsites within Igboora, Oyo State.

Materials and Methods

Location

The study was conducted in the Oyo State College of Agriculture and Technology, Igboora Oyo State, Nigeria. Igboora is located between latitude 7°26' and 2.40"N and longitude 3° 17' and 6.00"E, 27.5m above the sea level. The natural climate is characterized by both wet and dry seasons with the rainy season beginning from April lasting till October while the dry season begins from October and ends in April.

Soil Sampling and Experimental Design

The experiments was a Completely Randomized Design (CRD) with five treatments replicated three times. The treatments were five different locations of dumpsites within Igboora; Old Abattoir, New Abattoir, Oja Igboora, Oja Oba and Towobowo. Control samples were taken per location at 20 meter interval from each dumpsites. Three soil samples were randomly taken from each of the five selected dumpsites using soil auger, which was bulked to form a composite sample per location. Two sampling depths have been selected for the following reasons: the soil depth (0-20 cm) is the crop land plow layer in the study area, and the soil depth 20-40 cm constitute the average depth to which nutrient and clay particles are leached in a high rainfall area and fine root of trees have a role in nutrient addition and recycling. The samples collected were air dried and passed through a 2 mm sieve.



Soil Analysis

The pH in water was determined by using glass electrode pH meter. Organic carbon was determined by chromic acid oxidation method (Walkley and Black, 1934)

Particles size analysis was taken by the use of hydrometer method (Bouyoucos, 1951). The percent of sand, silt and clay of the soil were used to determine the textural class using USDA textural triangle land use description.

SITE	DESCRIPTION	COORDINATE
Old Abattoir	The abattoir was established about 300 years ago.	Latitude 7°26' 97"N Longitude 3°16'52.1"E
Control (C ₁)		Latitude 7°26' 71"N Longitude 3°16'51.8"E
New Abattoir	The New Abattoir was established in 2015 about 7 years ago.	Latitude 7°26' 26.1"N Longitude 3°16'19.3"E
Control (C ₂)		Latitude 7°26' 26.6"N Longitude 3°16'19.8"E
Oja-Igboora	The abattoir was established about 300 years ago.	Latitude 7°26' 97"N Longitude 3°16'52.2"E
Control (C ₃)		Latitude 7°26' 7.1"N Longitude 3°16'51.8"E
Oja-Oba	Oja-Oba was established in 2000 about 22 years ago.	Latitude 7°26' 27.7"N Longitude 3°16'24.4"E
Control (C ₄)		Latitude 7°26' 27.5"N Longitude 3°16'22.4"E
Towobowo	Was established about 200 years ago.	Latitude 7°25' 49.3"N Longitude 3°17'22.7"E
Control (C ₅)		Latitude 7°25' 48.3"N Longitude 3°17'20.9"E

Statistical Analysis

All data collected were analyzed using Genstat statistical package and means separated using least significant difference (LSD) at 5 % level of probability.

Results and Discussion

Effect of dumpsites on the pH, OC and physical properties of the soil

The result in Table 1 showed the physical and chemical properties of the soil at the five selected dumpsites and five control site across Igboora town in Oyo State. The pH of the dumpsites was highest at Old Abattoir with a pH of 7.33 while the lowest result (6.10) was observed from the control samples of both the Abattoir and Oja-Igboora.

The pH from all the samples ranged from slightly acidic to slightly alkaline in all the selected dumpsites. The result of the pH also showed that all the dumpsites had higher values of pH compared to the sample taken from the 20 m distance away (control).

Organic carbon assessment in all the dumpsites revealed that dumpsites at Towobowo market had the highest value (50 g kg⁻¹) organic carbon while the lowest value (18.9 g kg⁻¹) was obtained from the samples taken at 20m away from the new Abattoir dumpsites. Similarly, the OC content of the soil from these dumpsites was observed to be higher than their controls except the Old Abattoir dumpsite.

The particle analysis of the soil showed that the percent sand of the soil from these dumpsites was highest (918 g kg⁻¹) at Towobowo market dumpsites. The lowest fraction of sand (718 g kg⁻¹) was recorded in the control soils collected from Old Abattoir. It is noteworthy that the sand fraction was highest in all these selected dumpsites compared to their controls.

The silt fraction of the soil from the selected dumpsites was highest (150 g kg⁻¹) in both the controls from Old Abattoir and Oja-Igboora. However, the lowest silt fraction of (40 g kg⁻¹) was obtained from Towobowo dumpsites. Although sand fraction was highest in all the dumpsites, silt fraction was lower than the values obtained from their controls.

Clay fraction of the soil from the selected dumpsites was highest (132 g kg⁻¹) in the control taken from Old Abattoir and Oja-Igboora. However, the lowest values of (42 g kg⁻¹) was obtained from the dumpsites at Oja-Oba. Apart from the clay fraction from Towobowo dumpsites, all other dumpsites had lower amount of clay fraction compared to their controls. However, that of new Abattoir and the

control at the new Abattoir had the same clay value of 72 g kg^{-1} .

Generally, the pH values of the dumpsites assessed showed that they were higher than the control. Similarly, apart from the dumpsite at Old Abattoir, all other dumpsites had higher OC values which were significantly at 5 % level of probability. Percent sand was also significantly higher in all the dumpsites compared to the control. However, the percent silt and clay from these dumpsites were reduced compared to the control.

Effect of sampling depths on the physico-chemical properties of the soil

Table 2 showed the impact of the sampling depths on the physico-chemical properties of the soil across the selected dumpsites. The results of the soil analysis showed that the pH of the upper layer (0-20cm) of the soil was significantly higher than that of the sub-soil (20-40cm). Thus the pH of the soils from all the selected dumpsites reduced with the sampling depths with the upper layer having a pH value of 6.81 while the sub-soil had 6.73.

The organic carbon (OC) also followed the pattern of the pH reducing with the sampling depth. The OC of the upper layer of the soil was 35 g kg^{-1} while that of the subsoil was 20 g kg^{-1} . The values were significantly different at 5% level of probability.

Particle size analysis of the soil also revealed that the sand fraction of the soil at the dumpsites reduced with the sampling depth with the upper part of the soil having 848 g kg^{-1} while the sub-soil had 7940 g kg^{-1} . On the contrary, both the silt and clay fractions of the soil increased with the sampling depth. The upper part of the dumpsites had 98 g kg^{-1} silt and 54 g kg^{-1} clay while the sub-soil had 114 g kg^{-1} and 92 g kg^{-1} , respectively for silt and clay fractions of the soil. This observation is similar to earlier report of Olla *et al.* (2021) that observed a reduction in percent sand as well as increased percentage of both silt and clay in the sub-soil of different land use types within the Oyo State college of Agriculture and Technology Igboora, Nigeria.

Effect of dumpsites and sampling depth on the pH of the soil

The effect of dumpsites and samplings depth on the pH of dumpsites at Old Abattoir gave the highest value (7.31). The lowest pH value

(6.30) was recorded in the upper part of the soil at Abattoir and Oja-Igboora control. The pH value of the upper (0-20cm) part of the soil ranges from slightly acidic to neutral pH values.

Similar trend was observed in the sub-soil (20-40cm) across all dumpsites. The highest pH value of 7.35 was recorded in Old Abattoir while the lowest value of 5.90 was at Old Abattoir and Oja-Igboora, controls. Generally, the pH value from all the selected dumpsites decreased with the sampling depth except at Old Abattoir dumpsite.

Effect of dumpsites and sampling depths on the OC of the soil.

The effect of dumpsite and sampling depth is presented in table 4. The results showed the upper layer of the dumpsites at Towobowo as having the highest OC value of 86 g kg^{-1} . The lowest value of OC was observed at Oja-Igboora. On the other hand, the sub-soil of Oja-Igboora gave the highest value of OC (28 g kg^{-1}) while the lowest value of 13 g kg^{-1} was observed at the control point of the New Abattoir dumpsite.

Generally, the OC in all the dumpsites decreased with the sampling depth except the samples taken from Oja-Igboora. This observation may be as a result of the fact that the upper layer of the soil is the most biologically active of the soil profile (Adugna and Abegaz, 2015). It is important to also note that the amount of organic carbon in all the dumpsites and the control ranged from moderate to very high in terms of fertility rating for this area.

Effects of dumpsites and sampling depth on the sand fraction of the soil

The effect of dumpsite and sampling depth on the percent sand of the soil is presented in table 5. The results showed that the upper layer of the soil at Towobowo control site as having the highest value of 918 g kg^{-1} while the lowest value was observed at the Abattoir 738 g kg^{-1} . However, the sub-soil of Towobowo gave the highest sand fraction of 938 g kg^{-1} which was significantly higher than the values obtained at the control sites of Abattoir and Oja-Igboora. It is important to note that the sand fraction reduced with the sampling depth in all the dumpsites except at Abattoir and Towobowo.

Influence of dumpsites and sampling depth on silt fraction of the soil

The influence of dumpsite and sampling depth on the silt fraction of the soil. The results showed that the upper layer of Old Abattoir had the highest silt (160 g kg^{-1}) while the lowest value of 40 g kg^{-1} was obtained at the control site of Towobowo. On the other hand, highest value of 180 g kg^{-1} silt was recorded in the sub-soil of the control site at Old Abattoir and Oja-Igboora. While the lowest value of 20 g kg^{-1} was recorded at Towobowo.

Generally, the silt value from all the selected dumpsite increased with sampling depth.

Influence of dumpsite and sampling depth on the clay fraction of the soil

The results in Table 7 showed the influence of the dumpsite and sampling depth on the clay fraction of the soil. The result showed that the upper layer of Old Abattoir had the highest value of 102 g kg^{-1} while the lowest value of 42 g kg^{-1} was obtained at the site of New Abattoir, Oja-Igboora, Oja- Oba and controls of Oja-Oba and Towobowo.

On the other hand, the highest value of 202 g kg^{-1} clay was recorded in the sub-soil controls of Old Abattoir and Oja-Igboora while the lowest value of 42 g kg^{-1} clay was recorded in Oja-Oba, Towobowo and its control.

Conclusion

The pH, OC, percent sand, silt and clay from all locations under investigation showed that they were greatly affected by the dumpsites and the sampling depth. The pH of the dumpsites were higher than most agricultural soils. The OC were observed to be higher in these dumpsites compared to most agricultural soils. The dumpsites greatly increased the amount of sand in all the sites while the silt and clay fraction decreased. The pH, OC and percent sand were observed to reduce with sampling depth in all the sites. On the other hand, silt and clay fractions in all dumpsites increased with sampling depth. The study has revealed that the investigated dumpsites greatly influenced the pH values as well as the organic carbon contents of the soil around the dumpsites.

Table 1: Physical and chemical properties of the soil at the selected dumpsite

Location	pH	OC (g kg^{-1})	Sand (g kg^{-1})	Silt (g kg^{-1})	Clay (g kg^{-1})	Textural class
Old Abattoir	7.33	23	768	140	92	Sandy Loam
Control (C ₁)	6.10	24	718	150	132	Loamy Sand
New abattoir	7.07	36	818	110	72	Loamy Sand
Control (C ₂)	7.06	19	808	120	72	Loamy Sand
Oja Igboora	6.42	26	858	90	52	Loamy Sand
Control (C ₃)	6.10	24	718	150	132	Sandy Loam
Oja oba	7.02	30	888	70	42	Sand
Control (C ₄)	7.01	21	828	120	52	Loamy Sand
Towobowo	6.88	50	918	40	42	Sand
Control (C ₅)	6.74	23	888	70	42	Sand
LSD	0.05	0.2	1.1	21.2	0.7	

Table 2: Physical and chemical properties of the soil at the selected dumpsite as influenced by depth of sampling

Depth (cm)	pH	OC (g kg^{-1})	Sand (g kg^{-1})	Silt (g kg^{-1})	Clay (g kg^{-1})	Textural class
0-20	6.81	35	848	98	54	Loamy Sand
20-40	6.73	20	794	114	92	Loamy Sand
LSD	0.02	0.1	0.5	9.5	0.3	

Table 3: pH of the soil at the selected dumpsites as influenced by depth of sampling



Location	Depth (cm)	
	0-20	20-40
Old Abattoir	7.31	7.35
Control (C ₁)	6.30	5.90
New abattoir	6.97	7.16
Control (C ₂)	7.12	7.00
Oja Igboora	6.51	6.33
Control (C ₃)	6.30	5.90
Oja oba	7.02	7.02
Control (C ₄)	7.03	6.99
Towobowo	6.85	6.90
Control (C ₅)	6.73	6.74
LSD	0.07	0.07

Table 4: Organic carbon (g kg⁻¹) of the soil as influenced by the dumpsites and depth of sampling

Location	Depth (cm)	
	0-20	20-40
Old Abbatoir	31	15
Control (C ₁)	25	24
New abattoir	46	26
Control (C ₂)	24	13
Oja Igboora	24	28
Control (C ₃)	25	24
Oja oba	33	27
Control (C ₄)	26	16
Towobowo	86	14
Control (C ₅)	29	17
LSD	0.2	0.2

Table 5: Influence of dumpsites and depth of sampling on the sand fraction (g kg⁻¹) of the soil

Location	Depth (cm)	
	0-20	20-40
Old Abattoir	738	798
Control (C ₁)	818	618
New abattoir	858	778
Control (C ₂)	818	798
Oja Igboora	878	838
Control (C ₃)	818	618
Oja oba	898	878
Control (C ₄)	838	818
Towobowo	898	938
Control (C ₅)	918	858
LSD	1.5	1.5

Table 6: Influence of dumpsites and depth of sampling on the silt fraction (g kg⁻¹) of the soil

Location	Depth (cm)	
	0-20	20-40
Old Abattoir	160	120
Control (C ₁)	120	180
New abattoir	100	120
Control (C ₂)	120	120
Oja Igboora	80	100
Control (C ₃)	120	180
Oja oba	60	80
Control (C ₄)	120	120
Towobowo	60	20
Control (C ₅)	40	100
LSD	30	30

Table 7. Influence of dumpsites and depth of sampling on the clay fraction (g kg⁻¹) of the soil

Location	Depth (cm)	
	0-20	20-40
Old Abattoir	102	82
Control (C ₁)	62	202
New abattoir	42	102
Control (C ₂)	62	82



Oja Igboora	42	62
Control (C ₃)	62	202
Oja oba	42	42
Control (C ₄)	42	62
Towobowo	42	42
Control (C ₅)	42	42
LSD	1.0	1.0

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